IBM System/38

MANAGEMENT SUMMARY

The much talked about System/38 will finally see first customer shipment during summer 1980, if IBM can hold to the present schedule. The delay was apparently due to problems encountered in the development of the operating system and its integration with the data base management system. The operating system, known as the Control Program Facility (CPF), has been developed at IBM's Rochester, Minnesota laboratories. Industry sources indicate that as many as 400 programmers may be working on a solution to the operating system problems alone.

After slipping almost a full year (11 months to be exact), IBM's schedule now calls for deliveries of the System/38 to begin in July 1980. In addition, IBM has increased main storage maximums through the introduction of new submodels. The System/38 Model 3xx will now come with up to 1.5 megabytes of 64K-bit chip memory compared to the previously announced limit of 1 megabyte. The System/38 Model 5xx will be provided with up to 2 megabytes of 32K-bit chip main memory, eclipsing the previously announced limit of 1.5 megabytes. Between the Models 3XX and 5XX, 72 different submodels are available through combinations of various memory sizes and one to six fixed-disk files. The Model 3XX is available in 30 different submodels offering 5 different memory increments, while the Model 5XX is provided with 42 different submodels with 7 different memory increments.

Introduced on October 24, 1978, the System/38 is the largest and most powerful member of the IBM General Systems Division's expanding line of business data ➢

Designed as a replacement for its long active System/3, System/38 is the most powerful and most technically sophisticated product ever to be produced by GSD. Like the System/32 and System/34 which proceeded it by a few years, the System/38 is available only as a packaged system, with 72 submodels now being marketed.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, General Systems Division, 5775 Glenridge Drive, N.E., Atlanta, Georgia 30301. Telephone (404) 256-7000.

MODEL: System/38; 72 submodels based on the Model 300 and Model 500 processing units (30 Model 3xx and 42 Model 5xx).

DATE ANNOUNCED: October 1978.

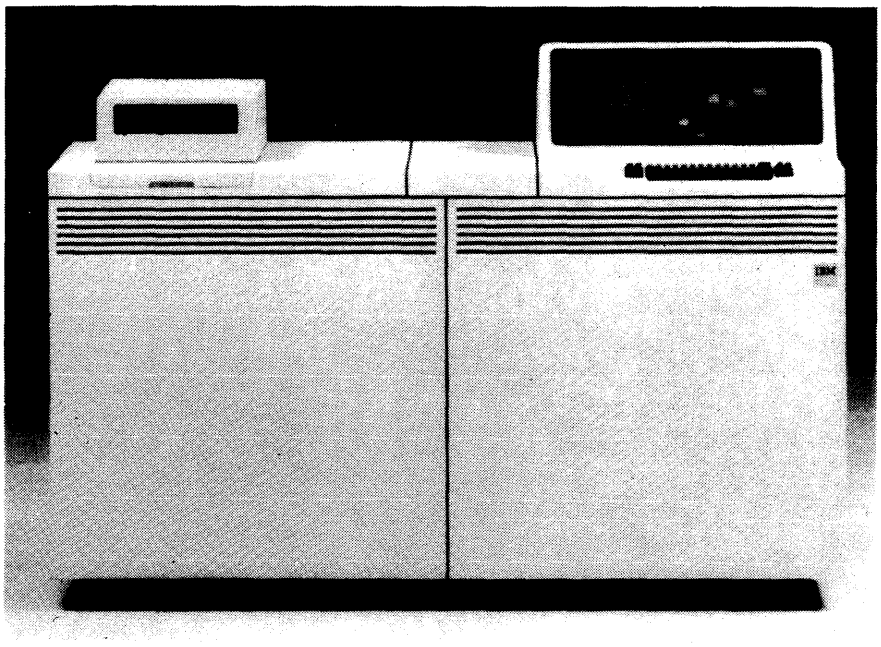
DATE OF FIRST DELIVERY: Scheduled for July 1980 (all hardware and software except SNA/SDLC which will be available in June 1981).

NUMBER INSTALLED TO DATE: 180 (all in various IBM owned sites and a few user test sites).

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes from a "halfword" of 16 bits, while 4 consecutive bytes form a 32-bit "word."

INSTRUCTIONS: IBM has not released details on the format of individual System/38 machine instructions, the ➤



The System/38 Model 5XX is a packaged system consisting of the 5381 System Unit and its integral units. These units include the central processor, up to 2048K of main memory, a system console with keyboard and display screen, a diskette magazine drive, up to 387.1 megabytes of fixed disk storage, and a workstation controller. A printer (not shown in the photo) is optional.

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processing systems. Featuring interactive operation, integrated data base support, and an extended RPG programming language, the System/38 represents an attractive migration path for current users of the smaller IBM System/34 and the aging, batch-oriented System/3.

The System/38 is only available in packaged models that offer from 512K to 2048K bytes of main memory, 64.5 to 387 million bytes of nonremovable disk storage, a diskette magazine drive, and a system console with keyboard and display. A multi-function 96-column card reader/punch, up to four 3370 Disk Drives (Model 5xx only—up to 2,285.2 megabytes), and up to two 650-lpm printers can be attached. The system supports direct attachment of up to 40 local workstations (displays and printers) plus a number of remotely attached workstations through up to four SDLC communications lines.

The heart of the System/38 is the System Unit, consisting of a processing unit, main storage, disk storage, system console keyboard/display, diskette magazine drive, optional I/O attachment, integrated workstation controller, and an optional communications controller. The CPU for the new system is available in two models. The Model 300 CPU is available with 512K, 768K, 1024K, 1280K, or 1536K bytes of memory using the same 64K-bit chips introduced in the 8100 system from IBM's Data Processing Division. The 300 series CPU has a cycle time of 1100 nanoseconds for a 4-byte fetch, and includes a nonexpandable control storage of 4K 32K-bit words. The Model 500 CPU is available with 512K, 768K, 1024K, 1792K, or 2048K memory that features new 32K-bit chip technology and has a cycle time of 600 nanoseconds per 4-byte fetch. The 500 CPU includes 8K 32-bit words of control storage. Control storage for both processor models uses the same 18K-bit chips that are packaged in the CRT that DPD introduced with the 8100. In addition to the new memory chips, the System 38 CPU's feature a new logic chip with up to 704 circuits. Compared with IBM's System/3, the new system's processor logic and memory chips have up to 28 to 32 times the number of circuits and storage cells, respectively.

IBM is offering several program products for use with the fully unbundled System/38. The most important of these are the Control Program Facility (CPF), RPG III, Interactive Data Base Utilities, and a Conversion Reformat Utility. These program products are usable on all models of the System/38.

The Control Program Facility is the major user interface with system functions. The major functions provided by CPF include:

- Control Language-control language programs, commands, prompts, and menus.
- Work (Job) Management-batch and interactive job management plus input and output spooling.
- Data Management—data description specification, data base management, and device data management.

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 communication devices over the same data communication 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 communication between processes and/or between a device and a process.**
- **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 or not the object is owned; and an existence, which specifies whether destruction of the object is implicit. Generic and unique operations are

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PERIPHERALS/TERMINALS

MODEL	DESCRIPTION & SPEED
DISPLAY/ KEYBOARDS	
	The following devices are components of the 5250 Information Display System.
5251	CRT Display Station; 12 lines by 80 characters (Models 1 & 2) or 24 lines by 80 characters (Models 11 & 12); Models 1 & 11 attach to the 5340 as a system console or to the 5251 Models 2 or 12; 188 multinational characters or 96 EBCDIC characters, both upper and lower case; 8-by-16 dot matrix, locally controlled high-intensity, blinking, nondisplay, underscore, column separator, and reverse-image functions; field editing features include alpha-only, signed numeric, field exit required, right adjust, mandatory entry, mandatory fill, bypass, auto-duplicate, monocase, and self-check modulus 10 and 11; eight terminals per 5250 controller; Models 2 & 12 communicate with a System/34 communications adapter operating in SDLC mode only; Models 2 & 12 communicate in half-duplex mode on non-switched point-to-point and multipoint communications lines which may be duplex or half-duplex facilities at speeds up to 9600 bps, and on switched point-to-point communications lines at speeds up to 4800 bps
5252	Dual CRT Display Station; same specifications as the 5251 Models 1 & 2; functions as two independent display stations, allowing separate jobs to be executed concurrently on each; may function as the system console
4600	Keyboard for 5251 or 5252 Display Stations; 83 keys including 49 alphanumeric, 24 control, and 19-key numeric pad; EBCDIC character set; typewriter-like layout; movable; optional keylock
4910	Magnetic Stripe Reader for 5251 or 5252 Display Stations; up to 128 ABA numeric characters including control characters per stripe
5256	Bidirectional Serial Matrix Printer; 132 positions, 4-by-8 dot matrix, 96 EBCDIC characters, 10 characters per inch, 6 or 8 lines per inch, continuous forms 3 to 15 inches wide, individual forms 6 to 14.5 inches wide; may be used as system printer and/or CRT hard-copy device; 40 cps (Model 1), 80 cps (Model 2), or 120 cps (Model 3)
PRINTERS	
3662	Belt-type line printer; 132 positions; 48, 64, or 96 character set; Model A is bolted on to the 5381 System Unit, Model B is a stand-alone unit; 650 lpm with 48-character set, 467 lpm with 64-character set, 364 lpm with 96-character set
5211	Belt-type line printer; 132 positions; translation capability (printed character substituting via OCL); 48, 64, or 96 standard character set print belts; 64, 96, or 188 multinational character set print belts; 48 character OCRA or B print belt; 38 and 42 character special print belts; 10 characters per inch; 6 or 8 lines per inch operator-controlled; program-controlled formatting; Model 1 with 38/42/64/96/188 character sets prints at 190/160 or 255/160/123/84/44 lpm, respectively; Model 2 with 38/42/48/64/96/188 character sets prints at 355/300 or 395/300/235/164/86 lpm, respectively
MAGNETIC TAPE	
3410/3411	Magnetic Tape Subsystem; 3411 includes one magnetic tape unit and controller in same frame; one to three 3410 magnetic tape units can be attached; three models available: Model 1: 800 bpi, 9-track, 12.5 ips Model 2: 800 bpi, 9-track, 25 ips Model 3: 800 bpi, 9-track, 50 ips
CARD EQUIPMENT	
5424	Multifunction Card Unit; 2 hoppers, 4 stackers; reads 250 cpm, punches 60 cpm, prints 60 cpm

- Object Management—management of related data that has a name and can be operated on with control language commands.
- Programmer Services—message handling, test and debug facilities, and file reference functions.
- System Operator Services—history and job log and operator messages.
- System Services—device configuration, security functions, save/restore functions, and concurrent management support.

RPG III, an extended version of IBM's time-proven RPG language announced along with the System/38, is upward-compatible from System/3 RPG II, although IBM says "minor source code changes may be required."

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 STORAGE

TYPE: Dynamic metal oxide semiconductor field effect transistor (MOSFET). The new chips use a silicone and

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RPG III features user-controlled logic flow, uses externally described data to reduce I/O coding and source program maintenance, enables programs to call other programs, offers new display-oriented instructions, has a short-form calculation format to reduce coding, offers data structure support for multiple-occurrence data, and allows for the redefinition of storage areas and the processing of either the entire data structure or any of the subfields. RPG II is the only programming language available for use on the System/38 at this writing, but it's a safe bet that IBM will add COBOL, FORTRAN, and possibly PL/1 facilities in due course.

The System/38 Interactive Data Base Utilities is a program product consisting of a comprehensive set of utility routines. These include a Source File utility for creating and maintaining program-language source files, a Data File utility for creating and maintaining data files and displaying specific records from data files, and a Query utility for extracting and presenting information from data files.

The Conversion Reformat utility operates on data from a data base file or a device file to perform sort, merge, and copy operations. This 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.

Several program products were introduced for use by System/3 users who want to upgrade to a System/38. These utilities execute on a System/3 and consists of routines that convert System/3 RPG II source programs to System/38 RPG III source programs; convert RPG II Auto Report source programs to RPG III Auto Report programs; convert System/3 procedures to System/38 control language programs; convert System/3 operational control language (OCL) to System/38 control language; convert selected System/3 utility statements to their System/38 equivalents; and generate data descriptions for System/3 disk files that are to be moved to the System/38 data base. A set of subroutines to be executed with the converted programs on System/38 are also available.

Application software support for the System/38 is provided by several packages including IBM's Manufacturing Accounting and Production Information Control System (MAPICS), which consists of 11 integrated applications, and by the Distribution Management System (DMS), a set of program modules designed for use by distributors.

A communications attachment for the System/38 provides the necessary system control for the direct attachment of up to four remote communications lines. Transmission at 600, 1200, 2400, 4800, 7200, and 9600 bits per second is supported across private or common-carrier lines.

aluminum metal oxide semiconductor (SAMOS) process. SAMOS is an n-channel MOSFET process. In these new chips, the metal gate reliability relative to shorts is improved by the use of silicon nitride. Surface leakage is controlled by a conductive polysilicon field shield. The Model 3XX CPU utilizes 64K-bit SAMOS process MOSFET chips in its main memory. These chips have a cycle time of 980 nanoseconds and an access time of 440 nanoseconds. The Model 5XX CPU has a main memory composed of 32K-bit SAMOS process MOSFET chips. These chips have a cycle time of 470 nanoseconds and an access time of 285 nanoseconds.

CYCLE TIME: Model 3XX, 1100 nanoseconds per 4-byte access; Model 5XX, 600 nanoseconds per 4-byte access. Specific times may vary according to instruction mix.

CAPACITY: Model 3XX, 524,288, 786,432, 1,048,576, 1,310,720, or 1,572,864 bytes; Model 5XX, 524,288, 786, 432, 1,048,576, 1,310,720, 1,572,864, 1,835,008, or 2,097,152 bytes.

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 modified 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.

STORAGE PROTECTION: 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 attempter 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, machine reconfiguration etc.; 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 PROCESSOR

The 5381 System Unit is composed of a processing unit, main storage, 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 ISI technology and is packaged on one planar board 10 by 15 inches. The board contains 29 LSI logic chips with approximately 20,000 circuits and five 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 a specific function. Each master slice chip contains over 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.

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Current analog-type data communications facilities are supported, as well as an adapter for AT&T's Data-Phone Digital Service. Analog-type facilities are given support either through the integrated 600/1200-bps, 2400 bps or 4800 bps adapters or through external modems attached through the EIA/CCITT interface features. Digital facilities using no modems are supported at 2400, 4800, or 9600 bps through the Data-Phone Digital Service Adapter.

Through this communications support, a System/38 can communicate as a terminal system to IBM System/370 CICS/VS and IMS/VS systems using synchronous data link control (SDLC). The System/38 can communicate with IMS/VS applications executing under OS/VS1 or OS/VS2 (MVS) as well as CICS/VS applications executing under DOS/VS, OS/VS1, or OS/VS2 (MVS). Communication with any of these operating systems when running under VM/370 is also supported. Communication is via levels of VTAM, ACF/VTAM, TCAM or ACF/TCAM supported by IMS/VS or CICS/VS at the time of shipment. NCP/VS or ACF/NCP/VS will be required as appropriate.

Competitively, IBM faces the most challenge with System/38 from Burroughs, Hewlett-Packard, and Honeywell (not necessarily in that order). To a lessor extent Univac, DEC, and NCR enter the picture. These however, are not the only competitors for a piece of the IBM marketplace. Companies like Qantel and Basic Four must also be considered as competitors of the System/38.

The introduction of the System/38 no doubt sent a number of IBM's competitors back to the drawing boards, but general reaction to the new system has been mixed and relatively mild. The fact that the System/38 followed so closely on the heels of the Data Processing Division's IBM 8100 Information System (Report 70C-491-11) may partially account for this. Many people in the industry are now taking a hard look at both systems to determine where each fits in the marketplace and which will have the most impact on their business. Others, while impressed with the technological aspects of the System/38, are adopting a "show me" attitude. On paper the System/38 looks impressive, but the skeptics want to be convinced that the new hardware and software technologies employed will live up to their advance billing. □

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 check-out of main memory prior to initial microprogram load time (IMPL). IMPL loads the system's microcode from diskette prior to transfer of control to the operator.

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 which are in turn 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 places 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 ten 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 to 8K bytes. The permanent and temporary directories have an index organization, an entry size of 10 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 5000 to 40,000 entries and required 128K bytes to one megabyte, while the temporary directory has 200 to 2000 entries and requires 5K bytes to 50K bytes.

CONTROL STORAGE: 4K 32-bit words of control storage is standard on the Model 3XX System Units, and 8K words is standard on the Model 5XX. Control storage is composed of 18K-bit chips. The technology employed is the same as 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. The Model 3XX has a processor cycle time of 400 or 500 nanoseconds; the Model 5XX, 200 or 300 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 4K or 8K of control storage, the system uses main storage for resident microcode. The amount of main storage required for this purpose depends on system 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.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The System/38 processor is configured with one high speed integrated channel. The channel has the

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capability of transferring up to 2.5 megabytes per second in byte mode and up to 5 megabytes per second in half-word mode. All peripherals that can be configured with the System/38 Model 3XX operate in byte mode. All peripherals except the 3370 Mass Storage Unit operate in byte mode on the System/38 Model 5XX. The 3370 operates in half-word mode.

IBM states that the System/38 I/O structure was designed with three major objectives in mind. The first objective to make use of LSI technology, the System's virtual addressing capability, and multiprogramming at the channel program level. The second objective was to employ a queued asynchronous structure, thus causing minimum impact on the processor because of channel program stacking. The final objective was to provide the channel bus (and thus the channel) with multiple I/O interface capability for feature addition and future configuration expansion. According to IBM, these design criteria were met with:

- A queued asynchronous system channel boundry.
- Employment of a channel processor. The processor executes single or multiple channel commands, allows direct memory access, provides for multiplexed I/O and supports intelligent I/O adapters on a common channel bus.
- Distributing function from the I/O managers, which translate data management I/O requests into channel programs, to the intelligent I/O adapters.

SIMULTANEOUS OPERATIONS: The processor provides overlapped operation of instruction fetch and execution functions. Employment of microprocessors in the channel, communications subsystem, work station controller, and line printer controller download some responsibility from the processor and allow for some simultaneity.

One of the more important units that is integral to the 5381 System Unit is the diskette magazine drive. This unit provides three functions; save/restore, diskette I/O, and CE servicing. The storage capacity of each diskette depends on type and formatting. Three types of diskette may be read by the unit in three different formats. Maximum capacity for the drive is 24 million bytes.

CONFIGURATION RULES

Each 5381 submodel includes a CPU; either 512K, 768K, 1024K, 1280K, 1536K, 1792K, or 2048K bytes of main memory; 4K or 8K bytes of control storage; from one to six spindles of disk storage (64.5 to 387.1 megabytes); a diskette magazine drive; a system console keyboard/display; an operator/service panel; and a workstation controller.

Optionally available devices for the System/38 include up to four communications lines (multiple devices per line), up to two 650-lpm printers, a multi-function card unit, and a magnetic tape subsystem with from one to four drives. System/38 Model 5 may also attach from one to four spindles of 3370 Disk Storage (571.3 to 2285.5 megabytes).

The workstation controller provides for direct local attachment of IBM 5250 Information Display System devices to the System/38. It provides 8 ports for attaching workstations (keyboard displays and/or printers) directly to the system in any combination. These 8 ports permit attachment of up to 12 devices. Devices supported via the workstation controller include the 5251 Models 1 and 11 Display Stations, the 5252 Dual Display Station and the 5256 Model 1, 2, and 3 Printers. (The Model 5252 display station is counted as two devices). The Device Control Expansion feature (5331/2) or the Device Interface Expansion feature (5321/2) can be used with a workstation controller to provide for up to 8 additional 5250 devices; thus, each appropriately featured workstation controller can support up to 20 workstations. A System/38 can support two workstation controllers, each with its own expansion feature; thus providing for a maximum of 40 of the IBM 5250 devices per system.

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 5250 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 Multi-function 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 Multi-function 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.

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The following table shows the processor unit expansion features required in order to include specific I/O capabilities on a System/38.

I/O FUNCTION REQUIRED	EXPANSION FEATURE REQUIRED			
	#1 (6300)	#2 (6301)	#3 (6302)	#4 (6303)
Communications Attachment	Yes	No	Yes	No
Second Workstation Controller	Yes	No	Yes	No
Multi-function Card Unit	No	Yes	Yes	No
Magnetic Tape Unit	No	Yes	Yes	Yes
Second Line Printer	No	Yes	Yes	No
3370 Disk Storage	No	No	No	Yes

MASS STORAGE

DISK STORAGE: The 5381 System Unit can contain from one to six spindles of integrated nonremovable disk storage. Each spindle has a storage capacity of 64,520,192 bytes. The disk rotational speed is 3125 rpm, providing a data transfer rate of 1.031 million bytes per second. Average rotational delay is 9.6 milliseconds. Cylinder to cylinder, average, and across-all-track head movement times are 9, 27, and 46 milliseconds respectively. There are 512 bytes per sector, 33 sectors per track (with one spare), 16,384 bytes per track, and 180,224 bytes per cylinder (11 tracks).

DISKETTE 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 is 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 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.

3370 DIRECT-ACCESS DISK STORAGE DEVICE: Provides up to 285.6 megabytes of storage per actuator and 571.3 megabytes per drive. The 3370 attaches to the System/38 Model 5XX via the 1130 Disk Storage Attachment.

The 3370 employs new thin-film technology heads and high-density LSI circuitry. Each 3370 has a single 571.3-megabyte spindle of disks which are accessed by two independent, movable actuators. Seeking with either actuator may be overlapped with seeking and/or reading/writing on the other actuator. Each actuator accesses one 25 285.6-megabyte DASD volume and has a separate address on the channel.

The 3370 head disk assembly (HDA) consists of two actuators and two disk component volumes assembled as a unit. These units are field-replaceable and movable only by IBM Field Engineering.

The 3370 makes use of fixed block architecture. Fixed block architecture provides for recording data in permanent preformatted 512-byte blocks on the disk surface. Each block of data is separately addressable and separately accessible, either singly or in contiguous strings of a variable number of blocks (maximum, approximately 65,000). One 3370 actuator (volume) spans 558,000 blocks of user space. User data is mapped, regardless of record size, to one or more 512-byte blocks on the disk.

On the 3370, data block position sensing is automatic. The fixed block architecture provides for relative block addressing. The 3370 has the capability to correct single data error bursts of up to 9 bits as well as to detect all single error bursts up to 16 bits in length. Command retry enables the storage control to recover from certain subsystem errors without recourse to system error recovery procedures. A switch for each drive address provides the means to protect data from being rewritten or erased. When the read/write switch is in the read-only position, any write command is rejected. The switch's state can be changed only when the device is not selected.

The 3370 has 558,000 blocks per actuator, 285,696,000 bytes per actuator, and 571,392,000 bytes per drive. Minimum, average, and maximum head movement times are 5, 20, and 40 milliseconds, respectively. Average rotational delay is 10.1 milliseconds, and the data transfer rate is 1.859 megabytes per second.

The 3370 is available in two models. The 3370 Model A11 contains the control adapter functions required for attachment to the 430 Disk Storage Attachment. The 3370 Model B11 attaches through an A11 unit. Up to three 3370 Model B11's can be attached to a 3370 Model A11 for a maximum of four units per System/38.

INPUT/OUTPUT UNITS

SYSTEM CONSOLE: Integral with the processor, the console 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 nondisplay. 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 CPF, and other functions requiring the operator service panel, system operator tasks may be performed at any authorized 5251/5252 attached to the system.

5250 SYSTEM MULTIPLE UNITS AND CLUSTERING: Feature 2680 provides the capability to connect multiple 5251 Models 1 and 11, 5252's, and 5256's to a single cable. Feature 2550 allows the attachment of up to four workstations, including 5251 Models 1 or 11, 5252's, or 5256's; feature 2551 increases the number of directly attached workstations to eight.

For all other units, please refer to the Peripherals/ Terminals table on the third page of this report.

COMMUNICATIONS CONTROL

The System/38 is provided with a multi-line communications capability through a facility integrated into the 5381 System Unit. 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.

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MODEL 1501 COMMUNICATION ATTACHMENT: This unit and its features provides 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 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 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.

Only one 1501 is allowed per system.

MODEL 5500/5501/5502/5508 1200-BPS INTEGRATED MODEMS: These versions of the 1200 bps line interface with integrated modem rely on internal clocking contained in the 3200 Line Base. The 550X interfaces can alternatively be operated at 600 bps via parameter modification to the CPF software. For private lines, the non-switched interface (#5500) is available. For switched lines, interfaces with Auto Answer (#5501) and manual answer (#5502) are available. There is also a non-switched with switched network backup (with Auto Answer) interface (#5508). The devices communicating with the System/38 must also be equipped with a similar 1200 bps integrated modem interface.

The 5500 provides for a cable attachment directly to a non-switched (2- or 4-wire) facility, type 3002. Both the 5501 and 5508 provide for cable attachment to a common carrier arrangement, type CBS or equivalent. The 5502 provides for cable attachment to a common-carrier arrangement, type CDT or equivalent. The 550X cannot be installed with either Model 3701 or 5650/5651.

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 position 2, 3, or 4 only.

MODEL 5640/5641/5740/5741 INTEGRATED MODEMS: These units are microprocessor based and operate over public switched network facilities or nonswitched leased lines. Multipoint control, multipoint tributary or point to point operation can be configured in the nonswitched modem (5640 and 5740). The switched modems (5641 and 5741) connect directly through an integrated protective coupler (pending FCC approval). These units feature improved data throughput due primarily to lower error rates according to IBM. These units allow the system operator to select a half speed option if the line error rate increases due to a poorly received signal. Remote site modems are switched to the new data rate automatically without operator intervention. Model 5640 operates on 4 wire nonswitched lines with an 8.5 millisecond delay at 2400 bps, while Model 5740 operates on the same lines at 4800 bps with a 24 millisecond delay. For Models 5640 and 5740, line conditioning is not required on non-switched lines. Models 5641 and 5741 operate with integrated auto-answer capability for switched networks. Model 5641 operates at 2400 bps while Model 5741 operates at 4800 bps.

MODEL 2000 COMMUNICATIONS ATTACHMENT: This feature works with the 1501 Communications Attachment to provide for multiplexing of up to four line appearances. The Model 2000 provides the necessary basic control storage and circuits for SDLC control on the attached lines. One Model 2000 is allowed per System/38.

MODEL 3200 LINE BASE: This features works in conjunction with the 1501 Communications Attachment and provides internal clocking for the 5501 Integrated Modems and interface for one of four line interface types that can be configured.

A separate line base is required for each communications line attachment. Under the System's Control Program Facility (CPF), each line operates with half-duplex SDLC protocol. Transmission at 600, 1200, 2400, 4800, 7200, or 9600 bps over leased (non-switched) or telephone (switched) lines is supported. Each line can operate at a different speed.

MODEL 3701 EIA INTERFACE: Provides for attachment of any external modem with RS-232C 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): An integrated data link adapter for data transmission over the AT&T nonswitched Dataphone Digital Service Network. The first version (#5650) supports point-to-point and multi-point lines. 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. Remote workstations that are to be linked to the System/38 via DDS require the 5251 (Model 2 or 12) to have the DDS adapter for multipoint, tributary lines (#5651).

SOFTWARE

CONTROL PROGRAM FACILITY (CPF): The system support program product for the System/38, CPF provides many integrated functions that are 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) that is 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

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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.

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 and 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 *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.

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 the 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.

RPG III: The only language currently available for the System/38 is RPG III. RPG III is upward-compatible from System/3 RPG II, but minor source code changes may be required. System/38 RPG III offers a number of enhancements over previous RPG products, including the following:

- Externally described data allows the user to eliminate or minimize the input and output specifications for externally described data files.
- Full procedural file specification allows the user to process the same file in both a random and sequential manner in the same program by the use of explicit input/output specifications.
- Explicit input/output operations provide enhancements to existing file processing operation codes as well as new file processing and control operation codes.
- Program structure allows the user to write a program without the requirement of a primary file.
- RPG III programs can call other programs.
- Data structures allow the redefinition of a storage area and the processing of either the entire data structure or any of the subfields.
- Multiple-occurrence data structures allow many advanced applications to be programmed in a straightforward manner.
- Indicators as data allow the user additional control of indicator status.
- DO loops allow for automatic loop counting.
- IF/ELSE operations allow the execution of a series of RPG III operations without the use of branching or indicator control.
- Program control of exception/error handling allows the RPG III user to control the exception/erros which can be raised by data management, and system and machine functions.

INTERACTIVE DATA BASE UTILITIES: 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

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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/3 BATCH CONVERSION UTILITIES: A program product that runs on an IBM System/3 and converts the programming elements of a System/3 installation to their System/38 equivalents. These utilities convert RPG II source programs to RPG III source programs; convert RPG II Auto Report source programs to RPG III Auto Report source programs; convert System/3 procedures to System/38 control language programs; convert System/3 operational control language (OCL) to System/38 control language; convert selected System/3 utility statements to their System/38 equivalents; and generate data descriptions for System/3 disk files that are to be moved to the System/38 data base.

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 13 RPG 11 to System/38 RPG III (including auto report), System/3 OFF source statements, 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.

SYSTEM/38 CCP EXECUTIVE SUBROUTINES: These subroutines must be present to run System/3 programs converted by the System/38 CCP Conversion Utilities. The subroutines allow converted programs to run on a System/38 with 5250 terminals. The subroutines do not support System/3 CCP System Operator or Terminal Operator Commands nor do they completely support all terminal printer functions.

APPLICATION PROGRAMS

IBM SYSTEM/38 DISTRIBUTION MANAGEMENT SYSTEM — INVENTORY MANAGEMENT, PRODUCTION REPLENISHMENT, AND ORDER VALIDITY EVALUATION (DMS/38-IMPROVE)

This product consists of 12 program modules designed for use by distributors. Included are modules for shipping, order entry and invoicing, accounts receivable, inventory accounting, sales analysis, general ledger, inventory management, purchasing management, payroll, receiving, purchase order writing and control, and accounts payable.

IBM SYSTEM/38 MANUFACTURING ACCOUNTING AND PRODUCTION INFORMATION CONTROL SYSTEM (System/38 MAPICS): This products consists of 11 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, and material requirements planning.

IBM SYSTEM/38 DISTRIBUTION MANAGMENT 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.

SYSTEM/38 DATA PREPARATION LICENSED PROGRAM: This product is designed for use in the retail industry. The program functions to restructure records written on diskettes at IBM 5265 POS Terminals and updates appropriate user files.

PRICING

POLICY: IBM offers the System/38 on a purchase 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. CPU's 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.

MAINTENANCE: 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:

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

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

For users with a maintenance contract, the System/38 is maintained under per-call class 2. Under this class the per-call charge during regular hours is $77.00 per hour, and during off hours the charge is $89.00 per hour. The hourly rate for systems engineering service is $57.00.

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

EQUIPMENT: The following systems are described by IBM as typical System/38 configurations.

SMALL SYSTEM/38: Includes the 5381 System Unit Model 322 with 512K bytes of memory and 129 megabytes of disk storage, six 5251 display stations, two 5256 Model 2 matrix printers, and one 3262 line printer. The purchase price is $122,540.

MEDIUM SYSTEM/38: Includes the 5381 System Unit Model 534 with 768K bytes of memory and 258 megabytes of disk storage, eighteen 5251 display stations, six 5256 Model 2 matrix printers, and one 3262 line printer. The purchase price is $236,305.

LARGE SYSTEM/38: Includes the 5381 System Unit Model 546 with 1024K bytes of memory and 387.1 megabytes of disk storage, thirty-two 5251 display terminals, eight 5256 Model 2 matrix printers, two 3262 line printers, and a 3410 and 3411 Model 2 magnetic tape unit. The purchase price is $355,865.■

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Lease Charge (3-year lease)*	Monthly Rental*
BASIC SYSTEMS					
5381	System Unit; includes processor unit, main memory, fixed storage, system console keyboard/display, diskette magazine drive, and one workstation controller				
	System Unit with Model 300 CPU and 512K bytes of main memory:				
0321	64.5 megabytes of fixed disk storage	$70,210	$358.00	$1,890	$2,173
0322	129.0 megabytes of fixed disk storage	78,780	400.00	2,153	2,475
0323	193.5 megabytes of fixed disk storage	92,420	448.00	2,551	2,931
0324	258.0 megabytes of fixed disk storage	100,990	490.00	2,814	3,233
0325	322.6 megabytes of fixed disk storage	114,240	546.00	3,196	3,671
0326	387.1 megabytes of fixed disk storage	122,810	588.00	3,459	3,973
	System Unit with Model 300 CPU and 768K bytes of main memory:				
0331	64.5 megabytes of fixed storage	75,210	380.00	2,041	2,346
0332	129.0 megabytes of fixed disk storage	83,780	422.00	2,304	2,648
0333	193.5 megabytes of fixed disk storage	97,420	470.00	2,702	3,104
0334	258.0 megabytes of fixed disk storage	105,990	512.00	2,965	3,406
0335	322.6 megabytes of fixed disk storage	119,240	568.00	3,347	3,844
0336	387.1 megabytes of fixed disk storage	137,810	610.00	3,610	4,146
	System Unit with Model 300 CPU and 1024K bytes of main memory:				
0341	64.5 megabytes of fixed disk storage	80,210	402.00	2,192	2,519
0342	129.0 megabytes of fixed disk storage	88,780	444.00	2,455	2,821
0344	258.0 megabytes of fixed disk storage	110,990	534.00	3,116	3,579
0345	322.6 megabytes of fixed disk storage	124,240	590.00	3,498	4,017
0346	387.1 megabytes of fixed disk storage	132,810	632.00	3,761	4,319
	System Unit with Model 300 CPU and 1280K bytes of main memory:				
0351	64.5 megabytes of fixed disk storage	85,210	424.00	2,343	2,692
0352	129.0 megabytes of fixed disk storage	93,780	466.00	2,606	2,994
0353	193.5 megabytes of fixed disk storage	107,420	514.00	3,004	3,450
0354	258.0 megabytes of fixed disk storage	115,990	556.00	3,267	3,752
0355	322.6 megabytes of fixed disk storage	129,240	612.00	3,649	4,190
0356	387.1 megabytes of fixed disk storage	137,810	654.00	3,912	4,492
	System Unit with Model 300 CPU and 1536K bytes of main memory:				
0361	64.5 megabytes of fixed disk storage	90,210	446.00	2,494	2,865
0362	129.0 megabytes of fixed disk storage	98,780	488.00	2,757	3,167
0363	193.5 megabytes of fixed disk storage	112,420	536.00	3,155	3,623
0364	258.0 megabytes of fixed disk storage	120,990	578.00	3,418	3,925
0365	322.6 megabytes of fixed disk storage	134,240	634.00	3,800	4,363
0366	387.1 megabytes of fixed disk storage	142,810	676.00	4,063	4,665
	System Unit with Model 500 CPU and 512K bytes of main memory:				
0521	64.5 megabytes of fixed disk storage	99,645	420.00	2,640	3,035
0522	129.0 megabytes of fixed disk storage	108,215	462.00	2,903	3,337
0523	193.5 megabytes of fixed disk storage	121,855	510.00	3,301	3,793
0524	258.0 megabytes of fixed disk storage	130,425	552.00	3,564	4,095
0525	322.6 megabytes of fixed disk storage	143,675	608.00	3,946	4,533
0526	387.1 megabytes of fixed disk storage	152,245	650.00	4,209	4,835
	System Unit with Model 500 CPU and 768K bytes of main memory:				
0531	64.5 megabytes of fixed disk storage	106,645	450.00	2,856	3,283
0532	129.0 megabytes of fixed disk storage	115,215	492.00	3,119	3,585
0533	193.5 megabytes of fixed disk storage	128,855	540.00	3,517	4,041
0534	258.0 megabytes of fixed disk storage	137,425	582.00	3,780	4,343
0535	322.6 megabytes of fixed disk storage	150,675	638.00	4,162	4,781
0536	387.1 megabytes of fixed disk storage	159,245	680.00	4,425	5,083
	System Unit with Model 500 CPU and 1024K bytes of main memory:				
0541	64.5 megabytes of fixed disk storage	113,645	480.00	3,072	3,531
0542	129.0 megabytes of fixed disk storage	122,215	522.00	3,335	3,833
0543	193.5 megabytes of fixed disk storage	135,855	570.00	3,733	4,289
0544	258.0 megabytes of fixed disk storage	144,425	612.00	3,996	4,591
0545	322.6 megabytes of fixed disk storage	157,675	668.00	4,378	5,029
0546	387.1 megabytes of fixed disk storage	166,245	710.00	4,641	5,331
	System Unit with Model 500 CPU and 1280K bytes of main memory:				
0551	64.5 megabytes of fixed disk storage	120,645	510.00	3,288	3,779
0552	129.0 megabytes of fixed disk storage	129,215	552.00	3,551	4,081
0553	193.5 megabytes of fixed disk storage	142,855	600.00	3,949	4,537
0554	258.0 megabytes of fixed disk storage	151,425	642.00	4,212	4,839
0555	322.6 megabytes of fixed disk storage	164,675	698.00	4,594	5,277
0556	387.1 megabytes of fixed disk storage	173,245	740.00	4,857	5,579

*Monthly lease and rental prices include equipment maintenance.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Lease Charge (3-year lease)*	Monthly Rental*
BASIC SYSTEMS					
	System Unit with Model 500 CPU and 1536K bytes of main memory:				
0561	megabytes of fixed disk storage	127,645	540.00	3,504	4,027
0562	129.0 megabytes of fixed disk storage	136,215	582.00	3,767	4,329
0563	193.5 megabytes of fixed disk storage	149,855	630.00	4,165	4,785
0564	258.0 megabytes of fixed disk storage	158,425	672.00	4,428	5,087
0565	322.6 megabytes of fixed disk storage	171,675	728.00	4,810	5,525
0566	387.1 megabytes of fixed disk storage	180,245	770.00	5,073	5,827
	System Unit with Model 500 CPU and 1792K bytes of main memory:				
0571	64.5 megabytes of fixed disk storage	134,645	570.00	3,720	4,275
0572	129.0 megabytes of fixed disk storage	143,215	612.00	3,983	4,577
0573	193.5 megabytes of fixed disk storage	156,855	660.00	4,381	5,033
0574	258.0 megabytes of fixed disk storage	165,425	702.00	4,644	5,335
0575	322.6 megabytes of fixed disk storage	178,675	758.00	5,026	5,773
0576	387.1 megabytes of fixed disk storage	187,245	800.00	5,289	6,075
	System Unit with Model 500 CPU and 2048K bytes of main memory:				
0581	64.5 megabytes of fixed disk storage	141,645	600.00	3,936	4,523
0582	129.0 megabytes of fixed disk storage	150,215	642.00	4,199	4,825
0583	193.5 megabytes of fixed disk storage	163,855	690.00	4,597	5,281
0584	258.0 megabytes of fixed disk storage	172,425	732.00	4,860	5,583
0585	322.6 megabytes of fixed disk storage	185,675	788.00	5,242	6,021
0586	387.1 megabytes of fixed disk storage	194,245	830.00	5,505	6,323
OPTIONS AND FEATURES					
1100	Printer Attachment for the first 5211 or 3262 printer	1,170	6.50	32	37
1110	Printer Attachment for the second 5211 or 3262 printer	3,315	10.50	92	105
1130	Disk Storage Attachment	5,850	13.50	156	179
1220	Attachment for first 5425 Multifunction Card Unit	4,290	18.00	113	130
1221	Attachment for second 5424 Multifunction Card Unit	205	1.50	5	6
1300	Automatic Initial Micro Program Load	1,950	2.50	54	62
2100	Audible Alarm	195	1.50	5	6
3210	Power Keylock	70			
6300/1	Processor Unit Expansion 1 or 2	1,950	5.50	54	62
6302	Processor Unit Expansion 3	390	1.50	11	12
6303	Processor Unit Expansion 4	585	1.50	16	18
7960	3411 Magnetic Tape Attachment	4,875	9.50	129	148
5302	Workstation controller (second); includes ports for up to 12 additional workstations	5,070	21.00	135	155
5331/2	Device Control Expansion; control storage for up to 8 additional workstations	1,230	2.50	32	37
5321/2	Device Interface Expansion; includes ports for up to 12 additional workstations (cannot be installed with 5331/2)	2,870	6.50	76	86
MASS STORAGE					
3370A11	Single Disk Drive and Control; 571.3 megabytes	40,620	126.00	1,080	1,269
3370B11	Add-on Disk Drive; 571.3 megabytes	27,070	94.50	720	846
PRINTERS					
3262	Stand-alone (Model B) or Bolt-on (Model A) 650-lpm printer; 132 positions; 6/8 lines per inch	16,200	144.00	418	491
594X	Print Belt for 3262; 48-, 60-, 64-, 96-, 188-char. set (purchase only)	170	—	—	—
5211	Line Printer; 300 lpm, 132 positions, 6/8 lines per inch	9,875	63.00	267	314
MAGNETIC TAPE EQUIPMENT					
3410	Model 1 Add-on Magnetic Tape Transport 9-track, 12.5 ips	6,230	85.00	206	245
3410	Model 2; same as Model 1 except 25 ips	8,330	93.50	274	326
3410	Model 3; same as Model 1 except 50 ips	10,310	104.00	344	409
3211	Single Density; 1600 bpi (3410 and 3411)	2,020	11.50	59	70
3221	Dual Density; 800/1600 bpi (3410 and 3411)	2,910	39.50	88	105
6550	7-track feature with 200, 556, 800, 1600 bpi reading (3410 and 3411)	2,910	22.50	88	105
3411	Model 1 Magnetic Tape Controller and Transport; 9-track, 12.5 ips	13,730	114.00	457	544
3411	Model 2; same as Model 1 except 25 ips	17,370	141.00	581	692
3411	Model 3; same as Model 1 except 50 ips	21,180	149.00	706	841
PUNCHED CARD EQUIPMENT					
5424	Model 1 Multi-function Card Unit; 2 hoppers, 4 stackers, reads 250 cpm, punches 60 cpm, prints 60 cpm	8,525	263.00	—	460
5424	Model 2; same as Model 1 except all speeds are doubled	11,280	396.00	—	732

*Monthly lease and rental prices include equipment maintenance.

IBM System/38

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Lease Charge (3-year lease)*	Monthly Rental*
COMMUNICATIONS					
1501	Communications Attachment; system control for up to 4 communications lines	780	6.50	22	25
2000	Communications Control	2,535	21.00	70	81
3200	Line Base	1,675	2.50	46	52
3701	EIA Interface	430	6.00	12	14
5650/1	Data-Phone Digital Service Adapter, point-to-point or multipoint	840	5.50	24	27
5500	1200 bps Modem, Nonswitched	660	9.00	18	21
5501	1200 bps Modem, Switched W/AA	880	8.00	25	29
5502	1200 bps Modem, Switched W/MA	660	10.00	18	20
5508	1200 bps Modem, switched W/Nonswitched Backup	1,015	10.50	27	31
5760	Auto Call Adapter	430	2.00	11	13
5640	2400 bps Modem, Nonswitched	2,030	24.00	58	67
5641	2400 bps Modem, Switched	2,240	25.00	66	75
5740	4800 bps Modem, Nonswitched	3,465	30.50	111	127
5741	4800 bps Modem, Switched	3,675	31.50	116	133
TERMINALS					
5251	Model 1 Display Station; 24 lines by 80 characters	2,660	19.50	80	94
5251	Model 2; same as Model 1 except includes internal communications adapter for transmission up to 9600 bps	3,875	41.50	130	153
5251	Model 11 Display Station; 24 lines by 80 characters	2,850	20.50	86	101
5251	Model 12; same as Model 11 except includes internal communications adapter for transmission at up to 9600 bps	4,050	44.50	136	160
2551	Dual Cluster Feature; allows attachment of up to 8 single or dual display stations or 5256 printers in any combination	3,040	23.00	92	108
2550	Single Cluster Feature	1,520	11.50	45	53
5252	Dual Display Station; includes 2 keyboards and 2 separate halves of the display screen	3,040	23.00	92	108
4601/2	Data Entry Keyboard (Proof or Non-Proof) for 5251 or 5252 Display Station	350	3.50	11	13
4910	Magnetic Stripe Reader for 5251 or 5252 Display Station	420	2.50	12	14
5256	Model 1 serial, bidirectional matrix printer; 40 cps, 132 positions, 10 cpi, 6/8 lines per inch	5,200	34.50	160	188
5256	Model 2; same as Model 1 except 80 cps	5,800	40.50	181	213
5256	Model 3; same as Model 1 except 120 cps	6,250	48.50	197	231

*Monthly lease and rental prices include equipment maintenance.

SOFTWARE

		One Time Charge	Monthly License Fee
5714-SS1	System/38 Control Program Facility		$460
5714-RG1	RPG III		69
5714-UT1	Interactive Data Base Facilities		30
5714-XR1	Display Information Facility		58
5714-CV1	System/3 Batch Conversion Utility		
	Model 8 and 10 Disk	$600	
	Model 12	600	
	Model 15	600	
5714-CV2	Conversion Reformat Utility		12
5714-CV3	CCP Conversion Utility	1,300	
5714-CV4	CCP Execution Subroutines		86
5714-D46	System/38 Inventory Management Production Replenishment and Order Validation Evaluation		172
MAPICS/38			
5714-M41	Production Control and Costing		115
5714-M42	Payroll		58
5714-M43	Accounts Payable		46
5714-M44	Accounts Receivable		46
5714-M45	Inventory Management		59
5714-M46	Production Data Manager		104
5714-M47	General Ledger		46
5714-M48	Sales Analysis		58
5714-M49	Order Entry and Invoicing		69
5714-M4A	Data Collection System Support		76
5714-M4B	Material Requirements Planning		115
Distribution Management System Financial Applications			
5714-M42	Payroll		58
5714-M43	Accounts Payable		46
5714-M47	General Ledger		46