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IBM System/3

A drawer beneath the 5424 Multi-Function Card Unit houses the compact 5444 Disk Storage Drive and its removable single-disk cartridge.

IBM's new, low-cost computer for small-scale business data processing. Designed mainly for companies that have not previously used computers, the System/3 has aroused controversy because of its new 96-column punched card and incompatibility with other current equipment.

MANAGEMENT SUMMARY

The System/3, announced on July 30, 1969, is the least expensive computer system yet produced by IBM. Aimed mainly at small businesses which are not now using computers, the System/3 employs a new 96-column punched card and may be the forerunner of a whole new line of IBM computer equipment.

Hardware rental prices for the System/3 begin at $945 per month for card systems and $1,325 per month for disk systems. Overall costs to System/3 users, however, will generally be substantially higher than these figures because the software, education, and systems engineering assistance are all separately priced under IBM's new "unbundling" policy. When comparing the System/3 with competitive equipment, prospective users should carefully consider the amounts of these "extras" they will need and the associated costs.

First customer deliveries of card-oriented System/3 configurations are scheduled for the first quarter of 1970. Deliveries of disk systems are due to begin in the third quarter of 1970. ▷

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, 112 East Post Road, White Plains, N. Y. 10601.

MODEL: System/3.

DATA FORMATS

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

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

FLOATING-POINT OPERANDS: No 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.")

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

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: 8,192, 12,288, 16,384, 24,576, or 32,768 bytes.

CYCLE TIME: 1.52 microseconds per 1-byte access.

CHECKING: Parity bit with each byte is generated during writing and checked during reading.

STORAGE PROTECTION: None.

CENTRAL PROCESSOR

INDEX REGISTERS: None; one 16-bit base register permits base-plus-displacement addressing of any higher storage location within 256 bytes of a specified base address.

INDIRECT ADDRESSING: None. ►

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▷ The System/3 processing unit is byte-oriented and uses IBM's new, integrated "Monolithic Systems Technology" (MST). All of the associated peripheral equipment is completely new. The key input/output device, required in all System/3 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 certainly leads to reduced equipment costs and card handling time, but the complexity of the unit may also lead to increased maintenance problems.

The System/3 hardware is compact and well-designed. The basic 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.

Internal speed of the System/3 is suprisingly high. Its core storage cycle time is 1.52 microseconds per one-byte access. Moreover, its addition speed of 26 microseconds for two 5-digit operands is faster than that of the System/360 Model 30. Conversely, the System/3's maximum printing speed of 200 lines per minute will severely restrict its throughput in most applications, and its disk access speeds are relatively slow.

Designed mainly for "entry" users who are installing their first computers, the System/3 probably will largely supersede the IBM System/360 Model 20 and 1130 computers in this important phase of the market. The 1130 was designed as a small-scale scientific computer, but it has also been employed in many business applications where users were unable to afford a Model 20. The System/3, with its clear-cut orientation toward business data processing requirements, represents a far more appropriate choice than the 1130 for most installations of this type. The System/3 is considerably less expensive and easier to use than the System/360 Model 20, but it currently lacks the Model 20's capabilities for high-speed input/output, its data communication facilities, and its card, disk, and program compatibility with the larger System/360 models.

The System/3, as introduced, has comparatively little appeal to most companies that are already using ▷

INSTRUCTION REPERTOIRE: 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.

ADDITION TIME: For two 5-decimal-digit numbers: 26 microseconds.

OPTIONAL FEATURE: 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. (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 5410 Processing Unit to accommodate each of the standard peripheral devices.

INPUT/OUTPUT CONTROL

CONFIGURATION RULES: Every System/3 requires one 5410 Processing Unit, one 5203 Printer, and one 5424 Multi-Function Card Unit. In addition, a maximum of two 5444 Disk Storage Drives, one 1255 Magnetic Character Reader, and one 5471 Printer-Keyboard or 5475 Data Entry Keyboard can be connected.

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

MASS STORAGE

5444 DISK STORAGE DRIVE, MODELS 1, 2, & 3: 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 beneath the Multi-Function Card Unit. The following combinations of models and resulting capacities are available:

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	9,830,400 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.

The removable 5540 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. ▶

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Print Area

Punch Area

Tier 1

Tier 2

Tier 3

A full-size reproduction of the new 96-column IBM card, showing the punch patterns for each of the 64 characters.

computers—and this limited appeal is almost certainly by IBM plan rather than by accident. The system's current drawbacks can be summarized as follows:

- Little upward compatibility with the larger computers in IBM's current line.

- Incompatible with existing punched card equipment.

- No data communication facilities.

- No magnetic tape, paper tape, optical character recognition, or display-type input/output equipment.

- Slow printing and disk access speeds.

- No compiler for COBOL, FORTRAN, or PL/I.

- No "packaged" application programs.

- Extra charges for software, education, and systems engineering help.

IBM is encouraging most System/3 users to do all their application programming in the RPG II language. A Basic Assembler is available, but its price is comparatively high and its use is being actively discouraged. RPG II is available for both card and disk systems. The language is an extended version of System/360 RPG that should be capable of handling most business programming requirements quite effectively.

INPUT/OUTPUT UNITS

5424 MULTI-FUNCTION CARD UNIT (MFCU): 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, either of which can be used with any System/3 Processing Unit. Cards are read serially at 250 cpm in Model A1 and 500 cpm in Model A2. Punching is 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.

5203 PRINTER: Uses interchangeable horizontal-chain cartridges. Two models are available, either of which can be used with any System/3 Processing Unit. With the standard 48-character set, rated printing speeds are 100 lpm for Model 1 and 200 lpm for Model 2.

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.

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▷ To assist System/3 users in preparing their application programs, IBM offers a unique Application Customizer Service. 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. This approach to the application programming problem is a new and interesting one, but it is too early to judge whether most users will find it more or less valuable than the "ready-made" application programs offered by some competing manufacturers.

IBM's new 96-column card 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 in 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 this 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 new 96-column card is clearly easier to handle, less expensive, and more compact to store than the 80-column card. Nonetheless, its introduction has 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 existing punched card equipment. Its introduction by the industry leader may well make it the card of the future—but even IBM has already hedged its bets by offering to connect 80-column card equipment to the System/3 for some prospective users.

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 $155 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 $85 per month and a 1500-cpm model at $115 per month. ▷

▶ An optional Dual-Feed Carriage allows two sets of non-overlapped forms to be printed simultaneously, with each set under independent program control. Use of this feature reduces the number of print positions by 14.

5471 PRINTER-KEYBOARD: 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: 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.)

1255 MAGNETIC CHARACTER READER: Reads and sorts MICR-encoded documents at up to 500 six-inch documents per minute. Has 6 stackers, and requires one and one-half sort passes for each digit position. Handles documents from 2.5 to 4.25 inches in width, 5.75 to 8.875 inches in length, and 0.003 to 0.007 inches in thickness. Also usable for off-line sorting.

COMMUNICATION CONTROL

No data communication facilities have been announced for the System/3 to date.

SOFTWARE

SYSTEM CONTROL PROGRAMS: These programs, which "perform the systems control functions that are basic to every installation," are supplied with the system at no additional charge, in separate versions for card-oriented and disk-oriented configuration. (All other System/3 software is separately priced.)

CARD-ORIENTED SYSTEM CONTROL PROGRAMS: Consist of a User 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.

DISK-ORIENTED SYSTEM CONTROL PROGRAMS: Consist of 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, 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 and one 5444 Disk Storage Drive (Model 1 or 2). ▶

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▷ The System/3 certainly represents a worthy and provocative addition to the line-up of small-scale business data processing systems on the market. It will be interesting to observe the nature and timing of the announcements that are almost certain to come as IBM upgrades and broadens the capabilities of its new product line. □

► **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 programs. Requires a System/3 with at least 12K bytes of core storage, a 5424 MFCU, a 5203 Printer with the Universal Character Set feature and a 60-character chain, and one 5444 Disk storage Drive (Model 1 or 2).

RPG II (REPORT PROGRAM GENERATOR): This is the principal programming system for 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.

Two different versions of RPG II are offered:

CARD RPG II: Can be used on a minimum System/3 configuration consisting of an 8K Processing Unit, a 5203 Printer, and a 5424 MFCU. Permits full utilization of the capabilites of these three devices. 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.

DISK RPG II: Requires a System/3 with at least a 12K Processing Unit, one 5444 Disk Storage Drive (Model 1 or 2), a 5203 Printer, and a 5424 MFCU. Permits full utilization of the capabilities of these devices. Provides all the functions of Card RPG II plus disk-file data management facilities, automatic overlays for programs which exceed core storage capacity, and six other useful language extensions. Permits three basic types of disk file organization: sequential, indexed, and direct. With all three types of organization, processing may be either sequential or direct.

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). Requires a System/3 with at least a 12K Processing Unit, one 5444 Disk Storage Drive (Model 1 or 2), a 5203 Printer, and a 5424 MFCU.

CARD SYSTEM UTILITIES: A set of five 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.

DISK-RESIDENT CARD UTILITIES: These five programs perform the same functions as the Card System Utilities described above, but are designed for disk-resident operation on a 12K System/3 with a 5444 Disk Storage Drive.

1255 MAGNETIC CHARACTER READER UTILITY: Controls the reading of MICR-encoded documents, accumulates appropriate totals, and places the data from the documents on disk and/or printer files. Requires a 12K disk-oriented System/3.

APPLICATION CUSTOMIZER SERVICE: Instead of the usual "packaged" application programs, IBM is offering a new service called the Application Customizer which is designed to assist users in preparing programs to handle six common data processing applications: Order Writing and Invoicing, Accounts Receivable, Inventory Accounting, Sales Analysis, Payroll, and General Ledger.

The user defines his requirements by completing application-oriented questionnaires and report specification sheets. These are keypunched and fed into a System/360 Model 20 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.

PRICING ⁄

MINIMUM CARD SYSTEM: Consists of 8K Processing Unit, 5424 Model A1 MFCU, and 5203 Model 1 Printer (with 96 print positions). Monthly rental, $945. Purchase price, $42,375.

For the above configuration with the faster 5424 Model A2 MFCU and 5203 Model 2 Printer: Monthly rental, $1,145. Purchase price, $47,800. ►

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▶ **TYPICAL DISK SYSTEM:** Consists of 12K 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, $1,825. Purchase price, $77,525.

For the above configuration with a 32K Processing Unit: Monthly rental, $2,400. Purchase price, $105,700.

SOFTWARE: Monthly rentals for some of the basic System/3 software facilities are as follows: Card RPG II, $25; Disk RPG II, $35; Basic Assembler, $75; Card System Utilities, $10. One-time charges for the Application Customizer Service range from $180 to $265 per application.

SUPPORT: IBM Systems Engineering assistance is available to System/3 users at a basic charge of $22 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.

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

This overall view of a typical System/3 installation shows the 5203 Printer in the foreground, the off-line 5486 Card Sorter at far right.