

Control Data Cyber 18 Family

MANAGEMENT SUMMARY

The Cyber 18-10, 18-20, and 18-30 computers, introduced in March 1976, were developed for the distributed data processing and small computer markets. They feature microprogramming techniques that result in increased data protection, more flexibility, and faster processing than Control Data's earlier System 17 series, which has been incorporated into the Cyber 18 family as Models 18-17A and 18-17B.

Control Data was one of the earliest and strongest proponents of distributed processing. In addition to the locally distributed architecture of the innovative 6000 Series computers introduced in the 1960's, the predecessors of the System 17 were widely used by Control Data as the basis for specialized "intelligent terminals" to fit the needs of individual situations. The System 17 has not been highly visible on the minicomputer scene, but it is quietly at work in many process control tasks in the petrochemical, petroleum, and drug industries. Curiously, the company has had much more visibility in the field of minicomputer peripherals, and has achieved a solid position in the market for small disk drives and tape drives along with printers, punched card units, and magnetic media.

The Control Data System 17 series was announced in July 1973 as an extension and replacement for the earlier real-time-oriented CDC 1700 systems, originally introduced in 1965. With more than 600 of the earlier systems installed at the time of the System 17's announcement, and three levels of CDC 1700 operating systems available, as well as dozens of major applications pro-

The Cyber 18 family from Control Data spans a wide range of configurations and applications for both business and industrial users while retaining software compatibility with CDC's earlier System 17 Series. The top-of-the-line Cyber 18-30 time-sharing system features dual processors, up to 512K bytes of memory, up to 400 million bytes of disk storage, and support for up to 64 interactive terminals.

CHARACTERISTICS

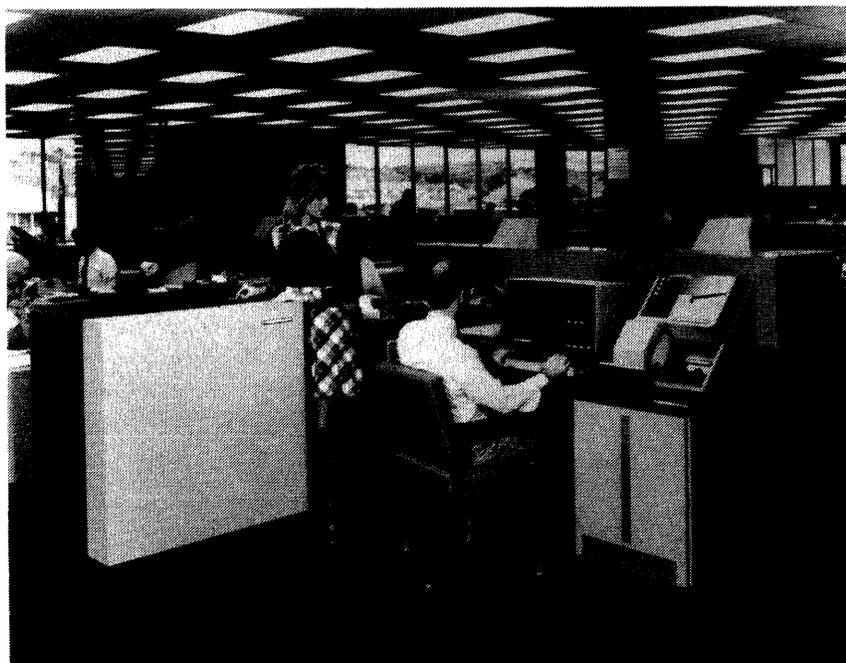
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Control Data is a worldwide business organization with over \$2 billion in annual revenues and 44,000 employees. Its areas of specialty are primarily in the design, manufacture, sale, and maintenance of a wide range of data processing equipment and the design and sale of professional services to business and industry. A major financial service subsidiary is Commercial Credit Company. Magnetic Peripherals (with Honeywell) and Computer Peripherals (with NCR) represent significant joint venture companies.

MODELS: Cyber 18-10, 18-20, and 18-30, based on a microprogrammable processor; Cyber 18-17A and 18-17B, based on CDC's "Basic" processor and formerly called the System 17.

DATE ANNOUNCED: March 30, 1976.

DATE OF FIRST DELIVERY: Late 1976 (late 1973 for System 17, now Cyber 18-17).



The Cyber 18-20 from Control Data represents the midpoint in the Cyber 18 family and supports up to 256K bytes of MOS memory, two floppy disk drives, and eight hard disk drives (400 million bytes). It features a new microprogrammable processor. Twelve software packages for the distribution and manufacturing industries are available from CDC, along with an RPG II that is very similar to IBM's RPG II for the System/3.

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CHARACTERISTICS OF THE CYBER 18 FAMILY

| MODEL | 18-10 | 18-20 | 18-17A | 18-17B | 18-30 |
|-------------------------------|-------------------|-------------------|------------|------------|-----------------------|
| Processor | Microprogrammable | Microprogrammable | Basic | Basic | Microprogrammable (2) |
| Memory (K=1024): | | | | | |
| Type | MOS | MOS | MOS | MOS | MOS |
| Minimum (bytes) | 32K | 32K | 8K | 8K | 64K* |
| Maximum (bytes) | 64K | 256K | 128K | 128K | 512K* |
| Cycle time (nanoseconds) | 750 | 750 | 900 | 600 | 750 |
| Maximum flexible disk (bytes) | 560K or 512K | 560K or 512K | 0 | 0 | 0 |
| Maximum hard disk (bytes) | 35 million | 400 million | 36 million | 36 million | 400 million |

*Includes both CPU's

grams representing more than \$10 million worth of software development, it made very good sense for the System 17 to have the same instruction repertoire and fundamental architecture as the older 1700's. A hallmark of the System 17 was its program, peripheral, and operator panel compatibility with the 1700's.

In August 1975, Control Data announced several enhancements for the System 17 that strengthened its competitive position in the scientific and process control fields. The new features included floating-point hardware, improved communications capabilities, remote A/D interfaces, additional D/A conversion units, a seven-frequency real-time clock, and such peripherals as magnetic tape units, punched tape units, and a card punch.

The traditional market targets for the CDC 1700's and the System 17 included industrial control, data acquisition, communications, OCR control, key-to-disk data entry, graphic systems control, terminal network control, hospital/medical, and amusement/recreational applications. The System 17 became the basis for CDC's Cyberdata data entry system and 979 bank entry system. These applications and others to be developed come under CDC's Data Systems Group.

In March 1976, Control Data enhanced and upgraded its small computer product line by introducing the Cyber 18 family. The new Cyber 18-10, 18-20, and 18-30 systems offer a variety of configurations: the 18-10 features floppy disk storage and a microprogrammable processor; the 18-20 can provide either floppy or hard disk storage (or both); and the 18-30 features two processors and supports up to 64 interactive terminals simultaneously.

In distributed applications, the Cyber 18-10 can function as an intelligent terminal, processing routine data on-site while sending larger jobs to a central computer. The 18-10 can emulate IBM 2780 and 3780 terminals, which makes it compatible with IBM host computers. In addition, it can emulate a CDC 200 User Terminal for use in large-scale Control Data system environments. The 18-10 features a memory size of from 32K to 64K bytes and up to six I/O slots that accept magnetic tape, communications, floppy disk, and card reader/printer controllers. An 18-10 system with 32K bytes of memory, a 300-cpm

NUMBER INSTALLED: Over 700 (including Cyber 18-17 systems).

DATA FORMATS

BASIC UNIT: 16-bit word.

FIXED-POINT OPERANDS: 16 or 32 bits.

FLOATING-POINT OPERANDS: For single-precision arithmetic, operands are 32 bits. For double-precision arithmetic, operands are 48 bits. The operands consist of a sign bit, an 8-bit exponent, and either a 23-bit (single precision) or a 39-bit (double precision) fraction. The exponent is biased by 128.

INSTRUCTIONS: All instructions are either one or two 16-bit words in length.

Storage-reference instructions have a 4-bit operation code, a 4-bit address mode (for indexing/addressing), and an 8-bit operand address (or a 16-bit operand address where 2-word addressing is required). Register-reference instructions have an 8-bit operations code and an 8-bit field called the modifier for replacement or modification of register contents. Shift instructions have an 8-bit operation code, a 1-bit direction flag, two 1-bit A/Q indicators, and a 5-bit shift count.

Inter-register instructions have an 8-bit operation code and a 2-bit indicator for the type of operation possible; the possible operations are exclusive OR, logical product, complement logical product, or arithmetic sum. The inter-register format is completed by a 1-bit first operand and a 5-bit second operand. The one-bit first operand can be combined with the first two bits of the second operand to indicate origin registers, while the last three bits of the second operand indicate destination registers. Shift and inter-register instructions are both subgroups of the register reference instructions. Skip instructions have a 12-bit operation code and a 4-bit skip count.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: MOS (metal oxide semiconductor).

CYCLE TIME: 750 nanoseconds on the microprogrammable (18-10, 18-20, and 18-30) processor, and either 600 or 900 nanoseconds on the 18-17 processor (different-speed memories cannot be mixed on the same system); 16-bit words are fetched.

CAPACITY: 32K to 64K bytes on the 18-10, 8K to 128K bytes on the 18-17, 32K to 256K bytes on the 18-20, and 32K to 256K bytes for each of the processors on an 18-30 system.

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PERIPHERALS/TERMINALS

| DEVICE | DESCRIPTION AND SPEED | MANUFACTURER |
|---|--|----------------------|
| MAGNETIC TAPE EQUIPMENT (Model 18-10, -20, -30) | | |
| 1860-72 | 7-track, 25 ips, 800 bpi NRZI; 20K 6-bit char./sec. | — |
| 1860-92 | 9-track, 25 ips, 800 bpi NRZI; 20K 8-bit bytes/sec. | — |
| (Model 18-17 only) | | |
| 616-72 | 7-track, 25 ips, 556/800 bpi NRZI/1600 bpi PE; 13.9K/20K char./sec. | Magnetic Peripherals |
| 616-92 | 9-track, 25 ips, 800 bpi NRZI/1600 bpi PE; 20K/40K bytes/sec. | Magnetic Peripherals |
| 616-95 | 9-track, 50 ips, 800 bpi NRZI/1600 bpi PE; 40K/80K bytes/sec. | Magnetic Peripherals |
| LINE PRINTERS (Model 18-10, -20, -30) | | |
| 1827-30 | 136 columns, full-line buffer, 12 vertical format channels, 64-character drum, 6/8 lines/inch; 300 lpm | — |
| 1827-60 | 132 columns, full-line buffer, 63-character print band, 6/8 lines/inch; 600 lpm | — |
| (Model 18-17 only) | | |
| 1742-30 | 136 columns, full-line buffer, 12 vertical format channels, 64-character drum, 6/8 lines/inch; 300 lpm | Computer Peripherals |
| 1742-120 | 136 columns, full-line buffer, 12 vertical format channels, 48-character train cartridge; 1200 lpm | Computer Peripherals |
| CARD EQUIPMENT (Model 18-10, -20, -30) | | |
| 1829-30 | Reader, 1000-card input hopper, photoelectric read checking, 300 cpm | — |
| 1829-60 | Reader, 1000-card input hopper, photoelectric read checking, 600 cpm | — |
| (Model 18-17 only) | | |
| 1725-1 | Punch, 1200-card hopper, 1300-card stacker, error checking, card counters; 100 cpm | Computer Peripherals |
| 1729-3 | Reader/punch, 1200-card hopper, 1300-card stacker; 500 cpm read, 100 cpm punch | Computer Peripherals |
| PAPER TAPE EQUIPMENT (Model 18-17 only) | | |
| 1720-1 | Paper tape controller for Facit 4020 Reader and 4070 punch, either of which must be obtained from Facit. | — |
| 4020 | 5, 6/7, or 8-level tape reader, 3-character buffer; 300 cps | Facit-Addo |
| 4070 | 5 to 8-level tape punch, 1 or 2-character buffer, 75 cps | Facit-Addo |
| TERMINALS/OPERATOR CONSOLES (Model 18-10, -20, -30) | | |
| 752-10 | Single-station, TTY-compatible display terminal, 1920-character display, 24 lines by 80 characters, 128-character set, typewriter layout, detachable keyboard, highlighting, cursor addressing; character-at-a-time transmission | — |
| 1811-1 | CRT/keyboard display console, 1920-character display, 24 lines by 80 characters 128-character set, 9-by-7 dot matrix; character, line, or page transmission | — |
| (Model 18-17 only) | | |
| 1711-4 | Model 33 KSR keyboard/printer, 64 ASCII char. set; 10 cps | Teletype |
| 1711-5 | Model 35 KSR keyboard/printer, 64 ASCII char. set; 10 cps | Teletype |
| 1713-4 | Model 33 ASR keyboard/printer, 64 ASCII char. set, paper tape reader and punch; 10 cps. | Teletype |
| 1713-5 | Model 35 ASR keyboard/printer, 64 ASCII char. set, paper tape reader and punch; 10 cps | Teletype |

card reader, a 300-lpm printer, a single CRT console, and synchronous communications capability can be purchased for about \$40,000.

The Cyber 18-20 supports a wide range of data processing applications with 12 software modules developed for the manufacturing and distribution industries. The 18-20

CHECKING: One parity bit per word is standard.

STORAGE PROTECTION: One memory protect bit per word is standard, and permits the implementation of a Program Protect System. This system sets (or resets) the protection bit associated with each operand and instruction contained in a given program, and causes an interrupt when

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features a memory size of from 32K to 256K bytes and up to 9 I/O slots that accept magnetic tape, floppy and hard disks, a card reader/line printer, and micro memory controllers. An 18-20 system with 64K bytes of memory, 1K bytes of microprogram memory, magnetic tape drive, card reader, line printer, and mass storage capability sells for about \$85,000.

The Cyber 18-30 is designed for time-sharing applications and can support up to 64 interactive terminals simultaneously. This computer system features dual processors, one dedicated to data communications and the other to time-sharing functions. There are dual memory interfaces, and each processor incorporates a tape cassette drive for diagnostics. The data communications processor interfaces to a communications multiplexer that supports up to 64 terminals in increments of 16. The 18-30 supports from 64K to 512K bytes of shared-error correcting memory and up to 9 I/O slots that accept magnetic tape, card reader/line printer, disk storage, and CRT console controllers. A dual-processor 18-30 that supports 32 terminals and has 384K bytes of main memory, 4K bytes of microprogram memory, communications links, a magnetic tape drive, a card reader, a line printer, and mass storage capability costs about \$116,000.

The Cyber 18-17 models (the new names for the System 17 processors) are designed for real-time applications, including production control, oil movement and control in refineries, telemetry, and key-to-disk data entry. They feature direct memory access, analog-to-digital conversion, from 8K to 128K bytes of main memory, a choice of either 600- or 900-nanosecond memory, and 12 I/O ports that accept controllers for terminals, disk drives, a line printer, synchronous communications, asynchronous communications, magnetic tape drives, a card reader, a card punch, and paper tape reader/punches. A 18-17 system with 32K bytes of memory, a card reader, a line printer, display units, a magnetic tape drive, and a disk cartridge drive sells for about \$65,000.

Software compatibility has been a hallmark of CDC product history, and the Cyber 18 Series bears this out. The Cyber 18-10, 18-17, 18-20, and 18-30 all share the same basic instruction set as the CDC 1700 and System 17.

Control Data currently offers two operating systems for the Cyber 18 Series. The Real-Time Operating System (RTOS) requires no mass storage, and can reside in memory after being loaded from a magnetic tape or other input device. It processes all processor time requests on a priority basis and supports multiprogramming. The Mass Storage Operating System (MSOS) is a multiprogramming system designed to support a variety of applications that require dedicated system utilization, batch processing, and program checkout features in a real-time environment. MSOS divides memory into a protected area (foreground) and an unprotected area (background). The Interactive Terminal-Oriented System (ITOS) is an

unauthorized access is attempted. (This system must be employed for time-sharing/multiprogramming operations.)

RESERVED STORAGE: The interrupt system reserves 64 words (128 bytes). The operating systems require from 3K to 16K bytes plus a job area.

CENTRAL PROCESSORS

GENERAL: The Cyber 18-10, 18-20, and 18-30 all use a microprogrammable 16-bit processor. Execution of macro programs stored in MOS main memory is controlled by micro-level programs stored in micro memory. ROM micro memory is provided for execution of the basic CDC 1700 instruction set and the additional enhancements which include character and field manipulation, indexing, micro memory referencing, autodata transfer, and main memory paging control. Read/write micro memory is available for microprogramming requirements. Arithmetic is one's-complement, signed, fixed-point, with hardware add/subtract/multiply/divide. The Cyber 18-30 uses two of these processors which share main memory; one processor functions as the time-sharing processor and the other as a communications processor. Automatic program loading (dead start) is provided through ROM. One internal tape cassette drive is included with each processor for loading diagnostics. The memory access time is 750 nanoseconds.

The fully parallel Cyber 18 (formerly System 17) processor retains software compatibility with the earlier CDC 1700 and includes the CDC 1700's instruction repertoire, interrupt structure, memory protection, program protection, remote autoloading, and breakpoint switch as standard features. Other standard features include hardware multiply/divide, 16 interrupts, 2 index registers, and a programmer's panel. Options on the 18-17 are offered for configuration expandability, for CDC 1700 peripheral compatibility, and for increased instruction versatility (floating-point hardware). The 18-17 system is built with MSI and LSI TTL technology and utilizes one's-complement arithmetic. The 900-nanosecond "A" version is a closely similar performance substitute for the CDC 1700, while the 600-nanosecond "B" version provides substantially higher performance.

REGISTERS: The Cyber 18-10, -20, and -30 processors each provide 14 registers. Seven traditional registers are used in the execution of normal CDC 1700 instructions, and four general-purpose registers have been added to support the enhanced instruction set. Three special-purpose registers are used exclusively for machine control.

The 16-bit A register is the principal arithmetic register (accumulator), and also serves as the data interface during I/O operations. The 16-bit Q register serves as an auxiliary accumulator or index register, and holds the address of the peripheral device during I/O operations. The P register serves as the program address counter. If main memory is 32K words or less, P is 15 bits. If main memory is greater than 32K words, P is 16 bits. The 16-bit X register is called the exchange register. Its prime function is to hold data going from or to storage; a secondary function is to hold one of the operands in most arithmetic operations. The 16-bit Y register serves primarily for address computation; a secondary function is its use as a counter during multiply, divide, and shift instructions. The 16-bit M register is the system mask register. Its function is to enable and disable interrupt lines. The 16-bit B register is used for storing the breakpoint address, while the 16-bit I register is used for indexing.

The four general-purpose registers, R1, R2, R3, and R4, are all 16-bit registers, and can be used for indexing, as accumulators, and for loop control. Lastly, two 16-bit registers, LB and UB, are lower and upper bound registers for unprotected memory areas.

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add-on to MSOS that provides a multi-user interactive RPG II environment.

FORTRAN, AUTRAN, RPG II, an assembler, and a macro assembler language are the currently available programming languages for the Cyber 18 Series. FORTRAN is a superset of ANSI basic FORTRAN, while AUTRAN provides procedural arithmetic and process specification capabilities for industrial control applications. The Cyber 18 RPG II is source-code-compatible with IBM's System/3 RPG II, and the assembler language provides the full set of CDC 1700 operation codes.

Application programs for the series consist of 12 packages, of which 8 are for use in the distribution industries and 4 apply to manufacturing. The distribution software includes order entry/invoicing, accounts receivable, inventory control, physical inventory, general ledger, payroll, purchase order processing, and accounts payable modules. The manufacturing software includes material requirements planning, bill of material processor, work-in-progress, and routing modules.

The Cyber 18 family competes against a wide variety of equipment from vendors such as Data General, DEC, Hewlett-Packard, IBM, and Interdata. Against these well-entrenched competitors, the Control Data line shows its greatest strength when the company's broad line of services is taken into account. CDC provides field service from approximately 160 locations worldwide (including nearly 90 in the U.S.) and also offers custom systems engineering support. (CDC, in fact, provides field support for a number of competitive minicomputer vendors.) Furthermore, CDC manufactures its own peripherals (as well as those of many of its competitors) and is able to provide factory-trained maintenance service as necessary. Both on-call and non-contract maintenance is offered, and service is obtainable for periods ranging from prime shift only to full 24-hour, 7-days-a-week coverage.

USER REACTION

Control Data refused to supply a list of Cyber 18 users, and Datapro was unable to locate enough to prepare a meaningful analysis of user reaction at this time.

In Datapro's 1976 survey of minicomputer users, we received responses from two users of the CDC System 17 (now the Cyber 18-17) and three users of the earlier CDC System 1700. The weighted average ratings assigned by these five users, on the usual scale of 4.0 for Excellent, were as follows: ease of operation—3.6; reliability of mainframe—3.8; reliability of peripherals—2.8; responsiveness of maintenance service—3.5; effectiveness of maintenance service—3.0; technical support—2.7; operating systems—2.8; compilers and assemblers—2.3; applications programs—2.0; ease of programming—3.0; ease of conversion—2.0; overall satisfaction—3.0. Thus, the users' overall level of satisfaction was fairly high despite some apparent weaknesses in the software for these earlier CDC minicomputers. □

The Cyber 18-17 processor has 17 registers. The 18-bit Z register holds a word being transferred between main memory and an external device. When a word comes from main memory, parity is checked in the Z register. When a word comes from an external source, parity is added to the word before it is transferred to main memory. The 16-bit S register specifies where a word is to be read from or written to main memory.

The two general-purpose registers are the 16-bit A register and the 16-bit Q register. The A register is the principal accumulator and also serves as the data interface during I/O operations. The Q register serves as an auxiliary accumulator or index register and holds the address of the peripheral device during I/O operations.

In addition, there are seven special-purpose registers. The P register serves as the program address counter. If main memory is 32K words or less, P is 15 bits. If main memory is greater than 32K words, P is 16 bits. The 16-bit X register is called the Exchange register. Its prime function is to hold data going from or to storage; a secondary function is to hold one of the operands in most arithmetic operations. The 16-bit Y register serves primarily for memory address computation; a secondary function is its use as a counter during multiply, divide, and shift instructions. The 16-bit M register is the system Mask register. Its function is to enable and disable interrupt lines. The 8-bit F register holds the instruction identification and/or addressing mode bits during the execution of an instruction. The Breakpoint register, called the B register, is 16 bits long and holds the address of data for the breakpoint mode of operation. Lastly, there is one memory location used as an index register. It is symbolically called register I.

The optional Hardware Floating-Point Unit (HFPU) contains six functional registers: the 16-bit Function/Status register, the 16-bit Command-Code register, the 16-bit Index register, the 16-bit Program Counter register, the 48-bit Floating-Point Accumulator (FPAC), and the 16-bit Stop/Save Address register. The Function/Status register is used as bit indicators for addressing precision, protect, fault, and error mode. The Stop/Save Address register is used to hold the beginning address of the save area for HFPU registers when the Stop command has been used. In addition, the HFPU contains several nonaccessible registers. The most important are the three 16-bit registers which together form the look-ahead buffer (LABF). The LABF's function is to hold the operand for the next floating-point calculation. The LABF performs fetching while a preceding floating-point operand is in the FPAC being acted upon.

The real-time clock contains two 16-bit registers. The Holding register is loaded by an OUTPUT command from the A register and used in comparison with the 16-bit binary counter. The Output Buffer register holds the last count for a READ STATUS command.

INDIRECT ADDRESSING: Yes, to multiple levels, in 32K (non-interleaved) mode only. To one level in 64K (interleaved) mode.

ADDRESSING: There are eight addressing modes on the Cyber 18-10, -20, and -30. The modes are Absolute, Indirect, Relative, Relative Indirect, Constant, Storage, Storage Indirect, and Field.

On the Cyber 18-17, there are seven addressing modes. Direct, relative, and indirect modes can be specified with either one- or two-word formats. The one-word formats permit using the first 256 words of memory as direct or indirect address references or to specify a displacement. The two-word formats use a full 16-bit address for the direct, indirect, or displacement value. The seventh mode combines one- or two-word relative with indirect addressing.

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Control Data's names for these modes are: Absolute (one-word direct), Constant (two-word direct), Indirect (one-word indirect), Storage (two-word indirect), Relative (one-word relative), 16-bit Relative (two-word relative), and Relative Indirect.

Indexing can be specified with any of these modes. Indexing is performed through either the auxiliary accumulator (Q register) or the memory index register (I register).

INSTRUCTION REPERTOIRE: 72 basic instructions. There are 15 storage reference instructions; in this category are 4 transfers, 6 arithmetic, 2 logical, and 2 jump/stop instructions. The register reference instructions number a total of 41, including 5 transfer, 7 arithmetic, 14 logical, 2 jump/stop, 6 shift, 2 I/O 3 interrupt, and 2 program protect instructions. The last category contains 16 skips.

INSTRUCTION TIMINGS: All times are in microseconds for full-word, fixed-point operands.

| | 18-17A (900-nsec. memory) | 18-17B 600-nsec. memory) | 18-10, 18-20, 18-30 |
|---------------------|---------------------------------|--------------------------------|---------------------------|
| Load/Store: | 1.8 | 1.2 | 1.76 |
| Add/Subtract: | 1.8 | 1.2 | 1.76 |
| Multiply/Divide: | 17.4 | 11.6 | 6.6/ 10.5 |
| Compare and Branch: | 1.3 | 0.88 | NA |

INTERRUPTS: The microprogrammable processors used in Cyber 18-10, -20, and -30 systems emulate the 16 levels of vectored interrupts featured on the 18-17 computers.

The 18-17 processor has one internal interrupt level for parity error, program protect fault, or power failure and 15 levels of external interrupts. Interrupt priority is programmable. Vectored priority interrupts are standard.

PHYSICAL SPECIFICATIONS:

| | 18-10 | 18-20 | 18-30 | 18-17 |
|-----------------|-------|-------|-------|-------|
| Height (inches) | 31 | 29 | 29 | 16.25 |
| Width (inches) | 48 | 61 | 61 | 19 |
| Depth (inches) | 32 | 31 | 31 | 19.25 |
| Weight (pounds) | 375 | 475 | 950 | 80 |
| Heat (BTU/hr) | 4099 | 4508 | 9016 | 2100 |

All systems require from 104 to 127 volts AC and a temperature range of from 50 to 95 degrees F.

INPUT/OUTPUT CONTROL

I/O CHANNELS: A non-buffered programmed data channel (AQ channel or Bus) is standard with all Cyber 18 CPU's. The "A" register is used to transfer data in and out of the computer, transmit function codes, and receive status bits. The "Q" register transmits the addresses of peripheral devices and the control signals. The AQ channel can handle data rates of 160K words/second (600-nanosecond system), 110K words/second (900-nanosecond system), or 50K words/second (CDC 1700 mode of operation). A Direct Storage Access Channel (DSA channel or Bus) is also a standard component that provides direct access by external devices to main storage at rates of 1.6 million words/second (600-nanosecond system), 1.1 million words/second (900-nanosecond system), or 370K words/second (SC 1700 mode of operation). Up to eight peripheral controllers can be attached to a channel.

SIMULTANEOUS OPERATIONS: The first 32K words of memory and the second 32K words of memory (contained in the Expansion Chassis) are in two separate banks. This

system architecture allows a computer memory reference in one bank to occur simultaneously with a DSA memory reference in the other bank.

CONFIGURATION RULES: The Cyber 18-10 processor has six I/O slots, with one reserved for a Model 1811-1 CRT console. The other five slots are available for controllers that accept magnetic tape drives, a card reader and line printer, a communications line adapter, a breakpoint controller, and flexible disk drives.

The Cyber 18-20 processor has 10 I/O slots, with 1 reserved for a Model 1811-1 CRT console. The other nine slots are available for controllers that accept magnetic tape drives, a card reader and line printer, a communications line adapter, hard disk drives, a breakpoint controller, micro memory (two slots), and an ECC MOS array.

In a Cyber 18-30 system, there are three I/O slots on the communications processor and five slots on the time-sharing processor. The communications processor allows one slot for the Model 1811-1 CRT console, one for a cassette tape drive for diagnostics, and one slot for a communications multiplexer which allows either 32 or 64 lines. The time-sharing processor allows one slot for sharing the 1811-1 CRT console, one for a second cassette tape drive for diagnostics, one for magnetic tape, one for hard disk, and one for a card reader/line printer controller.

The basic Cyber 18-17 system has 36 slots in the chassis, with pre-wired positions for the CPU and teletypewriter control (7 slots), memory controller (2 slots), 4K to 32K words of memory (8 slots), magnetic tape controller and phase-encode option (7 slots), one disk controller (5 slots), plus 4 AQ positions and 3 DSA positions for connection of peripherals and channels. For example, the real-time clock requires one slot and can be mounted in one of four AQ positions.

Memory expansion over 32K words or additional peripheral interfaces require a 1783-1 Expansion Chassis and a 1786-1 Memory Expansion Control (two expander slots), a 1785-1 AQ Channel Expansion (one slot in expander and one slot in basic processor), or a 1785-2 DSA Channel Expansion (one slot in expander and one slot in basic processor). The free-standing, rack-mountable Expansion Chassis provides 36 slot positions for 32K words (8 slots), a memory controller (2 slots), 10 AQ and 4 DSA wired positions, and 12 unwired positions for special interfaces.

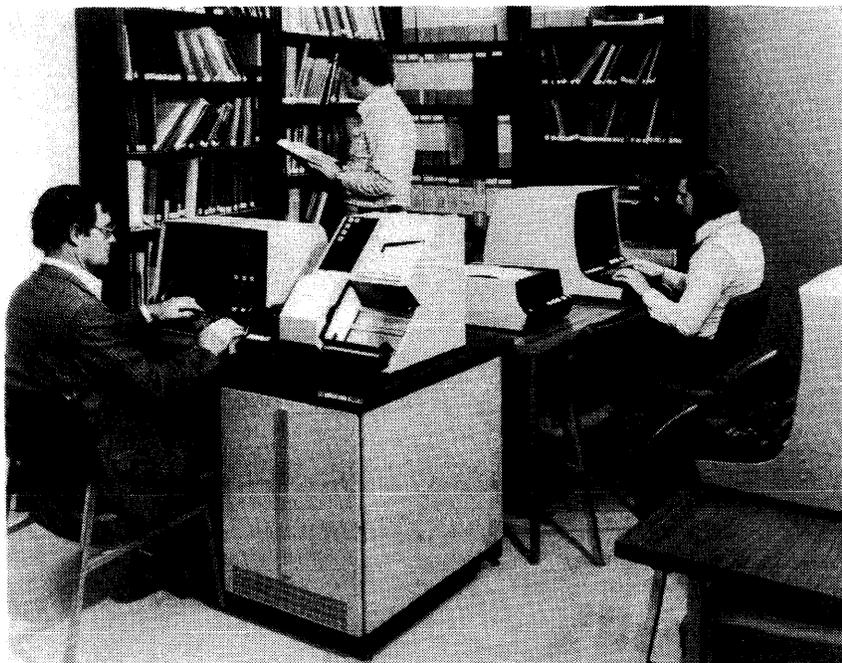
The Hardware Floating-Point unit requires 7 slots in the Expansion Chassis; interface is via the A/Q and DSA channels (1 slot in each) and 5 slots of the 12 unwired positions.

1865 FREE-STANDING FLOPPY DISK SUBSYSTEM: The 1865 drives are available only for Cyber 18-10 and 18-20 systems, and come in either IBM format (128 bytes per sector) or CDC format (196 bytes per sector). The IBM format yields 256K bytes of storage per diskette, while the CDC format yields 280K bytes. A maximum of two drives can be attached to a 1833-5 controller, which takes one I/O slot. The 1865-1 drive is designated as the first drive, and the 1865-2 is designated as the second. The drive reads one side of each diskette, accessing 26 sectors per track and 77 tracks per surface. The data transfer rate is 31,200 bytes per second, while the average access time is 343 milliseconds. The drives are manufactured by Magnetic Peripherals, Inc.

MASS STORAGE

856 FREE-STANDING CARTRIDGE DISK SUBSYSTEM: The 856 Series Disk drives are available only on Cyber 18-17 systems. The single-density 856-12 drive provides storage for 2.2 million 16-bit words on one fixed

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This top-of-the-line Cyber 18-30 utilizes two processors (one for time-sharing, the other for communications) while supporting up to 64 interactive terminals. Oriented toward educational institutions, the 18-30 can be configured with a maximum of 400 million bytes of disk storage and up to 512K bytes of shared main storage.

and one removable disk cartridge of the IBM 5440 type. The double-density 856-14 drive has a total storage capacity of 4.5 million words. Up to four voice-coil-positioned drives of either density can be attached to the 1733-2 controller (5 slots), which connects in turn to the DSA channel. The 1773-2 has absolute cylinder addressing and capability for seek-overlap. Each disk has 2 surfaces, with 200 or 400 tracks per surface (856-12 or 856-14), 29 sectors per track, and 96 words per sector. Average head-positioning time is 35 milliseconds. Average rotational delay is 12.5 milliseconds. Rotational speed is 2400 rpm, and data transfer rate is 156K words/second. The manufacturer is Magnetic Peripherals, Inc., a Control Data subsidiary.

1886 CARTRIDGE DISK SUBSYSTEMS: These single- and double-density controller and drive subsystems are used with Cyber 18-10 and 18-20 systems. The single-density 1866-12 drive stores 4.4 million data bytes using one fixed disk and one removable cartridge, while the double-density 1866-14 stores 8.8 million bytes. Up to four intermixed drives can be attached to the 1833-4 controller. Data is stored on two surfaces of each fixed and removable, single- or double-density cartridge, using 200 or 400 tracks per surface and 29 sectors per track. Average head-positioning time is 35 milliseconds, and rotational delay averages 12.5 milliseconds. Data is transferred at a rate of 312,000 bytes per second. These units are manufactured by Magnetic Peripherals, Inc.

1867 FREE-STANDING DISK PACK SUBSYSTEM: The 1867 drives are available only on Cyber 18-20 and 18-30 systems. The single-density 1867-10 drive provides storage for 25 million 8-bit bytes on a 5-surface disk pack. The double density 1867-20 drive provides storage for 50 million bytes. Up to eight drives of either density can be attached to the 1833-3 controller. Each pack has 3 platters, 5 recording surfaces, 1 servo surface, 5 tracks per surface, 64 sectors per track, and 192 bytes per sector. Average head-positioning time is 30 milliseconds. Average rotational delay is 8.33 milliseconds. The data transfer rate is 1.2 million bytes per second. The drives are manufactured by Magnetic Peripherals, Inc., a Control Data subsidiary.

INPUT/OUTPUT UNITS

See Peripherals/Terminals table.

COMMUNICATIONS CONTROL

1843-1 COMMUNICATIONS LINE ADAPTER (Models 18-10, -20 only): Provides multiplexed dual channel interfaces for the connection of two synchronous or asynchronous modems which conform to CCITT V.24 or EIA RS-232C standards. Selectable transmission rates include 110, 150, 300, 600, 1200, 2400, 4800, 9600 and 19,200 bits per second in asynchronous mode, or 1200, 2400, 4800, and 9600 bps in synchronous mode. Provides for software selection of half-duplex or full-duplex operation, 5-, 6-, 7-, or 8-bit character code lengths, even or no parity generation and checking, I/O speeds, and stop-bit length. Requires one I/O slot.

1743 COMMUNICATION CONTROLLERS (Model 18-17 systems only): The 1743-1 multiplexes two synchronous full- or half-duplex data channels at rates of 1200, 2400, 4800, 9600, or 19,200 bits per second. The 1743-2 multiplexes up to eight synchronous full- or half-duplex data channels at rates of 110, 300, 1200, 4800, or 9600 bps. In both the 1743-1 and 1743-2, the data rates are hardware-selectable; even, odd, or no parity is available; protect or non-protect mode can be manually set; and character structure can be five, six, seven, or eight data bits. The 1743-1, in addition, can select a character by switch. The 1743-2 can additionally handle one or two stop bits.

COMMUNICATIONS SOFTWARE: Timeshare 3 under MSOS 5 supports up to 64 concurrent users at remote interactive terminals, and requires the presence of both FORTRAN and File Manager 1.

SOFTWARE

OPERATING SYSTEMS: The Cyber 18 family is supported by two operating systems: the Real-Time Operating System Version 3 (RTOS 3), and the Mass Storage Operating System Version 5 (MSOS 5).

MSOS 5 is a multiprogramming system designed to support a variety of applications requiring dedicated system utilization, batch processing, and program checkout features in a real-time environment. Multiprogramming is on a priority basis, and there is no restriction on the number of I/O requests or programs that can be scheduled on the queue.

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MSOS 5 segregates main memory into two functional areas: protected memory and unprotected memory. Protected memory is reserved for executing the operating monitor and the user's application programs. Unprotected memory is used for the execution of batch job processing and program checkout. The size of protected and unprotected memory is variable.

The MSOS 5 Monitor is the real-time executive which serves as the interface to other programs and system resources on a priority basis. The bare-bones Monitor requires 3K bytes of memory and contains request processors for I/O, program scheduling, time delays, memory allocation, enable/disable scheduling, and background requests.

The MSOS 5 Job Processor is responsible for monitoring background programs and provides the interface for the batch stream, unattended jobs, operator-controlled jobs, compilation, assembling, and various utility functions.

The MSOS 5 File Manager creates and maintains both sequential and indexed files. It can be used by both background and foreground programs.

The minimum hardware required for MSOS 5 includes 16K words (32K bytes) of main memory, a console device (CRT or teletypewriter), an input device (cards or magnetic tape), an output device (cards or magnetic tape), and at least 1 million bytes of disk storage.

RTOS 3 is a subset of MSOS 5 that resides in memory with no need for a mass storage device. Up to 16 multi-programming priority levels are provided, and I/O requests are also processed on a priority basis. Minimum system requirements include 32K bytes of memory, a console device (CRT to teletypewriter), an input device (cards or magnetic tape), and an output device (cards or magnetic tape).

The *Interactive Terminal-Oriented System (ITOS)* is an add-on to MSOS 5 that provides a multi-user interactive RPG II environment. ITOS provides file manager utilities which are accessible from terminals, an on-line file-oriented data base, resource management, and data entry procedures. The ITOS executive and terminal manager interface with the MSOS job processor through system files and an interactive source-language text editor. ITOS requires a minimum configuration that includes 65K bytes of memory, one disk drive, one line printer, and one CRT console.

LANGUAGES: Control Data currently offers an assembler, a macro assembler, FORTRAN, AUTRAN, and RPG II.

Assembler 1 runs under RTOS 3 and includes the capability to assemble CDC 1700 operation codes. It provides pseudo operators, but does not include a macro capability.

Macro Assembler 3 runs under MSOS 5 and includes a full set of symbolic CDC 1700 machine instructions, macro instructions, assembler error diagnostics, free-field source formatting, and listing and binary output to appropriate units.

FORTRAN 3 A/B runs under MSOS 5 and has a syntax that is a superset of ANSI Basic FORTRAN. The extensions to the ANSI standard include ASSEM, BYTE, DATA, RELATIVE, and SIGNED BYTE. A subset of ANSI FORTRAN extensions is also implemented, including byte manipulation, an in-line assembly code, three execution-time packages, and a FORTRAN multiprogramming interface. The "A" compiler has a larger number of overlays than the "B" compiler and requires more compilation time but less main memory (16K bytes versus 32K bytes). If double precision is used, an additional 5K bytes are required.

AUTRAN 3 runs under MSOS 5 and provides procedural arithmetic and process specification capabilities for indus-

trial control applications. AUTRAN provides FORTRAN as a subset, includes scaling, alarming, and analog/digital control facilities, and is sold with an operator's console.

RPG II runs under MSOS 5 and is functionally compatible and source-code-compatible with IBM's System/3 RPG II. The package includes a compiler, interpreter, run-time support routines, and a data base manager. RPG II requires the SORT/MERGE utility.

UTILITIES: Each of the Cyber 18 operating systems includes a basic set of utilities.

APPLICATIONS SOFTWARE: CDC currently supports 12 application modules, of which 8 are for use in the distribution industry and 4 apply to manufacturing.

The *Order Entry/Invoicing Module* operates in the "post-billing" or order entry mode, produces a picking ticket by bin, and allows back orders. The module can produce a detailed daily invoice register, backlog reports, and daily, weekly, or monthly sales analysis reports. It maintains associated files, clears the daily invoice file, alters the invoice numbering sequence, and prints invoices, a sales history report, and stock status reports.

The *Accounts Receivable Module* automatically posts debits and credits from the invoicing module, while allowing additional entries to be made. This module prepares customer statements, detailed audit trails, cash receipts journals, an invoice register, and an age analysis report.

The *Inventory Control Module* can operate in a completely stand-alone environment, or it can be interfaced with other modules in the series. This module adds, changes, or deletes products on the Master File, and also permits inquiry into the stock status of any product. Reporting capabilities include a full stock status report of all items (selectable by class); an exception stock status report to highlight those items below the reorder point; a costed inventory report for accounting; and a usage analysis of monthly, yearly, and average historical usage.

The *Physical Inventory Module* accepts data after an actual physical count of inventory and produces an audit listing of inventory tags indicating any errors. The module provides the following reports based on the actual count: inventory tag edit report, missing tag report, unit cost report, and costed physical report.

The *General Ledger Module* accepts keyboard entries to develop trial balances, profit and loss statements, balance sheets, a chart of accounts listings, audit trails, and master file listings. This module also allows inquiry into account balances.

The *Payroll Module* is capable of simultaneously processing weekly, bi-weekly, semi-monthly, and monthly payrolls. Input consists of time worked, commissions to be paid, non-standard pay rates, and one-time deductions. The reports prepared by this module include a personnel register, a deduction register, a detailed pay register, weekly and year-to-date check registers, W-2 and 941 statements, and various tax reports.

The *Purchase Order Processing Module* produces purchase orders and tracks them if they become overdue or cause a price variance. It also updates inventory balances and reports historical vendor performance. The module allows blanket purchase orders and releases from the blanket orders, and also allows multiple shipment dates on a single purchase order. The major reports provided include a purchase order receipts report; an open orders report by PO number, part number, or vendor; a purchasing history report; a 24-week future cash commitment summary; and a cash requirement summary.

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The *Accounts Payable Module* operates as an independent system for the management of payables. The module accumulates information on vendors, vendor invoices, discounts, and expense distributions. It produces complete prepayment information, writes approved checks and related reports, and maintains historical data for analysis. This module also updates the general ledger chart of accounts. The major reports provided include a cash requirements report, an aged trial balance, a check reconciliation register, an expense distribution report, a monthly vendor payables summary, and a check register.

The *Material Requirements Planning Module* collects data from other inventory-related modules and simulates future inventory positions from present stock. Instead of using a traditional reorder point, this manufacturer-oriented module considers open purchase orders, sales levels, and other information to calculate a "net" material status of each item. This module can also be used to simulate hypothetical requirements. The major reports produced include a material requirements report; an order action report for items made in-house, purchased items, and all items; and a shortage projection report.

The *Bill of Material Processor Module* interfaces with the Material Requirements Planning Module to explode and generate material requirements; interfaces with the Routing Module to generate and update standard labor, burden, and outside processing costs; and interfaces with the Work-in-Progress Module to allocate stock for jobs in progress and relieve stock flow to terminated jobs. The module can handle up to 28 levels of assembly, and can implode or explode bills of materials. It also automatically updates production costs. The major reports produced by this module include a bill of materials report (single and multiple level), and "where used list" (single and multiple level), a costed bill of materials, and an operation sheet.

The *Work-in-Progress Module* interfaces with the Inventory Module, the Payroll Module, and the Routing Module to provide automatic inventory allocation, relief, adjustment, and replacement as work orders reach various phases of completion. It also provides automatic queuing of work from completed operations in the routing sequence, and automatic accumulation of work order-related costs from time cards, material requisition adjustments, and other data. The module queues partially completed jobs to the next operation, computes shop loads and production lead times, and spots variances between actual and standard costs during a production run. The major reports produced by this module include listings of work order and time card transactions, traveling routers, detail/summary work order status reports, workstation loading reports, and costed job reports.

The *Routing Module* establishes the standard routing sequence for a manufacturing process, including information needed to calculate work center loads, manufacturing lead times, and standard production costs. When labor rates change, a single change to the labor grade master file results in updated costs for all products affected. The module also sequences operations performed to produce an assembly.

PRICING

POLICY: Control Data makes the Cyber 18 systems available on either a purchase or lease basis. Lease terms are for one year with CDC or three to seven years with Commercial Credit Leasing Inc., a subsidiary of CDC's Commercial Credit Company subsidiary. Discounts are available under certain circumstances. For each year's lease with Commercial Credit Leasing over the basic three years,

discount one percent. Discount two percent for each 12-month increase in the basic two-year, noncancellable leasing period. Discount four percent for each year's rental paid in advance. Discounts are cumulative. Lease cancellation notice required after the noncancellable period is 90 days.

MAINTENANCE: The minimum maintenance contract is for one year unless a special arrangement is requested. The Principal maintenance plan provides for nine consecutive hours between 7:00 a.m. and 6:00 p.m., Monday through Friday, excluding holidays. The Modified maintenance plan provides for any nine consecutive hours between 5:00 a.m. and 8:00 p.m., Monday through Friday, excluding local holidays. Principal plan rates are quoted in the accompanying price list. Charges for the Modified plan and extended-period coverage are as follows:

| | Monday through Friday* | Saturday or Sunday |
|--------------------|------------------------------|--------------------------|
| Principal period | — | 3-8 |
| Modified principal | 1-4 | 5-12 |
| 16-hour period | 5-30 | 7-16 |
| 24-hour period | 9-45 | 4-9 |

*Percentage above Principal plan charges. Charges are cumulative. Percentages vary depending on the CDC group responsible for the product.

The non-contract maintenance rate is \$36/hour during normal working hours Monday through Friday. Outside this period, the rate is \$47/hour. The minimum charge is for two hours, including travel time. Transportation, lodging, and other expenses are at additional cost. Parts are at CDC's standard published rates.

All Control Data software is unbundled from the hardware. Each software product has a specified initial fee and a monthly license charge. A paid-up license can be obtained for certain products. All licenses are on an as-is basis where CEM (Central Enhancement and Maintenance) services are not available or not separately contracted for. For a monthly charge, CEM services provide corrective code, updates, enhancements, and rights to Successor Products generally offered by Control Data. Analyst service and support is available on a time and material basis. Installation is not included with Control Data software, nor is customer training or education, although courses can be arranged for separately.

EQUIPMENT: Typical configurations of the Cyber 18-10 and 18-20 systems are as follows:

TYPICAL 18-10M SYSTEM: Consists of an 18-10M central processor with 64K bytes of main memory, three 1920-character display terminals, a 300-lpm printer, a card reader/line printer controller, an 8-channel communications line adapter, a cartridge disk drive controller that supports up to four drives, a double-density (8.8 million bytes) cartridge disk drive, a flexible disk drive controller with up to two drives, and a 256K (IBM format) or 280K (CDC format) floppy disk drive. Purchase price is \$60,895.

TYPICAL 18-20 SYSTEM: Consists of an 18-20 central processor with 192K bytes of main memory, thirteen 1920-character display terminals, a 300-lpm printer, a card reader/line printer controller, two 8-channel communications line adapters, a storage module drive controller with up to eight drives, two 50-million-byte storage module drives, and one nine-track magnetic tape drive. Purchase price is \$137,102. ■

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EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental (1-Year Lease)* | Rental (3-Year Lease)* |
|--|--|-------------------|-------------------|------------------------------|------------------------------|
| CENTRAL PROCESSORS | | | | | |
| 18-10M | Microprogrammable processor with no main memory (can accommodate from 32K to 128K bytes of 750-nanosecond MOS), parity, memory protection, hardware multiply/divide, 16 micro interrupts, 16 macro interrupts, real-time clock, ADT (Automatic Data Transfer), cabinet, operator's panel, power supplies, one floppy disk controller and one 262K-byte drive, and one console controller | \$ 13,700 | \$ 83 | \$ 494 | \$ 457 |
| 18-17A | Basic processor with 8K bytes of 900-nanosecond memory, parity, memory protection, hardware multiply/divide, 16 interrupts, 2 index registers, breakpoint switch, console, power supply, and one console controller | 11,160 | 90 | 426 | 394 |
| 18-17B | Basic processor with 8K bytes of 600-nanosecond memory, parity, memory protection, hardware multiply/divide, 16 interrupts, 2 index registers, breakpoint switch, console, power supply, and console controller | 13,643 | 109 | 520 | 482 |
| 18-20 | Microprogrammable processor with no main memory (can accommodate from 32K to 256K bytes of 750-nanosecond MOS), parity, memory protection, hardware multiply/divide, 16 micro interrupts, 16 macro interrupts, real-time clock, ADT (Automatic Data Transfer), cabinet, operator's panel, power supplies, console controller, no micro memory | 15,300 | 113 | 551 | 510 |
| 18-30 | Timeshare System; includes dual processors (one for time-sharing, one for communications) with dual memory interfaces, paging registers, 2K words (4K bytes) of RAM micro memory in each processor, 64K bytes of MOS memory for communications in one processor with multiplexer loop interface adapter, loop multiplexer, cassette drive, cassette controller, 128K bytes of MOS memory for time-sharing in one processor, storage module drive (50-million-byte disk drive), adapter, 300-cpm card reader, 300-lpm line printer, cassette drive, operator's console, controller, 9-track tape drive and translator, cables, power supplies, and cabinets | 110,000 | 825 | 3,960 | 3,667 |
| MEMORY AND PROCESSOR OPTIONS (Models 18-17A and 18-17B) | | | | | |
| 1782-1 | 4K 16-bit words (900 nanoseconds) | 2,360 | 28 | 90 | 84 |
| 1782-2 | 4K 16-bit words (600 nanoseconds) | 3,054 | 32 | 117 | 108 |
| 1785-3 | 1700 AQ Channel Adapter (for Series 1700 peripherals) | 2,625 | 15 | 102 | 94 |
| 1785-4 | 1700 DSA Channel Adapter (for Series 1700 peripherals) | 1,575 | 15 | 61 | 57 |
| 1783-1 | Memory/Peripheral Expansion Chassis | 4,200 | 8 | 163 | 152 |
| 1785-1 | AQ Channel Expansion for 1783-1 | 1,050 | 10 | 41 | 38 |
| 1785-2 | DSA Channel Expansion for 1783-1 | 1,050 | 10 | 41 | 38 |
| 1786-1 | Memory Expansion Control (32K-64K words) for 1783-1 | 1,575 | 15 | 61 | 57 |
| 1781-1 | Floating-Point Hardware | 9,700 | 50 | 270 | 257 |
| 10336-1 | Real-Time Clock; seven selectable time rates | 1,200 | 12 | 32 | 30 |
| 10297-1 | NiCad Memory-Hold Battery (preserves 64K words for 8 hours) | 520 | 12 | 20 | 19 |
| MEMORY AND PROCESSOR OPTIONS (Models 18-10, 18-20, and 18-30) | | | | | |
| 1870-1 | 512 32-bit micro control instructions (user programmable); for 18-10 only | 1,744 | 19 | 64 | 59 |
| 1870-2 | 2048 32-bit micro control instructions (user programmable); for 18-10 only | 4,266 | 45 | 157 | 145 |
| 1874-1 | Error-correcting memory array; provides storage for the 5-bit correction codes for up to 192K bytes of MOS main memory | 5,000 | 45 | 184 | 170 |
| 1882-16 | 32K bytes of MOS memory, one protect bit and one parity bit for each 2 bytes, 750 nanosecond cycle time | 5,000 | 45 | 180 | 167 |
| 1882-32 | 64K bytes of MOS memory, one protect bit and one parity bit for each 2 bytes, 750 nanosecond cycle time | 10,000 | 90 | 360 | 333 |
| 1888-1 | Voltage transformer for 95, 105, 220, 230, 240, or 250 volts | 300 | 7 | 10 | 10 |
| 1890-1 | 200 UT emulation package | 760 | — | 25 | 24 |
| 1890-2 | 2780 emulation package | 760 | — | 25 | 24 |
| 1890-3 | 3780 emulation package | 760 | — | 25 | 24 |
| MASS STORAGE | | | | | |
| The following are available on the 18-20 and 18-30 models: | | | | | |
| 1833-1 | Storage module drive interface | 3,000 | 19 | 108 | 100 |
| 1833-2 | Storage module drive interface (dual processors) | 3,000 | 19 | 108 | 100 |
| 1833-3 | Storage module control (up to 8 drives) | 10,000 | 34 | 367 | 340 |
| 1867-10 | 25-million-byte disk pack drive | 12,000 | 120 | 441 | 408 |
| 1867-20 | 50-million-byte disk pack drive | 18,100 | 145 | 664 | 615 |
| The following are available on the 18-10 and 18-20 models: | | | | | |
| 1833-4 | Cartridge disk controller (up to 4 drives) | 2,500 | 32 | 74 | 68 |
| 1833-5 | Floppy disk drive controller (up to 2 drives) | 1,500 | 15 | 55 | 51 |
| 1865-1 | Floppy disk drive Unit 1, 256K bytes (IBM format) or 280K bytes (CDC format) | 1,620 | 19 | 59 | 55 |
| 1865-2 | Floppy disk drive Unit 2, same as 1865-1 | 1,620 | 19 | 59 | 55 |
| 1866-12 | Cartridge disk drive, single-density, 4.4 million bytes | 9,450 | 64 | 214 | 209 |
| 1866-14 | Cartridge disk drive, double-density, 8.8 million bytes | 13,125 | 91 | 338 | 329 |
| The following are available on the 18-17 models: | | | | | |
| 1733-2 | Cartridge disk controller (up to 4 drives) | 5,775 | 28 | 225 | 208 |
| 856-12 | 4.4-million-byte fixed/removable disk cartridge drive | 9,450 | 51 | 214 | 209 |
| 856-14 | 8.8-million-byte fixed/removable disk cartridge drive | 13,125 | 61 | 338 | 329 |

*Rental prices do not include equipment maintenance.

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| Purchase Price | Monthly Maint. | Rental (1-Year Lease)* | Rental (3-Year Lease)* |
|----------------|----------------|------------------------|------------------------|
|----------------|----------------|------------------------|------------------------|

MAGNETIC TAPE EQUIPMENT

The following are available on the 18-10, 18-20 and 18-30 models:

| | | | | | |
|---------|--|--------|----|-----|-----|
| 1832-4 | Magnetic tape controller, 7- or 9-track (up to 4 drives) | 5,250 | 42 | 193 | 179 |
| 1860-3 | Magnetic tape subsystem, 9 tracks | 10,200 | 74 | 373 | 345 |
| 1860-72 | 7-track magnetic tape drive, 25 ips, 800 bpi | 6,000 | 55 | 220 | 204 |
| 1860-92 | 9-track magnetic tape drive, 25 ips, 800 bpi | 7,100 | 55 | 260 | 241 |

The following are available on the 18-17 models:

| | | | | | |
|---------|---|-------|----|-----|-----|
| 1732-3 | Magnetic tape controller (up to 4 drives) | 5,250 | 42 | 193 | 179 |
| 10300-2 | Phase Encoding option for 9-track, 1600-bpi operation | 1,575 | 17 | 48 | 47 |
| 616-72 | 7-track magnetic tape drive, 25 ips, 556/800 bpi | 6,000 | 16 | 161 | 157 |
| 616-92 | 9-track magnetic tape drive, 25 ips, 800 bpi | 7,100 | 71 | 191 | 186 |
| 616-95 | 9-track magnetic tape drive, 25 ips, 800/1600 bpi | 7,700 | 77 | 207 | 202 |

LINE PRINTERS

The following are available on the 18-10, 18-20, and 18-30 models:

| | | | | | |
|---------|---|--------|-----|-----|-----|
| 1828-1 | Card reader/line printer controller (1 printer) | 1,000 | 8 | 36 | 33 |
| 1827-30 | 300-lpm line printer, drum, 64-character set, 136 cols. | 10,300 | 90 | 370 | 343 |
| 1827-60 | 600-lpm line printer, band, 63-character set, 132 cols. | 17,000 | 120 | 565 | 523 |

The following are available on the 18-17 models:

| | | | | | |
|----------|---|--------|-----|-------|-------|
| 1742-30 | 300-lpm line printer, drum, 64 character set, 136 cols. includes controller | 10,800 | 179 | 389 | 360 |
| 1742-120 | 1200-lpm line printer, train, character set, 136 cols.; includes controller, requires train cartridge | 52,500 | 269 | 1,641 | 1,600 |
| 595-4 | ASCII train cartridge, 64-character set | 3,339 | 36 | 81 | 80 |

CARD EQUIPMENT

The following are available on the 18-10, 18-20, and 18-30 models:

| | | | | | |
|---------|---|-------|----|-----|-----|
| 1828-1 | Card reader/line printer controller (not required if a line printer is already configured; 1 card reader) | 1,000 | 8 | 36 | 33 |
| 1829-30 | 300-cpm card reader, photo-electric | 2,940 | 45 | 106 | 98 |
| 1829-60 | 600-cpm card reader, photo-electric | 4,410 | 60 | 161 | 149 |

The following are available on the 18-17 models:

| | | | | | |
|--------|---|--------|-----|-----|-----|
| 1725-1 | 100-cpm card punch with controller | 25,000 | 180 | 700 | 665 |
| 1729-3 | 350-cpm card reader with controller, photo-electric | 3,440 | 85 | 131 | 122 |

PAPER TAPE EQUIPMENT

The following is available with the 18-17 models only:

| | | | | | |
|--------|---|-------|----|----|----|
| 1720-1 | Punched Paper Tape Controller for Facit 4020 Reader and 4070 Punch, both of which must be obtained from Facit | 2,000 | 10 | 58 | 55 |
|--------|---|-------|----|----|----|

COMMUNICATIONS EQUIPMENT

The following are available on the 18-10 and 18-20 models:

| | | | | | |
|--------|---|-------|----|----|----|
| 1843-1 | Communications Line Adapter, full/half duplex | 1,700 | 11 | 62 | 57 |
| 1843-2 | Communications Line Adapter, 8-channel | 2,200 | 19 | 68 | 63 |

The following are available on 18-17 models:

| | | | | | |
|--------|--|-------|----|-----|-----|
| 1743-1 | Synchronous Communications Controller, full/half duplex | 2,660 | 24 | 101 | 93 |
| 1743-2 | Asynchronous Communications Controller, full/half duplex | 2,950 | 24 | 116 | 107 |

TERMINALS/OPERATOR CONSOLES

The following are available for the 18-10, 18-20, and 18-30 models:

| | | | | | |
|--------|---|-------|----|----|----|
| 752-10 | Single-station, TTY-compatible 1920-character display station | 1,650 | 17 | 55 | 52 |
| 1811-1 | 1920-character CRT/keyboard console | 2,200 | 18 | 79 | 73 |

The following are available for the 18-17 models:

| | | | | | |
|--------|-----------------|-------|----|-----|-----|
| 1711-4 | Teletype 33 KSR | 1,470 | 34 | 42 | 41 |
| 1711-5 | Teletype 35 KSR | 3,150 | 43 | 85 | 83 |
| 1713-4 | Teletype 33 ASR | 1,680 | 39 | 55 | 54 |
| 1713-5 | Teletype 35 ASR | 5,040 | 51 | 133 | 126 |

MISCELLANEOUS

The following are available on the 18-17 models:

| | | | | | |
|--------|--|-------|---|----|----|
| 1787-3 | Pedestal cabinet for rack-mounted equipment | 1,100 | 0 | 32 | 31 |
| 1787-4 | Equipment cabinet for 17 rack-mounted equipment | 1,375 | 0 | 39 | 38 |
| 1787-5 | Equipment table for 1784 or 1729-3 | 400 | 0 | 12 | 11 |
| 1787-6 | Desk console for 1784; accommodates below-mounted 1783-1 | 1,250 | 0 | 36 | 35 |

*Rental prices do not include equipment maintenance.

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SOFTWARE PRICING

| | | <u>Initial Fee</u> | <u>Monthly Royalty</u> | <u>Paid-Up License</u> | <u>CEM Service</u> |
|--|--|------------------------|----------------------------|----------------------------|------------------------|
| A425-01 | Real-Time Operating System (RTOS) 3; includes monitor, job processor, binary loader, system initializer, system library routines, and copy/load utilities | \$ 150 | \$ 55 | \$ 2,350 | \$ 45 |
| A425-02 | Assembler 1 under RTOS 3; includes the capability to assemble CDC 1700 operation codes, provides pseudo operators, does not include a macro capability | 30 | NC | 30 | 15 |
| A425-08 | Peripheral Drivers 1A under RTOS 3; includes peripheral drivers and small computer maintenance monitor, diagnostics for the majority of CDC's peripherals | 110 | NC | 110 | NA |
| A425-11 | Magnetic Tape Utilities 2 under RTOS 3; includes the capability to block/deblock, label tapes, copy, EBCDIC/ASCII/BCD conversions | 30 | NC | 30 | 15 |
| A325-01 | Mass Storage Operating System 5; includes monitor, job processor, maintenance routines, checkout/debug utilities, installation file maintenance, and system initializer | 540 | 85 | 3,940 | 55 |
| A325-02 | FORTRAN 3A under MSOS 5; syntax is a superset of ANSI basic FORTRAN and a subset of ANSI FORTRAN extensions; includes byte manipulation, an in-line assembly code, three execution-time packages, and a FORTRAN multiprogramming interface | 30 | NC | 30 | 15 |
| A325-04 | File Manager 1 under MSOS 5; includes a general-purpose file manager that operates and maintains both indexed and sequential files, provides sequential indexed and direct methods of record retrieval as well as variations of both | 30 | NC | 30 | 15 |
| A325-05 | AUTRAN 3 under MSOS 5; oriented toward industrial control applications providing procedural arithmetic and process specification capabilities; provides FORTRAN as a subset; includes scaling, alarming, analog/digital control, and an operator's console | 3,890 | 260 | 14,290 | 175 |
| A325-06 | Macro Assembler 3 under MSOS 5; includes a full set of symbolic CDC 1700 machine instructions, macro instructions, assembler error diagnostics, free-field source format, listing and binary output to appropriate units | 30 | NC | 30 | 15 |
| A325-07 | Timeshare 3 under MSOS 5; supports up to 64 concurrent users at remote interactive terminals; access capability is provided to host processors; includes text editor, extended BASIC compiler, and interpreter | 540 | 85 | 3,940 | 55 |
| A325-12 | RPG II 1 under MSOS 5; functionally and source code-compatible with IBM's System/3 RPG II; includes compiler, interpreter, run-time support routines, and data base manager | 160 | 35 | 1,560 | 25 |
| A325-13 | SORT/MERGE 1 under MSOS 5; for tape or sequential disk files, requires A325-04 | 30 | NC | 30 | 15 |
| The following programs all run under MSOS 5: | | | | | |
| A325-14 | Interactive Terminal-Oriented System (ITOS) 1 | 1,000 | 200 | 7,800 | 70 |
| A325-16 | Order Entry/Inventory, Sales Analysis | 750 | 27 | 2,370 | NA |
| A325-17 | Accounts Receivable | 450 | 22 | 1,770 | NA |
| A325-18 | Inventory Control | 450 | 22 | 1,770 | NA |
| A325-19 | Accounts Payable | 450 | 22 | 1,700 | NA |
| A325-20 | Payroll | 450 | 22 | 1,700 | NA |
| A325-21 | General Ledger | 450 | 22 | 1,770 | NA |
| A325-22 | Routing 1 | 400 | 20 | 1,600 | NA |
| A325-23 | Bill of Material Processing | 515 | 25 | 2,015 | NA |
| A325-24 | Material Required Planning | 515 | 25 | 2,015 | NA |
| A325-25 | Purchasing | 400 | 20 | 1,600 | NA |
| A325-26 | Physical Inventory | 150 | 10 | 750 | NA |
| A325-27 | Work in Progress | 750 | 27 | 2,370 | NA |

*Rental prices do not include equipment maintenance.