

IBM System/38

MANAGEMENT SUMMARY

UPDATE: IBM has completely revamped its System/38 line of computers by replacing all of its older models (Models 4, 6, 18, 20, and 40) with six new models: 100, 200, 300, 400, 600, and 700. Peripherals announced included the 9332 and 9335 DASD subsystems, which extend the System/38's disk capacity support to 13.6 gigabytes; the 3196 and 3179 Model 220 workstations; the 4245 T12 and T20 printers; and the 3174 display station controller.

A variety of enhancements made to the System/38's CPF operating system provides significant connectivity and communications capabilities. System/36 and System/38 connectivity has been enhanced with the following facilities: 5250 Display Station Pass-Through, Distributed Data Management, and the availability of System/38 Document Library Services to users of Personal Services/36. Other connectivity aids include the Rolmbridge 5250 Link Protocol Converter and the System/38's ability to function as an end node in an Advanced Peer-to-Peer Network.

The IBM System/38 is a general-purpose data processing system designed to provide ease of use, application development facilities, reliability, and nondisruptive growth. The System/38's architecture and integrated data base support a full range of interactive workstation applications, as well as traditional batch applications. The new models comprising the System/38 product line—Models 100, 200, 300, 400, 600, and 700—provide significant price/performance increases over their predecessors, as well as additional growth capabilities for end users. All older System/38 models can be upgraded on-site to the new models, with the exception of the Model 100.

The entry-level System/38 Model 100 provides approximately 30 percent more internal speed than its predecessor, the Model 4, at a lower purchase price. Model 100 provides

The IBM System/38 family of general-purpose data processing systems is designed to provide ease of use, application development facilities, reliability, and nondisruptive growth. IBM continues to enhance this seven-year-old family of computers with new system offerings, communications product offerings, applications software, and peripherals.

MODELS: Models 100, 200, 300, 400, 600, and 700.

CONFIGURATION: 2MB to 32MB of main memory, 64.5MB to 13.6 gigabytes of disk capacity, and up to 256 workstations.

COMPETITION: Digital Equipment Corporation MicroVAX II and VAX; Data General MV/2000 DC, MV/4000, MV/10000; Hewlett-Packard; and Wang.

PRICING: Pricing for basic systems ranges from \$37,500 to \$385,490.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation (IBM), Old Orchard Road, Armonk, NY 10504. Contact your local IBM representative.

CANADIAN ADDRESS: Contact the IBM office in the nearest major city or IBM Canada Limited, Markham, 3500 Steeles Avenue East, Markham, Ontario, Canada. Telephone (416) 474-2111.

MODELS: Models 100, 200, 300, 400, 600, and 700.

DATA FORMATS

BASIC FORMAT: Eight-bit byte. Each byte can represent one alphanumeric character, two BCD digits, or eight binary



Six new models of IBM's System/38 offer users more flexibility, increased capacity, and improved performance at a lower cost, as well as enhanced connectivity with the IBM System/36. Two new advanced technology direct access storage devices, the IBM 9332 (left) and IBM 9335 (far left), provide System/38 users with more flexibility and options in system configuration, greater capacity (up to 13.6 gigabytes), and increased reliability.

IBM System/38

➤ users with 2 megabytes or 4 megabytes of main memory; a 4-byte access, 400-nanosecond main storage internal cycle time; 8K words (32-bit word) of control storage; and an instruction cycle time of 200 nanoseconds. In addition, Model 100 supports up to 128 workstations and up to 3.4 gigabytes of disk storage.

The Model 200 provides approximately 95 percent greater internal speed than the Model 4 and has a main memory capacity of either 4 megabytes or 6 megabytes; a 4-byte access, 400-nanosecond main storage internal cycle time; 12K words (32-bit word) of control storage; and a minimum instruction cycle time of 133 nanoseconds. Model 200 also supports up to 256 workstations and 6.8 gigabytes of disk storage.

The Model 300 supports 6 megabytes or 8 megabytes of main memory, with approximately 160 percent more internal speed than the Model 4; a 4-byte, 400-nanosecond main storage cycle time; 12K words of control storage; and a minimum instruction cycle time of 133 nanoseconds. Also supported are up to 256 workstations and 6.8 gigabytes of disk storage.

The Model 400 provides users with 6 megabytes or 8 megabytes of main memory; a 4-byte access, 400-nanosecond main storage cycle time; 12K words of control storage; and a minimum instruction cycle time of 67 nanoseconds. In addition, the Model 400 supports a maximum of 256 workstations and 13.6 gigabytes of disk storage. The Model 400 is reportedly 235 percent more powerful than the Model 4.

The Model 600, which provides about 340 percent more internal speed than the Model 4, supports 8 megabytes, 12 megabytes, or 16 megabytes of main memory, a maximum of 256 workstations, and 13.6 gigabytes of disk storage. Model 600 also provides users with a 4-byte access, 333-nanosecond main storage cycle time; 12K words of control storage; and a minimum instruction cycle time of 67 nanoseconds.

The top-of-the-line Model 700 extends the power and main memory capacity of the System/38 family by using IBM's new one-million-bit dynamic random access memory (DRAM) chip. Use of the 1M-bit memory chip makes it possible to store more than four million characters of information on a single circuit card, thereby doubling the memory capacity of the Model 700 to 32 megabytes. According to IBM, the Model 700 is 390 percent more powerful than the Model 4. It supports 16 megabytes and 24 megabytes of memory, in addition to the 32 megabytes previously mentioned. In addition, the Model 700 provides a 4-byte access, 267-nanosecond main storage cycle time; 12K words of control storage; and a minimum instruction cycle time of 67 nanoseconds. The Model 700 also supports 256 workstations and 13.6 gigabytes of disk storage.

Also announced with the new System/38 processors were the 9332/9335 direct access storage devices (DASD). Up to four strings of these new storage systems can be attached to ➤

➤ bits. Two consecutive bytes form a halfword of 16 bits, while four consecutive bytes form a 32-bit w

FIXED-POINT OPERAND: Information not available from vendor.

FLOATING-POINT OPERAND: Information not available from vendor.

INSTRUCTIONS: IBM has not released details on the format of individual System/38 machine instructions, the number of instructions in the instruction set, or the classification of individual instructions. According to IBM, the System/38 employs an advanced instruction set which embodies many basic supervisory, resource, and data base management functions (including data base operations that retrieve, update, and logically order data records).

IBM has indicated, however, that a major design goal of the System/38 was to provide an instruction interface to the user that was as independent as possible of hardware and device characteristics. To implement this concept, the System/38 makes heavy use of microcode so that the user need not be concerned with hardware addressing, auxiliary storage allocation and addressing, internal data structures and relationships, and channel and I/O interface details. Furthermore, the user instruction interface is object-oriented rather than byte-oriented. An object is defined by IBM as a construct that contains a specific type of information and can only be employed in a specific manner. Examples of System/38 objects are as follows:

- **Access Group**—An object that describes the physical grouping of other objects so that more efficient movement of objects between main memory and auxiliary storage may take place.
- **Context**—An object that provides information to allow addressability of other objects. This information includes object type, subtype, and name.
- **Controller Description**—An object that provides the necessary information to represent an I/O controller. The controller may be for a cluster of I/O devices or a station that attaches groups of communications devices over the same data communications link.
- **Cursor**—An object that provides a means to address a data space.
- **Data Space**—An object used to store data base records where all records have the same format.
- **Data Space Index**—An object that provides an index for a data space. The index yields a logical ordering of the records in the data space.
- **Index**—An object used to automatically order data and store it.
- **Logical Unit Description**—An object that makes a representation for a physical I/O device.
- **Network Description**—An object utilized to represent a network port of the system.
- **Process Control Space**—An object which contains the elements for process execution.
- **Program**—An object which uniquely selects and places in order machine interface (processor) instructions.
- **Queue**—An object which provides communications between processes or between a device and a process. ➤

IBM System/38

TABLE 1. SYSTEM COMPARISON

MODEL	Model 100	Model 200	Model 300	Model 400	Model 600	Model 700
SYSTEM CHARACTERISTICS						
Date announced	June 1986					
Date first delivered	August 1986					
Field upgradable to	—	—	—	—	—	—
Relative performance	1.29	1.94	2.58	3.35	4.39	4.9
Number of processors	1	1	1	1	1	1
Cycle time, nanoseconds	133	133	133	67	67	67
Word size, bits	32	32	32	32	32	32
Operating systems	Control Program Facility					
MAIN MEMORY						
Type	MOSFET	MOSFET	MOSFET	MOSFET	MOSFET	MOSFET
Minimum capacity, bytes	2MB	4MB	6MB	6MB	8MB	16MB
Maximum capacity, bytes	4MB	6MB	8MB	8MB	16MB	32MB
Increment size, bytes	2MB	2MB	2MB	2MB	4MB	8MB
Cycle time, nanoseconds	400	400	400	400	333	267
BUFFER STORAGE						
Minimum capacity	None	None	None	None	None	None
Maximum capacity	None	None	None	None	None	None
Increment size	Not applicable					
INPUT/OUTPUT CONTROL						
Number of channels:						
Byte multiplexer	—	—	—	—	—	—
Block multiplexer	—	—	—	—	—	—
Word	—	—	—	—	—	—
Other	—	—	—	—	—	—

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

▷ the Models 400, 600, and 700, for a maximum capacity of 13.6 gigabytes; Model 100 can support one string and Models 200 and 300 can support two strings.

The 9332 DASDs comprise Models 200, 220, 400, and 420. The Models 200 and 220 are standalone 200-megabyte, single-actuator DASDs. The Models 400 and 420 are 400-megabyte drives with two actuators each. Models can be rack-mounted or placed on a table. Multiple units can be attached in a string using a DASD controller.

The IBM 9335 DASD subsystem includes the A01 control unit which can handle up to four Model B01 DASDs. The B01 model has an 855.8-megabyte formatted capacity and two actuators. Both the A01 and B01 models can be mounted in the new IBM 9309 Rack Enclosures.

In the peripheral area, IBM has introduced the 3196 and 3179 Model 220 workstations, and the 4245 T12 and T20 line printers. The 3196 display station provides users of System/36 and System/38 computers with the ability to enter and retrieve data from System/370 processors, such as the IBM 43XX, 303X, 308X, and 3090 systems. The 3196 is designed for use in cluster configurations. In addition, the display station provides the ability to record and play back complex keystroke sequences. The 3196 features a nonglare, 12-inch screen, as well as either a 122-key typewriter keyboard or the IBM enhanced 102-key keyboard.

The IBM 3179 Model 220 color display station, attachable to both the System/36 and System/38, is designed for use within the 5250 Information Display System network. The 3179 Model 220 is identical to, and provides the same functions as the IBM 3179 Model 200 used with Sys-

- ▶ **Space**—An object where pointers and scalars are stored.
- ▶ **User Profile**—An object that provides identification for a valid user of the processor.

Each object consists of attributes, generic operations, and unique operations. Examples of attributes include a name, which provides a means to symbolically reference the object; an ownership, which identifies whether the object is owned; and an existence, which specifies whether destruction of the object is implicit. Generic and unique operations are divided between explicit and implicit functions. Explicit generic operations include authorization, addressing, and resource-related functions. Explicit unique operations include destroy, which removes the object from the system; modify, that enables changes in the object's attributes to be made; and materialize, that identifies the attributes or content of an object.

Implicit functions of both generic and unique operations include authorization enforcement, lock (nonentry) enforcement, and exclusive operations.

All objects reside in virtual storage and are allocated mass storage space. Objects are brought into main memory when needed and may be shared by all processes.

INTERNAL CODE: EBCDIC.

MAIN MEMORY

STORAGE TYPE: Dynamic metal oxide semiconductor field effect transistor (MOSFET). The chips use a silicon and aluminum metal oxide semiconductor (SAMOS) process. SAMOS is an n-channel MOSFET process. The metal gate reliability relative to shorts is reportedly improved by the use of silicon nitride in these chips. Surface leakage is controlled by a conductive polysilicon field shield. The processor unit uses Large Scale Integration (LSI) for the logic circuitry.

IBM System/38

► tem/370-based hosts, but in a smaller package. Also featured is the IBM enhanced keyboard designed for data processing, word processing, and personal computer environments.

New additions to the 4245 band printer line include the 4245 T12, a 1200 line-per-minute (lpm) printer, and the T20, a 2000 lpm printer. Both models can be attached to the System/36 or System/38 using the IBM Cabling System or twinax. According to IBM, the two new models offer greater print speed than previous IBM line printers with a twinax attachment. The printers feature 132 print positions, six or eight lines per inch under program control, a forms skip rate of 55 inches per second, and 10-character-per-inch spacing. They also support both OCR-A and OCR-B printing applications.

The IBM 3174 display station controller is a new subsystem controller offered in a variety of models. The compact 3174 is available in large cluster and small cluster models that allow for attachment of up to 32 and 16 display stations, respectively, to host processors, as well as to the System/38 and System/36.

A variety of enhancements made to the System/38's Control Program Facility (CPF) operating system provides significant connectivity and communications capabilities. System/36 and System/38 connectivity has been enhanced with the following: 5250 Display Station Pass-Through, Distributed Data Management, and the availability of System/38 Document Library Services to users of Personal Services/36.

The IBM 5250 Display Station Pass-Through function permits users to pass through a System/36 to sign on to a System/38 and use System/38 applications.

System/38 Distributed Data Management (DDM) provides increased connectivity among the System/36, System/38, and IBM System/370-based processors using IBM's Customer Information Control System/Virtual Storage (CICS/VS). Users can sign on to any system in a network of System/38s and System/36s and have access to data stored anywhere in the network.

System/38 CPF has also been enhanced to provide System/38 Office Host Document Interchange Architecture (DIA) Document Library Services to users of Personal Services/36. A user on a System/36 can be enrolled on the System/38 as a local user of DIA Library Services, and both System/36 and System/38 users are capable of accessing the documents.

The Rolmbridge 5250 Link Protocol Converter, jointly developed by IBM and Rolm, is a networking product that supplies switched data connection for asynchronous terminal and printer devices connected through a Rolm CBX II to a System/38 or System/36 host system.

Another connectivity aid is the System/38's ability to function as an end node in an Advanced Peer-to-Peer

► **CAPACITY:** Memory capacities for the IBM System/38 range from 2MB to 32MB. See Table 1 for specific memory capacities.

CYCLE TIME: Models 100, 200, 300, and 400—400 nanoseconds per 4-byte access; Model 600—333 nanoseconds per 4-byte access; Model 700—267 nanoseconds per 4-byte access.

CHECKING: All data paths between the central processor and main storage are parity-checked by byte. When data is stored, an error-correcting code is substituted for the parity bits. (A 000480ed Hamming code is appended to each 4-byte "word" of data.) When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and signalled so that appropriate program action can be taken.

RESERVED STORAGE: Information about reserved storage is not available from the vendor.

In the storage protection area, several types of authorizations are available with the System/38. The authorization visible to the user concerns the use of objects. Every reference to an object requires that the user requesting the reference have the authority for the operation to be performed. If the user does not have appropriate authority, the operation cannot continue and the attempted violation is recorded. Authorizations include retrieve, update, or destroy which may be granted on an individual or group user basis. Other authorizations include privileged instruction authority for user profile creation, process initiation, and machine reconfiguration; all object special authority, which grants unlimited use of all objects in the system; and storage limit authority, where the storage occupied by objects is charged against the storage limit of the user profile (owners have implied object authority over their own objects).

CENTRAL PROCESSORS

The 5381 System Unit (designed for the Models 100 and 200) and the 5382 System Unit (designed for the Models 300, 400, 600, and 700) each comprise a processing unit, main storage, integrated fixed disk storage, system console keyboard/display, diskette magazine drive, optional I/O attachments, an integrated workstation controller, and an optional communications controller. Facilities are provided for addressing main storage, performing arithmetic and logical processing, and controlling I/O units.

The processing unit is implemented using LSI technology and is packaged on one planar board, 10 inches by 15 inches. The board contains 29 LSI logic chips with approximately 20,000 circuits and 5 arrays. The logic chips are based on Schottky TTL circuitry and contain up to 704 logic gates plus more than 60 off-chip driver circuits and three layers of interconnection wiring above the silicon surface. The LSI technology uses a master-slice concept, with each chip containing a fixed number of logic circuits of various types, which may be interconnected in various ways to perform specific functions. Each master-slice chip contains more than 7,000 resistors, diodes, and transistors arranged in a series of narrow bands across the chip.

Features of the System/38 processor and system unit include instruction retry capability (except where "results" field is also an operand field), I/O controller retry, and reliability, availability, and serviceability (RAS) features.

The system control adapter (SCA) is an integral part of the system unit, serving as a central point for two important functions. First, the SCA provides the capability to initiate the system's power on/power off sequence. Second, the SCA performs both functional testing of the processor and diagnostic checkout of main memory prior to initial micropro-

IBM System/38

▷ Network (SNA/APPN). The new APPN feature allows System/36 and System/38 users to communicate across a network of interconnected System/36s on a logical, point-to-point basis, without the need for a central SNA host.

The heart of the System/38 is the System Unit, consisting of a processing unit, main storage, disk storage, a system console keyboard/display, a diskette magazine drive, optional I/O attachment, an integrated workstation controller, and an optional communications controller.

All System/38 models use the Control Program Facility (CPF) operating system. CPF provides many integrated functions that are, according to IBM, designed to satisfy the installation requirements for a multiprogrammed, batch, and on-line interactive system. The major facilities and features of CPF include object management facilities, work management facilities, data management facilities, application program development facilities, operator control facilities, and security facilities.

IBM offers several program products for use with the System/38, including RPG III, Cobol, and Basic programming languages; utilities; and communications products, including RJE, SNA, Advanced Program-to-Program Communications (APPC), 3270 Device Emulation Support, Document Interchange Architecture (DIA), System Network Architecture Distribution Services (SNADS), Distributed Host Command Facility (DHCF), X.25 communications support, the Enhanced 5250 Emulation Program for IBM PC attachment, and the Remote 5250 Emulation Program. Applications software support for the System/38 is provided by several packages, including IBM's Manufacturing Accounting and Production Information Control System Version II (MAPICS II), which comprises 13 integrated applications, the Distribution Management System (DMS/38) Customer Service and Purchasing Applications (consisting of 5 integrated applications), and the DMS/38 Financial Applications package (consisting of 4 integrated applications). IBM also offers Office/38, Data Preparation, Log Recovery, Text Management packages, and Information Management.

COMPETITIVE POSITION

Despite many industry analysts' belief that the System/38 will simply disappear in the not-too-distant future, IBM continues to prove through new announcements and enhancements that its seven-year-old family of System/38 computers is still very much alive and an active contender in the competition among minicomputers. All of the announcements IBM has made concerning the System/38—six new models with increased performance, double the main memory previously supported by the older Model 40, hardware enhancements including support for new workstations and printers, Release 8 of the Control Program Facility (CPF)—as well as its new communications connectivity products, fall in line with IBM's overall long-term strategy of moving toward convergence and standardized architecture within all of its product lines. IBM intends to offer a range of systems and communications services which are all based on a common architecture, allowing the

▷ gram load time (IMPL). IMPL loads the system's microcode from diskette prior to transfer of control to the operator.

Integral with the processor is a system console which consists of a 1024-character CRT (16 lines of 64 characters), a keyboard, and an operator service panel. The CRT displays attributes including protected fields, underscore, and non-display. The keyboard has a typewriter-like layout with 24 command function keys. A U.S. or multinational upper/lower character set can be selected. Keyboard entry of hexadecimal characters is permitted. With the exception of power-on IMPL, start Control Program Facility (CPF), and other functions requiring the operator service panel, system operator tasks may be performed at any authorized 5251/5252 attached to the system.

Addressing: Virtual Address Translation (VAT) is employed in the System/38 central processor. VAT uses a 48-bit virtual address which can yield an address space of up to 281 trillion bytes. This virtual address space is divided into 512-byte pages combined into segments of either 65,536 bytes or 16 megabytes. Each object is assigned to one of these segments. The VAT process works with these segments, extracting pages as needed (after address translation) and placing a page in an area of main memory called a page frame. The address conversion process utilizes certain VAT facilities including the primary directory, the permanent directory, the temporary directory, the hash table, the lookaside buffer, and page directory. The primary directory indicates the virtual address and status information of a page contained within a page frame. The permanent directory describes segments which must exist across initial program loads, while the temporary directory describes segments which are generally required during the execution of a particular job. The hash table is a list of entries used to index the primary directory. The lookaside buffer is a main storage resident directory which contains segment descriptors extracted from the permanent and temporary directories. IBM indicates about 90 percent of all directory lookups are satisfied in the lookaside buffer without resorting to searches of the permanent and temporary directories (which are pageable). The lookaside buffer has an array organization, an entry size of 10 bytes, and an entry format of a virtual address plus one disk-extent descriptor. Typically, the lookaside buffer has 400 to 800 entries with an overall size of 4K bytes to 8K bytes. The permanent and temporary directories have an index organization, an entry size of 10 bytes to 22 bytes, an entry format of a virtual address plus 1 to 4 disk-extent descriptors, and one or more entries per segment. Typically, the permanent directory has 5,000 to 40,000 entries and requires 128K bytes to 1 megabyte, while the temporary directory has 200 to 2,000 entries and requires 5K bytes to 50K bytes.

SPECIAL FEATURES: Eight-K 32-bit words of control storage are standard on the Model 100 and 12K words are standard on Models 200, 300, 400, 600, and 700. Control storage is composed of 18K-bit chips. The technology employed is the same as that used for main memory. The chip has a cycle time of 280 nanoseconds and an access time of 140 nanoseconds. One microinstruction is executed during each processor cycle. Models 100, 200, and 300 have a processor cycle time of 133 nanoseconds; Models 400, 600, and 700 have a control storage instruction cycle time of 67 nanoseconds. Cycle times are dependent on the microinstruction operation. As a measure of the System/38 processor's speed of operation, one- or two-byte arithmetic operations may be performed on signed-binary, unsigned-binary, or packed-decimal format data in one cycle.

The System/38 processor is heavily microcoded. In addition to the 8K words or 12K words of control storage, the system uses main storage for resident microcode. The amount of main storage required for this purpose depends on system

IBM System/38

TABLE 2. MASS STORAGE

MODEL	5381/5382 System Units	3370 DASD	9332 Models 2xx, 4xx	9335
Cabinets per subsystem	1-6; 1 on Model 100	Upto 8	Up to 16	Up to 16
Disk packs/HDAs per cabinet	—	1	—	—
Capacity	64.5MB	571.3MB for Models A11 and B11; 729.8MB for Models A12 and B12	200/400MB	855.8MB
Tracks/segments per drive unit	—	—	—	—
Average seek time, msec.	27	20	19.5	18
Average access time, msec.	36.6	29.1	30.1	26.28
Average rotational delay, msec.	9.6	10.1	9.6	8.28
Data transfer rate	1.03 M bytes/sec.	1.859M bytes/sec.	2.5M bytes/sec.	3M bytes/sec.
Controller model	Integrated	Integrated	Integrated	Integrated
Comments	Included with all System/38 computers; disk storage capacity depends on the number of drives each System/38 submodel contains.			

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

▷ company to offer a variety of communications services to both large account and small business users.

IBM has most certainly indicated its intention to extend the life cycle of the System/38. Although IBM has not made any overt announcements, popular belief suggests that many of the System/38's applications will be supported on a new hardware product line expected to be announced within the next three years; this new hardware family is expected to be some sort of extension to the current System/36 product line. Although logical, it surely will not be an easy task to perform. However, IBM will make certain that its 140,000-user System/34, /36, and /38 installed base is kept happy. Hence, IBM is also expected to continue announcing mid-life additions to its System/38 line until its next generation of mid-range hardware is announced.

The IBM System/38 competes with a variety of 16-bit and 32-bit systems designed for such markets as general-purpose business, office automation, and engineering/scientific. The upward extension of the System/38 family strengthens the product line, as well as poses a threat not only to Digital Equipment Corporation and Data General, but also Hewlett-Packard and Wang. These mini/super-mini vendors have previously held price and performance advantages over IBM in several significant markets, such as engineering and science. However, primary competition comes from the Digital and DG systems.

Digital Equipment's MicroVAX II provides a fair amount of competition for the System/38 Model 100. The MicroVAX II's main storage support of 16 megabytes is quadruple that supported by the Model 100. Although the Model 100's disk storage capacity of 3.4 gigabytes is greater than that found on Digital's offering, the MicroVAX II's support of 1.8 gigabytes is also a substantial amount supported by a low-end system. However, the MicroVAX II's support of 33 workstations does not even come close to the 128 supported by the Model 100.

► size, system configuration, and the number of system functions active at any specific time.

The System/38 data base is one of the items selected for heavy microcode support. The five divisions of the data base and a rough estimate of the percentage of microcode involvement are as follows: file definition, 100 percent; member definition, less than 50 percent; file opening, about 60 percent; data transfer, less than 15 percent; and file closing, about 60 percent. Microcode supports record lengths up to 32K bytes and files up to 256 megabytes.

PHYSICAL SPECIFICATIONS: The 5381 System Unit's base enclosure is 177.5 cm (70 inches) wide, 75 cm (29.5 inches) deep, and 126 cm (49.5 inches) high. Environmental information for the 5382 System Unit is not available from IBM.

CONFIGURATION RULES

Each 5381 or 5382 submodel includes a CPU; either 2048K, 4096K, 6144K, 8192K, 12,288K, 16,384K, or 32,768K bytes of main memory; 8K bytes or 12K bytes of control storage; a diskette magazine drive; a system console keyboard/display; an operator/service panel; and a Workstation Controller-Extended (WSC-E).

Additional hardware features include:

- From one to six spindles of disk storage (64.5MB to 387.1MB).
- Up to four strings of 9332 and 9335 Direct Access Storage Units (DASDs) in several configurations with integrated controllers. The Model 100 can attach a single string of 933Xs; Models 200 and 300 can attach up to two strings; Models 400, 600, and 700 can attach up to four strings.
- Up to two strings of 3370 DASD systems with 3370 Disk Storage Attachment features, providing the capability to attach up to eight 3370s.
- Direct attachment capability for up to 256 workstation devices (up to 128 on the Model 100)
- One or two adapter attached printers in any speed combination.

IBM System/38

TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed, Inches/Sec.	Transfer Rate, Bytes/Sec.
3410/3411	7	200, 556, or 800	NRZI	12.5, 25, or 50	2.5K to 40K
	9	1600/800 556/200	NRZI, PE	12.5, 25, or 50	10K to 80K
3422	—	1600 or 6250	PE	125	781K
3430	9	1600 or 6250	PE or GCR	50	312.5K
Printers	Printing Speed	Print Positions	Horizontal Spacing, Chars./Inch	Vertical Spacing, Lines/Inch	Form Size, Inches
3812 Pageprinter	12 ppm	—	10, 12, 15, 17.1, 27	6 or 8	8.5 to 14 wide, 7 to 10.5 long
3262-B1	364 to 650 lpm	132	10	6 or 8	3.5 to 16 wide, 3 to 14 long
4214	50 to 200 cps	—	5, 10, 12, 15, 16.7	3, 4, 6, or 8	Up to 14.88 wide
4224	200 to 500 cps	—	10, 12, 15	6 or 8	3 to 15 wide
4234 Model 2	120 to 410 lpm	—	10 or 15	3, 4, 6, 8, or 9	Up to 16 wide, up to 14 long
4245 T12 and T20	1200 or 2000 lpm	132	10	6 or 8	3.5 to 22 wide, 3 to 24 long
5219	40 or 60 cps	172	10, 12, 15	5½, 6 or 8	Up to 15.4 wide
5224	140 to 280 lpm	132 or 198	10	6 or 8	—
5225	195 to 560 lpm	132 or 198	10 or 15	6 or 8	—
5256	40, 80, 120 cps	132	10	6 or 8	3 to 15 wide or 6 to 14.5 wide

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ Although specifically designed as departmental office systems, Data General's MV/2000 DC and MV/4000 DC also can be classified as competition for the Model 100. Both the MV/2000 DC and MV/4000 DC provide more main memory—5 megabytes and 8 megabytes, respectively—compared to the Model 100's support of 4 megabytes. However, main memory is the only category in which DG's offerings come close to the entry-level IBM system. The System/38 Model 100 wins hands down in the amount of disk storage, as well as the number of workstations supported. The Data General MV/2000 DC and MV/4000 DC support 240 megabytes of disk storage—a dismal figure next to the Model 100's support of 3.4 gigabytes. DG's support of up to 32 workstations on the MV/4000 DC is a far cry from the 128 supported by the Model 100.

At the other end of the product line, the top-of-the-line Model 700 is likely to find some stiff competition from Digital's VAX 8300 and Data General's MV/10000. An important factor to consider when making a comparison is

➤ • 3410/3411 magnetic tape units and control (Models 1, 2, or 3), 3422 magnetic tape subsystem (Models A01 and B01), or 3430 magnetic tape subsystem (Models A01 and B01). (A 3411 can be attached as a second tape subsystem if a 3422 or a 3430 is attached.)

• Diskette magazine drive (standard).

• A maximum of four SNA/SDLC and/or BSC communications lines in any combination on Model 100 and up to 12 communications lines on all other models with multiple devices per line.

The Workstation Controller-Extended features allow for direct local attachment of a maximum of 256 IBM workstation devices per system (128 on Model 100). Up to eight WCS-E features, including the standard feature in position 1 of the base, can be attached on all models except on Model 100. Each provides 8 ports for attaching up to 32 workstations (keyboard displays and/or printers) directly to the system in any combination. In addition, the IBM 5150 Personal Computer, 5160 PC XT, and 5170 PC AT (with Display Station Emulation Adapter and the 5250 Emulation program) may attach as workstations.

IBM System/38

▶ that the Digital and DG offerings are both 32-bit superminis, whereas the System/38 Model 700 is a 16-bit mini-computer. However, IBM's high-end offering is quite capable of holding its own.

For example, both the Model 700 and the MV/10000 support a maximum of 32 megabytes of main storage; the VAX 8300's support of 24 megabytes is much less than that supported on the IBM and DG systems. The System/38 Model 700's disk capacity falls short of its competitors' offerings (26 gigabytes for the DG system and 1.8 gigabytes local and 164 gigabytes in a VAXcluster for the Digital systems). However, the Model 700 supports far more workstations (256 versus DG's 192 and Digital's 64 in a typical application).

One must also take into consideration the advanced networking tools that both the Digital and DG systems provide. Although IBM is making strides to achieve more connectivity among dissimilar systems, its competitors have already delivered more effective IBM and non-IBM networking tools. In that respect, IBM still has a lot of catching up to do.

ADVANTAGES AND RESTRICTIONS

An advantageous feature of the IBM System/38 is the system unit's advanced instruction set, which includes many basic supervisory, resource, and data base management functions. In addition, the system unit has an object-oriented architecture which is fundamental to its overall design. The 5381 and 5382 System Units manage storage on an object basis, thereby reducing user dependence on main storage size, physical disk location, and internal implementation. IBM has also combined hardware and programming technologies which have produced a powerful on-line system and, at the same time, has also maintained traditional batch capabilities.

The IBM System/38 offers users 6 models and 98 submodels within its product line. All of the IBM System/38 models use the same CPF operating system, run the same software, and support the same peripheral devices. This allows users to upgrade to a more powerful system without investing in new peripheral products and software packages.

New connectivity aids permit the System/38 to provide a performance bridge which extends from the high-end System/36 5360 Model D up to the 4381 superminicomputer. Although IBM has recently begun a campaign to introduce a variety of connectivity aids, one must take into consideration that the System/36, System/38, and System/370-based systems are all based on dissimilar architectures. Therefore, it is extremely difficult to connect these different architectures without some repercussions. In order to keep its current installed base happy, attract new customers, and remain competitive within a cutthroat industry, IBM must continue to research and invest in additional networking aids that will enhance its connectivity, not only among different IBM architectures, but also with a variety of non-IBM architectures.

▶ The Device Control Expansion feature does not provide any additional cable connectors but provides the necessary control storage to support eight devices attached via the cable connectors provided by workstation controllers.

The Device Interface Expansion feature provides the necessary control and eight twinax cable connectors for attachment of workstation devices.

The Processor Unit Expansion 1 feature (6300) is an I/O board/power supply that is required for attaching the 1501 Communications Attachment or a second workstation controller.

The Processor Unit Expansion 2 feature (6301) is an I/O board/power supply that is required for attaching the 5424 Multifunction Card Unit, the 3411 Magnetic Tape Unit, or a 5211/3262 Line Printer.

The Processor Unit Expansion 3 feature (6302) is an air-circulating/cable assembly that is required for the 1501 Communications Attachment, 5302 Second Workstation Controller, the 5424 Multifunction Card Unit, the 3411 Magnetic Tape Unit, or a second 5211/3262 Line Printer.

The Processor Unit Expansion 4 feature (6303) is a power expansion assembly that is required to attach the 3411 Magnetic Tape Unit or the 3370 Disk Drive.

The Processor Unit Expansion 5 feature (6304) is a gate/AC power supply and is required for any of the following features: attaching second communications attachment (1502); attaching third workstation controller (5303); attaching fourth workstation controller (5304).

The Processor Unit Expansion 6 feature (6305) is a board/power supply and is required for any of the following features: second communications attachment (1502); attaching third workstation controller (5303).

The Processor Unit Expansion 7 feature (6306) is a board/power supply and is required for attaching the fourth workstation controller (5304).

INPUT/OUTPUT CONTROL

A direct memory access (DMA) channel is a standard feature on the IBM System/38.

MASS STORAGE

A diskette magazine drive is standard on the System/38 and provides three functions: save/restore, diskette I/O, and CE servicing. The diskette magazine drive has two magazine positions and three slots for individual diskettes. Each magazine can contain up to 10 diskettes, resulting in a total on-line capacity of 23 diskettes. IBM diskette types 1, 2, and 2D can be read and written. The storage capacities of the various diskette types are given in the following table.

Diskette Type	Bytes per Sector	Diskette Capacity (bytes)
Diskette 1	128	246,272
	*256	284,160
	*512	303,104
Diskette 2	*128	492,544
	*256	568,320
	*512	606,208
Diskette 2D	256	985,088
	*512	1,136,640
	1024	1,212,416

▶ *Only supported at the machine interface level. ▶

IBM System/38

TABLE 4. TERMINALS

MODEL	3179 Model 220	3180 Model 2	3196	5150 PC/ 5160PC XT/ 5170 PC AT	5251	5291-002
DISPLAY PARAMETERS						
Max. chars./screen	1920	1920	1920	1920	1920	1920
Screen size (lines x chars.)	24 x 80	27 x 80 or 132	24 x 80	25 x 80	24 x 80	24 x 80
Symbol formation	7 x 11 dot matrix	Dot matrix	—	7 x 9 dot matrix	8 x 16 dot matrix	8 x 9 dot matrix
Character phosphor	Varies	—	Green or amber/ gold	Green on black	Light on dark; dark on light	Green on black
Total colors/no. simult. displayed	7	Monochrome	Monochrome	16	Monochrome	Monochrome
KEYBOARD PARAMETERS						
Style	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter
Character/code set	122	EBCDIC	102 or 122	246 characters	96, 199 multina- tional	EBCDIC
Detachable	Yes	Yes	Yes	Yes	Yes	Yes
Program function keys	24	24	—	10	24	24
OTHER FEATURES						
Buffer capacity	—	—	—	—	—	—
Tilt/swivel	Yes	Yes	Yes	—	Standard	Yes
Graphics capability	—	—	—	—	—	—
TERMINAL INTERFACE						
	IBM 5294 Re- mote Communi- cations Control Unit	EIA Interface	—			

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ An advantageous feature for the System/38 is that IBM offers its users a large selection of applications software—much more than some of its competitors have to offer. In addition, IBM strives to constantly enhance its System/38 software and to introduce new software packages. Users can also choose from thousands of third-party applications software packages.

Although users are offered a growth path within the System/38 line, and IBM's long-term strategy is to move toward convergence and standardized architecture for its entire product line, the top-of-the-line Model 700 cannot presently be upgraded to a larger System/38 family model. To expand the system to a larger IBM system would require the user to go through a costly and time-consuming major conversion.

However, when comparing the competition in terms of the overall product offering, prospective buyers should also take a close look at the reputation IBM has established for servicing its systems. IBM strives to constantly enhance its customer support services. Further proof of this commitment is evident in IBM's announcement of its intent to provide direct customer support for the IBM System/38 via an 800 WATS line through its System/38 Customer Assistance Center (CAC).

USER REACTION

Responses to Datapro's 1986 Computer Users Survey included returns from 347 users of the IBM System/38. The systems surveyed are the older System/38 models and not those covered within the text of this report; at the time of publication, these systems were too new to include in the survey. Of the users surveyed, 65 percent had purchased their systems, 9 percent rented or leased from the manufacturer, and 25 percent leased from a third party. As of

➤ IBM states that the performance of the diskette magazine drive will vary depending on system work load, the quantity of data files, and the length of data files involved.

The IBM System/38 also supports the 5424 multifunction card unit. The 5424 features two hoppers, four stackers, reads 250 cpm, punches 60 cpm, and prints 60 cpm.

Please refer to Table 2 for information about disk storage devices for the System/38.

INPUT/OUTPUT UNITS

Please refer to Table 3 for descriptions of magnetic tape equipment and printers.

TERMINAL

Please refer to Table 4 for descriptions of IBM terminals available for the System/38.

COMMUNICATIONS

The System/38 is provided with a multiline communications capability through a facility integrated into the 5381 and 5362 System Units. Four building blocks each with its own features can be configured to provide the desired functionality. These building blocks are the communications attachment, communications control, line base, and line interfaces.

Model 1501 Communications Attachment: This unit and its features provide basic system control and common circuits for up to four remote communications lines on a concurrent basis. Voice grade transmissions across private or common carrier lines are supported at 600, 1200, 2400, 4800, 7200, and 9600 bps. Through the use of the Model 1501 and its features, System/38's communications lines can support connection to one or more IBM System/370 or 303X host processors. The System/38 is viewed by the host as an RJE workstation emulating an IBM 3770 terminal, and is therefore supported under applications such as CICS/VS and IMS/VS.

➤ The System/38 communicates with IMS/VS applications operating under OS/VS1 or OS/VS2 (MVS) and CICS/VS

IBM System/38

▷ February 1986, the average length of installation for the systems was 51 months.

Although a variety of industries was represented, the industry represented most often in the survey was manufacturing. Principal applications included accounting/billing (83 percent), payroll/personnel (68 percent), order processing/inventory (67 percent), sales/distribution (48 percent), purchasing (45 percent), and manufacturing (44 percent).

Main memory on the System/38 averaged between 1 megabyte and 16 megabytes, with the largest single group (136 users) supporting between 4 megabytes and 8 megabytes. Total disk capacity supported ranged from 600 megabytes to 4.8 gigabytes. The number of local workstations in use averaged between 6 and 60. Sixteen percent used between 6 and 15 local workstations, 40 percent used between 16 and 30, and 30 percent used between 31 and 60. In addition, 70 percent of the respondents used remote workstations.

The programming language used most often on the System/38 was RPG (281 users). When asked if they had a disaster recovery plan, 42 percent of the users responded that they did, and another 23 percent indicated that they planned to implement one in 1986. Of the users surveyed, only 12 percent used third-party maintenance. Twenty-five percent of the users indicated that they have an established information center at their installation, and another 8 percent said that they planned to implement one.

Most applications software programming was performed by in-house personnel (94 percent). Other methods of obtaining applications software were through an independent supplier (47 percent), packaged programs from the manufacturer (35 percent), and contract programming (33 percent).

IBM System/38 users rated their systems as shown in the table below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	226	112	9	0	3.63
Reliability of system	291	50	3	0	3.84
Reliability of peripherals	219	116	9	0	3.61
Maintenance service:					
Responsiveness	213	111	19	2	3.55
Effectiveness	218	112	13	1	3.59
Technical support:					
Troubleshooting	122	165	54	6	3.16
Education	111	176	55	2	3.15
Documentation	105	192	41	7	3.14
Manufacturers software:					
Operating system	243	101	0	0	3.71
Compiler & assemblers	204	128	3	0	3.60
Application programs	53	149	62	10	2.89
Ease of programming	216	111	11	2	3.59
Ease of conversion	68	141	100	20	2.78
Overall satisfaction	202	132	6	0	3.58

*Weighted Average on a scale of 4.0 for Excellent.

The survey results indicate that IBM System/38 users are very pleased with their systems. In fact, 97 percent of the users surveyed said that their computers did what was expected and 99 percent said that they would recommend

▷ applications operating under DOS/VS, OS/VS1, or OS/VS2 (MVS) in System/370 Models 145 to 168 for IMS/VS and Models 135 to 168 for CICS/VS and 303X processors. Communications with any of these operating systems running under VM/370 is also supported. Access within the host is through VTAM, ACF/VTAM, TCAM, or ACF/TCAM.

With the System/38 using SDLC protocol in an SNA network, data communications into the host will be via a 370X front end, which will require NCP/VS or ACF/NCP/VS, as appropriate.

A maximum of two 1501 Communications Attachments are allowed per system.

Model 200 Communications Control: This feature provides the basic control storage and common circuits for SDLC and BSC data link control. Any line interface can be optioned via CPF parameter for either SDLC or BSC. The BSC support is for point-to-point switched or nonswitched only; multipoint is not supported.

Model 5760 Auto Call Adapter: This unit enables the System/38 to initiate a data link with a remote station automatically. Under program control, this unit automatically dials into a switched network facility, available in conjunction with the EIA interface. Each line with an Auto Call unit takes two interface positions, and therefore reduces the total number of line connections possible. The 5760 cannot be installed on the same line position with any other line interface type, and is installable in line positions 2, 3, or 4 only.

Model 2001/2003 Communications Control, SDLC/BSC: This feature provides the basic control storage and common circuits for both SDLC and BSC data link control. When the 1501 Communications Attachment is featured with Communications Control, SDLC/BSC, any line interface can be optioned via CPF parameter for either SDLC or BSC. This feature provides SDLC support for point-to-point switched or nonswitched and multipoint tributary attachment. BSC multipoint control is not supported.

Model 3200 Line Base: This feature provides the interface and control between the line interface features and the Communications Control interface. The Model 3200 Line Base is required for each line appearance and provides the necessary control required for each of the unique line interface types.

Model 3701 EIA Interface: This feature provides for attachment of any external modem with RS-232-C characteristics. Only one Model 3701 is allowed per Model 3200. IBM external modems which may be attached via Model 3701 and their speeds are as follows: 3863, 2400 bps; 3864, 4800 bps; 3865, 9600 bps; 3872 Model 1, 2400/1200 bps; 3874 Model 1, 4800/2400 bps; and 3875 Model 1, 7200/3600 bps.

Model 5650/5651 Digital Data Service Adapter (DDSA): This is an integrated data link adapter for data transmission over the AT&T nonswitched Data-Phone Digital Service Network. The first version (#5650) supports point-to-point and multipoint lines. An enhanced feature now allows support for remote data transmission at speeds up to 56K bps over the AT&T nonswitched Data-Phone Digital Service Network. The System/38 communications attachments (#1501, #1502) support one high-speed (56K bps) line per communications attachment (maximum two per system). The other version (#5651) supports the System/38 operating on a multipoint line as a tributary to a host, which serves as the control processor. Speeds of 2400, 4800, and 9600 bps are supported with the DDS adapters.

IBM System/38

➤ the System/38 to another user. Users' plans for acquisition and implementation in 1986 included expansions of current hardware (71 percent), expansions of data communications facilities (48 percent), proprietary software from other suppliers (40 percent), and additional software from the manufacturer (19 percent).

To further qualify some of our findings, we sought comments from three System/38 users. The first user we spoke to was the systems coordinator for a manufacturing firm on the West Coast. The company had converted to its present System/38 computer from an older IBM System/34. However, the user was not pleased with the conversion for several reasons: the hardware installation was extremely late, software installation was behind schedule, and the company was not pleased with IBM's field service troubleshooting capabilities. This user also said that he believed the System/38 CPU is not powerful enough, the operator's console is weak, and that IBM's packaged software, such as MAPICS, is lacking. On the positive side he said the CPF operating system and RPG III programming language are excellent tools. Although his overall feeling was that the system is very reliable, he would not recommend the System/38 to a prospective user.

The second user interviewed was the DP manager for an insurance firm in the Southwest. This user had converted from an IBM System/3 to his leased IBM System/38 more than five years ago. According to the DP manager, the conversion from the older system to the System/38 was a very smooth transition. In fact, he said he believed the System/38 is a remarkable minicomputer; he also said that it is IBM's best product. He further commented by saying that every announcement IBM has made pertaining to the System/38 has been an improvement and that most have been field upgradable. In essence, this user was extremely pleased with his system and would not hesitate recommending it to a potential IBM customer.

The third user contacted was the DP director for a trade association in the East. Like the other two users interviewed, this user commented that her company had converted to the System/38 from another system—in this case, a Honeywell Level 62 computer. The System/38 is used to accomplish accounting, order processing, and inventory applications, as well as insurance-related applications. This satisfied user said that she was able to reduce her DP staff from six programmers to three because of the increase in programmer productivity the System/38 has provided. She also mentioned that her company employed Sorbus, a third-party maintenance firm, to provide technical support for the System/38; her company was very pleased with Sorbus' field service staff. □

➤ **Model 5660 High-Speed Line Remote Attachment:** This feature allows the System/38 under the CPF operating system to communicate locally or remotely with a 3705 Communications Controller at nominal speeds of 57.6K bps (locally) or 56K bps (remotely). It also allows the System/38 to communicate remotely with a 4331 Communications Adapter or another System/38 at nominal speeds up to 56K bps.

Model 5680 Local High-Speed Attachment: This unit permits a Series/1 to be locally attached to a System/38 at a nominal line speed of 56K bps. Communication is point-to-point BSC and program-to-program.

The 2879 Enhanced Display Station Emulation Adapter: This feature provides for attachment of the IBM PC, IBM PC XT, IBM Portable PC, and IBM PC AT to the IBM System/38 and IBM System/36. The IBM PC with the Enhanced Display Station Emulation Adapter and Enhanced 5250 Emulation Program can attach directly to the System/38 and System/36 and can also attach remotely via the 5294 Remote Control Unit. The IBM PC will emulate the 5250 workstation family displays and printers.

The Rolmbridge 5250 Link Protocol Converter: This feature is a networking product that supplies protocol conversion for asynchronous terminal and printer devices connected through a Rolm CBX II to a System/38 or System/36 host system. The Rolmbridge 5250 Link Protocol Converter is integrated in the Rolm CBX II and provides link connection via twinax cable.

Physically, the Rolmbridge 5250 Link Protocol Converter comprises a Rolm CBX II resident card set which combines seven-channel protocol converter cards and a Rolmbridge 5250-specific CBX motherboard with integral twinax connectors for attachment to the twinax cable. The Rolmbridge 5250 Link Protocol Converter is expandable by multiples of seven, depending on the limitations of the host system (System/38 or System/36) and Rolm CBX II configurations. Data rates of up to 19.2K bps are limited only by the capabilities of the asynchronous link and device. Autobaud detection is provided.

The Rolmbridge 5250 Link Protocol Converter allows asynchronous devices, such as Rolm Desktop Products, other asynchronous display terminals, printers, and personal computers with terminal emulation software to appear as 5250 displays and printers. The 5250 datastream is converted to and from EBCDIC/ASCII to permit asynchronous devices to have the appearance of 5291 displays and 5256 printers and to access System/38 and System/36 applications programs.

SOFTWARE

OPERATING SYSTEM: *Control Program Facility (CPF)* is the IBM System/38's support program product. CPF provides many integrated functions designed to satisfy the installation requirements for a multiprogrammed, batch, and on-line interactive system. The major facilities and features of CPF are described in the following paragraphs.

The *object management facilities* of CPF allow objects to be grouped and located in the system. The general term "object" is used to refer to any named item (such as a program or a file) stored in the system. The general term is used because all kinds of objects are located in the same manner. The object management facilities allow users to name the objects they want without needing to specify the exact locations of the objects. Certain functions of CPF, which are valid for many different types of objects, can be performed through a single set of commands. For example, functions that provide security or backup copies of objects apply to all object types.

The *work management facilities* of CPF provide the framework through which the system and all the work performed on the system are controlled. These facilities provide the system functions needed to support a multiprogramming environment and to manage contention between jobs for main storage and other system resources. The work management facilities allow work to be submitted by the user, presented to the machine for execution, and controlled by the system operator. ➤

IBM System/38

► Through the work management facilities, specialized operating environments, called subsystems, control the use of resources needed for different types of work. When CPF is installed, it includes subsystems that support interactive, batch, and spooling processing. Although the work management facilities can be used to tailor subsystems to provide specialized operating environments, the system is fully operational when it is installed. By starting, controlling, and terminating subsystems, the system operator can control entire operating environments through the control language.

The *data management facilities* of CPF support both data base files and device files. Data base data management provides the functions required for creating data base files and performing input/output operations to them. Device data management provides similar operations for devices attached to the system, including functions to support the display devices.

Generally, the data base files or display device files are described apart from the programs that use the files. That is, the attributes of each field (such as its length, data type, and position in a record) are specified in the file description rather than in the program. These data descriptions are created with the use of the data description specifications. A specification form (similar to an RPG specification form) provides a common format for describing the data. The form provides fixed columns for frequently specified and required information, as well as keyword specifications for less frequently specified options.

Other device files are usually described in the traditional manner where the records and fields are described in the programs that use them. The spooling functions support the usual operations for reading files from input devices and writing files to output devices so that programs using the files are not tied directly to the external devices.

The *operator control facilities* of CPF enable a system operator to control the operations of jobs and subsystems, respond to system messages, and perform other operations normally performed by a system operator. These operations can be performed from any workstation and are not restricted to a single person.

The *security facilities* allow various levels of control over access to objects by individual workstation users. As security requirements change, the control provided by the security facilities can be modified.

The *save/restore functions* of CPF allow applications and data files to be backed up concurrently with unrelated system operations. These functions can be used to maintain backup copies of system and application objects, and the copies can be used to recover from system or application malfunctions.

The *control language* is the primary interface to CPF and can be used concurrently by users at different workstations. A single control language statement is called a command. Commands can be entered individually from workstations, entered as part of batch jobs, or used as statements to create control language programs. All of the commands use a consistent syntax. Each command is made up of a command name and parameters. A command name usually consists of a verb or action followed by a noun or phrase that identifies the receiver of the action. In addition, CPF provides prompting support for all commands, default values for most command parameters, and validity checking to ensure that a command is entered correctly before the function is performed. Thus, the control language provides a single, flexible interface to many different system functions that can be used by different system users.

Other features of CPF include:

- **Advanced Program-to-Program Communications (APPC)**—provides an SNA program-to-program protocol between two System/38s, between a System/38 and a System/36, and between a System/38 and CICS/VS. APPC is based on SNA LU6.2 and PU2.1 architecture and provides a peer relationship between the interconnected products. It allows the System/38 to function as a departmental node with the ability to duplicate systems between departments. System/38 provides a conversational interface to support user interconnect functions without the need to understand transmission/communications protocols.
- **3270 Device Emulation Support**—allows System/38 and locally or remotely attached IBM 5291s, 5292s, and other 5250 Information Display System devices to appear as a 3271 Control Unit and 3270 devices. Support for IBM 3270 Device Emulation includes support for the IBM Series/1 Realtime Programming System (RPS) Communications Manager and the IBM Series/1 Event Driven Executive (EDX) Communications Facility (CF) as a remote host.
- **SNA Alert Support**—notifies the SNA network operator of conditions detected by the System/38.
- **Mixed File and High-Level Language (HLL) Multiple Device Support**—applications written in RPG III or Cobol may have interactive communications with multiple devices and systems of the same or different types through a single file definition.
- **Communications Error Recovery Procedure (ERP) Enhancements**—lets users recover from many communications errors with little or no operator intervention.
- **High-Speed Line Remote (CCITT V.35) Attachment Feature**—can locally connect to a 3705-II at nominal speeds of 57.6K bps or remotely to a 3705-II, a 4331 Communications Adapter, or another System/38 at nominal speeds of up to 56K bps. The attachment feature supports CCITT V.35 networks at nominal speeds of up to 56K bps using either Binary Synchronous Communication (BSC) or Synchronous Data Link Control (SDLC) protocol.
- **Graphical Data Display Manager (GDDM)**—support for General Purpose Graphics in High Level Language (HLL) applications; Presentation Graphics Routines (PGR)—support for Business Graphics for HLL applications; and support for Graphics Data File (GDF) interchange.
- **Document Interchange Architecture (DIA) host support**—allows the System/38 to serve as an office systems host for document distribution and document library services. DIA distribution services provide support for sending documents to and receiving documents from other office systems hosts in an SNA network. The interchange of documents is accomplished by using the CPF System Network Architecture Distribution Services (SNADS). Remote distribution services are provided for the IBM System/38, IBM System/36, and DISOSS/370, and IBM 5520.
- **Display Station Pass-Through Support**—allows display station users at a System/38 to attach their devices to another System/38.
- **The System/38 Remote Attach Support**—allows a System/38 to appear as a host system for 3270 controllers and devices. The attached devices appear to CPF and applications programs as a remote 5250 display station. The user at the 3270 device views the System/38 5250 screens. Attachment is provided for SNA/SDLC connection. ►

IBM System/38

- ▶ • **SNADS support**—permits the System/38 to serve as an SNA Distribution Service Unit and allows for the distribution of documents and objects between other SNA Distribution Service Units such as DISOSS/370, IBM System/36 with PS/36, IBM 5520, and other System/38s. System/38 SNADS support permits the System/38 to act as an origin, destination, or intermediate system in a SNADS network. SNADS is independent of the format of the data to be interchanged and is used by System/38 DIA support as well as System/38 Object Distribution Facilities.
- **Distributed Host Command Facility (DHCF)**—allows users of IBM 3270 terminals connected to a System/370 to pass through the System/370 and run System/38 programs as if their terminals were directly attached to the System/38.
- **Object Distribution Facility**—enables programs, data files, messages, and job streams to be shared by users on other System/38s. In addition, a join-logical-file function that enhances the System/38's relational data base is also available with CPF. Users are able to read data from up to 32 physical files as if they were actually one file.

PROGRAMMING LANGUAGES: The IBM System/38 supports RPG III, Cobol, and Basic programming languages.

DATA BASE MANAGEMENT: Data base management facilities are integrated with the operating system.

DATA MANAGEMENT: The *System/38 Distributed Data Management (DDM)* Licensed Program and the System/36 Release 5 DDM feature of the System Support Program allow applications programs on either system to access files stored on the other. DDM lets a System/38 process files from a System/36 or another System/38, as well as receive requests for file processing from a System/36 or another System/38.

Programs written to read, add, update, and delete records in local files need not be modified, in most cases, to process the same files on remote systems that support DDM. A DDM file contains the name of a file on a remote system, as well as the APPC information necessary to establish communications with that remote system. An applications program at the source system is not aware that records being processed are actually stored on a different system. Programs written in RPG III, Cobol, Basic, PL/1, and CL to process local data base files do not have to be modified to process the same files on remote systems that support Target DDM. The determination of which file to process (local or remote) is made by following the System/38 file override and library list rules to find the file object. If the file object found is a DDM file, the records will be processed from the remote file named in the DDM file.

In addition, programs on remote systems that support Source DDM can access the System/38 data base. The maximum record size and key length supported are the lesser of those on the two systems, providing there is a difference in length. If both are System/38s, the maximum record length (32,766 bytes) and key length (120 bytes) are supported.

DATA COMMUNICATIONS: *Remote Job Entry Facility (RJEF)* is a licensed program which provides support for the System/38 to function as a Remote Job Entry (RJE) workstation for submission of jobs to a host System/370, 30XX, or 43XX while using Binary Synchronous Communications (BSC). Other features of RJEF include multileaving support concurrent with other System/38 programs and device operation; concurrent multiple RJE console interfaces to input host commands and view host and RJEF messages; up to

three readers operating concurrently; up to three printers operating concurrently; up to three punches operating concurrently; reader input from data base; and printer output directly to printer device or spooled.

System/38 Binary Synchronous Communications Remote Job Entry for VSE/POWER is a field-developed program designed for users of the System/38 with a need for remote job submission to host computers under control of the DOS/VSE operating system. It provides the user with the capability to submit jobs to DOS/VSE; monitor display and response to messages from VSE Power; and receive print or punch output.

The *Enhanced 5250 Emulation Program* supports attachment of the IBM Personal Computer, IBM PC XT, IBM Portable PC, and IBM PC AT to the System/38 and System/36. The Enhanced 5250 Emulation Program allows the IBM PC to operate as a standalone personal computer or as a 5250 workstation with a 5256 or 5219 printer.

The IBM Personal Computer in IBM 5250 emulation mode has access to all the functions of the host system available to a display station operator, providing the user with the power of the host System/38. Up to 128 Personal Computers can be attached locally on a System/38.

The Enhanced 5250 Emulation Program allows the user to establish one or two sessions with the host system. The sessions can be two display sessions, emulating 5291 or 5292-1 workstation terminals, one workstation session and one printer emulation session, or a single workstation session.

Printer emulation allows the IBM PC user, or any user attached to the host, to direct printed output from a host application program to the spool file for printing on an IBM PC printer. The printer emulation program treats the IBM PC printer as a 5256 matrix printer or a 5219 printer.

Additional functions of the Enhanced 5250 Emulation Program include host graphics support, 5292-2 subset, table-driven printer support, serial printer attachment support, enhanced graphics adapter support, and professional graphics controller support.

The *Remote 5250 Emulation Program* supports remote attachment of the IBM PC, IBM PC XT, IBM Portable PC, and IBM PC AT via communications lines to the IBM System/38 and IBM System/36. The Remote 5250 Emulation Program allows the IBM PC to operate as a standalone personal computer or as a remote 5250 workstation with an IBM 5256 or 5219 printer using the SDLC communications adapter in a remote environment. It also allows concurrent access to the IBM PC fixed-disk while the Remote 5250 Emulation Program is active and provides the capability to establish two host sessions and one IBM Personal Computer session.

The *X.25 Communications Attachment Feature* (Model 1521) allows attachment of two independent lines to packet switched networks. This feature provides an interface for attachment to the X.25 packet switched network through either an X.21 interface or one of two types of X.21 bis interfaces. System/38 will support attachment to X.25 via X.21 bis at speeds up to 19.2K bps (V.24 or RS-232-C) and 48K bps (V.35), and via X.21 (nonswitched only) at speeds up to 64K bps.

The X.25 feature enables communications through an X.25 network to all SNA devices and systems which currently attach to the System/38 over SNA/SDLC connections and provide compatible X.25 attachments.

IBM System/38

► System/38 X.25 communications support can also allow local attachment of a System/38 to another System/38 or a System/36 by configuring the System/38 as a DCE (Data Communications Equipment) interface and the other system as a normal DTE (Data Terminal Equipment) interface.

The System/38 is also capable of functioning as an end node in an *Advanced Peer-to-Peer Network (SNA/APPN)*. In APPN, each network node, a System/36 with the APPN feature installed, includes dynamically created and maintained tables that describe the path to reach the destination location. Users of System/38 DDM or 5250 Display Station Pass-Through must describe the destination location and the connection device for the adjacent node in the network. It is not necessary to know or describe the remaining network nodes or communications links.

5250 Display Station Pass-Through functions of System/36 System Support Program (SSP) and System/38 CPF allow access to either system from the other. A user may sign on to any system in the network of System/36 and System/38 units, and have access to applications and data stored anywhere in the network. All models of the 5250 family of workstations, locally and remotely attached, and workstations that emulate the 5250 family are supported.

PROGRAM DEVELOPMENT: The *Application Program Development Facilities* of CPF enable a programmer to perform most application development activities interactively from a workstation. These activities include entering source programs into the data base; compiling programs concurrently with normal system operations; testing programs in a protected environment so that production files are not inadvertently changed by a program that is being tested; debugging a program on-line, using CPF-provided functions to locate program errors; alternating between two interactive jobs simultaneously, such as reviewing a display of a compilation listing and reviewing the values of program variables; and correcting the program source code and recompiling the program.

UTILITIES: The *Interactive Data Base Utilities* is a System/38 program product consisting of a source entry utility for creating and maintaining program-language source files, a data file utility for creating and maintaining data files and for displaying specific records from data files, and a query utility for extracting and presenting information from data files. These utilities are capable of supporting both interactive and batch processing with multiple concurrent users and function concurrently with system operation.

Conversion Reformat Utility: Operates on data from a data base file or a device file to perform sort, merge, and copy operations. The conversion reformat utility allows the user to sort a physical file to produce a record address file, sort a physical file to produce a physical file, sort/merge multiple files to produce a physical file, and copy data from one or more files to produce a physical file or device file.

System/34 to System/38 Conversion Aid: Converts System/34 RPG to source code OCL, displays, sorts, and menus, etc., which can then be processed on a System/38. In addition, programs that substitute for System/34 functions are provided for the System/38. Version 1, Modification Level 3 allows use of IBM System/38 Control Program Facility (CPF), Release 5.0 functions, such as new Control Language (CL) commands and support for local data area and multiple devices in a file. An additional function has been provided to allow conversion in some situations not previously supported.

System/38 CCP Conversion Utilities: A program product designed to run on System/3 Models 8, 10 (disk), 12, and 15. These utilities convert System/3 RPG II to System/38 RPG III (including auto report), System/3 OFF source state-

ments, assignment set, OCL, and OCL procedures. These utilities are capable of generating control languages to off-load files, programs, and CL to the conversion media; create and load files; and load and compile RPG II programs (including auto report) and CL programs. Converted System/3 programs run on the System/38 require the System/38 CCP Executive Subroutines.

Workstation Search Facility: Provides the workstation user with a powerful, easy-to-use tool to display records from disk files based on terminal user-selected search criteria. This System/38 facility is based on the System/34 Workstation Search Facility. It includes enhancements that provide on-line assistance to the user during operation. Features of the System/38 Workstation Search Facility include ease of operation allowing non-DP personnel within the organization to search their files for information; reduces the need for alphabetically sorted master file listings; Keyword in Context (KWIC) technique for searching alphabetic fields without requiring data base changes by the user; use of up to an eight-character search argument with null characters anywhere within the argument; use of any combination of six logical search operators (equal, less than, less than or equal, greater than, greater than or equal, or not equal); AND/OR logic to define the relationship between the primary, secondary, and tertiary searches; support for both the 960 and 1920 screen versions on the 5251 and 5252 display stations; and supports System/38 physical files in either keyed sequence or arrival sequence.

Display Information Facility: Provides the System/38 programmer with a powerful tool to build on-line information applications consisting of combinations of alpha search, inquiry, update, add, delete, list, and user programs. This facility is designed to be used to generate programs that will give the user on-line access to data files. Tailoring capabilities permit users to incorporate their unique data base file formats, display formats, and report formats. These formats could be created, for example, by using the System/38 Data Description Specifications (DDS) or the System/38 Screen Design Aid (SDA). The result is a user-designed, on-line information application. Display Information Facility is applicable to most industry classifications. Distributors and manufacturers can use the facility to create on-line information applications consisting of interrelated searches, perform inquiries, and lists for customer and receivables files; contractors can do searches, inquiries, and lists for their employees and jobs; hospitals can build patient and guarantor searches, perform inquiries, enter patient information, and maintain hospital files.

System/38 Advanced Printer Function Utility: Provides users with a method of accessing the addressable matrix printing functions available on Models 1 and 2 of the IBM 5224 Printer and Models 1, 2, 3, and 4 of the IBM 5225 Printer. Users can design form layouts, logos, and special characters, and merge their output with a predefined form.

System/38 Transaction Switching Facility: Provides a set of programs to loosely couple multiple System/38s together with Binary Synchronous communications lines. It monitors communications lines between multiple System/38s and routes transactions for an inbound communications facility to the appropriate data base file for maintenance or inquiry transactions or to another outbound communications facility. Routing of transactions is controlled by communications line monitors with user-defined data. The Transaction Switching Facility requires little user knowledge of communications to loosely couple multiple System/38s.

System/38 File Support Utility PRPQs: With the IBM PC 5250 Emulation feature, provides additional support on the System/38 for attaching the IBM Personal Computer. The PRPQs let PC users create virtual diskettes on the host system. (A virtual diskette is a special file formatted by the

IBM System/38

► File Support Utilities to the same specifications as a two-sided diskette formatted by the Personal Computer Disk Operating System [DOS].) Each file record corresponds to a sector on the diskette. This virtual diskette can hold up to 320K bytes of data and up to 112 files. The PRPQs also provide a tool to assist host programmers in transferring data between the Personal Computer and the host system.

System/38 Office/38 Business Graphics Utility (BGU) is a general-purpose, menu-driven tool that allows System/38 users to create, modify, store, display, print, and plot color business graphics.

The *System/36-to-System/38 Conversion Aid* is designed to assist a System/36 user in converting programming source code and data files to the System/38. Programs are provided for tasks to be done on the System/36 and on the System/38. These programs are menu-oriented in that the user makes selections which then generate jobs to be executed in batch mode. These functions include the following conversions:

- System/36 RPG II to System/38 RPG III.
- System/36 Auto Report to System/38 Auto Report.
- System/36 Operation Control Language (OCL) to System/38 Control Language (CL).
- System/36 Display Format Specifications to System/38 Data Description Specifications.
- System/36 Sort Specifications to System/38 Reformat Utility Specifications.
- System/36 Menus to System/38 Data Description Specifications, CL.
- System/36 Message Member to System/38 Message File.
- System/36 Data Files to System/38 Data Files.

OTHER SOFTWARE: *IBM System/38 Distribution Management System—Customer Service and Purchasing Applications* consists of five program modules designed for use by distributors. Included are modules for Billing, Accounts Receivable, Inventory Control, Sales Analysis, and Purchasing.

IBM System/38 Manufacturing Accounting and Production Information Control System Version 2 (System/38 MAPICS II): This product consists of 13 integrated applications, including Production Control and Costing, Payroll, Accounts Payable, Accounts Receivable, Inventory Management, Product Data Management, General Ledger, Sales Analysis, Order Entry and Invoicing, Data Collection System Support, Material Requirements Planning, Capacity Requirements Planning, and Cross Application System Support.

System/38 MAPICS II provides full support to migrate files from System/38 MAPICS to MAPICS II. According to IBM, most, but not all, MAPICS applications have been enhanced to create MAPICS II. The modules that have not been enhanced include Sales Analysis and Data Collection System Support.

IBM System/38 Distribution Management System Financial Management Application (DMS/38): This product consists of three programs designed for use by distributors. Included are modules for Payroll, Accounts Payable, and General Ledger.

IBM System/38 Data Preparation Licensed Program: This product is designed for use in the retail industry. The program functions to restructure records written on dis-

quettes at IBM 5265 POS terminals and updates appropriate user files.

Log Recovery: This is a series of programs designed to enhance and expand the recovery capability available with the CPF operating system. Log Recovery uses the log file created by the Data Base Logging function of CPF and allows the user to recover damaged data base files and to ensure data base file integrity following an abnormal system termination. Through a series of menus and prompts, Log Recovery will help the user to restore the backup of a damaged or missing file, and then reapply logged records to bring the file to the current level. Log Recovery will also recover data base transactions which might have been lost in volatile storage as a result of a power loss or other abnormal system terminations. This provides an alternative to using a high-force write ratio on user files to avoid the loss of data in volatile storage.

Text Management: The Text Management program provides the capability for System/38 users to create, store, retrieve, revise, and print documents. The user can access the System/38 data base from the Text Management program. This provides the capability to selectively merge data base information within a text document. The functions of Text Management are used interactively through the 5251 Display Stations Models 11 and 12 concurrently with data processing operations. Documents are stored as members in files, allowing maximum flexibility for organization of documents. For example, a file can represent a folder in which all documents pertaining to a subject or job can be stored. In addition, each user can have one or more libraries for storage of document files. Up to 21 lines of the display can be used to enter or revise text. Line commands, similar to the System/38 Source Entry Utility (SEU), as well as command keys, are used to invoke the function of the Text Management program. All the System/38 functions of the Control Program Facility (CPF) are available to the Text Management user.

PRICING AND SUPPORT

POLICY: IBM offers the System/38 on a purchase, lease, or rental basis. Two rental policies are available: the standard Monthly Availability Charge (MAC) and the System/38 Term Availability Plan (TAP). Both MAC and TAP include maintenance charges.

The current Agreement for Lease or Rental of IBM Machines provides users with a single contract on which they can specify mixtures of rental and leased equipment, each with various terms. CPUs rented under the plan can be terminated or downgraded on 90 days' notice, and all other rented equipment can be terminated or downgraded on 30 days' notice. Base terms and extension terms are specified for each piece of equipment obtained through a leasing agreement.

System/38 Licensed Programs are provided under the Agreement for IBM Licensed Programs.

SUPPORT: The IBM System/38 is leased to the user under Rental Plan B, which entitles the user to maintenance for 24 hours per day, 7 days per week.

For purchased systems, the IBM System/38 is under Maintenance Group D. The minimum period of maintenance service is 9 consecutive hours between 7:00 a.m. and 6:00 p.m., Monday through Friday. Charges for maintenance coverage outside this period are based upon the following percentages of the minimum monthly maintenance charge (MMC) added to the MMC:

IBM System/38

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

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

For users without a maintenance contract, the System/38 is maintained under per-call Class 2. Under this class the per-call charge during regular hours is \$105 per hour, and during off-hours the charge is \$123 per hour. The hourly rate for systems engineering service is \$57.

EDUCATION: IBM offers a variety of training programs for the System/38. Contact your local IBM representative for a full listing.

TYPICAL CONFIGURATIONS: Sample configurations for the IBM System/38 systems are shown below. Complete equipment and software prices follow these configurations.

SYSTEM/38 MODEL 100:

5381 System Unit Model 100 with 2048KB of memory and 64.5MB fixed disk storage	\$37,500
Six 5251 Model 11 workstations	12,810
Two 5256 matrix printers (40 cps)	8,290
One 3262 line printer	12,620
System/38 Control Program Facility (CPF) Operating System	22,000
TOTAL PURCHASE PRICE:	\$93,220

SYSTEM/38 MODEL 700:

5382 System Unit Model ER6 with 32,768KB of memory and 387.1MB fixed disk storage	\$385,490
9335 A01/B01 DASD	29,750
Forty 5251 Model 11 workstations	85,400
Ten 5256 Model 2 matrix printers (80 cps)	26,040
Two 3262 line printers	25,240
System/38 CPF Operating System	22,000
TOTAL PURCHASE PRICE:	\$573,920

EQUIPMENT PRICES

	Purchase Price (\$)	Monthly Rental (\$)	Monthly Maint. (\$)
BASIC SYSTEMS			
5381 System Unit; includes processor unit, main memory, fixed storage, system console keyboard/display, diskette magazine drive, and one workstation controller.			
Model 100			
System Unit with Model 100 CPU and 2048K bytes of main memory:			
181 64.5 megabytes of fixed disk storage	37,500	3,800	390
System Unit with Model 100 CPU and 4096K bytes of main memory:			
1G1 64.5 megabytes of fixed disk storage	47,500	5,810	500
Model 200			
System Unit with Model 200 CPU and 4096K bytes of main memory:			
2GA 64.5 megabytes of fixed disk storage; includes expansion enclosure	65,340	6,420	522
2GB 129.0 megabytes of fixed disk storage; includes expansion enclosure	73,910	6,830	568
2G1 64.5 megabytes of fixed disk storage	62,500	6,300	520
2G2 129.0 megabytes of fixed disk storage	71,070	6,710	566
2G3 193.5 megabytes of fixed disk storage	84,910	7,320	618
2G4 258.0 megabytes of fixed disk storage	93,480	7,730	664
2G5 322.6 megabytes of fixed disk storage	106,920	8,320	725
2G6 387.1 megabytes of fixed disk storage	115,490	8,730	771
System Unit with Model 200 CPU and 6144K bytes of main memory:			
2QA 64.5 megabytes of fixed disk storage; includes expansion enclosure	75,340	8,430	632
2QB 129.0 megabytes of fixed disk storage; includes expansion enclosure	83,910	8,840	678
2Q1 64.5 megabytes of fixed disk storage	72,500	8,310	630
2Q2 129.0 megabytes of fixed disk storage	81,070	8,720	676
2Q3 193.5 megabytes of fixed disk storage	94,910	9,330	728
2Q4 258.0 megabytes of fixed disk storage	103,480	9,740	774
2Q5 322.6 megabytes of fixed disk storage	116,920	10,330	835
2Q6 387.1 megabytes of fixed disk storage	125,490	10,740	881

IBM System/38

BASIC SYSTEMS

5382 System Unit; includes processor unit, main memory, fixed storage, system console keyboard/display, diskette magazine drive, and extended workstation controller.

Model 300

System Unit with Model 300 CPU and 6144K bytes of main memory:

		Purchase Price (\$)	Monthly Rental (\$)	Monthly Maint. (\$)
FQA	64.5 megabytes of fixed disk storage; includes expansion enclosure	110,340	10,820	637
FQB	129.0 megabytes of fixed disk storage; includes expansion enclosure	118,910	11,230	683
FQ1	64.5 megabytes of fixed disk storage	107,500	10,700	635
FQ2	129.0 megabytes of fixed disk storage	116,070	11,110	681
FQ3	193.5 megabytes of fixed disk storage	129,910	11,720	733
FQ4	258.0 megabytes of fixed disk storage	138,480	12,130	779
FQ5	322.6 megabytes of fixed disk storage	151,920	12,720	840
FQ6	387.1 megabytes of fixed disk storage	160,490	13,130	886

System Unit with Model 300 CPU and 8192K bytes of main memory:

FYA	64.5 megabytes of fixed disk storage; includes expansion enclosure	120,340	12,830	747
FYB	129.0 megabytes of fixed disk storage; includes expansion enclosure	128,910	13,240	793
FY1	64.5 megabytes of fixed disk storage	117,500	12,710	745
FY2	129.0 megabytes of fixed disk storage	126,070	13,120	791
FY3	193.5 megabytes of fixed disk storage	139,910	13,730	843
FY4	258.0 megabytes of fixed disk storage	148,480	14,140	889
FY5	322.6 megabytes of fixed disk storage	161,920	14,730	950
FY6	387.1 megabytes of fixed disk storage	170,490	15,140	996

Model 400

System Unit with Model 400 CPU and 6144K bytes of main memory:

BQA	64.5 megabytes of fixed disk storage; includes expansion enclosure	145,340	13,920	747
BQB	129.0 megabytes of fixed disk storage; includes expansion enclosure	153,910	14,330	793
BQ1	64.5 megabytes of fixed disk storage	142,500	13,800	745
BQ2	129.0 megabytes of fixed disk storage	151,070	14,210	791
BQ3	193.5 megabytes of fixed disk storage	164,910	14,820	843
BQ4	258.0 megabytes of fixed disk storage	173,480	15,230	889
BQ5	322.6 megabytes of fixed disk storage	186,920	15,820	950
BQ6	387.1 megabytes of fixed disk storage	195,490	16,230	996

System Unit with Model 400 CPU and 8192K bytes of main memory:

BYA	64.5 megabytes of fixed disk storage; includes expansion enclosure	155,340	15,930	857
BYB	129.0 megabytes of fixed disk storage; includes expansion enclosure	163,910	16,340	903
BY1	64.5 megabytes of fixed disk storage	152,500	15,810	855
BY2	129.0 megabytes of fixed disk storage	161,070	16,220	901
BY3	193.5 megabytes of fixed disk storage	174,910	16,830	953
BY4	258.0 megabytes of fixed disk storage	183,480	17,240	999
BY5	322.6 megabytes of fixed disk storage	196,920	17,830	1,060
BY6	387.1 megabytes of fixed disk storage	205,490	18,240	1,106

Model 600

System Unit with Model 600 CPU and 8192K bytes of main memory:

DYA	64.5 megabytes of fixed disk storage; includes expansion enclosure	185,340	18,120	1,002
DYB	129.0 megabytes of fixed disk storage; includes expansion enclosure	193,910	18,530	1,048
DY1	64.5 megabytes of fixed disk storage	182,500	18,000	1,000
DY2	129.0 megabytes of fixed disk storage	191,070	18,410	1,046
DY3	193.5 megabytes of fixed disk storage	204,910	19,020	1,098
DY4	258.0 megabytes of fixed disk storage	213,480	19,430	1,144
DY5	322.6 megabytes of fixed disk storage	226,920	20,020	1,205
DY6	387.1 megabytes of fixed disk storage	235,490	20,430	1,251

System Unit with Model 600 CPU and 12,288K bytes of main memory:

DNA	64.5 megabytes of fixed disk storage; includes expansion enclosure	205,340	22,130	1,162
DNB	129.0 megabytes of fixed disk storage; includes expansion enclosure	213,910	22,540	1,208
DN1	64.5 megabytes of fixed disk storage	202,500	22,010	1,160
DN2	129.0 megabytes of fixed disk storage	211,070	22,240	1,206
DN3	193.5 megabytes of fixed disk storage	224,910	23,030	1,258
DN4	258.0 megabytes of fixed disk storage	233,480	23,440	1,304
DN5	322.6 megabytes of fixed disk storage	246,920	24,030	1,365
DN6	387.1 megabytes of fixed disk storage	255,490	24,440	1,411

IBM System/38



Model 600 (Continued)

		Purchase Price (\$)	Monthly Rental (\$)	Monthly Maint. (\$)
System Unit with Model 600 CPU and 16,384K bytes of main memory:				
DPA	64.5 megabytes of fixed disk storage; includes expansion enclosure	225,340	26,140	1,322
DPB	129.0 megabytes of fixed disk storage; includes expansion enclosure	233,910	26,550	1,368
DP1	64.5 megabytes of fixed disk storage	222,500	26,020	1,320
DP2	129.0 megabytes of fixed disk storage	231,070	26,430	1,366
DP3	193.5 megabytes of fixed disk storage	244,910	27,040	1,418
DP4	258.0 megabytes of fixed disk storage	253,480	27,450	1,464
DP5	322.6 megabytes of fixed disk storage	266,920	28,040	1,525
DP6	387.1 megabytes of fixed disk storage	275,490	28,450	1,571

Model 700

System Unit with Model 700 CPU and 16,384K bytes of main memory:

EPA	64.5 megabytes of fixed disk storage; includes expansion enclosure	255,340	28,120	1,352
EPB	129.0 megabytes of fixed disk storage; includes expansion enclosure	263,910	28,530	1,398
EP1	64.5 megabytes of fixed disk storage	252,500	28,000	1,350
EP2	129.0 megabytes of fixed disk storage	261,070	28,410	1,396
EP3	193.5 megabytes of fixed disk storage	274,910	29,020	1,448
EP4	258.0 megabytes of fixed disk storage	283,480	29,430	1,494
EP5	322.6 megabytes of fixed disk storage	296,920	30,020	1,555
EP6	387.1 megabytes of fixed disk storage	305,490	30,430	1,601

System Unit with Model 700 CPU and 24,576K bytes of main memory:

EJA	64.5 megabytes of fixed disk storage; includes expansion enclosure	295,340	36,020	1,472
EJB	129.0 megabytes of fixed disk storage; includes expansion enclosure	303,910	36,430	1,518
EJ1	64.5 megabytes of fixed disk storage	292,500	35,900	1,470
EJ2	129.0 megabytes of fixed disk storage	301,070	36,310	1,516
EJ3	193.5 megabytes of fixed disk storage	314,910	36,920	1,568
EJ4	258.0 megabytes of fixed disk storage	323,480	37,330	1,614
EJ5	322.6 megabytes of fixed disk storage	336,920	37,920	1,675
EJ6	387.1 megabytes of fixed disk storage	345,490	38,330	1,721

System Unit with Model 700 CPU and 32,768K bytes of main memory:

ERA	64.5 megabytes of fixed disk storage; includes expansion enclosure	335,340	43,920	1,592
ERB	129.0 megabytes of fixed disk storage; includes expansion enclosure	343,910	44,330	1,638
ER1	64.5 megabytes of fixed disk storage	332,500	43,800	1,590
ER2	129.0 megabytes of fixed disk storage	341,070	44,210	1,636
ER3	193.5 megabytes of fixed disk storage	354,910	44,820	1,688
ER4	258.0 megabytes of fixed disk storage	363,480	45,230	1,734
ER5	322.6 megabytes of fixed disk storage	376,920	45,820	1,795
ER6	387.1 megabytes of fixed disk storage	385,490	46,230	1,841

Purchase Price (\$)	Monthly Maint. (\$)	Monthly Lease Charge (3-year lease) (\$)	Monthly Rental* (\$)
---------------------------	---------------------------	---	----------------------------

OPTIONS AND FEATURES

1100	Printer Attachment for the first 5211 or 3262 printer	1,215	7.00	50	57
1110	Printer Attachment for the second 5211 or 3262 printer	3,445	11.50	141	161
1130	Disk Storage Attachment	5,168	15.00	243	279
1132	Second Disk Storage Attachment	5,610	15.00	346	398
1135	Printer Attachment for first 3203 printer	2,835	6.50	102	117
1136	Printer Attachment for second 3203 printer	5,070	11.00	186	214
1220	Attachment for first 5425 Multifunction Card Unit	4,460	20.00	174	200
1221	Attachment for second 5424 Multifunction Card Unit	213	2.00	6	7
1300	Automatic Initial Micro Program Load	2,025	3.00	84	96
2100	Audible Alarm	202	2.00	6	7
3210	Power Keylock	79	NA	NA	NA
6300/1	Processor Unit Expansion 1 or 2	2,025	6.00	84	96
6302	Processor Unit Expansion 3	405	2.00	17	19
6303	Processor Unit Expansion 4	608	2.00	23	26
6304	Processor Unit Expansion 5	4,055	9.00	137	158
6305	Processor Unit Expansion 6	2,430	5.50	87	100
6306	Processor Unit Expansion 7	3,040	5.50	108	124

NA—Not Available



IBM System/38

▶ OPTIONS AND FEATURES (Continued)

		Purchase Price (\$)	Monthly Maint. (\$)	Monthly Lease Charge (3-year lease) (\$)	Monthly Rental* (\$)
7960	3411 Magnetic Tape Attachment	3,230	10.50	200	230
7970	3430 Magnetic Tape Attachment	3,230	10.50	200	230
5321/2	Device interface expansion base and second expansion	2,870	6.50	102	117
5331/2	Device control expansion base and second expansion	1,230	2.50	43	49
5333/4	Device Control Expansion; control storage for up to 8 additional workstations	1,230	2.50	43	49
5323/4	Device Interface Expansion; includes ports for up to 12 additional workstations (cannot be installed with 5331/2)	2,980	6.50	102	117

MASS STORAGE

3370-A11	Single Disk Drive and Control; 571.3 megabytes	35,480	158	1,435	1,686
3370-A12	Add-on Disk Drive; 729.8 megabytes	35,480	134	NA	2,190
3370-B11	Add-on Disk Drive; 571.3 megabytes	26,000	118	1,075	1,263
3370-B12	Add-on Disk Drive; 729.8 megabytes	26,000	101	NA	1,640
9332/200	Direct Access Storage Subsystem; 200MB	8,500	18	NA	850
9332/400	Direct Access Storage Subsystem; 400MB	14,000	—	NA	—
9335-A01	Direct Access Storage Subsystem device function controller	8,500	18	NA	850
9335-B01	Direct Access Storage Device; 855.8MB	21,250	50	NA	2,125
9309-01	Rack Enclosure; 1 meter high	2,500	4	NA	250
9309-02	Rack Enclosure; 1.6 meters high	3,000	4	NA	300

PRINTERS

5219/D01	40-cps correspondence quality bidirectional tabletop print wheel printer	5,420	63.00	NA	NA
5219/D02	60-cps correspondence quality bidirectional tabletop print wheel printer	5,835	69.00	NA	NA
3262/013	325-lpm printer	12,620	148.00	459	539
3203	Chain/train printer, 48-character set, 132 positions; 1200-lpm	33,875	451.00	1,835	2,155
3262	Standalone 650-lpm printer; 132 positions; 6/8 lines per inch	15,040	161.50	624	733
594X	Print Belt for 3262; 48-, 60-, 64-, 96-, 188-char. set (purchase only)	186	NA	NA	NA
5211/001	160-lpm line printer	7,900	75.00	408	479
5211/002	Line printer; 300 lpm, 132 positions, 6/8 lines per inch	9,625	126.00	501	589
5224/001	Matrix printer; may be substituted for Model 5256 console printer; 140 lpm	6,395	57.00	339	398
5224/002	Matrix printer; may be substituted for Model 5256 console printer; 280 lpm	7,280	66.00	387	455
5225/001	Model 1 serial, matrix printer; 280/155 lpm; may be substituted for Model 5256 console printer	12,075	128.00	538	632
5225/002	Model 2 serial, matrix printer; 400/290 lpm; may be substituted for Model 5256 console printer	13,945	180.00	614	722
5225/003	Model 3 serial, matrix printer; 490/355 lpm; may be substituted for Model 5256 console printer	15,495	222.00	683	803
5225/004	Model 4 serial, matrix printer; 560/420 lpm; may be substituted for Model 5256 console printer	16,940	265.00	749	880
5256/001	Model 1 serial, bidirectional matrix printer; 40 cps, 132 positions, 10 cpi, 6/8 lines per inch	4,145	57.00	251	295
5256/002	Model 2; same as Model 1 except 80 cps	4,340	62.00	285	334
5256/003	Model 3; same as Model 1 except 120 cps	4,535	71.00	309	363
4214-002	Impact serial matrix bidirectional printer; 200/50 cps	4,200	49.00	NA	NA
4234-002	Dot band printer, Model 2; 120/300/410 lpm	8,800	85.00	NA	NA
4245/012	Model 12 High Speed Line Printer; 1200 lpm	NA	NA	NA	NA
4245/020	Model 20; same as Model 12 except 2000 lpm	NA	NA	NA	NA
4245/T12	Model T12 High Speed Printer; 1200 lpm	31,000	250	NA	2,050
4245/T20	Model 20; same as Model T12 except 2000 lpm	35,000	400	NA	2,340

MAGNETIC TAPE EQUIPMENT

3410/001	Model 1 Add-on Magnetic Tape Transport; 9-track, 12.5 ips, 20K bps	3,365	132.00	295	351
3410/002	Model 2; same as Model 1 except 25 ips, 40K bps	4,365	145.00	391	466
3410/003	Model 3; same as Model 1 except 50 ips, 80K bps	5,365	160.00	493	587
3211	Single Density; 1600 bpi (3410 and 3411)	1,140	17.00	NA	86
3221	Dual Density; 800/1600 bpi (3410 and 3411)	2,185	57.00	116	138
6550	7-track feature with 200, 556, 800, 1600 bpi reading (for 3410 and 3411)	2,185	32.50	116	138
3411/001	Model 1 Magnetic Tape Controller and Transport; 9-track, 12.5 ips, 20K bps	7,910	190.00	656	781
3411/002	Model 2, same as Model 1 except 25 ips, 40K bps	9,910	204.00	835	994
3411/003	Model 3; same as Model 1 except 50 ips, 80K bps	11,910	216.00	1,008	1,200

NA—Not Available

IBM System/38

		Purchase Price (\$)	Monthly Maint. (\$)	Monthly Lease Charge (3-year lease) (\$)	Monthly Rental* (\$)
PUNCHED CARD EQUIPMENT					
5424/A01	Model 1 Multifunction Card Unit; 2 hoppers, 4 stackers, reads 250 cpm, punches 60 cpm, printer 60 cpm	8,950	388.00	NA	752
5424/A02	Model 2; same as Model 1 except all speeds are doubled	11,840	585.00	NA	1,130
WORKSTATIONS					
3179/220	Model 220 Color Display Station	2,195	—	—	—
3196	Monochrome Display Station; available in Models A10, B10, A20, and B20	1,295	—	—	—
5251/011	Model 11 Display Station; 24 lines by 80 characters	2,135	21.00	141	166
5251/012	Model 12; same as Model 11 except includes internal communications adapter for transmission at up to 9600 bps	3,040	47.00	224	263
2551	Dual Cluster Feature; allows attachment of up to 8 single or dual display stations or 5256 printers in any combination	2,278	20.50	131	154
2550	Single Cluster Feature	1,139	10.50	66	78
4600	83-Key EBCDIC Keyboard	265	3.00	16	19
4601/2	Data Entry Keyboard (Proof or Non-Proof) for 5251 Display Station	312	3.00	16	19
4910	Magnetic Stripe Reader for 5251 Display Station	318	2.50	17	20
5291-002	Display Station with 24 lines by 80 characters, adjustable display unit, low-profile keyboard; for local or remote use	1,850	105.00	NA	NA
5302	Workstation controller, second	5,070	21.00	167	192
5303	Workstation controller, third	5,070	23.00	167	192
5304	Workstation controller, fourth	5,070	23.00	167	192
5402	Work Station Controller-Extended	6,200	29.00	251	289
5403	Work Station Controller-Extended	6,200	29.00	251	289
5404	Work Station Controller-Extended	6,200	29.00	251	289
5411	Work Station Controller-Extended	6,200	29.00	251	289
5412	Work Station Controller-Extended	6,200	29.00	251	289
5413	Work Station Controller-Extended	6,200	29.00	251	289
5414	Work Station Controller-Extended	6,200	29.00	251	289
COMMUNICATIONS					
2000	Communications Control SDLC	2,535	21	93	107
1501	Communications Attachment; system control for up to 4 communications lines	780	6.50	29	33
1502	Communications Attachment, second	780	6.50	29	33
1503	Communications Attachment, third	780	6.50	29	33
1521	X.25 Communications	5,000	50.00	212	244
2001	Communications Control SDLC/BSC	3,040	31.00	108	124
2003	Communications Control SDLC, second	3,040	31.00	108	124
2005	Communications Control SDLC/BSC, third	3,040	31.00	108	124
3200	Line Base	1,740	2.00	72	83
3701	EIA Interface	447	6.00	17	19
5650/1	Data-Phone Digital Service Adapter, point-to-point or multipoint	873	4.00	31	326
5500	1200 bps Modem, Nonswitched	686	9.00	23	26
5501	1200 bps Modem, Switched W/AA	915	8.00	35	39
5502	1200 bps Modem, Switched W/MA	686	10.00	23	26
5508	1200 bps Modem, Switched W/Nonswitched Backup	1,055	11.50	41	47
5760	Auto Call Adapter	447	3.00	18	20
5660	High-speed Line Remote V.35	873	5.50	22	25
2879	Enhanced Display Station Emulation Adapter	680	NA	NA	NA
5640	2400 bps Modem, Nonswitched	2,130	26.50	90	103
5641	2400 bps Modem, Switched	2,350	27.50	103	118
5650	DDSA Point-to-Point	873	5.50	34	38
5651	DDSA Multipoint	873	5.50	34	38
5740	4800 bps Modem, Nonswitched	3,710	33.50	171	197
5741	4800 bps Modem, Switched	3,900	34.50	180	207

NA—Not Available

IBM System/38

SOFTWARE PRICES

COMMUNICATIONS (Continued)

		Monthly License Fee (\$)	Onetime Charge (\$)
5714-RC1	Remote Job Entry Facility	185	5,000
5714-WSI	Workstation Search Facility for System/38	NA	752
5714-XA4	Retail Data Preparation	173	5,400
5798-NXW	System/3 to System/38 Batch Cobol Conversion Aid	NA	575
5798-RBC	System/3 Models 8/10 to System/38 Batch Conversion Aid	NA	690
5798-RDK	System/38 Version of System/3 to System/38 Batch Conversion Aid	NA	650
5798-RDY	System/38-Series/1 Communications Utility	50	NA
5798-RFD	System/38 Source Archive	NA	360
5798-RHE	System/38 Front End Processor	350	NA
5799-BEP	System/38 Log Recovery	58	NA
5799-BFZ	Text Management	50	NA
5714-SS1	System/38 Control Program Facility (CPF)	869	22,000
5714-RG1	RPG III	108	2,800
5714-CB1	Cobol	276	7,200
5714-UT1	Interactive Data Base Utilities	123	3,000
5714-XR1	Display Information Facility	104	3,250
5714-CV1	System/3 Batch Conversion Utility	NA	933
5714-CV2	Conversion Reformat Utility	20	600
5714-CV5	System/34 to System/38 Conversion Aid	NA	1,625
5714-CV7	System/3 to System/38 Conversion Aid	NA	2,810
5798-RNK	IBM System/38 Automated Information Management Development Package	NA	2,000
5798-RNJ	IBM System/38 Automated Information Management Presentation Package	NA	300
5714-BAI	IBM System/38 Basic	205	3,600
5798-RKB	IBM System/38 Binary Synchronous Communications Remote Job Entry for VSE/Power	165	NA
5796-ZEL	IBM System/38 Financial Desk Calculator	NA	320
5714-WPA	IBM System/38 OFFICE/38	60	1,800
5714-WP1	IBM System/38 OFFICE/38 Administrative Management	NA	1,500
5714-WP2	IBM System/38 OFFICE/38 Text Management	64	1,800
5210-RRL	IBM System/38 OFFICE/38 Worksheet/38	NA	2,700
5714-UT2	IBM System/38 Advanced Printer Function Utility	NA	1,200
5714-XE1	IBM System/38 Applications Made Easy	NA	4,000
5714-XR1	IBM System/38 Display Information Facility	104	3,250
5798-RHF	System/38 Message Switching System	NA	1,950
5798-RJG	System/38 Fixed Asset Accounting and Control	NA	2,400
5798-RKC	System/38 Transaction Switching	NA	2,850
5798-RLT	System/38 Network Configuration Tool	NA	875
5714-CV9	System/36-to-System/38 Conversion Aid	NA	600
2874	Remote 5250 Emulation Program	NA	195
2875	Enhanced 5250 Emulation Program	NA	195

MAPICS/38 II

5714-M71	Production Order and Costing	425	8,450
5714-M72	Payroll	220	4,370
5714-M73	Accounts Payable	160	3,220
5714-M74	Accounts Receivable	160	3,220
5714-M75	Inventory Management	290	5,750
5714-M76	Production Data Manager	445	8,860
5714-M77	General Ledger	185	3,680
5714-M78	Sales Analysis	210	4,200
5714-M79	Order Entry and Invoicing	280	5,520
5714-M7A	Data Collection System Support	260	5,520
5714-M7B	Material Requirements Planning	405	8,050
5714-M7G	Capacity Requirements Planning	375	7,480
5714-M7X	Cross Application System Support	120	2,420

Distribution Management System/38 (DMS/38)

5714-D41	Customer Service Billing	151	4,750
5714-D42	Accounts Receivable	132	4,150
5714-D43	Inventory Control	142	4,450
5714-D44	Sales Analysis	121	3,850
5714-D45	Purchasing	292	9,150
5714-D46	Inventory Management and Production	304	9,500
5714-D47	General Ledger	81	2,550
5714-D48	Accounts Payable	81	2,550
5714-D49	Payroll	104	3,250

NA—Not Available. ■