

IBM System/3

MANAGEMENT SUMMARY

The handwriting on the wall is now clear. IBM is making and executing specific plans to replace the System/3, its workhorse small business computer family for the past decade. Probably the most significant step in these plans occurred in October 1978, when IBM introduced the impressive new System/38 (Report M11-491-701), which provides an attractive upward growth path for current System/3 users.

Although the venerable System/3 is not the industry's longest-lived product line, it certainly ranks among the oldest and most successful. Its worldwide population of approximately 54,000 installations classifies it as the most widely used system of its kind. The only other computers achieving populations of that magnitude are Digital Equipment Corporation's PDP-8 and PDP-11 and the Data General Nova Series, all of which are comparatively low-priced minicomputers.

The System/3 was originally announced in July 1969 as the entry-level IBM computer system. Since then, advances in technology have permitted a more cost-effective entry-level system, the IBM System/32, to reach even smaller users than the ones for whom the System/3 was targeted. The novel System/3 Model 6, announced in late 1970 and intended for transaction processing, was the forerunner of the System/32.

The actively marketed members of the System/3 family today are the Model 4, Model 8, Model 12, and Model 15. These four models span a memory capacity range of 16K to 512K bytes. On-line disk capacities can range from 2.5 million to 447 million bytes of data storage. And no card-only configurations of these models are cur- ➤

The IBM System/3 will remain in the record books as one of the most successful computer products ever offered. Today, active interest is centered on the largest member of the product line, the Model 15. Recent IBM System/3 announcements have related to this model and involved hardware enhancements to memory and the system console. A typical Model 15 system can be purchased for \$243,000.

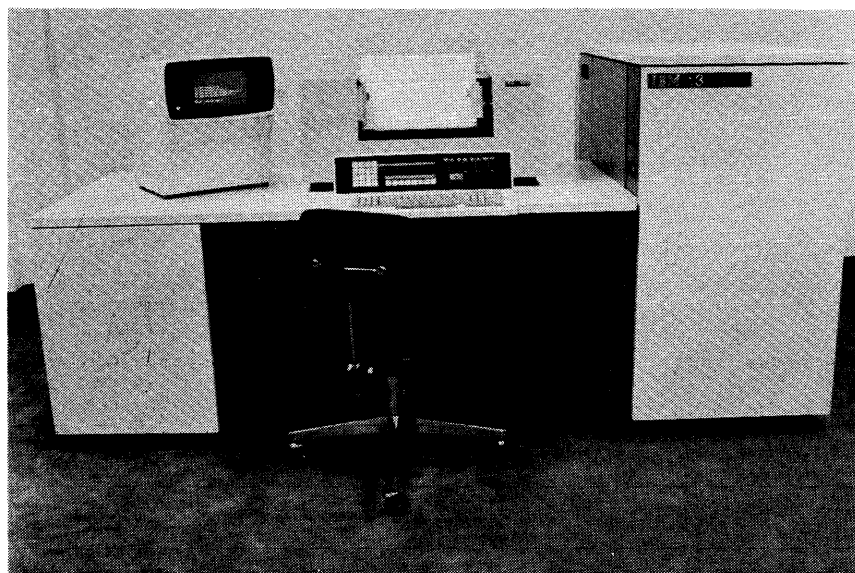
CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, General Systems Division, 875 Johnson Ferry Road N.E., Atlanta, Georgia 30342. Telephone (404) 256-7000.

MODELS: System/3 Model 4, submodel A18; Model 6, submodels B02 through B04; Model 8, submodels A14 through A18 (excluding A15); Model 10, submodels A02 through A07 and A12 through A17; Model 12, submodels B16 through B18 and C19 and C20; and Model 15, submodels A17 through A20, B17 through B20, C21 through C24, and D19 through D26.

DATE ANNOUNCED: Model 4—January 1976; Model 6—October 1970; Model 8—September 1974; Model 10—July 1969; Model 12—July 1975; Model 15—July 1973.

DATE OF FIRST DELIVERY: Model 4—June 1976; Model 6—December 1970; Model 8—June 1975; Model 10—January 1970; Model 12—June 1976; Model 15—March 1974. ➤



The last model announced in the System/3 product line was the Model 4, introduced in January 1976. The Model 4 is designed to handle multiple workstations, including IBM 3277 CRT Displays, 40-cps 3284 Serial Printers, 66-cps 3286 Serial Printers, 80- and 120-cps 3287 Serial Printers, and 120-lpm 3288 Line Printers. A basic Model 4 configuration can be purchased for \$36,357.

REFERENCE EDITION. This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no future update is planned.

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CHARACTERISTICS OF THE SYSTEM/3 MODELS

	Model 4	Model 6	Model 8	Model 10	Model 12	Model 15
SYSTEM CHARACTERISTICS						
Date of introduction	January 1976	October 1970	September 1974	July 1969	July 1975	July 1973
Date of first delivery	June 1976	December 1970	June 1975	January 1970	June 1976	March 1974
Number of submodels	1	3	4	12	5	20
Number installed to date, worldwide (estimated)	1,000	3,500	12,000	22,000	10,500	5,400
MAIN STORAGE						
Storage type	MOSFET	Core	MOSFET	Core	MOSFET	MOSFET
Cycle time, microseconds	1.52	1.52	1.52	1.52	1.52	1.52
Minimum capacity, bytes	65,536	8,192	16,384	8,192	32,768	49,152
Maximum capacity, bytes	65,536	16,384	65,536	49,152	98,304	524,288
Error correction	No	No	No	No	No	Yes
PROCESSOR						
Number of instructions	28	28	28	28	28	31
Add time, microseconds (5-digit decimal fields)	24.32	24.32	24.32	24.32	24.32	24.32
Multi-tasking	4	No	9	9	10	19 (15A, B, C) 20 (15D)
Storage protection	No	No	No	No	No	Yes
Dual-Program feature	No	No	Optional	Optional	Optional	No
AVAILABLE PERIPHERALS						
5444 Disk Storage	No	9.8 MB Max.	9.8 MB max.	9.8 MB max.	No	9.8 MB max.
5445 Disk Storage	No	No	No	41 MB max.	No	82 MB max.
5447 Disk Storage	9.8 MB max.	No	No	No	No	No
5448 Disk Storage	No	No	9.8 MB max.	9.8 MB max.	No	No
3340 Disk Storage	No	No	No	No	82 MB max.	162 MB max.
3344 Disk Storage	No	No	No	No	No	366 MB max.
Diskette	No	Yes	Yes	Yes	No	Yes
Magnetic tape	No	No	Yes	Yes	Yes	Yes
96-column card	No	Yes	No	Yes	Yes	Yes
80-column card	No	Yes	No	Yes	Yes	Yes
Maximum disk storage capacity	9.8 MB	9.8 MB	19.6 MB	50.8 MB	82 MB	447 MB
Programming languages	RPG II	RPG II, FORTRAN IV, BASIC	RPG II, FORTRAN IV, COBOL, Assembler	RPG II, FORTRAN IV, COBOL, Assembler	RPG II, FORTRAN IV, COBOL, Assembler	RPG II, FORTRAN IV, COBOL, Assembler

➤ rently offered—a clear indication that IBM's experiment with an "improved card medium," the 96-column card, has run its course.

The System/3 has been kept fresh during its life span through the introduction of semiconductor memory, larger memory capacities, and larger and faster disk units. Although the orientation of the System/3 family has been principally toward batch processing, the newest addition to the line, the Model 4, is intended primarily for multi-user, multi-task environments. The Model 4 can interface up to five local user terminals and printers. The capability to interface multiple local CRT terminals and printers through a Local Display Adapter feature is also available for the Models 8, 12, and 15. On the Models 8 and 12, up to 12 devices can be attached, and the Model 15 feature expands the capacity to 30 devices.

Models 6, 8, and 10 are no longer in new production, but can be obtained as refurbished units on an "as-available" basis. These models were removed from active production primarily because of their inability to support larger main memory and/or disk storage capacities. The withdrawal of the Model 8 occurred only nine months after its introduction in September 1974.

➤ **NUMBER INSTALLED TO DATE:** See Characteristics table above.

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 1 BCD digit, or 8 binary bits.

FIXED-POINT OPERANDS: Can range from 1 to 16 digits for source fields and from 1 to 31 digits for result fields. Logical operands can range from 1 to 256 bytes.

FLOATING-POINT OPERANDS: No hardware facilities for floating-point arithmetic are provided.

INSTRUCTIONS: 4, 5, or 6 bytes long in 2-address format; 3 or 4 bytes long in 1-address format; 3 bytes long in command format. (Each address can be represented by either a 2-byte direct address or a 1-byte "displacement," and all instructions contain a 1-byte operation code and a 1-byte "Q" code.)

INTERNAL CODE: EBCDIC (Extended Binary-Coded Decimal Interchange Code).

MAIN STORAGE

STORAGE TYPE: Magnetic core in Models 6 and 10; MOSFET (metal oxide semiconductor field effect transistor) integrated circuits in Models 4, 8, 12, and 15.

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PERIPHERALS/TERMINALS

DEVICE*	DESCRIPTION	SPEED
MAGNETIC TAPE EQUIPMENT		
3410-1 (8, 10, 12, 15)	9-track, 12.5 ips, 1600 bpi	20 KB
3410-2 (8, 10, 12, 15)	9-track, 25 ips, 1600/800 bpi	40/20 KB
3410-3 (8, 10, 12, 15)	9-track, 50 ips, 1600/800 bpi	80/40 KB
3411-1 (8, 10, 12, 15)	9-track, 12.5 ips, 1600 bpi (includes controller)	20 KB
3411-2 (8, 10, 12, 15)	9-track, 25 ips, 1600/800 bpi (includes controller)	40/20 KB
3411-3 (8, 10, 12, 15)	9-track, 50 ips, 1600/800 bpi (includes controller)	80/40 KB
CARD EQUIPMENT		
5496** (6 only)	Data Recorder, 96 col., on-line card reader and punch with print and off-line keypunch capabilities	22 cpm
129** (6 only)	Card Data Recorder, 80 col., on-line card reader and card punch with print and off-line keypunch capabilities	12-50 cpm
5424-A1 (10, 12, 15)	Multi-Function Card Unit, reads, punches, prints, 96-column	250/60 cpm
5424-A2 (10, 12, 15)	Multi-Function Card Unit, reads, punches, prints, 96-column	500/120 cpm
1442-6 (10, 12, 15)	Card Read Punch, 80-column	300/60 cpm
1442-7 (10, 12, 15)	Card Read Punch, 80-column	400/120 cpm
2501-A1 (15 only)	Reader, 80-column	600 cpm
2501-A2 (15 only)	Reader, 80-column	1000 cpm
2560-A1 (15 only)	Multi-Function Card Machine, reads, punches, prints, 80-column	500/160 cpm
2560-A2 (15 only)	Multi-Function Card Machine, reads, punches, prints, 80-column	310/120 cpm
PRINTERS		
5213 (4 or 6)	Serial, 132 columns, 64 characters	86 cps
2222 (6 only)	Serial, 222 columns, 64 characters, ledger-card feed	85 cps
5203-1 (8, 10, 12)	96, 120, or 132 columns, chain, 48 characters	100 lpm
5203-2 (8, 10, 12)	96, 120, or 132 columns, chain, 48 characters	200 lpm
5203-3 (8, 10, 12)	96, 120, or 132 columns, chain, 48 characters	300 lpm
1403-2 (8, 10, 12)	132 columns, chain/train, 48 characters	600 lpm
1403-5 (12, 15)	132 columns, chain/train, 48 characters	465 lpm
1403-N1 (10, 12, 15)	132 columns, chain/train, 48 characters	1100 lpm
OPTICAL READERS		
1255-1 (all)	MICR reader, 6 stackers	500 dpm
1255-2 (all)	MICR reader, 6 stackers	750 dpm
1255-3 (all)	MICR reader, 12 stackers	750 dpm
3881-1 (8, 10, 12, 15)	Mark Reader, on-line	4000 to 6000/hour
3881-2 (8, 10, 12, 15)	Mark Reader, off-line	3700 to 5400/hour
TERMINALS		
2265-2 (6 only)	Display/keyboard, 960 characters	2400 bps
3275-1 (8, 10, 12, 15)	Display/keyboard, 480 characters	Up to 8000 bps
3275-2 (8, 10, 12, 15)	Display/keyboard, 960 characters	Up to 8000 bps
3277-1 (4, 8, 10, 12, 15)	Display/keyboard, 480 characters	Up to 8000 bps
3284-1/-2 (4, 8, 10, 12, 15)	Printer, 480 or 1920 character buffers	40 cps
3287-1 (15 only)	Printer, 1968 character buffer	80 cps
3287-2 (15 only)	Printer, 1968 character buffer	120 cps
OPERATOR KEYBOARD CONSOLE (6 only)	Integrated keyboard for entering programs and data	—
PRINTER-KEYBOARDS		
5471 (8, 10, 12)	44-key typewriter-style console	15.5 cps

* Numbers in parentheses indicate the System/3 models capable of supporting each device.

**The 5496 and 129 cannot be used on-line on the same CPU.

➤ Until the announcement of the Model 4, it appeared that the System/3's growth would be only at the high end of the line, through the addition of improved multiprogramming capabilities and increased disk storage capacity. The Model 4, with its 9.8-megabyte disk storage limitation, ➤

➤ **CYCLE TIME:** 1.52 microseconds per 1-byte access in all models.

CAPACITY: Model 4—65,536 bytes; Model 6—8,192, 12,288, or 16,384 bytes; Model 8—16,384, 32,768, 49,152, or 65,536 bytes; Model 10—8,192, 12,288, 16,384, 24,576 ➤

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▷ appeared to contradict this hypothesis. But the Model 4 marked an entirely new direction for the System/3 line: multi-user capabilities. Since System/32 application programs can be recompiled for use on a System/3, the Model 4 appeared to be a bridge system between the two products, providing multi-user capabilities for S/32 users outgrowing the throughput capabilities of the smaller system.

All System/3 models are byte-oriented and use IBM's integrated "Monolithic Systems Technology" (MST). The main storage cycle time in all models is 1.52 microseconds per one-byte access. The System/3's instruction repertoire is far smaller and less powerful than that of the System/360 or System/370, and there is no program compatibility, at the machine or assembly-language level, between the System/3 and the larger IBM computers.

The principal characteristics of each of the six models of the System/3 are separately discussed in the paragraphs that follow.

SYSTEM/3 MODEL 4

The System/3 Model 4, announced in January 1976, marked a departure from IBM's previous direction by offering a multi-user, multi-tasking System/3 for small business data processing.

A System/3 Model 4 consists of: a 5404 processor with 64K bytes of MOSFET main memory, non-expandable; 4.9 or 9.8 million bytes of fixed-removable disk storage using 5440 disk cartridges in the new 5447 Disk Storage units; a 115-cps 5213 matrix printer; a 3277 Model 1 CRT display for logging operating system messages; one to five directly attached local workstations, which may be 480- or 1920-character CRT/keyboard displays or 40-cps, 66-cps, or 120-lpm printers; and one optional Bisync adapter that can accommodate additional remote workstations or permit communications with a host computer.

The basic processor includes provisions for directly attaching a console display plus two local workstations, and up to two more can be added through the Display Increment feature. Workstations include the 3277 Model 1 and 2 CRT display units (480 and 1920 characters, respectively) and the 5213 115-cps printer. Two serial printers, the 40-cps 3284 or the 66-cps 3286 serial printer or the 3288 120 lpm line printer, can be substituted for CRT display workstations. In addition, a serial I/O channel is available for the Model 4, just as for other System/3 models, for attachment of low-speed workstations or non-IBM peripherals.

The Model 4 employs the new 5447 Disk Storage units, available in two models. Model A1 can store up to 2.5 megabytes of information on each of two 5440 cartridges for a total capacity of 4.9 megabytes. The arrangement is familiar—one fixed and one removable cartridge mounted on the same spindle with a common access mechanism. Model A2 adds a completely independent module of two fixed cartridges in the same enclosure for a total storage capacity of 9.8 megabytes. Formats are ▷

▶ 32,768, or 49,152 bytes; Model 12—32,768, 49,152, 65,536, 81,920, or 98,304 bytes; Model 15—49,152, 65,536, 98,304, 131,072, 163,840, 196,608, 229,376, 262,144, 393,216, or 524,288 bytes.

CHECKING: Model 4, Model 6, Model 8, Model 10, and Model 12—a parity bit with each byte is generated during writing and checked during reading; Model 15—an error detection and correction function permits automatic correction of single-bit errors and detection of double-bit errors with no loss of processor time.

STORAGE PROTECTION: Write/Fetch Protection, which guards against unauthorized overwriting and/or reading of data in specified 2048-byte segments of storage, is a standard feature of the Model 15C and 15D but is not available for Model 4, Model 6, Model 8, Model 10, or Model 12.

CENTRAL PROCESSORS

REGISTERS: The complement of registers on the System/3 includes: the A-register, which temporarily stores one byte of data before processing by the ALU; the two-byte Address Recall registers, employed by the CPU during various instruction phases (each program level or interrupt level has its own); the B-register, which temporarily stores each data byte and instruction byte moved from storage to the ALU; the Condition register, designed to store the results of a compare (high, low, or equal) or arithmetic operation (overflow); the Data Recall register, a one-byte register which stores the Q-byte in single-address instructions or a byte from operand two in two-address instructions; the Length Count register, a one-byte register containing the length count of each instruction operand; the Instruction Address registers, which contain the address of the next byte of an instruction that is to be moved from main storage to one of the CPU registers (each program level or interrupt level has its own); the one-byte Op Code register; the two-byte Operand 1 Address register; the two-byte Operand 2 Address register; the one-byte Q-register, which holds the instruction Q-byte; the two-byte Storage Address register, charged with holding the logical address to be accessed in main storage; XR1 and XR2, the index register set(s); and the two-byte Program Status register (PSR), employed during interrupts. One PSR and one index register set are standard on all models; a second PSR and a second pair of index registers are installed on all models with the Dual Program feature.

Certain registers are found only on specific processor models. These include the Storage Data register, found on Models 8, 10, and 12 and employed for temporary storage of data moving between the CPU and memory; the Storage Protect registers (one for each 2K bytes of main memory) found on Models 15C and 15D; the Program Check Status and Program Check Address registers, found on the Model 15 and employed for interrupt level 7; and the Storage Data Bus In register, for temporary storage of data passing between the ALU and main storage on Models 12C and 15.

ADDRESSING: All models have two 16-bit base registers. The contents of either register can be added to a one-byte address (or "displacement") contained in an instruction, permitting base-plus-displacement addressing of any higher storage location within 256 bytes of the base address contained in the register. Indexing is also permitted through the use of an index register set (see Registers, above).

In addition, Models 12C and 15 have 32 8-bit registers utilized as an Address Translation Table (ATT) that enables these models to address up to 512K bytes of main storage. The Supervisor loads the appropriate values into the ATT registers, which are then used to convert the 16-bit addresses in users' programs into the 19-bit addresses required to address 512K bytes. ▶

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- ▷ completely compatible with those of other System/3 models.

Local workstations can be located up to 2000 feet from the Model 4 processor. The 480-character 3277 Model 1 provides 12 lines of 40 characters each, while the 3277 Model 2 provides 1920 display positions arranged in 24 lines of 80 characters. A separately priced keyboard is available for each. Both the 3284 and 3286 matrix printers are available as either a Model 1 that includes a 480-character buffer or a Model 2 that includes a 1920-character buffer. The 3284 operates at 40 characters per second; the 3286, at 66 characters per second. Characters are formed by a 4-by-7 dot matrix. The 3288 Model 2 operates at a nominal speed of 120 lines per minute and has a 120-character buffer. The print mechanism uses an engraved metal belt. All displays and printers use a 64-character set. Each display or printer counts as one of the five possible local workstations.

The disk enclosure, which houses either an A1 or A2 model, provides space on top for the 5213 printer, operator keyboard console, and 3277 system display.

Software support for the System/3 Model 4 consists of a new Communications Control Program (CCP) that is functionally equivalent to CCP for the System/3 Model 10 and a subset of the software support for the System/3 Model 6. The only programming language supported is RPG II.

CCP provides control of the multi-user environment. Previously compiled RPG II programs are initiated from a workstation. Up to four tasks can be active simultaneously, and multiple workstations can be connected through the Bisync adapter. The basic supervisor occupies 3.25K bytes of memory. Two pre-generated versions of CCP are available. The minimum version occupies 25K bytes and supports only 3270-family display and printer remote workstations, while the maximum version occupies 31.5K bytes and supports the full array of remote workstation types. All active tasks are co-resident in main memory. If insufficient memory space is available, a task cannot be initiated; i.e., no swapping facility is implemented. The workspace allocated to a task, however, need not be as large as the complete task itself. If the task is larger than the workspace available, the task will be automatically segmented. A new disk sort routine (\$15 per month), requiring 12K bytes, can be run as a CCP task. User tasks need not require user interaction on the CRT display or other peripheral devices; such "batch" tasks on multi-user systems are frequently referred to by other vendors as "phantom tasks." Access to the system is controlled via a password arrangement.

Instead of running under CCP, the user can operate the System/3 as a Model 6 with the following support: RPG II compilation, RPG II execution including the Auto Report and Telecommunications features, Conversational Utilities (Keyboard Source Entry and Keyboard Data Entry), Overlay Linkage Editor, Disk Sort Program, and Multileaving Remote Job Entry Workstation ▷

- ▶ **INSTRUCTION REPERTOIRE:** All models have 28 instructions, including addition and subtraction of unpacked (1 digit per byte) decimal operands, but no multiply or divide. Also included are an edit instruction and addition, subtraction, and comparison of logical characters.

In addition to these 28 basic instructions, Model 15 has 3 new instructions—Load CPU, Store CPU, and Command CPU—which are used to implement its multiprogramming capability.

INSTRUCTION TIMINGS: The following times, in microseconds, assume the use of direct (2-byte) operand addresses.

	Model 15D	All Other Models
Decimal add (5 digits):	19.76	24.32
Decimal subtract (5 digits):	19.76	24.32
Binary (logical) add (5 bytes):	19.76	24.32
Binary (logical) subtract (5 bytes):	19.76	24.32
Move (5 bytes):	19.76	24.32
Compare (5 bytes):	19.76	24.32
Edit (5 digits):	13.68	18.24
Load or store register (2 bytes):	6.08	9.12
Add to register (2 bytes):	6.08	9.12
Jump on condition:	3.04	4.56

INTERRUPTS: Model 8, Model 10, and Model 12 have five levels of program interrupts, in descending priority order: (1) Serial I/O Channel, (2) Unassigned, (3) BSCA, (4) Data Entry Keyboard or Printer-Keyboard, and (5) Dual Program Control (Interrupt Key). Any level of interrupt can interrupt the main program or the servicing of any lower-level interrupt. An interrupt causes a transfer of control to a predetermined location; the interrupt servicing program must store and then restore the index registers and program status register for the interrupt program.

Model 15 has a total of eight levels of program interrupts, including an I/O Operation End Interrupt, which facilitates spooling; a Program Check Interrupt, which improves throughput by preventing errors in one partition from halting the entire system; and a Supervisor Program Interrupt, for transfer of control from a problem program to the supervisor program.

OPTIONAL FEATURES: For Model 4 and Model 6, the Command Keys feature provides an additional set of eight keys which can be programmed to perform specific arithmetic operations in the Desk Calculator Mode. (Eight Command Keys are standard equipment.)

For Model 8, Model 10, and Model 12, the Dual Program feature permits independent loading and processing of two simultaneous programs. The operator can initiate, restart, or terminate either program independently of the other one. Whenever one of the two programs halts to await completion of an I/O operation, the other program is automatically initiated. (The feature is software-supported only for the Model 8, Model 10, and for Model 12 disk-oriented systems with at least 12K bytes).

Extra-cost features, called attachments, controls, or channels, must be added to the System/3 Processing Units to accommodate each of the standard peripheral devices.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The Processing Unit acts as a controller for all System/3 I/O operations. All I/O devices are connected through appropriate attachment features to an integral I/O channel. This channel includes buses and logic to determine interrupt priorities and to perform data transfers between main memory and the attached peripherals by "cycle-▶

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▷ (MRJE/WS). When a Model 4 is running under Model 6 software, only the 3.25K-byte resident supervisor detracts from user memory space. The Model 6 SCP must be Release 13 or later. Model 6 software not supported on the Model 4 includes FORTRAN, BASIC, and the 1255 MICR reader utility.

The minimum version of CCP can support as a remote workstation one point-to-point or multipoint line with 3270-family devices including clustered 3277 displays, stand-alone 3275 displays, and 3280 series printers. The full version of CCP adds remote workstation support for point-to-point or multipoint connection over one line with a 3241 Data Station Model 2, 3741 Programmable Work Station Model 4, or 3735 Programmable Buffered Terminal Model 1. In addition, Bisync communication is supported between the System/3 Model 4 and another System/3, System/7, System/32, System/360, or System/370 computer. The System/3 Model 4, however, cannot communicate with a remote workstation and function as an RJE terminal simultaneously. Typically, remote workstations will operate in half-duplex mode at 2400, 4800, or 7200 bps. Using IBM modems, transmission at up to 4800 bps over the switched telephone network and at up to 7200 bps over a leased voice-grade line is supported. Higher transmission speeds require a wide-band facility.

Generally, application programs written for the Model 6 will run on the Model 4 with minimum conversion, providing the necessary configuration minimums are met. It must be remembered, however, that these programs will not take advantage of the multi-user capabilities of the Model 4.

SYSTEM/3 MODEL 6

The IBM System/3 Model 6, introduced in October 1970, is a small-scale computer that is strikingly different in its peripheral equipment, software, and applications orientation from the original System/3 Model 10 unveiled by IBM in July 1969.

The System/3 Model 6 announcement stressed that this single computer system could be used in two radically different ways. As "the office computer," IBM introduced the Model 6 as a low-cost, stored-program computer, using disk drives for on-line file storage and featuring an Operator Keyboard Console for both data entry and system control. Ledger card processing was also offered as an option. All programming of standard business applications was to be normally done in the RPG II language. As "the problem solver," IBM introduced the System/3 Model 6 as a fast arithmetic processor designed to permit engineers, scientists, and other technicians to utilize the system at the keyboard via the conversational BASIC language. An optional CRT display unit was offered for quick display of the results of calculations. The Model 6 also offered features to permit its use as a simple desk calculator.

The Model 6 offered full operator control of the system via the Operator Keyboard Console. Input data was ▷

▶ stealing." Except on Models 4 and 8, the channel also includes logic to perform code translations between punched cards and the internal EBCDIC code.

SIMULTANEOUS OPERATIONS: Input/output operations are overlapped with computing through a memory "cycle-stealing" technique. The I/O devices "time-share" the processing unit according to predefined priorities established for each device. The 5415 features a 2-byte-wide data path for both 5444 and 5445 disk I/O, which reduces the number of CPU cycles required to service disk I/O requests.

CONFIGURATION RULES

Each System/3 Model 4 requires one 5404 Processing Unit (the 7081 Serial I/O Channel is optional), one 5447 Disk Storage and Control, a 5213 Model 3 Printer and 3960 Enhanced Print Rate attachment, and at least one workstation device. Workstation devices can be any one of the following: a 3277 Model 1 (480-character) or 3277 Model 2 (1920-character) CRT display; a 3284 Model 1 or 2 (40 cps) Printer, 3286 Model 1 or 2 (66 cps) Printer, 3287 Model 1 (80 cps) or Model 2 (120 cps) Printer, or 3288 120-lpm Line Printer. Up to five locally attached workstation devices can be connected. Three can be connected directly to the integrated display adapter that is standard on the 5404, and up to two additional devices can be attached through the 4704 Display Increment feature. If any Model 2 device (3277 Model 2, 3284 Model 2, etc.) is included in the configuration, a 3270 Model 2 attachment is required.

Only one 5447 Disk Storage drive, 5213 Model 3 Printer, or 2074 Binary Synchronous Communications Adapter can be used in a Model 4 system. The 5447 Model A1 has a 4.9-megabyte capacity, and Model A2 has a 9.8-megabyte capacity. The 2074 may include the 1315 Auto Call, 4703 Internal Clock, 7477 Station Select, or 7850 Text Transparency feature.

The System/3 Model 6 requires one 5406 Processing Unit (Command Keys 9 to 16 and the 5732 Processing Unit Expansion are optional), one 5444 Disk Storage Drive, and one Printer (either Model 5213 or Model 2222). A maximum of two 5444 Disk Storage Drives can be connected. In addition, the following devices can be connected: one directly attached 3741 Data Station, one 5496 Data Recorder (96-column) or 129 Card Data Recorder (80-column), one 1255 Magnetic Character Reader, one 2265 Display Station, one 5230 Data Collection System, and one Local Communications Adapter (LCA) for the attachment of a 3741 Data Station Model 1 or 2 or a BSC-equipped System/7. In place of the LCA, one Binary Synchronous Communications Adapter can be connected. The 2265 Display Station and the 2222 Printer cannot be used in the same system.

The System/3 Model 8 requires one 5408 Processing Unit, one 5203 Model 1 Printer, one 5444 Model A1 Disk Storage Drive, and either one 5471 Printer-Keyboard or one 3741 Model 1 Data Station, attached directly. The Model 8 may optionally include the 3500 Dual Programming Feature and a Local Display Adapter for the attachment of up to 12 devices of the 3270 family (3277 Model 1 or 2 Display Stations, 3284/3286/3287 Model 1 or 2 Printers, and 3288 Model 1 Printers in any combination). Any or all of the additional peripheral devices listed for the Model 10 below can be connected with the exception of the card equipment. The 5475 Data Entry Keyboard, the Local Communications Adapter and peripherals that attach to it, the 1403 Model 2 or N1 Printer, and the 5445 Disk Storage Drive.

Disk storage for the Model 8 can be increased beyond the 9.8-megabyte limitation, imposed by the 5444 disk units, to 19.6 megabytes through the addition of one 5448 Model A1 Disk Storage Drive. The 5448 connects to a 5408 CPU through the 5448 File Attachment feature. A 5732 Process- ▶

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▷ directly entered at the keyboard, with printing taking place on conventional (non-magnetic) ledger cards. This equipment was designed to seem familiar and comfortable to most small businessmen, as was the design approach used in setting up the applications.

Another reason for the introduction of the Model 6 was IBM's recognition of the fact that many small scientific and engineering firms had been spending their processing dollars with time-sharing firms. By providing the System/3 with a conversational BASIC compiler and an 85-cps serial printer, IBM attempted to exploit the computational power of its System/3 by luring small companies away from time-sharing and into the IBM fold for the first time.

Although the Model 6 is not in new production, refurbished units are still available at this writing.

The basic System/3 Model 6 configuration consists of a processing unit (with 8K, 12K or 16K bytes of core storage), an Operator Keyboard Console, an 85-cps serial printer (available in unique bidirectional-printing models), and a disk storage subsystem of 2.45 to 9.83 million bytes. The processing unit, main memory, and disk storage units are the same as those offered with the original System/3 Model 10. The Operator Console is different, and the wire matrix print mechanism of the serial printers is the same as that used with the System/370's 3215 Console Printer-Keyboard. The basic System/3 Model 6 configuration requires only about 120 square feet of floor space.

System/3 Model 6 configurations can be expanded by adding a 5496 Data Recorder (for reading, punching, and printing of 96-column cards at 22 cards per minute) or a 129 Card Data Recorder (for reading, punching, and printing of 80-column cards at 12 to 50 cards per minute), a 2265 Display Station, a 1255 Magnetic Character Reader, and a directly attached 3741 Data Station. Also, a Binary Synchronous Communications Adapter can be added to permit the system to serve as a programmable remote terminal (to another System/3 or to any larger computer in IBM's current product line).

The principal overall limitations of the System/3 Model 6 can be summed up as follows:

- In those business-oriented installations that do not include a card Data Recorder or diskette Data Station, all data files stored on the relatively extensive disk files (up to 9.8 million characters) must be laboriously entered a character at a time via the keyboard. Even using the optional Data Recorder, data input time is still relatively slow. Plainly, the direct attachment of the 3741 Data Station is meant to alleviate this labor.
- Line printing speeds are restricted to about 40 to 70 lines per minute, depending on the number of charac- ▷

▶ ing Unit Expansion A and 5733 Processing Unit Expansion B must be added to the 5408 CPU to provide mounting connectors and power for the 5448 File Attachment feature.

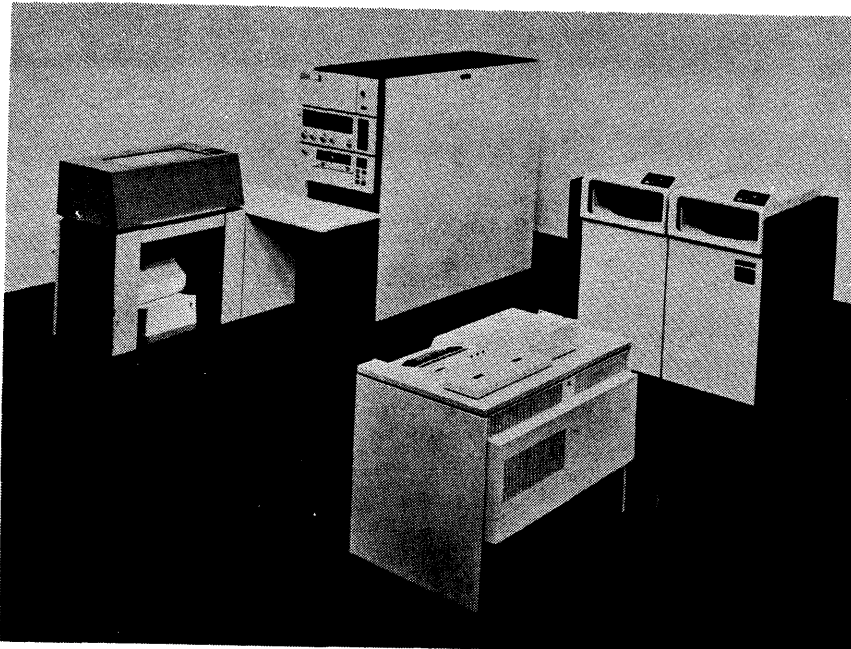
Every System/3 Model 10 requires one 5410 Processing Unit, one 5203 or 1403 Printer, and either one 5424 Multi-Function Card Unit (96-column) or one 1442 Card Read Punch (80-column); if the 1442 is used, a 5442 Disk Enclosure with at least one 5444 Disk Storage Drive is also required. The 5444 may be used on 5410 submodels A12 through A17. Any or all of the following additional peripheral devices can be connected: a Local Communications Adapter (for Disk Model 10's only) for the attachment of one 3741 Data Station Model 2 or Programmable Workstation Model 4, one 3271 Control Unit, one 3275 Display Station, or one System/7; one or two 5444 Disk Storage Drives; one 5448 Model A1 Disk Storage Drive; one 3410/3411 Magnetic Tape Subsystem with up to four drives; one 1255 Magnetic Character Reader; one 3881 Optical Mark Reader; one or two Binary Synchronous Communications Adapters; and either one 5471 Printer-Keyboard or one 5475 Data Entry Keyboard. The Local Communications Adapter (LCA) and the first Binary Synchronous Communications Adapter (BSCA) are mutually exclusive. To utilize IBM software support, disk-oriented systems must include at least 12K bytes of core storage and one 5444 Disk Storage Drive.

Models 5444 and 5445 Disk Storage Drives can coexist in the same Model 10 system, providing a maximum storage capacity of 50.8 megabytes (41 + 9.8). The 5444 disk subsystem can also be expanded to 19.6 megabytes through the addition of one 5448 Model A1 Disk Drive. The 5448 and 5445 disk subsystems are mutually exclusive. The 3901 and 3902 Disk Attachment features are required for the first and second 5445 Disk Storage Drives. The 3901 requires the 5732 Processing Unit Expansion A. Up to four Processing Unit Expansion features and the 3500 Power Supply Expansion feature are optional on the 5410. A Dual Programming feature (3500) is also available on the 5410. The 5448 Model A1 Disk Storage Drive requires the addition of a File Attachment feature to the 5410 CPU. A 5230 Data Collection System may be attached via either the BSCA or the LCA.

The System/3 Model 12 requires one 5412 Processing Unit; one 5203 or 1403 Printer; either one 5424 Multi-Function Card Unit (96-column), one 1442 Card Read Punch (80-column), or one 3741 Data Station; two 3348 Model 70 Data Modules; and a 3340 Direct Access Storage Facility Model C2. The Dual Programming feature (3500) is optional. Any or all of the following additional peripheral devices can be connected: one 3410/3411 Magnetic Tape Subsystem with up to four drives, one 1255 Magnetic Character Reader, one 3881 Optical Mark Reader, one Local Display Adapter, one Integrated Communications Adapter (ICA), one or two BSCA's, and one 5471 Printer Keyboard. The 3881 or 1255 requires the 7081 Serial I/O Channel and Processing Unit Expansion A, B, C, or D. The Local Display Adapter accommodates from 3 to 12 devices of the 3270 family, including the 3277-1 or -2 Displays, 3284-1 or -2 Printers, 3286-1 or -2 Printers, 3287-1 or -2 Printers, and 3288-2 Printers. The Local Display Adapter, ICA, and a second BSCA are mutually exclusive. A 5230 Data Collection System may be attached via the ICA or either BSCA.

Each System/3 Model 15 built around an A-level 5415 Processing Unit requires one 3277 Model 1 Display Station, one 5444 Model A2 Disk Storage Drive, one 1403 Printer (Model 2, 5, or N1) and 5421 Printer Control Unit, and either a 5424 Multi-Function Card Unit, a 1442 Card Read Punch, or a 2560 Multi-Function Card Machine, together with the necessary prerequisites. If a 1442 or 2560 is ▶

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The System/3 Model 12, like the Models 4, 6, 8, and 10, has a memory cycle time of 1.52 microseconds and an add time for 5 digits of 24.32 microseconds. The Model 12 is available in 12 submodels varying in main memory capacity from 32,768 bytes to 98,304 bytes and has a disk storage capacity of up to 82 megabytes. A basic Model 12 system is priced at \$100,331.

▷ ters printed per line and on the printer model used. Overall system throughput, restricted by the operator's keying action on input and the serial printer on output, will be correspondingly low in most commercial installations.

- Commercial, RPG II-oriented users must learn a fairly involved system control language called OCL (Operation Control Language) for directing the execution of every program. Those users who also utilize the BASIC programming language must learn an entirely different control language to direct the preparation and execution of BASIC programs.
- RPG II and BASIC programs generate and use mutually incompatible disk-based data files. Also, BASIC data files cannot be sorted by the Disk Sort program unless they are first converted to the appropriate format.

With regard to compatibility, the System/3 Model 6 uses basically the same RPG II, FORTRAN, and Disk Sort programs as the System/3 Model 10. The only differences between the two RPG compilers are those based on the unique I/O devices used in each system. Disk cartridge files prepared by the RPG II or Sort programs of one system can be processed with no difficulty by the other. The 5440 Disk Cartridges used in most models of the System/3, however, are incompatible with IBM's larger computer systems and virtually all competitive systems.

Applications such as billing, inventory control, accounts receivable, and sales analysis are the "bread and butter" uses of the Model 6 in the RPG II-based, business- ▷

▶ selected as the primary card I/O unit, a 5422 Disk Enclosure is also required.

The basic Model 15 configuration can be expanded by adding any or all of the following peripheral devices: a directly attached 3741 Data Station, a second 5444 Disk Storage Drive (Model A2 or A3), one to four 5445 Disk Storage Drives, one 3410/3411 Magnetic Tape Subsystem with up to four drives, one 1255 Magnetic Character Reader or one 3881 Optical Mark Reader (connected via the optional Serial I/O Channel), one or two BSCA's, one Local Communications Adapter (which takes the place of the first BSCA and permits local attachment of a 3741 Model 2 Data Station, a 3271 Control Unit, or a 3275 Display Station), and one Local Display Adapter for up to three devices of the 3270 family. (These may be 3277 Model 1 or 2 Display Stations, 3284/3286/3287 Model 1 or 2 Printers, and 3288 Model 1 Printers in any combination; up to nine expansions to the Local Display Adapter are allowed, each capable of adding three 3270-type devices.)

In Model 15 systems built around the B-, C-, or D-level 5415 Processing Units, a 3340 Direct Access Storage Facility with two, three, or four disk drives replaces the 5444 and 5445 Disk Storage Drives and precludes their attachment. Using 3340 drives, the maximum configuration includes two dual-drive 3340 Model B2's, providing up to 162 megabytes of user storage area plus 39.2 megabytes of 5445 simulation area not accessible to the user.

Model 3344 Direct Access Storage Drives are also available to Model 15D systems. The 3344 Model B2 is a 366-megabyte dual-drive subsystem that replaces one 82-megabyte dual-drive 3340, providing a maximum user storage capacity of 447 megabytes.

A 5230 Data Collection System may be attached to a Model 15 via either the BSCA or the LCA.

MASS STORAGE

3340 DIRECT ACCESS STORAGE FACILITY: Provides fairly rapid random access to large quantities of data stored ▶

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➤ oriented environment. Under BASIC, IBM divides the typical application areas into engineering/scientific, financial (such as bond analysis, lease analysis, rate of return calculations etc.), and general business (sales forecasting, cash flow analysis, overhead distribution, etc.). For installations using both RPG II and BASIC, almost any application is suitable for the System/3 Model 6, provided it does not require large data files and/or high-speed input/output beyond the capacity of the newly announced direct attachment of the 3741.

When the Model 6 was introduced in October 1970, applications software was notably absent from the IBM product offering. Since then, IBM has developed three different approaches to the application programming problem. First, there is a limited but steadily expanding complement of packaged application programs in three categories: IBM Program Products, Field Developed Programs, and Installed User Programs. Second, IBM offers the Application Customizer Service to aid Model 6 users in developing their own programs for Order Writing and Invoicing, Accounts Receivable, Inventory Accounting and Management, and Sales Analysis. These four applications areas have also been tailored for two specific industries under this service: lumber and building supply dealers and electrical distributors. Third, in response to criticism that its Application Customizer Service left the hardest part of the job (the coding and testing) undone, IBM offers a complete Application Programming Service for the same four applications at fixed prices.

IBM introduced the System/3 Model 6 in October 1970, and demonstrated it in 40 locations across the country on the same day. Customer deliveries of BASIC-oriented systems began in December 1970, and the first RPG-based systems were delivered in March 1971.

SYSTEM/3 MODEL 8

The Model 8 was announced on September 11, 1974, as the first new system introduction by the General Systems Division of IBM. The Model 8 is a batch processing system, without card functions, that supports direct attachment of the 3741 Data Station or 3741 Programmable Work Station. Additionally, the Model 8 supports Binary Synchronous Communications applications and the Integrated Communications Adapter, an option previously found only on IBM's larger computers.

Virtually all the peripherals available for the System/3 Model 10 are supported by the Model 8 with the exception of card equipment. The key input/output device, replacing the 5424 Multi-Function Card Unit, is the 3741 Data Station or 3741 Programmable Work Station. When connected to the Model 8, the 3741 functions as a fairly high-speed sequential input/output device using IBM's flexible diskettes ("floppy disks"). IBM quotes a rated speed of 1500 records per minute for diskette input and 1000 records per minute for output when the 3741 is directly attached to a Model 8. ➤

➤ in interchangeable 3348 Data Modules. Usable only with System/3 Model 12 and Model 15 B-level processors.

The 3340 drives are available in four models with the following configuration rules. Model A2 contains two drives and a control; it can be connected to a System/3 Model 15 via direct attachment. The Model A2 is prerequisite for each 3340 subsystem on a Model 15. The 3340 Models B1 and B2 contain one and two drives, respectively; they can be connected to a 3340 Model A2 to form a string of up to four drives. The maximum number of 3340 drives that can be connected via the integrated attachments is four drives on a Model 15. The 3340 Model C2 contains two drives and a control; it is connected to a System/3 Model 12 via direct attachment. The C2 subsystem cannot be expanded.

Each 3340 drive accommodates one 3348 Data Module, Model 70, at a time. The Data Module is a self-contained unit that includes not only the magnetic disks, but also the associated access arms and read/write heads. Since the same heads always service the same tracks, head alignment problems should be reduced and data reliability enhanced. Each Data Module is a sealed unit 8 inches high, 16 inches deep, 18 inches long, and 18 pounds in weight. Loading the Data Module is an automatic process; the operator simply places the Data Module on a drive, closes the drive cover, and turns on a switch. Processing can begin in less than 20 seconds.

The 3348 Model 70 Data Module has approximately 506 cylinders and a total storage capacity of 50.8 million bytes. It has 12 tracks per cylinder and can store up to 8,368 bytes in each track. The 3340 exhibits the following performance: track-to-track, average, and across-all-tracks head positioning times are respectively 10, 25, and 50 milliseconds; average rotational delay is 10.8 milliseconds, and data transfer rate is 885,000 bytes/second. (The physical timing of the 3340 drives indicates a rotational delay of 10.1 milliseconds (2900 rpm), but System/3 programming support imposes an additional delay.)

Of the 50.8-megabyte capacity of each Data Module, a constant 9.83 megabytes are required for program support. The following combinations of models and resulting data capacities are available:

No. of Drives	3340 Models	Data Capacity	Usable on System/3 Model:
2	A2	82,083,840 bytes	15
3	A2+B1	123,125,760 bytes	15
4	A2+B2	164,167,680 bytes	15
2	C2	82,083,840 bytes	12

It should be noted that the 3348 Data Module used with the System/3 is physically equivalent to modules used with the System/370. However, the data formatting technique of the System 3 prohibits interchanging 3348 modules between the System/3 and the System/370 for processing.

In addition to the sealed 3348 Data Modules, the 3340 subsystem includes other features that should contribute to improved reliability. An error correction code permits automatic correction of an error up to 3 bits long and detection of an error up to 11 bits long in each record. A closed-loop air filtration system reduces airborne contaminants that might cause read/write errors. A read-only switch on every 3340 drive is activated by inserting a latch in the Data Module; when the latch is not inserted, the data is protected against erasure or overwriting.

3344 DIRECT ACCESS STORAGE FACILITY: Provides expanded storage capacity for a System/3 Model 15D system only. The 3344 is offered in one dual-drive model that provides the equivalent storage capacity of ➤

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➤ In July 1975, IBM added the capabilities of the 3410/3411 Magnetic Tape Subsystem to the Model 8. At the same time, an improved method for attachment of local CRT clusters (the Local Display Adapter) was offered.

In May 1976, the 5448 Disk Storage Drives were announced for Models 8 and 10. The 9.8-megabyte 5448 units expand the maximum disk capacity of each of these systems from 9.8 megabytes to 19.6 megabytes. The 5448 drives are intended only as an adjunct to the 5444 Disk Storage Drives originally supplied with the systems and feature the same internal mechanism as the 5444 Models A2 and A3.

The minimum Model 8 system comprises a processing unit (with 16K, 32K, 48K, or 64K bytes of semiconductor main storage); either an operator's Printer-Keyboard or a 3741 Data Station, directly attached; a 100-lpm printer, and a 2.46-million-byte disk. The processing unit and disk storage are the same as those offered on the Model 10, but the MOSFET memory is the same as that of the Model 15.

System/3 Model 8 configurations can be expanded by adding a 5471 Printer-Keyboard (for operator communications, inquiry, program interaction, and secondary output), a 200-lpm or 300-lpm 5203 Printer (a Dual Feed Carriage is optionally available on the 5203), higher-capacity 5444 Model A disk drives (up to four), the 1255 Magnetic Character Reader, or the 3881-1 Optical Mark Reader. A Binary Synchronous Communications Adapter (BSCA), as well as the Integrated Communications Adapter (ICA), together give the Model 8 versatility as a processor, remote batch terminal, or host processor with its own network of local and/or remote terminals. The optional Serial Input/Output Channel (SIOC) is required for either the 1255 or 3881 readers. When the SIOC is selected on a Model 8, the BSCA cannot also be selected.

The Model 8 offers diskette I/O and disk-based batch processing for slightly lower entry costs than the Model 10, plus the availability of an Integrated Communications Adapter. The ICA provides three functions on the Model 8:

- Two local line interfaces, neither requiring a modem; one is rated at 8000 bps for 3270 terminals, the other at 2400 bps for attaching 3741 communications stations.
- One remote synchronous line for transmission at up to 7200 bps.

Only one of these three can be operating at once, but all three may be present on a Model 8.

The Model 8 offers the optional Dual Program feature, permitting two separate programs to run concurrently and share the processing unit facilities. This is the same feature offered for the Model 10.

The System/3 Model 8 differs from its nearest counterpart, the Model 10, in the following capabilities:

➤ four 3348 Model 70 Data Modules as employed in the 3340 Direct Access Storage Facility. One 3344 Model B2 drive can be attached to a 3340 subsystem. If the 3340 subsystem consists of four drives (maximum configuration), the 3348 must replace two of the four drives.

The 3344 uses a fixed 20-surface medium on each of the two drives. The formatted capacity of each drive is 203.5 megabytes, consisting of 828 tracks per surface, each recorded at 12,288 bytes per track. The 5445 simulation area reduces this capacity to 183 megabytes accessible to the user.

The 3348 drives have the same performance characteristics as the 3340 drives.

The following combinations of 3340 and 3348 disk storage configurations are allowable:

No. of Drives	3340 Models	3348 Models	User Data Capacity*	Usable on System/3 Model
2	A2	—	81.5	15B, C, D
3	A2+B1	—	122.4	15B, C
No. of Drives	3340 Models	3348 Models	User Data Capacity*	Usable on System/3 Model
3	A2+B1	—	122.4	15D
4	A2+B2	—	162.2	15B, C
4	A2	B2	447.2	15B, C, D

*Does not include 5445 simulation area.

5444 DISK STORAGE DRIVE, MODELS 1, 2, & 3: Available for System/3 Models 6, 10, and 15, the 5444 Models 1 and 2 each consist of one removable single-disk cartridge and one fixed disk on a single drive, served by a single access mechanism with four vertically-aligned heads. Model 3 accommodates one removable single-disk cartridge only. A System/3 can include one or two disk drives, housed in sliding drawers. The following combinations of models and resulting capacities are available.

No. of Drives	Models	Data Capacity
1	1	2,457,600 bytes
1	2	4,915,200 bytes
2	2+3	7,372,800 bytes
2	2+2	8,830,400 bytes

Model 1 has 100 data tracks on each recording surface, while Models 2 and 3 have 200 data tracks per surface. Each track consists of 24 sectors, and each sector can hold a 256-byte record.

For all models, average rotational delay is 20 milliseconds and data transfer rate is 199,000 bytes/second. Average head movement time is 153 milliseconds in Model 1 and 269 milliseconds in Models 2 and 3; track-to-track head positioning time for all three models is 39 milliseconds. Across-all-tracks head positioning time is 395 milliseconds in Model 1 and 750 milliseconds in Models 2 and 3.

The removable 5440 Disk Cartridge weighs 6 pounds and is about 15 inches in diameter and 2.5 inches high. It stores 1.22 million bytes when used with the 5444 Model 1 Drive and 2.45 million bytes when used with the 5444 Model 2 or 3.

5444 DISK STORAGE DRIVE, MODELS A1, A2, & A3: Available for System/3 Models 8, 10, and 15, these drives provide faster access than the original 5444 drives described above. Average head positioning time is 86 milliseconds for Model A1 and 126 milliseconds for Models A2 and A3; track-

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- ● No card equipment; instead, the 3741 is used.
- Attachment of up to 12 3270 displays and printers through the Local Display Adapter.
- Availability of the ICA.
- Use of only the higher-performance A models of the 5444 Disk Storage Drives.
- No Application Customizer or Programming Services initially available.

The 5408 Processing Unit for the Model 8 has the same architecture, instruction set, memory cycle time, and access time as the Model 10 Processing Unit. However, the Model 8 main memory is the MOSFET semiconductor type, as used in the Model 15; memory is available in four steps from 16K bytes to a maximum of 64K, in increments of 16K. Logic circuitry in the processor is based on IBM's Monolithic Systems Technology like the rest of the System/3 product line.

Programming support comes from the same SCP as that of the Model 10. Model 8 SCP includes the Communications Control Program (CCP) and Multi-Leaving Remote Job Entry Work Station (MRJE/WS). CCP allows users to develop communications systems using one of the Model 8-supported languages: Basic Assembler, COBOL, FORTRAN IV, or RPG II. MRJE/WS enables the Model 8 to act as a tributary system to a central System/370 and submit RJE OS jobstreams.

Model 8 Program Products comprise, in addition to the languages listed above, Disk RPG II, Disk Sort, DATA/3, and 1255 Utility. DATA/3 is an applications Program Product used to generate RPG II programs supporting the 3270 Information Display Systems.

The Model 8 currently supports only binary synchronous communications and not the new Synchronous Data Link Control (SDLC) technology of the System/370. However, the older binary synchronous technology will amply support the teleprocessing needs of System/3 users. The most common terminals on the Model 8 will be the 3741 for on-line processing and the 3270 Information Display Stations for inquiry or data entry.

The Model 8 will also support communications with the following IBM equipment:

- 1130 Computing System
- 2770 Data Communication System
- 2780 Transmission Terminal
- 3735 Buffered Terminal
- System/7
- System/360
- System/370

- to-track head positioning time for all three models is 28 milliseconds. Across-all-tracks head positioning time is 165 milliseconds for Model A1 and 255 milliseconds for Models A2 and A3. In other respects, Models A1, A2, and A3 have the same characteristics as Models 1, 2, and 3, respectively. Disk cartridges can be used interchangeably among the Models 6, 8, 10, and 15, and all programs written for the original models will run without change on the faster models. Higher-Performance Disk Attachments (#4501 and #4502) must be added to the 5410 Processing Unit in a Model 10 system to accommodate the faster drives. The following combinations of models and resulting capacities are available:

<u>No. of Drives</u>	<u>Models</u>	<u>Data Capacity</u>
1	A1	2,457,600 bytes
1	A2	4,915,200 bytes
2	A2+A3	7,372,800 bytes
2	A2+A2	9,830,400 bytes

5445 DISK STORAGE DRIVE: Provides comparatively large-capacity random-access storage for Model 10 and Model 15 (A series) systems on interchangeable, 11-disk 2316 Disk Packs. Each single-spindle drive holds one pack and stores 20.48 million bytes in 256-byte physical records; when IBM software support is used, all data is recorded in this format. If the System/3 format conventions are followed on a System/360 or System/370, data recorded on 2316 Disk Packs can be interchanged between the systems. Track-to-track, average and across-all-tracks head positioning times are respectively 25, 60, and 130 milliseconds. Average rotational delay is 12.5 milliseconds, and data transfer rate is 312,000 bytes/second.

A maximum of two 5445 drives (one Model 1 and one Model 2) can be connected to a 5410 (Model 10) Processing Unit. The 5410 must be equipped with the appropriate 5445 Disk Attachment and Processing Unit Expansion features. A maximum of four 5445 drives (or 81.92 million bytes of storage) can be connected to a 5415 (Model 15 A series only) Processing Unit equipped with the appropriate attachment features. The 5415's Scan/Read feature permits an index in 5445 Disk Storage to be scanned and read during a single revolution of the disk. Deliveries of the 5445 drives began in June 1972.

5447 DISK STORAGE DRIVE: Introduced in January 1976 for use with the System/3 Model 4, the 5447 Model A1 is a single-drive unit with one fixed and one removable 5440 disk cartridge. Data is recorded on four surfaces, each divided into 200 tracks with 24 sectors of 256 bytes. Total formatted capacity of the 5447 Model A1 is 4.9 megabytes.

The 5447 Model A2 is a dual-drive version of the Model A1 having three fixed and one removable 5440 disk cartridges. Total formatted capacity of the Model A2 is 9.8 megabytes.

On both models, the track-to-track head positioning time is 28 milliseconds, average head positioning time is 126 milliseconds, across-all-tracks head movement time is 255 milliseconds, and average rotational delay is 20 milliseconds. Data transfer rate is 199,000 bytes per second.

5448 DISK STORAGE DRIVE: Provides storage expansion to 5444 disk subsystems on System/3 Model 8 or Model 10 systems. One 9.8-megabyte 5448 Model A1 can be added to existing 5444 drives to provide a total of up to 19.6 megabytes of storage. The 5448 Model A1 consists of four fixed disks with eight recording surfaces, each having 200 tracks. Each track contains 24 sectors of 256 bytes, providing a formatted capacity of 9.8 megabytes. Track-to-track, average, and across-all-tracks head positioning times are respectively 28, 126, and 255 milliseconds. Average rotational delay is 20 milliseconds. Data transfer rate is 199,000 bytes per second.

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➤ SYSTEM/3 MODEL 10

Model 10, the original member of the System/3 family, was announced in July 1969. It offers file-oriented data processing, in contrast to the transaction-oriented data processing orientation of the System/3 Model 6. Moreover, the Model 10 provides substantially higher throughput rates in most applications and a greater choice of peripheral devices.

Nearly all of the associated peripheral equipment announced with the System/3 Model 10 was completely new. The principal input/output device in most System/3 Model 10 installations is the 5424 Multi-Function Card Unit (MFCU). The MFCU, like the 2560 Multi-Function Card Machine used in the System/360 Model 20, can perform the functions of card reading, punching, collating, and interpreting. Consolidation of all these functions into a single compact unit leads to reduced equipment costs and card handling time, but the complexity of the unit has caused maintenance problems and frequent card jams in some installations. The availability of direct attachment for the diskette-oriented 3741 Data Station will go a long way toward satisfying those users looking to replace the 5424 MFCU.

The basic Model 10 system—consisting of processing unit, printer and MFCU—requires only 150 square feet of floor space. Moreover, the units are interconnected by concealed, above-the-floor cables, eliminating the need for a raised floor. The optional disk storage drives are housed in drawers under the MFCU. The system console, MFCU, disk drives, and optional printer-keyboard are all within reach of a seated operator.

The most surprising aspect of the original System/3 announcement was the complete absence of any data communications facilities. This serious limitation on the system's sales appeal was removed in February 1970, when IBM announced a Binary Synchronous Communications Adapter (BSCA) for the System/3. The BSCA can turn the System/3 into a low-cost and flexible terminal computer, able to process data locally and communicate with other IBM computers at speeds ranging from 600 to 50,000 bits per second. The BSCA can be field-installed on any card or disk System/3. The RPG II Telecommunications Feature facilitates the programming of BSCA applications, but at additional cost.

In October 1970, IBM added the 300-line-per-minute 5203 Model 3 Printer and the 750-document-per-minute 1255 Model 2 and 3 Magnetic Character Readers to the System/3 product line. Each of these units provided a 50 percent speed increase over the previously available models.

Then, in February 1971, IBM announced a number of new products for the Model 10 that greatly alleviated many of its remaining limitations and broadened its spectrum of practical applications. The 5410 Model A7 (card) and A17 (disk) Processing Units offered 49,152 bytes of core storage, or 50 percent more than the previous maximum capacity. The 5444 Model A1, A2, ➤

➤ INPUT/OUTPUT UNITS

See the Peripherals/Terminals table on the third page of this report.

COMMUNICATIONS CONTROL

2074 BINARY SYNCHRONOUS COMMUNICATIONS ADAPTER (BSCA): For Models 4, 6, 8, 10, 12, and 15. Enables a System/3 to function as a processor terminal communicating with any of the following IBM devices:

- Another similarly equipped System/3.
- An 1130 Computing System.
- Any System/360 or System/370 computer equipped with appropriate communications control facilities.
- A 2770 Data Communications System.
- A 2780 Data Transmission Terminal.
- A 3735 Programmable Buffered Terminal.
- A 3741 Model 2 Data Station or 3741 Model 4 Programmable Work Station.
- A System/7 equipped with the BSCA.

Transmission is in half-duplex binary synchronous mode over a switched, leased, or private line. Either ASCII or EBCDIC transmission code can be used. Transmission over a non-switched data link can occur at 600, 1200, 2000, 2400, 3600, 4800, 7200, 19,200, 40,800 or 50,000 bits per second. When switched lines are used, transmission speed is limited to 600, 1200, 2000, 2400, or 3600 bits per second. BSCA operations are overlapped with computing and other I/O operations.

The BSCA alternatively enables a System/3 to operate as a tributary station on a multipoint leased or private line in conjunction with a central System/360 or 370 computer using either OS TCAM or OS or DOS BTAM. In this case the System/3 operates as a compatible member of the IBM family of BSC terminals at transmission rates of 1200 to 7200 bps.

Finally, the BSCA can equip the System/3 to function as the control station for a leased or private multipoint communications line supporting the following IBM BSC terminals:

- 3270 Information Display System terminals in single-station or multi-station configurations at 1200 to 7200 bps.
- 3735 Programmable Buffered Terminals at 1200, 2000, 2400, or 4800 bps.
- 2980 General Banking Terminal System at 600 to 4800 bps.
- System/7 with BSCA.

The BSCA is an optional feature for the 5404, 5406, 5408, 5410, 5412, or 5415 Processing Unit; the appropriate Processing Unit Expansion feature is a prerequisite. Several optional features, in turn, are available to enhance the capabilities of the BSCA. The Text Transparency feature permits transmission and reception of data in 8-bit binary image form as well as in EBCDIC code. The Station Selection feature enables the BSCA-equipped System/3 to operate as one of a number of IBM BSC terminals on a multipoint line. The Internal Clock feature generates timing signals for use with modems that lack a clocking facility. The Auto Call feature enables

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▷ and A3 Disk Storage Drives featured much faster access time (at higher prices) than the earlier 5444 Model 1,2, and 3 Drives. The 5545 Disk Storage Drives provided greatly increased capacity—20.48 million bytes per 2316 Disk Pack—together with fast access and data compatibility with the System/360 and 370 computers. The 5421 Printer Control Unit permitted the connection of a 600-lpm or 1100-lpm 1403 Printer in place of the much slower 5203 Printer. And finally, new COBOL and FORTRAN compilers offered System/3 users a much wider choice of programming languages and improved program compatibility with other computers.

In October 1971, IBM brought magnetic tape capabilities to the System/3 Model 10 by introducing the compact, low-cost 3410/3411 Magnetic Tape Subsystem and a variety of supporting software facilities. At the same time, IBM upgraded the system's communications facilities by adding a second BSCA and support for the 3270 Information Display System.

In November 1971, IBM announced that customers requiring 80-column card I/O on a System/3 Model 10 Disk System would henceforth be able to install a 1442 Card Read Punch in place of the 96-column 5424 Multi-Function Card Unit, which has previously been a required component in every System/3 Model 10 installation. This capability expanded the System/3's sales appeal by making it a suitable choice for users who need to retain the traditional 80-column cards for compatibility with existing systems and equipment.

In July 1972, IBM added the 3881 Optical Mark Reader to the complement of on-line I/O equipment for the System/3. The 3881 reads ordinary pencil marks or machine-printed marks from documents of widely varying sizes at a speed of 4000 or 6000 documents per hour.

In August 1974, IBM added the facility for direct attachment of the 3741 Data Station to Model 10 Disk Systems. The 3741 performs effectively as a high-speed I/O device and is supported under RPG II and Assembler, but not for COBOL or FORTRAN object programs. In effect, the 3741 replaces a card reader and card punch.

The introduction of the 5448 Disk Storage Drives in May 1976 probably had more impact on the System/3 Model 8 than on the Model 10. The increase from 9.8 to 19.6 megabytes via the 5448 drives is greatly overshadowed by the 41-megabyte maximum capacity of the 5445 Disk Storage Drives. However, the conversion from 5444 to 5445 drives requires a new disk attachment and drive and increases monthly rental charges by \$988, compared to \$430 monthly for the 5448 drive and attachment.

IBM software support for the System/3 Model 10, while far from sophisticated, is well tailored to complement the system's modest hardware capabilities. A set of System Control Programs, designed to handle basic operating and data management functions, is supplied to Model 10 users at no extra charge. The System Control Programs for disk-oriented systems include a supervisor and sched- ▷

▷ the System/3 to dial and initiate a call to a remote BSC terminal under program control. The EIA Local Attachment permits one 3275 Display Station or one 3271 Display Control Unit to be cable-connected directly to the BSCA without the use of a modem or data communications line.

SECOND BSCA: This optional feature enables a System/3 Model 10, 12 or 15 to control transmission simultaneously over two communications lines. Either the first BSCA or the Local Communications Adapter is a prerequisite. The Second BSCA has the same capabilities, options, and limitations as the First BSCA except that its range of transmission speeds is limited to 600 to 7200 bps; no broadband facilities are available for the Second BSCA.

4765 LOCAL COMMUNICATIONS ADAPTER (LCA): Provides for communication with a 3741 Model 2 or 4, 5231 Model 2 with BSCA, 3271/3274-1C, 3271/3275, 3271/3276-2, or System/7 with BSCA and System/3 Models 6, 10, and 15. Also provides for attachment of the 5230 Data Collection System on System/3 Models 10 and 15. Data transfer rate for the 4765 is 2400 bps. EBCDIC transmission code must be specified when applicable on the attached device. The LCA cannot be installed on the same system as the first BSCA.

2094 BINARY SYNCHRONOUS COMMUNICATIONS CONTROLLER (BSCC): Provides for the attachment of up to two additional binary synchronous communications lines on the Model 15D only. A maximum of one BSCC is allowed per system. This feature provides the terminal polling function (depending on terminal type attached) for one or two lines. Both lines can handle polling functions and operate in multipoint control station mode (half-duplex mode using two- or four-wire facilities) over non-switched communications lines at speeds up to 9600 bps. Text transparency is standard and applicable to EBCDIC-coded data only.

INTEGRATED COMMUNICATIONS ADAPTER (ICA): For Model 8 and Model 12. This optional adapter allows a single remote communications line to coexist with two local communications lines. Either of these line types is manually switch-selectable. The ICA supports the following three options:

- Synchronous line, medium-speed communications—data set clocking, switched or non-switched line in either a point-to-point or multipoint network up to 7200 bps.
- 8000-bps local interface—EIA attachment, requiring no modem, to attach multiple 3277 Display Stations with associated printers or a single 3275 Display Station.
- 2400-bps local interface—EIA attachment, requiring no modem, for such devices as the 3741-2 or 3741-4.

More than one ICA function can be attached to a System/3 Model 8 or 12, but only one ICA function can operate at a time. The functions are switch-selectable.

MULTIPLE LINE TERMINAL ADAPTER (MLTA): For Model 15. This RPQ feature for the 5415 Processing Unit permits connection of up to eight communications lines, with multiple low-speed terminals on each line. The MLTA accommodates the following IBM start/stop terminals: 1050 Data Communications System, 2740 and 2741 Communications Terminals, Communicating Magnetic Card Selectric Typewriter (CMCST), and System/7 (supported as a 2740 Model 1).

SOFTWARE

SYSTEM CONTROL PROGRAMMING: SCP is IBM's designation for the programs that perform the system con- ▷

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► uler that perform the functions of a simple operating system. All other System/3 software is separately priced.

IBM is encouraging most System/3 users to do their application programming in the RPG II language. RPG II is available for both card and disk systems. The language is an extended version of System/360 RPG that is capable of handling most business programming requirements quite effectively. As a significant step toward improved compatibility between the System/3 and the larger IBM computers, IBM in early 1971 announced a DOS RPG II compiler for the System/360 and 370. The DOS version supports all the facilities of System/3 RPG II except the telecommunications and automatic program overlay functions.

The ANS COBOL and FORTRAN compilers for the System/3 Model 10, announced in February 1971, provide alternative ways to bridge the compatibility gap. Both compilers offer upward language compatibility with their DOS and OS counterparts for the System/360 and 370.

Thus, System/3 Model 10 users can now elect to write their programs in any of three languages—RPG II, COBOL, or FORTRAN—without fear that they may have to start over if and when it becomes necessary to move up to a larger computer. Even so, the compatibility problems still have not been fully resolved. There are numerous differences in system control, data management, and operational characteristics which could hamper conversions from the System/3 to the System/370.

IBM's Application Customizer Service was first offered with the System/3 Model 10. Users with Model 10 card-based systems can utilize the service for accounts receivable, inventory accounting, order writing and invoicing, sales analysis, payroll, general ledger, accounts payable, and labor distribution. For Model 10 disk-based systems, the service is available for order writing and invoicing, inventory accounting and management, accounts receivable, and sales analysis. Using questionnaires defining the user's requirements as its input, the Application Customizer program produces detailed documentation to guide the user's programmer in writing the necessary RPG II coding. A high degree of user dissatisfaction with the original Application Customizer Service led IBM to offer two optional extensions: users of disk-oriented systems can elect to receive customized, computer-generated RPG II source code (which they must then compile and debug), while users of card-oriented systems can contract with IBM for the design, programming, and documentation of complete applications at fixed prices.

System/3 Model 10 users can also choose from the rapidly growing array of packaged application programs. IBM offers its own Program Products plus a variety of Field Developed Programs and Installed User Programs (all on a separately priced basis), and several System/3 user groups are promoting the interchange of programs among their members. A nationwide network of IBM ►

► trol functions which are basic to every installation. These programs are supplied with the system at no additional charge, whereas all other IBM software for the System/3 is separately priced.

MODEL 4 AND MODEL 6 SYSTEM CONTROL PROGRAMMING (SCP): These programs perform the system control functions that are basic to an RPG II-oriented System/3 Model 4 or Model 6 installation. All of the basic SCP programs can function with the minimum Model 6 configuration: 5406 Processing Unit with 8K bytes of core storage, one 5444-1 Disk Storage Drive, and one printer. All other standard I/O units are also supported.

It should be noted that every program executed on a System/3 Model 4 or Model 6 requires a set of Operation Control Language (OCL) statements to provide the system with information about the job to be run (such as what program to load, what files to use, what date to use, etc.). OCL for these systems is called conversational OCL because the operator keys in the control statements one at a time in response to queries (in the form of "keywords") from the system. (It is also possible to enter OCL statements via the optional Data Recorder.)

There are three sequences of OCL Statements to be learned by the operators: **LOAD**, for running a job whose OCL statements are not catalogued; **BUILD**, for cataloging OCL statements into a library; and **CALL**, for running a job whose OCL statements have been previously catalogued. Both the **LOAD** and the **BUILD** sequences contain a string of 20 keywords which must be individually responded to by the operator. The **CALL** sequence contains only four queries requiring operator response.

There are four categories of basic SCP routines:

- **DISK SYSTEM MANAGEMENT PROGRAMS:** Generate and maintain a disk-resident system capable of compiling, generating, and executing user programs. These SCP programs consist of a supervisor and a scheduler, which provide the user with selective program loading from disk, program roll-in/roll-out capability, I/O control, and execution of programs from OCL procedures. Job-to-job transition is automatic.
- **LIBRARY MAINTENANCE PROGRAM:** Permits the user to generate, maintain, and service the system disk and the source and object program libraries. The libraries can reside on any drive, but the system disk must reside on either the fixed or removable disk of Drive 1. Functions include library add, delete, display, and copy.
- **COPY/DUMP PROGRAM:** Provides the user with the capability of copying his disk files onto another disk drive or printing them on the printer. Printing can be specified to occur between certain limits, and any portions of the original file can be deleted.
- **UTILITY PROGRAMS:** Permit the user to prepare and maintain his disk files. The programs provided include Disk Initialization, Alternate Track Assignment, Alternate Track Rebuild, File and Volume Display, and File Delete.

The Overlay Linkage Editor Feature is an optional extension of the basic System Control Programming that creates loadable programs from multiple relocatable modules. Overlay structures can be created automatically or as designated by the user. Output from the Overlay Linkage Editor can be catalogued in the Object Library on disk or, for the Model 6 only, punched into cards. The feature requires a 12K 5406 Processing unit, one 5444 Disk Storage Drive, and a printer. The standard Model 4 configuration is also sufficient for this program. ►

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- Basic System Support Centers provides System/3 users with educational courses and computer time for preinstallation testing and debugging.

IBM's 96-column card, introduced originally with the System/3 Model 10, is about one-third the size of the familiar 80-column card and holds 20 percent more information. The card is 3.25 inches wide and 2.63 inches high. The upper portion of the card can accommodate up to 4 printed lines, each containing up to 32 characters. The lower portion consists of 3 "tiers" of punching positions; each tier can hold 32 characters of data. Punched data is expressed as a 6-bit code and represented by tiny round holes.

The 6-bit code restricted the card character set to 64 characters—a startling backward step in the era of expanded character sets. The restricted card code was all the more surprising in view of IBM's use of EBCDIC, which can accommodate up to 256 different characters, as the System/3's internal code.

IBM's continued emphasis on disk-based systems, coupled with the absence of new developments for card-based systems, can be interpreted as a sign that both 96-column and 80-column cards will eventually be phased out of its product lines.

SYSTEM/3 MODEL 12

The Model 12, announced on July 7, 1975, is essentially an improved MOSFET (Metal Oxide Semiconductor Field Effect Transistor) memory version of the older Model 10. The Model 12 features disk-file-oriented data processing, with magnetic tape and card I/O available. The System/3 Model 12 shows its file orientation by the implementation of the high-performance 3340 Direct Access Storage Facility (DASF). This facility provides 82.08 megabytes of data storage, with 9.83 megabytes more utilized for 5444 simulation (system libraries for Model 12 operation and maintenance). MOSFET memory was originally available in three sizes: 32K bytes, 48K bytes, and 64K bytes. In November 1976, two additional configurations were announced, with memory capacities of 80K and 96K bytes.

The basic Model 12 system consists of a 32K-byte processing unit, a 3340 DASF Model C2, a 5203 Printer, and either a 5424 MFCU, 1442 Card Read Punch, or directly attached 3741 Data Station.

The performance of the basic system can be enhanced through substitution of the 1403 Model 2, 5, or N1 Printer. Other peripheral expansions include the 3410/-3411 Magnetic Tape Subsystem, 1255 Magnetic Character Reader, 3881 Optical Mark Reader, and several options for connecting local and remote terminal devices. The traditional one or two Binary Synchronous Communications Adapters can be included, as can the Integrated Communications Adapter as found on the Model 8 and Model 15. In addition, the Local Display Adapter can be used in place of one of the BSCA features; the

- The Multi-Leaving Remote Job Entry Work Station Feature permits either a System/3 Model 4 or Model 6 system equipped with a Binary Synchronous Communications Adapter to function as a remote job entry work station to a System/370 system operating under OS/360, Release 2 of OS/VS1, or Release 2 of OS/VS2. Work station input can be entered through the console keyboard, a 5496 or 129 On-Line Data Recorder, a 5444/5447 Disk Storage Drive, or through a combination of these devices. Operator messages are printed on the Model 5213 or Model 2222 Printer. Output data sets can be directed to a printer, a Model 5496 or Model 129 On-Line Data Recorder, or written to disk. Output may also be routed to another work station or directed to central system input/output devices. All files created by the work station programs are standard System/3 consecutive files and can be accessed by the Disk Copy/Dump Program or a user-written RPG II or FORTRAN program. This feature requires a minimum of a 12K Processing Unit with a Binary Synchronous Communications Adapter with EBCDIC Transmission mode, a Model 5444/5447 Disk Storage Drive, and a printer.

The 3741 Data Station Feature is available for the System/3 Model 6 only, and provides support for the 3741-1 or 2 Data Station or the 3741-3 or 4 Programmable Work Station as a directly attached I/O device to the System/3. For the 3741-3 or 4, Application Control Language is not supported for use with data transfer. This feature does provide copy/dump functions to and from the 3741 and System/3, along with system management functions. Requirements for this feature are a 12K 5406 Processing Unit with a directly attached 3741.

MODEL 8 SYSTEM CONTROL PROGRAMMING: The Model 8 is supported by the SCP for the Model 10 Disk System. This is described below.

MODEL 10 CARD-ORIENTED SYSTEM CONTROL PROGRAMMING: IBM supplies two principal SCP's for card-oriented systems: a Program Maintenance Program, which facilitates maintenance of program decks, and a System Initialization Program, which initializes a communication area in core storage at the beginning of each day. These programs require a minimum System/3 Model 10 configuration (8K bytes, printer, and MFCU).

Also available for card-oriented systems is a Remote Job Entry Work Station Support routine that permits a System/3 equipped with a Binary Synchronous Communications Adapter to transmit OS/360 jobs to a central System/360 or 370 computer (256K Model 40 or above) and receive output from the central system upon completion of each job.

The installation of the BSCA requires that the Device Counter Logout Program also be installed. This program recovers the contents of counters accumulated during the execution of any BSCA card system object program which causes updating of the device log counter. Output is punched and/or printed at the operator's option.

MODEL 10 DISK-ORIENTED SYSTEM CONTROL PROGRAMMING: For disk-oriented Model 8 and 10 systems, IBM supplies four basic types of SCP's: Disk System Management Programs, a Library Maintenance Program, Disk Utility Programs, and a Disk Copy/Dump Program. The Disk System Management Programs include a supervisor and scheduler which provide automatic job-to-job transition, selective retrieval of object programs from a disk library, data management and input/output control, program overlays, a program roll-in/roll-out capability that facilitates the processing of inquiries, and support of the optional Dual Program feature. The Library Maintenance Program creates and updates source and object program libraries in disk storage. The Disk Utilities and Disk Copy/Dump facilitate the initialization and maintenance of disk

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- LDA permits up to twelve 3270 display and printer devices to be connected locally to a Model 12 processing unit.

Two Model 12 software features are of note. First, print spooling allows faster throughput because all printing is written to the print queue area of high-performance 3340 Direct Access Storage Facility. From the DASF, automatic or user-selected printing can take place from the print queue. Faster throughput results because CPU waiting time for printer operation is reduced. Secondly, the optional Dual Program feature allows two different programs to share the processing unit resources. Program products for the Model 12 include RPG II, COBOL, Basic Assembler, FORTRAN IV, Disk Sort, 1255 Utility, Tape Sort, Card Utilities, and DATA/3. RPG II on the Model 12 is compatible with Model 10 RPG II except for differences in the hardware support (primarily the 3340 DASF). On the Model 12, however, the Telecommunications, Auto Report, and Magnetic Tape Support features of RPG are standard rather than optional. The Disk Sort on the Model 12 is functionally identical with the Model 10 version except for support of up to eight input files from disk and/or tape. The other Program Products listed at the beginning of this paragraph are functionally identical with their Model 10 counterparts.

Model 12 System Control Programming is compatible with the package found on the Model 10 except for certain enhancements. These include the previously discussed print spooling and 3340 support, as well as additions to the Communication Control Program (CCP) and Multi-Leaving Remote Job Entry Work Station Program (MRJE/WS). Model 12 CCP includes two functions for working with local display devices not found in the Model 10 version.

The System/3 Model 12 differs from the Model 15 primarily in the following respects:

- Smaller allowable main memory.
- Smaller disk memory capability.
- Fewer peripheral choices.

The differences between the Model 12 and the Model 10 are the exact converse of the above list: larger memory, larger disk, and more peripheral choices.

Because of its preset, nonexpandable disk capability, the Model 12 has some of the flavor of the "packaged systems" that have become common in recent years. The configurational limitations on the Model 12 demonstrate some of the difficulties of maintaining multiple product lines. Loosening up the restrictions on the Model 12 would mean that it would begin to encroach on the Model 15. Raising the upper limits on the Model 15, in turn, would cause it to encroach on the System/370 line.

- files. These programs require a System/3 with at least 12K bytes of core storage, one 5444 Disk Storage Drive, a 5203 or 1403 Printer, and (on Model 10) a 5424 MFCU or 1442 Card Read Punch. Main memory residence requirements for the Disk System Supervisor range from about 3K to 4.75K bytes, depending upon the system configuration.

Optional SCP facilities for the Model 8 and for disk-oriented Model 10 systems include:

- Remote Job Entry Work Station: Enables a System/3 equipped with a BSCA to transmit OS/360 jobs to a central System/360 or 370 computer (256K Model 40 or above) and receive output from the central system upon completion of each job. Support of the 5444 Disk Storage Drive as a remote job entry I/O device is included. Requires about 5,120 bytes of main memory.
- IBM 5445 Disk Storage Drive Feature: Provides software support for the 5445 Disk Storage Drive as an I/O and data storage device—but not as a system or library residence device. Includes disk utility and copy/dump routines to facilitate the creation and maintenance of disk files. This feature is not available for the Model 8.
- Magnetic Tape Support Feature: Provides for the initialization and use of magnetic tape files. The feature will accommodate fixed or variable-length records, blocked or unblocked records, ANSI or IBM label formats, and ASCII or EBCDIC data codes. It will also accumulate and record tape error statistics.
- IBM 3881 Optical Mark Reader Feature: Provides system subroutines to handle data management and input control functions associated with on-line use of 3881.
- Macros Feature: Permits the use of user-coded macroinstructions for the control of nonstandard data management and I/O functions.
- BSCA Multiline/Multipoint Feature: Provides communications support for a point-to-point switched, point-to-point nonswitched, or multipoint configuration with the System/3 as a multidropped terminal or control station. Can support two BSCA's with different configurations. The Macros Feature (above) is a prerequisite.
- Communications Control Program: Provides control facilities for multi-terminal communications systems. IBM 3270 Information Display Systems or 3735 Programmable Buffered Terminals can be connected to the System/3 via a BSCA, and the System/3, in turn, can operate as a tributary terminal to a host System/360 or 370 computer. At least 48K bytes of dedicated storage is required in the System/3.
- Multi-Leaving Remote Job Entry Work Station Program: Permits a System/3 disk system equipped with a Binary Synchronous Communications Adapter to function as a remote job entry work station to a System/370 processor operating under control of HASP II, ASP, OS/VS2 JES, and OS/VS2 JES2/JES3. Work station input may be read from a 5424 MFCU, a 1442 Card Read Punch, a 5471 Printer-KeyBoard, a 5444 or 5445 Disk Storage Drive, a 3410/3411 Magnetic Tape Subsystem, or any combination of these devices. A printer or the 5471 Printer-KeyBoard can be used for operator messages, and output can be directed to a printer, the 5424 MFCU, the 1442 Card Read Punch, or written to disk or magnetic tape. Output can also be routed to another work station or directed to the central host computer system's I/O devices. All files created by the work station program can be accessed by user-written RPG II, COBOL, FORTRAN, and Assembler programs and by

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▷ The multiple-model family concept of the System/3 is clearly revealed as a marketing arrangement when you consider that all of the processors, from the Model 6 through the Model 15, exhibit the same internal execution speeds. However, the vast differences in the allowable main memory sizes, disk capacities, and peripheral support create substantial differences in the in-place performance of the various models. The family has been created by the careful exercise of configurational limits.

With the reduced emphasis on the original Models 6 and 10 and the more recent Model 8, the choices between the two high-end models, the Model 12 and Model 15, become more clearcut. The key is the memory size. The large capacity of the disk on the Model 12 shows IBM's acknowledgement of the growing requirements to maintain sizeable files on-line. (Acknowledgement may not be the proper connotation, because, after all, IBM has been a strong supporter of large-capacity disks for more than a decade.) The Model 15, with its large main memory and true multi-programming capabilities, provides substantially more processing capabilities than the Model 12. The Model 12 seems best suited for customers who need to process a few applications of fairly large volume.

SYSTEM/3 MODEL 15

The System/3 Model 15, introduced in July 1973, greatly increased the functional capabilities of IBM's popular small-scale computer line while retaining the proven architecture and software facilities of the earlier System/3 models. The availability of the Model 15 eased the minds of thousands of System/3 users by eliminating—or at least postponing—the need for a costly, traumatic conversion to a noncompatible system when their needs outgrow the capabilities of their present installations.

The Model 15 represents, in most respects, a bigger, better, and more costly System/3 Model 10. The Model 15 offers up to 524,288 bytes of MOSFET main storage and 447 million bytes of disk storage, whereas the Model 10 is limited to a maximum of 49,152 bytes of core storage and 50.8 million bytes of disk storage. The Model 15 systems software is a compatible superset of the Model 10 software, enhanced to support dual-partition multi-programming, spooling, device-independent data management, expanded communications control, and other throughput-boosting features. Moreover, in addition to accommodating most of the Model 10 peripheral devices, the Model 15 uses a CRT operator console and can support the 80-column 2560 Multi-Function Card Machine and 2501 Card Reader.

The Model 15 became even more attractive as a result of IBM's September 1974 announcement of native attachment of three models of the 3340 Direct Access Storage Facility. The widely publicized "Winchester" disk technology, originally available only to System/370 computer users, brings with it two or four times the capacity of the

▶ the Disk Copy/Dump Program. A minimum partition size of 8.25K bytes is required.

- **Dual Programming Feature:** Supports a limited dual-partition multiprogramming capability. The 5471 Printer Keyboard can be used by both program partitions for object program input/output or to enter operations control information, but neither the printer, a 3881 Optical Mark Reader, a multi-function card unit, or a 1442 Card Read Punch can be shared by two programs. Data files can be shared, but only one program at a time can write to a shared file. The Assembler Program, the Utility Program for the IBM 1255 Magnetic Character Reader, and library maintenance routines require a dedicated system.
- **3741 Data Station Feature:** Provides support for the 3741-1 or 2 Data Station or the 3741-3 or 4 Programmable Work Station as a directly attached I/O device to the System/3. For the 3741-3 or 4, Application Control Language is not supported for use with data transfer. This feature does provide copy/dump functions to and from the 3741 and System/3, along with system management functions. Requirements for this feature are a 12K Processing Unit with a directly attached 3741.
- **Overlay Linkage Editor and Checkpoint/Restart Feature:** Allows writing records at selected checkpoints for resuming program execution in the advent of a program halt. The overlay facility creates, either automatically or by user selection, loadable programs from multiple relocatable modules. Editor output may be catalogued in the Object Library or punched into cards.

MODEL 12 DISK-ORIENTED SYSTEM CONTROL PROGRAMMING: SCP for the Model 12 is almost the same as for the disk Model 10. Principal differences include the addition of print spooling and specific features within the Communications Control Program to handle CRT formats, and the substitution of 3340 disk support for the 5444/5445 support. System Libraries are maintained on the 3348 Data Modules by emulating a 5444.

SCP for the Model 12 requires at least 8K bytes of main memory. For the Dual Program feature, add 1K bytes. For print spooling, add 6K bytes for one program level or 7K bytes for two program levels. Additional memory will be required for the support of specific devices: 0.75K for the 3410/3411 tape subsystem; 0.25K for the 5471 Printer Keyboard; 0.75K for the directly attached 3741 Data Station; and 0.25K for the BSCA-2, ICA, LDA, or BSCA Multiline/Multipoint features. The minimum Model 12 configuration is a 32K 5412 Processing Unit, a 3340 Model C2 Direct Access Storage Facility, a 5203 or 1403 Printer, and a 5424 MFCU or 1442 Card Read Punch.

When print spooling is employed, each job's normal print output is stored in a print queue on a 3348 Data Module, where it can be accessed at disk I/O speed when the job is to be printed, either automatically or by user selection.

The Communications Control Program (CCP) for the Model 12 contains two features not present in the Model 10 CCP. Program Request Under Format reads a full 3270 screen of formatted data. The Printer Format Generator Routine generates 3270 formats tailored for printing.

MODEL 15 SYSTEM CONTROL PROGRAMMING: The IBM software for the System/3 Model 15 is a compatible superset of the software for System/3 Model 10 disk systems. Therefore, the emphasis in the following paragraphs is on the software facilities and features which are unique to the Model 15. Except where otherwise indicated, all Model 15 software facilities are usable on a minimum Model 15 system.

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➤ largest disk previously available, the 5445. The minimum 3340 disk configuration allowed on the Model 15 is the 3340 A2, containing two drives with a total of 82.08 million bytes of data storage. One or two additional drives can be added to raise the total data storage capacity to 123.13 or 164.17 million bytes.

The Model 15 line was further enhanced by the June 1976 introduction of the Model 15D. The initial announcement of four systems, with 160K, 192K, 224K, and 256K bytes of main memory, was followed in September 1976 by the announcement of two additional configurations of 96K and 128K bytes. Two additional submodels featuring 393K and 524K bytes were announced in May 1977. The Model 15D features three significant improvements over the original members of the Model 15 line.

Within the CPU, the 1.52-microsecond memory cycle time is shortened for certain non-I/O instructions, permitting the new system to take advantage of new software enhancements.

The principal software enhancement is a new System Control Program (SCP) that allows a third program partition in main memory. Previous System/3 SCP's for the Models 8, 10, 12, 15A, 15B, and 15C provided only two partitions. Therefore, the user can now add another batch system, program test/compilation, or communications job in addition to the two he may already have functioning. SCP has also been enhanced to allow sharing of more disk files and to allow programs in different partitions to update the same file. Additional improvements allow the user to define up to 192 active disk files per partition (compared to 40 on other System/3's), and spooled input from a 3741 Programmable Work Station can be variable in length, from 1 to 128 bytes, as opposed to a fixed record length of 96 bytes.

The third major enhancement is increased disk capacity—from 162 to 447 megabytes. The additional on-line capacity is provided by the 3344 Direct Access Storage Unit, available only on the Model 15D. The new 3344 drive provides a user storage capacity of 366 megabytes on a non-removable medium that offers the equivalent storage capacity of four logical 3348 Model 70 data storage modules.

The System/3 data formatting for the 3340 precludes interchanging data modules with a System/370-formatted 3340. In addition, only one of the two removable 3348 Data Modules, the Model 70, from the System/370 is available on the System/3. Finally, only 50.87 million bytes are available on each Model 70 Data Module, with 9.83 million bytes of that needed for program support.

IBM is promoting the Model 15 as an appropriate growth system for System/360 Model 20 users who have rebelled against the comparatively high cost of even the smallest System/370 configuration. The Model 15 supports the 2560 MFCM, which is the key peripheral device in most 360/20 installations, and a field-developed program is available to aid in converting 360/20 RPG programs into Model 15 RPG II. ➤

➤ The Model 15 System Control Programs are functionally compatible with their Model 10 counterparts, with additions to support two-partition multiprogramming, disk spooling, and the new Model 15 CPU features and peripheral devices. Source programs written for a System/3 Model 6, Model 8, or Model 10 must be recompiled prior to operation under Model 15 SCP, but data files and OCL (Operation Control Language) are directly compatible. To further ease the transition from a Model 10 to a Model 15, it is possible to operate a Model 15 system under Model 10 software; when this is done, the new features of the Model 15 are not used and the system operates in the same manner as a Model 10.

The most significant added feature of the Model 15 SCP is its capability to support multiprogramming in any of three environments: single batch with spooling, dual batch with spooling, or batch, communications, and spooling. The Supervisor controls the allocation of CPU time, giving Partition 2 (communications) priority over Partition 1 (batch). When an interrupt occurs, the Supervisor seizes control, processes the interrupt and transfers control to the highest-priority program that is in a ready state. A high-priority program gives up control whenever it encounters a condition that prevents further processing. The processing of a low-priority program is suspended upon completion of an event (e.g., an I/O operation) for which a higher-priority program is waiting.

When the Communications Control Program (CCP) is used, the communications partition can be further divided into smaller subpartitions ranging from 2K to 32K bytes in size. Multiple communications-oriented application programs can be executed concurrently in these subpartitions under CCP control. A detailed description of the CCP is presented below.

Spooling is another important added feature of the Model 15 SCP. Spooling can increase system throughput by reducing the amount of time the CPU must spend awaiting the completion of card and printer I/O operations. Moreover, it enables a single input or output device to serve both partitions. When spooling is employed, each job's normal card input (including OCL) is read by the card reader and stored in an input queue on a 5445 Disk Storage Drive, where it can be accessed at disk I/O speed when the job is processed. Similarly, the job's output is stored in a disk output queue and then printed and/or punched at a later time. Spooling on the Model 15 requires a 5445 Disk Storage Drive and from 8K to 20K bytes of main storage, depending on the options selected.

Released in June 1975 were seven spooling enhancements: 1) a new optional parameter under the START PRT operator command which allows all output in the print queue of a specified forms type to be printed; 2) a CHANGE command which can be used to change forms type or number of copies in a job or step in the print queue, or 3) card types or number of copies in the punch queue; 4) allowed specification of a disk (spooling device) track group size of "1" (useful with the 3340's, due to their higher per-track capacity); 5) an optional ROLL parameter on the START RDR operator's command which allows cards to be selected to all four stackers on a multifunction card unit (MFCU) before operator intervention is required (previously the operator had to stand by to empty each individual stacker as it filled); 6) a display of the print queue that now shows the number of pages for each step; and 7) ability to support spooled card readers and punches in a mix of 80- and 96-column types.

Further enhancements, released in September 1976 and November 1977, included improved spool stop and restart; separate priority for print and punch; copy pack with active spool file; a new system service program to copy the spool file to disk or tape, copy jobs into the reader queue from a file or terminal, copy print and punch steps to a file, ➤

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▷ The 5415 Processing Unit, the central component of every Model 15 system, is available with 49,152 to 524,288 bytes of main storage. The upper limit was originally 131K bytes, but this was expanded to 262K bytes in 1975 and to 524K bytes in 1977. IBM's MOSFET (metal oxide semiconductor field effect transistor) storage technology is used, as in the latest System/370 models, and up to 2048 bits of data are stored on a single chip. Cycle time of the Model 15 memory is the same as that of the Model 10: 1.52 microseconds per byte. Automatic correction of single-bit memory errors is a standard feature. On a cost-per-byte basis, the Model 15's MOSFET memory is offered at approximately one-fourth the price of the core memory used in the System/3 Model 10.

The 5415 Processing Unit has the same basic architecture, instruction set, and cycle time as its Model 10 counterpart, the 5410. Thus, the Model 15's greater throughput is not derived through an increase in raw CPU power (the System/3 has always boasted surprisingly high internal speed), but through its increased storage capacity and more powerful software. To support the improved software, IBM added a number of new facilities to the 5415 Processing Unit:

- Storage Protection, which prevents users' programs from interfering with one another or with the Supervisor.
- I/O Operation End Interrupt, which facilitates multi-programming by enabling the Model 15 to operate as an interrupt-driven system.
- Program Check Interrupt, which makes it unnecessary to halt the entire system when an error occurs in one partition.
- 2-byte-wide data path for 5444 or 5445 Disk Storage Drives, which reduces the interference with CPU operations imposed by disk input and output.
- Scan/Read for 5445 Disk Storage Drives, which permits a disk index to be scanned and retrieved in a single rotation instead of two.
- An Address Translation Table (ATT), which consists of 32 registers and enables the Model 15 to address up to 262K bytes of storage.

The System/3 Model 15 supports all of the Model 10 peripheral devices except the 5444 Model 1, 2, 3 and A1 Disk Storage Drives, the 5203 Printer, the 5471 Printer-Keyboard, and the 5475 Data Entry Keyboard. The original 5444 Disk Storage Drive models are replaced by the newer 5444 Models A2 and A3, with their faster head positioning mechanisms, and by up to four of the 20.48-million-byte 5445 Disk Storage Drives (or, on the B, C, and D-level processors, by from two to four 3340 and 3344 drives). The 5203 Printer is replaced by the faster 1403, available in three models with rated speeds of 465, 600, and 1100 lines per minute. The 5471

▶ and copy spool queue status display to a file or terminal; and a device number log for each partition.

Other additional facilities of the Model 15 SCP include: 1) device-independent data management, which allows a sequential file to be assigned at execution time to any one of numerous I/O devices; 2) system-assigned halt defaults, which reduce the need for operator intervention when errors are encountered; 3) reduced system overhead through improved transient handling, reduced interpartition interlock time, and faster operator communication via the CRT console; and 4) additional OCL statements and options, which define program processing in the multiprogramming and spooling environments.

The Model 15 SCP supports all the peripheral devices available for the system. As of June 1975, the SCP was upgraded to support 3340 Direct Access Storage Facilities and direct attachment of the 3741 Data Station. It also supports the following features of the Model 15 CPU: I/O Operation End Interrupt, Program Check Interrupt, Storage Protection, console CRT display, and expanded main storage capacities to 256K bytes.

The following software facilities which were optional for the Model 10 are standard features of the Model 15 SCP: Magnetic Tape and 5445 Disk Storage Support, Macros, Overlay Linkage, Editor, Checkpoint/Restart, and BSCA Multiline/Multipoint. The Macros facility permits the use of user-coded macro-instructions to control nonstandard data management and I/O functions. The Overlay Linkage Editor creates loadable programs from multiple relocatable modules. The Checkpoint/Restart facility aids users in writing checkpoint records and in restarting interrupted programs from the last checkpoint rather than from the beginning. The BSCA Multiline/Multipoint facility provides communications support for a point-to-point switched, point-to-point nonswitched, or multipoint configuration with the System/3 as a multidropped terminal or control station; it can support two BSCA's with different configurations.

Added as of September 1975 was support for the Multi-Leaving Remote Job Entry Work Station Program. MRJE/WS for the Model 15 is program, data, and transmission compatible with that for System/3 Models 6, 8, 10, and 12.

The Model 15 SCP can be used on the minimum Model 15 system, as defined in the "Configuration Rules" paragraph of this report. Spooling, however, requires the addition of a 5445 Disk Storage Drive. The minimum main storage requirement for the Supervisor is 18K bytes, and this can expand to as much as 24K bytes when a variety of peripheral devices must be supported. Spooling adds another 8K to 20K bytes to the residence requirement, depending on the options selected. Batch partitions can range from 8K to 49K bytes in size. The maximum partition size on a 512K-byte system is 488K bytes.

Additional improvements to the SCP were made with Release 2 of Programming Support for the System/3 Model 15D. These include an INCLUDE OCL statement, conditional OCL dependent on UPSI switch setting, an enhanced unit record restart, and identification of CCP tasks on spool queues.

COMMUNICATIONS CONTROL PROGRAM (CCP): This optional SCP component provides control facilities for multi-terminal communications systems connected to a System/3 via either the BSCA or the MLTA (see "Communication Control," above). The System/3, in turn, can operate as a tributary terminal to a host System/360 or 370 computer. The CCP: 1) permits programs coded in COBOL, FORTRAN, or RPG II to access the terminals; 2) handles resource management to reduce contention between programs accessing the same files; 3) monitors the terminals and

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▷ and 5475 are replaced by the 3277 Display Station, which provides improved communication between the system and its operator. The 1255 Magnetic Character Reader or the 3881 Optical Character Reader can be connected to a Model 15 via the optional Serial I/O Channel.

As alternatives to the 5424 Multi-Function Card Unit, which uses IBM's compact new 96-column cards and was at one time the only card I/O device available for the System/3, Model 15 users can elect to use either of two 80-column card units: the 1442 Card Read/Punch or the 2560 Multi-Function Card Machine. Alternatively, with the direct attachment of the 3741 Data Station, magnetic diskettes can be substituted for the 5424 or 2560 Multi-Function Card devices on a Model 15. In addition, a 2501 Card Reader can be used as an auxiliary 80-column input unit. Support for both the 80-column and 96-column card units is provided by all the Model 15 systems software facilities, thus diluting IBM's strong initial commitment to the 96-column card as a key feature of the System/3 approach to data processing.

The Binary Synchronous Display Adapter, for Model 15D, provides for attachment of up to two additional communications lines per system. The Local Display Adapter, also available for the Model 8 and Model 12, is substantially expanded on the Model 15. A total of up to thirty 3270 devices, including displays and printers, can be attached. The Binary Synchronous Communications Adapters and similar devices can handle up to 45 devices. This brings to the System/3 line the capabilities for multiple, simultaneous use, a processing mode that has become very popular for turnkey business data processing systems. The multiprogramming capabilities of the Model 15 greatly enhance the potential of the multiple-use mode as compared to the Model 8 and Model 12. However, the user will have to do substantial programming work to take advantage of the hardware capabilities that are now available.

The IBM software support for the Model 15 is a largely upward-compatible and greatly improved version of the Model 10 software. The no-charge System Control Programming (SCP) lets Model 15 users enjoy numerous "big computer" capabilities that were previously unknown to System/3 users, including real dual-partition multiprogramming, disk spooling of unit record input and output data, a task dispatcher, interrupt handlers, and the ability to assign sequential files to specific types of devices at execution time. The Model 15's multiprogramming facility replaces the optional Dual Programming Feature of the Model 8, 10, and 12 and offers far more operational flexibility. A Model 15A, B, or C user can operate his system either with two batch partitions or with one batch partition and one communications partition, with concurrent spooling in either case. Each batch partition can occupy from 8K to 49K bytes of main storage. Model 15D users are provided with a third partition, permitting one additional program to be executing concurrently. ▷

▶ responds to their commands; and 4) controls the concurrent execution of multiple application programs within the CCP partition. The CCP can occupy a partition larger than the normal 49K-byte maximum size, but individual programs running under CCP control are limited to 32K bytes. When used with a BSCA-equipped System/3, the CCP supports the following IBM terminals: other System/3's (in point-to-point switched or non-switched arrangement, as a multipoint control station, or as a multipoint tributary), 3270 Information Display Systems (in a multipoint nonswitched arrangement), 3735 Programmable Buffered Terminals (in switched or multipoint arrangements), and System/7 computers (in point-to-point switched or non-switched and multipoint arrangements).

In Model 4 systems, CCP also supports up to four concurrently executing tasks.

Additional improvements to the CCP were made with Release 2 of Programming Support for the System/3 Model 15D. These include support of the BSCC, multiple CCP program packs, lifting of the restriction on the number of programs that can be defined in the CCP assignment set, a resident DFF format index, support for additional terminals, priority termination of a user job, and mixing of terminals on a BSCA line.

The maximum number of 3270 terminals that can be supported by CCP on any one communications interface on a Model 15D is as follows: Display Adapter, 30; LCA, 45; first BSCA, 45; second BSCA, 45; and each line of the BSCC, 45.

RPG II (REPORT PROGRAM GENERATOR): This is the principal programming system for all models of the IBM System/3. The programmer, using five different types of pre-printed specification sheets, prepares a set of specifications that describe the form of the input data, the calculations to be performed, and the format of the desired output. These specifications are transcribed into punched cards and fed into the MFCU. The RPG processor then generates a machine-language object program to perform the specified functions.

The RPG II language is an extended version of earlier IBM RPG languages. It provides the facilities of System/360 RPG plus at least 20 useful extensions, including the ability to define and execute closed subroutines, to use dual input/output areas, and to debug programs at the source-language level.

The RPG II compiler for the System/3 Model 6 operates under control of the System Control Programming (SCP) software. Minimum system size for compilation and execution includes one 5406 Processing Unit with 8K bytes of core storage, a 5444 Model 1 Disk Storage Drive, and a 5213 or 2222 Printer. RPG II for the Model 6 will also support the 5496 Data Recorder or the 129 Card Data Recorder, and object programs will support the 2265 Display Station and a ledger card device. The 1255 Magnetic Character Reader is not supported.

System/3 Model 6 RPG II is source-language-compatible with Disk RPG II for the other System/3 models, except for differences originating from different I/O devices. It is also used on the System/3 Model 4.

Two different versions of RPG II are offered for the System/3 Model 10. The second or disk-oriented version is also offered for the System/3 Model 8 and Model 12.

• Card RPG II. Can be used on a minimum Model 10 configuration consisting of an 8K 5410 Processing Unit, a 5203 or 1403 Printer, and a 5424 MFCU. If 80-column cards are to be utilized as program data or source statements, a 1442 Card Read Punch is required. The only ▶

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▷ Predictably, the Model 15 user will pay a fairly high price for this "big computer" software in terms of main storage residence requirements. The Supervisor will normally occupy from 18K to 24K bytes, and spooling will require another 8K to 20K bytes, depending on the options selected by the user. Fortunately, the price of Model 15 main storage is low enough to make these rather lavish software requirements a matter of small concern to most users; another 32K bytes of main storage can be added for a modest \$220 to \$275 per month.

Also available for the Model 15 are improved versions of the following System/3 Program Products: RPG II, COBOL, FORTRAN, Basic Assembler, Disk Sort, Tape Sort, and Card Utilities. All of these products support the new Model 15 peripheral devices, and the RPG II and COBOL compilers offer a number of other worthwhile new facilities.

Two communications-oriented programs that deserve special attention are DATA/3, a Program Product that generates interactive terminal-control programs for CRT displays used in inquiry or data entry applications, and the Communications Control Program (CCP), an SCP extension that can control the concurrent execution of multiple application programs within a single partition. At the hardware level, the Model 15 offers essentially the same remote communications control facilities as the Model 10. In addition, the Local Communications Adapter (LCA) permits direct connection of either a 3741 Model 2 Data Station (IBM's "floppy disk" data entry unit) or a 3270 Information Display System.

The System/3 Model 15 is generally upward-compatible with the earlier Model 6 and Model 10 systems, but there are a few important caveats. Disk and tape data files and Operational Control Language (OCL) are directly compatible, but all source programs written for a Model 6 or Model 10 must be recompiled before they can be executed under Model 15 SCP. Model 10 programs written in Basic Assembler language may require changes prior to reassembly. In all cases, naturally, the Model 15 system must include an adequate complement of peripheral equipment.

To make the conversion from a Model 10 disk system to a Model 15 even easier, Model 15 users can elect to operate their system under the control of Model 10 software. When this "Model 10 mode" is used, the new features of the Model 15 are ignored and the system operates in the same manner (and, presumably, at about the same speed) as a Model 10.

And what will a System/3 Model 15 user do when he has outgrown the capabilities of his system? Until quite recently, he was faced with the same old problem of converting to the System/370 or a competitive computer line. And, despite the availability of upward-compatible System/370 compilers for RPG II, COBOL, and FORTRAN, there are still numerous differences in ▷

▶ limitations on the number of input and/or output files are those imposed by the number of physical I/O devices available. Object programs are produced in the form of punched card decks which can be loaded for immediate execution; there are no associated control programs. The optional Magnetic Tape Feature enables Card RPG II programmers to handle sequential input and output files on magnetic tape; the records must be of fixed length, and may be either blocked or unblocked and in either EBCDIC or ASCII code.

- **Disk RPG II:** Requires a 16K 5408, a 12K 5410, or a 32K 5412 Processing Unit, one 5444 Disk Storage Drive (or a 3340 Direct Access Storage Facility on the Model 12), a 5203 or 1403 Printer, and a 5424 MFCU, 1442 Card Read Punch, or directly attached 3741 Data Station. It provides disk-file data management facilities, automatic overlays for programs which exceed core storage capacity, and three types of file organization: sequential, indexed, and direct. All three types of files can be processed either sequentially or randomly. The Magnetic Tape Feature enables Disk RPG II programmers to handle sequential input and output files on magnetic tape; the records may be fixed or variable in length, blocked or unblocked, and in either EBCDIC or ASCII code. (The feature is optional on Models 8 and 10, but standard on Model 12.) The 5445 Disk Storage Drive Feature allows RPG II users to process sequential, indexed, or direct data files on 5445 Drives (not on the Model 12).

Model 15 RPG II provides all the facilities of Model 10 Disk RPG II plus device-independent data management, variable-length magnetic tape records, support of the 2501 Card Reader, 2560 MFCM, and 3277 Display Station, and several other new facilities. In addition, four features which are separately priced options for the Model 10 are included in the price of Model 15 RPG II: Telecommunications, Auto Report, Magnetic Tape support, and 5445 Disk Storage support.

Release 2 of Programming Support for the System/3 Model 15D added these enhancements to RPG II: improved array processing through the use of a new algorithm for finding a variably indexed array element; ability to suppress an auto report listing; file name identification on halts; and elimination of special file buffers for an output, update, or combined file.

RPG II AUTO REPORT FEATURE: This feature is standard on the Model 12, and is an optional enhancement of Model 4, Model 6, Model 8, or Model 10 Disk RPG II. Auto Report is a precompiler that reduces the coding effort required to prepare report programs. A single Auto Report output field specification written by the programmer can result in the generation of RPG II statements to indicate printing with editing, insert column headings, control spacing and horizontal alignment of the data, define total fields, accumulate totals by control levels, and flag total lines with asterisks. The Auto Report functions may be specified for only one printer file in any RPG II program. Auto Report also provides a COPY statement that permits RPG II source statements to be copied from a disk library into source programs that are about to be compiled.

RPG II TELECOMMUNICATIONS FEATURE: This feature is standard on the Model 12, and is an optional extension of Model 4, Model 6, Model 8, or Model 10 RPG II. It facilitates the transmission and reception of binary synchronous data over voice-grade or high-speed communications lines. The programmer fills out an RPG II Telecommunications Specification Sheet, which specifies the functions to be performed. The feature permits a System/3 equipped with the BSCA to operate in any of the following communications modes: receive only, transmit only, receive with conversational reply, transmit with conversational reply, or ▶

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▷ system control, data management, and operational characteristics which make nearly any System/3-to-370 conversion a costly, time-consuming task. In October 1978, IBM opened up a promising new growth path for System/3 users by announcing that the new System/38 (Report M11-491-701) will feature a System/3-compatible PRG programming system and a set of conversion utilities designed specifically to facilitate conversions from the System/3 to the System/38.

USER REACTION

Detailed below are the responses from 37 users of IBM System/3 computers received during Datapro's 1979 survey of general-purpose computer users. Represented in the survey were 46 systems, with 5 multiple-system users operating a total of 16 systems and the remainder operating 1 system each. The survey sample consisted of 11 System/3 Model 10's, 8 Model 12's, 17 Model 15's, and 10 unspecified System/3 models. A total of 12 systems were purchased, 29 were on rental or lease from IBM, and 3 were on third-party lease.

The user population can be characterized as small to medium-sized firms involved in doing their own programming, primarily in business applications. Eleven of the 37 users had licensed application programs from IBM. Contracted programs from outside sources and proprietary packages appeared in fewer than 7 of the users' installations. The earliest date of installation was January 1970 (a Model 10), and the latest date was June 1978 (a Model 15D). RPG II was by far the most widely used language. The largest system in the survey was a Model 15D with 512K bytes of main memory, 447 million bytes of on-line disk storage, and 22 interactive terminals. The most on-line terminals (30) appeared on another Model 15D. Terminals were not, however, a typical element in the configurations represented in our survey.

The ratings provided by the 37 System/3 users are summarized below.

	Excellent	Good	Fair	Poor	1979 WA*	1977 WA*
Ease of operation	20	14	2	0	3.5	3.5
Reliability of mainframe	28	6	3	0	3.7	3.8
Reliability of peripherals	18	14	4	1	3.3	3.4
Responsiveness of maintenance service	16	18	3	0	3.3	3.6
Effectiveness of maintenance service	14	17	5	1	3.2	3.4
Technical support	8	13	12	3	2.7	3.0
Operating systems	13	21	1	2	3.2	3.3
Compilers and assemblers	13	21	2	1	3.2	3.3
Applications programs	6	12	7	4	2.7	2.8
Ease of programming	13	19	3	1	3.2	3.3
Ease of conversion	12	17	6	1	3.1	3.2
Overall satisfaction	12	22	2	1	3.2	3.3

*Weighted Average on a scale of 4.0 for Excellent.

An examination of the 1979 and 1977 user ratings shows that the System/3 remained the same in one category (Overall Satisfaction) and dropped in all of the other 11 categories. In eight of these categories, however, the decline was only one-tenth of a point. The largest drops occurred in maintenance responsiveness and technical

▷ alternate transmit and receive file. The System/3 can function as a terminal in one of three types of networks: point-to-point switched, point-to-point nonswitched, or multipoint.

RPG II DISPLAY CONTROL FEATURE: Available on the Models 4, 10 (disk), 12, and 15, this feature provides telecommunications services for local or remote 3270 devices and is automatically linked into RPG II application programs via the SPECIAL file exit capability. Neither the Basic Assembler nor the RPG II Telecommunications Feature is required. Automatic buffering and queuing of terminal data is provided, as well as complete line control procedures.

Up to 18 terminals can be controlled using this feature, 12 of which can be attached via the LCA. Two sub-routines provide support of 3270's with or without CCD, at the user's option.

BASIC: System/3 BASIC is a conversational, stand-alone computing system designed for mathematical problem solving on a System/3 Model 6. The System/3 BASIC programming language is fully compatible with the BASIC language co-developed by GE and Dartmouth College and currently used with most time-sharing systems.

Programs and data files are created at the keyboard in a conversational mode. (The 5496 or 129 Card Data Recorder can also be used to load source programs into the system). There are four types of lines that can be entered: BASIC source program statements, data-file lines, comment lines, and system commands. All statements are checked for proper syntax as they are entered.

The system commands specify an immediate system action, such as saving a program or data file, executing a program, modifying a work file, etc. These system commands constitute a control language that is entirely different from the OCL statements used to control the System/3 when operating under the System Control Programming software.

Debugging aids are provided to assist in checking programs at execution time. Also, a number of utility functions are provided to perform such support functions as system generation, disk initialization, disk copy, etc.

BASIC also provides another mode of service, called the Desk Calculator mode, utilizing the console's Command Keys rather than any detailed programming language. Operating in this mode, the user can add, subtract, multiply, divide, compute powers and roots, and use built-in logarithmic and trigonometric functions.

BASIC is a stand-alone computing system. However, it can co-reside on the same system disk cartridge as the SCP software. In such co-residence situations, control can be easily transferred back and forth between the two operating systems.

Data and program files are prepared in a manner unique to the BASIC system. Thus, an RPG-prepared object program cannot use the data files prepared by a BASIC program, and vice versa. These incompatible disk files can be made compatible by converting them with the Data Interchange Utility (DIU), one of the optionally available "Conversational Utilities."

Source Programs, data files, and systems programs are all stored on disk for direct accessibility. The system uses a 64K-byte "virtual memory," implemented through software paging, to permit the compilation and execution of large programs that otherwise would not fit into main memory. A 500-statement BASIC program can be compiled from disk in about 30 to 35 seconds, once all the statements have been entered and verified. BASIC programs can be listed at the rate of about 60 statements per minute on a 5213 Model 1 Printer.

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- support (three-tenths of a point), while effectiveness of maintenance service declined by two-tenths of a point.

The principal strength of the System/3 can be summarized by the comment of one user: "One of the highest productive batch processors on the market." Principal weaknesses cited by the users were largely the same as in our previous surveys; the users expressed a desire for improved multiprogramming capabilities, addition of input spooling on certain models, and enhancement of the System/3's interactive capabilities. It seems unlikely that many of the users' requests for improvements will be granted by IBM. The System/3's useful life is fast drawing to a close, and therefore IBM's active commitment to improvement and enhancement of the product line is likely to be phased out in the foreseeable future. □

- ▶ The minimum System/3 Model 6 configuration will support the use of BASIC. Fully expanded configurations can also be used to advantage. Both the 5213 and 2222 Printers are supported, as well as the 5496 Data Recorder, the 129 Card Data Recorder, and the 2265 Display Station.

COBOL: The System/3 Subset ANS COBOL Compiler, for Models 8, 10, 12, and 15, supports these six modules of the American National Standard COBOL language: Nucleus (Level 1), Sequential Access (Level 1), Random Access (Level 1), Table Handling (Level 2), Segmentation (Level 1), and Library (Level 1). The compiler also supports certain elements of higher-level ANS COBOL modules and some IBM extensions. The ANS Sort and Report Writer modules, however, are not implemented. System/3 COBOL is upward-compatible with the ANS COBOL compilers for the System/360 and 370, and is a superset of IBM 1130 COBOL.

For the System/3 Model 8, COBOL compilation requires a 16K 5408 Processing Unit, a 5471 Printer-Keyboard or 3741 Data Station, and at least one 5444 Disk Storage Drive and a 5203 Printer.

For the System/3 Model 10, COBOL compilation requires a 16K 5410 Processing Unit with at least one 5444 Disk Storage Drive, a 5203 or 1403 Printer, and a 5424 MFCU or 1442 Card Read Punch. Also supported are the 5445 Disk Storage Drives and the 5471 Printer-Keyboard. Processing of magnetic tape files with fixed- or variable-length records, blocked or unblocked formats, and EBCDIC or ASCII data codes also is supported.

For the System/3 Model 12, COBOL compilation requires a 32K 5412 Processing Unit with at least a 3340 DASF; a 5424 MFCU, 1442 Card Read Punch, or directly attached 3741 Data Station/Programmable Work Station; and a 5203 or 1403 Printer. Model 12 COBOL is functionally equivalent to Model 10 COBOL.

The Model 15 COBOL compiler provides all the facilities of System/3 Model 10 COBOL, plus the ability to use the SCP Roll-out/Roll-in routines, support of multi-volume indexed disk files, and support of the 2501 Card Reader, 2560 MFCM, and 3277 Display Station with operator console keyboard. Support for the 3741 Data Station is limited to compilation.

In June 1975, Model 15 COBOL was enhanced to allow work files in the main data area of a 3340 disk; also, through the ASSIGN clause of the SELECT statement, the user can now define an index file as "update" without additions.

FORTRAN: The System/3 Disk FORTRAN IV compiler accepts source programs written in the IBM System/360 Basic FORTRAN IV language, which encompasses American National Standard Basic FORTRAN. It also accepts programs written in IBM 1130 Basic FORTRAN IV with minor modifications. Language extensions beyond the Basic FORTRAN level include the DEBUG facility, the IMPLICIT statement, the relational IF statement, and explicit length specification for the INTEGER and REAL Type statements. Also included are commercial subroutines which perform essentially the same functions as the IBM 1130 Commercial Subroutine Package.

The Compiler runs on a System/3 Model 6, Model 8, Model 10, Model 12, or Model 15 disk system, providing full FORTRAN compatibility among the models except for changes that may be necessitated by differences in their I/O equipment. Compilation requires at least a 12K processing unit with at least one 5444 Disk Storage Drive (one 3340 DASF on the Model 12) and a printer. The 3741 Data Station is supported for compilation only. A program of about 150 source cards can be compiled and executed on a 12K system. Also supported for the Model 10 are the 5445 Disk Storage Drives and the 5471 Printer-Keyboard, as well as I/O support for both formatted and unformatted records on magnetic tape. Model 12 FORTRAN IV is identical to Model 10 FORTRAN IV except for the elimination of 5445 support. The Model 15 FORTRAN compiler provides all the facilities of Model 6, Model 8, Model 10, and Model 12 FORTRAN, and also supports the new I/O devices available for the Model 15 and multi-volume magnetic tape files.

BASIC ASSEMBLER: Converts programs coded in a symbolic assembly language into executable object programs. Creates stand-alone programs that have no defined interfaces with the other System/3 software support. May be used to assemble relocatable subroutines for use with Card or Disk RPG II, COBOL, or FORTRAN programs.

For the Model 8, the minimum configuration includes a 5408 Processing Unit with 16K bytes of main storage, a 5203 Printer, and one 5444 Disk Storage Drive.

For the Model 10, the minimum configuration includes a 5410 Processing Unit with 12K bytes of core storage, a 5424 MFCU or 1442 Card Read Punch, a 5203 or 1403 Printer with the Universal Character Set feature and a 60-character chain, and one 5444 Disk Storage Drive.

For the Model 12, the minimum configuration includes a 5412 Processing Unit with 32K bytes of main storage; a 5424 MFCU, 1442 Card Read Punch, or directly attached 3741 Data Station/Programmable Work Station; a 5203 or 1403 Printer; and a 3340 DASF.

For the Model 15, the minimum configuration includes a 5415 Processing Unit with 48K bytes of main storage, a 3277 Display System with an Operator Console Keyboard, a 5444 Disk Storage Drive, a 1403 Printer with the Universal Character Set Feature and a 60-character chain, and either a 5424 MFCU, 2560 MFCM, 1442 Card Read Punch, or 2501 Card Reader.

CONVERSATIONAL UTILITY PROGRAMS: There are three optionally available disk-resident utility programs for use under the System/3 Model 4 or Model 6 SCP software: Keyboard Data Entry, Keyboard Source Entry, and Data Interchange Utility.

Keyboard Data Entry allows the operator to use the System/3 console keyboard as a key-to-disk data entry station. Data files can be prepared and organized for direct usage by RPG II and Disk Sort programs. Ten batch and ten final totals can be utilized. ▶

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- ▶ **Keyboard Source Entry** enables the user to key RPG II source statements or other procedures directly into the source program library on disk. Compilation can then take place from disk.

Data Interchange Utility permits the user to convert RPG-produced data files into BASIC data files, and vice versa.

DISK SORT: Sorts disks into either ascending or descending sequence on any System/3 disk system. Accepts files organized in sequential, indexed, or direct fashion. Can perform a full-record sort, a tag sort (yielding a file of 3-byte record addresses arranged in the desired sequence), or a "tagalong" sort (yielding a sequenced file of records containing only the key fields and data fields specified by the user).

The function and syntax of specifications sheets for the System/3 Model 4 and Model 6 Disk Sort programs are identical to those used with the System/3 Model 8 or Model 10 Disk Sort. Output data files created by the Model 6 Disk Sort can be processed by the Model 8 or Model 10 Disk Sort, and conversely. The Model 4 Disk Sort can generate an object module that can be executed as a task under CCP or as a program in batch mode.

The Disk Sort functions under control of the SCP software. On the Model 6, it requires the minimum 8K-byte processing unit, one 5444 Disk Storage Drive, and one printer. Minimum configuration for a Model 8 includes a 16K processor, one 5444 Disk Storage Drive, a 5203 Printer, and a 3741 Data Station. Minimum configuration for a Model 10 is a 12K processing unit, one 5444 Disk Storage Drive, a 5203 or 1403 Printer, and a 5424 MFCU or 1442 Card Read Punch. The Disk Sort 5445 Disk Storage Drive Feature provides all functions available with the Disk Sort for System/3 Model 10 users of the 5445 Disk Storage Drive.

The Model 12 Disk Sort requires a minimum configuration consisting of a 32K-byte processing unit; a 5424 MFCU, 1442 Card Read Punch, or directly attached 3741 Data Station/Programmable Work Station; a 5203 or 1403 Printer; and a 3340 DASF. In addition to the functions provided in the Model 10 Disk Sort, the Model 12 version supports up to eight input files from disk and/or tape.

The Model 15 Disk Sort program is functionally identical to the Model 10 Disk Sort with the 5445 Disk Storage Drive feature, plus several enhancements. Up to four disk drives are supported for use as input, output, or work files. Minimum configuration for a Model 15 is a 48K processor, a 3277 Display Station with operator console keyboard, a 5444 Disk Storage Drive, a 1403 Printer, and a card reader. The Model 15 Disk Sort allows input from up to eight files and the files can be any combination of disk, tape, cards, and/or diskette. The sorting techniques have also been changed to yield improved performance even if the available high-performance disk drives are not used.

DISK-RESIDENT MAGNETIC TAPE SORT: Sorts fixed-length records on magnetic tape files, in either blocked or unblocked format and EBCDIC or ASCII data code. The Model 10, Model 12, and Model 15 versions are functionally identical. Requires a 12K Model 10 processor, 32K Model 12 processor, or 48K Model 15 processor with at least one 5444 Disk Storage Drive (3340 DASF on Model 12) and three magnetic tape units.

CARD SYSTEM UTILITIES: A set of utility programs is provided for both Model 10 and Model 15 card-oriented systems.

- **Model 10:** A set of six programs designed for operation on an 8K card-oriented System/3. The Reproduce/Interpret Program handles the reproduction and/or interpretation of 96-column cards, with or without re-

formatting. The 96-Column List Program lists cards on the printer without reformatting. The MFCU Sort/Collate Program performs a variety of sorting, merging, matching, selecting, and sequence-checking functions. The Data Recording and Data Verification Programs enable a System/3 equipped with a 5475 Data Entry Keyboard to be used for on-line punching and verification of 96-column cards. The 80-96 Conversion Program allows a System/3 equipped with a 1442 Card Read Punch to read 80-column cards and punch the information into 96-column cards, with reformatting.

- **Model 15:** A set of four disk-resident programs designed to handle a variety of punched card utility functions. The Sort/Collate Program supports either the 5424 MFCU or the 2560 MFCM and performs numerous sorting, merging, matching, selecting, and sequence-checking functions. The Card List Program lists 80-column or 96-column cards on the printer without reformatting. The Reproduce/Interpret Program handles the reproduction and/or interpretation of 80-column or 96-column cards, with or without reformatting. The Gang-punch Program (new for the Model 15) handles interspersed master card gang-punching, count-controlled gang-punching, and punching based on matching control fields in master and detail cards. Three of the Model 10 Card Utilities programs are not included in the Model 15 Card Utilities: Data Recording, Data Verification, and 80-96 Conversion.

1255 MAGNETIC CHARACTER READER UTILITY: Controls the reading and sorting of MICR-encoded documents, accumulates appropriate totals, and places selected data from the documents on disk and/or printer files. It requires a 12K-byte System/3 Processing Unit and functions under control of the SCP software. The subroutines are used with a user-written RPG II or Assembler program. All models except the Model 15 support the 1255 Utility. Device control and data management services are provided as part of the SCP for the Model 15.

DATA/3: This System/3 Program Product, introduced along with the Model 15 and also available for the Model 8, 10, or 12, generates terminal control programs for the following types of applications: inquiry, inquiry with update, data entry, and data entry with master file input. The programmer fills out two RPG-like forms: a data description form and a program definition form. DATA/3 uses this information to generate RPG II source programs, which are subsequently compiled and executed. Programs generated by DATA/3 support the 3270 Information Display System, the 5444 and 5445 Disk Storage Drives, and the 3340 DASF. DATA/3 can be used on a System/3 Model 8, Model 10, Model 12, or Model 15, in connection with either the Multiline/Multipoint software or the Communications Control Program.

APPLICATION CUSTOMIZER SERVICE: As an alternative to the usual "packaged" application programs, IBM offers a novel service called the Application Customizer, which is designed to assist users in preparing programs to handle the most common data processing applications.

The user defines his requirements by completing application-oriented questionnaires and report specification sheets. These are keypunched and fed into a computer at an IBM Basic Systems Center. The resulting output consists of detailed application documentation, from which the users' own programmer writes the necessary System/3 programs (usually in the RPG II language).

Documentation produced by the Application Customizer includes a data dictionary, a listing of the contents and format of each record, an application flowchart, an ▶

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► **RPG-oriented description** of each program, and a sample of each report.

Customized Source Code is now available as an optional additional output from the Application Customizer Service. The user who elects this option receives raw, machine-generated RGP II source code on a 5440 Disk Cartridge; he must then add various constants and indicators, compile the programs, and test and debug them in the usual fashion.

For the System/3 Model 6, the Application Customizer Service currently covers four applications, available with or without Customized Source Code:

- Order Writing and Invoicing
- Inventory Accounting and Management
- Accounts Receivable
- Sales Analysis

The same packages are available tailored for two specific classes of users: lumber and building supplies dealers, and electrical distributors.

For card-oriented System/3 Model 10 computers, the Application Customizer Service currently covers eight applications:

- Order Writing and Invoicing
- Inventory Accounting
- Accounts Receivable
- Sales Analysis
- Payroll
- General Ledger
- Accounts Payable
- Labor Distribution

For disk-oriented System/3 Model 10 computers, the Application Customizer Service currently includes the following, with or without Customized Source Code:

- Order Writing and Invoicing
- Inventory Accounting and Management
- Accounts Receivable
- Sales Analysis

APPLICATION PROGRAMMING SERVICE: This IBM service, introduced in September 1971, enables System/3 Model 6 and Model 10 users to have their basic business application programs designed, generated, tested, and documented by IBM Systems Engineers at fixed prices. The service currently covers four applications: Order Writing and Invoicing, Accounts Receivable, Inventory Accounting and Management, and Sales Analysis.

The Application Programming Service consists of four main steps. First, the user and an IBM representative fill out questionnaires defining the application and the formats of the required reports. Second, IBM processes the information at its Application Customizing Center to generate the required programs. Third, IBM tests the programs to make sure they produce the agreed-upon results, using test data and machine time provided by the user. Fourth, IBM turns over the tested application programs and associated documentation to the user.

APPLICATION PROGRAMS: In addition to the two services described above, IBM offers a limited number of packaged programs for specific applications. The current Application Program Products, which receive centralized IBM support, are listed in the price list at the end of this report. Also available are a variety of Field Developed Programs (FDP's) and Installed User Program (IUP's). Support for the FDP's and IUP's is limited to pertinent error-correction information during the first six months after initial availability of each program.

Other sources of programs, technical information, and education are the System/3 user groups. Two IBM-affiliated user groups, COMMON and Guidance International, are open to System/3 users. Moreover, at least two independent organizations, Group 3 and the National Association of IBM System/3 Users, have been formed specifically to aid System/3 users.

PRICING

POLICY: IBM offers the System/3 on a purchase or rental basis. The standard IBM rental contract includes equipment maintenance and entitles the customer to up to 176 hours of billable time per month. Time used in excess of that amount is billed, for most System/3 components, at an extra-use rate of 10% of the basic hourly rate, (i.e., 10% of 1/176 of the monthly rental for each hour of extra use).

IBM's new Agreement for Lease or Rental of IBM Machines, announced on April 4, 1977, abolished the Term Availability Plan, Term Lease Plan, Extended Term Plan, and other specially developed longer-term leasing contracts. The new agreement provides users with a single contract on which they can specify mixtures of rental and leased equipment, each with various terms. CPU's rented under the new plan can be terminated or downgraded on 90 days' notice, and all other rented equipment can be terminated or downgraded on 30 days' notice. Base terms and extension terms are specified for each piece of equipment obtained through a leasing agreement. As was the case with the various extended lease plans (FTP, ETP, TAP, etc.), the more extension periods in the contract term, the lower the lease price.

Generally, the base term and extension terms for the System/3 models coincide with those of the abolished Term Availability Plan: a three-year basic term followed by one-year extension terms. Accruals toward purchase of up to 50 percent of the purchase price are permitted during the first base term (36 months) of a lease contract. The new agreement also continues IBM's policy of upper-limit price protection for both lease and purchase contracts. Specified maximum second-year and third-year lease and purchase prices correspond to annual increases of about 5 percent.

SOFTWARE: System/3 users receive the basic System Control Programs at no additional cost. All other IBM software, including compilers and utility routines, is priced separately. Prices of the current IBM Program Products are listed at the end of this report.

SUPPORT: IBM Systems Engineering assistance is available to System/3 users at a basic charge of \$33.00 per hour.

EDUCATION: Two-day introductory courses are offered at no charge. Various other System/3 courses are available at separate charges.

MAINTENANCE: The IBM System/3 is leased to the user under rental plan A, which entitles the user to maintenance for 24 hours per day, 7 days per week.

For purchased systems, the IBM System/3 is under maintenance group D. The minimum period of maintenance service is 9 consecutive hours between 7:00 a.m. and 6:00 p.m. Monday through Friday. Charges for maintenance coverage outside this period are based upon the following percentages of the minimum monthly maintenance charge (MMC) added to the MMC:

	Consecutive hours			
	9*	12	16	20 24
Monday-Friday (until 8:00 a.m. Saturday)	10	12	14	16 18
Saturday (until 8:00 a.m. Sunday)	4	5	7	8 9
Sunday (until 8:00 a.m. Monday)	5	7	9	11 12

*Outside of the hours 7:00 to 6:00 p.m.

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► System/3 Model 4

MINIMUM SYSTEM: Consists of 64K 5404 Processing Unit, one 5447 Disk Storage Drive and Control, one 5213 Model 3 Printer, one 3277 Model 1 Display Station, and one 78-key operator console keyboard. Purchase price, \$32,824.

System/3 Model 8

MINIMUM SYSTEM: Consists of 16K 5408 Processing Unit, 5444 Model A1 Disk Storage Drive, 5203-1 Printer, and 5471 Printer-Keyboard. Purchase price, \$43,130.

MINIMUM DATA STATION SYSTEM: Consists of 16K 5408 Processing Unit, 5444 Model A1 Disk Storage Drive, 5203-2 Printer, and a directly attached 3741 Data Station. Purchase price, \$53,395.

System/3 Model 10

TYPICAL DISK SYSTEM: Consists of 12K 5410 Processing Unit, 5424 Model A2 MFCU, 5203 Model 2 Printer (with 120 print positions), 5471 Printer-Keyboard, and one 5444 Model 2 Disk Storage Drive (4.90 million bytes). Purchase price, \$63,655.

System/3 Model 12

MINIMUM SYSTEM: Consists of 32K 5412 Processing Unit, 5424 Model A2 MFCU, 5203 Model 1 Printer, and 3340 Model C2 DASF. Purchase price, \$90,976.

System/3 Model 15

MINIMUM SYSTEM: The basic configuration required to utilize the Model 15 processing support consists of a 5415 Model A17 Processing Unit (48K bytes), 3277 Model 1 Display Station, 1403 Model 5 Printer, 5424 Model A1 MFCU, and one 5444 Model A2 Disk Storage Drive, plus all necessary attachments and control units. Purchase price, \$102,811.

EXPANDED SYSTEM: A typical large Model 15 disk system consists of a 5415 Model A20 Processing Unit (128K bytes), 3277 Model 1 Display Station, 1403 Model N1 Printer, 2560 Model A1 MFCM, 2501 Model A2 Card Reader, one 5444 Model A2 Disk Storage Drive, and four 5445 Disk Storage Drives, plus all necessary attachments and control units. Purchase price, \$220,065.■

EQUIPMENT PRICES

		Monthly Charges					
		Purchase Price	Monthly Maint.	Rental*	3-Year Lease*	2-Year Lease*	1-Year Lease*
PROCESSORS AND MAIN STORAGE							
5404	Processing Unit (for Model 4 systems): Model A18; 65,536 bytes	\$ 13,790	\$176.00	\$775	\$705	—	—
5406	Processing Unit (for Model 6 systems): Model B2; 8,192 bytes Model B3; 12,288 bytes Model B4; 16,384 bytes	20,190 23,140 23,490	130.00 136.00 136.00	873 1,046 1,210	793 951 1,100	— — —	— — —
1550	Command Keys (9-16)	689	0.50	25	22	—	—
5408	Processing Unit (for Model 8 systems): Model A14; 16,384 bytes Model A16; 32,768 bytes Model A17; 49,152 bytes Model A18; 65,536 bytes	19,540 20,325 21,110 21,895	100.00 105.00 110.00 115.00	832 903 974 1,045	757 822 887 952	— — — —	— — — —
5410	Processing Unit (for Model 10 non-disk systems): Model A2; 8,192 bytes Model A3; 12,288 bytes Model A4; 16,384 bytes Model A5; 24,576 bytes Model A6; 32,768 bytes Model A7; 49,152 bytes	11,310 14,260 14,610 23,360 23,710 32,810	43.00 47.50 47.50 63.50 63.50 88.00	482 638 820 1,182 1,529 1,991	439 581 746 1,075 1,390 1,810	— — — — — —	— — — — — —
5410	Processing Unit (for Model 10 disk systems): Model A12; 8,192 bytes Model A13; 12,288 bytes Model A14; 16,384 bytes Model A15; 24,576 bytes Model A16; 32,768 bytes Model A17; 49,152 bytes	15,850 18,800 19,150 27,900 28,250 37,350	94.50 99.00 99.00 115.00 115.00 140.00	682 834 1,015 1,369 1,716 2,172	620 759 923 1,245 1,560 1,975	— — — — — —	— — — — — —
5412	Processing Unit (for Model 12 systems): Model B16; 32,768 bytes Model B17; 49,152 bytes Model B18; 65,536 bytes Model C19; 81,920 bytes Model C20; 98,304 bytes	31,180 31,965 32,750 39,185 39,970	223.00 228.00 233.00 243.00 248.00	1,633 1,704 1,775 2,017 2,088	1,485 1,550 1,615 1,835 1,900	— — — — —	— — — — —
5415	Processing Unit (for Model 15 systems without 3340): Model A17; 49,152 bytes Model A18; 65,536 bytes Model A19; 98,304 bytes Model A20; 131,072 bytes	47,620 48,405 51,675 53,245	204.00 209.00 214.00 223.00	2,079 2,150 2,364 2,506	1,890 1,955 2,150 2,280	— — — —	— — — —
5415	Processing Unit (for Model 15 systems with 3340): Model B17; 49,152 bytes Model B18; 65,536 bytes	69,530 70,315	212.00 216.00	2,954 3,025	2,685 2,750	— —	— —

*Prices include equipment maintenance.

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EQUIPMENT PRICES

Monthly Charges

		<u>Purchase Price</u>	<u>Monthly Maint.</u>	<u>Rental*</u>	<u>3-Year Lease*</u>	<u>2-Year Lease*</u>	<u>1-Year Lease*</u>
PROCESSORS AND MAIN STORAGE (Continued)							
	Model B19; 98,304 bytes	73,585	221.00	3,239	2,945	—	—
	Model B20; 131,072 bytes	75,155	230.00	3,381	3,075	—	—
	Model C21; 163,840 bytes	81,510	234.00	3,756	3,415	—	—
	Model C22; 196,608 bytes	83,080	239.00	3,898	3,545	—	—
	Model C23; 229,376 bytes	84,650	243.00	4,040	3,675	—	—
	Model C24; 262,144 bytes	86,220	252.00	4,182	3,805	—	—
	Model D19; 98,304 bytes	80,550	239.00	3,547	3,225	—	—
	Model D20; 131,072 bytes	82,120	248.00	3,689	3,355	—	—
	Model D21; 163,840 bytes	85,390	252.00	3,903	3,550	—	—
	Model D22; 196,608 bytes	89,960	257.00	4,045	3,680	—	—
	Model D23; 229,376 bytes	88,530	261.00	4,187	3,810	—	—
	Model D24; 262,144 bytes	90,100	270.00	4,329	3,940	—	—
	Model D25; 393,216 bytes	99,580	349.00	4,923	4,480	—	—
	Model D26; 524,288 bytes	105,860	389.00	5,491	5,000	—	—
PROCESSOR OPTIONS AND ATTACHMENTS							
For Model 4:							
3960	5203 Printer Base Attachment; for 115-cps printing	2,700	22.00	174	159	—	—
7081	Serial I/O Channel	4,380	5.00	216	197	—	—
For Model 6:							
1550	Command Keys 9 through 16	689	0.50	26	24	—	—
3210	5496 Data Recorder Attachment	1,375	2.00	55	51	—	—
3901	Printer Attachment for 5213 Model 1	2,410	19.50	97	89	—	—
3902	For Model 2	2,410	19.50	97	89	—	—
3903	For Model 3	2,410	19.50	97	89	—	—
3960	5203 Printer Base Attachment; for 115-cps printing	2,700	22.00	174	159	—	—
5732	Processing Unit Expansion A; required for any combination of 7081 Serial I/O Channel, 2074 BSCA, 4765 LCA, or 3741 Attachment (8220)	972	6.50	44	40	—	—
6378	Second Disk Attachment for 5444 Model 3 or second Model 2	1,420	5.00	61	56	—	—
7081	Serial I/O Channel	4,380	5.00	216	197	—	—
7951	Printer Attachment for 2222 Model 1	2,410	19.50	97	89	—	—
7952	For Model 2	2,410	19.50	97	89	—	—
7960	Display Station Attachment	2,580	1.50	108	99	—	—
8220	3741 Display Station/Programmable Work Station Attachment	4,525	16.00	260	237	—	—
For Model 8:							
3480	Dual Feed Carriage Control; for 5203 Printer	727	1.00	34	32	—	—
3500	Dual Programming Feature	3,220	1.00	160	146	—	—
3960	5203 Printer Base Attachment	1,290	7.50	54	50	—	—
3970	5203 Printer Speed Attachment; for Model 1 or 2	554	3.00	20	19	—	—
3972	For Model 3	1,400	6.50	74	68	—	—
4040	5448 Disk File Attachment	2,590	24.00	145	132	—	—
4110	5741 Printer Keyboard Attachment	1,670	5.00	71	65	—	—
4701	Magnetic Tape Base Attachment	1,105	2.50	63	58	—	—
5732	Processing Unit Expansion A; required for 7081 Serial I/O Channel or 2074 BSCA	972	6.50	44	40	—	—
5733	Processing Unit Expansion B; requires 5732	451	0.50	25	23	—	—
6378	Second Disk Attachment; for 5444 Model 3 or second Model 2	1,970	6.00	86	79	—	—
7081	Serial I/O Channel	4,380	5.00	216	197	—	—
7960	3411 Magnetic Tape Attachment	2,740	7.50	166	151	—	—
8220	3741 Display Station/Programmable Work Station Attachment	4,525	15.50	260	237	—	—
For Model 10:							
3480	Dual Feed Carriage Control; for 5203 Printer	727	1.00	34	32	—	—
3500	Dual Programming Feature	3,220	1.00	160	146	—	—
3901	First 5445 Attachment	14,060	32.00	691	629	—	—
3902	Second 5445 Attachment; requires 3901	422	1.00	18	15	—	—
3970	5203 Printer Attachment for Model 1	1,845	10.50	74	69	—	—
3971	For Model 2	1,845	10.50	78	71	—	—
3972	For Model 3	2,690	14.00	128	118	—	—
4040	5448 Disk File Attachment	2,590	24.00	145	132	—	—
4100	5424 MFCU Attachment for Model A1	3,125	13.50	113	103	—	—
4101	For Model A2; requires 4100	3,758	15.50	131	120	—	—
4110	5741 Printer Keyboard Attachment	1,670	5.00	71	65	—	—
4120	Data Entry Keyboard Attachment	1,875	1.00	63	58	—	—
4130	1442 Card Reader/Punch Attachment; for Models 6 and 7	4,890	14.50	260	237	—	—
4140	1403 Printer Attachment for Model 2	2,900	20.50	159	146	—	—
4150	For Model 1	3,175	20.50	234	214	—	—
4501	Higher Performance First Disk Attachment	554	1.00	26	24	—	—
4502	Second Disk Attachment	554	1.00	26	23	—	—
5501	Power Supply Expansion; provides additional 6-volt power	1,580	1.00	66	60	—	—
5732	Processing Unit Expansion A; required for any combination of RPQ 1442, 5445, 3411, or 3741 attachments	1,285	3.00	48	44	—	—
5733	Processing Unit Expansion B	451	.50	25	23	—	—
5734	Processing Unit Expansion C	1,550	1.00	73	67	—	—
5735	Processing Unit Expansion D	451	1.00	25	23	—	—
6378	Second Disk Attachment; for 5444 Model 3 or second Model 2	1,420	5.00	61	56	—	—
7081	Serial I/O Channel	4,380	5.50	216	197	—	—
7951	3411 Magnetic Tape Attachment	3,370	9.50	218	199	—	—
8220	3741 Display Station/Programmable Work Station Attachment	4,525	15.50	260	237	—	—
8642	Universal Character Set Control; for 6639 on 5203 Printer	269	1.00	17	16	—	—

*Prices include equipment maintenance.

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EQUIPMENT PRICES

Monthly Charges

		Purchase Price	Monthly Maint.	Rental*	3-Year Lease*	2-Year Lease*	1-Year Lease*
PROCESSOR OPTIONS AND ATTACHMENTS (Continued)							
For Model 12:							
3480	Dual Feed Carriage Control	727	1.00	34	32	—	—
3500	Dual Programming Feature	3,220	1.00	160	146	—	—
3960	5203 Printer Base Attachment	1,290	7.50	54	50	—	—
3970	5203 Printer Attachment for Model 1 and 2; requires 3960	554	3.00	20	19	—	—
3972	For Model 3; requires 3960	1,400	6.50	74	68	—	—
4100	5424 MFCU Attachment for Model A1	3,125	13.50	113	103	—	—
4101	For Model A2; requires 4100	633	2.00	18	17	—	—
4110	5741 Printer Keyboard Attachment	1,670	5.00	71	65	—	—
4130	1442 Card Reader/Punch Attachment; for Models 6 and 7	4,890	14.50	260	237	—	—
4135	1403 Printer Attachment for Model 5	159	1.50	7	7	—	—
4140	For Model 2	414	1.50	19	18	—	—
4150	For Model N1	693	1.50	94	86	—	—
4160	1403 Printer Base Attachment	2,485	19.00	140	128	—	—
4701	Magnetic Tape Base Attachment	1,105	2.50	63	58	—	—
5501	Power Supply Expansion; provides 6-volt power	1,580	1.00	66	60	—	—
5502	Provides 24-volt power	635	1.00	22	20	—	—
5732	Processing Unit Expansion A; required for any combination of 3411, 8220, card reader, or 7801	1,285	3.00	48	44	—	—
5733	Processing Unit Expansion B	451	.50	25	23	—	—
5734	Processing Unit Expansion C	1,550	1.00	73	67	—	—
5735	Processing Unit Expansion D	451	1.00	25	23	—	—
7081	Serial I/O Channel	4,380	5.50	216	197	—	—
7960	3411 Magnetic Tape Attachment	2,740	7.50	166	151	—	—
8220	3741 Display Station/Programmable Work Station Attachment	4,525	15.50	260	237	—	—
8642	Universal Character Set Control; for 6639 on 5203 Printer	269	1.00	17	16	—	—
For Model 15:							
1580	Card Print Control for 2560	1,165	3.00	33	31	—	—
1601	Channel Terminator	2,185	1.00	59	54	—	—
3901	First 5445 Attachment	14,060	32.00	691	629	—	—
3903	Second 5445 Attachment	2,700	1.00	102	94	—	—
4100	5424 MFCU Attachment for Model A1	3,125	13.50	113	103	—	—
4101	For Model A2; requires 4100	633	2.00	18	17	—	—
4130	1442 Card Reader/Punch Attachment; for Models 6 and 7	4,890	14.50	260	237	—	—
4135	1403 Printer Attachment for Model 5	159	1.50	7	7	—	—
4140	For Model 2	414	1.50	19	18	—	—
4150	For Model N1	693	1.50	94	86	—	—
4160	1403 Printer Base Attachment	2,485	19.00	140	128	—	—
5501	Power Supply Expansion; provides 6-volt power	1,580	1.00	66	60	—	—
5502	Provides 24-volt power	635	1.00	22	20	—	—
5733	Processing Unit Expansion 1	451	.50	25	23	—	—
5734	Processing Unit Expansion 2	1,550	1.00	73	67	—	—
5735	Processing Unit Expansion 3	451	1.00	25	23	—	—
5813/14	DDS Adapter	756	4.50	27	25	—	—
6378	Second Disk Attachment; for 5444 Model 3 or second Model 2	1,970	6.00	86	79	—	—
7081	Serial I/O Channel	4,380	6.00	216	197	—	—
7901	3284/3287 Printer Attachment	1,050	3.00	33	31	—	—
7951	3411 Magnetic Tape Attachment	3,370	9.50	218	199	—	—
8090	2501 Card Reader Attachment	6,270	7.00	206	188	—	—
8100	2560 MFCM Attachment	5,890	15.50	206	188	—	—
8220	3741 Display Station/Programmable Work Station Attachment	4,525	15.50	260	237	—	—
CONSOLE							
3277	Display Station, Model 1 (required in Model 15 systems)	1,730	9.00	79	—	\$ 67	—
4632	78-key Operator Console Keyboard (required on 3277)	707	15.00	34	—	29	—
3277	CRT display (for 5404):						
	Model 1; 480-character display	1,730	9.00	79	—	67	—
	Model 2; 1920-character display	2,240	21.00	115	—	98	—
4630/ 31/34	Keyboard for either model; 66 keys; EBCDIC typewriter/EBCDIC Data Entry/ASCII typewriter	520	5.00	13	—	11	—
4633/35	Keyboard for either model; 78 keys; EBCDIC typewriter/ASCII typewriter	609	8.50	31	—	26	—
MASS STORAGE							
3340	Direct Access Storage Facility:						
	Model A-2 (2-drives plus control)	37,800	96.50	1,234	—	1,050	—
	Model B-1 (additional drive)	20,790	51.00	690	—	587	—
	Model B-2 (2 additional drives)	26,460	82.50	870	—	740	—
	Model C-2 (2 drives plus control)	28,950	86.50	954	—	812	—
3348	Data Module (for 3340 drives):						
	Model 70; 41.04 million bytes plus 9.83 million bytes exclusively for program support	2,200	Time &	82	—	70	—
3344	Direct Access Storage Facility (for use with 3340 DASF on Model 15D only)	41,600	179.00	1,451	—	941	—

*Prices include equipment maintenance.

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EQUIPMENT PRICES

		Monthly Charges					
		Purchase Price	Monthly Maint.	Rental*	3-Year Lease*	2-Year Lease*	1-Year Lease*
MASS STORAGE (Continued)							
5444	Disk Storage Drive:						
	Model A1; 2.46 million bytes	5,935	71.50	255	—	—	—
	Model A2; 4.92 million bytes	7,030	71.50	384	—	—	—
	Model A3; 2.46 million bytes	5,935	71.50	255	—	—	—
	Model 1; 2.46 million bytes	5,700	51.50	209	—	—	—
	Model 2; 4.92 million bytes	6,765	51.50	345	—	—	—
	Model 3; 2.46 million bytes	5,700	51.50	209	—	—	—
5540	Disk Cartridge (for 5444 drives)	175	Time & Mat'l.	Purch. only	—	—	—
5422	Disk Enclosure (required for attachment of 5444 Disk Storage Drives when 5424 MFCU is not used)	3,605	11.50	145	—	—	—
5445	Disk Storage Drive:						
	Model 1; first 5445 on 5415; 20.48 million bytes	10,410	147.00	450	—	—	—
	Model 2; second 5445 on 5410; 20.48 million bytes	9,965	139.00	429	—	—	—
	Model 3; dual-pack 5445; 40.76 million bytes	20,430	288.00	879	—	—	—
5447 A1	5-megabyte disk drive (for 5404)	8,730	93.00	501	—	426	—
5447 A2	10-megabyte disk drive (for 5404)	12,065	144.00	692	—	589	—
5448	9.8-megabyte disk drive (for 5408 and 5410)	7,060	100.00	347	—	295	—
MAGNETIC TAPE EQUIPMENT							
3410	Magnetic Tape Unit:						
	Model 1; 20 KB	5,935	67.50	230	—	193	212
	Model 2; 40/20 KB	7,935	74.50	306	—	257	282
	Model 3; 80/40 KB	9,825	82.00	383	—	322	352
3411	Magnetic Tape Unit and Control:						
	Model 1; 20 KB	13,080	104.00	509	—	428	468
	Model 2; 40/20 KB	16,550	112.00	648	—	544	596
	Model 3; 80/40 KB	20,180	119.00	787	—	661	724
3211	Single Density Feature (for 3410 and 3411, Models 2 and 3 only)	1,925	9.50	65	—	55	60
3221	Dual Density Feature (for 3410 and 3411, Models 2 and 3 only)	2,775	39.50	98	—	82	90
7003	System/3 Attachment (required on 3411)	2,430	3.50	91	—	76	84
3741	Data Station:						
	Model 1	4,680	46.00	223	—	190	—
	Model 2	5,655	59.00	273	—	233	—
3741	Programmable Work Station:						
	Model 3	6,705	69.50	356	—	303	—
	Model 4	7,680	77.00	408	—	347	—
PUNCHED CARD EQUIPMENT							
5424	Multi-Function Card Unit:						
	Model A1; reads 250 cpm, punches and prints 60 cpm	7,810	235.00	421	—	—	—
	Model A2; reads 500 cpm, punches and prints 120 cpm	10,340	350.00	634	—	—	—
1442	Card Read Punch:						
	Model 6; reads 300 cpm, punches 80 cols/sec.	11,660	137.00	384	—	—	—
	Model 7; reads 400 cpm, punches 160 cols/sec.	12,560	161.00	558	—	—	—
3950	5410/5415 Coupling (required on 1442)	1,215	1.50	39	—	—	—
2501	Card Reader (for Model 15 only):						
	Model A1; 600 cpm	12,940	71.50	280	—	—	—
	Model A2; 1,000 cpm	13,170	102.00	370	—	—	—
3630	1501 Coupling (required on 2501)	176	NC	5	—	—	—
2560	Multi-Function Card Machine (for Model 15 only):						
	Model A1; reads 500 cpm, punches 160 cols/sec.	22,290	240.00	896	—	—	—
	Model A2; reads 310 cpm, punches 120 cols/sec.	16,360	240.00	697	—	—	—
Card Print Feature for 2560 Model A1:							
1575	First Two Lines (requires 1580 on 5415)	4,855	32.00	192	—	—	—
1576	Second Two Lines	4,855	32.00	192	—	—	—
1577	Third Two Lines	4,855	32.00	192	—	—	—
5486	Card Sorter:						
	Model 1; 1,000 cpm	3,115	53.00	129	—	—	—
	Model 2; 1,500 cpm	3,560	80.00	176	—	—	—
5496	Data Recorder (96-column)	4,005	78.00	227	—	—	—
7501	System/3 Attachment (required on 5496)	1,160	15.00	60	—	—	—
129	Card Data Recorder (80-column):						
	Model 1; Punch-Verifier (non-print)	3,650	66.50	180	—	—	—
	Model 2; Printing Punch (non-verifier)	4,090	72.50	200	—	—	—
	Model 3; Printing Punch Verifier	4,380	74.00	216	—	—	—
7503	Card I/O Attachment (required on 129)	1,560	18.00	107	—	—	—
3610	Expansion Feature (required on 129)	292	NC	10	—	—	—
2265	Display Station	4,935	36.50	205	—	—	—
5471	Printer-Keyboard	3,300	72.50	155	—	—	—
5475	Data Entry Keyboard	1,855	10.00	57	—	—	—

*Rental prices include equipment maintenance.

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EQUIPMENT PRICES

		Monthly Charges					
		Purchase Price	Monthly Maint.	Rental*	3-Year Lease*	2-Year Lease*	1-Year Lease*
PRINTERS							
3284	Matrix printer; 40 cps (for 5404):						
	Model 1; 480-character buffer	2,980	56.50	157	—	134	—
	Model 2; 1920-character buffer	3,345	56.50	167	—	142	—
3286	Matrix printer; 66 cps (for 5404):						
	Model 1; 480-character buffer	3,985	62.00	189	—	161	—
	Model 2; 1920-character buffer	4,415	62.00	200	—	170	—
3287	Matrix printer:						
	Model 1; 80 cps	5,960	49.00	187	—	159	—
	Model 2; 120 cps	6,355	60.50	227	—	193	—
8330	3271/3272 Attachment	955	3.50	33	—	28	—
8700	Variable-Width Forms Tractor	168	0.50	6	—	5	—
3288	Line Printer; 120 lpm (for 5404)	7,440	100.00	431	—	367	—
5213	Printer:						
	Model 1; pin-feed platen (for Model 6 only)	4,115	69.00	200	—	—	—
	Model 2; vertical forms control (for Model 6 only)	5,310	94.50	251	—	—	—
	Model 3; vertical forms control, bidirectional printing (for Model 4 or Model 6 only)	5,440	108.00	314	—	—	—
2222	Printer (with ledger card device; for Model 6 only):						
	Model 1; unidirectional printing	10,930	165.00	439	—	—	—
	Model 2; bidirectional printing	11,070	180.00	484	—	—	—
5203	Printer (for Model 8, Model 10, and Model 12 only):						
	Model 1; 100 lpm, 96 positions	7,005	96.50	304	—	—	—
	Model 2; 200 lpm, 96 positions	7,805	108.00	371	—	—	—
	Model 3; 300 lpm, 96 positions	10,880	181.00	547	—	—	—
3475	Dual-Feed Carriage (for 5203)	2,865	27.50	98	—	—	—
4730	Additional Chain Cartridge (for 5203 Model 1 and 2)	2,865	1.50	98	—	—	—
4740	Additional Chain Cartridge (for 5203 Model 3)	2,145	46.50	138	—	—	—
5558	24 Additional Print Positions (for 5203)	1,180	2.50	65	—	—	—
5559	12 Additional Print Positions (for 5203)	587	—	—	—	—	—
5560	36 Additional Print Positions (for 5203)	1,750	2.50	98	—	—	—
8639	Universal Character Set Attachment (for 5203)	236	—	—	—	—	—
1403	Printer (requires 5421):						
	Model 2; 600 lpm, 132 positions	23,100	389.00	1,035	—	869	952
	Model 5; 465 lpm, 132 positions	22,120	280.00	802	—	674	738
	Model N1; 1100 lpm, 132 positions	40,040	450.00	1,210	—	1,016	1,113
1416	Interchangeable Train Cartridge (for 1403 Model N1)	2,795	Time & Mat'l.	106	—	—	—
1376	Auxiliary Ribbon Feeding (for 1403 Model 2 or 5)	2,100	33.50	98	—	82	90
4740	Interchangeable Chain Cartridge Adapter (for 1403 Model 2 or 5)	2,030	—	92	—	77	85
8640	Universal Character Set Feature (for 1403 Model N1)	447	2.50	11	—	9	10
8641	Universal Character Set Feature (for 1403 Model 2)	313	2.50	11	—	9	10
5421	Printer Control Unit (required for 1403 Model 2, 5, or N1)	—	—	384	—	—	—
MICR/OCR EQUIPMENT							
1255	Magnetic Character Reader (requires #7081):						
	Model 1; 500 dpm, 6 stackers	37,230	302.00	1,015	—	—	—
	Model 2; 750 dpm, 6 stackers	42,610	483.00	1,235	—	—	—
	Model 3; 750 dpm, 12 stackers	58,020	636.00	1,625	—	—	—
3215	Dash Symbol Transmission (for 1255)	35	—	56	—	—	—
4380	51-column Card Sorting (for 1255)	661	—	16	—	—	—
4520	High-Order Zero and Blank Selection (for 1255 Model 3 only)	1,380	5.50	36	—	—	—
6303	System/3 Adapter (required on 1255)	5,600	4.50	150	—	—	—
7060	Self-Checking Numbers (for 1255)	2,240	2.50	59	—	—	—
3881	Optical Mark Reader (requires #7081):						
	Model 1; for on-line use	53,950	165.00	1,680	—	1,430	—
	Model 2; for off-line use	49,140	131.00	1,533	—	1,305	—
	Model 3; for off-line use	62,930	157.00	1,857	—	1,580	—
1471	BCD Read (for 3881)	2,255	1.50	67	—	57	—
3450	Document Counters (for 3881)	895	2.00	22	—	19	—
3550	Dual Density (for 3881 Model 2 only)	5,680	0.50	174	—	148	—
3801	Expanded Storage (for 3881)	2,255	0.50	67	—	57	—
6451	Serial Numbering (for 3881)	6,640	29.50	204	—	174	—
COMMUNICATIONS EQUIPMENT							
2074	Binary Synchronous Communications Adapter; for Models 4, 8, 10, 12, 15	6,895	63.00	385	350	—	—
1315	Auto Call Feature; for all models	1,170	1.00	55	51	—	—
3601	EIA Local Attachment; for Models 8, 10, 12, 15	563	1.00	33	31	—	—
4703	Internal Clock Feature; for all models	734	1.00	34	32	—	—
4781	1200 bps Integrated Modem (requires #4703 and #5201); for Models 8, 10, 12, 15	387	3.50	17	16	—	—
5201	Modem Base (for mounting #4781); for Models 8, 10, 12, 15	937	2.50	38	35	—	—
7477	Station Selection Feature; for all models	580	1.00	26	24	—	—
7850	Text Transparency Feature; for all models	580	1.00	26	24	—	—

*Rental prices include equipment maintenance.

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EQUIPMENT PRICES

Monthly Charges

		<u>Purchase Price</u>	<u>Monthly Maint.</u>	<u>Rental*</u>	<u>3-Year Lease*</u>	<u>2-Year Lease*</u>	<u>1-Year Lease*</u>
COMMUNICATIONS EQUIPMENT (Continued)							
2084	Binary Synchronous Communications Adapter, Second (#2074 is a prerequisite); for Models 10, 12, 15	6,895	63.00	361	350	—	—
2094	Second Binary Synchronous Communications Adapter (for Model 15D only)	9,205	30.00	441	401	—	—
1325	Auto Call Feature; for Models 10, 12, 15	1,170	1.00	55	51	—	—
3602	EIA Local Attachment; for Models 10, 12, 15	563	1.00	33	31	—	—
4723	Internal Clock; for Models 10, 12, 15	734	1.00	34	32	—	—
4782	1200 bps Integrated Modem (requires #4723 and #5202); for Models 8, 10, 12, 15	516	5.00	25	23	—	—
5202	Modem Base (for mounting #4782); for Models 10, 12, 15	937	2.50	38	35	—	—
7487	Station Selection Feature; for Models 10, 12, 15	580	1.00	26	24	—	—
7851	Text Transparency Feature; for Models 10, 12, 15	580	1.00	26	24	—	—
4645	Integrated Communications Adapter; for Models 8 and 12	4,415	17.00	165	151	—	—
4801	8000 bps Local Interface (for local attachment of an IBM binary synchronous 3275 Display; modems not required); for Models 8 and 12	760	1.00	28	26	—	—
4802	2400 bps Local Interface (for local attachment of an IBM binary synchronous terminal; modems not required); for Models 8 and 12	760	1.00	28	26	—	—
6202	Synchronous Line, Medium Speed (up to 7200 bps); for Models 8 and 12	2,300	2.50	87	79	—	—
4702	Local Display Adapter; for 5408, 5412, or 5415; for local attachment of up to three 3277-1 and/or 3284/3286-1/3287 printers	4,495	23.50	186	170	—	—
4704	Display Increment (for three additional displays and/or printers); for Models 4, 8, 12	1,050	1.00	42	38	—	—
4705	Model 2 Attachment (for Model 2 displays or printers); for Models 4, 8, 12	599	3.50	24	22	—	—
4765	Local Communications Adapter; for local attachment of a 3741 Model 2, a 3271 Control Unit, or a 3275 Display; for Model 6	4,570	28.50	194	176	—	—
	For Models 10 and 15	4,570	27.00	206	188	—	—
4601	Display Adapter; for Model 15	9,340	27.00	333	303	—	—
4602	Device Interface; for Model 15	1,310	1.00	44	40	—	—
4891	First Line Base	999	5.00	45	41	—	—
4892	Second Line Base	999	5.00	45	41	—	—

*Prices include equipment maintenance.

SOFTWARE PRICES

	<u>Monthly License Fees</u>					
	<u>Model 4</u>	<u>Model 6</u>	<u>Model 8</u>	<u>Model 10</u>	<u>Model 12</u>	<u>Model 15</u>
PROGRAM PRODUCTS—SYSTEMS						
BASIC	—	\$127	—	—	—	—
Basic Assembler	—	—	\$ 90	\$ 90	\$ 89	\$116
COBOL, subset ANS with library	—	—	94	94	89	116
FORTRAN IV, disk-based	—	120	110	110	118	155
Sort, CCP, disk-based	\$15	—	—	—	—	18
Sort, disk-based	10	10	10	10	47	61
5445 & 5448 feature	—	—	69	69	—	Incl.
Sort, tape-based	—	—	76	76/76*	81	106
RPG II, card-based	—	—	—	37*	—	—
Braille feature	—	—	—	—	—	—
BSCA feature	—	—	—	37*	—	—
Tape feature	—	—	—	32*	—	—
RPG II, disk-based	40	40	54	54	89	116
Auto Report feature	17	17	17	17	Incl.	Incl.
BSCA feature	46	46	46	46	Incl.	Incl.
Tape feature	—	—	39	39	Incl.	Incl.
3270 Display Control feature	25	—	25	25	22	22
5445 & 5448 feature	—	—	39	39	—	Incl.
Utilities, Card	—	—	—	10*	—	18
Utilities, Conversational	16	16	—	—	—	—
Utilities, Disk Based Card	—	—	10	10	16	16
Utility, 1255	—	87	75	75	72	—

*Model 10 card-only system.

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SOFTWARE PRICES

PROGRAM PRODUCTS— APPLICATIONS	Monthly License Fees					
	Model 4	Model 6	Model 8	Model 10	Model 12	Model 15
Apparel Business Control**	—	—	—	\$ 82*	—	—
Appropriation Accounting System**	—	—	—	132*	—	—
Bill of Material Processor**	—	—	\$ 61	61	—	—
Business Analysis/BASIC**	\$ 61	\$ 61	—	—	—	—
Card Bill of Material & Requirements Planning**	—	—	—	71*	—	—
Citation Processing**	—	—	—	132*	—	—
Data Collection Support for System/3 DATA/3	—	—	—	—	\$ 38	—
EPIC—Socrates	—	—	149	149	142	\$163
EPIC—Fast	—	—	—	—	211	—
EPIC—Budget Finance	—	—	—	—	104	—
EPIC—Student	—	—	—	—	133	—
Health Welfare & Pension Fund**	232	232	—	—	87	—
Health Welfare & Pension Fund Disk**	—	—	198	198	—	—
Inventory & Requirements Planning	—	—	94	94	—	—
Job Analysis System (JAS/3)	—	—	99	99	—	—
Law Enforcement System**	—	—	—	87*	—	—
Math/BASIC	55	55	—	—	—	—
Optimum Blending**	—	—	—	98*	—	—
Order Point Technique for Inventory Mgmt.**	—	—	—	55*	—	—
Shop Loading & Control	—	—	163	163	—	—
Stat/BASIC	55	55	—	—	—	—
Unit Inventory Techniques**	—	—	—	82*	—	—
Utility Billing System**	—	—	—	87*	—	—

*Model 10 card-only system.
**Installation License applies.