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IBM System/3

MANAGEMENT SUMMARY

As announced on July 30, 1969, the IBM System/3 was oriented primarily toward filling the business data processing needs of small companies that had not previously used computers. For these "entry" users, the System/3 clearly had—and still has—a lot to offer: compactness, ease of operation, surprisingly high internal speed, and an attractively low price-tag.

But when viewed by companies that were already using computers, and by first-time users who had familiarized themselves with competitive equipment, the original System/3 had some serious limitations. It offered little upward compatibility with the larger IBM computers. Its new 96-column card, though compact and easy to handle, was incompatible with all existing punched card equipment. It offered no data communications or magnetic tape capabilities. Its printing and disk access speeds were way below par. Its disk storage capacities were quite limited. And it offered no compiler for the widely used COBOL or FORTRAN language.

During the past five years, a series of IBM product announcements has eliminated most of these limitations and greatly broadened the system's sales appeal. As a result, the System/3 is now available in three distinctively different versions—Models 6, 10, and 15—and merits serious consideration from practically every prospective buyer of a small-scale computer. It is equally well suited for use as a stand-alone business data processing system or as a programmable batch terminal in a data communications network.

With over 20,000 installations to date, IBM's low-cost business data processing system is the world's most widely used computer. It is now offered in three different versions: the transaction-oriented Model 6, the batch-oriented Model 10, and the more powerful Model 15.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

MODELS: System/3 Model 6, Model 10, and Model 15.

DATA FORMTS

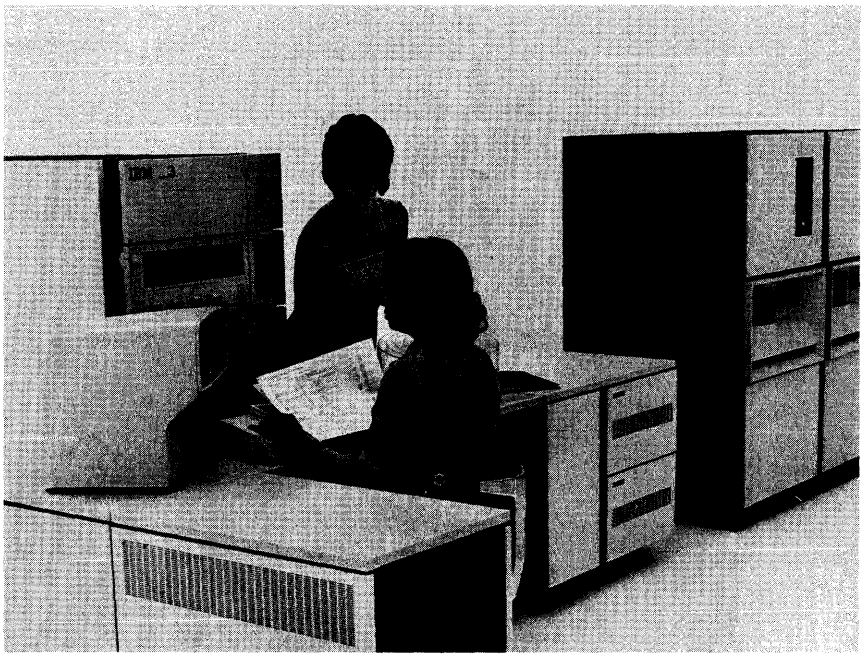
BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 1 BCD digit, or 8 binary bits.

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)



Model 15 is the newest, most powerful, and most expensive of the three versions of IBM's System/3. Thus, it's probably not for first-time computer users, but it provides the growth potential that many Model 10 users have sorely needed. The Model 15 CPU features an operator console with CRT display output. At right are two 5445 Disk Storage Drives, which use interchangeable 2316 Disk Packs and can store 20.48 million bytes each.

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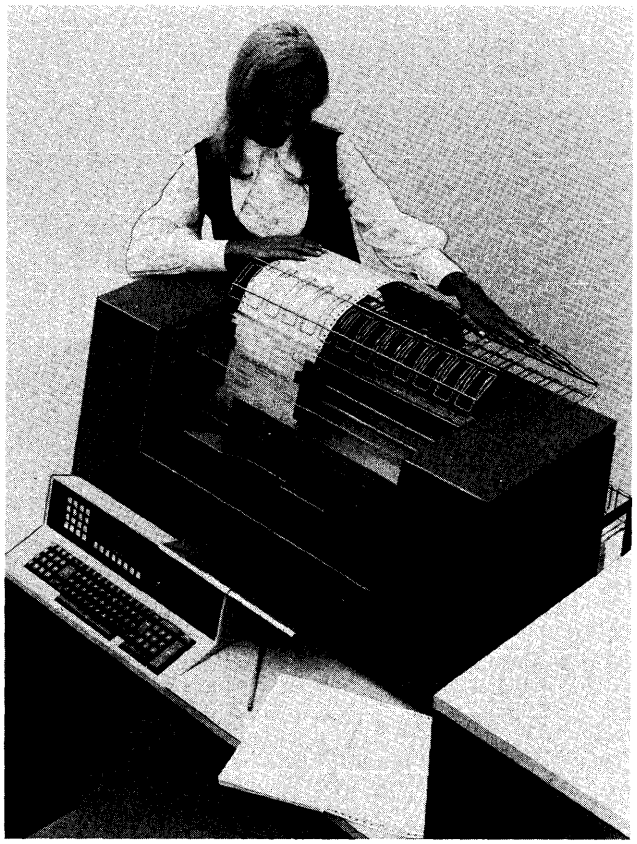

This System/3 Model 6 is equipped with the wide-carriage 2222 Printer which enables it to handle ledger card processing. Cards up to 11 by 14 inches can be inserted into the feed slot (center).

All System/3 models are byte-oriented and use IBM's integrated "Monolithic Systems Technology" (MST). Internal speed of the System/3 is relatively high. Its main storage cycle time in all three models is 1.52 microseconds per one-byte access. Moreover, its addition speed of 24.4 microseconds for two 5-digit operands is faster than that of the System/360 Model 30. Conversely, 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.

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 (now called Model 10) that IBM unveiled in July 1969.

The System/3 Model 6 announcement stressed that this single computer system can 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

MAIN STORAGE

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

CAPACITY: Model 6–8,192, 12,288, or 16,384 bytes; Model 10–8,192, 12,288, 16,384, 24,576, 32,768, or 49,152 bytes; Model 15–49,152, 65,536, 98,304, or 131,072 bytes.

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

CHECKING: Model 6 and Model 10–a parity bit with each byte is generated during writing and checked during reading; Model 15–an error detection and correcion 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 15, but is not available for Model 6 or Model 10.

CENTRAL PROCESSORS

ADDRESSING: All models have two 16-bit base registers. The contents of either register can be added to 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.

In addition, Model 15 has a 32-register Address Translation Table (ATT) that enables it to address up to 131K 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 17-bit addresses required to address 131K bytes.

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 TIMES: The following times, in micro-seconds, apply to all three models and assume the use of direct (2-byte) operand addresses.

Decimal add (5 digits):	24.4
Decimal subtract (5 digits):	24.4
Binary (logical) add (5 bytes):	24.4
Binary (logical) subtract (5 bytes):	24.4
Move (5 bytes):	24.4
Compare (5 bytes):	24.4
Edit (5 digits):	24.4
Load or store register (2 bytes):	9.1
Add to register (2 bytes):	9.1
Jump on condition:	4.56

INTERRUPTS: Model 10 has five levels of program interrupts, in descending priority order: (1) Serial I/O Channel,

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Operator Keyboard Console for both data entry and system control. Ledger card processing is also offered as an option. All programming of standard business applications is 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 engineeers, scientists, and other technicians to utilize the system at the keyboard via the conversational BASIC language. An optional CRT display unit is offered for quick display of the results of calculations. The Model 6 also offers features to permit its use as a simple desk calculator.

The original System/3 Model 10 features batch-mode punched card and/or disk processing and has been enthusiastically accepted by thousands of first-time computer users. Yet many other prospective users shied away from the Model 10 because its tab-oriented processing techniques differ so radically from their present methods of processing data via manual techniques or electronic accounting machines. The System/3 Model 6 was designed as a keyboard-oriented system that these prospective users would be able to understand and use with comparative ease.

The Model 6 offers full operator control of the system via the Operator Keyboard Console. Input data is directly entered at the keyboard, and printing can take place on conventional (non-magnetic) ledger cards. This equipment will seem familiar and comfortable to most small businessmen, as will 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 have 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 is attempting 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.

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

(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 interrupted program.

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

OPTIONAL FEATURES: For 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 10, 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 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.

CONSOLE: The 3277 Model 1 Display Station, equipped with a 78-key Operator Console Keyboard, is a required component of every Model 15 system. The 3277 displays up to 480 characters, in 12 lines of 40 characters each.

INPUT-OUTPUT CONTROL (MODEL 6)

CONFIGURATION RULES: Every System/3 Model 6 requires one 5406 Processing Unit, one 5444 Disk Storage

In the System/3 Model 10, the compact 5444 Disk Storage Drive and its removable single-disk cartridge are conveniently housed in a drawer beneath the 5424 Multi-Function Card Unit.

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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, and a 1255 Magnetic Character Reader. 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 Model 6 offers disk-based processing at lower entry costs than the original Model 10 system. It appears that the Model 6 has been deliberately restricted in size and I/O device flexibility in order to eventually force users with growing needs to upgrade to punched card processing and the larger configurations possible with the Model 10.

The System/3 Model 6 lacks the following features and capabilities of the System/3 Model 10:

- No line printer.
- No high-speed card processing.
- No expansion of core storage beyond 16K bytes.
- No large-capacity disk drives.
- No magnetic tape I/O.
- No optical mark reader.
- No COBOL compiler.
- No assembler.

But the Model 6 offers some significant features of its own:

- Low-cost serial printers with rated speeds of 85 cps.
- Ledger card processing, with optical reading of the ledger card identification number and last-line mark.
- The 2265 Display Station.
- The conversational BASIC language.
- RPG II, FORTRAN, and BASIC capabilities on the same system.
- A low-cost disk entry system, beginning at $1,062 per month, including business-oriented software.

And finally, 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, all data files stored on the relatively extensive disk files (up to 9.8 million

Drive, and one Printer (either Model 5213 or Model 2222). A maximum of two 5444 Disk Storage Drives can be connected. In addition, one 5496 Data Recorder (96-column) or 129 Card Data Recorder (80-column), one 1255 Magnetic Character Reader, one 2265 Display Station, and one Binary Synchronous Communications Adapter can be connected. The 2265 Display Station and the 2222 Printer cannot be used in the same system.

I/O CHANNELS: The 5406 Processing Unit acts as a controller for all System/3 I/O operations. All I/O devices are connected, via the appropriate attachment features, to a single I/O attachment interface called the Input/Output Channel. The channel includes logic to establish the "cycle-stealing" and interrupt priorities and to perform code translations between the punched card and internal EBCDIC codes.

SIMULTANEOUS I/O OPERATIONS: Input/output operations are overlapped with computing through a memory "cycle-stealing" technique.

INPUT/OUTPUT CONTROL (MODEL 10)

CONFIGURATION RULES: 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 5422 Disk Enclosure with at least one 5444 Disk Storage Drive is also required. Any or all of the following additional peripheral devices can be connected: one or two 5444 Disk Storage Drives, one or two 5445 Disk Storage Drives, 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. To utilize IBM software support, disk-oriented systems must include at least 12K bytes of core storage and one 5444 Disk Storage Drive.

I/O CHANNELS: The 5410 Processing Unit acts as a controller for all System/3 I/O operations. All I/O devices are connected, via the appropriate attachment features, to a single I/O attachment interface called the Input/Output Channel. The channel includes logic to establish the "cycle-stealing" and interrupt priorities and to perform code translations between the punched card and internal EBCDIC codes.

SIMULTANEOUS I/O 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.

INPUT/OUTPUT CONTROL (MODEL 15)

CONFIGURATION RULES: Every System/3 Model 15 requires one 5415 Processing Unit, 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 selected as the primary card I/O unit, a 5422 Disk Enclosure is also required.

The basic configuration can be expanded by adding any or all of the following peripheral devices: a second 5444 Disk Storage Drive (Model A2 or A3), one to four 5445 Disk Storage Drives, one 3410/3411 Magnetic Tape Subsystem

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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.)

- Line printing speeds are restricted to about 40 to 70 lines per minute, depending on the number of characters 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 all 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-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.

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 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 Binary Synchronous Communications Adapters, one Multiple Line Terminal Adapter (an RPQ feature), and 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).

I/O CHANNELS: The 5415 Processing Unit acts as a controller for all System/3 I/O operations. All I/O devices are connected, via the appropriate attachment features, to an I/O attachment interface called the Input/Output Channel. The channel includes logic to establish the "cycle-stealing" and interrupt priorities and to perform code translations between the punched card and internal EBCDIC codes.

SIMULTANEOUS I/O 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.

MASS STORAGE

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; minimum head movement time for all three models is 39 milliseconds.

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 10 and 15. These drives provide faster access than the original 5444 drives described above. Average head movement time is 86 milliseconds for Model A1 and 126 milliseconds for Models A2 and A3; minimum head movement time for all three models is 28 milliseconds. 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, and all programs written for the original models will run without

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users in developing their own programs for Order Writing and Invoicing, Accounts Receivable, Inventory Accounting and Management, and Sales Analysis. Third, in response to critism that its Application Customizer Service left the hardest parts of the job (the coding and testing) undone, IBM now offers a complete Application Programming Service for the same four applications at fixed prices.

IBM introduced the System/3 Model 6 on October 28, 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. By mid-1973, an estimated 3,800 Model 6 systems had been installed, indicating that the Model 6 is gaining widespread acceptance yet not selling nearly as rapidly as its Model 10 counterpart.

The Model 6, like all current IBM computer systems, is marketed on an "unbundled" basis, meaning that most of the software, educational courses, and technical support are separately priced. When comparing the Model 6 with competitive equipment, prospective users should carefully consider the amounts of these "extras" they will need and the associated costs.

In summary, the System/3 Model 6 is well designed to appeal to first-time computer users—particularly those who are unfamiliar with tab-oriented data processing techniques. The availability of RPG II, BASIC, and FORTRAN helps to make the Model 6 an unusually flexible system that can handle both the business and scientific computational needs of many small companies. The throughput capabilities of the Model 6 in most applications, however, are significantly lower than those of IBM's own System/3 Model 10 and many batch-oriented competitive systems.

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 key input/output device, required in all non-disk 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 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:

No. of Drives	Models	Data Capacity
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 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. Average head movement time is 60 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) 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.

INPUT/OUTPUT UNITS

3410/3411 MAGNETIC TAPE SUBSYSTEM: Adds magnetic tape capabilities to the System/3 Model 10 and Model 15. The 3410 is a tape unit only, while the 3411 contains both a tape unit and the subsystem control unit. The compact, waist-high cabinets are cable-connected to one another at the front corners, making it possible to place them side by side or at any angle up to 90 degrees to one another. Both the 3410 and the 3411 are available in three models, whose principal characteristics are as follows:

	Model 1	Model 2	Model 3
Tape speed, inches/sec	12.5	25	50
Recording density, bpi	1600	1600/800*	1600/800*
Data rate, bytes/sec:			
At 1600 bpi (phase encoded)	20,000	40,000	80,000
At 800 bpi (NRZI)	Not avail.	20,000*	40,000*
Inter-block gap, inches	0.6	0.6	0.6
Rewind time, minutes/2400' reel	3	3	2

*Requires Dual Density feature.

All three models use half-inch tape recorded in the standard IBM 9-track formats. A single 3410/3411 subsystem, consisting of a 3411 Magnetic Tape Unit and Control and up to three additional 3410 Magnetic Tape Units, can be connected to a System/3 Model 10 or 15. Model 1, 2, and 3 tape units cannot be intermixed in a subsystem. A System/3 Attachment is required on the 3411 and a 3411 Magnetic Tape Attachment is required on the 5410 or 5415 Processing Unit. The Processing Unit Expansion Feature A

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complexity of the unit has caused maintenance problems and frequent card jams in some installations.

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 highly 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. Deliveries began in the first quarter of 1971. The RPG II Telecommunications Feature facilitates the programming of BSCA applications—at an additional software cost of $35 per month.

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 provides 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 new 5410 Model A7 (card) and A17 (disk) Processing Units have 49,152 bytes of core storage, or 50 percent more than the previous maximum capacity. The 5444 Model A1, A2, and A3 Disk Storage Drives offer much faster access time (at higher prices) than the earlier 5444 Model 1, 2, and 3 Drives. The 5445 Disk Storage Drives provide 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 permits the connection of a 600-lpm or 1100-lpm 1403 Printer in place of the much slower 5203 Printer. And finally, the COBOL and FORTRAN compilers offer 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

is a prerequisite on the 5410. In addition, every 3410 and 3411 tape unit must be equipped with either the Single Density (1600 bpi) or Dual Density (1600 or 800 bpi) feature; the Dual Density capability is not available for the Model 1 units.

Features of the 3410/3411 subsystem include single-capstan drive, linear rewind, simplified tape threading, and a push-pull quick-release latch. The tape units are connected to the control unit in radial rather than series fashion to facilitate maintenance. Only digital signals are transmitted across the interface to reduce the sensitivity to noise. The 3410/3411 subsystem was announced in October 1971. Deliveries to System/3 users began in October 1972.

5424 MULTI-FUNCTION CARD UNIT (MFCU): For Model 10 or Model 15. Combines the functions of a 96-column card reader/punch, collator, and interpreter in a single unit. Consists of two 2,000-card feed hoppers, a read station, and four 600-card stackers. Cards fed from either or both hoppers can be read, punched, printed, and fed into any of the four stackers under program control. Card sorting is also possible through the use of a multiple-pass sorting technique.

The 5424 is offered in two models. Cards are read serially at 250 cpm in Model A1 and 500 cpm in Model A2. Punching in performed serially at 60 cpm in Model A1 and 120 cpm in Model A2. Printing occurs at a speed of 60 cpm in Model A1 and 120 cpm in Model A2 when printing in any or all of the first three line positions on each card. There is a fourth line position which, if used, causes the printing speed to drop to 48 cpm for Model A1 and 96 cpm for Model A2. Each of the 4 lines can hold up to 32 printed characters.

1442 CARD READ PUNCH: For Model 15. Provides 80-column card input/output capabilities when installed in place of the 96-column 5424 MFCU. Either a 1442 Model 6 or Model 7 Card Read Punch can be connected to the 5415 Processing Unit via a #4130 Card Read Punch Attachment on the 5415 and a #3950 Coupling feature on the 1442. Also required is the 5422 Disk Enclosure, which houses one or two 5444 Disk Storage Drives on a System/3 Model 15 when no 5424 MFCU is installed. The 1442 has a 1200-card feed hopper, a single card feed path, and two 1300-card stackers. It can read or punch standard 80-column cards, or read cards and punch additional data into them during the same pass. Model 6 reads at 300 cards per minute and punches at 80 columns per second, while Model 7 reads at 400 cards per minute and punches at 160 columns per second. The rated speed for punching full cards (columns 1 through 80) is 50 cpm for Model 6 and 91 cpm for Model 7.

2501 CARD READER: For Model 15. Reads 80-column cards serially by column at either 600 cpm (Model A1) or 1000 cpm (Model A2). Has a 1200-card feed hopper and a single 1300-card stacker. Can be connected to the 5415 Processing Unit via an #8090 Attachment on the 5415 and a #3630 Coupling feature on the 2501. The 2501 cannot serve as the primary card input unit for a System/3 Model 15; it can be used only in addition to a 5424, a 1442, or a 2560.

2560 MULTI-FUNCTION CARD MACHINE (MFCM): For Model 15. Combines the functions of an 80-column card reader/punch, collator, and interpreter in a single unit. Consists of two 1,200-card feed hoppers, a solar-cell read station, a punch station, an optional print station,

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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 who need 80-column card I/O on a System/3 Model 10 Disk System will henceforth be able to install a 1442 Card Read Punch in place of the 96-column 5424 Multi-Function Card Unit, which had previously been a required component in every System/3 Model 10 installation. This capability expands 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 of machine-printed marks from documents of widely varying sizes at a speed of 4000 to 6000 documents per hour.

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 scheduler 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 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

and five 1,300-card stackers. Cards fed from either or both hoppers can be read, punched, printed, and fed into any of the five stackers under program control.

The 2560 is offered in two models, A1 and A2. Cards are read serially by column, at 500 cpm in Model A1 and 310 cpm in Model A2. Punching is at the rate of 160 columns per second in Model A1 and 120 columns per second in Model A2. When all 80 columns of each card are punched, the speed is 91 cpm in Model A1 and 65 cpm in Model A2.

The optional Card Print feature, for the 2560 Model A1 only, provides 2, 4, or 6 printing heads, each adjustable to print in any one of 25 line positions on the cards. Each line can be up to 64 characters long. Printing speed, regardless of the number of lines printed, is 150 print positions per second.

One 2560, Model A1 or A2, can be connected to the 5415 Processing Unit via the #8100 MFCM Attachment.

Also required is the 5422 Disk Enclosure, which houses one or two 5444 Disk Storage Drives on a System/3 Model 15 when no 5424 MFCU is installed.

5203 PRINTER: For Model 10. Uses interchangeable horizontal-chain cartridges. Three models are available. With the standard 48-character set, rated printing speeds are 100 lpm for Model 1, 200 lpm for Model 2, and 300 lpm for Model 3.

The standard 96-position print line can optionally be expanded to 120 or 132 positions. Vertical spacing is 6 or 8 lines per inch, and horizontal spacing is 10 characters per inch. Skipping speed is 16.67 inches per second at the usual spacing of 6 lines per inch. Vertical format is under program control; there is no carriage control tape.

The standard 48-character chain cartridge can be replaced by other operator-changeable cartridges. If the Universal Character Set feature is installed, the cartridge may contain from 48 to 120 different characters. Larger character sets will usually result in reduced printing speeds.

5213 PRINTER: For Model 6. An 86-character-per-second serial printer capable of printing a 64-character set across 132 print positions. The print mechanism is a 7-by-7 wire matrix similar to that used in the 3215 Console Printer of the IBM System/370. Characters are printed at 10 characters per inch, 6 lines per inch.

There are three models of the 5213 Printer: Model 1 moves its forms by a pin-feed platen, with single or double spacing controlled by the operator; Model 2 employs a tapeless vertical forms control carriage and has a high-speed skip feature; Model 3 is similar to Model 2, but adds the capability of bidirectional printing, eliminating nonproductive "carriage-return" operations. The fact that the printing element can print while moving in either direction can lead to higher throughput speeds than with the unidirectional models. The optional Enhanced Print Rate Attachment for the 5406 Processing Unit drives the 5213 Model 3 Printer at a nominal print rate of 115 characters per second, a 35 percent increase over the basic 86-cps speed. Throughputs for the various models of the 5213, measured in terms of lines per minute, can span the range from under 20 to over 100 lpm, but will typically fall between 40 and 70 lpm.

The 5213 Model 1 handles continuous, marginally-punched forms 13-7/8 inches in width, while Models 2 and 3 can handle continuous forms ranging from 3 to 14-7/8 inches in

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The optional 2265 Display Station complements the basic 5213 Printer by serving as a high-speed output device for the System/3 Model 6.

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

width. All models can accommodate forms ranging from 3 to 14 inches in width and having up to 6 parts.

2222 PRINTER: For Model 6. Uses the same basic print mechanism as the Model 5213 Printer and prints in serial mode at 85 characters per second. The Model 2222 features an extra-wide carriage (220 character positions per line) and a dual, pin-feed tractor (with vertical forms control on the primary tractor only). The Model 2222 has been especially designed to feed, identify, and print on large ledger cards (6 to 14 inches wide, 8 to 11 inches long).

Each ledger card is manually fed, optically identified by a binary-coded identification number printed along the right-hand margin, aligned to the next available print line by an optical sensing device, printed on (using print positions 80 to 220), and ejected for manual stacking. This cycle typically takes about 4 seconds.

The ledger card's identification number is used to locate the corresponding disk-stored data record. This technique is much more flexible than that of storing a restricted amount of information on a magnetic stripe on the reverse side of a ledger card itself. There are two models of the 2222 Printer: Model 1 uses a uni-directional printing technique, and Model 2 uses a bidirectional technique to achieve higher effective speeds.

1403 PRINTER: For Model 10 or Model 15. Provides fast, high-quality printed output by means of a horizontal chain or train mechanism. With the standard 48-character set, rated printing speed is 465 lpm for the 1403 Model 5, 600 lpm for the 1403 Model 2, and 1100 lpm for the 1403 Model N1. All three models have 132 print positions. Skipping speed is 33 inches per second on short skips and 75 inches per second on skips of more than 8 lines. Vertical format is controlled by the stored program. The optional Universal Character Set feature (for Model 2 or N1 only) permits the use of operator-changeable chain or train cartridges containing up to 120 different characters. A single 1403 Printer, Model 2 or N1, can be connected to the 5410 or 5415 Processing Unit via a 5421 Control and attachment. The 1403 Model 5 is available only for the Model 15.

OPERATOR KEYBOARD CONSOLE: An integrated input device that forms part of every System/3 Model 6 configuration. This device is the primary means of operator control over the system and, in basic Model 6 systems that do not include the optional 5496 Data Recorder or 1255 Magnetic Character Reader, the Keyboard Console is the only means of entering programs and data.

Data is entered at the keyboard through three groups of keys: a typewriter-style alphanumeric keyboard, an adding-machine style 10-key numeric keyboard, and an 8-or 16-key command keyboard. Several other operator control keys are provided.

The eight standard Command Keys are pre-programmed to perform (in Desk Calculator Mode) such functions as add, subtract, multiply, divide, square root, and exponentiation. Eight additional Command Keys are optionally available and can be programmed as desired. The Command Keys have 20 registers associated with them for storing and accumulating Calculator operands and results.

The Operator Keyboard Console also contains a Switch Panel and an Indicator Panel. The Switch Panel is used for operator control of the entire system. The Indicator Panel not only provides normal system status indicators, but can also provide programmable indicators to guide the operator in performing fixed sequences of operations.

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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 restricts the card character set to 64 characters–a startling backward step in the era of expanded character sets. The restricted card code is 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.

The 96-column card is clearly easier to handle, less expensive, and more compact to store than the 80-column card. Nonetheless, its introduction aroused considerable controversy. The EDP industry has made significant progress toward standardization and data compatibility during the past few years, with the 80-column card being accepted as an almost universal standard. The 96-column card is incompatible with all previous punched card equipment. Its introduction by the industry leader, seconded by its use in the impressive Burroughs B 1700 systems, may well make it the card of the future–but both IBM and Burroughs are hedging their bets by offering 80-column card equipment as well.

Along with the System/3, IBM introduced two off-line devices for use with the 96-column card. The 5496 Data Recorder is a buffered unit that performs the functions of both a keypunch and verifier, at a rather stiff rental price of $158 per month. The 5486 Card Sorter is a table-top unit that has six stackers and requires one and one-half card passes for each numeric column sorted–another curious step backward. The sorter is offered in a 1000-cpm model at $91 per month and a 1500-cpm model at $123 per month.

SYSTEM/3 MODEL 15

The System/3 Model 15, introduced on July 10, 1973, greatly increases 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. Thus, the availability of the Model 15 should ease the minds of thousands of current and prospective 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 new

5471 PRINTER-KEYBOARD: For Model 10. Provides keyboard input and typed output. Consists of a 44-key typewriter-style keyboard and a Selectric-type printing mechanism, which operates independently under program control. Rated output speed is 15.5 characters per second. Mounts on the System/3 console work table. (IBM software support for the 5471 requires a disk-oriented System/3 with at least 12K bytes of core storage.)

5475 DATA ENTRY KEYBOARD: For Model 10. Permits on-line data recording and verification in conjunction with the System/3 Processing Unit and Multi-Function Card Unit. Has the same keyboard, character set, and touch as the independent IBM 5496 Data Recorder, which is the basic unit for punching and verifying the new 96-column cards. Mounts on the System/3 console work table. (On-line data entry, of course, represents extremely inefficient use of the System/3 hardware and will normally be done only in installations with very low-volume input and processing requirements.)

5496 DATA RECORDER: For Model 6. Serves as either an on-line reader of 96-column cards or an on-line card punch and print device. In either input or output mode, rated throughput is 22 cards per minute. Only data that is being punched can also be printed on the cards.

The 5496 Data Recorder was announced with the original System/3 Model 10 as an off-line keypunch for 96-column card preparation; see Report 70D-491-22 for a detailed description. When connected to a System/3 Model 6, the 5496 Data Recorder can also be used in off-line mode as a buffered keypunch by setting a switch on the console.

129 CARD DATA RECORDER: For Model 6. A buffered keypunch-verifier for standard 80-column cards; see Report 70D-491-21 for a detailed description. Any model of the 129 can be connected to the 5406 Processing Unit via a #3210 Data Recorder Attachment on the 5406 and a #7503 Card Input/Output Attachment and #3610 Expansion Feature on the 129. The 129 and the 96-column 5496 Data Recorder cannot be used in the same system.

When used on-line, the 129 can read up to 50 cards per minute and can punch (or punch and print on Models 2 and 3) from 12 to 50 cards per minute, depending on the number of columns punched in each card. Conversions between the 80-column card code and the System/3 code are performed automatically. When switched to the off-line mode, the 129 operates as a conventional buffered keypunch and/or verifier. All optional features for the 129 are compatible with the Card Input/Output Attachment except the Self-Checking Number feature. However, the Accumulate, Direct Punch Control, Verify Read Control, and Production Statistics features are all inoperative in the on-line mode.

1255 MAGNETIC CHARACTER READER: For Model 6, Model 10, or Model 15. Reads and sorts MICR-encoded documents from 5.75 to 8.875 inches in length, 2.5 to 4.25 inches in width, and 0.003 to 0.007 inch in thickness. Three models are available. Model 1 reads up to 500 six-inch documents per minute, while Models 2 and 3 read up to 750 six-inch documents per minute. Models 1 and 2 have six horizontal stackers arranged in a single vertical bay and require one and one-half sort passes for each digit position. Model 3 has twelve horizontal stackers in two vertical bays. The optional Self-Checking Number, 51-Column Card Sorting, and Dash Symbol Transmission features are available for all three models. Model 3 can also be equipped

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model offers up to 131,072 bytes of MOSFET main storage and 91.7 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 multiprogramming, spooling, device-independent data management, expanded communications control, and other throughput-boosting features (but not virtual storage–at least not yet). Moreover, in addition to accommodating most of the Model 10 peripheral devices, the Model 15 uses a new CRT operator console and can support the 80-column 2560 Multi-Function Card Machine and 2501 Card Reader. Thus, the Model 15 offers Model 10 users a natural and highly welcome growth path with minimum conversion effort.

IBM is also 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.

Typical Model 15 systems will range from $3,300 to over $7,000 in monthly rental, with purchase prices ranging from $141,000 to $295,000. The basic $3,300 per month will buy a 49K CPU with CRT display console, a single 4.9-million-byte disk drive, a 465-lpm printer, and a 5424 Multi-Function Card Unit that reads 250 cpm and punches or prints at 60 cpm. Customer shipments of the Model 15 began in March 1974, with the 131K CPU scheduled to follow in June 1974.

The 5415 Processing Unit, the central component of every Model 15 system, is available with 48K, 65K, 98K, or 131K bytes of main storage. 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 new MOSFET memory is offered at approximately one-fourth the price of the core memory used in the System/3 Model 10–bad news for the several companies that are currently offering add-on memory units for the System/3.

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 has added a number of new facilities to the 5415 Processing Unit:

with the High-Order Zero and Blank Selection feature, which reduces off-line sorting times. One 1255 can be connected to a System/3 via a Serial I/O Channel on the Processing Unit and a System/3 Adapter (#6303) on the 1255 itself. All three models can also be used for off-line sorting.

2265 MODEL 2 DISPLAY STATION: Serves as an optional rapid output device for the System/3 Model 6, displaying up to 15 lines of 64 characters per line on the face of a CRT display screen. Solid-line characters are displayed in green on a gray background. A character brightness control is provided. This unit is basically the same as the single-station Model 2265 unit used with the System/360 and System/370 computers.

The 2265 Display Station cannot be used in the same system with a 2222 Printer. As supported by BASIC, the 2265 requires the Command Keys option on the Processing Unit. As supported by RPG II, the 2265 requires a 12K- or 16K-byte Processing Unit.

3881 OPTICAL MARK READER: For Models 10 and 15. Reads machine-printed and/or hand-marked data from documents ranging from 3 by 3 inches to 9 by 12 inches in size. Model 1 reads data directly into a System/3 Model 10 or 15 at a speed of 4000 to 6000 documents per hour, depending upon the document size. Model 2 operates off-line, transferring the data to a 3410 Model 1 Magnetic Tape Unit at a speed of 3700 to 5400 documents per hour. Up to 2480 marking positions are available on each 9-by-12-inch document. Up to six different document formats, loaded from format control sheets, can be stored and read during the same run. An optional BCD Read feature facilitates the processing of turnaround documents, and a Serial Numbering feature prints consecutive numbers on the documents being processed. One 3881 Model 1 can be connected to a System/3 Model 10 or 15 via a Serial I/O Channel on the Processing Unit.

COMMUNICATION CONTROL

BINARY SYNCHRONOUS COMMUNICATIONS ADAPTER (BSCA): For Models 6, 10, 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.
- 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.
- 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.

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- Storage Protection, which prevents users' programs from interfering with one another or with the Supervisor.

- I/O Operation End Interrupt, which facilitates multiprogramming 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 131K 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. 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 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. 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 of the Model 15 systems software facilities announced to date. Thus, IBM's strong initial commitment to the 96-column card as a key feature of the System/3 approach to data processing has now been heavily diluted.

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

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 bps, 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 5406, 5410, 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 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 or Model 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.

LOCAL COMMUNICATIONS ADAPTER (LCA): For Models 10 and 15. This optional feature for the 5410 and 5415 Processing Units permits direct, local attachment of either one 3741 Model 2 Data Station (Report 70D-491-41), one 3271 Control Unit (Report 70D-491-11), or one 3275 Display Station (Report 70D-491-11). Data is transferred at 2400 bps in non-transparent EBCDIC mode. The LCA requires the appropriate Processing Unit Expansion feature, and cannot be installed in combination with the First BSCA.

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).

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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 10 and offers far more operational flexibility. A Model 15 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.

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 $200 to $250 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 new 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, a new Local Communications Adapter (LCA) permits direct connection of either a 3741 Model 2 Data Station (IBM's new "floppy disk" data entry unit, described in Report 70D-491-41) or a 3270 Information Display System (Report 70D-491-11).

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 Operation 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.

SOFTWARE

SYSTEM CONTROL PROGRAMMING: SCP is IBM's designation for the programs that perform the system control 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.

SYSTEM/3 MODEL 6 SYSTEM CONTROL PROGRAMMING (SCP): These programs perform the system control functions that are basic to an RPG II-oriented System/3 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 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 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 the System/3 Model 6 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 System/3 Model 6 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 for the Model 6:

- **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

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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? At present, he's 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 system control, data management, and operational characteristics which make nearly any System/3-to-370 conversion a costly, time-consuming task. But by the time Model 15 users begin demanding a still bigger and better version of the System/3, the odds are good that IBM will be ready to provide it. System/3 users are making it increasingly clear that they tend to be independent souls who are unwilling to be stampeded into a costly conversion effort to a costly System/370–and there are so many System/3 users that IBM simply must accommodate them. Therefore, the only reasonable solution seems to be continued expansion and development of the System/3 product line. If IBM doesn't do it, others will.

USER REACTION

IBM is often credited with opening up an important new segment of the computer market with the announcement of the System/3 in 1969. Certainly IBM's concept of an inexpensive, easy-to-use entry-level computer system has been enormously successful. By the end of 1973, more than 20,000 systems had been installed, making the System/3 the most widely used computer ever produced.

Another important measure of the success of a computer system is the degree of satisfaction expressed by its users. In a Datapro survey of 20 System/3 users, the overwhelming majority rated the overall performance of their systems as good or excellent. The ratings assigned by these ten System/3 Model 6 and ten System/3 Model 10 users are summarized below:

	Excellent	Good	Fair	Poor	
Overall performance	11	7	1	1	3.4
Ease of programming	6	12	2	0	3.2
Ease of operation	10	9	1	0	3.45
Hardware reliability	12	6	2	0	3.3
Maintenance service	12	7	1	0	3.55
Technical support	9	10	0	1	3.35
Manufacturer's software	6	10	4	0	3.1

Thus, for most users, the System/3's performance has lived up to their expectations. The two users who expressed dissatisfaction with the overall performance of the

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 cataloged in the Object Library on disk and/or punched into cards. The feature requires a 12K 5406 Processing unit, one 5444 Disk Storage Drive, and a printer.

The Multi-Leaving Remote Job Entry Work Station Feature permits a System/3 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 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 12K 5406 Processing Unit with a Binary Synchronous Communications Adapter with EBCDIC Transmission mode, a Model 5444 Disk Storage Drive, and a printer.

SYSTEM/3 MODEL 10 CARD-ORIENTED SYSTEM CONTROL PROGRAMS: 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.

SYSTEM/3 MODEL 10 DISK-ORIENTED SYSTEM CONTROL PROGRAMS: For disk-oriented 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 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 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 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

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system found it unsuitable to handle the volume of input required in their applications. What the users liked most about the System/3 was that it was easy to use and required relatively little training for operators or for programmers. Users also gave the System/3 high ratings for reliability, although some had experienced some mechanical problems with peripherals.

The most commonly recurring complaints concerned performance limitations caused by slow peripheral devices and main memory capacity restrictions. For the Model 6, the slow card reading speeds, the lack of a line printer, and the main memory limitation were cited as particular disadvantages. Model 10 users also felt somewhat constrained by main memory limitations, and they criticized the disks and disk software more often than other input/output devices for having slow access times and for performing somewhat inefficiently. In addition, some Model 10 users felt limited by the total amount of disk storage available and by the software restrictions limiting the number of files on a disk pack for the Model 5445 Disk Pack Drives.

Users of BASIC on the System/3 gave mixed responses as to their satisfaction with that language. One user stated that the System/3 BASIC is better than that available in most time-sharing arrangements, but added that the documentation would be difficult to understand by an individual who is not familiar with the language. The current lack of availability of BASIC for the System/370 is particularly frustrating to the user who has outgrown the processing capabilities of the System/3.

User complaints about performance limitations on both the Model 6 and the Model 10 reflect the amount of growth many small businesses have experienced since the initial introduction of the System/3. Although some Model 10 users expressed an interest in eventually upgrading to the Model 15 to take advantage of its multiprogramming capabilities and enhanced input/output capabilities, Model 15 deliveries are just beginning, and no Model 15 users were located for this survey. However, Datapro did find two users who were utilizing System/3 Model 10 systems as remote batch terminals on-line to larger central processors–IBM's other prescribed growth path for System/3 installations. Both expressed satisfaction with the performance of the System/3 as a remote job entry terminal, although the capability to transmit to and from disks, due for release with the Multi-Leaving Remote Entry Work Station Program, was cited as a much-needed improvement.

IBM support was a sore point for some System/3 users, but was also mentioned as a plus for IBM by others. Overall, even among those individuals who expressed complaints about specific aspects of the system, the message is clear that IBM has managed to please a great many first-time computer users with the System/3's reliability and ease of use. □

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 5120 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.

- 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 the 3881.

- Macros Feature: Permits the use of user-coded macro-instructions 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 sytems. 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 Workstation 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 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 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

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operations control information, but neither the printer, a 3881 Optical Mark Reader, a multifunction card unit, or a 1442 Card Read Punch can be shared by two programs. Data files on disk 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.

SYSTEM/3 MODEL 15 SYSTEM CONTROL PROGRAMS: 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 new software facilities and features which are unique to the Model 15. Except where otherwise indicated, all announced Model 15 software facilities were scheduled for availability in March 1974 and are usable on a minimum Model 15 system.

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 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 new 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 new 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.

Other new or improved 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. It also supports the following new 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 131K 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.

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.

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 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). The CCP is scheduled to become available to Model 15 users in September 1974.

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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 preprinted 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 System/3 Models 10 and 15 except for differences originating from different I/O devices.

Two different versions of RPG II are offered for the System/3 Model 10

- 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 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 5410 Processing Unit with 12K bytes of core storage, one 5444 Disk Storage Drive, a 5203 or 1403 Printer, and a 5424 MFCU or 1442 Card Read Punch. 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 optional 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 5445 Disk Storage Drive Feature allows RPG II users to process sequential, indexed, or direct data files on 5445 Drives.

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.

RPG II AUTO REPORT FEATURE: This optional enhancement of Model 6 or 10 Disk RPG II 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 optional extension of Model 6 or 10 RPG II 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 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 multi-point.

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, modify 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,

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divide, compute power 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.

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 10 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 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.

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.

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 10, 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 a 12K processing unit with at least one 5444 Disk Storage Drive and a printer. 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. The Model 15 FORTRAN compiler provides all the facilities of Model 6 and Model 10 FORTRAN and also supports the new I/O devices available for the Model 15.

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 10, the minimum configuration includes a 5410 Processing Unit with at least 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 15, the minimum configuration includes a 5415 Processing Unit with 48K bytes of core 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 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.

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 disk files into either ascending or descending sequence. 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 functions and syntax of specifications sheets for the System/3 Model 6 Disk Sort program are identical to those used with the System/3 Model 10 Disk Sort. Output data files created by the Model 6 Disk Sort can be processed by the Model 10 Disk Sort, and vice versa.

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The Disk Sort Functions under control of the SCP software. On a Model 6, it requires the minimum 8K-byte processing unit, one 5444 Disk Storage Drive, and one printer. 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 15 Disk Sort program is functionally identical to the Model 10 Disk Sort with the 5445 Disk Storage Drive Feature. Up to four 5445 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 2444 Disk Storage Drive, a 1403 Printer, and a card reader.

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 and Model 15 versions are functionally identical. Requires a 12K Model 10 processor or a 48K Model 15 processor with at least one 5444 Disk Storage Drive 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 reformatting. 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 gangpunching, 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. Device control and data management services are provided as part of the SCP for the Model 15. The subroutines are used with a user-written RPG II or Assembler program.

DATA/3: This System/3 Program Product, introduced along with the Model 15, 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 and both the 5444 and 5445 Disk Storage Drives. DATA/3 can be used on either a System/3 Model 10 or Model 15, in connection with either the Multiline/Multipoint software or the Communications Control Program. The planned availability dates are March 1974 for the Model 10 and May 1974 for the Model 15.

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 user's 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 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 RPG 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
Accounts Receivable
Sales Analysis

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 Customer Service currently includes the following, with or without Customized Source Code:

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This view of a System/3 Model 10 installation shows the CPU at left, the 5203 printer in the foreground, the 5424 Multi-Function Card Unit at center rear, and the off-line 5486 Card Sorter at right.

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 Managmeent, 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 Programs (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 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).

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 $26.00 per hour.

EDUCATION: Two day introductory courses are offered at no charge. Various other System/3 courses are available at costs averaging about $40 per student per day.

EQUIPMENT: The following typical purchase and rental prices include controllers and adapters.

System/3 Model 6

MINIMUM SYSTEM: Consists of 8K 5406 Processing Unit, 5213 Model 1 Printer, and 5444 Model 1 Disk Storage Drive (2.45 million bytes). Monthly rental, $1,002. Purchase price, $47,830. Adding RPG II, Conversational Utilities, and Disk Sort would raise the monthly rental by $60 for the commercial user. Adding BASIC for mathematical processing raises the monthly rental by $112. Using the 5213 Model 2 Printer with vertical forms control increases the monthly rental by $41 and the purchase price by $1,840.

MINIMUM LEDGER CARD SYSTEM: Consists of 8K 5406 Processing Unit, 2222 Model 1 Printer, and 5444 Model 1 Disk Storage Drive. Monthly rental, $1,196. Purchase price, $58,310.

TYPICAL COMMERCIAL CARD SYSTEM: Consists of 12K 5406 Processing Unit, 5496 Data Recorder, 5213 Model 3 Printer, and 5444 Model 2 Disk Storage Drive (4.92 million bytes). Monthly rental, $1,563. Purchase price, $69,430. Substitution of a 16K-byte Processing Unit in this configuration raises the monthly rental by $115 and the purchase price by $700.

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System/3 Model 10

MINIMUM CARD SYSTEM: Consists of 8K 5410 Processing Unit, 5424 Model A1 MFCU, and 5203 Model 1 Printer (with 96 print positions). Monthly rental, $1,016. Purchase price, $45,690.

For the above configuration with the faster 5424 Model A2 MFCU and 5203 Model 2 Printer: Monthly rental, $1,233. Purchase price, $51,510.

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). Monthly rental, $1,966. Purchase price, $83,520.

For the above configuration with a 32K Processing Unit: Monthly rental $2,580. Purchase price, $102,520.

EXPANDED DISK SYSTEM: Consists of 49K 5410 Processing Unit, 5424 Model A2 MFCU, 1403 Model N1 Printer, 5471 Printer-Keyboard, two 5444 Model A2 Disk Storage Drives (9.8 million bytes), and two 5445 Disk Storage Drives (41 million bytes). Monthly rental, $5,603. Purchase price, $228,280.

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 (49K 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. Monthly rental (including maintenance), $3,305. Purchase price, $141,000.

EXPANDED SYSTEM: A typical large Model 15 disk system consists of a 5415 Model A20 Processing Unit (131K 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. Monthly rental (including maintenance), $7,040. Purchase price, $295,100. ■

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*
PROCESSORS AND MAIN STORAGE				
5406	Processing Unit (for Model 6 systems):			
	Model B2; 8,192 bytes	29,300	127	601
	Model B3; 12,288 bytes	35,200	132	719
	Model B4; 16,384 bytes	35,900	132	836
1550	Command Keys (9-16)	999	0.50	20
5732	Processing Unit Expansion	1,750	6	35
5410	Processing Unit (for Model 10 non-disk systems):			
	Mod. A2; 8,192 bytes	16,400	38.75	334
	Mod. A3; 12,288 bytes	21,700	42.75	442
	Mod. A4; 16,384 bytes	22,400	42.75	566
	Mod. A5; 24,576 bytes	40,000	57	816
	Mod. A6; 32,768 bytes	40,700	57	1,060
	Mod. A7; 49,152 bytes	59,000	79	1,380
5410	Processing Unit (for Model 10 disk systems):			
	Mod. A12; 8,192 bytes	23,000	85	470
	Mod. A13; 12,288 bytes	28,300	89	576
	Mod. A14; 16,384 bytes	29,100	89	698
	Mod. A15; 24,576 bytes	46,600	104	948
	Mod. A16; 32,768 bytes	47,300	104	1,190
	Mod. A17; 49,152 bytes	65,600	126	1,510
3500	Dual Program Feature (for 5410)	5,830	1	118
5732	Processing Unit Expansion Feature A (for (5410)	1,850	3	37
5415	Processing Unit (for Model 15 systems):			
	Model A17; 49,152 bytes	63,000	210	1,510
	Model A18; 65,536 bytes	67,000	215	1,610
	Model A19; 98,304 bytes	78,000	220	1,860
	Model A20; 131,072 bytes	86,000	230	2,060
5501	Power Supply Expansion	2,250	1.00	1
5733	Processing Unit Expansion 1	800	0.50	20
5734	Processing Unit Expansion 2 (5733 is prerequisite)	2,200	1.00	6
5735	Processing Unit Expansion 3 (5734 is prerequisite)	800	1.00	20
	Note: The above four features provide additional CPU power supply and connections; they are required for certain combinations of peripheral, communications, and/or RPQ equipment.			

*Rental prices include equipment maintenance.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*
CONSOLE				
3277	Display Station, Model 1 (required in Model 15 systems)	3,460	7	76
4632	78-key Operator Console Keyboard (required on 3277)	1,420	11	35
MASS STORAGE				
5444	Disk Storage Drive:			
	Model A1; 2.46 million bytes	8,610	66	204
	Model A2; 4.92 million bytes	10,200	66	306
	Model A3; 2.46 million bytes	8,610	66	204
	Model 1; 2.46 million bytes	8,720	47.75	167
	Model 2; 4.92 million bytes	10,400	47.75	275
	Model 3; 2.46 million bytes	8,720	47.75	167
5540	Disk Cartridge (for 5444 drives)	175	Time & Mat'l.	Purch. only
5422	Disk Enclosure (required for attachment of 544 Disk Storage Drives when 5424 MFCU is not used)	4,990	12	102
6378	Second Disk Attachment (required on 5406 for a 5444 Mod. 3 or a second 5444 Mod. 2)	2,420	5	45
6378	Second Disk Attachment (required on 5410 for a 5444 Mod. 3 or A3 or a 2nd 5444 Mod. 2 or A2)	2,560	5	47
4501	Higher-Performance First Disk Attachment	999	1	20
4502	Higher-Performance Second Disk Attachment (required on 5410 for a 5444 Mod. A3 or a 2nd 5444 Mod. A2; #6378 is a prerequisite)	999	1	20
6378	Second Disk Attachment (required on 5415 for a 5444 Mod. A3 or a 2nd 5444 Mod. A2)	3,495	6	67
5445	Disk Storage Drive:			
	Model 1; first 5445 on 5410 or 5415; 20.48 million bytes	16,000	86	357
	Model 2; second 5445 on 5410 or 5415; 20.48 million bytes	15,300	81	341
	Model 3; dual-pack 5445, 40.76 million bytes	31,400	168	698
3901	First 5445 Disk Attachment (for 5410); required for Model 1 and 3.	20,400	33.50	510
3902	Second 5445 Disk Attachment for 5410; required for Model 2 and 3.	612	1	15
5732	Processing Unit Expansion A (required on 5410 for connection of #3901)	1,850	3	37
5733	Processing Unit Expansion B (required on 5410 if both #3901 and #2074, BSCA, are installed)	816	.50	20
3901	First 5445 Attachment (required on 5415 for first 5445 Mod. 1)	20,000	33	500
3903	Second 5445 Attachment (required on 5415 for second 5445 Mod. 1)	3,000	1	75
INPUT/OUTPUT UNITS				
3410	Magnetic Tape Unit:			
	Model 1; 20 KB	7,850	45.75	188(1)
	Model 2; 40/20 KB	10,500	51	249(1)
	Model 3; 80/40 KB	13,000	56	311(1)
3411	Magnetic Tape Unit and Control:			
	Model 1; 20 KB	17,300	71	412(1)
	Model 2; 40/20 KB	21,900	76	525(1)
	Model 3; 80/40 KB	26,700	81	637(1)
3211	Single Density Feature (for 3410 & 3411, Models 2 & 3 only)	2,550	7.50	55(1)
3221	Dual Density Feature (for 3410 & 3411, Models 2 & 3 only)	3,670	27.50	81(1)
7003	System/3 Attachment (required on 3411)	3,210	3	76(1)
7951	3411 Magnetic Tape Attachment (required on 5410 Processing Unit)	4,890	10	163
7951	3411 Magnetic Tape Attachment (required on 5415 Processing Unit)	4,800	10	160
5424	Multi-Function Card Unit:			
	Model A1; reads 250 cpm, punches and prints 60 cpm	10,200	142	291
	Model A2; reads 500 cpm, punches and prints 120 cpm	13,500	204	437
4100	MFCU Attachment (required on 5410 for 5424 Mod. A1)	4,530	14.25	85
4101	MFCU Attachment (required on 5410 for 5424 Mod. A2; 4100 is prerequisite)	900	2	16
4100	MFCU Attachment (required on 5415 for 5424 Mod. A1)	4,450	14	84
4101	MFCU Attachment (required on 5415 for 5424 Mod. A2; 4100 is prerequisite)	900	2	16
1442	Card Read Punch:			
	Model 6; reads 300 cpm punches 80 cols/sec.	14,400	56	270
	Model 7; reads 400 cpm, punches 160 cols/sec.	15,500	66	392
3950	5410/5415 Coupling (required on 1442)	1,500	1	30
4130	1442 Attachment (required on 5410)	8,870	15.25	193
4130	1442 Attachment (required on 5415)	8,700	15	190

*Rental prices include equipment maintenance.
(1) A discount of 8% or 16% from these rental prices is available under a 12-month or 24-month Fixed-Term Lease, respectively.

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EQUIPMENT PRICES

	INPUT/OUTPUT UNITS (Continued)	Purchase Price	Monthly Maint.	Rental (1-year lease)*
2501	Card Reader (for Model 15 only):			
	Model A1; 600 cpm	11,200	35.50	198
	Model A2; 1,000 cpm	11,400	49.75	260
3630	2501 Coupling (required on 2501)	153	NC	5
8090	2501 Attachment (required on 5415)	6,700	7.50	150
2560	Multi-Function Card Machine (for Model 15 only):			
	Model A1; reads 500 cpm, punches 160 col/sec.	27,500	98	627
	Model A2; reads 310 cpm, punches 120 col/sec.	20,200	98	489
8100	2560 MFCM Attachment (required on 5415)	6,300	16	150
1580	Card Print Control (for 5415)	1,250	3	25
Card Print Feature for 2560 Model A1:				
1575	First Two Lines (requires 1580 on 5415)	5,990	14.25	137
1576	Second Two Lines	5,990	14.25	137
1577	Third Two Lines	5,990	14.25	137
5213	Printer (for Model 6 only):			
	Model 1; pin-feed platen	6,320	48.75	163
	Model 2; vertical forms control	8,160	66	204
	Model 3; vertical forms control, bidirectional printing	8,360	76	255
3901	Printer Attachment (required on 5406 for 5213 Mod. 1)	3,490	19.25	71
3902	Printer Attachment (required on 5406 for 5213 Mod. 2)	3,490	19.25	71
3903	Printer Attachment (required on 5406 for 5213 Mod. 3)	3,490	19.25	71
3960	Enhanced Print Rate Attachment (required on 5406 for printing at 115 cps with 5213 Mod. 3; replaces 3903 Attachment)	4,890	21.25	122
2222	Printer (with ledger card device; for Model 6 only):			
	Model 1; undirectional printing	16,800	107	357
	Model 2; bidirectional printing	17,000	117	392
7951	Printer Attachment (required on 5406 for 2222 Mod. 1)	3,490	19.25	71
7952	Printer Attachment (required on 5406 for 2222 Mod. 2)	3,490	19.25	71
5203	Printer (for Model 10 only):			
	Model 1; 100 lpm, 96 positions	11,400	68	247
	Model 2; 200 lpm, 96 positions	12,700	77	301
	Model 3; 300 lpm, 96 positions	17,700	129	443
3475	Dual-Feed Carriage (for 5203)	3,960	20.25	80
4730	Additional Chain Cartridge (for 5203 Mod. 1 & 2)	3,960	1	80
4740	Additional Chain Cartridge (for 5203 Mod. 3)	2,960	33.50	112
5558	24 Additional Print Positions (for 5203)	1,620	2	54
5560	36 Additional Print Positions (for 5203)	2,420	2	80
8639	Universal Character Set Attachment (for 5203)	324	1	10
3970	Printer Attachment (required for 5203 Mod. 1)	3,160	10	59
3971	Printer Attachment (required for 5203 Mod. 2)	3,160	10	59
3972	Printer Attachment (required for 5203 Mod. 3)	4,610	13.25	96
3480	Dual Feed Carriage Control (required on 5410 for #3475 on 5203)	1,310	1	26
8642	Universal Character Set Control (required on 5410 for #6639 on 5203)	486	1	15
1403	Printer:			
	Model 2; 600 lpm, 132 positions	28,500	174	764(1)
	Model 5; 465 lpm, 132 positions	27,300	125	591(1)
	Model N1; 1100 lpm, 132 positions	34,600	200	892(1)
1416	Interchangeable Train Cartridge (for 1403 Mod. N1)	2,960	Time & Mat'l.	98
1376	Auxiliary Ribbon Feeding (for 1403 Mod. 2 or 5)	2,590	16	74(1)
4740	Interchangeable Chain Cartridge Adapter (for 1403 Mod. 2 or 5)	2,630	NC	74(1)
8640	Universal Character Set Feature (for 1403 Mod. N1)	387	1.75	10(1)
8641	Universal Character Set Feature (for 1403 Mod. 2)	387	1.75	10(1)
5421	Printer Control Unit (required for 1403 Mod. 2, 5, or N1)	12,900	26.50	265
4140	5410 Attachment for 1403 Mod. 2	5,250	21.25	122
4150	5410 Attachment for 1403 Mod. N1	5,760	21.25	178
4135	1403 Model 5 Printer Attachment (for 5415)	4,700	21	110
4140	1403 Model 2 Printer Attachment (for 5415)	5,150	21	120
4150	1403 Model N1 Printer Attachment (for 5415)	5,650	21	175

*Rental prices include equipment maintenance.
(1) A discount of 8% or 16% from these rental prices is available under a 12-month or 24-month Fixed-Term Lease, respectively.

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EQUIPMENT PRICES

	INPUT/OUTPUT UNITS (Continued)	Purchase Price	Monthly Maint.	Rental (1-year lease)*
1255	Magnetic Character Reader:			
	Model 1; 500 dpm, 6 stackers	39,400	214	821
	Model 2; 750 dpm, 6 stackers	45,100	341	999
	Model 3; 750 dpm, 12 stackers	61,400	448	1,320
3215	Dash Symbol Transmission (for 1255)	35	NC	50(1)
4380	51-column Card Sorting (for 1255)	734	NC	15
4520	High-Order Zero & Blank Selection (for 1255 Mod. 3 only)	1,460	5	30
6303	System/3 Adapter (required on 1255)	5,930	4	123
7060	Self-Checking Numbers (for 1255)	2,370	2.50	49
7081	Serial I/O Channel (required on 5406 for connection of 1255)	7,490	5	153
7081	Serial I/O Channel (required on 5410 for connection of 1255 or 3881)	7,940	5	162
7081	Serial I/O Channel (required on 5415 for connection of 1255 or 3881)	7,790	6	159
3881	Optical Mark Reader:			
	Model 1; for on-line use	57,100	142	1,368(2)
	Model 2; for off-line use	52,000	112	1,248(2)
1471	BCD Read (for 3881)	2,390	1.50	56(2)
3450	Document Counters (for 3881)	948	2	22(2)
3550	Dual Density (for 3881 Model 2 only)	6,010	.50	142(2)
3801	Expanded Storage (for 3881)	2,390	.50	56(2)
6451	Serial Numbering (for 3881)	7,030	25.50	167(2)
5486	Card Sorter:			
	Mod. 1; 1000 cpm	4,780	38.75	91
	Mod. 2; 1500 cpm	5,470	59	123
5496	Data Recorder	7,750	55	158
3210	Data Recorder Attachment (required on 5406)	1,990	2	40
7501	System/3 Attachment (required on 5496)	2,240	11	45
129	Card Data Recorder:			
	Model 1; Punch-Verifier (non-print)	6,240	38.75	127
	Model 2; Printing Punch (non-verifier)	6,990	42.75	142
	Model 3; Printing Punch Verifier	7,490	43.75	153
7503	Card I/O Attachment (required on 129)	2,670	11	76
3610	Expansion Feature (required on 129)	499	10	NC
3210	Data Recorder Attachment (required on 5406)	1,990	2	40
2265	Display Station	5,530	40.75	173
7960	Display Station Attachment (required on 5406)	3,740	1.50	76
5471	Printer-Keyboard	5,070	32.50	108
4110	Printer-Keyboard Attachment (required on 5410)	3,020	5	54
5475	Data Entry Keyboard	2,420	7	42
4120	Data Entry Keyboard Attachment (required on 5410)	2,720	1	47
	COMMUNICATIONS EQUIPMENT			
2074	Binary Synchronous Communications Adapter (requires #5732 on 5406 Processing Unit)	13,200	66	270
1315	Auto Call Feature (for #2074)	1,990	1	40
4703	Internal Clock Feature (for #2074)	1,240	1	25
7477	Station Selection Feature (for #2074)	999	1	20
7850	Text Transparency Feature (for #2074)	999	1	20
2074	Binary Synchronous Communications Adapter (requires #5732 on 5410 Processing Unit)	12,500	66	285
1315	Auto Call Feature (for #2074)	2,110	1	42
3601	EIA Local Attachment (for 2074)	1,020	1	25
4703	Internal Clock Feature (for #2074)	1,320	1	26
7477	Station Selection Feature (for #2074)	1,050	1	21
7850	Text Transparency Feature (for #2074)	1,050	1	21
2084	Binary Synchronous Communications Adapter, Second (#2074 is a prerequisite)	12,500	66	285
1325	Auto Call Feature (for #2084)	2,110	1	42
3602	EIA Local Attachment (for #2084)	1,020	1	25
4723	Internal Clock (for #2084)	1,320	1	26
7487	Station Selection Feature (for #2084)	1,050	1	21
7851	Text Transparency Feature (for #2084)	1,050	1	21
2074	Binary Synchronous Communications Adapter (requires #5733 on 5415 Processing Unit)	12,300	65	280
1315	Auto Call Feature (for #2074)	2,075	1	42
3601	EIA Local Attachment (for 2074)	1,000	1	25

*Rental prices include equipment maintenance.

(1) A discount of 8% or 16% from these rental prices is available under a 12-month or 24-month Fixed-Term Lease, respectively.
(2) A discount of 15% from these rental prices is available under a 24-month Extended-Term Lease.