IBM 3090 Series

MANAGEMENT SUMMARY

UPDATE: *After another year of disappointing 3090 hardware sales and unrelenting competition from plug-compatible rivals, IBM took steps to make its two-year-old mainframe line more attractive. First, the company increased the performance of all existing models without an increase in price. IBM even lowered the price of two models. Secondly, IBM announced three-processor and six-processor versions of the 3090 to push performance levels closer to the 100 million-instructions-per-second (MIPS) range. The new enhanced mainframes along with the two new models announced on January 26, 1987 are now part of IBM's new and improved 3090 "E" series of mainframes, since the letter E is now appended to all the latest versions. Enhancements include faster CPU cycle times, larger maximum central memories and the use of one-megabit memory chips, larger channel capacities, and up to one gigabyte of expanded storage on the two top-end models. Most of these hardware enhancements won't be available until May 1987 or later. The new three-way Model 300E and six-way Model 600E will be available third-quarter 1987. Customers who ordered the previous 3090 versions on or before January 23, 1987 will now automatically get the corresponding "E" models. Users with previous 3090 models will also be able to upgrade to the corresponding E Models. Upgrades will be available immediately or by May 1987 or third-quarter 1987, depending on models. In addition to hardware announcements, IBM also announced new VM products.*

The announcement of new models and enhancements to previous models came days after IBM's dismal fourth-quarter 1986 results came out. Fourth-quarter profits were $1.39 billion, down from the $2.68 billion reported for fourth quarter 1985. Earnings for the year were $4.79 billion, a 27 percent drop from the $6.56 billion reported for 1985. Profits for 1985 were also down from the previous year. The profit declines of the last two years mark the first

The 3090 Processor Complex is IBM's strategic top-end mainframe line and should continue to be so for the balance of this decade.

MODELS: 3090 Models 150E, 180E, 200E, 300E, 400E, 600E.
CONFIGURATION: Single, dual, three-way, four-way, and six-way systems; 32MB to 256MB of main memory; up to 1GB of expanded storage; 16 to 128 channels.
COMPETITION: Amdahl 5890, Control Data Corporation Cyber 180 Model 990E and 995E, Digital Equipment VAX 8974 and Vax 8978, Honeywell DPS 90 Series, NAS Alliance Series, and Unisys A 15 Series and 1100/90.
PRICE: Base purchase prices range from $1,250,000 for the Model 150E to $10,944,000 for the Model 600E

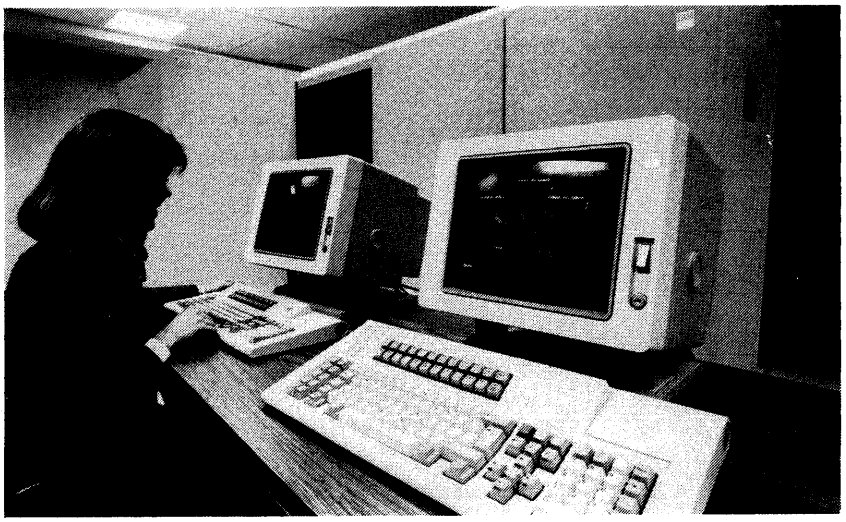
CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Old Orchard Road, Armonk, New York 10504. Contact your local IBM representative. In Canada, 1150 Eglington Avenue, Don Mills, Ontario. Telephone (416) 443-2111.

MODELS: IBM 3090 Model 150E, Model 180E, single processors; Model 200E, dual-processor; Model 300, three-way processor; Model 400E, four-way processor; Model 600, six-way processor

DATA FORMATS

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



The IBM 3090 Model 200E dual processor, shown here, and the other 3090 models feature Emitter Coupled Logic and Thermal Conduction Modules, and achieve a cycle time of 17.75 nanoseconds.

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back-to-back poor showing for IBM since the post World War II computer era began. IBM is apparently hoping the announcement of new hardware early in 1987 will help make this a turnaround year.

Last year, IBM tried to stimulate sales with sweeping 3090 and 308X price cuts and the introduction of new entry-level models. This year, the company is trying to accomplish this with the introduction of new models including a top-end model, and enhancements to existing models. In effect, users can buy faster 3090s at the same price as previous 3090 versions. As if this weren't enough, the company is selling the new Model 150E and Model 400E versions at prices lower than the previous versions of these two products. The Model 400E sells for $125,000 less than the previous Model 400, and the Model 150E sells for $50,000 less than the previous Model 150. The Model 400E now sells for $7,819,000, while the Model 150E sells for $1,250,000.

The enhancements and new models are attempts to overcome several persistent problems. Problem No. 1 is price/performance. Many potential buyers still don't see much difference between the 3090 and the 308X Series. IBM has been adding new features and improving 3090 performance to change this perception. Problem No. 2 originates with the IBM plug-compatible vendors, namely Amdahl and National Advanced Systems (NAS). Last year, NAS announced new Alliance Series models that were more powerful than IBM's then top-end Model 400. Amdahl also announced a four-way Model 600 that was more powerful than the Model 400. Such marketing moves placed more pressure on IBM to announce its new top-end Model 600E six-way processor, a system analysts and industry insiders had expected IBM to announce much earlier.

By mid-year and beyond, observers should know whether the apparent tweaking of existing 3090 technology along with the introduction of the new three-way and six-way processors will have taken care of problems one and two.

Specifically, here is a brief rundown of all the 3090 enhancements:

- IBM increased CPU cycle times. CPU cycle time for all the 3090s except for the Model 150E is now 17.2 nanoseconds compared to 18.5 nanoseconds for the previous 3090 versions. The Model 150E is the slowest of the new 3090 versions at 17.75 nanoseconds.

- IBM again increased maximum expanded storage capacities. Now users can conceivably increase this special memory option to a full gigabyte on the two top-end 400E and 600E models. Previously, maximum expanded storage capacity was 512 megabytes. Additionally, the Model 150E can now be outfitted with 64 to 128 megabytes of expanded storage, which was not available for the Model 150 announced in 1986. The Model 180E can be outfitted with up to 256 megabytes of expanded storage, and the Model 200E can have up to 512 megabytes of expanded storage.

bits. Data can be represented as 32-bit words, 64-bit double words, and 128-bit extended words for floating-point arithmetic.

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; one half word (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

STORAGE TYPE: One-megabit memory chips

CAPACITY: 32 to 256 megabytes. See Table 1 for capacities of individual models.

CYCLE TIME: See Table 1.

CHECKING: The processor controller plays a major role in error detection and recovery. Data paths between the central processor and central storage are parity-checked by byte. Parity bits are included in each command or data word. When the data are 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. For processors using the expanded storage option, single-bit and double-bit errors are detected and corrected for all data read from expanded storage. Triple-bit errors and some multiple-bit errors are also detected, but not corrected. Unrecoverable errors are flagged.

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.

Key-controlled storage protection provides both store and fetch protection, preventing unauthorized access or modification of information in central storage. Store protection prevents the contents of main storage from being altered by storage addressing errors in programs or input from I/O devices. Fetch protection prevents the unauthorized fetching of data and instructions from main storage. Up to 15 programs and their associated main storage areas can be protected at one time. A 7-bit storage key, acting as a security lock, protects each 4K-byte block of storage. Key-controlled protection is standard on all System/370 models.

CENTRAL PROCESSORS

The 3090 Series consists of the Models 150E and 180E, two single processors, the Model 200E, a dyadic processor, the Model 300E, a three-way processor, the Model 400E, a four-way processor, and the Model 600E, a six-way processor. The Model 400E can be partitioned to approximate the performance of a Model 200E on each side of the partition. Likewise, a Model 600E can be partitioned to approximate the performance of a Model 300E on either side of the partition. If one of the processors within a Model 200E or Model 400E complex fails, the remaining central processors can continue to operate. In addition to the central processor complex, which includes shared central storage, and buffer memory and 16 to 128 integrated channels, 3090 mainframes require at least one of the following components:

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TABLE 1. SYSTEM COMPARISON

MODEL	Model 150E	Model 180E	Model 200E	Model 300E	Model 400E	Model 600E
SYSTEM CHARACTERISTICS						
Date announced	January 26, 1987	January 26, 1987	January 26, 1987	January 26, 1987	January 26, 1987	January 26, 1987
Date first delivered	January 1987*	January 1987*	January 1987*	January 1987*	Third quarter 1987	Third quarter 1987
Field upgradable to	Model 180E	Model 200E	Model 300E, Model 400E	Model 600E	Model 600E	—
Relative performance	—	—	—	—	—	—
Number of processors	1	1	2	3	4	6
Cycle time, nanoseconds	17.75	17.2	17.2	17.2	17.2	17.2
Word size, bits	32	32	32	32	32	32
Operating systems	MVS/SP, MVS/XA, VM/HPO, VM/XA	MVS/SP, MVS/XA, VM/HPO, VM/XA	MVS/SP, MVS/XA, VM/HPO, VM/XA	MVS/SP, MVS/XA, VM/HPO, VM/XA	MVS/SP, MVS/XA, VM/HPO, VM/XA	MVS/SP, MVS/XA, VM/HPO, VM/XA
MAIN MEMORY						
Type	1M-bit chips	1M-bit chips	1M-bit chips	1M-bit chips	1M-bit chips	1M-bit chips
Minimum capacity, bytes	32MB**	32MB**	64MB**	64MB**	128MB**	128MB**
Maximum capacity, bytes	64MB	64MB	128MB	128MB	256MB	256MB
Increment size, bytes	32MB	32MB	64MB	64MB	128MB	128MB
Cycle time, nanoseconds	—	—	—	—	—	—
BUFFER STORAGE						
Minimum capacity	64KB	64KB	128KB	192KB	256KB	384KB
Maximum capacity	64KB	64KB	128KB	192KB	256KB	384KB
Increment size	—	—	—	—	—	—
INPUT/OUTPUT CONTROL						
Number of channels:						
Byte multiplexer	0-4	0-4	Not specified	0-4	Not specified	0-8
Block multiplexer	16, 24	16, 24, 32	32, 40, 48, 64	32, 40, 48, 64	64, 80, 96, 128	64, 80, 96, 128
Word	—	—	—	—	—	—
Other	—	—	—	—	—	—

*By May 1987, IBM will modify these models to bring them up to full performance potential. **In addition to conventional main memories, all the models can be outfitted with optional expanded storage. Refer to expanded-storage chart in Characteristics section for more details.

- IBM increased maximum central memories. A Model 200E can now have up to 128 megabytes of main memory, compared to the previous Model 200 which went up to 64 megabytes. A model 400E can have up to 256 megabytes of main memory, compared to the previous Model 400 which went up to 128 megabytes. Memories also make use of one-megabit chip technology first introduced in 1986.

- IBM increased maximum channel capacities. The Model 200E can now have up to 64 channels compared to the previous Model 200, which went up to 48 channels. The Model 400E can now have up to 128 channels compared to the previous Model 400 which went up to 96 channels.

Most of these extended central memory, expanded storage, and channel capacity options will not be immediately available. IBM is delivering the enhanced models themselves in two steps. In January, IBM began shipping processors and model upgrades with performance equivalent to the corresponding previous 3090 models. In May, IBM will be upgrading the installed machines to bring them up to full performance. Additional Model 200E and Model 400E central storage will be available in May 1987, additional 200E/400E channels will be available by fourth-quarter 1987, and additional 200E/400E expanded storage of up to a full gigabyte will be available by first-quarter 1988. Likewise, the additional 64 channels for the Model 300E and the additional 128 channels for the Model 600E will not be available until fourth-quarter 1987. Additional expanded storage for the Model 300E of up to 512 megabytes, and

- **3092 Processor Controller Model 1 or 2;**
- **3097 Power and Coolant Distribution Unit Model 1 or 2;**
- **3370 Direct Access Storage Model A2, each with a string-switch feature;**
- **Access to a channel-attached IBM 3803 Tape Control Unit Model 2 or equivalent and its associated IBM 3420 Magnetic Tape Unit Model 4, 6, or 8;**
- **3864 Modems Model 2 with an automatic calling unit feature or equivalent;**
- **3089 Power Units Model 3 or other 400E Hz power source; and**
- **operator display station for system control program communications.**

For a detailed rundown of how many of each component must be configured with the Models 150E, 180E, 300E, 200E, 400E, and 600E, please refer to the Configuration Rules section of this report.

Processor hardware technology is built around the use of Emitter Coupled Logic (ECL) and Thermal Conduction Modules (TCM). EML is faster than the transistor-to-transistor logic IBM uses in the 308X Series. To dissipate the heat, IBM makes extensive use of its TCM technology. TCMs are helium-filled, encapsulated modules covered by cold plates through which chilled water circulates to absorb heat. A TCM contains up to 100 silicon chips mounted on a multilayered ceramic substrate. Each central processor uses nine TCMs with the associated circuit board. Overall design makes external wiring or cabling unnecessary.

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additional Model 600E expanded storage of up to one gigabyte will not be available until first-quarter 1988.

Model upgrades will be available either during this two-step upgrade phase or during third-quarter 1987, depending on models. Users can upgrade a Model 150 to Model 180E, a Model 180 to 200E, and a Model 200 to 400E during this January/May delivery period. The upgrades that follow will be available beginning third-quarter 1987: Model 150E to 180E, Model 180E to Model 200E, Model 200 to Model 300E, Model 400 to Model 600E, Model 200E to Model 300E, Model 200E to Model 400E, Model 400E to Model 600E, and Model 300E to Model 600E.

Now here's how the latest two models stack up. The Model 300E has approximately 1.6 times the instruction execution rate of the Model 200 operating under MVS/XA. It supports up to 128 megabytes of central storage, 512 megabytes of expanded storage, 64 channels, and three Vector Facilities. The Model 600E has approximately 1.5 to 1.6 times the instruction execution rate of the Model 400 operating under MVS/XA. It supports up to 256 megabytes of central storage, one gigabyte of expanded storage, 128 channels, and six Vector Facilities. When operating in partition mode, the Model 600E approximates the performance of a Model 300E on either side of the partition.

When the 3090 was first announced IBM also introduced related operating system software enhancements, including Virtual Machine support in an Extended Architecture environment. Virtual Machine/Extended Architecture System Facility is seen as a new commitment to VM in the 31-bit environment. New VM products announced January 26, 1987 include these four releases:

- VM/SP High Performance Option Release 5. This product is offered as an adjunct to VM/SP Release 5 and comes with additional features. The product is designed to support large CMS-based interactive environments and facilitates the running of MVS/370 production systems under VM. The product merges functions from VM/SP Release 5 in addition to VM/SP HPO Release 5 functions and supports up to 9,900 SPOOL files per user. This relieves the previous constraint of 9,900 SPOOL files per system.

- VM Inter-System Facilities. This product brings together two VM/SP HPO Release 4.2 systems. Using this product, the two VM/SP HPOs appear to function as one single, but larger system, making it possible for more users to participate in the same application environment.

- VM/XA Systems Facility Release 2 Additional Enhancements. This release extends VM/XA support to the new processor systems announced on January 26, 1987 including the Models 300E and 600E. The product also provides support for IBM 3380 Models AE4 and BE4 and 3880 Models 11, 13, 21, and 23 Control Units, the IBM 5080 Graphics System, the IBM 3480 Magnetic Tape Subsystem, the IBM 3890 Document Processor, the IBM 3720 Communications Controller, and 3090 Expanded

To improve system performance and throughput, the processors feature three memory hierarchies. They are shared central storage (main memory), a high-speed buffer memory, and optional expanded storage. Refer to Table 1 for a listing of central storage options for each processor model. In addition to main memory, each processor contains a 64K-byte buffer memory, which handles instruction, operand, and data fetches.

A third level of memory that's optionally available for all 3090 models is expanded storage. The expanded storage memory helps reduce paging and swapping loads to channel-attached paging devices in storage constrained and heavy paging environments. Controlled by the system control program, expanded storage transfers 4K-byte pages to and from central storage. Expanded storage options are listed in the following chart:

EXPANDED STORAGE BY MODEL	MINIMUM AND INTERMEDIATE	MAXIMUM
Model 150E	64 megabytes	128 megabytes
Model 180E	64, 128, or 192 megabytes	256 megabytes
Model 200E	64, 128, 192, or 256 megabytes	512 megabytes
Model 300E	64, 128, 192, 256 megabytes	512 megabytes
Model 400E	128, 256, 384, 512 megabytes	1 gigabyte
Model 600E	128, 256, 384, 512 megabytes	1 gigabyte

Each central processor in a 3090 complex is microcode controlled and contains an instruction element (IE), execution element (EE), control storage element (CSE), and buffer control element (BCE).

The IE controls the sequencing of all instructions and can handle multiple instructions at the same time. The IE decodes instructions; calculates addresses; sends fetch requests to the BCE in central storage; determines fetch priority, and controls storage requests. In addition, it provides the EE with operation codes, operands, and operand addresses.

The Execution Element (EE) executes instructions set up by the IE and operates in parallel with the IE. The EE processes instructions and interruptions; overlaps operations with the IE; initiates control functions, and performs various logic and arithmetic functions. Arithmetic results can include fixed point, fixed-point multiply, convert to binary, convert to decimal, floating point, and extended-precision floating point.

The Control Storage Element (CSE) contains the microcode needed for controlling the EE. The CSE controls microcode execution in the central processor and contains the supporting control storage areas and registers that are used by the central processors.

The Buffer Control Element (BCE) handles the movement of data to and from memory, performs dynamic address translation, and controls the high-speed buffer. The BCE contains the 64K-byte high-speed buffer, a buffer directory, a translation lookaside buffer (TLB), and Dynamic Address Translation (DAT) hardware.

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Storage. The product also supports a "Vary Channel Path," command, which lets operators make a channel path logically available or unavailable to one or more real devices.

- VM/XA Realtime Monitor/SP Release 2. This release complements the previous release of this product and provides additional support for processors announced on January 26, 1987. It also supports Vector Facility data gathering, provides additional user friendly display command options in addition to changes made in VM/XA System Facility Release 2. The product only runs under VM/XA Systems Facility Release 2.

Major 3090 features that clearly differentiate the product line from the 308X Series, IBM's previous mainframe generation, include logic gate design, expanded storage, and the Vector Facility.

In the logic gate area, IBM 3090s use Emitter Coupled Logic, a faster technology than the transistor-to-transistor logic used in the 308X.

Expanded storage is a new cache memory concept. The expanded storage facility improves system performance by reducing the paging and swapping load to channel-attached paging devices in storage constrained and heavy paging environments. The facility transfers 4K-byte pages to and from central storage synchronously with processor operations. Expanded storage involves operating system instructions rather than application software. Additionally, the operation is under full control of the operating system rather than users. By helping to curtail channel traffic between central storage and attached I/O devices, expanded storage helps reduce system overhead and enhances throughput.

The Vector Facility, which IBM is calling an extension of the central processor's instruction and execution elements, can be added to each Model 150E, Model 180E and to each processor within a Model 200E, Model 300E, Model 400E, and Model 600E complex. Operating under System/370 and 370/Extended Architecture modes, the Vector Facility adds 171 new instructions to the processor complex and 16 vector registers that each contain one-hundred and twenty-eight 32-bit elements. Multiplier and arithmetic/logic units can produce 32-bit or 64-bit floating-point sums, differences, and products during each machine cycle using pipelining techniques. Compound instructions can produce both a product and sum during each machine cycle. Structural design, reservoir modeling, fluid dynamics, and load flow are among the applications suited to vectorized computing. The new Vector Facility is a field-installable option that is implemented in both hardware and software. According to IBM, the facility can improve system performance for vector, parallel, and scalar operations.

COMPETITIVE POSITION

While life offers few constants, people connected with the computer industry have come to expect one thing: constant

The high-speed buffer, as noted above, provides faster access to instructions. While data is being referenced during instruction execution, the high-speed buffer, the buffer directory, and the TLB are accessed at the same time for address comparison.

The buffer directory contains the absolute central storage addresses for data residing in the high-speed buffer. The TLB stores the real address of the referenced page for a translated virtual address in central storage, making subsequent translations for the same virtual address unnecessary because the real address is immediately available in the TLB. The DAT translates virtual addresses to real addresses and loads them in the TLB.

The 3090 Series supports both System/370 and 370-XA operational modes. In System/370 mode, the 3090 supports S/370 extended facility, 3033 extension, and extended addressing. Additionally, up to 16 channels can be assigned to a channel set operating under MVS/SP 1. 3.5, and up to 32 channels per channel set when operating under VM/High Performance Option, Release 3.6. In 370-XA mode, the 3090 supports 31-bit addressing, bimodal addressing, larger and more flexible I/O configurations, channel path selection under hardware control, and support for Start Interpretive Execution instruction by allowing support of guest S/370 or 370-XA virtual machines. What follows are larger explanations of some of the features available under either mode.

Other standard features on the 3090 Processor Complex include:

- **Channel indirect addressing, which permits contiguous areas of virtual storage to be mapped into noncontiguous areas of real storage.**
- **Channel set switching, which (in S/370 mode only) dynamically switches channel sets between processors under program control should one of the central processors fail. Up to 32 channels for each channel set are supported, depending on the system control program used.**
- **Datastreaming, which permits data-transfer rates up to three megabytes/second on block multiplexer channels, and cable lengths of up to 400 feet.**
- **Extended addressing, which (in S/370 mode only) permits the addressing of real storage of up to 64 megabytes of central storage on the 3090 Model 200E operating under the MVS/SP or VM/SP with the VM/SP High Performance Option.**
- **A 31-bit addressing capability, which (in 370-XA mode only) provides for a virtual storage addressing range of up to two gigabytes. In 370-XA mode, bimodal addressing capabilities permit both 24-bit and 31-bit programs to execute concurrently.**
- **System/370 extended facility, which (standard in S/370 mode only) speeds up certain supervisor functions, improves the efficiency of dynamic address translation, improves CPU performance, and improves system integrity by providing special protection for low-address main storage vital to the system control program, all while operating under MVS/SP.**
- **Byte-oriented operand feature, which allows fixed-point, floating-point, and logical storage operands of most unprivileged instructions to appear on any byte boundary without causing a specification exception and a program interruption. This feature does not apply to instruction addresses, privileged instructions, or channel-command words.**

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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

IBM revenue and earnings growth that is as predictable as the sunrise. That perception began to change when IBM experienced a bad 1985 followed a bad 1986. At first, IBM and industry observers wrote off 1985 as a "transitional" year, but two unprecedented back-to-back drops in earnings looked like the beginnings of an ugly trend. Since IBM controls anywhere from 75 to 80 percent of the large-scale systems market, depending on what surveys are consulted, observers have been wondering just how healthy the mainframe world is in general, and how bad off IBM is in particular.

Analysts are pointing to several possible reasons for the IBM slump. First, IBM now relies more heavily on outright hardware sales rather than lease income, making it more vulnerable to cyclical changes in the mainframe world. With relatively flat revenues from hardware, IBM has been relying more heavily on growth in the software and services segments of its businesses. According to a recent survey conducted by International Data Corporation (IDC), a computer-industry market research firm, fewer IBM mainframe sites are expecting to install additional systems during early 1987. Keep in mind, however, the survey was taken in 1986 before IBM announced new 3090 enhancements and models. While demand for 3090 Model 400s remained strong during 1986, demand for Models 150 and 180 had been disappointing, according to the IDC survey. Before the latest announcements, IDC was predicting IBM revenue growth of between -3 percent and +3 percent during first-quarter 1987.

A second factor adding to IBM revenue woes is the nagging question of price/performance. According to industry observers, many big mainframe users are not clamoring at the moment for more raw horsepower, often measured in MIPS (millions of instructions per second). Many IBM 308X users, meanwhile, who are continuing to migrate through the 308X line don't perceive a big enough price/performance difference between the 308X models and the 3090s to make the jump to the newer product line.

To make matters worse, IBM's two top plug-compatible rivals, Amdahl and NAS, both announced top-end main-

- **Virtual machine assist (VMA), which (standard in S/370 mode only) improves central processor performance when operating under VM/SP High Performance Option by reducing the amount of time in the real supervisor state.**
- **Preferred Machine Assist, which (standard in S/370 mode only) is designed to improve the performance of an MVS guest machine running under VM/SP. The feature allows any MVS/SP release that supports more than 16 megabytes of real storage to use real storage greater than 16 megabytes when operating as a virtual-equals-real virtual machine.**
- **Start Interpretive Execution (SIE) Assist, which (standard 370-XA mode only) provides improved performance of V=R preferred guests.**
- **3033 Extension, which provides dual address-space facility to aid communication between virtual address spaces, provides for faster I/O queuing, and provides for a suspend-and-resume facility. This last feature gives the program a controlling function over the execution of a channel program.**

The 3090 Series uses the System/370 Universal Instruction Set for binary, decimal, and floating-point arithmetic operations. The instruction set has 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.

A modular unit that works closely with the 3090 complex is the 3092 Processor Controller. The 3092 Models 1 and 2 is a major system component which performs many key monitoring and control functions for all 3090 models. When Model 200E or Model 300E users upgrade to a Model 400E or Model 600E respectively, they must also upgrade from a 3092 Controller Model 1 to a Model 2. Processor activities include:

- **power sequence control and initialization;**
- **power on and off;**
- **monitoring and control of power supplies, temperatures and coolant flows;**
- **support for S/370 or 370-XA modes of operation;**

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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/ 6250		125	200,000 780,000
3430	9	1600	PE	50	80,000
	9	6250	GCR	50	312,500
3480					
Model B22	18	38,000	—	79	3,000,000
Model B11	18	38,000	—	79	1,500,000

Printers	Printing Speed	Print Positions	Horizontal Spacing, Chars./Inch	Vertical Spacing, Lines/Inch	Form Size, Inches
3203 Model 5	1200 lpm	132	10	6 or 8	3.5 to 20.0 wide, 3.0 to 24.0 long
3800:					
Model 1	Up to 20,040 lpm	136, 163, 204	10, 12, 15	6, 8, 12	6.5 to 14⅞ wide, 3.5 to 11.0 long
Model 3*	Up to 20,040 lpm	136, 163, 204	10, 12, 15	6, 8, 10, 12	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 1	2200, 3000, or 3600 lpm	132 std.; 168 opt.	10	6 or 8	Not specified

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

frames last year said to outperform IBM's Model 400, its previous top-end model.

To remedy this situation and address some of these problems, IBM introduced two new 3090 models in January 1987, the three-way Model 300E and the six-way Model 600E. IBM is scheduled to deliver these new models by third quarter 1987. This is also when NAS is scheduled to

- **control of the configuration of hardware elements; and**
- **control unit function for required and optional consoles and an optional printer.**

Other functions include:

- **local and remote alarm capabilities;**
- **error recovery;**

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bring out its top-end Model 100, a four-processor system rated at 81.2 MIPS. Amdahl, meanwhile, is scheduled to deliver its top-end Model 600, rated at between 56 and 75 MIPS by fourth quarter 1987.

Last September, Amdahl also announced the availability of a channel transfer speed of 4.5 megabytes per second for all of its models. In January 1987, NAS increased its data transfer speed to six megabytes per second for all AS/XL mainframes. IBM's and most other current mainframe products have a top transfer rate of 3 megabytes per second, although analysts are expecting IBM to increase transfer speeds to 4.5 or 6 megabytes per second sometime this year.

As IBM continues to battle the PCMs while courting standoffish mainframe customers, its traditional U.S. mainframe rivals seem less of a factor than ever before. The Great Shakeout of 1986 saw mainframe vendors enter into mergers and planned corporate alliances to remain competitive in an IBM-dominate mainframe world.

Burroughs and Sperry, now a single corporate entity under the Unisys banner, contend they can compete against the IBM monolith better by combining their user bases to form a larger critical mass. Honeywell, on the other hand, has thrown in the towel after years of disappointments, and now believes it can better serve its considerable worldwide user base through planned alliances with Groupe Bull of France and NEC of Japan. This move makes sense, since the three have shared technologies to create similar system architectures. The three have been marketing one another's product lines for years. NCR, meanwhile, has been doing fine exploiting niche markets such as transaction processing. It no longer really competes in the mainframe world.

ADVANTAGES AND RESTRICTIONS

When announced in February 1985, the IBM 3090 seemed to fall short of the dramatic technology breakthroughs many IBM watchers were expecting. Now that a full two years have elapsed since the announcement of IBM's new strategic mainframe line, support for an earlier observation is all the more stronger. It's even become something of an industry cliche that goes something like this; IBM 370 architectural improvements will proceed at an *evolutionary* rather than *revolutionary* pace. As proof, witness the recent evolution. The first 3090 model to be delivered in 1985, the two-processor Model 200, was little more powerful than an existing four-way IBM 3084 QX. The Model 400, previously the fastest 3090 machine, was finally delivered in August 1986, a year and a half after the series was announced. In January 1987, IBM announced a six-way Model 600E, the new top-end model that will be delivered in third quarter 1987, two and a half years after the original 3090 Series unveiling. In this time, CPU cycle times have gradually improved. The first 3090s had a cycle time of 18.5 nanoseconds compared to 24 nanoseconds available with the IBM 308X Series. The latest 3090 versions now operate at 17.2 nanoseconds. (The low-end Model 150E operates at 17.75 nanoseconds.)

• execution of error analysis routines for isolation of failing field replaceable units;

• diagnostic capabilities; and

• full processor complex remote service capability.

In addition, the controller collects information for three areas: system activity display frames, I/O problem determination frames, and status information for customer problem analysis frames.

Each controller model includes two processor elements (A-side and B-side) and requires the following for full-processor support: two 3370 DASD Model A2 units (each with a string-switch feature); access to a channel-attached 3803 Tape Control Unit Model 2 (or equivalent) and its associated 3420 Magnetic Tape Unit Models 4, 6, or 8 (or equivalent), and one 3864 Modem Model 2 (or equivalent) with an automatic calling unit feature.

While one processor element remains active, the other processor acts as a backup processor. It also continues to monitor the active processor and stands at the ready should the active processor fail. In most cases, if the active processor fails, a switchover to the backup processor occurs.

The 3092 Controller contains a system power panel that includes power on and off switches, emergency power off, and power status and service mode indicators.

When the 3090 Processor Complex is initialized, the 3092 validates areas of central storage as error-free data locations, records failing storage locations, and assigns the hardware system area in central storage based on continuous error-free locations. When power sequencing is completed, the processor controller performs an initial microprogram load.

Another major 3092 feature is error-recovery. The controller logs errors as they occur and then analyzes and correlates multiple symptoms, and isolates the failure to the failing field-replaceable units. When system attempts to correct errors fail or when errors occur frequently, an audible alarm is sounded to bring the problem to the attention of the operator. Other activities and features include enhancements to automate the reporting of problems and remote support access to assist with problem resolution.

The 3097 Power and Coolant Distribution Unit contains the power distribution functions, heat exchanger, pumps, and controls necessary to cool the liquid-cooled portion of the processor complex. Other features include an I/O Power Sequence Control capability for power on and off control of up to 128 I/O control units. The 3097 Model 2 has all the power and cooling distribution capabilities of the 3097 Model 1, but does not include the input/output power sequence control function. This provides flexibility to users who want to use I/O power sequencing on control units attached to their 3090. Additionally, Model 2 users can upgrade to a Model 1.

The 3089 Power Unit Model 3 supplies 400 Hz power to the 3090 Processor Complex. The unit contains a motor-generator housed in a noise-suppressing frame and was designed for machine-room environments.

The 3180 Display Station Model 145 is used as either a system or maintenance console. The 3090 Models 150E, 180E, 200E, and 300E require a system console for interaction with the processor complex and the two 3092 processor elements and a service support console. The Model 400E and Model 600E require two system consoles and a system support console. The service support console must be placed

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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

In the memory chip technology area, IBM introduced 288K-bit chips when the 3090s were first announced, a big improvement over the 64K-bit chips used in the previous mainframe generation. Now IBM uses one-million bit chips in its latest mainframe versions, a dramatic technology leap that should improve processing speed and throughput. In the logic gate area, IBM switched from the transistor-to-transistor logic used in the 308X Series to the faster Emitter Coupled Logic.

The 1985 announcement of the new Vector Facility seem a clear indication commercial mainframes of the future will be incorporating specialized architectures to carry out specialized tasks, such as compute-intensive engineering/scientific applications, side by side with commercial applications. Users can add a Vector Facility to each processor of a 3090 mainframe, making it possible to introduce vector capabilities at a reasonable price. Vector capabilities were not available for the 308X mainframe generation.

A final improvement IBM introduced to bypass channel bottlenecks is expanded storage, a special part of processor memory reserved for system use only. This optional feature helps ease the paging and swapping load of the processor and reduces system overhead. It's now available to all the 3090 mainframes in varying degrees. A fully configured Model 400E or Model 600E can have up to one gigabyte of expanded memory. Expanded storage takes advantage of the fact that the CPU complex can process data at a much faster rate than peripheral devices can send it. By moving data to this intermediate storage area, data can be made available to the CPU a lot quicker. Analysts have long felt, however, that the full benefits of expanded storage are not achievable until IBM increases channel speeds to a full six megabytes per second. Maximum I/O channel speed in data streaming mode remains at three megabytes per second. IBM may be on the verge of announcing a 4.5 or 6 megabytes per second capability very shortly. Software issues are believed to be the stumbling block for the moment.

To take full advantage of the expanded storage concept, users who haven't done so already, will have to migrate to

within 33 feet of the 3092 controller, while the system display can be placed 4,921 feet from the 3092.

The 3864 Modem Model 2 is required to obtain service for the 3090 Processor Complex. A unit comes equipped with an Automatic Calling Unit (#5801) and a dedicated telephone line for the remote service facilities.

Error detection and correction can be performed at several levels. Should automatic recovery procedures fail, a user has access to problem analysis frames and procedures to facilitate recovery and also has access to the remote service facility (RSF).

The 3092 Processor Controller usually plays a key role in error recovery. The controller provides both automatic recovery from many hardware malfunctions such as errors in main storage and reports machine or channel-check interruptions. When an error is detected, the 3092 automatically performs error analysis to pinpoint the error and isolate the field-replaceable unit or units that could be causing the problem. When detected, the controller logs in the problems and offers diagnosis.

When errors cannot be corrected automatically, users can begin problem analysis procedures from the system console index frame. If the problem was caused by a power malfunction, the first of a set of power status problem analysis frames is displayed. When the problem lies elsewhere, the first of a second set of problem analysis frames is displayed. Problem analysis categories include non-I/O hardware errors; unsuccessful IPL; enabled or disabled wait state; interface control checks; I/O device errors, and operator console lockout.

When it's determined that assistance from the remote service facility (RSF) is required, the operator can initiate remote service from the problem analysis procedures or by invoking the RSF authorization frame and establishing the remote connection. When the service request is authorized, a telephone number is automatically dialed over the public switched network to establish a connection with a remote modem. The remote modem acknowledges the connection and activates the RSF. The RSF can assume control over the 3090 system and manipulate the processor unit through remote control.

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.

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the System/370 Extended Architecture operating system. Operating software releases that support the extended architecture are MVS/SP-JES3 Version 2 Release 1.3 and 1.5. Extended architecture offers such enhancements as storage constraint relief through 31-bit addressing, the dynamic channel subsystem, and a number of reliability, availability, and serviceability features.

Even with all of IBM's technology advances, a big bugaboo for many IBM shops continues to be interconnectivity, an area IBM has begun to address. It is difficult to make IBM's various computer lines using different operating systems talk to one another. Fielding multiple incompatible computer products aimed at various markets no longer seems to be good business strategy. IBM has been trying to correct the problem with software and hardware products and also with the recent delivery of the mid-range 9370, a product that extends the range of the IBM 370 architecture along with MVS and VM operating systems down to the supermini level. This will make it possible for users to download portions of MVS and VM applications residing within larger host systems to a departmental level machine. Making standard IBM operating systems available to a greater variety of product lines is, of course, long overdue, since rival vendors such as Digital already have product-wide compatibility.

Another area of advantage centers around upward growth compatibility. Users outgrowing a 308X Series processor can migrate to the 3090. Field upgradability is not possible between the two systems, but the 3090 will support the same software and peripherals supported on the 308X Series.

When making price comparisons between the new 3090 Series and competing systems, users should be aware of what the 3090 Series includes. Most of the required components are priced separately. The Model 200E, for instance, includes the central processors, 64 megabytes of main memory, two 64K-byte buffers, and 32 integrated channels. Priced separately are the 3092 Processor Controller Model 1, the 3097 Power and Coolant Distribution Unit, two 3089 Model 3 Power Units, two 3370 Model A2 DASDs, two 3180 Model 145 Display Stations, and the 3864 Model 2 Modem, all required components.

USER REACTION

The 1986 Datapro survey of general purpose mainframes yielded responses from 25 IBM 3090 Model 200 users. (Models announced after February 1986 were not rated.) The Model 200 systems were in operation an average of 15.79 months at the time the survey was taken. Of those surveyed, 44 percent said they purchased the machines from IBM, while 56 percent leased the hardware from a third party. None leased from IBM. Sites surveyed represented a variety of industries with no single industry clearly dominating. Industries mentioned most often were banking/finance/securities, utilities, and insurance. Four users from each of these areas responded. Other industries responding in order of frequency were health care/medical

Reliability, availability, and serviceability features are implemented throughout the 3090 Processor Complex. RAS capabilities include:

- **TCM/ECL technology that provides a low intrinsic failure rate;**
- **A dual processor controller that can switch over to and initialize the functional side should the other side fail;**
- **Multiple security provisions for data integrity and system security;**
- **Alternate input for like functions using service language commands, display frames, and function keys; and**
- **Multiple consoles for monitoring functional console activity and for backup.**

Availability features include:

- **Automatic error detection and correction in both central storage and expanded storage;**
- **Storage deallocation;**
- **Ability to take a failing channel off-line;**
- **Automatic fault isolation concurrent with operation; and**
- **Operator problem analysis procedures to correct problems without the need for a service call.**

Serviceability features include:

- **On-site problem solving through use of field-replaceable unit isolation, trace tables, and logout error recording; and**
- **Automatic remote service capability.**

SPECIAL FEATURES: To address computationally intensive scientific and engineering applications, IBM offers the Vector Facility. The feature, which can be added to any processor within a 3090 complex, adds a vector extension to the basic IBM System/370 and 370 Extended Architecture. The Vector Facility is suited to such applications as structural design, reservoir modeling, fluid dynamics, and load flow. The Vector Facility is a field-installable option that is implemented in both hardware and software.

The facility can be installed on the Models 150E and 180E and on each processor of a dyadic Model 200E, a three-way Model 300E, a four-way Model 400E, and a six-way Model 600E and will be supported by MVS/XA and VM/SP High Performance Option. The Vector Facility feature adds 171 new instructions and 16 vector registers each containing 128 32-bit elements. Other features include binary, 32-bit, and 64-bit floating-point operands, using contiguous, noncontiguous, and random addressing.

The new features should produce results using fewer machine cycles. Multiplier and arithmetic/logic units using pipelining techniques can produce 32-bit or 64-bit sums, differences, or products during each cycle. Compound operations are able to produce both a product and sum during each cycle. Other features designed to improve the performance of engineering/scientific jobs include high-speed multiply, fast floating-point add/subtract, fast loop control execution, and 64-bit wide data paths.

According to IBM, the facility can improve system performance for vector, parallel, and scalar operations. Engineering/scientific (E/S) jobs using the Vector Facility had 4.1 to 9.2 times the internal throughput rate of a 3081 Model Group KX per central processor. E/S jobs measured for

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(three), service bureaus (three), and retail/wholesale (two). Finally, industries mentioned at least once were government, engineering/scientific, transportation, chemical/petroleum, and manufacturing. The primary application areas are consistent with overall large-system survey results. Accounting/billing was rated as the top application area at 76 percent. Runner ups included payroll/personnel (60 percent), purchasing (44 percent), order processing/inventory (40 percent), and health care/medical and insurance (both tied at 24 percent).

As would be expected, most of the rated Model 200s are part of large-scale configurations. Out of 25 sites, users from 19 sites said they had configured more than 64 megabytes of main memory. Another five had between 32 and 64 megabytes of memory, while one had between 16 and 32 megabytes of memory. Additionally, 22 sites had more than 60 local workstations and 24 sites had more than 60 remote workstations.

During 1986, 84 percent of those surveyed said they planned to acquire additional software from the manufacturer, and 80 percent said they planned to purchase proprietary software from other suppliers. Only 4 percent said they planned to acquire a Unix-based operating system. At the time the survey was taken, 100 percent said they obtained applications software from in-house personnel, 44 percent said they obtained it from contract programming, 16 percent said they obtained it from the manufacturer's personnel, 52 percent said they bought packaged programs from the manufacturer, and 56 percent said they obtained software from independent suppliers.

Finally, 72 percent said they had a disaster recovery plan and 76 percent said they had an information center.

The table that follows shows how the 25 sites rated their 3090 Model 200s. Interestingly, overall ratings results are quite strong in most categories. Just the same, ratings in the maintenance service and technical support area are quite respectable. Predictably, IBM did not do as well in the software categories, particularly within the applications software area.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	12	11	2	0	3.40
Reliability of mainframe	21	4	0	0	3.84
Reliability of peripherals	17	8	0	0	3.68
Maintenance service:					
Responsiveness	14	10	1	0	3.52
Effectiveness	15	9	0	0	3.63
Technical support:					
Troubleshooting	10	15	0	0	3.40
Education	7	17	1	0	3.24
Documentation	5	19	1	0	3.16
Manufacturer's software:					
Operating system	10	14	1	0	3.36
Compiler & assemblers	9	15	1	0	3.32
Application programs	2	15	6	0	2.83
Ease of programming	0	20	5	0	2.80
Ease of conversion	1	16	8	0	2.72
Overall satisfaction	6	18	1	0	3.20

*Weighted Average on a scale of 4.0 for Excellent.

engineering/scientific scalar processing performance had 2.1 to 3.1 times the internal throughput of a 3081 KX for each central processor.

A Model 150E with a Vector Facility should perform 1.2 to 3.5 times better than it would under scalar performance alone. A Model 180E should perform at 1.5 to 3.2 times its scalar performance. A Model 200E should have 2.1 to 2.2 times the performance of a Model 180 outfitted with a Vector Facility. A Model 300E should have 1.6 to 1.7 times the performance of a Model 200 with a Vector Facility. A Model 400E is expected to have 2.0 to 2.2 times the performance of a Model 200 with a Vector Facility. A Model 600E should have 1.4 to 1.6 times the performance of a Model 400 with a Vector Facility.

PHYSICAL SPECIFICATIONS: The specifications listed are for the older Model 200 and Model 400 systems. Specifications for the new "E" models were not yet available at press time. A basic Model 200 configured with 64 megabytes of main memory and 32 channels will typically require 37.4 kVAs when operating at 400 Hz. This same configuration has a typical heat output to air of 12.1 Btus per hour. A fully configured Model 200 featuring 64 megabytes of main memory, 128 megabytes of expanded storage, and 48 channels requires 44.1 kVAs. This same configuration has a typical heat output to air of 13.2 Btus per hour. A basic Model 400E configured with 128 megabytes of main memory, 64 channels will typically require 40.0 kVA. This same configuration has a typical head output of 10.6 Btus.

CONFIGURATION RULES

The 3090 Processor Complex Model 150E consists of a single central processor, a 3092 Processor Controller Model 1, a 3097 Power and Coolant Distribution Unit Models 1 or 2, one 3089 Power Unit Model 3, two 3370 Direct Access Storage Model A2s each with String Switch (#8150), two 3180 Display Station Model 145s, and a 3864 Modem Model 2 equipped with Automatic Calling Unit (#5801).

The 3090 Processor Complex Model 180E consists of a single central processor, a 3092 Processor Controller Model 1, one 3097 Model 1 Power and Coolant Distribution Unit, one 3089 Power Unit Model 3 (or two 3089s if processor complex is configured with more than 192 megabytes or 256 megabytes of Expanded Storage in addition to a Vector Facility), two 3370 Direct Access Storage Model A2s each with String Switch (#8150), two 3180 Display Station Model 145s, and a 3864 Modem Model 2 equipped with Automatic Calling Unit (#5801).

The 3090 Model 200E Processor Complex consists of two central processors, a 3092 Processor Controller Model 1, and a 3097 Power and Coolant Distribution Unit. It also requires two 3089 Power Unit Model 3s or other appropriate 400 Hz source of power, two IBM 3370 Direct Access Storage Device Model A2s with string switch (#8150), two IBM 3180 Model 145 display stations, and an IBM 3864 Modem Model 2 equipped with Automatic Calling Unit (#5801).

The 3090 Model 300E consists of three central processors, a 3092 Processor Controller Model 1, a 3097 Power and Coolant Distribution Unit Models 1 or 2, two 3089 Model 3 power units or equivalent power source, two 3370 Model A2 DASDs each with String Switch (#8150), two 3180 Model 145 Display Stations, and a 3864 Modem Model 2 equipped with Automatic Calling (#5801).

The Model 400E Processor Complex consists of four central processors, a 3092 Processor Controller Model 2, and two 3097 Power and Coolant Distribution Units Models 1 or 2. It also requires four power units (3089 Model 3), or other appropriate 400 Hz source of power, two 3370 Model A2s

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Several users were contacted for further comments about the 3090. Users at a Texas hospital chain, a Chicago telephone utility, and a New England retail/wholesale business all said they had virtually no problems with their 3090 Model 200s after more than a year of service. The utility users said the Model 200 "runs faster than the 3081," the IBM system the site upgraded from. The retail/wholesale concern said Model 200 reliability is "excellent." "We've had 99.8 percent uptime," the user said. The hospital site user said he was pleased with the smaller size of the Model 200 complex compared to the four-processor 3084 system previously installed.

When all 25 surveyed users were asked if their Model 200s performed as expected, 96 percent said "Yes," while 4 percent were undecided. When asked if they would recommend the Model 200 to others, the results were identical. □

with String Switch (#8150), three 3180 Model 145 display stations, and two 3864 Modem Model 2s, each equipped with Automatic Calling Unit. (#5801).

The Model 600E consist of six central processors, a 3092 Model 2 Processor Controller, two 3097 Model 1 or 2 Power and Coolant Distribution Units, four 3089 Model 3 Power Units or equivalent 400 Hz power source, two 3370 Model A2 DASDs, three 3180 Model 145 Display Stations, 3864 Modem Model 2 equipped with Automatic Calling (#5801).

INPUT/OUTPUT CONTROL

The channel subsystem (CSS) handles all I/O operations for the central processors. The CSS controls communication between a configured channel, control unit, and device. The I/O configuration data set (IOCDS), selected at system initialization, identifies channel, control unit, and device configurations to the channel subsystem. The I/O Configuration Program creates the IOCDS, which is stored on 3370 DASDs attached to the processor controller. During initialization, the IOCDS information is used to build necessary control blocks in the hardware system area of central storage. In addition, the CSS contains a channel control element (CCE), which interacts with central storage, the central processors, and the channels. In operation, the CCE initiates and ends channel operations, provides central storage access control, and assigns priorities for I/O operations.

In byte multiplexer operation, channels can be used either in byte multiplex mode or in burst mode. In byte multiplex mode, several relatively slow-speed I/O devices can operate concurrently. In block multiplex operation, channels can operate either in high-speed transfer mode or in datastreaming mode. In datastreaming mode, a block multiplexer channel can transfer at up to three megabytes per second, and 1.5 megabytes per second in high-speed transfer or DCI mode. Each byte multiplexer channel is capable of operating with an aggregate data rate in the range of 90K to 300K bytes per second for data transfer burst sizes of four bytes or more. Configurations consisting of control units with faster I/O interface tags and larger data transfer burst sizes can achieve the higher performance.

Up to eight control units can be attached to a channel, and each channel can address up to 256 I/O devices.

Channels may operate in either System/370 Extended Architecture (370-XA) mode or System/370 Mode. In 370-XA mode, up to four channel paths are available to any attached I/O device. During any I/O operation, one of the available channel paths to any specific I/O device is selected. Channel path selection is a hardware function rather than a system-control program function. In System/370 mode, any channel may be assigned any valid channel address without concern for priority. Logically, channels are organized into two sets, one per central processor. Operating under the MVS/System Product, Version 1 Release 3.5, up to 16 channels can be assigned to a channel set, while the maximum is 32 channels per channel set when operating under the VM/High Performance Option Release 3.6. Channel set switching is a standard feature available on this processor.

MASS STORAGE

IBM disk storage devices are covered in Table 2.

INPUT/OUTPUT UNITS

IBM tape drives and printers are 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 3814 uses an integrated microcode-driven processor and features password authorization, stored configurations, and extensive self-diagnostic functions. The 3814 system consists of three basic units, each available in four models. These include the Models A1 to A4 control units, Models B1 to B4 remote units, Models C1 to C4 expansion units, and the 3604 Model 6 Keyboard/Display Unit.

For a more detailed report on the 3814 and its features please refer to Report 70D9-504MK-101 in Volume 2. Another new product relating to peripherals is the IBM 3044 fiber-optic channel extender link. The product allows peripherals to be placed up to 6,600 feet (2 kilometers) farther away from IBM processors. According to IBM, remote printer displays and other low- to medium-speed peripherals using the fiber-optic link can run at speeds almost matching the speeds of devices locally connected to a central processor.

TERMINALS

IBM terminals are covered in Table 4.

COMMUNICATIONS CONTROL

3705 COMMUNICATIONS CONTROLLER: This programmable front-end network processor can be connected to either a byte or block multiplexer channel on a 3090 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

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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 consists of a central control unit which operates under control of the Advanced Communications Function/Network Control Program, Emulator Program, or Partitioned Emulator Program. Main storage is available in 512K-, 786K-, 1024K-, or, on Model 1, 2048K-byte sizes. 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 and 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. 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 3275 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 Model 1. Model 2 allows for attachment of up to 24 full-duplex or half-duplex lines. Model 2 is field-upgradable to Model 1.

SOFTWARE

OPERATING SYSTEMS: The 3090 Processor Complex is supported natively by the MVS/SP and VM/SP operating systems. Any program written for the System/370 or 370-XA mode can be run on a 3090 using MVS/SP or VM/SP provided the program: 1) is not time-dependent, 2) is not dependent on system facilities and peripherals that may be present or absent from a 3090 configuration, and 3) does not depend on results or functions as defined in the System/370 Principles of Operation as being unpredictable, model dependent, or deviations, 4) does not depend in 370-XA mode on the contents of instruction parameter fields B and C on interception of the SIE, and 5) does not depend (in S/370 mode) on the presence of the 2K-byte page size, or the presence of storage protection keys associated with 2K-byte blocks of storage.

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

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).

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 and 3090 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 and 3090 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 3.5 provides support for IBM 3090 Series processors in System/370 mode, simplifies global resource serialization processing, and provides standalone dump support for the 3480 Magnetic Tape Subsystem in full-function mode. This release does not support the expanded storage option available on 3090 processors.

MVS/SP-JES2 Version 1 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, improved SPOOL offload facility, and enhancements to the $SCAN facility. Additionally, the release reduces planned outages through operator-modifiable initialization parameters and changes to JES2 initialization-definition statements.

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

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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 a hardware function. Channel path selection and I/O busy condition management provide up to four channel paths to each I/O device. The facility also increases I/O device accessibility by allowing each central processor to initiate operations with any of the I/O devices and to handle any I/O interruption conditions. 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 1.3 provides support for the 3090 Processor Complex in System/370 Extended Architecture (370-XA) mode. The release supports the expanded storage option for the 3090 processor and also provides for additional reliability, availability, and serviceability enhancements.

Multiple Virtual Storage/System Product 2.1.3 Vector Facility Enhancement supports the Vector Facility. The software product lets systems using the Vector Facility recognize a vector user and assigns the vector job to the central processor set up for vector processing. The software release features vector affinity, System Management Facilities, enhanced operator commands, and serviceability enhancements. Operating under MVS/XA, a vector affinity feature automatically allows the users to run on the central processor that has the Vector Facility. System Management Facilities provides accounting information detailing Vector Facility usage and affinity. New operator commands let operators display systems using the Vector Facility and bring the processor equipped with the Vector Facility on- or off-line. The Vector Facility can be brought off-line independent of the central processor. Additionally, the Interactive Problem Control System and standalone dump have been enhanced. Checkpoint restart supports the Vector Facility.

MVS/SP-JES2/3 Version 2 Release 1.5 provides virtual storage constraint relief through MVS-XA exploitation, and expanded trace facilities. Additionally, the release provides two new JES3 user exits, improved usability for job networking, and greater flexibility in coding initialization statements.

MVS/SP-JES3 Version 2 Release 1.7 provides supports for the Model 400 in System/370 Extended Architecture mode and also provides reconfiguration support. Reconfiguration support involves those functions involved in processor side partitioning and expanded storage. A side consists of the channel paths, processors, expanded storage elements, real storage elements, and vector facilities that can support a single operating system.

MVS/XA Data Facility Product Version 2 Release 1 provides support for IBM disk storage devices, tape and printer devices, in addition to virtual storage constraint relief below the 16-megabyte line. Specifically, the release provides support for the IBM 3380 Extended Capability Models AD4/BD4 and AE4/BE4, the IBM 3430 Magnetic Tape Subsystem, and the IBM 4245, 4248, and 3262 Model 5 line printer. Also featured are Direct Access Device Space Management enhancements in allocation and partial release and increase available virtual storage below the 16-megabyte line.

DFSORT Release 7 improves sorting performance in MVS/XA environments by using IBM System/370-XA Sorting Assists and providing virtual storage constraint relief.

VM 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 provides virtual machines with the ability to run multiple operating systems concurrently and with a conversational time-sharing system.

VM 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 Virtual Machine/System Product High Performance Option Release 3.6 and 4.2, functionally equivalent to VM/SP HPO Release 3.4, provides support for the IBM 3090 Model 200 in S/370 architecture, its expanded storage, and up to 48 channels. VM/SP HPO will also support the 3090 Model 400 in partitioned processing mode when the processor becomes available.

VM/SP High Performance Option Release 4.2 Support for Vector Facility supports the Model 200 equipped with the Vector Facility and will support the Model 400 with the Vector Facility in partitioned mode only. This latest release of the High Performance Option contains all the functions of the currently available VM/SP HPO Releases 3.6 and 4. VM/SP HPO Release 4 supports the execution of vector applications while also supporting VS Fortran Version 2 on CMS, Assembler H, the Engineering and Scientific Subroutine Library, additional control program commands, and applications that use the Vector facility. Such applications do not require special setups and programming.

VM/SP High Performance Option Release 5 is offered as an adjunct to VM/SP Release 5 and comes with additional features. The product is designed to support large CMS-based interactive environments and facilitates the running of MVS/370 production systems under VM. The product merges functions from VM/SP Release 5 in addition to VM/SP HPO Release 5 functions and supports up to 9,900 SPOOL files per user. This relieves the previous constraint of 9,900 SPOOL files per system.

VM Inter-System Facilities brings together two VM/SP HPO Release 4.2 systems. Using this product, the two VM/SP HPOs appear to function as one single, but larger system, making it possible for more users to participate in the same application environment.

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 supports the IBM 3090 processors and the Start Interpretive Execution (SIE) Assist feature. Additionally, it provides dedicated-only support of the 3090 expanded storage. Furthermore, dedicated support is provided for

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the 3880 Model 23 Storage Control, the 3380 Model AE4 and BE4 DASD units, the 3370 DASD, and the 3430 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.

VM/XA Systems Facility Release 2 supports the Model 400 in four-way, single-image configuration, supports the Vector Facility; upgrades the CMS component to CMS 4, and extends CMS program product support. It also supports the 3800 Model 3 in Model 1 compatibility mode, provides load parameter support, and provides a dialed terminal test/normal reset capability. Serviceability enhancements include control program trace facility and dump viewing facility component improvements.

VM/XA Systems Facility Release 2 Additional Enhancements extends VM/XA support to the new processor systems announced on January 26, 1987 including the Models 300E and 600E. The product also provides support for IBM 3380 Models AE4 and BE4 and 3880 Models 11, 13, 21, and 23 Control Units, the IBM 5080 Graphics System, the IBM 3480 Magnetic Tape Subsystem, the IBM 3890 Document Processor, the IBM 3720 Communications Controller, and 3090 Expanded Storage. The product also supports a "Vary Channel Path," command, which lets operators make a channel path logically available or unavailable to one or more real devices.

VM/XA Realtime Monitor/SP Release 2 complements the previous release of this product and provides additional support for processors announced on January 26, 1987. It also supports Vector Facility data gathering, provides additional user friendly display command options in addition to changes made in VM/XA System Facility Release 2. The product only runs under VM/XA Systems Facility Release 2.

INTERACTIVE EXECUTIVE/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 LANGUAGES: 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; VS Fortran Version 2 Compiler, Library and Interactive Debug; VS Fortran Version 2 Library; OS PL/1 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.

DATABASE 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/1 I/O error processing, dynamic backout enhancements, DL/1 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 is 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 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

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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 each 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/1 database system, according to IBM. The dictionary simplifies the entry of DL/1 database definition and declaration for Cobol, PL/1, and Assembler language programs.

Query Management Facility (QMF) is an interactive database 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/T-CAM) 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), Network Communication Control Facility (NCCF), 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 structures (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 it to CICS if it 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.

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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 database 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 database. 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 users 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.

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).

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.

The 3090 Vector Facility Simulator, operating under CMS virtual machines on VM/SP and VM/XA, provides software simulation of 3090 Vector Facility hardware instructions. The program offering simulates 3090 Vector Facility instructions in object programs, helps scalar applications migrate to the 3090 Vector facility and helps programmers develop new vector applications. In addition, the simulator provides statistics related to application migration and development and serves as a vector processor instruction tool. The product can run on 4300, 308X, and 3090 processors.

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 devises, 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.

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, generate control statements for utilities to move data, and identifies all affected Job Control Language statements and produce jobstreams to update them.

Vector Processing Subsystem/Vector Facility simulates the IBM 3838 Array Processor. This lets users run 3838 applications on a 4381, 308X, or 3090 host system in System/370 Extended Architecture mode running either scalar or vector modes. The facility supports the concurrent use of real and virtual 3838s.

The Engineering and Scientific Subroutine Library provides Fortran and Assembler applications programmers with a set of mathematical subroutines whose performance is enhanced through the IBM 3090 Vector Facility. The Library runs under MVS/XA or VM/SP HPO, and VM/XA. Programs generated under VS Fortran Versions 1 and 2, or Assembler H Version 2 can take advantage of the facility. In addition to vector support, scalar versions of the subroutines are also supported.

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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 $165 per hour and the per-call charge during off hours is $190 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 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

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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 3090 configurations. They include all the necessary control units and adapters, but do not include any specialized software.

SMALL CONFIGURATION:

3090 Model 150E Processor Complex; 32 megabytes of main memory, 16 integrated channels	$1,250,000
One 3092 Processor Controller Model 1	200,000
One 3097-1 Power and Coolant Distribution Unit	121,000
One 3089 Power Unit Model 3	38,000
Two 3370 Direct Access Storage Model A2s	70,960
Two 3180 Display Station Model 145s	4,790
Automatic Calling Unit for 3864-2 Modem	1,090
90 3278 Display Unit Model 2s	141,480
Three 3274-31A Communications Controllers	49,950
Nine 6901 Terminal Adapters	8,262
Three 3880 Model 3 Controllers Controllers	180,810
Three 3380-AE4 Direct Access Storage Devices (DASD)	367,440
Nine 3380-BE4 DASD Slave Units	883,260
Sixteen 3420 Model 8	318,080
Sixteen 6250/1600 bpi Dual Density Features	35,280
Two 3803-2 Tape Controllers	55,100
Multiple Tape Control Switch; two tape control	6,130
Two 3480 Tape Cartridges A22 Control Units	130,860
Four B22 Cartridge Tape Units	172,480
Three 4248 Model 2 printers	225,000
One 3800 Model 3 laser printer; (20,040 lpm)	330,750
TOTAL PURCHASE PRICE:	$4,590,722

MEDIUM CONFIGURATION:

3090 Model 200 Processor Complex; 64 megabytes of main memory, 32 integrated channels	$4,100,000
128 megabytes of expanded storage	695,000
One 3092 Processor Controller Model 1	200,000
One 3097-1 Power and Coolant Distribution Unit	121,000
Two 3089 Power Unit Model 3s	76,000
Two 3370 Direct Access Storage Model A2s	70,960
Two 3180 Model 145 Display Stations	4,790
Automatic Calling Unit for 3864-2 Modem	1,090
90 3278 Display Unit Model 2s	141,480
Three 3274-31A Communications Controllers	49,950
Nine 6901 Terminal Adapters	8,262
Three 3880 Controllers Model 3	180,810
Three 3380-AE4 Direct Access Storage Devices (DASD)	367,440
Nine 3380-BE4 DASD Slave Units	883,260
Sixteen 3420 Model 8	318,080
Sixteen 6250/1600 bpi Dual Density Features	35,280
Two 3803-2 Tape Controllers	55,100
Multiple Tape Control Switch; two tape control	6,130
Two 3480 Tape Cartridges A22 Control Units	130,860
Four B22 Cartridge Tape Units	172,480
Three 4248 Model 2 printers	225,000
One 3800 Model 3 laser printer; (20,040 lpm)	330,750
TOTAL PURCHASE PRICE:	$8,173,722

LARGE CONFIGURATION:

3090 Model 600E Processor Complex; 128 megabytes shared central storage, 64 integrated channels	$10,944,000
64 megabytes of additional central storage; A side	540,000
64 megabytes of additional central storage; B side	540,000
512 megabytes of expanded storage; A side	2,435,000
512 megabytes of expanded storage; B side (1 gigabyte of expanded storage total)	2,435,000
First additional channel group; 8 channels, A side	130,000
Second additional channel group; 8 channels, A side	130,000
Third additional channel group; 16 channels, A side	260,000
First additional channel group; 8 channels, B side	130,000
Second additional channel group; 8 channels, B side	130,000

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Third additional channel group; 16 channels, B side	260,000
One 3092 Processor Controller Model 2	235,000
Two 3097-1 Power and Coolant Distribution Unit	242,000
Four 3089 Model 3 Power Units	152,000
Two 3370 Direct Access Storage Model A2s	70,960
Three 3180 Model 145 Display Stations	7,185
Two Automatic Calling Units for 3864-2 Modem	2,180
90 3278 Display Unit Model 2s	141,480
Three 3274-31A Communications Controllers	49,950
Nine 6901 Terminal Adapters	8,262
Six 3880 Controllers Model 3	361,620
Six 3380-AE4 Direct Access Storage Devices (DASD)	734,880
Eighteen 3380-BE4 DASD Slave Units	1,766,520
Sixteen 3420 Model 8s	318,080
Sixteen 6250/1600 bpi Dual Density Features	35,280
Two 3803-2 Tape Controllers	55,100
Multiple Tape Control Switch; two tape control	6,130
Two 3480 Tape Cartridges; A22 Control Units	130,860
Four B22 Cartridge Tape Units	172,480
Three 4248 Model 2 printers	225,000
One 3800 Model 3 laser printer; (20,040 lpm)	330,750
TOTAL PURCHASE PRICE:	$22,979,717

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
PROCESSORS & FEATURES					
Model 150E	Processor Complex consists of CPU, 32MB of central storage, 64K-bytes of buffer memory, and 16 integrated channels; requires 3092-1 Processor Controller, 3097-1 or -2 Power and Coolant Distribution Unit, 3089-3 Power Unit, two 3180-145 System Consoles, and 3864-2 with Automatic Calling Unit	1,250,000	2,400	108,350	—
Model 180E	Processor Complex consists of CPU, 32MB of central storage, 64K-bytes of buffer memory, and 16 integrated channels; requires 3092-1 Processor Controller, 3097-1 or-2 Power and Coolant Distribution Unit, 3089-3 Power Unit, two 3180-145 System Consoles, and 3864-2 with Automatic Calling Unit	2,200,000	2,870	183,350	—
Model 200E	Processor Complex; consists of two CPUs, 64MB of main memory, 64K-byte buffer per CPU, and 32 integrated channels; requires 3092-1 Processor Controller, 3097-1 or -2 Power & Coolant Distribution Unit, two 3089-3 Power Units, two 3180-145 System Consoles, and a 3864-2 Automatic Call Unit	4,100,000	5,900	414,000	—
Model 300E	Processor Complex; consist of three CPUs, 64K-byte buffer per CPU, 64MB of main memory, 32 integrated channels,; requires 3092 Model 1 Processor Controller, 3097 Model 1 or 2 Power & Coolant Distribution Unit, two 3089 Model 3 Power Units, two 3180 Model 145 System Consoles, 3864-2 Modem	5,750,000	8,600	479,170	—
Model 400E	Processor Complex; consists of four CPUs, 128MB of main memory, 64K-byte buffer per CPU, and 64 integrated channels; requires 3092-2 Processor Controller, two 3097-1 or -2 Power & Coolant Dist. Units, four 3089-3 Power Units, three 3180-145 System Consoles, and two 3864-2 Automatic Call Units	7,819,000	11,910	786,900	—
Model 600E	Processor Complex; consists of six CPUs, 64K-byte buffer per CPU, 128MB of main memory, 64 integrated channels; requires 3092 Model 2 Processor Controller, two 3097 Model 1 or 2 Power & Coolant Distribution Units, four 3089 Model 3 Power Units, three 3180 Model 145 System Consoles, two 3864-2	10,944,000	17,000	912,000	—
Required 3090 Hardware					
3092-1	Processor Controller; required for 150E, 180E, 200E, and 300E	200,000	1,125	18,000	—
3092-2	Process Controller; required	235,000	1,295	21,140	—
—	Upgrade from 3092 Model 1 to 3092 Model 2	35,000	—	—	—
3097-1	Power and Coolant Distribution Unit for 3090 Models 150E, 180E, 200E, 300E, 400E, or 600E	121,000	220	10,880	—
3097-2	Power and Coolant Distribution Unit; has same distribution capabilities as 3097 Model 1, but does not have I/O power sequence control function; required for 3090 Models 200E, 300E, 400E, or 600E	111,000	200	9,250	—

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

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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:

3090 Model 150E Processor Complex; 32 megabytes of main memory, 16 integrated channels	$1,250,000
One 3092 Processor Controller Model 1	200,000
One 3097-1 Power and Coolant Distribution Unit	121,000
One 3089 Power Unit Model 3	38,000
Two 3370 Direct Access Storage Model A2s	70,960
Two 3180 Display Station Model 145s	4,790
Automatic Calling Unit for 3864-2 Modem	1,090
90 3278 Display Unit Model 2s	141,480
Three 3274-31A Communications Controllers	49,950
Nine 6901 Terminal Adapters	8,262
Three 3880 Model 3 Controllers Controllers	180,810
Three 3380-AE4 Direct Access Storage Devices (DASD)	367,440
Nine 3380-BE4 DASD Slave Units	883,260
Sixteen 3420 Model 8	318,080
Sixteen 6250/1600 bpi Dual Density Features	35,280
Two 3803-2 Tape Controllers	55,100
Multiple Tape Control Switch; two tape control	6,130
Two 3480 Tape Cartridges A22 Control Units	130,860
Four B22 Cartridge Tape Units	172,480
Three 4248 Model 1 printers (3600 lpm)	225,000
One 3800 Model 3 laser printer; (20,040 lpm)	330,750
TOTAL PURCHASE PRICE:	$4,590,722

MEDIUM CONFIGURATION:

3090 Model 200 Processor Complex; 64 megabytes of main memory, 32 integrated channels	$4,100,000
128 megabytes of expanded storage	695,000
One 3092 Processor Controller Model 1	200,000
One 3097-1 Power and Coolant Distribution Unit	121,000
Two 3089 Power Unit Model 3s	76,000
Two 3370 Direct Access Storage Model A2s	70,960
Two 3180 Model 145 Display Stations	4,790
Automatic Calling Unit for 3864-2 Modem	1,090
90 3278 Display Unit Model 2s	141,480
Three 3274-31A Communications Controllers	49,950
Nine 6901 Terminal Adapters	8,262
Three 3880 Controllers Model 3	180,810
Three 3380-AE4 Direct Access Storage Devices (DASD)	367,440
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Three 4248 Model 1 printers (3600 lpm)	225,000
One 3800 Model 3 laser printer; (20,040 lpm)	330,750
TOTAL PURCHASE PRICE:	$8,173,722

LARGE CONFIGURATION:

3090 Model 600E Processor Complex; 128 megabytes shared central storage, 64 integrated channels	$10,944,000
64 megabytes of additional central storage; A side	540,000
64 megabytes of additional central storage; B side	540,000
512 megabytes of expanded storage; A side	2,435,000
512 megabytes of expanded storage; B side (1 gigabyte of expanded storage total)	2,435,000
First additional channel group; 8 channels, A side	130,000
Second additional channel group; 8 channels, A side	130,000
Third additional channel group; 16 channels, A side	260,000
First additional channel group; 8 channels, B side	130,000
Second additional channel group; 8 channels, B side	130,000

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Third additional channel group; 16 channels, B side	260,000
One 3092 Processor Controller Model 2	235,000
Two 3097-1 Power and Coolant Distribution Unit	242,000
Four 3089 Model 3 Power Units	152,000
Two 3370 Direct Access Storage Model A2s	70,960
Three 3180 Model 145 Display Stations	7,185
Two Automatic Calling Units for 3864-2 Modem	2,180
90 3278 Display Unit Model 2s	141,480
Three 3274-31A Communications Controllers	49,950
Nine 6901 Terminal Adapters	8,262
Six 3880 Controllers Model 3	361,620
Six 3380-AE4 Direct Access Storage Devices (DASD)	734,880
Eighteen 3380-BE4 DASD Slave Units	1,766,520
Sixteen 3420 Model 8s	318,080
Sixteen 6250/1600 bpi Dual Density Features	35,280
Two 3803-2 Tape Controllers	55,100
Multiple Tape Control Switch; two tape control	6,130
Two 3480 Tape Cartridges; A22 Control Units	130,860
Four B22 Cartridge Tape Units	172,480
Three 4248 Model 1 printers (3600 lpm)	225,000
One 3800 Model 3 laser printer; (20,040 lpm)	330,750
TOTAL PURCHASE PRICE:	$22,979,717

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
PROCESSORS & FEATURES					
Model 150E	Processor Complex consists of CPU, 32MB of central storage, 64K-bytes of buffer memory, and 16 integrated channels; requires 3092-1 Processor Controller, 3097-1 or -2 Power and Coolant Distribution Unit, 3089-3 Power Unit, two 3180-145 System Consoles, and 3864-2 with Automatic Calling Unit	1,250,000	2,400	108,350	—
Model 180E	Processor Complex consists of CPU, 32MB of central storage, 64K-bytes of buffer memory, and 16 integrated channels; requires 3092-1 Processor Controller, 3097-1 or-2 Power and Coolant Distribution Unit, 3089-3 Power Unit, two 3180-145 System Consoles, and 3864-2 with Automatic Calling Unit	2,200,000	2,870	183,350	—
Model 200E	Processor Complex; consists of two CPUs, 64MB of main memory, 64K-byte buffer per CPU, and 32 integrated channels; requires 3092-1 Processor Controller, 3097-1 or -2 Power & Coolant Distribution Unit, two 3089-3 Power Units, two 3180-145 System Consoles, and a 3864-2 Automatic Call Unit	4,100,000	5,900	414,000	—
Model 300E	Processor Complex; consist of three CPUs, 64K-byte buffer per CPU, 64MB of main memory, 32 integrated channels,; requires 3092 Model 1 Processor Controller, 3097 Model 1 or 2 Power & Coolant Distribution Unit, two 3089 Model 3 Power Units, two 3180 Model 145 System Consoles, 3864-2 Modem	5,750,000	8,600	479,170	—
Model 400E	Processor Complex; consists of four CPUs, 128MB of main memory, 64K-byte buffer per CPU, and 64 integrated channels; requires 3092-2 Processor Controller, two 3097-1 or -2 Power & Coolant Dist. Units, four 3089-3 Power Units, three 3180-145 System Consoles, and two 3864-2 Automatic Call Units	7,819,000	11,910	786,900	—
Model 600E	Processor Complex; consists of six CPUs, 64K-byte buffer per CPU, 128MB of main memory, 64 integrated channels; requires 3092 Model-2 Processor Controller, two 3097 Model 1 or 2 Power & Coolant Distribution Units, four 3089 Model 3 Power Units, three 3180 Model 145 System Consoles, two 3864-2	10,944,000	17,000	912,000	—
Required 3090 Hardware					
3092-1	Processor Controller; required for 150E, 180E, 200E, and 300E	200,000	1,125	18,000	—
3092-2	Process Controller; required	235,000	1,295	21,140	—
—	Upgrade from 3092 Model 1 to 3092 Model 2	35,000	—	—	—

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Required 3090 Hardware (Continued)					
—	3097 Model 2-to-Model 1 Upgrade	10,000	—	—	—
4650	I/O Power Sequence Control for the 3090 Models 150, 180, 200, or 400	8,000	50	720	—
3089-3	Power Unit; 3090 Model 150E requires one 3089 Model 3, Model 180E configured with more than 192 or 256 megabytes of Expanded Storage and a Vector Facility requires two, the Model 200E requires two, Model 400E requires four, Model 3 300E requires two, and Model 600E requires four	38,000	90	3,415	—
3180-145	Console Display Station; two required for the 3090 Models 150E, 180E, 200E, and 300E, and three for the Models 400E and 600E	2,395	300	—	—
5801	Automatic Call Unit for the 3864-2 Modem	1,090	192	—	—
Expansion Frames					
7330	Expansion Frame for Models 150E and 180E; requires 1545	45,000	50	4,050	—
7330	Expansion Frame for Model 200E; requires 3854 or 1545	45,000	50	4,050	—
7330	Expansion Frame for Model 400E on A side; requires 3854 or 1545	45,000	50	4,050	—
7331	Expansion Frame for Model 400E on B side: requires 3856 or 1546	45,000	50	4,050	—
Channel Groups: Model 150E					
3848	Eight additional channels	130,000	145	10,830	—
Channel Groups: Model 180E					
3848	First additional channel group; eight channels	130,000	145	10,830	—
3849	Second additional channel group, eight channels; requires 3848	130,000	145	10,830	—
Channel Groups: Model 200E					
3850	First additional channel group; 8 channels	130,000	145	11,690	—
3851	Second additional channel group; 8 channels.	130,000	145	11,690	—
3854	Third additional channel group, 16 channels; requires 7330	260,000	290	23,380	—
Channel Groups: Model 300E					
3850	First additional channel group; eight channels	130,000	145	11,690	—
3851	Second additional channel group; eight channels	130,000	145	11,690	—
3854	Third additional channel group; 16 channels	260,000	290	3,854	—
Channel Groups: Model 400E					
	—A side:				
3850	First additional channel group	130,000	145	11,690	—
3851	Second additional channel group	130,000	145	11,690	—
3854	Third additional channel group; requires 7330	260,000	290	23,380	—
	—B side:				
3852	First additional channel group	130,000	145	11,690	—
3853	Second additional channel group	130,000	145	11,690	—
3856	Third additional channel group; requires 7331	260,000	290	23,380	—
Channel Groups: Model 600E					
	—A side:				
3850	First additional channel group	130,000	145	11,690	—
3851	Second additional channel group	130,000	145	11,690	—
3854	Third additional channel group	260,000	290	23,380	—
	—B side:				
3852	First additional channel group	130,000	145	11,690	—
3853	Second additional channel group	130,000	145	11,690	—
3856	Third additional channel group	260,000	290	23,380	—
Additional Central Storage					
	Model 150E or Model 180E:				
4064	Additional 32 megabytes	270,000	250	22,500	—
	Model 200E:				
4128	Additional 64 megabytes	540,000	500	45,000	—
	Model 300E:				

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Additional Central Storage (Continued)					
4128	Additional 64 megabytes	540,000	500	45,000	—
	Model 400E:				
4128	Additional 64 megabytes for A side	540,000	500	45,000	—
4228	Additional 64 megabytes for B side	540,000	500	45,000	—
Expanded Storage: Model 150E					
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
6128	Expansion from 64 megabytes to 128 megabytes; requires 5064	290,000	400	31,940	—
Expanded Storage: Model 180E					
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabytes	1,275,000	1,700	128,320	—
6128	Expansion from 64 megabytes to 128 megabytes; requires 5064	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes; requires 5064	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes; requires 5064	870,000	1,200	88,740	—
6193	Expansion from 128 megabytes to 192 megabytes; requires 5128 or 6128	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes; requires 5128 or 6128	580,000	800	59,180	—
6258	Expansion from 192 megabytes to 256 megabytes; requires 5192, 6192, or 6193	290,000	400	29,580	—
Expanded Storage: Model 200E					
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabytes	1,275,000	1,700	128,320	—
5512	First 512 megabytes	2,435,000	3,300	266,460	—
6128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
6512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
6193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,160	—
6513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
6258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
6514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
6515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
Expanded Storage: Model 300E					
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabytes	1,275,000	1,700	128,320	—
5512	First 512 megabytes	2,435,000	3,300	266,460	—
6128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
6512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
6193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,160	—
6513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
6258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
6514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
6515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
Expanded Storage: Model 400E					
	—A side:				
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabytes	1,275,000	1,700	128,320	—
5512	First 512 megabytes	2,435,000	3,300	266,460	—
6128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Required 3090 Hardware (Continued)					
3097-1	Power and Coolant Distribution Unit for 3090 Models 150E, 180E, 200E, 300E, 400E, or 600E	121,000	220	10,880	—
3097-2	Power and Coolant Distribution Unit; has same distribution capabilities as 3097 Model 1, but does not have I/O power sequence control function; required for 3090 Models 200E, 300E, 400E, or 600E	111,000	200	9,250	—
—	3097 Model 2-to-Model 1 Upgrade	10,000	—	—	—
4650	I/O Power Sequence Control for the 3090 Models 150, 180, 200, or 400	8,000	50	720	—
3089-3	Power Unit; 3090 Model 150E requires one 3089 Model 3, Model 180E configured with more than 192 or 256 megabytes of Expanded Storage and a Vector Facility requires two, the Model 200E requires two, Model 400E requires four, Model 3 300E requires two, and Model 600E requires four	38,000	90	3,415	—
3180-145	Console Display Station; two required for the 3090 Models 150E, 180E, 200E, and 300E, and three for the Models 400E and 600E	2,395	300	—	—
5801	Automatic Call Unit for the 3864-2 Modem	1,090	192	—	—
Expansion Frames					
7330	Expansion Frame for Models 150E and 180E; requires 1545	45,000	50	4,050	—
7330	Expansion Frame for Model 200E; requires 3854 or 1545	45,000	50	4,050	—
7330	Expansion Frame for Model 400E on A side; requires 3854 or 1545	45,000	50	4,050	—
7331	Expansion Frame for Model 400E on B side: requires 3856 or 1546	45,000	50	4,050	—
Channel Groups: Model 150E					
3848	Eight additional channels	130,000	145	10,830	—
Channel Groups: Model 180E					
3848	First additional channel group; eight channels	130,000	145	10,830	—
3849	Second additional channel group, eight channels; requires 3848	130,000	145	10,830	—
Channel Groups: Model 200E					
3850	First additional channel group; 8 channels	130,000	145	11,690	—
3851	Second additional channel group; 8 channels.	130,000	145	11,690	—
3854	Third additional channel group, 16 channels; requires 7330	260,000	290	23,380	—
Channel Groups: Model 300E					
3850	First additional channel group; eight channels	130,000	145	11,690	—
3851	Second additional channel group; eight channels	130,000	145	11,690	—
3854	Third additional channel group; 16 channels	260,000	290	3,854	—
Channel Groups: Model 400E					
	—A side:				
3850	First additional channel group	130,000	145	11,690	—
3851	Second additional channel group	130,000	145	11,690	—
3854	Third additional channel group; requires 7330	260,000	290	23,380	—
	—B side:				
3852	First additional channel group	130,000	145	11,690	—
3853	Second additional channel group	130,000	145	11,690	—
3856	Third additional channel group; requires 7331	260,000	290	23,380	—
Channel Groups: Model 600E					
	—A side:				
3850	First additional channel group	130,000	145	11,690	—
3851	Second additional channel group	130,000	145	11,690	—
3854	Third additional channel group	260,000	290	23,380	—
	—B side:				
3852	First additional channel group	130,000	145	11,690	—

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Channel Groups: Model 600E (Continued)					
3853	Second additional channel group	130,000	145	11,690	—
3856	Third additional channel group	260,000	290	23,380	—
Additional Central Storage					
	Model 150E or Model 180E:				
4064	Additional 32 megabytes	270,000	250	22,500	—
	Model 200E:				
4128	Additional 64 megabytes	540,000	500	45,000	—
	Model 300E:				
4128	Additional 64 megabytes	540,000	500	45,000	—
	Model 400E:				
4128	Additional 64 megabytes for A side	540,000	500	45,000	—
4228	Additional 64 megabytes for B side	540,000	500	45,000	—
Expanded Storage: Model 150E					
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
6128	Expansion from 64 megabytes to 128 megabytes; requires 5064	290,000	400	31,940	—
Expanded Storage: Model 180E					
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabytes	1,275,000	1,700	128,320	—
6128	Expansion from 64 megabytes to 128 megabytes; requires 5064	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes; requires 5064	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes; requires 5064	870,000	1,200	88,740	—
6193	Expansion from 128 megabytes to 192 megabytes; requires 5128 or 6128	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes; requires 5128 or 6128	580,000	800	59,180	—
6258	Expansion from 192 megabytes to 256 megabytes; requires 5192, 6192, or 6193	290,000	400	29,580	—
Expanded Storage: Model 200E					
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabytes	1,275,000	1,700	128,320	—
5512	First 512 megabytes	2,435,000	3,300	266,460	—
6128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
6512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
6193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,160	—
6513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
6258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
6514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
6515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
Expanded Storage: Model 300E					
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabytes	1,275,000	1,700	128,320	—
5512	First 512 megabytes	2,435,000	3,300	266,460	—
6128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
6512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—

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

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		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Expanded Storage: Model 400E (Continued)					
6512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
6193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,160	—
6513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
6258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
6514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
6515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
	B Side:				
7064	First 64 megabytes	405,000	500	42,740	—
7128	First 128 megabytes	695,000	900	74,700	—
7192	First 192 megabytes	985,000	1,300	98,740	—
7256	First 256 megabytes	1,275,000	1,700	128,320	—
7512	First 512 megabytes	2,435,000	3,300	266,460	—
8128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
8192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
8256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
8512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
8193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
8257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,180	—
8513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
8258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
8514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
8515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
Expanded Storage: Model 600E					
	—A side:				
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabyes	1,275,000	1,700	128,320	—
5512	First 512 megabytes	2,435,000	3,300	266,460	—
6128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
6512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
6193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,160	—
6513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
6258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
6514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
6515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
	—B side:				
7064	First 64 megabytes	405,000	500	42,740	—
7128	First 128 megabytes	695,000	900	74,700	—
7192	First 192 megabytes	985,000	1,300	98,740	—
7256	First 256 megabytes	1,275,000	1,700	128,320	—
7512	First 512 megabytes	2,435,000	3,300	266,460	—
8128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
8192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
8256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
8512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
8193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
8257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,180	—
8513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
8258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
8514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
8515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
VECTOR FACILITY					
	—For Models 150E and 180E:				
1545	Vector Facility; requires 7330	325,000	300	29,240	—
	—For Model 200E:				
1545	First Vector Facility; requires 7330	325,000	300	29,240	—
1550	Second Vector Facility	230,000	175	20,700	—
	—For Model 300E:				
1545	First Vector Facility	325,000	300	29,240	—
1550	Second Vector Facility	230,000	175	20,700	—
1555	Third Vector Facility	230,000	175	20,700	—
	—For Model 400E:				
1545	First Vector Facility on A side; requires 7330	325,000	300	29,240	—
1550	Second Vector Facility on A side	230,000	175	20,700	—

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

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		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
VECTOR FACILITY (Continued)					
1546	First Vector Facility on B side; requires 7331	325,000	300	29,240	—
1551	Second Vector Facility on B side	230,000	175	20,700	
	—For Model 600E:				
1545	First Vector Facility for A side	325,000	300	29,240	—
1550	Second Vector Facility for A side	230,000	175	20,700	—
1555	Third Vector Facility for A side	230,000	175	20,700	—
1546	First Vector Facility for B side	325,000	300	29,240	—
1551	Second Vector Facility for B side	230,000	175	20,700	—
1556	Third Vector Facility for B side	230,000	175	20,700	—
SYSTEM UPGRADES					
	3090 Model 150 to Model 180E	950,000	—	—	—
	3090 Model 180 to Model 200E; requires 3848 and 4064 on Model 180 or 180E, and the Model 200E requires two 3089s or equivalent 400 Hz power source	1,370,000	—	—	—
	3090 Model 150E to Model 180E	950,000	—	—	—
	3090 Model 180E to Model 200E; requires 3848, 3849, and 4064 on the Model 180 or 180E, and the Model 200E requires two 3089s or equivalent 400 Hz power	1,370,000	—	—	—
	3090 Model 180 to Model 200E; requires 3848, 3849, and 4064 on Model 180 or 180E, and the Model 200E requires two 3089 Model 3s, or equivalent 400 Hz power	1,370,000	—	—	—
	3090 Model 180E to Model 200E; requires 3848, 3849, and 4064 on Model 180 or 180E, and the Model 200E requires two 3089 Model 3s, or equivalent 400 Hz power	1,370,000	—	—	—
	3090 Model 200 to 300E; requires 7330	1,755,000	—	—	—
	3090 Model 200E to 300E; requires 7330	1,605,000	—	—	—
	3090 Model 200 to Model 400E; upgrade to Model 400E and 600E requires that the B side maintain symmetry for central storage, expanded storage, and channels	3,719,000	—	—	—
	3090 Model 200E to Model 400E; upgrade to Model 400E and 600E requires that the B side maintain symmetry for central storage, expanded storage, and channels	3,719,000	—	—	—
	3090 Model 400 to Model 600E; upgrade to Model 400E and 600E requires that the B side maintain symmetry for central storage, expanded storage, and channels; also requires 7330 and 7331	3,160,000	—	—	—
	3090 Model 400E to Model 600E; upgrade to Model 400E and 600E requires that the B side maintain symmetry for central storage, expanded storage, and channels; also requires 7330 and 7331	3,035,000	—	—	—
	3090 Model 200 to Model 300E; requires 7330 on Model 200 or Model 200E	1,755,000	—	—	—
	3090 Model 200E to Model 300E; requires 7330 on Model 200E	1,605,000	—	—	—
	3090 Model 400 to Model 600E; requires 7330 and 7331 on Model 400 or Model 400E. Upgrades to Model 400E and Model 600E will require that the B side maintain symmetry for central storage, expanded storage, and channels.	3,160,000	—	—	—
	3090 Model 300E to Model 600E; upgrades to Model 400E and 600E will require that the B side maintain symmetry for central storage, expanded storage, and channels	5,194,000	—	—	—
	3090 Model 400E to Model 600E; requires 7330 and 7331 on Model 400 or Model 400E. Upgrades to Model 400E and Model 600E will require that the B side maintain symmetry for central storage, expanded storage, and channels.	3,035,000	—	—	—

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Expanded Storage: Model 300E (Continued)					
6193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,160	—
6513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
6258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
6514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
6515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
Expanded Storage: Model 400E					
	—A side:				
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabytes	1,275,000	1,700	128,320	—
5512	First 512 megabytes	2,435,000	3,300	266,460	—
6128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
6512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
6193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,160	—
6513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
6258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
6514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
6515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
	B Side:				
7064	First 64 megabytes	405,000	500	42,740	—
7128	First 128 megabytes	695,000	900	74,700	—
7192	First 192 megabytes	985,000	1,300	98,740	—
7256	First 256 megabytes	1,275,000	1,700	128,320	—
7512	First 512 megabytes	2,435,000	3,300	266,460	—
8128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
8192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
8256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
8512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
8193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
8257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,180	—
8513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
8258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
8514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
8515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
Expanded Storage: Model 600E					
	—A side:				
5064	First 64 megabytes	405,000	500	42,740	—
5128	First 128 megabytes	695,000	900	74,700	—
5192	First 192 megabytes	985,000	1,300	98,740	—
5256	First 256 megabyes	1,275,000	1,700	128,320	—
5512	First 512 megabytes	2,435,000	3,300	266,460	—
6128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
6192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
6256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
6512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
6193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
6257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,160	—
6513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
6258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
6514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
6515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
	—B side:				
7064	First 64 megabytes	405,000	500	42,740	—
7128	First 128 megabytes	695,000	900	74,700	—
7192	First 192 megabytes	985,000	1,300	98,740	—
7256	First 256 megabytes	1,275,000	1,700	128,320	—

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Expanded Storage: Model 600E (Continued)					
7512	First 512 megabytes	2,435,000	3,300	266,460	—
8128	Expansion from 64 megabytes to 128 megabytes	290,000	400	31,940	—
8192	Expansion from 64 megabytes to 192 megabytes	580,000	800	59,160	—
8256	Expansion from 64 megabytes to 256 megabytes	870,000	1,200	88,740	—
8512	Expansion from 64 megabytes to 512 megabytes	2,030,000	2,800	223,580	—
8193	Expansion from 128 megabytes to 192 megabytes	290,000	400	29,580	—
8257	Expansion from 128 megabytes to 256 megabytes	580,000	800	59,180	—
8513	Expansion from 128 megabytes to 512 megabytes	1,740,000	2,400	191,640	—
8258	Expansion from 192 megabytes to 256 megabytes	290,000	400	29,580	—
8514	Expansion from 192 megabytes to 512 megabytes	1,450,000	2,000	159,700	—
8515	Expansion from 256 megabytes to 512 megabytes	1,160,000	1,600	127,760	—
VECTOR FACILITY					
	—For Models 150E and 180E:				
1545	Vector Facility; requires 7330	325,000	300	29,240	—
	—For Model 200E:				
1545	First Vector Facility; requires 7330	325,000	300	29,240	—
1550	Second Vector Facility	230,000	175	20,700	—
	—For Model 300E:				
1545	First Vector Facility	325,000	300	29,240	—
1550	Second Vector Facility	230,000	175	20,700	—
1555	Third Vector Facility	230,000	175	20,700	—
	—For Model 400E:				
1545	First Vector Facility on A side; requires 7330	325,000	300	29,240	—
1550	Second Vector Facility on A side	230,000	175	20,700	
1546	First Vector Facility on B side; requires 7331	325,000	300	29,240	—
1551	Second Vector Facility on B side	230,000	175	20,700	
	—For Model 600E:				
1545	First Vector Facility for A side	325,000	300	29,240	—
1550	Second Vector Facility for A side	230,000	175	20,700	—
1555	Third Vector Facility for A side	230,000	175	20,700	—
1546	First Vector Facility for B side	325,000	300	29,240	—
1551	Second Vector Facility for B side	230,000	175	20,700	—
1556	Third Vector Facility for B side	230,000	175	20,700	—
SYSTEM UPGRADES					
	3090 Model 150 to Model 180E	950,000	—	—	—
	3090 Model 180 to Model 200E; requires 3848 and 4064 on Model 180 or 180E, and the Model 200E requires two 3089s or equivalent 400 Hz power source	1,370,000	—	—	—
	3090 Model 150E to Model 180E	950,000	—	—	—
	3090 Model 180E to Model 200E; requires 3848, 3849, and 4064 on the Model 180 or 180E, and the Model 200E requires two 3089s or equivalent 400 Hz power	1,370,000	—	—	—
	3090 Model 180 to Model 200E; requires 3848, 3849, and 4064 on Model 180 or 180E, and the Model 200E requires two 3089 Model 3s, or equivalent 400 Hz power	1,370,000	—	—	—
	3090 Model 180E to Model 200E; requires 3848, 3849, and 4064 on Model 180 or 180E, and the Model 200E requires two 3089 Model 3s, or equivalent 400 Hz power	1,370,000	—	—	—
	3090 Model 200 to 300E; requires 7330	1,755,000	—	—	—
	3090 Model 200E to 300E; requires 7330	1,605,000	—	—	—
	3090 Model 200 to Model 400E; upgrade to Model 400E and 600E requires that the B side maintain symmetry for central storage, expanded storage, and channels	3,719,000	—	—	—

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Mass Storage					
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
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	—	—	—

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Mass Storage (Continued)					
	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
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	—

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IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
SYSTEM UPGRADES (Continued)					
	3090 Model 200E to Model 400E; upgrade to Model 400E and 600E requires that the B side maintain symmetry for central storage, expanded storage, and channels	3,719,000	—	—	—
	3090 Model 400 to Model 600E; upgrade to Model 400E and 600E requires that the B side maintain symmetry for central storage, expanded storage, and channels; also requires 7330 and 7331	3,160,000	—	—	—
	3090 Model 400E to Model 600E; upgrade to Model 400E and 600E requires that the B side maintain symmetry for central storage, expanded storage, and channels; also requires 7330 and 7331	3,035,000	—	—	—
	3090 Model 200 to Model 300E; requires 7330 on Model 200 or Model 200E	1,755,000	—	—	—
	3090 Model 200E to Model 300E; requires 7330 on Model 200E	1,605,000	—	—	—
	3090 Model 400 to Model 600E; requires 7330 and 7331 on Model 400 or Model 400E. Upgrades to Model 400E and Model 600E will require that the B side maintain symmetry for central storage, expanded storage, and channels.	3,160,000	—	—	—
	3090 Model 300E to Model 600E; upgrades to Model 400E and 600E will require that the B side maintain symmetry for central storage, expanded storage, and channels	5,194,000	—	—	—
	3090 Model 400E to Model 600E; requires 7330 and 7331 on Model 400 or Model 400E. Upgrades to Model 400E and Model 600E will require that the B side maintain symmetry for central storage, expanded storage, and channels.	3,035,000	—	—	—
MASS STORAGE					
3350	Direct Access Storage; 317.5MB per drive:				
	Model A2; Dual Disk Drive	32,030	173.00	2,268	1,930
	Model A2F; Dual Disk Drive with 2MB fixed-head storage	39,970	224.00	2,826	2,405
	Model B2; Add-on Dual Disk Drive	25,360	130.00	1,804	1,535
	Model B2F; Add-on Dual Disk Drive for 2MB fixed-head storage per drive	33,300	182.00	2,362	2,010
	Model C2; Two-drive disk storage and associated control	33,130	182.00	2,362	2,010
	Model C2F; Two-drive disk storage and associated control	41,070	234.00	2,920	2,485
	1320 Primary Controller Adapter (permits selection of A2/AF controller as on-line controller via manual switch on the C2/C2F)	220	1.50	16	14
	8150 String Switch for 3350 A2, A2F, C2, C2F	3,690	9.50	277	236
3370	Direct Access Storage:				
	Model A1; Single Disk Drive; 571.3MB	35,480	158.00	1,686	1,435
	Model B1; Add-on Single Disk Drive for attachment to Model A1	26,600	118.00	1,263	1,075
	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
3375	Direct Access Storage; 819.7MB per drive:				
	Model A1; contains logic and power for up to three Model B1 units	24,730	139.00	1,686	1,435
	Model B1; connects to a 3375 Model A1	18,700	105.00	1,351	1,150
	Model D1; provides dual controller function in a 3375 string; requires one Model A1 and two Model B1s	23,590	128.00	1,604	1,365
	4951 Model D1 Attachment for Model A1	2,590	6.00	102	87
	4952 Model D1 Attachment for Model B1	NC	NC	NC	NC
	8150 String Switch Feature for 3375 A1	3,795	1.50	181	154
	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	4,823	4,105
	Model AA4; 2.52 billion bytes of storage; connects to two 3880 storage directors	88,780	325.00	5,511	4,690
	Model B4; connects to a Model A4 or AA4 unit	64,440	240.00	4,001	3,405
	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	—

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IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
MASS STORAGE (Continued)					
	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	45,960	—	—	—
	Model BD4 to BE4	45,960	—	—	—
	3880 Model Upgrades:				
	Model 1 to Model D21	83,480	—	—	—
	Model 1 to Model E21	123,480	—	—	—
	Model 1 to Model G21	203,480	—	—	—
	Model 1 to Model H21	283,480	—	—	—
	Model 1 to Model J21	363,480	—	—	—
	Model G21 to Model H21	80,000	—	—	—
	Model G21 to Model J21	160,000	—	—	—
	Model H21 to Model J21	80,000	—	—	—
	Model 3 to Model D23	83,480	—	—	—
	Model 3 to Model E23	123,480	—	—	—
	Model 3 to Model G23	203,480	—	—	—
	Model 3 to Model H23	283,480	—	—	—
	Model 3 to Model J23	363,480	—	—	—
	Model E23 to Model G23	80,000	—	—	—
	Model E23 to Model H23	160,000	—	—	—
	Model E23 to Model J23	240,000	—	—	—
	Model G23 to Model H23	80,000	—	—	—
	Model G23 to Model J23	160,000	—	—	—
	Model H23 to Model J23	80,000	—	—	—
	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
MAGNETIC TAPE EQUIPMENT					
3420	Magnetic Tape Units:				
	Model 3; 120,000 bytes/sec. at 1600 bpi; 75 ips	11,930	226.00	699	587
	Model 4; 470,000 bytes/sec. at 6250 bpi; 75 ips	15,340	226.00	979	822
	Model 5; 200,000 bytes/sec. at 1600 bpi; 125 ips	16,000	248.00	943	792
	Model 6; 780,000 bytes/sec. at 6250 bpi; 125 ips	17,920	248.00	1,125	945
	Model 7; 320,000 bytes/sec. at 1600 bpi; 200 ips	17,920	297.00	1,115	937
	Model 8; 1250 bytes/sec. at 6250 bpi; 200 ips	19,880	365.00	1,355	1,121

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NC—No charge.

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
MAGNETIC TAPE EQUIPMENT (Continued)					
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	—
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	—

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
IBM 3820 (Continued)					
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	—
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

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
MAGNETIC TAPE EQUIPMENT (Continued)					
	6420 6250 bpi Density Feature (for 3420 Models 4, 6, and 8)	1,600	68.00	95	80
	6425 6250/1600 bpi Density Feature (for 3420 Models 4, 6, and 8)	2,205	90.00	138	116
	6631 Single Density Feature (for Models 3, 5, and 7)	2,870	67.50	162	136
	3550 Dual Density Feature (for Models 3, 5, and 7)	3,705	113.00	211	177
	6407 7-Track Feature (for Models 3, 5, and 7)	2,870	98.00	162	136
3803	Tape Controller:				
	Model 1; for 3420 Model 3, 5, and 7 drives	20,680	144.00	1,215	1,021
	Model 2; for 3420 Model 3 through 8 drives	27,550	199.00	1,770	1,487
	5310 9-Track NRZI Feature (permits connection of 800-bpi drives to 3803-2)	3,080	2.00	170	143
	6320 7-Track NRZI Feature (permits connection of 800-bpi drives to 3803-2; 5310 is prerequisite)	1,515	2.00	85	71
	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	14.00	354	297
	1793 For 3 Tape Controls	7,820	23.00	459	385
	1794 For 4 Tape Controls	9,195	23.00	537	451
	3551 Dual Density Feature (for 3803-1)	2,300	3.50	128	108
	6148 Remote Switch Attachment	910	—	51	43
	6408 7-Track Feature (for 3803-1)	2,300	3.50	128	108
	8100 Two-Channel Switch	4,600	6.50	262	220
3422	Magnetic Tape Subsystem				
	Model A1 Control Unit	36,800	400.00	2,240	—
	Model B1 Magnetic Tape Unit	17,900	165.00	1,060	—
	3005 Two Channel Switch	3,250	4.00	167	—
	3010 Two-Control Unit Switch; primary	7,350	19.00	387	—
	3015 Two-Control Unit Switch, Secondary	5,250	19.00	282	—
	3020 Data Streaming	1,575	32.00	111	—
3430	Magnetic Tape Subsystem				
	Model A1; Tape Unit and Control	33,400	251.00	2,345	—
	Model B1; Tape Unit Only	16,900	176.00	1,245	—
4991	Multi-drive Attachment	600	5.00	42	—
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	385.00	4,190	—
	Model B22 Magnetic Tape Unit	43,120	240.00	2,745	—
	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 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					
2501	Card Reader (with control):				
	Model B1; 600 cpm	19,610	155.00	672	—
	Model B2; 1000 cpm	19,920	170.00	828	—
3505	Card Reader:				
	Model B1; 800 cpm	36,030	316.00	1,455	—
	Model B2; 1200 cpm	37,270	432.00	1,720	—
	3921 51/80-Column Interchange	6,370	125	288	—
	5450 Optical Mark Read	10,130	116.00	430	—
	6555 Selective Stacker	2,845	16.00	109	—
	8103 3525 Punch Adapter	6,370	8.00	254	—
	8105 3525 Read/Punch Adapter	7,010	11.00	319	—
	8100 3525 Card Print Control	3,810	11.00	139	—

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IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
PUNCHED CARD EQUIPMENT (Continued)					
3525	Card Punch:				
	Model P1; 100 cpm	25,520	214.00	1,035	—
	Model P2; 200 cpm	26,520	290.00	1,305	—
	Model P3; 300 cpm	27,520	362.00	1,570	—
	1533 Card Read Feature	7,645	54.00	305	—
	1421 Basic Card Print	16,750	213.00	670	—
	5273 Multi-Line Card Print	1,365	62.00	179	—
	8339 Two-Line Card Print	874	8.00	27	—
PRINTERS					
IBM 3203					
Model 5	Train printer; 1200 lines per minute (lpm)	33,875	472	2,155	1,835
6360	Speed Enhancement	2,080	—	83	71
IBM 3262					
Model 1	Band printer; 252 to 650 lpm	15,040	202.50	733	624
Model 2	Band printer; 252 to 650 lpm	15,040	202.50	733	624
Model 3	Band printer; 252 to 650 lpm	15,040	202.50	733	624
Model 5	Band printer; 252 to 650 lpm	17,000	202.50	1,016	865
5450	OCR Feature	3,990	42.00	136	116
1090	Audible Alarm	201	—	6	5
IBM 3800					
Model 1	High-speed laser printer; prints up to 20,040 lpm	215,000	1,165	16,070	12,360
Model 3	High-speed laser printer; prints up to 20,040 lpm	330,750	776	15,020	—
1010	Accumulator	21,250	138	964	—
1021	Accumulator Expansion	5,445	42	246	—
1490	Burster-Trimmer-Stacker	52,500	358	2,395	1,840
5401	127 Writable Character Generator Storage Positions (Additional)	4,695	29	159	123
5410	Raster Pattern Storage (Additional)	8,655	8	392	—
7810	Tape-to-Printing Subsystem Feature (Model 1)	12,630	57	636	489
8170	Two-Channel Switch (Model 1)	10,270	23	427	330
8180	Two-Channel Switch (Model 3)	10,270	23	427	—
—	Product upgrade from 3800 Model 1 to Model 3	115,000			
IBM 3820					
Model 1	Page Printer; laser-based machine prints up to 20 pages per minute	28,350	310	1,680	—
3005	Pattern Storage Memory, 256KB	1,050	10	61	—
3010	Pattern Storage Memory, 512KB	1,700	20	102	—
3020	Pattern Storage Memory, 1024KB	3,000	40	184	—
3025	Pattern Storage Memory, 2048KB	6,000	80	368	—
3030	Pattern Storage Memory, 3072KB	9,000	120	552	—
3040	EIA Interface Cable 12m	125	—	—	—
3045	EIA Interface Cable 6m	90	—	—	—
3050	EIA Interface Attachment	500	10	34	—
3055	S/370 Channel Interface Attachment	2,600	40	164	—
3065	Pattern Storage Memory, 4096KB	12,000	160	736	—
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	—

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IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
Cluster Controllers: (Continued)					
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
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

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IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
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
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

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IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
IBM 4245 (Continued)					
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	—
IBM 4248					
Model 1	Variable-speed band printer; 2200, 3000, and 3600 lpm	75,000	1,070	6,205	—
3751	36 additional print positions; plant installed	10,000	110	615	—
3753	36 additional print positions; field installed	15,000	110	615	—
TERMINALS					
Cluster Controllers:					
	3274 Model 21A; local, SNA mode	14,220	77.00	944	803
	3274 Model 21B; local, 3272 mode	14,220	80.00	944	803
	3274 Model 21C; remote; requires 3701	9,900	59.00	662	563
	3274 Model 21D; local, 3272 mode	14,220	85.00	944	803
	3274 Model 31A; local, SNA mode	16,650	97.00	1,107	942
	3274 Model 31C; remote; requires 3701	12,420	79.00	825	702
	3274 Model 31D; local, 3272 mode	16,650	105.00	1,107	942
	3274 Model 41A; local, SNA mode	18,230	62.00	1,169	995
	3274 Model 41C; remote; requires 3701	13,840	43.00	885	753
	3274 Model 41D; local, 3272 mode	18,230	62.00	1,169	995
	3274 Model 51C; remote; requires 3701	4,885	40.00	304	259
	3274 Model 61C; remote; requires 3701	7,600	29.00	468	398
1550	CCITT V.35 Interface	525	1.50	23	20
1800	Extended Function Storage, D2 CSE	2,430	20	152	129
1801	Control Storage Expansion	790	4.00	54	46
3101	Internal Disk Drive Enhancement	1,620	15	107	91
3622	Extended Function Storage, Ty C1	950	8.50	89	76
3623	Extended Function Storage, Ty C2	1,265	10.50	116	99
3625	Extended Function Storage, Ty C3	950	8.50	89	76
3627	Extended Function Storage, Ty D1	950	8.50	89	76
3631	Extended Function Storage, Ty D3	820	7	54	46
3650	Extended Function Storage, Ty C1	1,640	15	107	91
3660	Extended Function Storage, DS	1,550	2	92	78
3680	Encrypt/Decrypt; -1C, 3274 -21C, -31C, -41C, -51C, and -61C only	1,780	2.00	90	77
3701	External Modem Interface; requires 6302 or 6303	337	3.00	17	15
5101	Internal Disk Drive Enhancement	1,530	14	100	85
5550	Power Expansion	341	1.50	17	15
5650	Dataphone Digital Service; point-to-point; -21C, -31C, -41C, -51C, and -61C only	840	1.50	38	33
5651	Dataphone Digital Service; multipoint; -21C, -31C, or -51C only	840	1.50	38	33
5655	X.21 Adapter; nonswitched networks; -41C or -61C only	800	1.50	35	30
5656	X.21 Adapter; switched networks; -41C or -61C only	800	2.00	43	37
	Terminal Adapters (for Models -21X, -31X, and -51C only)—				
6901	Type A1; devices 9 through 16	918	2.00	55	47
6902	Type A2; devices 17 through 24	918	2.00	55	47
6903	Type A3; devices 25 through 32	918	2.00	55	47
7801	Type B; requires 5550	986	4.00	65	55
7802	Type B1; devices 1 through 4	986	4.00	65	55
7803	Type B2; devices 5 through 8	831	2.50	55	47
7804	Type B3; devices 9 through 12	831	2.50	55	47
7805	Type B4; devices 13 through 16	831	2.50	55	47
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	14	12
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	58	52
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.

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
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	106	90
	3278 Model 2; 1920 char.	1,572	10.00	109	93
	3278 Model 3; 2560 char.	1,716	10.50	133	113
	3278 Model 4; 3440 char.	1,804	11.50	136	116
	3278 Model 5; 3564 char.	2,060	13.00	160	136
3610	Extended Character Set Adapter	—	—	16	14
3620	Character Set Extension	464	2.50	28	24
4621	Keyboard; 75 Key EBCDIC Ty	334	2.00	21	18
4622	Keyboard; 75 Key EBCDIC De	334	3.00	21	18
4623	Keyboard; 75 Key EBCDIC De/Kp	334	3.00	21	18
4624	Keyboard; 75 Key ASCII Ty	334	2.00	21	18
4626	Keyboard; 87 Key EBCDIC Typ/APL	455	2.50	25	22
4627	Keyboard; 87 Key EBCDIC Ty	455	2.50	25	22
4628	Keyboard; 87 Key ASCII Ty	455	2.50	25	22
4629	Keyboard; 87 Key EBCDIC Typ/Text	455	2.50	25	22
3278 Display Station Options:					
3620	Character Set Extension	464	2.50	28	24
6360	Selector Light Pen	394	0.50	21	19
4999	Magnetic Reader Control	273	3.50	16	14
Color Display Stations:					
	3279 Model S2A; base color; 1920 char.	2,190	19.00	183	156
	3279 Model S2B; extended color; 1920 char.	2,415	19.00	187	159
	3279 Model S3G; extended color; 2560 char.	3,115	25.00	282	240
	3279 Model 2X; base/extended color; 1920 char.	2,190	19.00	188	160
	3279 Model 3X; base/extended color; 2560 char.	2,235	19.00	207	176
3850	Extended Function (Model 2X or 3X)	210	2.00	14	12
Keyboards:					
	For 3279—				
4621	75-Key EBCDIC Typewriter	417	1.50	21	18
4622	75-Key EBCDIC Data Entry	417	2.50	21	18
4623	75-Key EBCDIC Data Entry, keypunch layout	417	2.50	21	18
4624	75-Key ASCII Typewriter	417	1.50	21	18
4626	87-Key EBCDIC Typewriter/Text; 3278 only	569	2.00	25	22
4627	87-Key EBCDIC Typewriter; 3278/3274 only	569	2.00	25	22
4628	87-Key ASCII Typewriter; 3278/3274 only	569	2.00	25	22
4629	87-Key EBCDIC Typewriter/Text; 3278 only	569	2.00	25	22
4640	87-Key EBCDIC Typewriter Overlay	569	2.00	25	22
4651	87-Key EBCDIC Attribute Select Typewriter	569	2.00	25	22
4652	87-Key EBCDIC Attribute Select Typewriter/APL	569	2.00	25	22
SYSTEM MANAGEMENT					
IBM 3814 Switching Management System, Models:					
A1	Controller Unit (4 x 4)	47,480	145	2,630	**2,105
A2	Controller Unit (4 x 8)	60,420	189	3,350	**2,680
A3	Controller Unit (8 x 4)	64,740	185	3,595	**2,875
A4	Controller Unit (two 4 x 4s)	69,570	203	3,875	**3,095
B1	Remote Unit (4 x 4)	39,710	98	2,205	**1,765

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
COMMUNICATIONS EQUIPMENT (Continued)					
	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.

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	—	—	517
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

**Onetime charge.*

IBM 3090 Series

		Monthly Charge		Initial Charges		
		Basic License ($)	DSLO ($)	Basic License ($)	DSLO ($)	Monthly Licensed Program Support ($)
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	—	—	—
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. ■

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
IBM 3814 Switching Manageme (Continued)					
B2	Remote Unit (4 x 8)	52,660	143	2,920	**2,335
B3	Remote Unit (8 x 4)	56,970	138	3,165	**2,530
B4	Remote Unit (two 4 x 4s)	61,800	156	3,435	**2,745
C1	Expansion Unit (4 x 4)	37,980	95	2,105	**1,680
C2	Expansion Unit (4 x 8)	50,930	139	2,820	**2,255
C3	Expansion Unit (8 x 4)	55,240	134	3,065	**2,450
C4	Expansion Unit (two 4 x 4s)	60,070	153	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	109	93
3287-1	Hard Copy Printer	4,830	40.00	317	270
3287-2	Hard Copy Printer	5,150	50.00	388	330
1410	Expanded Storage Unit	4,800	21.50	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	15.00	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
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	19.50	284	**226
6011	Additional Remote Two-Channel Switch Control	2,415	14.50	133	**106
6012	Second Additional Remote Two-Channel Switch Control	2,415	14.50	133	**106
6013	Third Additional Remote Two-Channel Switch Control	2,415	14.50	133	**106
CHANNEL EXTENSION					
3044-C01	Fiber-Optic Channel Extender Link; channel unit	8,500	25	—	—
3044-D01	Fiber-Optic Channel Extender Link; downstream unit	8,500	25	—	—
COMMUNICATIONS EQUIPMENT					
3705-80	Communications Controller:				
	Model 81 (256K bytes, 4 lines)	36,600	259.00	1,986	1,690
	Model 82 (256K bytes, 10 lines)	46,600	271.00	2,603	2,215
	Model 83 (256K bytes, 16 lines)	52,600	282.00	3,067	2,610
	Channel Adapters:				
	1551 Type 1	3,340	9.50	223	190
	1544 Type 4	4,410	8.00	308	262
	8002 Two-Channel Switch	2,090	2.50	111	95
	Business Machine Clocks:				
	1409 50 bps	424	1.00	16	14
	1410 110 bps	424	1.00	16	14
	1412 200 bps	424	1.00	16	14
	1413 300 bps	424	1.00	16	14
	1414 600 bps	424	1.00	16	14
	1415 1200 bps	424	1.00	16	14
	1416 2400 bps	424	1.00	16	14

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

IBM 3090 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Rental Charge* ($)	Monthly Charge (2-Year Lease)* ($)
COMMUNICATIONS EQUIPMENT (Continued)					
	Communications Line Attachment Features:				
	6712 Line Set Type 2	5,440	11.00	296	252
	6713 Line Set Type 3	4,850	9.00	263	224
	6714 Line Set Type 4	2,060	4.00	101	91
	6715 Line Set Type 5	10,320	15.00	536	456
	5657 Line Set Type 8	2,600	3.50	132	112
	5658 Line Set Type 9	1,550	3.00	75	64
	6261 Remote Program Loader	9,335	28.00	530	451
3725	Communications Controller:				
	Model 1; up to six channel adapters and from 512K to 1024K bytes of main stor age capacity	75,000	224.00	4,020	—
	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	200.00	3,030	—
	1561 Channel Adapter	6,750	8.50	363	—
	4666 Internal Clock Control	1,500	2.00	78	—
	4771 Line Attachment Base Type A	19,000	17.00	1,015	—
	4772 Line Attachment Base Type B	26,400	29.00	1,420	—
	4911 Line Interface Coupler Type 1	2,600	2.00	141	—
	4921 Line Interface Coupler Type 2	3,000	2.00	159	—
	4931 Line Interface Coupler Type 3	3,000	2.00	159	—
	4941 Line Interface Coupler Type 4A	2,600	2.00	141	—
	4942 Line Interface Coupler Type 4B	3,000	2.00	159	—
	7100 Storage Increment 256K	4,375	20.00	234	—
	8320 Two Processor Switch	4,000	3.00	216	—
3726	Communications Controller Expansion	32,000	42.00	1,710	—
3727	Operator Console	2,390	27.00	196	—

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

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	1,612	117
	Release 3 through 3.6	—	—	2,170	1,627	240
5740-XC6	MVS/SP-JES2 Version 2					
	Releases 1.0, 1.1, 1.2, and 1.5	12,840	9,630	4,280	3,210	—
	Release 1.3 and 1.7	12,840	9,630	4,280	3,210	673
5740-XYN	MVS/SP-JES3 Version 1					
	Release 1	—	—	2,150	1,612	117
	Release 3 through 3.5	—	—	2,380	1,784	517
5665-291	MVS/SP JES3 Version 2					
	Releases 1.0, 1.1, 1.2, and 1.5	13,500	10,125	4,500	3,375	1,250
	Release 1.3 and 1.7	14,430	10,821	4,810	3,607	1,335
5664-167	VM/SP					
	Releases 1, 2, 3, and 3.1	—	—	493	332	69
5664-169	VM/XA Systems Facility	10,500	7,875	3,500	2,625	583
	Release 2	11,220	8,415	3,740	2,805	623
5664-173	VM/SP High-Performance Option					
	Release 3.0,-3.2, and 3.4	4,980	3,740	1,660	1,240	136
5664-173	VM/SP High Performance Option Release 4.2 Support for Vector Facility	5,325	3,993	1,775	1,331	—
5667-126	Interactive Executive/370 (IX/370)	*10,000	—	—	—	495
5665-284	Data Facility Product					
	Releases 1.0, 1.1, and 1.2	1,590	1,191	530	397	82

**Onetime charge.*

IBM 3090 Series

		Monthly Charge		Initial Charges		
		Basic License ($)	DSLO ($)	Basic License ($)	DSLO ($)	Monthly Licensed Program Support ($)
Languages and Compilers:						
5668-962	Assembler H Version 2	465	348	155	116	7
5668-958	VS Cobol II Compiler and Library	6,420	4,812	1,070	802	53
5668-940	VS Cobol II Library	2,550	1,908	425	318	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	747	558	249	186	18
5748-LM3	VS Fortran Library only; Release 4.0 and 4.1	219	162	73	54	7
5734-FO2	Fortran IV (G1) Compiler	—	—	98	73	11
5734-FO3	Fortran IV (H Extended) Compiler	—	—	426	319	—
5734-LM3	Fortran IV Library (Mod II)	—	—	131	98	17
5734-FO5	Fortran Interactive Debug	*3,600	—	256	—	—
5668-903	VS Fortran Interactive Debug Release 2	1,920	1,397	320	240	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	1,125	843	375	281	38
5748-AP1	VS APL Release 4	—	—	386	289	41
5734-PL1	PL/1 Optimizing Compiler Release 4	—	—	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	7
5746-RG1	RPG II	—	—	150	112	7
5796-PNQ	Pascal/VS	*6,000	—	215	—	—
Data Management:						
5740-XX2	IMS/VS Version 1 Release 3	—	—	2,427	1,821	240
	Data Communications Feature	—	—	2,250	—	192
5665-332	IMS/VS Version 2 Release 1	—	—	3,900	2,925	825
5665-319	Interactive System Productivity Facility (ISPF) for MVS Version 2.1.2	600	450	190	142	30
5665-317	Interactive System Productivity Facility/Program Development Facility (ISPF/PDF MVS) for MVS Version 2.1.2	3,500	2,625	500	375	14
5740-XX7	GIS/VS (Generalized Information System/VS)	—	—	1,340	1,005	92
5740-XXF	DB/DC Data Dictionary	—	—	1,110	832	115
Data Communications:						
5740-XX1	CICS/OS/VS Release 6	5,730	4,290	1,910	1,430	160
5748-XXH	Graphical Data Display Manager (GDDM) Release 3	767	575	159	120	36
5668-947	Network Communications Control Facility (NCCF) Version 2 Release 2	2,250	2,010	375	335	55
5668-920	Network Problem Determination Application (NPDA) Version 3 Release 2	1,650	1,237	264	198	22
5748-XP1	Remote Spooling Communication System/Systems Network Architecture (RSCS/SNA) Release 3	—	—	111	83	38
5665-285	TSO Extensions for MVS/370	1,500	1,125	500	375	87
5665-293	TSO Extensions for MVS/XA	1,560	1,170	520	390	94
5735-RC3	ACF/TCAM Version 2	2,420	1,815	874	655	91
5665-280	ACF/VTAM Version 2	3,745	2,809	1,245	934	225
5665-288	MVS/Operator Communication Control Facility (MVS/OCCF)	1,050	786	350	262	8
Engineering/Scientific Support:						
5740-SM1	DFSORT (Data Facility Sort) Release 7	—	—	247	185	19
5750-ESE	Engineering/Scientific Support System-Entry					
5668-863	Engineering and Scientific Subroutine Library	—	—	700	525	—
5665-368	Vector Processing Subsystem/Vector Facility	*40,000	*30,000	—	—	—

**Onetime charge.* ■