SYSTEM IDENTITY	Burroughs B 1700			Burroughs B 1700		
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	B 1712 24 — Integrated circuit 6K–40K bytes 0.666			B 1714 24 — Integrated circuit 16K–65K bytes 0.666		
SOFTWARE Assembler Operating System Compilers	Yes Yes Cobol; RPG; Fortran; Basic			Yes Yes Cobol; RPG; Fortran; Basic		
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	9480	2.3M	NA	9480	2.3M	NA
MAGNETIC TAPE	Model	Type (trks) / Char/In.	Peak Xfer, cps	Model	Type (trks) / Char/In.	Peak Xfer, cps
	9381 Series	Reel (9) / 800	10K/18K/ 36K	9381 Series	Reel (9) / 800	10K/18K/ 36K
CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	9115/9116 9119 9210 9319	Reader Reader Punch Read/punch/print	300/600 300 100 300/60	9115/9116 9119 9210 9319	Reader Reader Punch Read/punch/print	300/600 300 100 300/60
PRINTERS	Model	Type / Columns	Peak Speed	Model	Type / Columns	Peak Speed
	9240 9245 9247 9249	Line / 132 Line / 132 Line / 132 Line / 132	475/700 lpm 300/400 lpm 750 lpm 90/180 lpm	9240 9245 9247 9249	Line / 132 Line / 132 Line / 132 Line / 132	475/700 lpm 300/400 lpm 750 lpm 90/180 lpm
PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			None		
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe		Model	Capacity, char/stripe	
	None			None		
OTHER PERIPHERALS; COMMENTS	MICR reader–sorters; data communications					

— Not Applicable   NA Not Available

SYSTEM IDENTITY	Burroughs B 1700			Burroughs B 1700		
CENTRAL PROCESSOR & WORKING STORAGE						
CPU Model No.	B 1726			B 1728		
Word Length (bits)	24			24		
I/O Channels	—			—		
Type of Storage	Integrated circuit			Integrated circuit		
Capacity (words)	24K-98K bytes			16K-65K		
Cycle Time (μ sec)	0.666			0.667		
SOFTWARE						
Assembler	Yes			No		
Operating System	Yes			Yes		
Compilers	Cobol; RPG; Fortran; Basic			Cobol; Fortran; RPG; Basic		

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	9480	2.3M	NA	NA	8.1M	NA
	9486	47.8M	NA			
	9371	From 7M	NA			

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	9381	Reel (9)	800	10K/18K/	NA	9	NA	96K
	Series			36K	NA	7	NA	72K

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	9115/9116	Reader	300/600	NA	96-col rdr/pch	NA
	9119	Reader	300	NA	80-col rdr/pch	800/300
	9210	Punch	100			
	9319	Read/punch/print	300/60			

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	9240	Line	132	475/700 lpm	NA	Line	48	400 lpm
	9245	Line	132	300/400 lpm	NA	Line	NA	1,040 lpm
	9247	Line	132	750 lpm				
	9249	Line	132	90/180 lpm				
	9240-3	Line	132	1,040 lpm				

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			NA	Reader	1,000
				NA	Punch	100

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None		None	

OTHER PERIPHERALS; COMMENTS		Multiline controller; disc cartridge; MICR; console printer

— Not Applicable   NA Not Available

BURROUGHS

B 1700 Report Update

OVERVIEW

In July, 1973, Burroughs Corporation announced the latest and largest processor in its 1700 line of business-oriented general purpose computers. Target areas for its use are industries such as banking, wholesaling, distributing, manufacturing, hospitals, government, and education.

The announcement of the B 1728 is significant because it extends what was originally a line of small business machines into the small-to-medium area. In fact, the 1728 overlaps the capabilities of Burroughs current entry into the Medium Systems area, specifically, the "700" series B 2700/3700 computers.

The B 1728 has all of the characteristics and capabilities of the formerly announced members of the 1700 line: the B 1712 and 1714 (the so-called "1710" systems) and the 1726. (The 1726 and 1728 together are called the "1720" systems.) These features include compatibility with Burroughs' B 300/B 500 (achieved through emulation or straight compatibility, depending on model), and emulation capabilities for IBM's 1401/1440/1460. Other characteristics shared by the new arrival with the series are its orientation towards communications (a multiline controller was announced), and its ability to use the peripherals and subsystems available on the 1712, 1714, and 1726. It also shares a market thrust towards small or new businesses as well as large firms that require satellite data processing computers.

COMPARISON WITH OTHER BURROUGHS PRODUCTS

The B 1728 is similar to the 1726 in that both have the same control memory/main memory stratifications and speeds, although the 1728 control memory can be expanded from 6,144 bytes to 8,192 bytes, double that of the 4K maximum available on the 1726.

They have similar I/O channel schemes, and all of the peripherals that can be attached to the 1726 can also be attached to the 1728.

Both use the MCP-II multiprogramming operating system, and the same programming languages: Cobol, Fortran, RPG, Basic, NDL (Network Definition Language), and UPL (User Programming Language). Also, both can use the same applications software, including the Burroughs-authored business management system software.

Both the 1726 and the 1728 can use the multi-line controller announced simultaneously with the 1728. Use of this controller provides a maximum of 8 lines on the 1726 and 16 lines on the 1728. The controller uses direct memory access and transmits data at 9,600 bits per second. It is very similar to the Data Communications Processor in use with the Burroughs Medium Systems.

The B 1728 differs from the B 1726 in that the main memory capacity of the B 1728 is larger: 64K bytes expandable in 16K increments to 262K bytes.

Another difference between the B 1728 and B 1726 is that a head-per-track systems disc memory with integrated controller is included in the basic price of the 1728; it is available at separate cost on the 1726. The disc is a modified version of the head-per-track discs available with the Medium Systems processors: it has the same access time (20 milliseconds); its capacity is slightly lower (8.1 million bytes) because of modifications necessary to adapt the disc to the 1728. Disc expansion is the same as that available for the Medium Systems — up to 5 units can be attached for a total of 40.5 million bytes for the 1728. The disc is used to store systems programs and, additionally, user programs and data.

Also announced were phase-encoded, 1,600 bpi tape drives for use on the 1726 and the 1728. Transfer speeds for the 3 drives announced are 40, 80, and 120 kilobytes per second, respectively.

Other devices that have been announced for the 1728 seem to be modified versions of devices available on the Medium Systems; these include an 80-column card reader with a reading speed of 800 cards per minute, and an 80-column card punch with a punching speed of 300 cards per minute; paper tape equipment with respective read/punch speeds of 1,000 and 100 characters per second; and a chain printer with a 48-character set and a speed of 400 lines per minute. High-speed devices that also seem to be modified Medium Systems devices are the 9-channel magnetic tape unit with a 96-kilobyte transfer rate and a 7-channel tape unit with a 72-kilobyte transfer speed.

Because a pattern of adapting Medium Systems peripherals to the "1700" line is developing, a relevant question is, what does the emergent "1700" line have over the existent "700" line?

For one thing, the "1700" series uses the more modern stratified approach to memory technology. Control memory is bipolar semiconductor and operates at 167 nanoseconds (2 bytes). Main memory, also integrated circuit memory, cycles at 667 nanoseconds (3 bytes). This layered approach yields faster execution times than the core technology of the "700" series.

Secondly, the "1700" series can be configured at lower monthly rentals than their "700" series counterparts.

Thirdly, the operating system of the "1700" series computers is more sophisticated than that of the "700" series Medium Systems. The MCP-II uses a pure paging scheme (similar to that used on the multiprocessing 6700/7700 machines) and dynamically reconfigures microcode instructions. These features give it a performance edge over the "700" series MCP-V, which uses a segmentation form of virtual addressing and a fixed microcode instruction set.

Competitive Position

The first obvious target for comparison is Burroughs' own Medium Systems processors, the B 2700/3700. The B 1728 has several distinct advantages. Analysis of monthly rental costs for comparable configurations of the B 1728 and B 2700/3700 indicate that the B 1728 is less expensive. The maximum memory capacity of the B 1728 outstrips that of the smaller B 2700 configurations, and maximum memory of the B 3700 is only 38 kilobytes greater than that of the B 1728.

Other factors in favor of the B 1728 are its more modern technology already discussed, and the somewhat more sophisticated MCP-II.

The major advantage of the B 2700/3700 series over the B 1728 is the significantly greater on-line storage capacity, but future announcements may alter this.

Other more modern competition includes the IBM System/370 Model 125. The B 1728 was scheduled for first delivery September, 1973. Comparisons therefore can only be speculative, pending actual throughput analyses.

The B 1728 is good for applications that need large amounts of on-line storage; it has in excess of a half-billion bytes of on-line storage. How-

ever, the S/370 Model 125 dual-density 3330 Model 11 drives give it an 800 million-byte capacity. Model 1 packs give a 400-million byte capacity, which is less than that offered on the 1728.

The 1728 is also good for applications that are oriented toward communications; the single line controller of the earlier 1700 systems is available, plus the multiline controller, as announced (an independent processor), can connect up to 16 lines. The IBM System/370 Model 125 can support 6 synchronous lines or 16 start-stop lines with one optional adapter or double that with a second optional adapter. IBM offers a Network Control Program that eases the user's network definitions, but Burroughs Network Definition Language offers more flexibility and it is easier to use.

As far as operating systems go, the MCP as defined in the main 1700 report is better than any of the competing operating systems for increased throughput without unnecessary overhead.

Both operating systems require some user sophistication. IBM's DOS/VS is not for the novice, since throughput on a virtual memory machine as implemented by DOS/VS, where core is a strict limitation, requires considerable planning to avoid "thrashing". Job mix and balancing functions must be performed by the user with DOS/VS. MCP-II, on the other hand, performs these functions and allocates system resources. The 1728 is a good system. The only truly negative feature that we have found lies not in the 1728 hardware, but in the business management system software available for applications. Users of this system, which is available on other Burroughs machines, have complained that its extreme modularity makes it slow and unnecessarily redundant.

CONFIGURATION GUIDE

The B 1728-1 Basic System includes a central processor; 6,111 bytes of control memory (167 nanoseconds for 2 bytes); 65,536 bytes of main memory (667 nanoseconds for 3 bytes); an I/O subsystem with 14 I/O positions; a console printer and control; a head-per-track disc file control (partly integrated); and a head-per-track systems disc. The latter comprises one disc file electronics unit and one disc file storage unit (capacity: 8.1 million bytes, average access time: 20 milliseconds).

The basic system is modular and can be expanded as follows:

- Main memory (LSI) from 65,536 bytes to a maximum of 262,144 bytes, in 16K-byte increments.

- IC control memory from the standard 6,144 bytes to 8,192 bytes.

- Head-per-track disc from the standard 8.1 million bytes to 40.5 million bytes in 8.1 million-byte increments.

- Removeable disc subsystems up to a maximum of 525 million bytes.

Addition of a second electronics unit as available on the "700" series disc system, but not yet announced for the 1728, would allow a 1 x 2 exchange and the addition of another 40.5 million bytes of on-line storage. Additionally, a disc pack memory controller connects the modular disc pack memory subsystem. Transfer rate is 625,000 bytes per second. The maximum disc capacity is 525 million bytes.

The I/O subsystems offer buffered controls for the following devices: 96- and 80-column card equipment, line printers, the head-per-track memory, disc cartridge memory, magnetic tape, paper tape, MICR reader/sorters, and the data communications single line control. Buffered controls speed up I/O transfer considerably, which is important in systems with I/O bound applications, such as business systems invariably use.

BURROUGHS

B 1700 Systems

OVERVIEW

Burroughs B 1700 computers are small-scale general business systems aimed at both small and/or new businesses as well as large firms that need satellite data processing installations. They provide efficient competition for the IBM System/3, Honeywell Models 2020 and 2030, NCR 50, and Univac 9200.

The 3 models currently in the B 1700 series — B 1712, B 1714, and B 1726 — vary essentially in processor cycle rate, size range of main memory, and available peripherals. The B 1726 also has a control memory that operates at 4 times its main memory operating rate of 666 nanoseconds per 24 bits.

Peripheral equipment available includes 80- and 96-column card readers and punches, 96-column card sorters, and multifunction units, disc units, line printers, magnetic tape units, a data communications interface, and a console printer. Also available is a new series of MICR document reader-sorters, which are of special interest for banking applications. All devices are buffered; up to 8 individual I/O controls are available on any of the 3 systems.

Two versions of the Master Control Program (MCP) operating system have been announced for the 1700 series: MCP I and MCP II. MCP I is a serial programming system which is not released to date. MCP II provides a multiprogramming environment. Both MCPs are responsible for dynamic control of memory and resource assignment, I/O operations, operator communications, library management, logging, and other functions. The commands for the MCP, entered via the console or via control cards, are simple to use and understand.

Burroughs supplies a comprehensive library of business management software (BMS) for customers who do not have or cannot afford to develop their own software. The BMS package is functionally general enough so that it can be tailored to almost any user environment. This generality, however, has resulted in some user complaints in relation to slow processing.

The programming languages available are Cobol, Basic, Fortran, and RPG. The language compilers in each case generate "s-code," Burroughs' version of machine language. The s-code is then executed by interpreters for each language. RPG is handled somewhat differently; the RPG compiler generates Cobol s-code, which is then executed by the Cobol interpreter.

A design feature, strongly emphasized by Burroughs, is "bit addressability." Burroughs claims that this is the ability of the B 1700 processors to address an individual bit in memory. It is true that the 1700 microinstructions are capable of direct bit manipulation and that memory fetch addresses are at the bit level. However, the B 1700 memory is physically divided into 8-bit words. The CPU addresses main memory physically on byte boundaries so that parity bits can be checked and created. What the microinstructions can do that is noteworthy is access memory in either positive or negative increments respective to a referenced bit, for a specified number of words of variable length.

The variable instruction, operand, and word lengths are the design features that Burroughs should really be emphasizing. At the s-code level, the Burroughs word (or "unit") can be defined as 1 to 65,535 bits (8,191 characters). This flexibility allows improved utilization of available space and faster execution. In regard to space savings, Burroughs is making a claim of a 20 to 40% reduction in the amount of memory needed to execute programs. Users of variable word length machines from other manufacturers have reported space savings of as much as 70%. Burroughs' 40% is probably a conservative estimate.

Configuration Guide

Tables 1 and 2 show the variations in processor speed, memory size, and supported peripherals of the three B 1700 series models. It also contains configuration information. A minimum entry configuration for the B 1700 series could include a B 1714 with 16,384 bytes of memory, an A 9350 console printer, an A 9419-2 96-column reader-punch (300/60 card per minute), an A 9245-16 32-column line printer, and an A

Table 1. Burroughs B 1700: Series Comparison and Configuration Information

Characteristic or Device	B 1712	B 1714	B 1726	Comments
Processor Speed (msec)	0.5	0.25	0.125	
Memory Size (bytes)	16–40K	16–65K	24–98K	
Increment Sizes	8K	8K	8K to 65K; 16K to 98K	On the 1726, main memory increments replace the basic configuration memory. MOS/LSI semiconductor.
Control Memory	—	—	x	2K or 4K available for 1726.
9340 Console Printer & Control	x	x	x	Required.
I/O Channels (max without I/O expansion feature)	5	5	8	On the 1726, there are 5 types of I/O subsystem connections. 1 each std.
I/O Channels (max with I/O expansion feature)	8	8	8	Max 2 expansion features on 1726; adds 1 each of 3 types of subsystem connections.

HIGH-SPEED PERIPHERALS

Direct Access Devices				At least 1 dual drive required. Max 2 for 1714, unless MICR reader/ sorter is used, then max 1. Need I/O expansion feature when 2 disc subsystems or when 1 disc and 1 MICR are used.
9480 Single Disc Cartridge Drive (2.3 or 4.6 mb; 90 msec)	x	x	x	Data in cartridges is recorded in 180-byte segments; avg head positioning is 60 msec; rotational delay 20 msec; transfer rate is 193 kb/sec.
9481 Dual Disc Cartridge Drive (4.6 or 9.2 mb; 90 msec)	x	x	x	
9486-2 Dual Disc Pack Drive (95.5 mb; 42.5 msec)	—	—	x	Max 1/control.
9371 Head-per-Track Memory Bank (7 or 14 mb; up to 5 units; 20 and 40 msec, respectively.)	—	—	x	Max 1/control.
Magnetic Tape				Max 1 control/processor.
9491-2 9-Channel Magnetic Tape Unit (10 kb; NRZ; 800 bpi)	x	x	x	Max 4/control.
9381-12/13/14 9-Channel Magnetic Tape Cluster (18 kb; 2/ 3/4 stations)	—	x	x	
9381-22/23/24 9-Channel Magnetic Tape Cluster (36 kb; 2/ 3/4 stations)	—	x	x	
9390-3 7-Channel Magnetic Tape Unit (18/50 kb; NRZ; 200 or 556 bpi)	—	—	x	

9480-2 dual disc cartridge file (4.6 million bytes). Every system must include a console printer and a disc subsystem.

Expansion within the series, except for the 1726, is eased by add-on memory modules and compatibility of peripherals. On the 1726, the basic configuration memory is replaced during upgrading. Also, the 1726 will not handle the slow-speed printers of the 1712 and 1714.

Expansion to larger computers in the Burroughs 700 series (the B 2700, B 3700, and B 4700) is eased by the fact that the larger computers are designed to run in a similar multiprogramming environment. They also accept without modification the higher-level languages, especially Fortran and Cobol, that can be run on the B 1700s.

Upgrading from Burroughs commercial minicomputers and the B 500 systems is eased by

Table 2. Burroughs B 1700: Configuration Information

Characteristic or Device	B 1712	B 1714	B 1726	Comments
Card Equipment				Max 2 controls/processor. Max 3 readers on 1726.
9115 80-Col Card Reader (300 cpm)	x	x	x	
9116 80-Col Card Reader (600 cpm)	—	x	x	
9111/2 80-Col Card Readers (800, 1,400 cpm)	—	—	x	
9210 80-Col Card Punch (100 cpm)	x	x	x	
9119-1 96-Col Card Reader (300 cpm)	x	x	x	Max four 96-col readers, or if MICR used, probably 3.
9319-2 96-Col Card Reader-Punch (300/60 cpm)	x	x	x	
9319-4 96-Col Reader-Punch (500/120 cpm)	—	x	x	
9419-2 96-Col Reader-Punch Data Recorder	x	x	x	
9419-6 96-Col Multifunction Card Unit (includes sorter)	x	x	x	
Line Printers				Max 1 control/processor.
132-Col Line Printers (90-300 lpm)	x	x	—	
132-Col Line Printer (400 lpm)	—	x	—	
132-Col Line Printers (475-750 lpm)	—	x	x	
132-Col Line Printer (1,040 lpm)	—	—	x	
Reader-Sorters				Max 1 control/processor. If used, requires I/O expansion feature. If used, only 1 disc subsystem can be used on 1714.
MICR Reader-Sorters (600 cpm; 8 or 12 pockets)	—	x	x	
MICR Reader-Sorters (900 cpm; 8 or 12 pockets)	—	x	x	
MICR Reader-Sorter (1,000 cpm; 13 pockets)	—	—	x	
MICR Reader-Sorter (1,625 cpm; 4-16 pockets)	—	—	x	
Data Communications Single Line Control	—	x	x	Max 2 controls/processor, controls need line adapters.

their high-level language programs that will run on the B 1700 and make full use of the B 1700 configurations. B 300 programs can run under an emulator.

Performance and Competitive Position

B 1700 is well suited for the typical scope of small business data processing needs. The provision of customer-oriented software packages, and the high-level language compatibility with the 700 series computers make the B 1700 an excellent entry system for a small business or for a large firm that requires satellite data pro-

cessing installations. The interfaces possible between computers in the 700 series in a communications environment, and the compatibility of other peripherals establish the B 1700 as a growth system. The multiprogramming facilities, albeit limited, are an encouraging step in a small system.

Burroughs is marketing the B 1700 series as implicit competition for the IBM System/3. Similar to System/3, Burroughs offers both 80- and 96-column card peripherals and data preparation equipment. Both systems offer Basic, RPG, Fortran, and Cobol. IBM also offers Assembler

and a desk calculator. Burroughs, however, is aiming at the Cobol market; this is indicated by the facts that RPG is interpreted by the Cobol interpreter for the B 1700, and that Burroughs offers COFIRS (Cobol from IBM RPG Specifications), which is designated to automatically convert IBM's RPG to Burroughs' Cobol.

Multiprogramming can be done in both series. Burroughs' operating environment is suitable for multiprogramming because of the larger available core capacity and better space allocation. On the System/3 Model 10, IBM realistically offers 2 levels of multiprogramming as an option. Both systems apply variations on the theme of virtual memory. The System/3 Model 6 employs disc storage, and swapping to handle Basic programs that would not normally fit into main storage. The B 1700 MCP II uses a paging technique of programmer-defined or compiler-defined segments to accomplish a similar end.

System/3 offers time sharing; B 1700 does not, although release of an interactive Basic compiler is planned. Both systems have communications capabilities. The configuration of Burroughs' communications system should be greatly facilitated by the use of the Network Definition Language (NDL), a high-level language originally designed for the medium systems in the 700 series.

A major difference, from the users' point of view, is that source code on the B 1700 is upward compatible with the rest of the 700 series. This is not the case with System/3 code or data files.

History

Burroughs, founded in 1905, is one of the 2 largest manufacturers of electronic accounting machines, as well as one of the largest computer manufacturers. The company employs over 52,000 people, grosses approximately $900 million a year, and maintains a worldwide marketing force.

The B 1700 is currently the second smallest system in the 700 series of computers. The Burroughs chain now extends from the L Series terminal computers introduced in 1968 through the B 700 and B 1700 small business computers to the B 2700, 3700, 4700, 5700, 6700, and 7700 medium- and large-scale computers. All are programmable in Cobol; most of the computers operate in multiprogramming mode and share many of the same peripherals. This enables expansion within a computer line that ranges from the very small to the very large.

MAINFRAME

All systems in the B 1700 series use large-scale integrated (LSI) circuit main memory. This small-size, high-density circuitry is faster, more reliable, and more easily maintained than conventional magnetic core. Main memory operates with a 666-nanosecond cycle time; control memory (B 1726) cycles in 167 nanoseconds. These speeds are significantly faster than the speeds of most competitive systems.

Bit Addressability

For the B 1700 Burroughs is advertising "bit addressability," a concept that has been existent at least since IBM's ill-fated STRETCH. Burroughs claims that this is the ability of the B 1700 processors to address an individual bit in memory. Microinstructions' memory fetch addresses are at the bit level. However, the CPU addresses main memory physically only on byte boundaries in order to check and create parity bits for the 8-bit words (into which the memory is physically divided). The difference with Burroughs' access of main memory is that it can be done either in negative or positive increments respective to the desired bit; the data can be rotated to isolate the appropriate starting bit during the memory fetch.

Normally, bit manipulation at this level isn't noteworthy. However, Burroughs has thoughtfully provided a varying word length which optimally means that storage can be allocated in bits. The interpreters can directly invoke calls to microinstructions that operate on bits. More importantly, this avoids the crime of wasted storage classically committed by higher-level languages that require byte boundaries for values that could be represented in less than a byte. This manipulation of individual bits — generally a systems programmer's concept — is an interesting development from a manufacturer whose machines are oriented toward the higher-level languages.

One result is that bit addressability gives the ease of higher-level language coding, plus some of the storage utilization of a systems language, namely, Assembler — an almost ideal blend. Add to this, the microcoded interpreters, which allow dynamic reconfiguration of the hardwired microinstructions on the basis of a series of software microinstructions tailored to the appropriate higher-level language, and the B 1700 becomes a technological blend of minicomputer sophistication and general-purpose computer flexibility.

A logical extension of this sophistication is that the 1700 systems are well suited to be "universal emulators." Technologically, the 1700 systems are so flexible at the microcode level that they could emulate any machine.

PERIPHERALS

Tables 1 and 2 contain peripheral device characteristics and configuration information for the three B 1700 series models.

Slow-Speed Peripherals

The operator's console features a built-in magnetic cassette unit intended for the initial entry of systems software and, when needed, the entry of diagnostic software.

The card reader controls will allow a dynamically determinable card size; for example, the readers will handle only 36 columns of a card instead of the full 80 or 96.

A new series of MICR document reader-sorters provide 8 to 12 distribution pockets and sorting speeds of 600 or 900 documents per minute, or 4 to 16 pockets at 1,000 or 1,625 documents per minute.

High-Speed Peripherals

Disc storage is available in 3 different forms; their respective capacities and access times appear in Table 1. Suitability for on-line random access is relative to access time, with the cartridge disc file least suited and the head-per-track disc best suited. The latter is available only on the B 1726.

Magnetic tape equipment is a subset of the equipment that is offered for the larger 700 series computers. Both slow-speed tape units and slow-speed tape clusters are available for B 1700.

Data Communications

For data communications, the B 1700 can interface with other models in the series and with larger Burroughs 700 systems, either as a "host" or a remote batch collection terminal system. The data communications single-line control option can handle up to 2 lines on the B 1714 and 3 lines on the B 1726. Synchronous or asynchronous lines, that operate at a maximum of 9,600 bits per second, can be controlled. The 1700 is best suited for remote terminal processing for a larger central computer. Presently the option is capable of operation with all Burroughs data communications terminals (namely, the TC, RT, and TU series). Burroughs states that the option later will be expanded to include standard synchronous and asynchronous communications conventions of other manufacturers' terminals.

SOFTWARE

Burroughs "soft" machines offer a sophisticated operating system and a very flexible set of applications packages.

Operating System

Two versions of the Master Control Program operating system have been announced for the B 1700: MCP I and MCP II. The installed base is operating under MCP II, since MCP I is not available yet. MCP I is planned as an entry-level (minimum 16K main memory) batch serial operating system that handles all I/O scheduling, dynamic control of memory and resource assignments (including the addition of memory and peripherals), disc program library management, operator and system communication (via console or control cards), job status and logging, program compilation and loading, file management, and utilities. MCP I is expected to need a minimum of 4K for resident requirements.

MCP II, currently available, does all of the functions of MCP I, plus the system handles communications controllers, MICR reader-sorters, and scheduling and loading of programs in a multiprogramming environment. It also provides spooling in the form of pseudo readers and disc backup for printers. The MCP II requires at least 8K bytes of main storage.

The MCP is a paging operating system; page sizes are controlled either by the MCP or by the programmer (the Cobol SEGMENT-LIMIT clause, for example). Paging is facilitated by code (not data) that is entirely reentrant; therefore, there is no need to write back to disc. Data, however, is always written to disc if space is required. Associated with the programs in core is a run status nucleus, tables/stacks, and a segment dictionary, which at any time indicates the pages resident in main storage. If space is needed, it is allocated dynamically in the following page order: available memory, not in use code, in use code, not in use data, and in use data. This is the optimum order with respect to minimized disc access.

Interrupts in the 1700 are soft interrupts; for example, there is a timer bit set every 100 milliseconds, and software must test the bit in order to realize a "timer" interrupt.

The 1700 interpreters reside in 4K or less of core and can be overlayed. On the 1712 and 1714, the MCP resides in whatever core is available. On the 1726, the interpreters reside in control memory, which is either 2K or 4K.

The MCP's paging technique will allow it to run faster as more core is made available. Therefore, we feel that in the 98K bytes (max) available for the 1726, 3 programs are a reasonable multiprogramming mix. Burroughs claims that the 1710 systems also can multiprogram effectively.

We were sceptical about the ability of the 1710 systems (1712, 1714) to multiprogram effectively. A meeting with Burroughs was arranged to discuss the machines and watch a 1714 with 48K, running MCP II. We had 3 Burroughs-authored demonstration programs, subsets of BMS programs, that performed the following: card input; inventory totaling and printing; and file updating. The programs could be further characterized as heavy card input, light processing, light printing; light input, light processing, heavy printing; and light input, heavy processing, light printing. Each of the 3 programs was run serially; the timings were recorded. The programs were than multiprogrammed.

Their order of entry into the system was 2, 3, 1. In this order, the programs ran in 69% of the time required by the serial execution. We then requested that the programs be run in the order 1, 3, 2. In this order, the programs ran in 93% of the time required by serial execution. The pseudo-reader of MCP II was not used in either multiprogramming example. We feel that if this option had been used, more favorable timings would have resulted. Disc backup for the printers, however, was used.

Clearly, for the 1714 to multiprogram effectively, the order of job submission can be critical. This in itself requires knowledge of the job types in terms of resource utilization.

Applications Software

Burroughs offers a comprehensive library of business management software in wholesaling, distribution, and manufacturing, including reports; invoicing, accounts receivable, and inventory control; accounts payable; payroll; and general ledger. Other management systems exist for contractors, credit unions, automobile dealers, utilities, and government.

The firm also offers bank management software in proof and transit; demand deposit ac-

counting; savings accounting; installment loan accounting; and general ledger accounting.

Hospital management software includes reports; patient accounting; medical records; payroll and personnel reporting; and general and responsibility accounting.

All of Burroughs' software is modular in design, which allows modification of packages to suit individual users' needs. This generality of design has aroused some user complaints of lengthy execution times.

Programming Languages

Users intending to write their own software can do so in Basic, Cobol, Fortran, or RPG.

Basic is batch only. Cobol is an extended ANS Cobol. Fortran is also an extended ANS. Cobol programs can run on a 16K entry level system. RPG is handled as if it were Cobol, below the compiler level.

The "variable micrologic" of the B 1700 series computers allows dynamic respecification of the micrologic to fit the particular parameters and requirements of a specific language. For example, Cobol and Fortran vary in their needs for transfers of large data areas. The Cobol compiler might invoke a specially designed move instruction that is not subject to the traditional limit of 256 characters; whereas, the Fortran compiler could still use the traditional instruction. The sequence of (software) microinstructions is changed by the specific interpreter called by the control program.

The minimum number of interpreters per purchased machine is 2: one for SDL (Systems Definition Language, Burroughs' high-level language version of Assembler), and 1 for the language that the users' applications programs employ (Cobol/RPG or Fortran).

Burroughs also offers COFIRS for users of IBM's RPG who may wish to convert their programs to Burroughs' Cobol. Input to COFIRS is an RPG source deck. Output is Burroughs' Cobol.

Users who plan on a communications environment will have their configuration definition (for Burroughs-supported terminals) eased by the use of the Network Definition Language (NDL). Parameter statements to the NDL compiler create instructions and tables for handling the Burroughs-supported terminals. NDL also handles

respecification of the communications network as terminals are added or deleted.

MAINTENANCE

Maintenance for the B 1700 series is performed by Burroughs service personnel available on-call during mutually agreeable business hours and operating from over 200 branch locations throughout the country. First-year maintenance is included in the lease or provided by a separate contract.

HEADQUARTERS

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