IBM 308X Series

MANAGEMENT SUMMARY

UPDATE: *The 3090 Series may be IBM's premier mainframe product, but for many users the older 308X Series endures as evidenced by a healthy 308X resale market. While even a used 308X purchase may seem like a technological deadend, the processor line remains attractive to many from a price/performance standpoint and some models continue to hold value on the resale market. To sell out remaining inventories, IBM lowered purchase prices for 308X models twice during 1986. At the moment, 308X systems can only be obtained from IBM on an "as available" basis. In February of this year, IBM raised rental and lease prices for 308X and many other hardware products an average of 10 percent and raised maintenance prices an average of four to 10 percent. Software fees and one-time charges also went up 10 percent. Not surprisingly, the only major 308X hardware enhancements to emerge in 1986 were in the peripherals area. IBM announced two new high-speed printers, enhanced its 3480 cartridge devices, and brought out a low-end 3480 model. IBM also announced a special trade-in allowance in January 1987 to encourage customers to trade in their single-density 3380 DASDs for the double-density 3380 models. On the software front, IBM announced a new release of MVS that's scheduled to be available by the end of this year.*

For all intents and purposes, the new 3090 Models 150 and 180 entry-level mainframes and new high-end 4381 systems that overlapped the performance of 308X models have all but replaced the 308X Series. Now it's only a question of convincing more IBM 308X users of that. To the continued chagrin of IBM people, getting more 308X users to migrate to the new 3090 machines has been an uphill marketing battle since the 3090 was introduced two years ago. In February 1986, IBM introduced the new 3090 Models 150 and 180 single processors and also replaced 4381s with new higher performing 4381s. Mainframe sales, ➤

IBM's family of large-scale computer systems, the 308X Series, currently has seven models available with memory capacities that range from 8 to 128 megabytes. The most powerful processor in the series, the 3084 QX, can operate as a tightly coupled four-processor system or as two independent dual-processor systems.

The 308X Series reigned through the early 1980s as IBM's highly successful top-end mainframe line, but has since been supplanted by the IBM 3090 top-of-the-line series. For the time being, 308X processors will be available on a limited basis or until they are phased out entirely.

MODELS: 3083 Model Groups CX, EX, BX, and JX; 3081 Model Groups GX and KX; 3084 Model Group QX.
CONFIGURATION: One-, two-, and four-processor systems; 8MB to 128MB of memory; 8 to 48 channels.
COMPETITION: Amdahl 580 Series, Honeywell DPS 8/70, NAS AS/8000 and AS/9000 Series, and Unisys 1100/90 and B 7900.
PRICE: Prices range from $605,000 for an entry-level 308X Processor Complex to $4,845,000.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Old Orchard Road, Armonk, New York 10504. Contact your local IBM representative.

In Canada: Contact IBM office in nearest major city or IBM Canada Limited, Markham, 3500 Steeles Avenue East, Markham, Ontario, Canada. Telephone (414) 474-2111.

MODELS: 3083 Processor Complex Model Group CX, EX, Model Group BX, and Model Group JX; 3081 Processor Complex Model Group GX and Model Group KX; and 3084 Model Group QX.

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent one alphanumeric character, two BCD digits, or eight binary bits. Two consecutive bytes form a "halfword" of 16 bits, while four consecutive bytes form a 32-bit "word."

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; one halfword (16 bits) or one word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: One word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; two words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format; or four words in "extended precision" format.

INSTRUCTIONS: 2, 4, or 6 bytes in length, specifying zero, one, or two memory addresses, respectively.

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

MAIN STORAGE

Main memory in the single processor 3083 Group uses two-way interleaving of contiguous 2K-byte blocks of storage. ➤

IBM 308X Series

TABLE 1. SYSTEM COMPARISON

MODEL	3083 CX	3083 EX	3083 BX	3083 JX
SYSTEM CHARACTERISTICS				
Date announced	October 1984	February 1984	February 1984	February 1984
Date first delivered	April 1985	February 1984	February 1984	February 1984
Field upgradable to	3083 EX	3083 BX	3083 JX or 3081 GX	3081 KX
Relative performance	0.75	1.0	1.4 to 1.5	1.8 to 2.0
Number of processors	1	1	1	1
Cycle time, nanoseconds	24	24	24	24
Word size, bits	32	32	32	32
Operating systems	MVS/370, MVS/XA, VM/SP	MVS/370, MVS/XA, VM/SP	MVS/370, MVS/XA, VM/SP	MVS/370, MXS/XA, VM/SP
MAIN MEMORY				
Type	MOS	MOS	MOS	MOS
Minimum capacity, bytes	8MB	8MB	8MB	8MB
Maximum capacity, bytes	32MB	32MB	32MB	32MB
Increment size	8MB	8MB	8MB	8MB
Cycle time, nanoseconds	312	312	312	312
BUFFER STORAGE				
Minimum capacity	Not specified	Not specified	Not specified	Not specified
Maximum capacity	Not specified	Not specified	Not specified	Not specified
Increment size	Not specified	Not specified	Not specified	Not specified
INPUT/OUTPUT CONTROL				
Number of channels:				
Byte multiplexer	0 to 4	0 to 4	0 to 4	0 to 4
Block multiplexer	8 to 16	8 to 16	8 to 24	8 to 24
Word	—	—	—	—
Other	—	—	—	—

however, continued to be disappointing and partly explained why IBM profits were down for an unprecedented two years straight. The 3090 Models 150 and 180, in particular, did not sell as well as IBM had hoped. Many 3083 users were apparently considering upgrades to bigger 3081s rather than planning migrations to the 3090 Series, according to International Data Corporation (IDC), the Framingham, Massachusetts market research firm. Many 308X users did not perceive a big enough price/performance difference between 308X models and new 3090s to make the switch, according to market analysts.

Partly to change this perception and nudge more 308X users into the 3090 camp, IBM announced in January fully enhanced 3090 versions that feature faster CPU cycle times, and more memory and channel options. The performance enhancements will be incorporated into 3090 models without an increase in price. Whether these performance adjustments will do the trick remains to be seem.

In the peripheral area, IBM launched a promotional campaign to encourage users to purchase 3380 Model AE4 and BE4 double-density direct access storage devices (DASDs), first introduced in 1985. For a limited time, users who purchased the older AA4, A4, and B4 models can replace the machines with AE4 or BE4 and receive a $16,000 discount for each machine. The offer is good for users planning to install double-density models between January 26 and June 30 of this year. Additionally, the replacement models must have an estimated shipping date of May 29 or sooner. The offer is opened to users holding title to the older 3380 machines and to leasing companies.

In the auxiliary storage area, IBM brought out the new 3422 magnetic tape subsystem using conventional 10½-inch,

Main memory within the two-processor 3081 Group is shared by both central processors. Memory makes use of two- or four-way interleaving depending on storage size. Main memory within the four-way 3084 Processor is shared by all four central processors. Main memory uses two-way interleaving.

STORAGE TYPE: MOS (metal oxide semiconductor); 16K-bit or 64K-bit RAM chips.

CAPACITY: 8 to 128 megabytes. See Table 1 for capacities of individual models.

CYCLE TIME: See Table 1.

CHECKING: All data paths between the central processor and main storage are parity-checked by byte. When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and signaled so that appropriate program action can be taken.

The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard in all models. The storage protection array is maintained by the system controller.

RESERVED STORAGE: Similar to the System/370, main memory is reserved for interrupt routines, program status words, CPU timer logout area, machine-check interrupt code, and register save area.

CENTRAL PROCESSORS

There are three basic systems in the 308X Series: the entry-level 3083, the dual-processor 3081, and the four-processor 3084. Four 3083 model groups and two 3081 model groups are available. There is only one 3084 model group. All models within a model group are functionally identical, but differ in instruction rate. Table 1 shows the relative performance ratings of all 308X processors.

Each of the 308X central processors is microcode-controlled and includes an instruction element (IE), variable field

IBM 308X Series

TABLE 1. SYSTEM COMPARISON (Continued)

MODEL	3081 GX	3081 KX	3084 QX
SYSTEM CHARACTERISTICS			
Date announced	February 1984	February 1984	February 1984
Date first delivered	February 1984	February 1984	June 1984
Field upgradable to	3081 KX	3084 QX	—
Relative performance	2.3 to 2.9	3.3 to 4.1	6.0
Number of processors	2	2	4
Cycle time, nanoseconds	24	24	24
Word size, bits	32	32	32
Operating systems	MVS/370, MVS/XA, VM/SP, VM/XA	MVS/370, MVS/XA, VM/SP, VM/XA	MVS/370, MVS/XA, VM/SP, VM/XA
MAIN MEMORY			
Type	MOS	MOS	MOS
Minimum capacity, bytes	16MB	16MB	32MB
Maximum capacity, bytes	64MB	64MB	128MB
Increment size	8 or 16MB	8 or 16MB	16 or 32MB
Cycle time, nanoseconds	312	312	312
BUFFER STORAGE			
Minimum capacity	32KB per CPU	64KB per CPU	64KB per CPU
Maximum capacity	32KB per CPU	64KB per CPU	64KB per CPU
Increment size	—	—	—
INPUT/OUTPUT CONTROL			
Number of channels:			
Byte multiplexer	0 to 4	0 to 4	0 to 4
Block multiplexer	16 to 24	16 to 24	48
Word	—	—	—
Other	—	—	—

reel-to-reel magnetic tape technology. The subsystem features the Model A01 controller and tape unit and the Model B01 unit containing one tape unit. IBM brought out the new magnetic tape product as an interim response to the continued popularity of reel-to-reel technology, despite aggressive IBM efforts to move its users to its new 3480 cartridge tape technology. To encourage more customers to migrate to cartridge tape technology, IBM also brought out an entry-level version of its 3480 magnetic tape cartridge system. The new 3480 A11 controller and B11 dual tape drive models are similar to the A22/B22 models in virtually all respects except for data transfer speed. The 3480 B11 has a transfer speed of 1.5 million bytes per second, half the speed of the B22 model. IBM also introduced in 1986 the 3480 Automatic Cartridge Loader. The optional product lets operators premount up to five cartridges, counting the cartridge mounted on the drive. The auto loader will automatically unload up to six cartridges without operator intervention.

Turning to the high-speed printer area, IBM improved the price/performance of its two high-end data processing printers, the 4248 impact printer and the 3800 laser printer. The 4248 Model 2 high-speed band printer uses a new hammer magnet technology to achieve acceptable print quality at 4000 lines per minute (lpm). It sells for $75,000, the same list price of the printer model it replaces, the 4248 Model 1. Introduced in 1984, the Model 1 band printer achieved a top-speed of 3600 lpm, then the fastest band printer available. Similar to the Model 1, the new Model 2 is a variable speed printer that can operate at 2200, 3200, or 4000 lpm. It features 132 print positions, expandable to 168 print positions for printing two documents side by side to enhance throughput. The Model 2 can operate in 3211 model using 3211 application programs or 4248 mode. Additionally, the operator can set up and store up to 20

element (VFE), execution element (EE), control storage element (CSE), and buffer control element (BCE). The central processor cycle time is 24 nanoseconds on all models.

Instruction sequencing, address generation for storage requests, and initiation of storage requests are handled by the instruction element (IE). The IE contains its own buffers, registers, and hardware to process instructions other than those executed in the VFE.

All storage-to-storage (SS and SSE) instructions are executed in the variable field element (VFE). The VFE has a decimal adder, two input (source) registers, and two output (sink) registers. While the IE is using data contained in one VFE input register, it can also be filling the other input register. Likewise, the IE moves data from the VFE output registers to the storage data register in the IE.

The execution element (EE) performs the following arithmetic operations: fixed-point multiply/divide, convert to binary, convert to decimal, floating point, and extended precision floating point.

The control storage element (CSE), a logical component in the central processor that contains control storage and registers, controls microcode execution in the central processor. Microcode is paged in from the system area in main memory by the pageable part of control storage.

Immediate execution of in-place microinstructions is handled by a lookaside directory within control storage. Newly paged microinstructions overlay the least recently used (LRU) microcode.

Data movements between the central processors and memory are handled by the buffer control element (BCE). The BCE performs virtual-to-real address translation, controls the buffer (cache), and includes a 32K-byte cache, directory, directory lookaside table (DLAT), dynamic address translation (DAT) hardware, and a store-back array.

Each 3081 Model Group GX central processor has a 32K-byte cache storage unit for high-speed access to instructions and data. Each 3081 Model Group KX and 3084 Model

IBM 308X Series

print jobs for later recall. Items that can be recalled include print density, hammer adjustment, speed, and stacker mode. The 4248 Model 2 became available last February.

The new 3800 Model 6 laser printer, operating at up to 134 pages per minute (ppm), is the new entry-level model, replacing the 3800 Model 1. The Model 6 sells for $175,000, or less than the cost of the withdrawn Model 1 ($215,000) and less than the Model 3 ($330,750). The Model 6 is similar to the Model 3 in most aspects except for speed. At a top printing speed of 215 ppm, the 3800 Model 3 remains IBM's fastest printer. Both the Model 3 and Model 6 operate on-line, print at 240 by 240 dots per inch, and operate in either Model 1 compatibility mode or all-points-addressable mode, which allows characters to be located at any defined point on a page.

Hardware activity within the 308X processor line itself was minimal last year. The introduction of a new top-end model line confirms the view of many that IBM product cycles will be getting shorter and technological enhancements between product cycles will occur at an evolutionary rather than revolutionary pace. For instance, it seems reasonable to believe the 308X Series "X" models, first announced and delivered in February 1984, continue to have something to offer users migrating through the series.

The 308X Series "X" models feature increased memory capacities, a faster central processor cycle time, and a reduction in the number of Thermal Conduction Modules required, when compared with the original models. Upgrades are available which allow equal main memory capacities on both the base models (E, B, and J) and the improved X models. All 3083 models support up to 32 megabytes of main memory, all 3081 models support up to 64 megabytes, and the 3084 supports up to 128 megabytes. The machine cycle time is 24 nanoseconds on all X models.

According to IBM, the 3083 Models EX, BX, and JX provide a five to eight percent performance improvement over the E, B, and J models in MVS, MVS/XA, and VM/SP HPO CMS environments. The 3081 Model GX has an instruction execution rate that is approximately 8 percent faster than the 3081 Model G in an MVS or MVS/XA environment and approximately 11 percent faster in a VM/SP HPO CMS environment. The instruction execution rate of the 3081 Model KX is about 10 percent faster than that of the 3081 Model K in MVS and MVS/XA environments; in VM/SP HPO CMS environments, the improvement is about 14 percent. In single-image mode, the 3084 Model QX provides an 8 percent performance improvement over the 3084 Model Q in an MVS/XA installation.

The 3083 Model CX, EX, BX, and JX have eight megabytes of main memory, expandable to 32 megabytes. According to IBM, the 3083 Model CX can be field upgraded to the Model EX, the 3083 Model EX can be field upgraded to the Model BX, and the Model BX can be field upgraded to the Model JX, all in about five hours. The 3083 Model BX can also be upgraded to a 3081 Model GX. The 3083

Group QX processor has a 64K-byte cache storage unit. The cache has a two-cycle access time for eight bytes of data. Address translation is performed in parallel. Lines of data in the cache are replaced using a least recently used (LRU) algorithm. The absolute addresses for lines of data contained in the cache are located in the directory. IBM has released no information on cache storage capacities for the 3083 processors.

Virtual-to-real address translation is performed by dynamic address translation (DAT) hardware. Once a virtual address is translated, the real address of the referenced page is stored in the directory lookaside table (DLAT), which contains up to 128 virtual/real address pairs. In System/370 mode, virtual addressing is limited to 16 megabytes. Using the standard extended addressing feature, addressing in excess of 16 megabytes of real storage can be achieved. In the System/370 Extended Architecture (370-XA) mode, both real and virtual addressing are expanded to two billion bytes.

The 308X uses improved packaging techniques for its logic circuitry. Based on Schottky TTL in the form of gate arrays, the circuitry is contained in an enclosure called the thermal conduction module (TCM). The TCM is a helium-filled, encapsulated unit that has up to 118 silicon logic chips mounted on a multilayered ceramic substrate. Depending on the model, each central processor is made up of 12 to 52 TCMs mounted on two to eight multilayered boards that contain all chip and module interconnections. No external wiring or cabling is needed as a result of this design. The module is covered by a cold plate through which chilled water is circulated for heat dissipation. The TCM, according to IBM, provides increased computing power while reducing space requirements by 21 percent, cooling facilities by about 70 percent, and power requirements by about 66 percent when compared to the IBM 3033 Model U8. The TCM is a field-replaceable unit (FRU).

Memory in the 308X is implemented in monolithic and LSI technologies. A two-level design is used in each processor: central, or main, storage and the high-speed buffer (cache). The system area, typically an area of memory of at least 262K bytes, is designated at initial microcode load (IML) for system usage and is not available for user programs. Main memory is configured in two or more direct-access basic storage elements (BSEs) which have the logic for fetching or storing doublewords from or into the data arrays. Memory has two-way interleaving, except in the 3084 which has two- or four-way interleaving, of contiguous 2K-byte blocks of storage. Error checking and correction (ECC) bits are stored with data in the data arrays.

The system controller is the switching point in the 308X Processor Complex, and interconnects the logical units of the complex: the central processor(s), central storage, and the external data controller (EXDC). The 3083 and 3081 systems include one system controller that performs the following activities:

- **Controls data transfers.**
- **Resolves conflicts between the two 3081 CPUs.**
- **Switches data flow between various processor components: CPUs, memory, and EXDC.**
- **Maintains the storage protection array and the time-of-day clock.**
- **Blocks access to central storage from a requesting 3081 processor until the processor in use has successfully completed a data transfer.**
- **Assigns priorities to and keeps track of storage module accesses.**

IBM 308X Series

Model JX can be field upgraded to the IBM 3081 Model KX in about eight hours.

The 3081 systems are what IBM calls "dyadic" processors, consisting of two integrated CPUs operating under a single operating system. Each processor has access to 16 to 64 megabytes of shared storage and its own set of channels. IBM states that although the 3081's dyadic structure is similar to the MP and AP complexes found in its 303X series, the new architecture is unique in that channels can be assigned to either CPU. Each Model Group GX processor has a 32K-byte high-speed buffer, while each Model Group KX processor has a 64K-byte buffer. The two-way integrated structure of the 3081 processors is said to offer greater system availability, since processing can continue in a reduced state even with one of the processors down. Channels can be automatically switched under program control to the functioning processor until the problem can be corrected. The 3081 cannot, however, be split into two uniprocessors executing simultaneously.

The four-processor 3084, which is equivalent to two 3081 Model Group KX systems, is capable of being partitioned. Use of the partitioned mode results in a highly available hardware system generally capable of continuing operation while failing portions are isolated, repaired, and returned to the operating configuration. The 3084 has two dyadics and when operating in this split mode, each dyadic can operate independently with the full capabilities of the resources attached.

The System/370 Extended Architecture (370-XA) provides extended addressing and additional channel capabilities for large MVS applications. Any 308X system can operate in either System/370 or 370-XA mode. In 370-XA mode, real and virtual storage addressing are expanded from 24 bits (16 million bytes) to 31 bits (2 billion bytes). Bimodal operation permits the concurrent execution of 24-bit and 31-bit programs.

The 308X Series is supported by the MVS/SP (Multiple Virtual Storage/System Product) and VM/SP (Virtual Machine/System Product) operating systems. To support the System/370 Extended Architecture, IBM announced MVS/Extended Architecture (MVS-XA). MVS-XA consists of two elements: MVS/SP Version 2 and the Data Facility Product (DFP). MVS/SP Version 2 includes all of the functions of Version 1 Release 3 plus the following enhancements: support for 31-bit real and virtual storage addresses, support for larger and more flexible I/O configurations, additional RAS features, and enhanced operator commands. The DFP provides data management, device support, program library management, and utility functions.

MVS/SP Version 2 Release 2, the latest version of MVS, was announced in October 1986 and will be available by third and fourth quarter 1987. The new releases are functionally equivalent with previous releases of MVS/SP, but feature operational enhancements, additional system constraint relief, and some new functions. For more details, refer to the software section of this report, and for an even

While the other 308X Processor Units have only one system controller, each side of the 3084 Processor Unit has a system controller. Each system controller in the 3084 acts as a switching device among all other logical components of one side of the processor unit by interconnecting the two central processors and the external data controller with central storage. The two system controllers coordinate the use of processor unit resources, with each managing the hardware resources on its side of the 3084 Complex.

The 3084 Complex has two physical modes of operation: single-system mode and partitioned mode. In single-system mode, the 3084 Complex operates as a single system under a single control program making its maximum hardware resources available. In partitioned mode, the 3084 Complex is partitioned so that it has two symmetric sides, each side operating independently under its own program control. In a single-system 3084 Complex, each system controller has direct access to both sides of central storage. If central storage receives an access request from each of the two system controllers simultaneously, central storage determines which request is honored first.

Error handling in the 308X is provided on several levels for maximum efficiency and is often assisted by the 3082 Processor Controller. Error correction and recovery are tried as the first step. Processor checkpoint retry in the CPU, channel error detection and recovery for the channels, and error checking and correction in central storage represent the specific methods used in the individual system elements. If an error cannot be pinpointed through normal routines, the 3082 initiates a probability calculation as to the most likely place an error could occur.

Processor checkpoint retry uses a series of error detection latches and backup facilities which are periodically tested by each processor for errors. If there are no errors, a checkpoint is taken by the CPU. A checkpoint is a reference marker, stored within the backup facilities, that retains information about the state of the CPU at the time the checkpoint was taken. If an error is detected by a CPU, instruction execution stops, the CPU generates an error logout, and returns to the last checkpoint. The processor can be restored to its operational state as of the checkpoint, and processing can be restarted from this point.

Retry is performed up to eight times by the CPU. If the error has not been corrected by the eighth retry, the processor either enters the check-stop state or takes a machine check interruption. An interruption is also generated in the check-stop state. If the error is corrected by the eighth try, normal processing resumes. According to IBM, processor checkpoint retry is an improved recovery method over older systems because it involves a retry of a series of instructions, rather than of a single instruction.

Detecting channel errors can involve either the 3082 Controller or an I/O control unit, depending on the error. If the 3082 is involved, error recovery can be performed via the control program, or the 3082 can temporarily stop channel operation to investigate channel status information before reinitializing the I/O devices in use. If the error is detected by a control unit, the 3082 may not have to be used, since the control unit can issue a command retry to the channel without an I/O interruption occurring.

Within central storage, all single-bit errors are detected and corrected. Error checking and correction (ECC) also detects all double-bit and most multiple-bit errors but does not correct them.

Additional key features standard on the 308X Processor Complex include:

IBM 308X Series

TABLE 2. MASS STORAGE

MODEL	3350 Disk	3375 Disk	3380 Disk
Cabinets per subsystem	1 to 32	1 to 32	1 to 16
Disk packs/HDAs per cabinet	2 HDAs	1 HDA	2 HDAs
Capacity	317.5MB per HDA	819.7MB	1260MB or 2520MB per HDA
Tracks/segments per drive unit	33,300	—	—
Average seek time, msec.	25	19	15 to 17
Average access time, msec.	33.4	29.1	23.3 to 25.3
Average rotational delay, msec.	8.4	10.1	8.3
Data transfer rate	1,198,000 bytes/sec.	1,859,000 bytes/sec.	3,000,000 bytes/sec.
Controller model	3830-2 or 3880-1, -2, -11, or -21	3880-1 or -2	3880-2, -3, -13, or -23
Comments	Fixed-head models available; Model A2 includes logic and power for up to 3 B2s or 2 B2s and 1 C2 unit	Model A1 includes logic and power for up to 3 B1s or 2 B1s and 1 D1 unit	Model A4 includes logic and power for up to 3 B4 units

more detailed examination, refer to the MVS/370 and MVS/XA Product Enhancement report on Page SW35-504MK-217 in Volume 3 of *Datapro 70*.

COMPETITIVE POSITION

With the January announcement of more 3090 performance enhancements, including faster 17.2/17.75 nanosecond cycle times, one-megabit memory chips, and capacious memory configurations, IBM has once again tried to technically distance its new flagship line from the aging 308X Series. The message here is simple: Users even thinking of installing a 308X instead of a 3090 will be left to fend in a technological abyss. While customers can still get 308X models on an "as available" basis, you can bet that from here on out, IBMers will encourage customers to move on to the 3090 line.

To make a jump to the 3090 line more attractive, in January 1987 IBM lowered the list price of its enhanced Model 150E entry level model from $1,300,000 to $1,250,000. The Model 150E, which comes with 32 megabytes of main memory and 16 channels, also has a faster 17.75 CPU cycle time (compared to 18.5 nanoseconds for the previous version) and can now be outfitted with expanded storage, an option that wasn't available when the processor was first introduced in 1986. The 3090 Models 150E and 180E single processors were originally introduced as replacements from the 3083 processors, but many Model 150/180 sales apparently never materialized. IDC reports many 3083 users were not interested in a 3090 for the time being. Instead of a 3090, many were considering moving up to a bigger 308X model, according to an IDC survey published at the end of 1986.

While IBM tried to solve its marketing problems, NAS and Amdahl, IBM's top plug-compatible rivals, were plotting strategies of their own. NAS struck first in May 1986 with the introduction of the AS/XL 50, a new entry-level system featuring 32 megabytes of main memory and 16 channels. It's rated at 22 MIPS (millions of instructions per second). In January 1987, Amdahl announced the 5890 Model 190 single processor, a system which Amdahl calls the most powerful uniprocessor it has ever offered. Similar to the

- **Channel indirect addressing, which permits contiguous areas of virtual storage to be mapped into noncontiguous areas of real storage.**
- **Channel set switching, which dynamically switches channel sets between processors under program control.**
- **A dynamic channel subsystem for the 3081 and 3084, which enables individual I/O channels to operate with any central processor. Any CPU can initiate I/O requests to, or handle I/O interrupts from, any I/O device.**
- **Data streaming, which permits data transfer rates up to 3 megabytes/second on block multiplexer channels.**
- **Extended addressing, which permits the addressing of real storage in excess of 16 megabytes. With MVS/SP, user programs and portions of the control program can be located at real addresses up to 32 megabytes.**
- **A 31-bit addressing capability, which expands both real and virtual storage addressing to 2 billion bytes. Both 24-bit and 31-bit programs can execute concurrently.**
- **System/370 extended facility, which speeds up certain supervisor functions, improves the efficiency of dynamic address translation, and improves CPU availability by protecting certain low-address central storage locations, all while operating under MVS/SP.**
- **Byte-oriented operand feature, which allows byte boundary alignment of the operands of most unprivileged instructions.**
- **Virtual machine assist (VMA), which improves virtual system performance under VM/370 by reducing the time VM/370 spends in the real supervisor state. VMA has been enhanced to allow the segment protection function to be performed by VMA instead of by the VM control program.**
- **Preferred Machine Assist, which is designed to improve the performance of an MVS guest machine running under VM/SP. The feature provides the guest operating system with complete control of the processor, dedicated channels, and I/O devices.**
- **Start Interpretive Execution (SIE) Assist, which provides improved performance of V = R preferred guests running under the VM/XA Systems Facility. SIE Assist reduces the number of instructions VM executes when supporting dedicated devices on preferred guests.**

IBM 308X Series

TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed, Inches/Sec.	Transfer Rate, Bytes/Sec.
3420:					
Model 3	7	556/800	NRZI	75	41,700/60,000
	9	800	NRZI	75	60,000
	9	1600	PE	75	120,000
Model 5	7	556/800	NRZI	125	69,500/100,000
	9	800	NRZI	125	100,000
	9	1600	PE	125	200,000
Model 7	7	556/800	NRZI	200	111,200/160,000
	9	800	NRZI	200	160,000
	9	1600	PE	200	320,000
Model 4	9	1600	PE	75	120,000
	9	6250	GCR	75	470,000
Model 6	9	1600	PE	125	200,000
	9	6250	GCR	125	780,000
Model 8	9	1600	PE	200	320,000
	9	6250	GCR	200	1,250,000
3422		1600/			200,000
		6250		125	780,000
3430	9	1600	PE	50	80,000
	9	6250	GCR	50	312,500
3480					
Model B22	18	38,000 (bytes)	—	79	3,000,000
Model B11	18	38,000 (bytes)	—	79	1,500,000

Printers	Printing Speed	Print Positions	Horizontal Spacing, Chars./Inch	Vertical Spacing, Lines/Inch	Form Size, Inches
3800:					
Model 3	Up to 215 ppm	136, 163, 204	10, 12, 15	6, 8, 10,12	6.5 to 14⅞ wide, 3.5 to 11.0 long
Model 6	Up to 134 ppm	—	—	—	6.5 to 14⅞ wide, 3.5 to 11.0 long
3820 Model 1	20 pgs/min.	—	10, 12, other	—	7.0 to 8.5 wide, 10.5 to 14 long
4245 Model 12	1200 lpm	132	10	6 or 8	3.5 to 22.0 wide, 3.0 to 24.0 long
4245 Model 20	2000 lpm	132	10	6 or 8	3.5 to 22.0 wide, 3.0 to 24.0 long
4248 Model 2	2200, 3200, or 4000 lpm	132 std.; 168 opt.	—	—	Not specified

**Model 3 can operate in all-points-addressable mode.*

NAS Model AS/XL 50, a base model comes with 32 megabytes of main memory and 16 channels and is rated at about 21 MIPS. The NAS AS/XL 50 sells for $3,050,00, the Amdahl 5890 Model 190 sells for $2,625,000, and as noted, the IBM 3090 Model 150E, rated at 10.1 MIPS, sells for $1,250,000. The base IBM price comes in low compared to the other, but of course, this price doesn't include other required hardware such as a processor controller, power and coolant distribution unit, power unit, and other items that are priced separately.

- **3033 Extension, a microcode assist that improves MVS/SP performance via controlled, cross-address-space access.**

The IBM 308X Series has a high level of reliability, availability, and serviceability (RAS) assured through several important system features:

- **A central processor, made up of TCMs and associated boards, that needs no external wiring or TCM-to-TCM cabling.**

IBM 308X Series

In addition to the IBM plug-compatible vendors, incompatible mainframe products from vendors like Honeywell, Burroughs, and Control Data, which used to compete with the IBM 308X, have since been upgraded to compete with the 3090 or else have been superseded by newer offerings. Sperry, now part of the Unisys alliance, continues to offer the 1100/90, a processor line similar in vintage to the IBM 308X and just as out of date.

ADVANTAGES AND RESTRICTIONS

To protect customer investments in software and peripherals, it is now common practice for IBM and competing vendors to market processor lines with a built-in "migration path," as vendors like to call it. The 308X Series, which is now reaching the end of its product cycle, is no exception, since 308X customers can migrate to the 3090 Series when processing and capacity needs dictate. On the negative side, however, when IBM announces a new product line, customers can expect to watch their investments in earlier IBM models decline in value as the processors they purchased perhaps not too long ago drift into an all-too-early obsolescence. Many users who have already exceeded the capabilities of the 308X Series and who plan to migrate to a 3090 must also contemplate a processor swap out since there is no field upgradability between the two series. Such is the state of the mainframe business.

Of course, there continue to be many users with smaller 308X systems who do not need the power of a 3090 for the moment. These users can continue to migrate through the processor line and upgrade to successively larger 308X models. With the announcement of the entry-level 3083 Model CX in 1984, IBM provided 308X Series users with the ability to expand the processing power of their operation by 10 times. Memory still ranges from 8 megabytes on the entry-level 3083 to a maximum of 128 megabytes on the 3084.

The 308X Series supports System/370 Extended Architecture, which offers such enhancements as 31-bit addressing, the dynamic channel subsystem, and a number of reliability, availability, and serviceability features. IBM has been encouraging its customers to upgrade to MVS/XA. IBM offers the MVS Custom-Built Installation Process Offering (CBIPO), a service designed to automate or eliminate the customer tasks required to install IBM software. To further encourage 308X customers to move to MVS/XA, IBM began offering a XA operating system deal it hoped customer could not pass up. In June 1986, IBM began offering XA for free to customers not using XA for the first eight months and at half price for the following 12 months. In July 1986, IBM followed up the MVS/XA deal with an attractive VM/XA offer.

USER REACTION

Datapro's 1986 survey of general purpose computer users yielded 289 responses from IBM 3083, 3081, and 3084 users, the largest single group of users out of all the mainframe sites surveyed. On the average, most of these systems were installed more than two and a half years at the time of

- **In the 3081 and the 3084, an integrated two-way or four-way processor design that permits a failed CPU to be removed from the configuration, while processing can continue on the other CPU. This allows continued processing and deferred servicing.**
- **The ability to switch channels associated with a failed CPU to the functioning CPU in a 308X Complex with more than one CPU.**
- **The 3082 Processor Controller, which provides a wide range of maintenance and diagnostic routines for on-site servicing, and has a data communications link for contacting IBM field support personnel.**
- **Remote diagnostics conducted by IBM support personnel using the field engineering RETAIN program.**

The 308X Series processors function in either System/370 mode or in System/370 Extended Architecture (370-XA) mode. In System/370 mode, address translation of page sizes is limited to 4K bytes and segment sizes to 64K bytes. Only 4K storage protect keys are used. The 370/XA mode supports 31-bit addressing, larger and more flexible I/O configurations, and channel path selection under hardware control.

The 308X Series instruction repertoire encompasses the System/370 Universal Instruction Set, which includes 156 instructions that provide binary, decimal, and floating-point arithmetic operations. The System/370 instruction set includes complete arithmetic facilities for processing variable length decimal and fixed-point binary operands, as well as instructions which handle loading, storing, comparing, branching, shifting, editing, radix conversion, code translation, logical operations, packing, and unpacking. In addition, a group of "privileged instructions," usable only by the operating system, handle input/output and various hardware control functions.

Two types of interrupts can be generated: normal and error. Normal interrupts include channel end, device end, attention status, and busy status. Error interrupts include those caused by data parity error, address parity error, invalid buffer address, keyboard, parity error, keyboard invalid address, command byte parity, and invalid command.

SPECIAL FEATURES: The 3082 Processor Controller is a freestanding processor that concurrently supervises and monitors all ongoing activities in the 308X complex. Four models are available, depending on the number of channels present: Model X8, for 8 channels; Model X16, for 16 channels; Model X24, for 24 channels; and Model X48, for 48-channel systems. The 3082 acts as the controller for the system console (an IBM 3278 Model 2A), the service support console, an optional printer, and an optional programming support console. On the 3084, a maximum of two of each device may be controlled by the 3082 controller. The system console interacts directly with the 308X, displays system status, and performs all standard console functions. The service support console interacts with the diagnostic routines built into the 308X processor and can also function as a backup console. The programming support console is a 3278 Model 2 equipped with a switch to change from a programming support device to a diagnostic console. The optional printer can be a 3230 Model 2, 3268 Model 2, or 3287 Model 1 or 2.

The 3082 Processor Controller also functions as the system monitor and supervisor, providing the following services:

- **Controls system power-on sequencing and initial microcode load (IML).**
- **Monitors voltage levels and coolant flow in the processors.**

IBM 308X Series

TABLE 4. TERMINALS

MODEL	3178	3179	3180	3278	3279
DISPLAY PARAMETERS					
Max. chars./screen	1920	1920	1920 to 3564	960 to 3564	1920 to 2560
Screen size (lines x chars.)	24 x 80	24 x 80	24/32/43 x 132	12 to 43 x 80, 27 x 132	12/24/32/43 x 80
Symbol formation	7 x 14 dot matrix	7 x 11	7 x 11	7 x 11	7 x 11
Character phosphor	Green	White	White	White	White
Total colors/no. simult. displayed	—	Up to 7	—	—	Up to 7
KEYBOARD PARAMETERS					
Style	Data Entry, typewriter	Modifiable	Data entry, typewriter	Several	Several
Character/code set	ASCII, EBCDIC	ASCII, EBCDIC	ASCII, EBCDIC	ASCII, EBCDIC	ASCII, EBCDIC
Detachable	Standard	Standard	Standard	Standard	Standard
Program function keys	10/12 Standard	24 Standard	24 Standard	Standard	Optional
OTHER FEATURES					
Buffer capacity	—	—	—	—	6 prog. sym. sets
Tilt/swivel	Standard	Standard	Standard	No	No
Graphics capability	No	No	No	No	Yes
TERMINAL INTERFACE	RS-232-C	RS-232-C	RS-232-C	RS-232-C	RS-232-C

the survey. Of those surveyed, 47.40 percent purchased their systems, while 7.27 percent rented or leased them from IBM, and 45.33 percent rented or leased from a third party.

These systems are used primarily for the big four DP applications: accounting and billing (73.01 percent), payroll/personnels (63.32 percent), order processing and inventory control (46.71 percent), and purchasing (40.83 percent). Other major application areas mentioned in order of frequency are sales and distribution (29.76 percent), manufacturing (21.45 percent), engineering/scientific (20.42 percent), insurance (18.34 percent), banking (14.53 percent), health care, and math/statistics, (both 13.15 percent). Other applications mentioned less often were education, process control, petroleum/fuel oil, and construction/architecture.

Compared to the latest generation of mainframes which now offers gigabyte-size main memory capacities, available memory capacities on 308X systems now seem relatively small. Most 308X users have memory capacities within the 16-megabyte to 32-megabyte range (55.75 percent). Thirty-two megabytes is the maximum memory available with the single-processor 3083 systems. Some 26.48 said they had memory capacities within the 32 megabyte to 64 megabyte range, capacities available with the two-processor 3081 systems. Only about 10.10 percent said they had memory capacities greater than 64 megabytes, available only with the four-processor 3084 system.

Many users (74.74 percent) clearly indicated they planned to expand their current hardware configurations, perhaps with the addition of more memory, larger systems, or more peripherals. Likewise, on the software side, 71.28 percent said they planned to acquire additional software from IBM, while 79,58 percent said they planned to purchase proprietary software from other suppliers. At the time of the survey, most 308X users (95.16 percent) generated applications programs from their own in-house personnel, while some 59.52 percent also obtained software from independent suppliers, and 51.56 percent obtained packaged software from the manufacturer. A smaller number (47.75

- **Controls dynamic reconfiguration of processor elements such as CPUs, central storage arrays, channel groups, and interface adapter elements.**
- **Performs a system sampling operation that can extract specific system performance data.**
- **Initiates processor unit error recovery measures such as checkpoint retry and error analysis and isolation.**
- **Provides a data communications link to IBM field support.**
- **Contains an integrated processor control file with system information libraries for microcode, I/O configuration, channel parameters, and diagnostics.**

PHYSICAL SPECIFICATIONS: 308X processors require 400 Hz power provided by the IBM 3089 Power Unit or equivalent source of power. Typical 3083 kVA requirements at 400 Hz range from 10.5 kVA to 11 kVA. Processors in the 3083 model group weigh between 5,860 and 5,930 pounds depending on model. Within the 3081 group, weights range from 6,230 to 6,770 pounds. Typical 3081 kVA requirements at 400 Hz range from 15.4 to 19.4. Within the 3084 group, weight ranges from 12,700 to 13,780 pounds. Typical 3084 kVA requirements at 400 Hz range from 36.8 to 48.8 kVA. Environmental conditions for the 308X Series should hold to between 60 and 85 degrees Fahrenheit at a relative humidity of between 20 and 80 percent.

CONFIGURATION RULES

The basic 308X Processor Complexes consist of one or more central processors, main memory, an external data controller (EXDC) for channel control, and a system controller. The 3083 processors represent the entry-level systems in the 308X Series. Four model groups are available: Model Groups CX, EX, BX, and JX. All four can have 8, 16, 24, or 32 megabytes of main memory. Model Groups CX and EX are available with 8 or 16 I/O channels, while Model Groups BX and JX are available with 8, 16, or 24 channels.

The 3081 Model Groups GX and KX Processor Complexes include two central processors in a dyadic, or tightly coupled, arrangement. Both models are available with 16, 24, 32, 48, or 64 megabytes of main memory and with 16 or 24 channels.

The 3084 Model Group QX Processor Complex includes four central processors with 32, 48, 64, 96, or 128 megabytes of main memory and 48 channels. The 3084 Processor Complex can be used as a tightly coupled four-processor

IBM 308X Series

percent) obtained software through contract programming, and an even smaller number (7.27 percent) obtained software from the manufacturer's personnel.

As usual, the survey results showed IBM users were not all that pleased with IBM application software. Users gave IBM application software a weighted average of 2.73, which is better than fair, but not as good as the rating for other rated mainframes. According to the survey, users rated software for 11 other systems from IBM and other vendors better than that provided for the 308X, while users rated software for nine other systems lower.

In other areas, 65.05 percent said they had implemented a disaster recovery plan, while 16.26 said they were planning to do so during 1986. Additionally, 63.32 percent said they had implemented an information center, while 10.03 percent said they planned to do so in 1986.

The following table listed how all 308X users surveyed rated their various 3081, 3083, and 3084 systems.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	103	168	18	0	3.29
Reliability of mainframe	232	53	3	0	3.80
Reliability of peripherals	163	119	6	0	3.55
Maintenance service:					
Responsiveness	156	118	11	3	3.48
Effectiveness	156	119	10	1	3.50
Technical support:					
Troubleshooting	95	164	30	0	3.22
Education	87	175	27	0	3.21
Documentation	64	170	53	2	3.02
Manufacturer's software:					
Operating system	105	166	15	0	3.31
Compiler & assemblers	91	177	15	1	3.26
Application programs	19	149	68	8	2.73
Ease of programming	23	201	57	2	2.87
Ease of conversion	25	156	84	10	2.71
Overall satisfaction	53	224	10	0	3.15

*Weighted Average on a scale of 4.0 for Excellent.

When asked if their systems performed as expected, 97.23 percent said "Yes," 0.35 percent said "No," and 1.73 percent said they were "Undecided." When asked if they would recommend their systems to others, 95.50 percent said "Yes," 1.04 percent said "No," and 2.77 percent were "Undecided." □

system with shared resources or as two dual-processor systems operating independently. When run as a four-processor system, the 3084 can operate in 370-XA mode only.

The 308X Processor Complex also requires a 3087 Model 1 or Model 2 Coolant Distribution Unit (CDU) and a 3089 Power Unit (or other appropriate 400-Hz power supply). The 3084 Processor Complex requires two of each unit. The 3087 Model 1 CDU controls the temperature and flow of chilled water through the thermal conduction modules (TCMs). The CDU has two pumps, one of which is on standby for activation if the operating pump fails. The 3087 Model 2 dissipates the heat generated by the CPU into the air of the computer room, rather than transferring the heat into the building's chilled water supply.

INPUT/OUTPUT CONTROL

The 308X uses an external data controller (EXDC) to handle all I/O operations. A fully integrated I/O processor, the EXDC contains 8 channels as standard on the 3083, 16 channels as standard on the 3081, and 48 channels as standard on the 3084. In 370 mode, channels on the 3081 are organized logically into two sets (one for each CPU), with a maximum of 16 channels permitted in one set. In 370-XA mode, any channel can operate with either CPU. Physically, the channels on the 3081 are configured into two (standard) or three groups of 8 channels each. The 3083 Model Groups CX and EX can have a maximum of two 8-channel groups, while the 3083 Model Groups BX and JX can have a maximum of three 8-channel groups. The 3084 has six 8-channel groups.

Channels can be configured as either byte or block multiplexer channels. A maximum of four byte multiplexer channels per system is possible. Block multiplexer channels are generally used when byte multiplexer channels are not needed. Any channel in the system can be given a valid channel address, but the addresses must be contiguous within the channel set. Block multiplexer channels can operate in either the standard DC interlock or 3-megabytes-per-second data streaming mode. Up to eight I/O control units can be attached to either a byte or block multiplexer channel, and each channel can address up to 256 I/O devices (each on its own subchannel).

The EXDC has a microcode-controlled Channel Processing Element (CPE) that fetches channel command words (CCWs), starts and ends data server element (DSE) operations, analyzes status, posts interruptions, and assists DSEs in command chaining and indirect addressing. The CPE has up to three DSEs (each associated with a channel set) that control data transfers between the I/O devices and central storage. Each DSE operates with eight interface adapter elements (IAEs) that are connected to the channels in the DSE. An IAE performs service-in and service-out tagging, identifies incoming data transfers and signals the proper DSE, and provides data during data transfers.

Up to two channel-to-channel adapters are optional on the 308X to interconnect the 308X and another system via a channel from each unit. Additional eight-channel groups, which increase the number of channels from 8 to 16 or from 16 to 24, are also optional.

Also available is the 3088 Multisystem Channel Communication Unit, a standalone I/O Control Unit that provides channel-to-channel communication facilities for multiple IBM 303X, 308X, or 4300 processors. The 3088 provides the capability of interconnecting from four to eight processor channels. The channel interfaces can be configured with 32 or 64 contiguous unit addresses that provide the function of a Channel-to-Channel Adapter. From 126 to 252 logical Channel-to-Channel Adapter links are provided. The 3088 requires one control unit position on each processor channel to which it is attached. One unshared subchannel is required on each attached channel for each unit address.

The 3044 Fiber Optic Channel Extender Link provides the ability to connect low- to medium-speed peripheral devices, I/O control units, switching units, and channel-to-channel interfaces to an IBM 4300 Series, 308X Series, or 3090 Series channel at distances up to 2 kilometers. The 3044 consists of two units, one that attaches to the processor channel and another that attaches to the I/O control unit, connected by a fiber optic cable. The 3044 link allows I/O devices to be "locally" attached to channels instead of being remotely attached via communications equipment. The 3088 Multisystem Channel Communication Unit can be connected to the 3044 channel link, operating in data streaming or

IBM 308X Series

nondata streaming mode. The 3044 supports devices operating at up to 1.25 megabytes per second.

MASS STORAGE

(Covered in Table 2.)

INPUT/OUTPUT UNITS

(Covered in Table 3.)

The 3814 Switching Management System is designed to aid in the management of complex DP configurations by providing centralized control of control-unit switching. The system is covered in greater detail in Report 70D9-504MK-101 in Volume 2.

TERMINALS

(Covered in Table 4.)

COMMUNICATIONS

The *3705 Communications Controller* programmable front-end network processor can be connected to either a byte or block multiplexer channel on a 3083, 3081, or 3084 processor.

The 3705 consists of a Basic Module and up to three Expansion Modules. The Basic Module houses the Central Control Unit and Control Panel. Also contained in these modules are the storage, Channel Adapters, Communications Scanners, Line Interface Bases, and Line Sets required to accommodate up to 352 communication lines. Configuration rules for the 3705 are quite complex. The maximum number of lines that can be connected is a function of the 3705 model, the line speeds and types, and the mode of operation. In the 2701/2/3 Emulation mode, a maximum of 255 lines can be controlled. Line speeds can range from 45.5 to 56,000 bits per second. In the Network Control Program (NCP) mode, data is transferred between the 3705 and the host computer via a single subchannel interface.

The entry-level *3705-80* series consists of Models 81, 82, and 83. The 3705-80 has 256K bytes of storage and supports 4, 10, or 16 communication lines. The 3705-80 can be used as a front-end communications processor or as a remote concentrator.

When connected to a host IBM processor, a 3705 can use either the Network Control Program (NCP) or the 2701/2/3 Emulation Program. NCP/VS, for virtual environments, includes all of the facilities of the original NCP and also has the partitioned Emulation Programming Extension (PEP) capability which permits operation in the NCP mode and Emulation mode concurrently.

The 3705 Controllers are supported under the VTAM and TCAM access methods. The Advanced Communications Function for NCP, ACF/NCP/VS (and related Systems Support Programs), adds capabilities for multiple-processor environments. An X.25 NCP Packet Switching Interface is now available for use with ACF/NCP/VS. To utilize ACF/NCP/VS, the Advanced Communication Function for VTAM and TCAM is required. ACF/VTAM supports CICS/VS, IMS/VS, Power/VS, JES1/RES, JES2/RJE, TSO, VSPC, SSS, and BTP user programs. ACF/TCAM supports CICS/VS, TSO, SSS, and user programs.

The *3725 Communications Controller* consists of the Model 1 and the Model 2. It features a central control unit which operates under control of the Advanced Communications Function/Network Control Program, Emulator Program, or Partitioned Emulator Program. Main storage can range from 512K bytes to three megabytes and can be added in 256K-byte increments. It can be attached to either byte or block multiplexer or selector channels on the host processor. Up to six channel adapters are available with two adapters standard in the base frame. Four can be added via the 3726 Expansion Unit. With the optional two-processor switch feature, connection can be made to a maximum of eight processors, six of which can operate concurrently. The Maintenance and Operator Subsystem allows for host-independent maintenance. Up to 14 communication scanners and line interfaces are provided by a transmission subsystem. The scanners are microprocessor-based and can control eight Line Interface Couplers with up to 32 lines. The 3727 Operator Console provides an operator interface to the Maintenance and Operator Subsystem of the 3725.

The 3725 supports X.25, X.21, and V.35 attachment and line speeds ranging from 50 bits per second to 256K bits per second.

Model 1 consists of the 3725 Communication Controller and the 3726 Communication Controller Expansion. Up to 256 full-duplex or half-duplex lines may be attached with the Model 1 in combination with the Model 2. Up to 96 duplex lines can be attached to a Model 1, and up to 80 can be attached to a Model 2. The Model 2 is field-upgradable to the Model 1.

The 3725 now supports up to eight token-ring attachments at any one time. The IBM Cabling System allows direct attachment to the IBM Token-Ring Network.

Enhancements to the Models 1 and 2 and the 3726 Communication Controller Expansion now offer reduced Line Interface Coupler weights for lines operating in BSC, EBCDIC, or SDLC half-duplex at 14.4Kbps and for lines operating at 128Kbps with a non-switched X.24/V.11 interface. Line Interface Coupler Type 4B is now available at 256Kbps. Non-SNA Interconnection Release 4 will support the 3725 with ACF/NCP Version 4 Release 2 for the 3725 and 3720 in the MVS environment.

The Network Communications Control Facility (NCCF Version 2) executes on MVS/370 and/or MVS/XA in compatibility mode. It supports ACF/VTAM and ACF/TCAM through a network operator with facilities for controlling data communications networks. With NCCF, network operations are performed from designated 3270 terminals, which free the system console operator from network responsibilities. NCCF also provides communications and data base facilities for the collection, storage, and retrieval of network errors in support of the Network Problem Determination Application (NPDA).

SOFTWARE

OPERATING SYSTEMS: The 308X Processor Complex is supported natively by the MVS/SP and VM/SP operating systems. Any program written for the System/370 or 303X can be run on a 308X using MVS/SP or VM/SP provided the program: 1) is not time-dependent, 2) is not dependent on the mix of system facilities and peripherals in the 308X, and 3) does not depend on results or functions as defined in the System/370 Principles of Operation. The 308X is not supported natively by either DOS/VSE with or without Advanced Functions or VS1/Basic Programming Extensions (BPE). IBM indicated it will provide local programming support to the following situations: 1) DOS/VSE Systems Control Programs executing in conjunction with Release 3 of VSE/Advanced Functions programs, and 2) VS1/BPE programs, both of which are running under VM/SP on a 308X.

MVS (MULTIPLE VIRTUAL STORAGE): MVS (OS/VS2) is IBM's large-scale operating system, designed to handle multiprocessor configurations. MVS provides a

IBM 308X Series

virtual I/O (VIO) paging mechanism for temporary data sets and private virtual storage for up to 16 million bytes for individual TSO users. Workload Management Routines monitor the use of processing resources and allocate resources to jobs or time-sharing users. MVS also provides Resource-Use Routines, a set of algorithms that monitor the use of system resources and recommend scheduling changes to optimize the utilization of system resources. Deadline scheduling under JES3 dynamically alters the scheduling priority of jobs in order to meet completion deadlines. Other MVS facilities include a network job processing capability that permits the transmission of program input and output between compatible JES3 installations and recovery capabilities for multiprocessing configurations, including alternate path retry, dynamic device reconfiguration, and manual switching of peripheral devices between central processors.

Remote job entry under MVS is supported under the Job Entry Systems, JES2 and JES3. Facilities are included for multileaving transmission between the host computer and intelligent remote terminals.

MVS provides language translators for all of the System/370 programming languages: Assembler, RPG, Cobol, Fortran, PL/1, and Algol. Users of Assembler, Cobol, or Fortran, in fact, are offered a choice of two or more translators.

To improve certain performance characteristics of the MVS product, IBM introduced microcode-based enhancements such as MVS/System Extensions (MVS/SE). The availability of MVS/SE is made possible through the System/370 Extended Facility feature, standard in all 308X systems. Among its features, MVS/SE provides reduced processor time to execute certain frequently used control program functions, faster address translation by more efficient use of the translation lookaside buffer (TLB), improved system availability through storage protection, and improved system resource utilization.

MVS/System Product (MVS/SP), the next stage of MVS enhancements, is the current product targeted for use in the 308X systems. Utilizing JES2 and JES3, MVS/SP is available in two versions and several releases, which are described below.

MVS/System Product—Version 1: MVS/SP is a generic term referring to the various announced releases of MVS/SP-JES2 (5740-XYS) and MVS/SP-JES3 (5740XYN).

MVS/SP-JES2/3 Version 1 Release 1 includes all the functions of MVS/SE Releases 1 and 2 plus the following: support for the IBM 3375 and 3380 DASD operating through the 3880 Controller Models 2 or 3; support for the Data Facility/Device Support Release 1 program product (5740-AM7), which provides data management control for the 3380 DASD and 3880 controllers; support for 3278 and 3279 displays as multiple console support (MCS) consoles; and performance equivalent to a system running MVS Release 3.8 with MVS/SE Release 2.

MVS/SP-JES2/3 Version 1 Release 2 provides several enhancements over Release 1. Cross memory services offers the potential to reduce system virtual storage requirements and improve data isolation. It utilizes the microcode-assisted 3033 Extension feature on the 308X. Global resource serialization improves the Enqueue/Dequeue (ENQ/DEQ) structure, extends the function to the multiprocessor environment, and can serialize access to system resources across processor boundaries. In addition, Release 2 offers improved reliability, accessibility, and serviceability (RAS) functions; improved installation management of the paging subsystem by directing VIO pages to specific page data sets; enhanced NJE job networking facilities in MVS/SP-JES2; and support of the 3375 and 3380 DASD as spool and checkpointing devices.

MVS/SP-JES2/3 Version 1 Release 3 features the following enhancements over Release 2: support for up to 32 megabytes of addressable storage, in conjunction with the Extended Addressing feature; support for the 308X Processor Complex; performance increases of about 10 percent on uniprocessors and 12 percent on attached/multiprocessors in TSO/batch environments; improved memory management techniques; enhanced JES3 global resources to provide greater processor potential; and improved RAS, particularly to reduce the number of unscheduled IPLs.

MVS/SP-JES2/3 Version 1 Release 3.1 features support for the 3880 Storage Control Models 11 and 13, support for concurrently running multiple copies of ACF/TCAM Version 2 Release 4 in the same processor, and JES3 support for the Interactive Data Transmission Facility of TSO Extensions. Additionally, enhancements to the output writer enable a JES3 global to more effectively utilize tightly coupled processors.

MVS/SP-JES2/3 Version 1 Release 3.2 offers the following enhancement to Release 3.1: support for the MVS/Operator Communications Control Facility (MVS/OCCF), which allows one or more remote MVS systems to be operated from a user-designated MVS system.

MVS/SP-JES2/3 Version 1 Release 3.3 provides 10 new user exits, user control of SYSOUT data set grouping, and the capability to dynamically add and delete spool data sets without warmstarts.

MVS/SP-JES2/3 Version 1 Release 3.4 was announced in February 1984 as a replacement for Release 3.3. Release 3.4 provides new device support for the 3800 Model 3 Printing Subsystem in all-points-addressable mode, the 4245 Printer, 4248 Printer, 3262 Model 5 Printer when defined as a 4248, and the 3430 Magnetic Tape Subsystem. Release 3.4 also supports 308X processors with more than 32 megabytes of memory. The 3084 is supported in partitioned mode with up to 64 megabytes of memory per side. A functional subsystem (FSS) enhancement to the JES structure allows additional address spaces to be activated by the primary subsystem to provide job entry subsystem functions outside the JES2 address space. In addition, Release 3.4 includes a change in the way virtual storage is allocated for JES2 device-related control blocks. A portion of the virtual storage required for remote devices is allocated only when the remote device is signed on or started. The storage is subsequently released when the device signs off. According to IBM, this change will offer the greatest improvement to installations that have a large number of inactive remote devices. Enhancements for JES3 also include improved processor utilization in tightly coupled multiprocessor environments, improved operational interfaces, a better procedure library update facility, a new SPOOL format and architecture, increased control over job output, improved JES3 networking data transmission and header support, and five new user exits.

MVS/SP-JES2/3 Version 1 Release 3.5, announced in February 1985, provides support for the new IBM 3090 Series processors, simplifies global resource serialization processing, and provides standalone dump support for the 3480 Magnetic Tape Subsystem in full-function mode.

MVS/SP-JES2 Version 1 Release 3.6 was announced in February 1985. Release 3.6 provides virtual storage constraint relief in the JES2 private area by using the 31-bit addressing and extended private virtual storage capabilities of MVS/XA. Release 3.6 also includes SPOOL restructuring and constraint removal and improved SPOOL offload facility.

IBM 308X Series

MVS/System Product Version 2: MVS/SP Version must be installed in conjunction with the Data Facility Product. The two programs are known collectively as MVS/Extended Architecture (MVS/XA) and are designed to support the new System/370 Extended Architecture. The Data Facility Product provides data management, device support, program library management, and utility functions. MVS/XA also requires Assembler H Version 2, a functional replacement for OS Assembler H Release 5, and SMP Release 4.

MVS/SP Version 2 includes all of the functions of Version 1 Release 3 plus a number of enhancements. Version 2 supports 31-bit real and virtual storage addressing. It also supports larger and more flexible I/O configurations. Some of the I/O processing previously performed by the operating system is now performed by the 308X dynamic channel subsystem. Dynamic path selection permits a 3380 Model AA4 DASD to reconnect to any channel path identified by the originating MVS system. Improved RAS, including page protection for significant system areas, a new system trace facility, and improved dumping and formatting options are also included.

MVS/SP-JES2/3 Version 2 Release 1.1 is an enhancement to Release 1.0 that contains additional virtual storage constraint relief, serviceability features, operational improvements, and device support. Release 1.1 supports all of the functions announced for MVS/SP-JES2/3 Version 1 Releases 3.1, 3.2, and 3.3, except for support of the 3800 Model 3 Printing Subsystem. Additional Release 1.1 enhancements include improvements in system link library concatenation processing, automated dump analysis and suppression of duplicate dumps, and several RAS enhancements, including the ability to restart system management facilities (SMF) after a failure without an IPL.

MVS/SP-JES2/3 Version 2 Release 1.2 provides all of the functions of Release 1.1 plus the following enhancements: support for the 3800 Model 3 Printing Subsystem, support for the 3290 Information Panel and the 3278 Model 5 Display Station as operator consoles in JES2 environments, message-rate relief enhancements, interactive problem control system enhancements, global resource serialization improvements, auxiliary storage manager enhancements, RAS enhancements, and support for the JES2 component of MVS/SP-JES2/3 Version 1 Release 3.4.

MVS/SP-JES2/3 Version 2 Release 1.3, announced in February 1985, provides support for the Extended Recovery Facility (XRF), which increases the availability of IMS/VS Version 2 DB/DC transaction processing. XRF is described below under IMS/VS.

MVS/SP-JES2/3 Version 2 Release 1.5 was announced in February 1985. For JES2, Release 1.5 provides the same capabilities as MVS/SP-JES2 Version 1 Release 3.6, described above, as well as improved user extension services, a new user exit, and a reduction in the need for planned interruptions when parameter changes are needed. In the JES3 environment, Release 1.5 provides virtual storage constraint relief, expanded trace facilities, two new user exits, greater flexibility in coding initialization statements, and improved networking facilities.

MVS/SP-JES2/3 Version 2 Release 2 was announced in October 1986 and is scheduled to be available by third and fourth quarter 1987. The new releases are functionally equivalent with previous releases of the MVS/SP product line, but deliver a number of enhancements. MVS/XA Data Facility Product Version 2 Release 3 is a corequisite for the new operating versions. Enhancements include I/O configuration definition; new PARMLIB parameters; data in virtual; virtual storage and system constraint relief; experation data enhancement; allocations and scheduler JCL enhancements; paging and SRM enhancements; IPCS enhancements; console function; JES2/JES3; and TSO/E Release 3 support. Please refer to the "IBM Corporation MVS/370 & MSV/XA" Report on Page SW35-504MK-201 and the MVS Product Enhancement Report on Page SW35-504-218 in Volume 3 for more details about the new releases.

VIRTUAL MACHINE FACILITY/370: VM/370 is a system control program (SCP) that manages a computing system's resources (CPU, storage, and input/output devices) so that all are available to many users at the same time. Each user has at his/her disposal the functional equivalent of a real, dedicated computing system. VM/370 is designed for use on currently available 308X systems which have the Dynamic Address Translation feature and operate in the System/370 Mode. VM/370 provides virtual machines with the ability to run multiple operating systems concurrently and with a conversational time-sharing system.

VM/370 has four major elements: the control program (CP), which controls the resources of the real computer to provide multiple virtual machines; the Conversational Monitor System (CMS), a subsystem that gives users a wide range of conversational time-sharing facilities, including creation and management of files and compilation, testing, and execution of problem programs; the remote spooling communications system (RSCS), which permits users to transmit and receive files from remote stations; and the interactive problem control system (IPCS), which provides system diagnostics routines.

The Remote Spooling Communication Subsystem/Systems Network Architecture (RSCS/SNA) provided support for VM/SP Release 2 as of April 1984. RSCS/SNA Release 3 provides the ability to share printers with other SNA applications and spool VM/370 files via an SNA network to a JES2 node or to another RSCS/SNA VM/370 system.

While the VM/370 control program manages the concurrent operation of the virtual machines, one of the standard System/370 operating systems manages the work flow within each virtual machine. Because each virtual machine executes independently of other virtual machines, each one may use a different operating system, or a different release of the same operating system.

VM/System Extensions (VM/SE) is a program product that enhances the performance and functionality of VM/370. Specifically, it provides improved performance for all operating systems executing in a virtual machine environment through the resource manager function, improved performance for DOS/VS, OS/VS1, SVS, and MVS operating systems running in a virtual machine through more efficient shadow page and shadow segment table management, support of MVS/SE in a virtual machine, virtual storage preservation by locating the contents of virtual storage in user-defined virtual machines into direct access storage for system recovery measures, spooling of accounting records to disk storage instead of punched cards, and CMS processing of standard tape labels.

The *VM/System Product (VM/SP)*, which extends the capabilities of VM/370 and VM/SE, supports the 308X Series processors. VM/SP Release 1 provides a number of enhancements, including support for multiprocessor configurations; support for the 3380 DASD using the 3880 Model 2 or 3 Storage Controller as a paging, spooling, SYSRES, or minidisk device; support for the 3375 DASD; support for the 3800 Printing Subsystem as a virtual spooling device; and support for the 308X Processor Complex. Improved RAS functions include missing I/O interrupt detection, dynamic space allocation for a dump after IPL, and checkpoint limit expansion for spool files. Release 1 also provides support for MVS/SP-JES2/3 as guest operating systems. Cross memory services of Release 2 of MVS/SP are supported, and the 3033 Extensions feature is not required in this situation.

IBM 308X Series

VM/SP Release 2 contains all of the functions of Release 1 with a number of enhancements. A programmable operator support facility provides the capability to log messages, suppress messages, redirect messages, execute commands, and preprogram message responses. New CMS end-user functions include an enhanced screen capability, a full screen capability, and enhanced command capabilities. Release 2 also provides DIAL command support for remote BSC 3270 users. The maximum number of communications lines has been increased to 256. Additional enhancements include restructuring of the CMS nucleus, enhanced ASCII support for 3101 terminal users, a trace table recording facility that records a history of system operations on spool, and an enhanced query command.

In addition to the functions provided by Release 2, VM/SP Release 3 provides SQL/DS support, enhancements to CMS, CP extensions for application programs, improved VSAM support, and support for the 3290 Information Panel.

VM/SP Release 3.1 contains all of the functions of Release 3, plus installation support for VM/SP HPO Release 3.2 and a directory mapping capability.

The *VM/SP High Performance Option* is an extension to VM/SP. VM/SP HPO was issued in three releases. Release 1 provides performance enhancements for the CMS environment by supporting the segment protection extension to VMA on the 3081 Model D16. Release 2 supports the Preferred Machine Assist feature, supports all 308X models operating in the System/370 mode, and provides enhancements to facilitate transition to and from a single processor mode. Release 3 enables VM to utilize up to 32 megabytes of real memory and supports the 3880 Storage Control Model 11. VM/SP Release 1.1 is a prerequisite for VM/SP HPO Release 1 or 2, while VM/SP Release 2 is a prerequisite for VM/SP HPO Release 3.

VM/SP HPO Release 3.2 is designed to work with VM/SP Release 3, which is a prerequisite. Release 3.2 contains all of the functions currently available with VM/SP HPO Release 3.

VM/SP HPO Release 3.4, announced in February 1984, provides improvements in the number of users supported and/or reductions in response time. Release 3.4 contains an enhanced paging system that allows more efficient direct access storage device utilization by swapping virtual pages in and out of main storage in blocks. Up to 64 megabytes of real memory are supported. Release 3.4 also includes control program changes designed to reduce system overhead and serialization.

The *VM/XA Systems Facility* supersedes the VM/XA Migration Aid, which was designed to ease the conversion from MVS/SP Version 1 to MVS/XA. The VM/XA Systems Facility incorporates all of the facilities of the VM/XA Migration Aid Release 2, including concurrent support for one MVS/SP Version 1, DOS/VSE, or OS/VS1 preferred virtual machine and one or more MVS/XA test machines with test and debugging facilities. In addition, the VM/XA Systems Facility includes support for the new IBM 3090 processors and the Start Interpretive Execution (SIE) Assist feature. Dedicated support is provided for the 3880 Model 23 Storage Control, the 3380 Model AE4 and BE4 DASD units, the 3370 DASD, and the 3480 tape unit. The VM/XA Systems Facility will exploit the full dyadic capabilities of the IBM 4381-3, 3081, 3090 Model 200, 3084, and 3090 Model 400 (in partitioned mode) by enabling V = R guest operating systems to simultaneously run on both instruction processors in full dyadic mode.

Interactive Executive/370 (IX/370): IX/370 is IBM's implementation of the Unix System V operating system. Designed for the VM/SP environment, IX/370 runs as a guest under VM/SP Release 3.0 or later. IX/370 includes the following functions based on Unix System V: support for IBM and other full-duplex ASCII terminals, the Bourne shell command language, a hierarchical file system, a text processing and document preparation facility, the ability to control and track document and source code changes, and the ability to copy files to other Unix systems. In addition, IBM has added the following extensions to Unix: virtual memory support, multiple IX/370 system support, file system enhancements that allow data block sizes of 4096 bytes, extended file and logical record locking, and a full-screen editor with windowing.

PROGRAMMING LANGUAGE: Programming languages available with the 308X Series include *VS Cobol II; OS/VS Cobol compiler and library; Cobol Interactive Debug; VS Fortran Version 2 Compiler; Library; and Interactive Debug; VS Fortran Compiler and Library; Fortran IV (H Extended) Compiler; Fortran IV (G1); Fortran H Extended Optimization Enhancement; Fortran Interactive Debug; OS Fortran IV Library (MOD II); IBM Fortran Language Conversion Program; OS PL/I Optimizing Compiler and Libraries; OS/VS PL/I Checkout Compiler and the Optimizing Compiler; IBM Basic; RM Basic; a business-oriented compiler interpreter for VM/370-CMS; DOS/VSE; and SSX/VSE environments; APL2; RPG II; Assembler H Version 2, and Pascal/VS.*

DATA BASE MANAGEMENT: IBM's two major database management offerings are *Information Management System/VS-DB* and *Database 2 (DB2)*. By far, IMS/VS-DB continues to be the center of IBM's data system universe. IMS/VS Version 2 Release 1, the latest version first announced in 1985, allows IMS to operate under both MVS/XA and MVS/370. In addition to all the functions of IMS/VS Version 1, Version 2 also supports the MVS/XA *Extended Recovery Facility (XRF)*, virtual storage constraint relief for Fast Path users, improved DL/I I/O error processing, dynamic backout enhancements, DL/I scheduling changes, data sharing improvements, and several other enhancements.

XRF, a major IMS addition, is an MVS/XA and SNA enhancement designed to increase the availability of IMS/VS Version 2 DB/DC transaction processing. XRF is now included in IMS/VS Version 2 and in MVS/SP Version 2 Release 1.3 with the Availability Enhancement. XRF uses additional hardware and software to create an alternate IMS/VS Version 2 subsystem and keeps the alternate subsystem synchronized with the active subsystem. Whenever service to end users is disrupted, the alternate IMS/VS subsystem takes over the workload of the active system. XRF thus reduces the time that end users are prevented from accessing the system.

IMS lets users generate and access a database with automatic cross-referencing among data records. IMS/VS offers on-line message processing with the optional IQF (Interactive Query Facility) or GIS/VS (General Information System), and batch inquiry with GIS or GIS/VS are available. In addition, a data language (DL/1), whose function is to register user I/O coding with simpler commands to IMS, is provided.

Four primary physical data organizations are provided in IMS:

- Hierarchical Sequential Access Method (HSAM)—an extension of basic serial tape and disk file processing (SAM). This method offers limited data independence and no interrelatability of the data base through "pointers." In order to insert a data base record, the data base must be copied up to that point, the new record written, and the rest of the data base copied. Each record is physically present

IBM 308X Series

in the serial order in which it logically appears in the data base.

- Hierarchical Indexed Sequential Access Method (HISAM)—provides an imbedded hierarchy of ISAM-like data sets that are related by sets of symbolic pointers or keys. The distinguishing aspect of HISAM (or HSAM), as opposed to the hierarchical direct methods described below, is that all segments in a physical data base record are "related by physical juxtaposition." HISAM does not yield particularly good results in an on-line environment.

- Hierarchical Direct Access Method (HDAM)—stores data in a physical tree structure with all segments in a physical data base record related by direct addresses. Segments can be interrelated to each other as physical twins (multiple occurrences of the same segment type under a given parent), physical parents (segment immediately above), or physical childing (first and last occurrence of each segment type immediately subordinate) through chains of pointers. HDAM uses OSAM as a base for data storage and provides very effective access to dependent segments—especially in teleprocessing environments—at some overhead cost in terms of data base size.

- Hierarchical Indexed Direct Access Method (HIDAM) provides an ISAM index to data physically stored in OSAM format. The ISAM index contains the key of a root segment and a direct address to the root segment, while the actual storage of data is done in OSAM data sets. Because the data base index and the actual base are kept on two separate data sets, reorganization of the index separately from the data is facilitated. HIDAM is the most generally appropriate and most often used data organization method for IMS applications.

In addition to the above data structures and access methods, the basic batch-oriented version of IMS (IMS/VS-DB) can be augmented with data communications capability to produce a transaction-driven system. This is achieved by combining IMS/VS-DB with either *IMS/VS Data Communication (IMS/VS-DC)*, or *Customer Information Control System/VS (CICS/VS)*. The DB system is a prerequisite to IMS/VS-DC. The resulting full-scale IMS is known as the DB/DC system, and can handle both batch and on-line operations concurrently. A DB/DC system can have a variety of physical terminals, each of which can have one or more logical or symbolic names. Individual security parameters can be associated with each terminal's logical name.

As an alternative to IMS/VS-DC, a DB/DC system can be put together using the CICS. CICS generally provides similar functional capabilities with lower overhead in some environments. CICS was designed for relatively short program modules of about 2K to 6K bytes, while the IMS/VS-DC is better suited to 20K-byte modules or larger.

Database 2 (DB2) is IBM's relational database product that can run under either MVS/XA or MVS/370. It's designed to coexist or complement IMS/VS-DB. In addition to supporting IMS/VS, DB2 supports TSO and CICS/VS, and uses a single high-level data access language, *Structured Query Language*, to program in either high-level language or interactive mode. To simplify DASD space allocation and VSAM data set definition, DB2 uses high-level interfaces to subsystems such as VSAM. DB2 also supports disk logging and optionally available dual logging for automated recovery, and provides "help" facilities to assist all types of users. DB2 can be used to implement decision support systems and traditional applications. According to IBM, the product is particularly suited for environments in which application requirements and data structures are subject to frequent change.

DATA MANAGEMENT: IBM systems employ several data management structures to organize, access, update, retrieve, catalog, store, and generally manage data resources in addition to application packages designed for specific functions and benefits. Data management access methods may use the queued access or basic access techniques. Basic access approaches permit access of all data organizations while queued access applies only to sequential and indexed sequential data sets. Both access types use several kinds of access methods that vary in function. *VSAM (Virtual Storage Access Method)* encompasses both access techniques. VSAM uses a modified basic and queued access technique and applies to direct and sequential data sets.

Data management tools and applications that may make use of these file structures include *DB/DC Data Dictionary* and *Query Management Facility (QMF)*.

DB/DC Data Dictionary provides a central source of information describing files, databases, programs, and user-defined resources, and how they all interrelate. The Data Dictionary can help enforce naming conventions and establish a central control point particularly within organizations that permit remote locations to develop and run their own data and programs. The application can be particularly beneficial to organizations planning to convert to a DL/I data base system, according to IBM. The dictionary simplifies the entry of DL/I database definition and declaration for Cobol, PL/I, and Assembler language programs.

Query Management Facility (QMF) is an interactive data base facility designed for users with little or no processing experience. QMF operates with DB2 in MVS/XA and MVS/370 environments. In VM/370 environments, QMF works with data in SQL/DS. End-user functions handled by QMF include ad-hoc query in SQL or QBE languages, report preparation, procedure definition and execution, data preparation for graphics presentations, and definitions of a data extract that can be invoked by Data Extract, a companion IBM program.

DATA COMMUNICATIONS: Communications support under MVS is provided by the Advanced Communication Function/Telecommunications Access Method (ACF/TCAM) and Advanced Communication Function-/Virtual Telecommunications Access Method (ACF/VTAM). Other IBM cornerstone products within the communications area are CICS/OS/VS, the Transaction Processing Facility, Time Sharing Option (TSO), NetView, and other related products.

ACF/VTAM acts as an operating system for major IBM communications subsystems. It handles resource sharing and the logical handling of users requests. ACF/TCAM is a high-level access method which supports a variety of terminals and supports most applications under MVS/370, MVS/XA, and VS1.

The Customer Information Control System (CICS/OS/VS) is a general-purpose data communications monitor that operates in a single partition or region of an IBM 308X system under MVS to control multiple on-line user terminals and applications. By consolidating the required communications interfaces and I/O and control functions, CICS isolates the user's applications programs from the communications environment and, to a considerable degree, from the operating system itself.

Written in Assembler language, CICS provides transaction processing support for database management or file control programs written in Assembler, PL/1, or Cobol, thus allowing on-line applications to be developed without significantly greater difficulty than similar batch programs. In addition to supporting several external database management struc-

IBM 308X Series

tures (e.g., IMS/VS-DB's DL/1), CICS includes some native data management capabilities.

CICS/OS/VS also gives the user the ability to share network resources with other VTAM communications application programs. By using VTAM's read-ahead capabilities, and by providing a direct interface between the application program and the terminal control program, the system provides for more terminal I/O overlap. CICS/OS/VS Version 1 Release 6 provides for command-level application programs assembled with Assembler H Version 2 to use 31-bit addressing. Up to one gigabyte virtual storage requests are supported.

CICS Version 1 Release 7, announced in 1985, was released in response to IBM users who have been urging IBM to implement several major enhancements. Key improvements center around the new Resource Definition On-line (RDO) facility and an automatic installation facility for VTAM terminals. RDO makes it possible to add additional devices to a system without having to bring down the system. It also eliminates the need to reassemble the terminal control table. Additionally, users can add devices without having to define them to CICS, if they has already been defined to VTAM. This feature reduces the need for terminal definitions, the storage they consume, and the administrative and programming effort required to manage them. Under Release 7, it is also possible to define terminals and ship their definitions automatically to a CICS system, eliminating any need to define a device more than once.

Other Release 7 enhancements include improved VSAM and VTAM support, CICS monitoring enhancements, additional device support, improved task control, new command level programming languages, improved IMS/VS data base support. Other enhancements include intercommunication improvements, additional support for VS Cobol II and OS PL/I Optimizing Compiler and Libraries, simpler installation and customization, and CICS library improvements.

The Transaction Processing Facility supports realtime transaction processing applications using a centralized data base. IBM claims a system response time using the product of consistently less than two seconds, one-to-three minute system restart times, and 98.8 percent system availability within environments that operate 24 hours a day. TPF performs work, main storage, program, and data management functions.

Time Sharing Option (TSO), IBM's interactive facility, operates in large MVS/370 and MVS/XA environments. The facility allows each TSO user full access to MVS and a 16-megabyte address space through computer terminals. The facility supports a range of terminals that may be shared between TSO and other TCAM or VTAM applications. TSO is typically used by systems programmers who maintain system libraries, catalogs, and procedure libraries; application programmers working within batch, interactive, and DB/DC environments; program librarians who create, maintain, and control development support and production libraries; end user operating interactive programs, and Information Center users.

NetView is a network management licensed program composed of a number of products now available as a single offering. It includes the functions of Network Communication Control Facility (NCCF), Network Logical Data Manager (NLDM), Network Problem Determination Application (NPDA), VTAM Node Control Application (VNCA), and Network Management Productivity Facility (NMPF). NetView components include a command facility, a session monitor, a hardware monitor, a status monitor, on-line help facility, help desk facility, and browse facility. Enhanced functions available under NetView include terminal access facility support of large screen and color applications; CLISTs driven applications messages; disk log enhancements; modem support; alerts; purge attached command; Token-Ring Network support; virtual route blockage indication; session setup failure notification; extended recovery facility in MVS/XA; automatic operations and recovery; realtime update of the domain status panel; and important message indicator.

PROGRAM DEVELOPMENT: IBM offers many tools to help programmers, end users, and various "knowledge workers" develop and maintain applications. IBM packages include Application Prototype Environment, the Screen Definition Facility/Customer Information Control System, Cross System Product Set, Cross System Product/Application Development, and Cross System Product/Application Execution, IMS Application Development Facility II, Query Management Facility, Time Sharing Option, TSO Extensions, Conversional Monitor System, and Interactive System Productivity Facility.

The Interactive System Productivity Facility (ISPF) Version 2.1.2 for MVS is a common dialog manager for IBM licensed programs and application development. Capabilities include support of an ISPF/GDDM environment, extensions to the table services, an interface to TSO Extensions Release 2, and support for the 3290 terminal. Version 2.1.2 uses 31-bit addressing mode and includes APL2 support.

The Interactive System Productivity Facility/Program Development Facility (ISPF/PDF) Version 2.1.2 for MVS is used to create and maintain both source programs and text data. ISPF/PDF provides interfaces to many system facilities through the use of menus which relieve the user of the need to know the specific command syntax of the interactive system being used. Version 2.1.2 uses 31-bit addressing mode and supports the Kanji language. Both ISPF and ISPF/PDF provide virtual storage constraint relief (VSCR) and allow growth of ISPF and ISPF/PDF by using the extended address space of MVS/XA.

UTILITIES: Common IBM utilities include the IMS/VS Queue Loader, IMS/VS Message Requeuer, DFSORT (Data Facility Sort), and DOS/VS Sort/Merge.

OTHER SOFTWARE: IBM offers a number of resource management tools for users who want to better monitor peripherals and operate them more efficiently. Products that help users do this include the Data Facilities Products, MVS/XA DFP Version 2 and MVS/370 DFP, the Data Facilities Hierarchical Storage Manager (DFHSM), and the Direct Access Storage Device Migration Aid.

The Data Facility Products, MVS/XA DFP Version 2 and MVS/370 DFP, handle a number of data management functions in addition to device support, program library management, catalog support, and utility functions. Major features include space allocation for tape and disk volumes, storing, naming, and cataloging data sets, and transfer of data between real and auxiliary storage devices. DFP supports 3330/3333, 3340, 3344, 3350, 3375, and 3380 DASDs, 3880 cache storage control, 3800 Printing Subsystem, 3480 Magnetic Tape Subsystem, 3430 Magnetic Tape Subsystem, and 4245, 4248, and 3262 Model 5 impact printers.

The Data Facilities Hierarchical Storage Manager (DFHSM) is a program designed to make the best use of storage devices, using costs, capacities, and the importance of the data being manipulated as its major operating criteria. In typical operations, DFHSM will allocate active data sets to fast-access devices, such as DASDs, and moves less active data sets to less costly media such as 3480 or 3420 magnetic tape devices, or 3850 Mass Storage Subsystem or other DASDs. DFHSM provides data backup support, recovery, automatic deletion, data conversion, and compaction.

IBM 308X Series

The Direct Access Storage Device Migration Aid automatically handles much of the programming required to move data from one device to another. The program recommends new blocking factors, generates control statements for utilities to move data, and identifies all affected Job Control Language statements and produces jobstreams to update them.

PRICING AND SUPPORT

POLICY: The IBM Agreement for Lease or Rental of IBM Machines defines four usage plans by which monthly charges are determined. IBM assigns each machine to one of these four plans.

Plan A provides the customer with up to 176 hours of billable time per month. Time used in excess of that amount is charged at an hourly rate that is 1/176th of the Monthly Rental Charge (MRC) multiplied by the Additional Use Charge Percent (usually 10 percent).

Plan B includes unlimited usage of the unit in the Monthly Rental Charge or Monthly Lease Charge.

Plan C monthly charges are determined by multiplying the amount of processing performed by the machine (not the time in use) by the Monthly Use Charge specified for the particular unit. The processing is measured by a meter attached to the unit. The monthly charges include all equipment maintenance, insurance charges, and property taxes.

Plan D is a monthly rental charge which includes complete maintenance coverage for 7 days per week, 24 hours per day. After the first three months, this charge includes all parts and on-site maintenance during prime-time Monday through Friday for 9 hours selected by the customer between 7:00 a.m. and 6:00 p.m. There is an option for additional coverage.

The most significant change brought about by the agreement was the ability to include equipment with differing lease terms on a single lease contract and the special long-term lease plans that had been offered under several amendments to the previous lease agreement. Specifically, the Extended Term Plan (ETP), Fixed Term Plan (FTP), Term Lease Plan (TLP), and Alternate Term Plan (ATP) were discontinued. However, the new agreement permits lease terms similar to those of the discontinued plans to be routinely implemented. Customers with existing term plan agreements can continue with those contracts and extend them in accordance with their provisions. IBM has stipulated final termination dates beyond which none of these discontinued plans may be extended. These dates are listed below.

Extended Term Plan	April 3, 1980
Fixed Term Plan	April 3, 1981
Term Lease Plan	April 3, 1982
Alternate Term Plan	April 3, 1983

Customers having no new agreement after these dates will revert to the Monthly Availability Charge under the previous lease agreement.

In August 1974, IBM extended its Purchase Option Plan to allow users renting under the Monthly Availability Charge (MAC), Extended Term Plan (ETP), and Fixed Term Plan (FTP) to accumulate up to 36 months of purchase option credits toward the purchase of the equipment. The total amount accrued cannot exceed 50 percent of the purchase price of the equipment at the date of purchase. The 48-month Term Lease Plan also permits the accumulation of purchase credits through 48 months to a maximum of 50 percent of the purchase price. Previously, the Monthly Availability Charge contract permitted accumulation of up to 12 months of purchase option credits, and the Fixed Term Plan and Extended Term Plan included provision for accumulation of up to 24 months of purchase option credits. Under terms of the new lease agreement, users purchasing their rented or leased systems may apply between 50 and 60 percent of the accumulated monthly charges to the purchase price. The specific percentage allowed is dependent upon the equipment.

SUPPORT: IBM offers both contract and on-call maintenance support. The basic monthly maintenance charge includes any period of 9 consecutive hours between 7:00 a.m. and 6:00 p.m., Monday through Friday. Customers may also purchase extended maintenance coverage that includes 12-, 16-, 20-, or 24-hour coverage on weekdays, Saturdays, Sundays, and holidays. A premium is also charged for 9-hour, 5-day maintenance in which the 9-consecutive-hours period falls outside the 7:00 a.m. to 6:00 p.m. limits.

For users without a maintenance contract, the 308X Series is maintained under per-call class 3. Under this class, the per-call charge during regular hours is $218 per hour and the per-call charge during off hours is $250 per hour.

Software support comes in several forms which are described in the following paragraphs.

IBM has five designations for its software products: System Control Programs (SCP), Program Products (PP), Application Programs (PPA), Field Developed Programs (FDP), and Installed User Programs (IUP).

System Control Programs provide those functions which are fundamental to the operation and maintenance of a system (e.g., loader, scheduler, supervisor, and data management) and include the MVS and VM/370 operating systems. SCPs are provided to IBM customers at no charge and to non-IBM customers for nominal distribution costs (namely, the cost of the media and a duplication charge). IBM customers also receive full IBM software support, which includes all updates, temporary fixes, and generally all enhancements to the software packages. All other IBM software is separately priced.

SCPs are modified by Selectable Units (SUs), which are microcode packages that implement the same types of enhancements that were formerly provided by subsequent releases of software packages. At present, SUs are also provided at no charge, but only to IBM customers with the appropriate equipment.

In addition, basic monthly charges have been established for maintenance of the IBM system control programs and other licensed program products. The minimum term of agreement is one year. Customers with multiple systems will have a choice as to how they can have local programming support handled at their locations. Users who have IBM perform local program support at all computer sites pay the Basic Monthly License fee for all locations. Users who decide, however, to control the installation and support of designated licensed programs from a central site, pay the Basic License Fee at the central site and a Distributed Systems License Option (DSLO) monthly fee for all other locations. The DSLO rates are lower than the basic monthly support charges.

Support charges for the systems software products described in this report are listed at the end of the equipment price list. Local programming support charges have been discontinued.

Program Products include all language processors, communications support programs, and utility programs, and are

IBM 308X Series

licensed separately. Application Programs (PPAs) are problem- and industry-oriented software packages that are also licensed separately, including full support. Also available on an individual-charge basis, but without centralized IBM programming support, are numerous Field-Developed Programs and Installed User Programs for the 308X Series.

The centralized IBM Support Center provides 24-hour, 7-day customer access by telephone (an 800 number is provided). It utilizes the Software Support Facility data base, which incorporates every problem encountered and resolved (or unresolved) by the central support group. The customer is assisted in making out any APAR (program problem report), and gets advice on temporary fixes or bypasses.

The Support Center is the first level of support. If it cannot resolve a problem, the customer is put in touch with the Change Team Support Specialist, who is directly familiar with the section of coding relating to the problem being reported. If, after working with this individual, the problem still cannot be resolved, the PSR (Program Support Representative) from the customer's local office will be dispatched to assist. Under the new support plan, many of the facilities that were previously provided by IBM support personnel at no charge have become billable activities.

EDUCATION: IBM "Professional Courses" are individually priced. System Features Instruction is offered to users of IBM data processing equipment at no charge. Customer Executive Seminars, Industry Seminars, and promotional sessions are still offered at no charge by IBM invitation.

TYPICAL CONFIGURATION: The following systems illustrate possible 308X configurations. They include all the necessary control units and adapters, but do not include any specialized software.

SMALL CONFIGURATION:

IBM 3083 Model CX0 Processor basic 8-megabyte complex	$605,000
3082 Processor Controller Model X8 (8 channels)	145,000
3087 Coolant Distribution Unit Model 1	50,000
3089 Power Unit	38,000
Two 3278-2A System Consoles	4,008
Two 4641 Keyboards	1,454
One 3375 DASD Model A1; (819.7 megabytes)	24,730
One 3375 DASD Model B1 (819.7 megabytes)	18,700
3880 Model 2 Controller	60,270
One 3380 DASD Model AE4 (5.04 gigabytes)	122,480
One 3380 Model BE4	98,140
One 3880 Model 3 Controller	60,270
One A11 Cartridge Tape Controller	49,080
Two B11 Cartridge Tape Units (two drives per unit)	77,620
Four 2511 Automatic Cartridge Loaders	35,600
12 Model 3178 Model C30 display terminals (1920 characters each with 87-key keyboard and numeric pad)	13,140
One 3274-41C Cluster Controller	13,840
One 3701 External Modem Interface	337
One 6303 High Performance Communications Adapter	1,010
One 4245 Model 20 Impact Printer (2000 lpm)	35,000
TOTAL PURCHASE PRICE:	$1,453,679

MEDIUM CONFIGURATION:

IBM 3081 Model GX3 Processor; basic 32-megabyte complex	$1,965,000
3082 Processor Controller Model X16 (16 channels)	195,000
3087 Coolant Distribution Unit Model 1	50,000
3089 Power Unit	38,000
Three 3278-2A System Consoles	6,012
Three 4641 Keyboards	2,181
One 3375 DASD Model A1 (819.7 megabytes)	24,730
Three 3375 DASD Model B1s (819.7 megabytes per unit)	56,100
One 3880 Model 2 Controller	60,270
One 3380 DASD Model AE4 (5.04 gigabytes)	122,480
Three 3380 Model BE4s	294,420
One 3880 Model 3 Controller	60,270
One A22 Cartridge Tape Controller	65,430
Two B22 Cartridge Tape Units (two drives per unit)	86,240
Four 2511 Automatic Cartridge Loaders	35,600
30 Model 3278-3 display terminals (2560 char. each)	51,480
One 3274-41C Cluster Controller	13,840
One 3701 External Modem Interface	337
One 6303 High Performance Communications Adapter	1,010
One 3800 Model 3 Printing Subsystem	330,750
One 4245 Model 20 Impact Printer (2000 lpm)	35,000
TOTAL PURCHASE PRICE:	$3,494,150

LARGE CONFIGURATION:

IBM 3084 Model QXC Processor; 128-megabyte complex	$4,845,000
3082 Processor Controller Model X48 (48 channels)	490,000
Two 3087 Coolant Distribution Units Model 1	100,000
Two 3089 Power Units	76,000
Three 3278-2A System Consoles	6,012
Three 4641 Keyboards	2,181
Two 3380 DASD Model AE4s (5.04 gigabytes per unit)	244,960
Six 3380 Model BE4s	588,840
Two 3880 Model 3 Controllers	120,540
Two A22 Cartridge Tape Controllers	130,860
Eight B22 Cartridge Tape Units (two drives per unit)	344,960
Sixteen 2511 Automatic Cartridge Loaders	142,400
One 3211 Control Unit Coupler	4,045
90 Model 3278-5 display terminals (3564 char. each)	185,400
Three 3274-41C Cluster Controllers	41,520
Three 3701 External Modem Interfaces	1,011
Three 6303 High Performance Communications Adapters	3,030
One 3800 Model 3 Printing Subsystem	330,750
Two 4248 Model 2 Impact Printers (4000 lpm)	150,000
Two 3751 features (36 additional print positions; plant installed)	20,000
TOTAL PURCHASE PRICE:	$7,827,509

IBM 308X Series

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (4-Year Lease)* ($)
PROCESSORS & FEATURES					
3083CX	Processor Complex; includes one CPU, buffer storage unit, 8 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and a 3278-2A System Console:				
	Model CX0; 8,388,608 bytes	605,000	1,445.00	60,370	48,300
	Model CX1; 16,777,216 bytes	685,000	1,770.00	69,810	53,850
	Model CX2; 25,165,824 bytes	765,000	2,095.00	79,270	63,420
	Model CX3; 33,554,432 bytes	845,000	2,420.00	88,720	70,980
3083EX	Processor Complex; includes one CPU, buffer storage unit, 8 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model EX0; 8,388,608 bytes	655,000	1,870.00	63,550	50,840
	Model EX1; 16,777,216 bytes	735,000	2,195.00	72,990	58,390
	Model EX2; 25,165,824 bytes	815,000	2,520.00	82,450	65,960
	Model EX3; 33,554,432 bytes	895,000	2,845.00	91,900	73,520
3083BX	Processor Complex; includes one CPU, buffer storage unit, 8 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model BX0; 8,388,608 bytes	930,000	2,170.00	101,750	81,410
	Model BX1; 16,777,216 bytes	1,010,000	2,495.00	111,200	88,970
	Model BX2; 25,165,824 bytes	1,090,000	2,820.00	120,650	96,530
	Model BX3; 33,554,432 bytes	1,170,000	3,145.00	130,100	104,100
3083JX	Processor Complex; includes one CPU, buffer storage unit, 8 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model JX0; 8,388,608 bytes	1,180,000	2,720.00	134,800	107,800
	Model JX1; 16,777,216 bytes	1,260,000	3,045.00	144,250	115,350
	Model JX2; 25,165,824 bytes	1,340,000	3,370.00	153,600	122,850
	Model JX3; 33,554,432 bytes	1,420,000	3,695.00	163,000	130,400
3081GX	Processor Complex; includes two CPUs, two 32K-byte buffer storage units, 16 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Unit or other appropriate power source, and 3278-2A System Console:				
	Model GX1; 16,777,216 bytes	1,805,000	3,255.00	187,750	150,200
	Model GX2; 25,165,824 bytes	1,885,000	3,580.00	197,150	157,700
	Model GX3; 33,554,432 bytes	1,965,000	3,905.00	206,650	165,300
	Model GX4; 50,331,648 bytes	2,125,000	4,555.00	225,550	180,450
	Model GX6; 67,108,864 bytes	2,285,000	5,205.00	244,450	195,550
3081KX	Processor Complex; includes two CPUs, two 64K-byte buffer storage units, 16 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model KX1; 16,777,216 bytes	2,105,000	3,715.00	231,750	185,400
	Model KX2; 25,165,824 bytes	2,185,000	4,040.00	241,200	192,900
	Model KX3; 33,554,432 bytes	2,265,000	4,365.00	250,600	200,500
	Model KX4; 50,331,648 bytes	2,425,000	5,015.00	269,550	215,650
	Model KX6; 67,108,864 bytes	2,585,000	5,665.00	288,500	230,750
3084QX	Processor Complex; includes four CPUs, four 64K-byte buffer storage unit, 48 integrated channels, and main memory as specified; requires 3081K to 3084 Upgrade, 3082 Model Q48 Processor Controller, two 3087 Coolant Distribution Units, two 3089 Power Units or other appropriate power source, and two 3278-2A System Consoles:				
	Model QX3; 33,554,432 bytes	3,885,000	7,090.00	473,900	379,100
	Model QX4; 50,331,648 bytes	4,045,000	7,740.00	492,850	394,250
	Model QX6; 67,108,864 bytes	4,205,000	8,390.00	511,700	409,350
	Model QX9; 100,663,296 bytes	4,525,000	9,690.00	549,550	439,650
	Model QXC; 134,217,728 bytes	4,845,000	10,990.00	587,300	469,850

**Includes equipment maintenance.*
***Four-year lease.*
NC—No charge.

IBM 308X Series

ADDITIONAL 308X HARDWARE		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (4-Year Lease)* ($)
3082	Processor Controller; supports Processor Complex with number of channels specified:				
	Model X8; 8 channels	145,000	735.00	7,790	6,235
	Model X16; 16 channels	195,000	785.00	10,080	8,060
	Model X24; 24 channels	245,000	835.00	12,380	9,910
	Model X48; 48 channels	490,000	1,670.00	24,780	19,820
1545	First additional channel group for 3083EX, BX, and JX; includes eight block multiplexer channels	80,000	95.00	4,288	3,430
1550	Additional channel group for 3081 or 3083BX and JX; includes eight block multiplexer channels	80,000	95.00	4,288	3,430
	Channel-to-Channel Adapter; for 3082:				
1850	First unit	15,000	40.00	685	550
1851	Second unit	5,000	25.00	227	182
1852	Third unit; B side	15,000	40.00	685	550
1853	Fourth unit; B side	5,000	25	228	182
4650	I/O Power Sequence Control	4,000	2.00	182	145
4651	I/O Power Sequence Control; B side	4,000	2.00	182	145
3278 2A	Display Console CRT	2,004	19.00	160	136
4641	75-Key Keyboard	727	5.50	60	51
3087	Coolant Distribution Unit:				
	Model 1	50,000	65.00	2,740	2,190
	Model 2	72,000	65.00	4,060	3,250
3089	Power Unit:				
	Model 1	38,000	74.50	1,580	1,260
	Model 2	38,000	90.00	3,415	—
3088	Multisystem Channel Communication Unit:				
	Model 1; connects to 4 processors	95,000	128.00	—	—
	Model 2; connects to 8 processors	145,000	160.00	—	—
	3088 Upgrade:				
	Model 1 to Model 2	55,000	—	—	—
SYSTEM UPGRADES					
	3083 CX0 to 3083 CX1	80,000	—	—	—
	3083 CX0 to 3083 CX2	160,000	—	—	—
	3083 CX0 to 3083 CX3	240,000	—	—	—
	3083 CX1 to 3083 CX2	80,000	—	—	—
	3083 CX1 to 3083 CX3	160,000	—	—	—
	3083 CX2 to 3083 CX3	80,000	—	—	—
	3083 EX0 to 3083 EX1	80,000	—	—	—
	3083 EX0 to 3083 EX2	160,000	—	—	—
	3083 EX0 to 3083 EX3	240,000	—	—	—
	3083 EX1 to 3083 EX2	80,000	—	—	—
	3083 EX1 to 3083 EX3	160,000	—	—	—
	3083 EX2 to 3083 EX3	80,000	—	—	—
	3083 BX0 to 3083 BX1	80,000	—	—	—
	3083 BX0 to 3083 BX2	160,000	—	—	—
	3083 BX0 to 3083 BX3	240,000	—	—	—
	3083 BX1 to 3083 BX2	80,000	—	—	—
	3083 BX1 to 3083 BX3	160,000	—	—	—
	3083 BX2 to 3083 BX3	80,000	—	—	—
	3083 JX0 to 3083 JX1	80,000	—	—	—
	3083 JX0 to 3083 JX2	160,000	—	—	—
	3083 JX0 to 3083 JX3	240,000	—	—	—
	3083 JX1 to 3083 JX2	80,000	—	—	—
	3083 JX1 to 3083 JX3	160,000	—	—	—
	3083 JX2 to 3083 JX3	80,000	—	—	—
	3081 GX1 to 3081 GX2	80,000	—	—	—
	3081 GX1 to 3081 GX3	160,000	—	—	—
	3081 GX1 to 3081 GX4	320,000	—	—	—
	3081 GX1 to 3081 GX6	480,000	—	—	—
	3081 GX2 to 3081 GX3	80,000	—	—	—

**Includes equipment maintenance.*
***Four-year lease.*
NC—No charge.

IBM 308X Series

SYSTEM UPGRADES (Continued)

	Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (4-Year Lease)* ($)
3081 GX2 to 3081 GX4	240,000	—	—	—
3081 GX2 to 3081 GX6	400,000	—	—	—
3081 GX3 to 3081 GX4	160,000	—	—	—
3081 GX3 to 3081 GX6	320,000	—	—	—
3081 GX4 to 3081 GX6	160,000	—	—	—
3081 KX1 to 3081 KX2	80,000	—	—	—
3081 KX1 to 3081 KX3	160,000	—	—	—
3081 KX1 to 3081 KX4	320,000	—	—	—
3081 KX1 to 3081 KX6	480,000	—	—	—
3081 KX2 to 3081 KX3	80,000	—	—	—
3081 KX2 to 3081 KX4	240,000	—	—	—
3081 KX2 to 3081 KX6	400,000	—	—	—
3081 KX3 to 3081 KX4	160,000	—	—	—
3081 KX3 to 3081 KX6	320,000	—	—	—
3081 KX4 to 3081 KX6	160,000	—	—	—
3084 QX3 to 3084 QX4	160,000	—	—	—
3084 QX3 to 3084 QX6	320,000	—	—	—
3084 QX3 to 3084 QX9	640,000	—	—	—
3084 QX3 to 3084 QXC	960,000	—	—	—
3084 QX4 to 3084 QX6	160,000	—	—	—
3084 QX4 to 3084 QX9	480,000	—	—	—
3084 QX4 to 3084 QXC	800,000	—	—	—
3084 QX6 to 3084 QX9	320,000	—	—	—
3084 QX6 to 3084 QXC	640,000	—	—	—
3084 QX9 to 3084 QXC	320,000	—	—	—
3083 EX to 3083 BX (no change in storage size)	270,000	—	—	—
3083 BX to 3083 JX (no change in storage size)	250,000	—	—	—
3083 BX to 3081 GX (no change in storage size; requires feature 1545 and 16MB of memory in the 3083)	715,000	—	—	—
3083 JX to 3081 KX (no change in storage size; requires feature 1545 and 16MB of memory in the 3083)	765,000	—	—	—
3081 GX to 3081 KX (no change in storage size)	300,000	—	—	—
3081 KX1 to 3084 QX3 (feature 1550 is required in the 3081)	1,700,000	—	—	—
3081 KX2 to 3084 QX4 (feature 1550 is required in the 3081)	1,780,000	—	—	—
3081 KX3 to 3084 QX6 (feature 1550 is required in the 3081)	1,860,000	—	—	—
3081 KX4 to 3084 QX9 (feature 1550 is required in the 3081)	2,020,000	—	—	—
3081 KX6 to 3084 QXC (feature 1550 is required in the 3081)	2,180,000	—	—	—
3082 X8 to 3082 X16	50,000	—	—	—
3082 X8 to 3082 X24	100,000	—	—	—
3082 X16 to 3082 X24	50,000	—	—	—
3082 X16 to 3082 X48	295,000	—	—	—
3082 X24 to 3082 X48	245,000	—	—	—

Mass Storage

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
3350	Direct Access Storage; 317.5MB per drive:				
	Model A2; Dual Disk Drive	32,030	190.00	2,491	2,120
	Model A2F; Dual Disk Drive with 2MB fixed-head storage	39,970	246.00	3,108	2,645
	Model B2; Add-on Dual Disk Drive	25,360	143.00	1,980	1,685
	Model B2F; Add-on Dual Disk Drive for 2MB fixed-head storage per drive	33,300	200.00	2,597	2,210
	Model C2; Two-drive disk storage and associated control	33,130	200.00	2,597	2,210
	Model C2F; Two-drive disk storage and associated control	41,070	257.00	3,208	2,730
	1320 Primary Controller Adapter (permits selection of A2/AF controller as on-line controller via manual switch on the C2/C2F)	220	1.50	18	15
	8150 String Switch for 3350 A2, A2F, C2, C2F	3,690	9.50	304	259
3370	Direct Access Storage:				
	Model A1; Single Disk Drive; 571.3MB	35,480	173.00	1,851	1,575
	Model B1; Add-on Single Disk Drive for attachment to Model A1	26,600	129.00	1,387	1,180
	Model A2; 729.8MB; contains logic and power for up to three Model B2 units	35,480	134.00	2,190	—
	Model B2; connects to a 3370 Model A2	26,600	101.00	1,640	—
	8150 String Switch for 3370 A1	3,830	1.50	181	154

**Includes equipment maintenance.*
***Four-year lease.*
NC—No charge.

IBM 308X Series

Mass Storage (Continued)		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
3375	Direct Access Storage; 819.7MB per drive:				
	Model A1; contains logic and power for up to three Model B1 units	24,730	144.00	1,851	1,575
	Model B1; connects to a 3375 Model A1	18,700	109.00	1,486	1,265
	Model D1; provides dual controller function in a 3375 string; requires one Model A1 and two Model B1s	23,590	133.00	1,763	1,500
	4951 Model D1 Attachment for Model A1	2,590	6.00	112	95
	4952 Model D1 Attachment for Model B1	NC	NC	NC	NC
	8150 String Switch Feature for 3375 A1	3,795	1.50	199	169
	3375 Model B1 to D1 Upgrade	7,520	—	—	—
3380	Direct Access Storage:				
	Model A4; 2.52 billion bytes of storage; connects to one 3880 storage director	77,680	285.00	5,305	4,515
	Model AA4; 2.52 billion bytes of storage; connects to two 3880 storage directors	88,780	325.00	6,057	5,155
	Model B4; connects to a Model A4 or AA4 unit	64,440	240.00	4,400	3,745
	Model AD4; 2.52 billion bytes per unit; connects to two 3880 storage directors	88,780	295.00	5,105	—
	Model BD4; connects to a Model AD4 or AE4 unit	64,440	215.00	3,715	—
	Model AE4; 5.04 billion bytes per unit; connects to two 3880 storage directors	122,480	295.00	7,590	—
	Model BE4; connects to a Model AE4 or AD4 unit	98,140	215.00	6,190	—
3880	Storage Control; includes two storage directors:				
	Model 1; each storage director can attach up to four 3350 A2/A2F, or 3375 A1 or D1 in any combination	60,270	176.00	4,124	3,510
	Model 2; provides one storage director for 3350 or 3375 storage and one for 3380 storage	60,270	176.00	4,124	3,510
	Model 3; provides two storage directors for 3380 storage	60,270	176.00	4,124	3,510
	Model 4; provides one storage director which can attach up to four 3375 Model A1s	30,000	82.50	2,370	—
	Model E21; same as D21, but with 16 megabytes	165,400	600.00	11,300	—
	Model G21; same as D21, but with 32 megabytes	237,400	650.00	15,970	—
	Model H21; same as D21, but with 48 megabytes	309,400	700.00	20,640	—
	Model J21; same as D21, but with 64 megabytes	381,400	750.00	25,310	—
	Model D23; connects to 3380 to form cache/DASD subsystem; 8 megabytes (re quires 8170)	129,400	575.00	8,965	—
	Model E23; same as D23, but with 16 megabytes	165,400	600.00	11,300	—
	Model G23; same as D23, but with 32 megabytes	237,400	650.00	15,970	—
	Model H23; same as D23, but with 48 megabytes	309,400	700.00	20,640	—
	Model J23; same as D23, but with 64 megabytes	381,400	750.00	25,310	—
	3380 Model Upgrades:				
	Model AD4 to AE4	43,660	—	—	—
	Model BD4 to BE4	43,660	—	—	—
	3880 Model Upgrades:				
	Model 1 to Model D21	69,130	—	—	—
	Model 1 to Model E21	105,130	—	—	—
	Model 1 to Model G21	177,130	—	—	—
	Model 1 to Model H21	249,130	—	—	—
	Model 1 to Model J21	321,130	—	—	—
	Model G21 to Model H21	72,000	—	—	—
	Model G21 to Model J21	144,000	—	—	—
	Model H21 to Model J21	72,000	—	—	—
	Model 3 to Model D23	69,130	—	—	—
	Model 3 to Model E23	105,130	—	—	—
	Model 3 to Model G23	177,130	—	—	—
	Model 3 to Model H23	249,130	—	—	—
	Model 3 to Model J23	321,130	—	—	—
	Model E23 to Model G23	72,000	—	—	—
	Model E23 to Model H23	144,000	—	—	—
	Model E23 to Model J23	216,000	—	—	—
	Model G23 to Model H23	72,000	—	—	—
	Model G23 to Model J23	144,000	—	—	—
	Model H23 to Model J23	72,000	—	—	—
	6148 Remote Switch Attachment	NC	NC	NC	NC
	6149 Remote Switch Attachment, Additional	NC	NC	NC	NC
	6150 Remote Switch Attachment for Eight-Channel Switch	NC	NC	NC	NC
	6550 Speed Matching Buffer for 3380	9,705	40.00	597	508
	6560 Speed Matching Buffer	11,420	40	518	441
	8160 Two Channel Switch	3,580	5	241	—
	8170 Two-Channel Switch Pair	6,225	11.00	421	358
	8171 Two-Channel Switch Pair, Additional	16,610	38.50	1,136	967
	8172 Eight-Channel Switch	22,850	53.50	1,563	1,330

**Includes equipment maintenance.*
***Four-year lease.*
NC—No charge.

IBM 308X Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
MAGNETIC TAPE EQUIPMENT					
3420	Magnetic Tape Units:				
	Model 3; 120,000 bytes/sec. at 1600 bpi; 75 ips	11,930	248.00	768	645
	Model 4; 470,000 bytes/sec. at 6250 bpi; 75 ips	15,340	248.00	1,075	903
	Model 5; 200,000 bytes/sec. at 1600 bpi; 125 ips	16,000	272.00	1,035	869
	Model 6; 780,000 bytes/sec. at 6250 bpi; 125 ips	17,920	272.00	1,235	1,037
	Model 7; 320,000 bytes/sec. at 1600 bpi; 200 ips	17,920	326.00	1,225	1,029
	Model 8; 1250 bytes/sec. at 6250 bpi; 200 ips	19,880	401.00	1,465	1,231
	6420 6250 bpi Density Feature (for 3420 Models 4, 6, and 8)	1,600	74.00	103	87
	6425 6250/1600 bpi Density Feature (for 3420 Models 4, 6, and 8)	2,205	99.00	151	127
	6631 Single Density Feature (for Models 3, 5, and 7)	2,870	74.00	177	149
	3550 Dual Density Feature (for Models 3, 5, and 7)	3,705	124.00	231	194
	6407 7-Track Feature (for Models 3, 5, and 7)	2,870	107.00	177	149
3803	Tape Controller:				
	Model 1; for 3420 Model 3, 5, and 7 drives	20,680	158.00	1,335	1,121
	Model 2; for 3420 Model 3 through 8 drives	27,550	218.00	1,945	1,634
	5310 9-Track NRZI Feature (permits connection of 800-bpi drives to 3803-2)	3,080	2.00	186	156
	6320 7-Track NRZI Feature (permits connection of 800-bpi drives to 3803-2; 5310 is prerequisite)	1,515	2.00	92	77
	Multiple Tape Control Switches (for switching up to sixteen 3420 tape drives between up to four 3803 control units):				
	1792 For 2 Tape Controls	6,130	15.00	388	326
	1793 For 3 Tape Controls	7,820	25.00	504	423
	1794 For 4 Tape Controls	9,195	25.00	590	496
	3551 Dual Density Feature (for 3803-1)	2,300	3.50	139	117
	6148 Remote Switch Attachment	910	—	55	46
	6408 7-Track Feature (for 3803-1)	2,300	3.50	139	117
	8100 Two-Channel Switch	4,600	6.50	288	242
3422	Magnetic Tape Subsystem				
	Model A1 Control Unit	36,800	440.00	2,460	—
	Model B1 Magnetic Tape Unit	17,900	181.00	1,165	—
	3005 Two Channel Switch	3,250	4.00	183	—
	3010 Two-Control Unit Switch; primary	7,350	20.00	425	—
	3015 Two-Control Unit Switch, Secondary	5,250	20.00	310	—
	3020 Data Streaming	1,575	35.00	122	—
3430	Magnetic Tape Subsystem				
	Model A1; Tape Unit and Control	33,400	251.00	2,575	—
	Model B1; Tape Unit Only	16,900	176.00	1,365	—
4991	Multi-drive Attachment	600	5.00	46	—
3480	Model A11 Tape Controller	49,080	355.00	2,810	—
	Model B11 Tape Unit	38,810	220.00	2,160	—
	Model A22 Tape Controller	65,430	423.00	4,605	—
	Model B22 Magnetic Tape Unit	43,120	264.00	3,015	—
	1511 Channel Attachment, First	5,785	21.00	357	—
	1512 Channel Attachment, Second	5,785	21.00	357	—
	1513 Channel Attachment, Third	5,785	21.00	357	—
	2511 Automatic Cartridge Loader	8,900	40	485	—
	3211 A11/A22 Control Unit Coupler	4,045	—	—	—
	3480 Upgrades:				
	Model A11 to Model A22; 3201 required for conversion to Model A22	14,000	—	—	—
	Model B11 to Model B22	11,000	—	—	—
PUNCHED CARD EQUIPMENT					
3505	Card Reader:				
	Model B1; 800 cpm	36,030	328.00	1,600	—
	Model B2; 1200 cpm	37,270	449.00	1,890	—
	3921 51/80-Column Interchange	6,370	130.00	316	—
	5450 Optical Mark Read	10,130	120.00	473	—
	6555 Selective Stacker	2,845	16.00	119	—
	8103 3525 Punch Adapter	6,370	8.00	279	—
	8105 3525 Read/Punch Adapter	7,010	11.00	350	—
	8100 3525 Card Print Control	3,810	11.00	152	—

**Includes equipment maintenance.*
***Four-year lease.*
NC—No charge.

IBM 308X Series

	PUNCHED CARD EQUIPMENT (Continued)	Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
3525	Card Punch:				
	Model P1; 100 cpm	25,520	222.00	1,135	—
	Model P2; 200 cpm	26,520	301.00	1,435	—
	Model P3; 300 cpm	27,520	376.00	1,725	—
	1533 Card Read Feature	7,645	56.00	335	—
	1421 Basic Card Print	16,750	221.00	737	—
	5273 Multi-Line Card Print	1,365	64.00	196	—
	8339 Two-Line Card Print	874	8.00	29	—
	PRINTERS				
	IBM 3262				
Model 1	Band printer; 252 to 650 lpm	15,040	202.50	806	686
Model 2	Band printer; 252 to 650 lpm	15,040	202.50	806	686
Model 3	Band printer; 252 to 650 lpm	15,040	202.50	806	686
Model 5	Band printer; 252 to 650 lpm	17,000	202.50	1,117	951
5450	OCR Feature	3,990	42.00	149	127
1090	Audible Alarm	201	—	6	5
	IBM 3800				
Model 3	High-speed laser printer; prints up to 215 pages per minute (ppm)	330,750	776	16,520	—
Model 6	High-speed laser printer; prints up to 134 ppm	175,000			
1010	Accumulator	21,250	138	1,060	—
1021	Accumulator Expansion	5,445	42	270	—
1490	Burster-Trimmer-Stacker	52,500	372	2,630	2,020
5401	127 Writable Character Generator Storage Positions (Additional)	4,695	29	174	135
5410	Raster Pattern Storage (Additional)	8,655	8	431	—
7810	Tape-to-Printing Subsystem Feature (Model 1)	12,630	57	699	537
8170	Two-Channel Switch (Model 1)	10,270	23	469	363
8180	Two-Channel Switch (Model 3)	10,270	23	469	—
	IBM 3820				
Model 1	Page Printer; laser-based machine prints up to 20 pages per minute	28,350	310	1,845	—
3005	Pattern Storage Memory, 256KB	1,050	10	67	—
3010	Pattern Storage Memory, 512KB	1,700	20	112	—
3020	Pattern Storage Memory, 1024KB	3,000	40	202	—
3025	Pattern Storage Memory, 2048KB	6,000	80	404	—
3030	Pattern Storage Memory, 3072KB	9,000	120	607	—
3040	EIA Interface Cable 12m	125	—	—	—
3045	EIA Interface Cable 6m	90	—	—	—
3050	EIA Interface Attachment	500	10	37	—
3055	S/370 Channel Interface Attachment	2,600	40	180	—
3065	Pattern Storage Memory, 4096KB	12,000	160	809	—
	IBM 4245				
Model 12/ D12	Band printers; 1200 lpm. Model 12 attaches to IBM byte, block, or selector channels. The Model D12 attaches via 3274, 4700 controllers or, 4361 processor workstation adapter.	31,000	250	2,050	—
Model 20/ D20	Band printers; 2000 lpm. Model 20 attaches to IBM byte, block, or selector channels. The Model D20 attaches via 3274, 4700 controllers, or 4361 processor workstation adapter.	35,000	400	2,340	—
Model T12	Band printer; 1200 lpm. Model attaches via twinax or the IBM Cabling System to IBM System/36 and IBM System/38 processors.	31,000	250	2,050	—
Model T20	Band Printer; 2000 lpm. Model attaches via twinax or IBM Cabling System to IBM System/36 and IBM System/38 processors.	35,000	400	2,340	—
	4245 Upgrades:				
	Model 12/D12/T12 to Model 20/D20/T20	10,000	—	—	—
	IBM 4248				
Model 2	Variable-speed band printer; 2200, 3200, and 4000 lpm	75,000	800	6,205	—
3751	36 additional print positions; plant installed	10,000	110	615	—
3753	36 additional print positions; field installed	15,000	110	615	—

**Includes equipment maintenance.*
***Four-year lease.*
NC—No charge.

IBM 308X Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
TERMINALS					
Cluster Controllers:					
	3274 Model 21A; local, SNA mode	14,220	77.00	1,038	883
	3274 Model 21B; local, 3272 mode	14,200	80.00	1,038	883
	3274 Model 21C; remote; requires 3701	9,990	59.00	727	619
	3274 Model 21D; local, 3272 mode	14,220	85.00	1,038	883
	3274 Model 31A; local, SNA mode	16,650	97.00	1,216	1,035
	3274 Model 31C; remote; requires 3701	12,420	79.00	907	772
	3274 Model 31D; local, 3272 mode	16,650	105.00	1,216	1,035
	3274 Model 41A; local, SNA mode	18,230	62.00	1,281	1,090
	3274 Model 41C; remote; requires 3701	13,840	43.00	973	828
	3274 Model 41D; local, 3272 mode	18,230	62.00	1,281	1,090
	3274 Model 51C; remote; requires 3701	4,885	40.00	334	284
	3274 Model 61C; remote; requires 3701	7,600	29.00	513	437
1550	CCITT V.35 Interface	525	1.50	25	22
1800	Extended Function Storage, D2 CSE	2,430	20	166	141
1801	Control Storage Expansion	790	4.00	59	50
3101	Internal Disk Drive Enhancement	1,620	15	117	100
3622	Extended Function Storage, Ty C1	950	8.50	97	83
3623	Extended Function Storage, Ty C2	1,265	10.50	127	108
3625	Extended Function Storage, Ty C3	950	8.50	97	83
3627	Extended Function Storage, Ty D1	950	8.50	97	83
3631	Extended Function Storage, Ty D3	820	7	59	50
3650	Extended Function Storage, Ty C1	1,640	15	117	100
3660	Extended Function Storage, DS	1,550	2	100	85
3680	Encrypt/Decrypt; -1C, 3274 -21C, -31C, -41C, -51C, and -61C only	1,780	2.00	99	84
3701	External Modem Interface; requires 6302 or 6303	337	3.00	18	16
5101	Internal Disk Drive Enhancement	1,530	14	109	93
5550	Power Expansion	341	1.50	18	16
5650	Dataphone Digital Service; point-to-point; -21C, -31C, -41C, -51C, and -61C only	840	1.50	41	36
5651	Dataphone Digital Service; multipoint; -21C, -31C, or -51C only	840	1.50	41	36
5655	X.21 Adapter; nonswitched networks; -41C or -61C only	800	1.50	38	33
5656	X.21 Adapter; switched networks; -41C or -61C only	800	2.00	47	40
	Terminal Adapters (for Models -21X, -31X, and -51C only)—				
6901	Type A1; devices 9 through 16	918	2.00	60	51
6902	Type A2; devices 17 through 24	918	2.00	60	51
6903	Type A3; devices 25 through 32	918	2.00	60	51
7801	Type B; requires 5550	986	4.00	71	60
7802	Type B1; devices 1 through 4	986	4.00	71	60
7803	Type B2; devices 5 through 8	831	2.50	60	51
7804	Type B3; devices 9 through 12	831	2.50	60	51
7805	Type B4; devices 13 through 16	831	2.50	60	51
6302	Common Communications Adapter; SDLC or BSC; up to 9600 bps with Type A only Terminal Adapters and up to 7200 bps with Type B or mix; -21C, -31C, -41C, -51C, and -61C only	365	2.00	15	13
6303	High Performance Communications Adapter; SDLC or BSC; 9600 bps with Type B Terminal Adapters or mix; -21, -31C, -41C, -51C, and -61C only	1,010	8.50	67	57
8801	Watertight Power Connector; -21A/B/D, -31A/D, and -41A/D	NC	NC	NC	NC

Note: IBM no longer accepts lease/rental orders for any model of the 3274 Control Unit. Listed lease/rental prices apply to hardware installed prior to 8/24/84.

Cluster Display Stations:

	3179 Model 1; 1920 char.; w/122-key Typewriter keyboard	2,095	—	—	—
	3178 Model C10; 1920 char., w/75-key Data Entry keyboard	1,040	—	—	—
	3178 Model C20; 1920 char., w/87-key Typewriter keyboard	1,095	—	—	—
	3178 Model C30; 1920 char., w/87-key Typewriter keyboard and numeric pad	1,095	—	—	—
	3178 Model C40; 1920 char., w/87-key Typewriter keyboard and numeric pad	1,095	—	—	—
	3278 Model 1; 960 char.	1,484	10.00	115	98
	3278 Model 2; 1920 char.	1,572	10.00	119	102
	3278 Model 3; 2560 char.	1,716	10.50	146	124
	3278 Model 4; 3440 char.	1,804	11.50	149	127
	3278 Model 5; 3564 char.	2,060	13.00	175	149
3610	Extended Character Set Adapter	—	—	17	15
3620	Character Set Extension	464	2.50	30	26
4621	Keyboard; 75 Key EBCDIC Ty	334	2.00	22	19

**Includes equipment maintenance.*
***Four-year lease.*
NC—No charge.

IBM 308X Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Cluster Display Stations: (Continued)					
4622	Keyboard; 75 Key EBCDIC De	334	3.00	22	19
4623	Keyboard; 75 Key EBCDIC De/Kp	334	3.00	22	19
4624	Keyboard; 75 Key ASCII Ty	334	2.00	22	19
4626	Keyboard; 87 Key EBCDIC Typ/APL	455	2.50	27	24
4627	Keyboard; 87 Key EBCDIC Ty	455	2.50	27	24
4628	Keyboard; 87 Key ASCII Ty	455	2.50	27	24
4629	Keyboard; 87 Key EBCDIC Typ/Text	455	2.50	27	24
3278 Display Station Options:					
3620	Character Set Extension	464	2.50	30	26
6360	Selector Light Pen	394	0.50	24	20
4999	Magnetic Reader Control	273	3.50	17	15
Color Display Stations:					
	3279 Model S2A; base color; 1920 char.	2,190	19.00	201	171
	3279 Model S2B; extended color; 1920 char.	2,415	19.00	204	174
	3279 Model S3G; extended color; 2560 char.	3,115	25.00	310	264
	3279 Model 2X; base/extended color; 1920 char.	2,190	19.00	206	176
	3279 Model 3X; base/extended color; 2560 char.	2,235	19.00	227	193
3850	Extended Function (Model 2X or 3X)	210	2.00	15	13
Keyboards:					
	For 3279—				
4621	75-Key EBCDIC Typewriter	417	1.50	22	19
4622	75-Key EBCDIC Data Entry	417	2.50	22	19
4623	75-Key EBCDIC Data Entry, keypunch layout	417	2.50	22	19
4624	75-Key ASCII Typewriter	417	1.50	22	19
4626	87-Key EBCDIC Typewriter/Text; 3278 only	569	2.00	27	24
4627	87-Key EBCDIC Typewriter; 3278/3274 only	569	2.00	27	24
4628	87-Key ASCII Typewriter; 3278/3274 only	569	2.00	27	24
4629	87-Key EBCDIC Typewriter/Text; 3278 only	569	2.00	27	24
4640	87-Key EBCDIC Typewriter Overlay	569	2.00	27	24
4651	87-Key EBCDIC Attribute Select Typewriter	569	2.00	27	24
4652	87-Key EBCDIC Attribute Select Typewriter/APL	569	2.00	27	24
SYSTEM MANAGEMENT					
IBM 3814 Switching Management System, Models:					
A1	Controller Unit (4 x 4)	47,480	159	2,630	**2,105
A2	Controller Unit (4 x 8)	60,420	207	3,350	**2,680
A3	Controller Unit (8 x 4)	64,740	203	3,595	**2,875
A4	Controller Unit (two 4 x 4s)	69,570	223	3,875	**3,095
B1	Remote Unit (4 x 4)	39,710	107	2,205	**1,765
B2	Remote Unit (4 x 8)	52,660	157	2,920	**2,335
B3	Remote Unit (8 x 4)	56,970	151	3,165	**2,530
B4	Remote Unit (two 4 x 4s)	61,800	171	3,435	**2,745
C1	Expansion Unit (4 x 4)	37,980	104	2,105	**1,680
C2	Expansion Unit (4 x 8)	50,930	152	2,820	**2,255
C3	Expansion Unit (8 x 4)	55,240	147	3,065	**2,450
C4	Expansion Unit (two 4 x 4s)	60,070	168	3,340	**2,670
Additional Hardware and Options					
Upgrades	Model A1 to A4, Model B1 to B4, or Model C1 to C4	22,090	—	—	—
3178-C20	Display Station	1,095	—	—	—
3278-2	Display Station	1,572	10.00	119	102
3287-1	Hard Copy Printer	4,830	41.00	348	296
3287-2	Hard Copy Printer	5,150	52.00	426	362
1410	Expanded Storage Unit	4,800	23.00	246	**196
1420	Printer and Display Station Attachment	1,990	3.00	103	**83
1430	Alternate Controller	1,990	3.00	103	**83
1440	System Attachment Feature	5,700	16.00	307	**248
1520	Internal Channel Expansion; four controller unit interfaces	1,550	1.00	86	**69
1521	Internal Channel Expansion; eight controller unit interfaces	3,100	1.00	168	**135

**Includes equipment maintenance.*
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NC—No charge.

IBM 308X Series

	Additional Hardware and Options (Continued)	Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
1531	External Channel Expansion; first 4 x 4 interface	5,350	1.00	294	**235
1532	External Channel Expansion; second 4 x 4 interface	5,350	1.00	294	**235
1811	Control Unit Power Sequencing; provides sequencing for first group of control units	518	1.00	27	**21
1812	Control Unit Power Sequencing; provides sequencing for second group of control units	518	1.00	27	**21
1813	Control Unit Power Sequencing; provides sequencing for third group of control units	518	1.00	27	**21
1814	Control Unit Power Sequencing; provides sequencing for fourth group of control units	518	1.00	27	**21
6350	Additional System Power Sequencing	207	—	8	**6
6010	Remote Two-Channel Switch Control—Basic	5,180	21.00	284	**226
6011	Additional Remote Two-Channel Switch Control	2,415	15.00	133	**106
6012	Second Additional Remote Two-Channel Switch Control	2,415	15.00	133	**106
6013	Third Additional Remote Two-Channel Switch Control	2,415	15.00	133	**106
	CHANNEL EXTENSION				
3044-C01	Fiber-Optic Channel Extender Link; channel unit	8,500	27	—	—
3044-D01	Fiber-Optic Channel Extender Link; downstream unit	8,500	27	—	—
	COMMUNICATIONS EQUIPMENT				
3705-80	Communications Controller:				
	Model 81 (256K bytes, 4 lines)	36,600	269.00	2,180	1,855
	Model 82 (256K bytes, 10 lines)	46,600	281.00	2,861	2,435
	Model 83 (256K bytes, 16 lines)	52,600	282.00	3,372	2,870
	Channel Adapters:				
	1551 Type 1	3,340	9.50	245	209
	1544 Type 4	4,410	8.00	338	288
	8002 Two-Channel Switch	2,090	2.50	122	104
	Business Machine Clocks:				
	1409 50 bps	424	1.00	17	15
	1410 110 bps	424	1.00	17	15
	1412 200 bps	424	1.00	17	15
	1413 300 bps	424	1.00	17	15
	1414 600 bps	424	1.00	17	15
	1415 1200 bps	424	1.00	17	15
	1416 2400 bps	424	1.00	17	15
	Communications Line Attachment Features:				
	6712 Line Set Type 2	5,440	11.00	325	277
	6713 Line Set Type 3	4,850	9.00	289	246
	6714 Line Set Type 4	2,060	4.00	117	100
	6715 Line Set Type 5	10,320	15.00	589	501
	5657 Line Set Type 8	2,600	3.50	145	123
	5658 Line Set Type 9	1,550	3.00	82	70
	6261 Remote Program Loader	9,335	29.00	583	496
3725	Communications Controller:				
	Model 1; up to six channel adapters and from 512K to 1024K bytes of main storage capacity	75,000	232.00	4,420	—
	Model 2; up to two channel adapters and 512K bytes of main storage capacity (Model 2 to Model 1 Upgrade charge is $16,000)	60,500	208.00	3,330	—
	1561 Channel Adapter	6,750	8.50	399	—
	4666 Internal Clock Control	1,500	2.00	85	—
	4771 Line Attachment Base Type A	19,000	17.00	1,115	—
	4772 Line Attachment Base Type B	26,400	30.00	1,560	—
	4911 Line Interface Coupler Type 1	2,600	2.00	155	—
	4921 Line Interface Coupler Type 2	3,000	2.00	174	—
	4931 Line Interface Coupler Type 3	3,000	2.00	174	—
	4941 Line Interface Coupler Type 4A	2,600	2.00	155	—
	4942 Line Interface Coupler Type 4B	3,000	2.00	174	—
	7100 Storage Increment 256K	4,375	20.00	257	—
	8320 Two Processor Switch	4,000	3.00	237	—
3726	Communications Controller Expansion	32,000	43.00	1,880	—
3727	Operator Console	2,390	28.00	215	—

**Includes equipment maintenance.*
***Four-year lease.*
NC—No charge.

IBM 308X Series

SOFTWARE PRICES

		Monthly Charge		Initial Charges		
		Basic License ($)	DSLO ($)	Basic License ($)	DSLO ($)	Monthly Licensed Program Support ($)
Operating System Software:						
5740-XYS	MVS/SP-JES2 Version 1					
	Release 1 and 2	2,150	1,627	—	—	240
	Release 3 through 3.6	2,170	1,642	—	—	123
5740-XC6	MVS/SP-JES2 Version 2	4,280	3,210	12,840	9,630	673
5740-XYN	MVS/SP-JES3 Version 1					
	Release 1, Release 2	2,150	1,612	—	—	117
	Release 3	2,380	1,784	—	—	400
5665-291	MVS/SP JES3 Version 2	4,810	3,607	14,430	10,821	1,335
5664-167	VM/SP					
	Releases 1, 2, 3, and 3.1	500	375	—	—	69
5664-169	VM/XA Systems Facility					
	Release 2	3,740	2,805	11,220	8,415	623
5664-173	VM/SP High-Performance Option					
	Release 3.0,-3.2, and 3.4	1,775	1,331	5,325	3,993	136
5664-173	VM/SP High Performance Option Release 4.2 Support for Vector Facility	1,775	1,331	5,325	3,993	136
5667-126	Interactive Executive/370 (IX/370)	—	—	*10,000	—	495
5665-295	Data Facility Product (DFP) for MVS/370	600	450	1,590	1,191	186
5665-XA2	Data Facility Product (DFP) for MVS/XA	900	675	*38	—	300
Languages and Compilers:						
5668-962	Assembler H Version 2	155	116	465	348	7
5668-958	VS Cobol II Compiler and Library	1,070	802	6,420	4,812	53
5668-940	VS Cobol II Library	425	318	2,550	1,908	53
5740-CB1	Cobol OS/VS Compiler and Library Version 2 Release 3	365	273	—	—	15
5748-FO3	VS Fortran Compiler and Library Release 4.0 and 4.1	249	186	747	558	18
5748-LM3	VS Fortran Library only; Release 4.0 and 4.1	73	54	219	162	7
5734-FO2	Fortran IV (G1) Compiler	98	73	—	—	11
5734-FO3	Fortran IV (H Extended) Compiler	426	319	—	—	17
5734-LM3	Fortran IV Library (Mod II)	131	98	—	—	17
5734-FO5	Fortran Interactive Debug	256	—	*3,600	—	—
5668-903	VS Fortran Interactive Debug Release 2	320	240	1,920	1,397	26
5668-806	VS Fortran Version 2 Compiler, Library, and Interactive Debug	750	563	—	—	—
5668-805	VS Fortran Version 2 Library	200	150	—	—	—
5668-864	IBM Fortran Language Conversion Program	—	—	*28,000	—	—
5748-XX1	VS Basic	549	411	—	—	19
5668-996	IBM Basic	375	281	1,125	843	38
5748-AP1	VS APL Release 4	386	289	—	—	41
5734-PL1	PL/1 Optimizing Compiler Release 5.1	296	222	—	—	39
5734-PL2	PL/1 Checkout Compiler Release 3	575	431	—	—	7
5734-PL3	PL/1 Optimizing Compiler and Library Release 4	398	298	—	—	53
5734-LM4	PL/1 Resident Library	64	48	—	—	7
5734-LM5	PL/1 Transient Library	37	27	*1,535	—	7
5740-RG1	OS/VS RPG II	221	165	663	495	13
5746-RG1	RPG II	160	120	—	—	7
5796-PNQ	Pascal/VS	247	—	*6,300	*5,670	—
5668-899	APL2 Release 1 and Release 2	695	521	4,170	3,126	37
Data Management:						
5740-XX2	IMS/VS Version 1 Release 3	2,593	1,944	—	—	240
	Data Communications Feature with MSC and Fast Path Version 1 Release 3	2,250	1,687	—	—	192
5665-332	IMS/VS Version 2 Release 1	3,900	2,925	—	—	825
5665-319	Interactive System Productivity Facility (ISPF) for MVS Version 2 Release 2	218	163	690	517	30
5665-317	Interactive System Productivity Facility/Program Development Facility (ISPF/PDF MVS) for MVS Version 2 Release 2	575	431	4,025	3,015	14
5740-XX7	GIS/VS (Generalized Information System/VS)	1,340	1,005	—	—	92
5740-XXF	DB/DC Data Dictionary	1,110	—	*15,000	—	115
5740-XYR	Database 2 (DB2)	2,675	2,006	16,050	12,036	374
5665-354	DB2 Performance Monitor	975	—	*29,000	—	—
5748-XXJ	Structured Query Language/Data System (SQL/DS)	464	347	—	—	144
5746-XX1	Data Language/1/DOS/VS (DL/1) Version 1 Release 7	459	344	—	—	149
5668-788	Data Extract (DXT) Version 2 Release 1	300	225	—	—	—

**Onetime charge.*

IBM 308X Series

		Monthly Charge		Initial Charges		
		Basic License ($)	DSLO ($)	Basic License ($)	DSLO ($)	Monthly Licensed Program Support ($)
Data Management (Continued)						
5785-ECY	Query.DL/1 for IMS/VS	—	—	*20,000	—	—
5740-XXH	Resource Access Control Facility (RACF)	841	630	—	—	43
5665-329	Data Facility Hierarchical Storage Manager (DFHSM) Version 2	800	600	—	—	141
5740-SM1	DFSORT (Data Facility Sort) Release 7	247	185	—	—	19
Data Communications:						
5740-XX1	CICS/OS/VS Release 6, Release 6.1, and Release 7	1,910	1,430	5,730	4,290	160
5668-795	CICS/Conversational Monitor System (CICS/CMS) Release 1	—	—	*900	—	—
5748-XXH	Graphical Data Display Manager (GDDM) Release 3 and Release 4	159	120	767	575	36
5665-361	NetView for MVS/370	1,060	795	—	—	124
5665-362	NetView for MVS/XA	1,255	941	—	—	128
5668-947	Network Communications Control Facility (NCCF) Version 2 Release 2	375	335	2,250	2,010	55
5668-920	Network Problem Determination Application (NPDA) Version 3 Release 2	264	198	1,650	1,237	22
5748-XP1	Remote Spooling Communication System/Systems Network Architecture (RSCS/SNA) Release 3	111	83	—	—	38
5665-285	TSO Extensions for MVS/370	500	375	1,500	1,125	87
5665-293	TSO Extensions for MVS/XA	520	390	1,560	1,170	94
5735-RC3	ACF/TCAM Version 2	874	655	2,420	1,815	91
5665-280	ACF/VTAM Version 2	1,245	934	3,745	2,809	225
5665-288	MVS/Operator Communication Control Facility (MVS/OCCF)	350	262	1,050	786	8
5748-T12	Transaction Processing Facility (TPF) Version 2.2	12,310	—	32,100	—	—
5664-309	Professional Office System (PROFS); charges for up to 100 CSTUs	995	—	*22,000	—	—
5665-290	Distributed Office Support System/370 (DISOSS/370)	1,485	1,110	4,570	3,425	223
Engineering/Scientific Support:						
5668-863	Engineering and Scientific Subroutine Library	700	525	—	—	—
5665-368	Vector Processing Subsystem/Vector Facility	—	—	*40,000	*30,000	—

**Onetime charge.* ■