

R 3/76

IBM System/32



Shown here in a hospital application, the System/32 features a compact, integrated design that makes it suitable for a variety of office environments. The central processing unit, main memory, disk file, and diskette I/O unit are all housed in the desk-sized console to the left of the keyboard and printer. When equipped with the Hospital Financial Management System software, the System/32 is designed to meet the data processing needs of small hospitals with approximately 50 to 150 beds.

MANAGEMENT SUMMARY

IBM started off 1975 with a flourish by announcing its newest and most economical entry in the small business computer market. Called the System/32, and designed and marketed by IBM's General Systems Division, the system can be rented for less than \$1,000 per month and is aimed at the vast number of potential first-time computer users. IBM defines the typical System/32 prospect as a business with sales in the range of from \$1 million to \$10 million and up to 250 employees. IBM expects the System/32 to be the biggest-selling computer system ever announced. The new system was introduced on January 7, 1975, with first customer deliveries scheduled to follow in just 60 days.

The System/32 was described by IBM representatives as "the easiest to operate, smallest, and lowest-priced general business computer ever announced by IBM." It achieves its small size through the use of state-of-the-art components and its ease of use through IBM-supplied Industry Application Programs that are delivered already compiled and debugged, with extensive prompting facilities to assist the operator. The System/32 can be programmed to perform either interactive or batch processing, using data entered either through the on-line

IBM's new System/32 is a low-cost, easy-to-operate, desk-sized computer. Developed for first-time computer users in small businesses, the System/32 comes equipped with preprogrammed Industry Application Packages designed to eliminate the need for an in-house programming staff. For users of larger computers, the System/32 offers interesting possibilities as an intelligent terminal.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, General Systems Division, 875 Johnson Ferry Road N.E., Atlanta, Georgia 30342.

MODEL: System/32.

DATA FORMATS

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

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

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

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

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

MAIN STORAGE

STORAGE TYPE: MOSFET (metal oxide semiconductor field effect transistor) integrated circuits.

CYCLE TIME: 600 nanoseconds per 1-byte access.

CAPACITY: 16,384 bytes standard in all models; expandable to 24,576 or 32,768 bytes through installation of one or two 8K Additional Storage modules.

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

RESERVED STORAGE: 2K bytes are reserved for SCP (System Control Programming) functions in all models; the remainder of main storage is available for user programming.

CENTRAL PROCESSOR

The System/32 central processing unit is a microprocessor that uses bipolar logic circuits and is physically located on a swing-open gate in the lower left front portion of the cabinet. The microprograms that control the processor's operations are stored in 8K bytes of MOSFET writable control storage.

ADDRESSING: The System/32 has two 16-bit index registers. The contents of either register can be added to a one-byte address (or "displacement") contained in an instruction, permitting base-plus-displacement addressing of any higher storage location within 256 bytes of the base address contained in the register.

IBM System/32

▷ operator keyboard or via diskettes prepared off-line, although no multiprogramming capability is currently provided for the system. Optional communications capabilities also allow it to operate as a remote terminal or as a satellite system within a communications network including larger IBM computers.

The System/32 is packaged as a compact, desk-sized configuration that includes all the components of the system—the central processing unit, memory, keyboard, CRT display, printer, disk storage unit, and diskette drive. It requires no special flooring, air conditioning, or power supplies, and can be plugged into a 208/230-volt electrical outlet right in the office. Since the computer is no longer sheltered in a computer-room environment, security from unauthorized access is provided by an optional keylock for turning on the system.

Ten models of the System/32 are available; they are distinguished by their various printing capabilities and disk storage capacities. The basic System/32 consists of a central processing unit with 16K bytes of metal oxide semiconductor (MOS) main memory, 5 million bytes of non-removable disk storage, a printer, keyboard console, CRT display screen, and single diskette I/O drive. Main memory for all central processor models can be increased to a maximum of 32K bytes, in 8K increments.

The System/32 customer can select a bidirectional serial printer with a print speed of either 40 or 80 characters per second or one of three 132-position line printers with a speed of 50, 100, or 155 lines per minute. The serial printers can be used to produce output on ledger cards or other individual forms similar to those processed by typewriters. At present, however, the System/32 lacks the split platens, single-form feed chutes, magnetic-stripe readers, and other flexible forms-handling facilities offered by many of the competitive small accounting computers. Only one printer can be used in a System/32 configuration.

Non-removable disk storage is provided in a capacity of either 5 million bytes or 9.1 million bytes. Off-line and back-up storage for additional data files is provided by IBM diskettes (or “floppy disks”), which are priced at \$8 each and have a capacity of up to 246,272 bytes of data in the System/32 format or 303,104 bytes in a special “extended” format. The diskette also serves as the sole vehicle for data entry, aside from the console keyboard, and has a capacity of 242,944 bytes when data is recorded off-line using an IBM 3740 Data Entry System. Both punched-card peripherals and magnetic tape capabilities were noticeably absent from the System/32 announcement, as well as any facilities for reading MICR- or OCR-encoded documents.

The central processor utilizes bipolar logic and features an 8K-byte MOSFET writable control storage unit to contain the microcode that controls the operation of the system. Data is represented in 8-bit bytes in EBCDIC format. IBM specifies that the average microcode-level instruction ▷

▶ **INSTRUCTION REPERTOIRE:** The System/32 has a repertoire of 61 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. More than half of the 61 instructions are used for input/output handling.

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

| | |
|--------------------------------------|--------------|
| Decimal add (5 digits): | 150.8 |
| Decimal subtract (5 digits): | 150.8 |
| Binary (logical) add (5 bytes): | 72.0 |
| Binary (logical) subtract (5 bytes): | 71.4 |
| Move (5 bytes): | 42.6 |
| Compare (5 bytes): | 56.2 |
| Load or store register (2 bytes): | 19.8 to 25.2 |
| Add to register (2 bytes): | 26.2 to 38.2 |
| Jump on condition: | 26.2 or 28.8 |

INTERRUPTS: At the end of most I/O operations, the microprocessor issues a signal that the operation has ended and causes the program to branch to a special interrupt handler routine. Interrupts for the disk drive and printer are handled entirely by the hardware, while programs must be provided to handle keyboard interrupts.

PHYSICAL SPECIFICATIONS: The 5320 System Unit, a single desk-size cabinet that houses all components of the System/32, is 70 inches wide, 27 inches deep, and 38 inches high. It weighs 640 pounds. The system requires access to one grounded 208/230-volt electrical outlet for system power and one grounded 115-volt outlet for IBM testing equipment. Air conditioning is not required for the system except in extreme operating environments, but IBM recommends normal office air conditioning for operator comfort.

INPUT/OUTPUT CONTROL

CONFIGURATION RULES: Every System/32 consists of a single desk-size cabinet that houses the central processing unit, main storage, fixed-disk storage unit, diskette drive, serial or line printer, keyboard console, and display screen. The ten current models of the System/32 are distinguished by their printing capabilities and disk storage capacities, as shown in the following matrix:

| | 5.0 million bytes disk storage | 9.1 million bytes disk storage |
|---------------------------|--------------------------------------|--------------------------------------|
| 40-cps serial printer: | Model A12 | Model A13 |
| 80-cps serial printer: | Model A22 | Model A23 |
| 50-lpm line printer: | Model B12 | Model B13 |
| 100-lpm line printer: | Model B22 | Model B23 |
| 155/120-lpm line printer: | Model B32 | Model B33 |

All models have a basic main storage capacity of 16K bytes, which can be expanded to 24K or 32K bytes, and all models can be equipped for data communications by installing either the SDLC or BSCA feature, as described under COMMUNICATIONS CONTROL. Only one input/output unit of each type can be used in a System/32, and no other on-line peripheral equipment is available for use with the system at this writing.

SIMULTANEOUS OPERATIONS: All System/32 input and output operations are overlapped with each other and with internal processing, except for diskette reading and writing.

MASS STORAGE

DISK STORAGE: A disk unit containing either 5,053,440 or 9,169,920 bytes of non-removable disk storage is an integral component of every System/32. The disk unit consists of either 164 or 298 cylinders of 2 tracks each. Each track, in turn, contains 60 sectors of 256 bytes each. All data is recorded on one side of a single fixed disk that is served by two read/write heads mounted on a pivoting access arm. The disk is mounted vertically in the lower left ▶

IBM System/32

▷ time is 1000 nanoseconds. Program instruction execution times, however, are considerably slower than those of the System/3, with a decimal add of 5 digits requiring approximately 150 microseconds on a System/32 as compared to approximately 24 microseconds on a System/3 central processor. Other noteworthy performance parameters of the System/32 include the ability to overlap input/output processing with internal processing (except for diskette operations), a transfer rate of 889,000 bytes per second between the disk file and main memory, and a 600-nanosecond main memory cycle time.

A System/32 can be equipped with only one communication line at present, enabling it to handle half-duplex data transmission in either the binary synchronous (BSC) mode or IBM's new Synchronous Data Link Control (SDLC) protocol. In the binary synchronous mode, it can communicate with another System/32, a System/3, System/7, System/360, System/370, or an IBM 3741 Model 2 Data Station or 3741 Model 4 Programmable Work Station. The SDLC line discipline is a fundamental component of IBM's recently announced System Network Architecture for future communications products. Thus, System/32 users can expect to be compatible with the present and future IBM communications offerings. SDLC on the System/32 will enable it to perform as a remote workstation to larger System/370 computers operating under the DOS/VS, OS/VS1, or OS/VS2 operating system.

IBM claims that System/32 is so easy to use that it can be operated by clerical personnel with a minimum of training and will not require the services of a programming staff. To make that possible, IBM is supplying separately priced Industry Application Programs (IAP's) that contain all the coding necessary to get a user installation up and running, plus operator run books and training materials to aid the operator in understanding the functions of each application package. Five such packages are currently available, aimed at users in construction, wholesale food, wholesale paper and office products, hospitals, and membership organizations and associations. The Industry Application Programs include routines to perform billing, order entry, invoicing, accounts receivable, and payroll, plus additional functions such as inventory control, job costing, membership mailing lists, etc., that are unique to each industry area. All of the currently available IAP's will execute on a minimum System/32 configuration with 16K bytes of main memory. More such program packages can be expected as IBM gets its System/32 marketing campaign underway.

Operating system support is supplied by a small, 2K-byte System Control Program plus a separately priced utility program product that includes a Sort Utility, a Data File Utility, and a Source Entry Utility. The SCP and Sort utility capabilities are similar to those for the System/3 Model 6. For those users who wish to write their own programs, RPG II, the only programming language announced for the System/32, also provides processing capabilities similar to those of the System/3 Model 6 ▷

▶ part of the System/32 cabinet, behind the CPU logic and main memory.

The disk rotational speed is 2964 rpm, yielding a nominal data transfer rate of 889,000 bytes per second and an average rotational delay (latency) of 10.1 milliseconds. Head positioning times for the two models, in milliseconds, are as follows:

| | Average | Minimum | Maximum |
|--------------------|---------|---------|---------|
| 5.0-megabyte unit: | 70 | 13 | 180 |
| 9.1-megabyte unit: | 72.5 | 14.2 | 167 |

INPUT/OUTPUT UNITS

DISKETTE DRIVE: A single drive unit that reads and writes data on flexible diskettes is an integral component of every System/32. The IBM diskette (or "floppy disk") is a small, flexible, reusable magnetic disk that is permanently enclosed in a protective jacket about eight inches square and a fraction of an inch thick. The data capacity of each diskette is 242,944 bytes (1898 records of 128 bytes each) when used to exchange data between a System/32 and a 3740 Data Entry System or other IBM equipment. Diskettes to be used exclusively with a System/32 can contain up to 246,272 bytes of data in the standard format (128-byte sectors) or 303,104 bytes in "extended" format (512-byte sectors).

Data is read from or written on a diskette at a nominal speed of 31,250 bytes per second. Diskette records can be read at the rate of up to 3400 128-byte records per minute and written and verified at up to 1800 128-byte records per minute.

KEYBOARD: The System/32 keyboard is used by the operator to enter data and control the system's functions. It consists of a standard typewriter keygroup, a 10-key numeric keygroup arranged in adding-machine fashion, and a group of function keys. In addition, the typewriter keys in the top row are dual-defined, providing a total of 24 command keys for controlling program functions.

A small operator panel, located at the right of the keyboard, contains the power on/off switch; LOAD, START, and STOP keys; and indicator lights that signify Keyboard Ready, Processor Check, Thermal Check, and Power Check conditions. The power on/off switch can be replaced by an optional key-operated switch that protects against unauthorized use of the system.

DISPLAY: A small CRT display screen, located just to the left of the keyboard and printer, is an integral component of every System/32. It can display up to 240 characters of information in 6 lines of 40 characters each. The display is used to provide operator guidance, input verification, and auxiliary output under program control. The System/32 will normally be programmed to display all data entered via the keyboard so that the operator can verify its accuracy before the system acts upon it.

SERIAL PRINTER: A bidirectional serial matrix printer, rated at either 40 or 80 characters per second, is an integral component of every System/32 Model A. Matrix characters are formed by 8 wires arranged in a vertical array, with each wire printing dots in up to 4 of 7 possible horizontal positions. The character set consists of 64 symbols, and there are 132 print positions, spaced 10 to the inch. Vertical spacing is 6 lines per inch. A variable-width forms tractor feeds continuous forms ranging from 3-1/2 to 14-7/8 inches in width. Forms with up to 6 parts and a maximum thickness of 0.018 inch can be handled. Ledger cards and other pre-cut forms can be processed singly in typewriter fashion.

LINE PRINTER: A horizontal-belt line printer is an integral component of every System/32 Model B. The rated printing speed, in lines per minute, depends upon the specific model and character set chosen, as follows: ▶

IBM System/32

▷ version, including the Auto Report and RPG II Telecommunications Feature.

In fact, in designing the System/32, IBM borrowed substantially from the System/3 Model 6, its earlier offering in the small "office computer" sweepstakes. The data representations and instruction repertoires of the two systems are quite similar, and several of the System/32 software products, as mentioned above, are adaptations of the products originally supplied for the System/3 Model 6. IBM, however, also took account of many of the limitations of the Model 6 and developed an improved package that is available for a considerably lower price. System/32 performance enhancements include the following:

- Data entry on the System/3 Model 6 is performed one character at a time through the keyboard, or via the relatively slow optional Data Recorder. On the System/32 IBM has incorporated a diskette drive that reads data from IBM diskettes at a rate of 3400 128-byte records per minute.
- The System/32 features a selection of line printing speeds ranging from 50 to 155 lines per minute, a considerable improvement over the 70-lpm maximum provided by the serial printer in the System/3 Model 6.
- System/3 Model 6 commercial users who write their programs in RPG II are required to learn a fairly complicated system control language called the Operation Control Language (OCL) to provide the instructions needed for program execution. Basically the same OCL is used on the System/32, but it is supplied to the user in cataloged procedures accompanying the application programs and can be invoked through simple operator commands. (Users who write their own programs in RPG II, however, must still cope with the OCL.)
- When it was initially introduced, the Model 6 had little in the way of supporting application software to ease the way into data processing for first-time computer users. In contrast, Industry Application Programs for five targeted industry sectors, several of which are derivatives of IBM Field Developed Programs and Installed User Programs for the System/3, played an important role in the System/32 announcement. These packages have varying facilities for customizing the programs through user questionnaires, but the Application Customer Service and Application Programming Service introduced by IBM to aid System/3 users in developing their own programs for "bread and butter" business applications are not currently offered to System/32 users. System/32 customers receive their IBM-supplied software in the form of object code, thus relieving them of the task of compiling and debugging the programs.

Although the System/32 obviously isn't meant by IBM to be a replacement for the more costly System/3, the high ▷

| | <u>48-Character Set</u> | <u>64-Character Set</u> |
|-------------------|-------------------------|-------------------------|
| Models B12 & B13: | 50 | 50 |
| Models B22 & B23: | 100 | 100 |
| Models B32 & B33: | 155 | 120 |

Characters are formed by means of an interchangeable metal print belt with an engraved type font in one of three character sets: 48-character EBCDIC, 64-character EBCDIC, or 64-character ASCII. There are 132 print positions, spaced 10 to the inch. Vertical spacing is 6 lines per inch. A variable-width forms tractor feeds continuous forms ranging from 3-1/2 to 14-7/8 inches in width. Forms with up to 6 parts and a maximum thickness of 0.020 inch can be handled. The use of card stock is not recommended.

3740 DATA ENTRY SYSTEM: This key-to-diskette system, which is fully described in Report 70D-491-41, can be used off-line to record data on diskettes for entry into a System/32 via its integral diskette drive. Alternatively, a 3741 Model 2 or Model 4 can communicate directly with a System/32 equipped with the Binary Synchronous Communications Adapter (BSCA).

The basic components of a 3740 Data Entry System are the 3741 Data Station, 3741 Programmable Work Station, and 3742 Dual Data Station. The 3741 Model 1 and 2 Data Stations are alike except that Model 2 includes a binary synchronous communications interface. The 3741 Model 3 and 4 Programmable Work Stations are like the 3741 Models 1 and 2, respectively, with the addition of user programming capability. All models can be equipped with a 40-character-per-second 3713 Printer or a 155-line-per-minute 3717 Printer.

Every 3741 Data Station or Programmable Work Station includes a microprocessor, a CRT unit for data, control, and status display, and a diskette drive; a second drive can be added. The 3742 Dual Data Station provides two operator stations that have independent diskette drives but share the CRT unit and microprocessor.

All models of the 3741 and 3742 provide facilities for recording manually keyed data on diskettes and for verifying previously keyed data. Each diskette can hold up to 1,898 data records, and the records can vary from 1 to 128 characters in length.

COMMUNICATIONS CONTROL

SYNCHRONOUS DATA LINK CONTROL (SDLC) COMMUNICATIONS: This optional feature, in conjunction with stored-program control, enables a System/32 to communicate with a System/370 Model 115, 125, 135, 145, 155-II, 158, 165-II, or 168 computer via an appropriately equipped 3704 or 3705 Communications Controller. The System/370 must be operating under DOS/VS, OS/VS1, or OS/VS2 VTAM, and the 3704 under NCP/VS.

The SDLC feature enables the System/32 to communicate in half-duplex mode at a speed of up to 7200 bps on a single non-switched point-to-point or multipoint line, or at up to 4800 bps on a switched point-to-point line. The System/32 operates as an SDLC secondary station and can share a communications line with other IBM SDLC terminals using the same transmission rate. Data transmission or reception is overlapped with System/32 processing and/or I/O operations other than diskette reading or writing.

Only one SDLC feature can be installed on a System/32, and the SDLC and BSCA features are mutually exclusive. A prerequisite is either one of the IBM integrated modems or the EIA Interface, as described below.

BINARY SYNCHRONOUS COMMUNICATIONS ADAPTER (BSCA): This optional feature, in conjunction with stored-program control, enables a System/3 to function as a processor/terminal communicating with any of the following IBM devices:

- Another System/32 equipped with the BSCA. ▶

IBM System/32

▷ degree of compatibility between the two systems should make conversions fairly easy. System/3 programs written in RPG II must be modified to account for new System/32 input/output devices and recompiled on a System/32. System/3 card and tape data files can be converted at an IBM data center and returned to the customer in System/32-acceptable format on diskettes.

A System/3 Model 8 or Model 15 will be a natural choice for customers who outgrow their System/32 configurations, and conversions from a System/32 to a System/3 are performed in the same straightforward manner described above. For either conversion, data files can be transmitted to the data center over a binary synchronous communications line, and IBM states that such conversions can be performed within the regular 75 hours of test time allotted to each System/32 customer.

The System/32 incorporates design concepts and components that are aimed at providing a high degree of reliability. In contrast to the other computers in its product line, IBM claims that the System/32 requires no regular preventive maintenance. Diagnostics supplied with the system are executed each time the system is initialized and can isolate most central processor malfunctions to an easily replaceable circuit board. The System/32 disk file incorporates a new arm movement technique designed to prolong its operation. The entire disk file is packaged in an airtight module to eliminate errors or malfunctions resulting from dust; in the event of a disk failure, the entire module can be removed and replaced by a new one with a minimum of time and effort. System/32 customers who rent the equipment have access to 24-hours-per-day, 7-days-per-week on-call maintenance service from IBM. Customers who purchase the system receive 5-days-per-week, 9-hours-per-day maintenance service under the Minimum Monthly Maintenance Charge, or they can elect round-the-clock service for an additional charge.

With the System/32 announcement, IBM also unveiled a new Term Availability Plan that offers a saving of approximately 5% in first-year monthly rental charges to customers who select a three-year lease contract. The three-year lease represents a departure in IBM pricing policy in that IBM reserves the right to increase the monthly charges by up to 5% during both the second and third years of the lease term.

With equipment rental prices for a basic configuration ranging from \$770 to \$1,085 per month under the Term Availability Plan, the System/32 promises to be a strong contender in the race to woo small businesses into the fold of computer-based data processing. Datapro considers the System/32 to be one of IBM's most significant announcements since the System/3 and predicts that it will substantially enlarge the market for small-scale computer systems, both for IBM and for resourceful competitors. □

- ▶ ● A System/3, System/7, or System/360 Model 20 computer equipped with a BSCA.
- A System/360 or System/370 computer via an Integrated Communications Adapter, 2701 Data Adapter Unit, or 3704 or 3705 Communications Controller equipped for binary synchronous communications.
- A 3741 Model 2 Data Station or 3741 Model 4 Programmable Work Station.

The BSCA feature enables the System/32 to communicate in half-duplex mode at a speed of up to 7200 bps on a single non-switched point-to-point or multipoint line, or at up to 4800 bps on a switched point-to-point line. The transmission code may be ASCII, EBCDIC, or EBCDIC Text Transparency, as selected at program compilation time. Data transmission or reception is overlapped with System/32 processing and/or I/O operations other than diskette reading or writing.

The BSC devices at all termination or drop points of a data link to which the System/32 is connected must use the same transmission rate, code, and clocking source (modem or business machine). When used on a multipoint line, the System/32 operates as a BSC tributary station; it is not supported for operation as a control station. Therefore, communications with other BSC devices which do not have control station capability must be accomplished via a non-switched point-to-point line.

Only one BSCA feature can be installed on a System/32, and the BSCA and SDLC features are mutually exclusive. A prerequisite is either one of the IBM integrated modems or the EIA Interface, as described below.

INTEGRATED MODEMS: IBM offers a choice of five integrated modems for use with a System/32 equipped with either the SDLC or BSCA feature. Their characteristics can be summarized as follows:

- #5500—1200 bps, non-switched.
- #5501—1200 bps, switched network with Auto Answer.
- #5600—2400 bps, non-switched point-to-point.
- #5602—2400 bps, non-switched multipoint tributary.
- #5610—2400 bps, switched network with Auto Answer.

Only one integrated modem can be installed in a System/32, and the Processing Unit Expansion feature is required when any one of the three 2400 bps modems is chosen. The optional Switched Network Backup (SNBU) feature, available with or without an Auto Answer capability, provides for backup attachment of the System/32 to the public switched network when one of the 2400 bps integrated modems (#5600 or #5602) is used on a non-switched line as the prime communications link.

EIA INTERFACE: This feature can be chosen as an alternative to the IBM integrated modems for use with a System/32 equipped with either the SDLC or BSCA feature. It provides a cable and interface that meet the EIA RS-232C specifications and permit the attachment of an external modem supplied by IBM or another vendor. If the modem does not provide its own clocking, the Internal Clock feature, which provides a clocking speed of 600 or 1200 bps, is also required. IBM modems that can be connected to the EIA Interface include the 3872 Model 1 (2400/1200 bps), 3874 Model 1 (4800/2400 bps), and 3875 Model 1 (7200/3600 bps).

SOFTWARE

SYSTEM CONTROL PROGRAM: The System/32 System Control Program (SCP) includes a supervisor that occupies 2K bytes of main memory and provides the basic facilities that permit selective loading of programs from the disk, control all input/output operations, provide a program rollout/rollin capability, and provide support for data communications transmission.

Communication between the user and the SCP is provided through an Operation Control Language (OCL). These statements provide the system with information on how a ▶

IBM System/32

► job should be executed, such as the names of files to be processed, where the files are located, and what program to load. Normally, the collection of OCL statements required to direct the execution of a job is stored in procedures in disk storage and can be invoked by entering simple commands through the operator keyboard. Procedures are also supplied for execution of the utility programs that accompany the System Control Program and for the Industry Application Programs available to System/32 users. New procedures can be developed for user-written applications programs and specialized operations. The System/32 OCL has the capability to prompt the operator to supply required parameters or to specify default values for missing OCL parameters, as well as a logical IF statement that initiates execution of jobs based on conditions tested by the OCL.

Control of all I/O operations is provided by SCP data management routines. Support is provided for the CRT display, the keyboard (including the capability to recognize and interpret special function and command keys), the printer, and the disk unit. The diskette is supported by a Load/Dump utility only. Disk files can be organized in sequential, indexed sequential, or direct fashion.

A rollout/rollin capability is provided to suspend processing programs in order to allow an inquiry to be made into the file. The executing program is rolled out to disk storage, the inquiry program is executed, and the interrupted processing program is then returned to main memory to resume processing.

The SCP maintains a system history area on the disk that contains a log of recently executed OCL statements and system activities. The contents of the history area may be displayed on the operator console and printed if desired to provide a record of system processing activity.

Utility programs supplied with the SCP assist the user in preparing and maintaining his disk files. The programs provided include Disk Initialization, Alternate Track Assignment, Alternate Track Rebuild, File and Volume Display, and File Delete. In addition, a set of routines is provided to permit copying of data, programs, and procedures from the diskette to the disk file and to transfer such information from the disk file to the diskette to provide back-up files and off-line storage. The entire system library, selected files, or portions of files can be transferred to diskette files. In order to provide sufficient contiguous storage space for creation of new files, the operator can invoke the COMPRESS OCL procedure to reorganize the contents of the disk file in a contiguous area next to the systems library. The SAVE procedure allows one file or all files to be transferred to diskette with a specified retention period. Files can also be added to existing files saved previously on diskette. Both single- and multiple-volume diskette files can be created. The DELETE procedure permits files to be removed from disk storage to create space for new members.

COMMUNICATIONS SOFTWARE: Initial communications software for the System/32 will consist of the RPG II Telecommunications Feature, which provides support for transmission and reception of binary synchronous data over voice-grade or high-speed communications lines. This feature permits a System/32 to operate in any of the following communications modes: receive only, transmit only, receive with conversational reply, or alternate transmit and receive file. The RPG II Telecommunications Feature permits a System/32 executing programs written in RPG II to function as a terminal in one of three types of networks: point-to-point switched, point-to-point non-switched, or multipoint. The System/32 Binary Synchronous Communications support also includes a system utility that permits communications characteristics, such as the line type, line speed, terminal address, and number of error retries, to be specified at program execution time. System/32 Binary Synchronous Communications support is scheduled for release in May 1975.

A System/32 batch workstation capability that will permit the System/32 to operate in a communications network

with System/370 computers was announced for later release. The batch workstation utility program will operate with IBM's Synchronous Data Link Control (SDLC) protocol and will enable System/32 computers to perform as remote workstations to System/370 Models 115 through 168 that are equipped with 3704 or 3705 Communications Controllers operating under the Network Control Program. This utility program permits the System/32 to transmit jobs to a System/370 computer and receive output from the central system upon completion of the job. In addition, the System/32 can receive multiple jobs, including control language and data, from a System/370 computer for execution at the local site. The batch workstation utility also includes provisions for compressing blanks and duplicate characters to ensure more efficient data transmission and to expand compressed data transmitted from the central system. A minimum of seven buffers, each 256 bytes in size, are provided.

The SDLC Workstation Utility for communication with System/370 computers operating under control of the OS/VS1 operating system with Remote Entry Services (RES) is scheduled for release in May 1976. A version of the utility that will permit communication with the DOS/VS operating system with POWER/VS is scheduled for delivery in August 1976, and the OS/VS2 with Job Entry Subsystem 2 (JES 2) version is scheduled for delivery in November 1976.

SYSTEM/32 UTILITIES PROGRAM PRODUCT (5725-UT1): In addition to the file management utilities supplied with the SCP control program, IBM offers a System/32 Utilities Program Product that provides basic data base management capabilities. This separately priced program product consists of three programs: Data File Utility (DFU), Sort, and Source Entry Utility (SEU). The Sort program is similar in function to the System/3 sort, while the DFU and SEU programs are newly written for the System/32.

The Data File Utility (DFU) program provides the following data base management functions: data file creation and maintenance, data file inquiry, and data file list. All three functions utilize catalogued RPG II File Description and Input Specifications so that the operator need enter only the name of the file and the name of the catalogued RPG II specifications. The utility prompts the operator to enter additional information required to tailor the program to the user's processing requirements.

The Data File Creation and Maintenance function of DFU operates only on indexed sequential files and provides facilities for creating and updating user data files. The program prompts the operator by displaying the field name for the data to be entered on the display console. When updating is being performed, the data currently in the field is displayed to assist the operator. Other features include automatic duplication of fields, control totals, generated record keys, and modulus 10 and 11 self-check digits for verifying entered data.

The Data File Inquiry function of DFU allows inquiries into indexed sequential files. Retrievals are performed by record key, and a function key can be used to roll forward or backward in key sequence through the file. Selected records can be printed with page and column headings.

The Data File List function of DFU provides a report-writing capability for listing and summarizing selected information from indexed or sequential files. Selection of records is based on record types defined in the RPG II input specifications for the file, and the file can be sorted in either ascending or descending order prior to printing. Output reports include page and column headings, edited data fields, and selected column totals with up to three levels of subtotals.

The System/32 Sort Utility provides basically the same functions as the System/3 sort. Disk files can be sorted in ascending or descending sequence. The Sort program accepts files organized in sequential, indexed, or direct order. It can select records based on a comparison of the contents of a field with a constant or another field or a tag sort in which only the control field and a record address are

IBM System/32

► retrieved. A summary sort groups records with similar control fields and summarizes designated numeric fields into a single summary record. The Sort program automatically allocates disk space for a work file and can handle indexed, direct, and sequential file organizations.

The Source Entry Utility (SEU) program can be used to create and maintain user-written OCL procedures, RPG II source code statements, and Sort source code statements. The SEU is accompanied by Sort, RPG II, and Auto Report format descriptions to aid the user in entering source statements correctly. Functions include the capability to move statements within source or procedure members, to include library source or procedure members in new members, to insert up to 99 new statements into an already-existing member, and to delete selected statements. A function key can be used to roll backward or forward through the code to locate a selected statement. A record being entered or updated is displayed on the operator display screen as the data is entered. Optional functions available with SEU are the capability to perform syntax diagnosis on RPG II and Auto Report source statements as they are entered and the capability to resequence statements in a source-code member.

RPG II (REPORT PROGRAM GENERATOR; 5725-RG1):

RPG is currently the only programming language available for the System/32. The programmer, using up to six different preprinted coding forms, 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. RPG II for the System/32 offers essentially the same features as the System/3 Model 6 RPG II, with variations in the data management facilities for the support of System/32 input/output devices. For example, the SET/KEY display support feature provided with the System/3 Model 6 has been replaced by an operator prompting function that can display messages stored in a program or in the system library. In addition, the System/32 RPG II Interactive Data Entry (IDE) function permits the console to be used as an interactive data entry device. Data can be entered through the system keyboard, displayed for reference on the display screen, and routed to an executing RPG II program for processing. The program provides operator prompting on the CRT display. A program can be assigned one IDE file, which can accommodate various types of records from 4 to 160 characters in length. The IDE program is automatically generated by RPG II when CONSOLE is specified as the Device on the File Description Sheet.

RPG II AUTO REPORT FEATURE: This optional enhancement of System/32 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 System/32 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/32 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/32 can function as a terminal in one of three types of networks: point-to-point switched, point-to-point nonswitched, or multi-point.

INDUSTRY APPLICATION PROGRAMS

The initial System/32 software complement includes five Industry Application Programs that provide routines to

perform the data processing functions required by small businesses in the selected industry areas. Each Industry Application Program package also includes detailed operator instructions and the OCL procedures required for execution of the programs. All Industry Application Programs are written in RPG II and are distributed on IBM-owned diskettes. Various techniques are provided for tailoring the programs to satisfy specialized user requirements.

WHOLESALE FOOD DISTRIBUTION ACCOUNTING AND MANAGEMENT SYSTEM (5605-D61): Designed specifically to meet the requirements of the wholesale food industry, this package includes programs that perform billing, inventory control, accounts receivable, and sales analysis. Functions performed by the Billing system include order entry and editing, production of slot-sequenced picking documents for warehouse operations or case labels, customer invoices, an audit trail of daily billing activities, and a daily summary of each salesperson's activity. Other information provided by the Billing program includes the provision of multiple pricing options, special allowance notations, suggested retail prices, and automatic substitutions and special offers. The Billing program accumulates accounts receivable information that is later available to the Sales Analysis, Inventory Control, and Accounts Receivable programs for further analysis and evaluation.

The Inventory Control programs maintain perpetual inventory and "on-order" status for each item in inventory. A weekly buyer's report provides data on sales by item and inventory demand and movement. Reports on inventory activities, including inventory turns, profitability, and stockouts, can be prepared on a weekly or monthly basis or on demand. The Sales Analysis programs produce reports on the sales activities and performance of individual items, sales personnel, and customer activities. Either detailed or summary reports can be selected. The Accounts Receivable program uses data accumulated by the Billing program to produce weekly and monthly statements and aging reports. The programs handle both open-item and balance-forward customer accounts and print a copy of the aged trial balance on demand. Delinquent notices are automatically prepared for monthly delinquent accounts.

The Billing, Inventory Control, Accounts Receivable, and Sales Analysis programs are tailored to individual customer requirements through the use of a questionnaire that permits the user to select optional functions and reports and to tailor file volumes and data field sizes. The Wholesale Food Distribution Accounting and Management System requires the System/32 System Control Program and the Utilities Program Product for execution, and is scheduled for initial release in March 1975.

SYSTEM/32 MEMBERSHIP AND MAILING LIST

SYSTEM (5725-K11): These programs provide the capability to establish interrelated data files to handle membership dues accounting, publication accounting, information exchange, and event participation accounting. The programs prepare invoices for membership dues and for publications, maintain lists of chapter memberships, produce dynamic listings of the membership base for analysis, and handle receipts of dues and publication payments. Membership identification cards, 3 x 5 information cards, and membership rosters can be produced. User-defined membership codes of up to 11 characters can be used. Dues and special charges can be calculated by an individual rate per member, by class of membership, or by a set rate for all members. Mailing functions include label preparation and mailing lists based on user-specified criteria, circulation and postal zone summary reports, and agency distribution of publications. In addition, a record of individual participation in association-sponsored events can be accumulated, and a statistical summary of membership participation maintained. The ANALYZE command permits interrogation of the data base to produce selective membership mailings, dynamic membership lists, and statistical profiles of the organization membership.

If only membership dues administration and mailing functions are desired, a minimum System/32 configuration can accommodate approximately 13,000 to 15,000 ►

IBM System/32

► members. Interactive file maintenance facilities include automatic updating of all files with one transaction, periodic updating by member class to maintain membership codes, special charges and dues, and individual updating of selected records. The Membership and Mailing List System is scheduled for release in April 1975 and requires the System/32 Systems Control Program and the Utilities Program Product.

SYSTEM/32 CONSTRUCTION MANAGEMENT ACCOUNTING SYSTEM (CMAS): This industry application package consists of the following four programs: Job Costing (5725-M61), Accounts Payable (5725-M62), Payroll (5725-M63), and General Ledger (5725-M64). These programs provide a wide variety of accounting and management reports for single- or multi-company organizations. Reports produced by the Payroll program, in addition to paychecks and employee earnings statements, include payroll registers containing totals of employee hours worked and data on deductions and gross and net pay, a labor cost report for each job, and reports on workmen's compensation and insurance and union contributions. Job Cost Analysis produces reports on actual cost of materials, labor, subcontracting activities, and overhead compared to estimated costs. The system also provides a selection of financial management reports associated with general ledger accounting. Facilities for tailoring the programs permit the system to accommodate company growth. Use of the Construction Management Accounting System requires the System/32 System Control Program and the Utilities Program Product. The scheduled availability date for CMAS is February 1975.

SYSTEM/32 HOSPITAL FINANCIAL MANAGEMENT SYSTEM (HFMS): This system is designed to handle the information processing needs of small hospitals with capacities ranging from 50 to 150 beds. Four programs are included in the package: Patient Billing (5725-H11), Accounts Receivable (5725-H12), Payroll (5725-H13), and General Ledger/Accounts Payable (5725-H14). The programs produce daily census reports on patient statistics, admissions and outpatient visits, and accounts receivable transactions.

The Patient Billing system automatically generates reports on room charges and provides daily general ledger revenue summaries for input to the General Ledger/Accounts Payable programs. The General Ledger/Accounts Payable system is based on the standard AHA chart of accounts and can be tailored to fit user charts of accounts with up to seven-digit account codes. The system provides monthly financial reports, general ledger trial balances, and accounts payable functions. The Accounts Receivable program permits daily posting, reporting, and control of all accounts receivable transactions, and can accept keyed entry of data on new accounts or automatic entry of new accounts from the Patient Billing program. The Payroll program handles hourly or salaried employees on a biweekly payroll period. The system can accommodate up to ten rates and voluntary deductions per employee and one non-federal tax routine. Other reports include accrued benefits, personnel status, labor distribution, and automatic preparation of input to the General Ledger/Accounts Payable system.

The Hospital Financial Management System requires the System/32 System Control Program and the Utilities Program Product. The complete package is scheduled for availability in April 1975.

SYSTEM/32 PROFIT AND ASSET MANAGEMENT SYSTEM FOR PAPER MERCHANTS AND OFFICE PRODUCTS DISTRIBUTORS: This industry application package is available in two versions: Billing, Accounts Receivable, and Sales Analysis (BARSA)—5605-D41; and

Billing, Inventory Control, Accounts Receivable, and Sales Analysis (BICARSA)—5605-D42.

The Billing program includes order entry and editing and preparation of invoices and price lists using a number of pricing options. Output from the Billing application is accumulated for use by the Inventory Control, Sales Analysis, and Accounts Receivables applications. The Inventory Control program provides weekly and monthly reports on inventory movement and status, while the Sales Analysis program produces summaries of item, item class, customer, and salesman activity. The Accounts Receivable program supports both open-item and balance-forward customers and on-demand printing of the aged trial balance.

These application programs use a questionnaire for selection of optional functions and reports and to tailor file volumes and data field sizes. Printing control options permit selection of printed items at program execution time. Both the System/32 System Control Program and the Utilities Program Product are prerequisites for execution. Version 1 of the Profit and Asset Management System is scheduled for availability in March 1975. Version 2, which will provide more flexibility, is scheduled for release in June 1975.

PRICING

EQUIPMENT: The following two systems illustrate the limits of non-communications-oriented System/32 configuration possibilities. No software is included in the indicated prices.

MINIMUM SYSTEM: Consists of 5320 Model A12 System Unit, including 16K bytes of main storage, 5.0 million bytes of disk storage, diskette drive, 40-cps serial printer, keyboard, and display. Monthly rental, \$809 (1-year lease) or \$770 (TAP). Purchase price, \$33,100.

EXPANDED SYSTEM: Consists of 5320 Model B33 System Unit with 32K bytes of main storage, 9.1 million bytes of disk storage, diskette drive, 155-lpm line printer, keyboard, and display. Monthly rental, \$1,239 (1-year lease) or \$1,181 (TAP). Purchase price, \$44,800.

SOFTWARE: System/32 users receive the basic System Control Program at no additional cost. All other IBM software, including RPG II and the Industry Application Programs, is separately priced, with the Industry Application Programs having both an initial charge and a monthly license charge. The Industry Application Programs are supplied on IBM-owned diskettes, include documentation, operator manuals, and instructional materials, and are maintained by IBM.

CONTRACT TERMS: IBM offers the System/32 on a purchase or rental basis. Two rental policies are available, the standard Monthly Availability Charge (MAC) and the newly announced System/32 Term Availability Plan (TAP). The TAP has a contract duration of 36 months and has a first-year monthly charge that is approximately 5 percent lower than the Monthly Availability Charge. The TAP provides lease and purchase price protection for a period of one year and accrual of up to 50% of the purchase price of the equipment at the end of three years. IBM reserves the right, on 60 days' notice, to increase the TAP monthly charge and/or purchase price by up to 5% during the second year of the lease, and by another 5% during the third year. The customer can elect to extend the TAP contract for any number of one-year periods and for one period of less than a year. Equipment acquired under the TAP may be field-upgraded, although modifications that result in a model downgrade will incur a termination charge. IBM offers a discount of 10 percent to qualified educational institutions. ■

IBM System/32

EQUIPMENT PRICES

| BASIC SYSTEM | | Purchase Price | Monthly Maint. | Rental (1-year lease)* | Rental (TAP, 1st year)* |
|--------------|---|-------------------|-------------------|------------------------------|-------------------------------|
| 5320 | System Unit (includes CPU, 16K bytes of main storage, fixed-disk storage unit, diskette drive, printer, keyboard, and display): | | | | |
| Model A12 | 40 cps serial printer, 5.0 MB disk storage | 33,100 | 165.00 | 809 | 770 |
| Model A13 | 40 cps serial printer, 9.1 MB disk storage | 36,100 | 175.00 | 898 | 855 |
| Model A22 | 80 cps serial printer, 5.0 MB disk storage | 33,300 | 170.00 | 851 | 810 |
| Model A23 | 80 cps serial printer, 9.1 MB disk storage | 36,300 | 180.00 | 940 | 895 |
| Model B12 | 50 lpm line printer, 5.0 MB disk storage | 37,500 | 185.00 | 914 | 870 |
| Model B13 | 50 lpm line printer, 9.1 MB disk storage | 40,500 | 195.00 | 1,003 | 955 |
| Model B22 | 100 lpm line printer, 5.0 MB disk storage | 37,600 | 195.00 | 982 | 935 |
| Model B23 | 100 lpm line printer, 9.1 MB disk storage | 40,600 | 205.00 | 1,071 | 1,020 |
| Model B32 | 155 lpm line printer, 5.0 MB disk storage | 37,800 | 205.00 | 1,050 | 1,000 |
| Model B33 | 155 lpm line printer, 9.1 MB disk storage | 40,800 | 215.00 | 1,139 | 1,085 |
| 1005 | Additional Storage; 8,192 bytes (maximum of 2) | 2,000 | 2.50 | 50 | 48 |
| 4655 | Keylock | 70** | - | 70** | 70** |
| - | Additional Print Belt (for 5320 B models; available in 48-character EBCDIC, 64-character EBCDIC, or 64-character ASCII) | 170 | - | - | - |

COMMUNICATIONS FEATURES

| | | | | | |
|------|--|-------|-------|-----|-----|
| 2074 | Binary Synchronous Communications Adapter | 3,600 | 10.00 | 95 | 90 |
| 3701 | EIA Interface | 420 | 4.50 | 12 | 11 |
| 4703 | Internal Clock | 210 | 0.50 | 6 | 6 |
| 5500 | 1200 bps Integrated Modem, Non-Switched | 660 | 5.00 | 19 | 18 |
| 5501 | 1200 bps Integrated Modem, Switched with Auto Answer | 880 | 7.00 | 25 | 24 |
| 5600 | 2400 bps Integrated Modem, Non-Switched Point-to-Point | 2,240 | 11.50 | 68 | 65 |
| 5602 | 2400-bps Integrated Modem, Non-Switched Multi-point Tributary | 2,490 | 13.00 | 75 | 71 |
| 5610 | 2400-bps Integrated Modem, Switched with Auto Answer | 2,550 | 14.00 | 76 | 72 |
| 5733 | Processing Unit Expansion (prerequisite for 5600, 5602, or 5610) | 320 | 0.50 | 8 | 8 |
| 6301 | Synchronous Data Link Control (SDLC) Communications | 4,400 | 15.00 | 116 | 110 |
| 7951 | Switched Network Backup | 357 | 3.50 | 11 | 10 |
| 7952 | Switched Network Backup with Auto Answer | 535 | 5.00 | 16 | 15 |

* Rental prices include equipment maintenance.

** Single use charge.

SOFTWARE PRICES

| PROGRAM PRODUCTS | Initial Charge | Monthly License Charge |
|--|-------------------|---------------------------|
| System/32 RPG II | - | 25 |
| System/32 Utilities Program Product (Data File Utility, SORT, and Source Entry Utility) | - | 15 |
| INDUSTRY APPLICATION PROGRAMS | | |
| System/32 Wholesale Food Distribution Accounting and Management System: Billing, Inventory Control, Accounts Receivable, and Sales Analysis (BICARSA) | 2,975 | 140 |
| System/32 Membership and Mailing List System | 1,485 | 62 |
| System/32 Construction Management Accounting System: Job Costing | 470 | 20 |
| Accounts Payable | 575 | 25 |
| Payroll | 815 | 30 |
| General Ledger | 470 | 20 |
| System/32 Hospital Financial Management System: Patient Billing | 405 | 20 |
| Accounts Receivable | 370 | 18 |
| Payroll | 695 | 34 |
| General Ledger/Accounts Payable | 530 | 28 |
| System/32 Profit and Asset Management System for Paper Merchants and Office Products Distributors: Billing, Accounts Receivable, and Sales Analysis (BARSA) | 2,500 | 120 |
| Billing, Inventory Control, Accounts Receivable, and Sales Analysis (BICARSA) | 2,975 | 140 |