

# IBM ES/4381 Series

## MANAGEMENT SUMMARY

**UPDATE:** *Although its future appears uncertain, the ES/4381 midrange mainframe series continues to play a strategic role within the IBM System/370 product family. For the moment, IBM has not announced plans for a follow-on series or new migration path for its large base of DOS/VSE users—the largest single software base in the IBM fold. In February 1988, IBM announced two specialized mainframe versions, the Model Group 91E and the Model Group 92E, which support the Enterprise Systems Architecture/(ESA)370 and Expanded Storage. ESA is the latest version of IBM's premier mainframe MVS operating system. Except for ESA-related capabilities, the two new top-end models are functionally equivalent to the Model Groups 23 and 24. With ESA, the 4381 becomes part of IBM's Enterprise Systems (ES) family.*

In June 1988, IBM withdrew the Model Groups 12, 13, and 14 from marketing. The company continues to market the Model Group 11 as an entry-level machine.

Despite IBM's best efforts to migrate DOS/VSE users to MVS, the popularity of VSE has not diminished. In response to strong VSE interest, IBM announced new VSE enhancements last year. Some of these enhancements came at the request of GUIDE, an IBM midrange user group.

The current ES/4381 line now consists of seven models, the Model Groups 11, 21, 22, 23, 91E, all single processors; and the Model Groups 24 and 92E, dual processors. The Models 21 through 24, first announced in early 1987, were shipped during the first quarter of 1988. The new

The IBM 4381 Series continues to be the company's key midrange hardware platform. It's designed for users who don't need the power and complexity of IBM's water-cooled 3090 mainframes as well as for users who plan an eventual migration to the IBM large systems.

**MODELS:** 4381 Model Groups 11, 21, 22, 23, 24, 91E, and 92E.

**CONFIGURATION:** The 4381 Series features five single processors and two dual processors. Memory ranges from 4 megabytes to 64 megabytes.

**COMPETITION:** Control Data Corporation 960 Series; Digital VAX 6200 Series; Honeywell Bull DPS 8000; NAS AS/EX Series; Unisys A 10 and V Series.

**PRICE:** From \$175,000 to \$1,160,000.

## CHARACTERISTICS

**MANUFACTURER:** International Business Machines Corp. (IBM), Old Orchard Road, Armonk, New York 10504. Contact your local IBM representative.

**CANADIAN ADDRESS:** 1150 Eglinton Avenue, Don Mills, Ontario. Telephone (416) 443-2111.

## DATA FORMATS

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



*The Model Groups 91E and 92E are specialized 4381s that run ESA/370, IBM's latest version of the MVS operating system. Otherwise, they are functionally equivalent to the Model Groups 23 and 24.*

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**TABLE 1. SYSTEM COMPARISON**

MODEL	Model Group 11	Model Group 21	Model Group 22	Model Group 23
<b>SYSTEM CHARACTERISTICS</b>				
Date announced	February 1986	May 1987	May 1987	May 1987
Date first delivered	May 1986	First Quarter 1988	First Quarter 1988	First Quarter 1988
Field upgradable to	4381-21, -22	4381-22	4381-23	4381-24, -91E
Relative performance	1.0	1.5	2.2	3.5
Number of processors	1	1	1	1
Cycle time, nanoseconds	68	68	68	52
Word size, bits	32	32	32	32
Operating systems	DOS/VSE, OS/VS1, MVS/SP, VM/SP, MVS/XA, VM/XA, VM/SP HPO, AIX/370	DOS/VSE, OS/VS1, MVS/SP, VM/SP, MVS/XA, VM/XA, VM/SP HPO, AIX/370	DOS/VSE, OS/VS1, MVS/SP, VM/SP, MVS/XA, VM/XA, VM/SP HPO, AIX/370	DOS/VSE, OS/VS1, MVS/SP, VM/SP, MVS/XA, VM/XA, VM/SP HPO, AIX/370
<b>MAIN MEMORY</b>				
Type	MOS	MOS	MOS	MOS
Minimum capacity, bytes	4M	8M	16M	16M
Maximum capacity, bytes	16M	16M	32M	64M
Increment size, bytes	4M, 8M	8M	16M	16M
Cycle time, nanoseconds	Not specified	Not specified	Not specified	Not specified
<b>BUFFER STORAGE</b>				
Minimum capacity	4KB	8KB	32KB	64KB
Maximum capacity	4KB	8KB	32KB	64KB
Increment size	0	0	0	0
<b>INPUT/OUTPUT CONTROL</b>				
Number of channels:				
Byte multiplexer	1 std., 1 opt.	1 std., 1 opt.	1 std., 1 opt.	1 std., 1 opt.
Block multiplexer	5 std., 6 opt.	5 std., 6 opt.	5 std., 6 opt.	5 std., 6 opt.
Word	0	0	0	0
Other	0	0	0	0

➤ 91E and 92E models were announced in February 1988 and first delivered during fourth-quarter 1988.

The ES/4381 Series overlaps the performance of the ES/3090 Series at the low end. A basic 91E rates at 4.8 million instructions per second (MIPS), while a basic 92E rates at 8.1 MIPS. An entry-level ES/3090 Model 120S rates at 7.4 MIPS, and an ES/3090 Model 150S rates at 11.5 MIPS.

While the 4381 continues to be IBM's primary offering for midrange and remote site computing, the model line also serves as a platform for users planning to migrate from the older DOS/VSE operating system to the larger MVS and 3090 environments. IBM encourages DOS users to convert by providing conversion aids and support, but these efforts are meeting only limited success. Now that the 4381 Series can support ESA/370, IBM's newest operating environment, medium-scale users can take advantage of some of the benefits available in a 3090 environment.

To implement ESA/370 on the new models, users must install Multiple Virtual Storage/System Product (MVS/SP) Version 3 Release 1 and MVS/Data Facility Product (DFP) Version 3. (For information about ESA/370, please refer to the "IBM 3090 Series" report in this tab and to the "IBM Corp. MVS & MVS/XA Operating Systems" report on Page SW35-504MK-301, Volume 3.)

In general, ESA provides large-systems users with additional storage constraint relief and addressing capabilities. It also remains compatible with existing 24-bit and 31-bit addressing, user applications, and external interfaces. ESA/370 brings total virtual memory spaces to 16 trillion

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

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

**FLOATING-POINT OPERANDS:** One word, consisting of 24-bit fraction and 7-bit hexadecimal exponent in short format; two words, consisting of 56-bit fraction and 7-bit hexadecimal exponent in long format; or four words in extended-precision format. Floating-point notations can be expressed in single precision (32 bits), double precision (64 bits), or extended precision (128 bits) sums.

**INSTRUCTIONS:** 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively.

The 4381 Series uses the System/370 Universal Instruction Set. The instruction set includes complete arithmetic facilities for processing variable-length decimal and fixed-point binary operands, as well as instructions which handle loading, storing, comparing, branching, shifting, editing, radix conversion, code translation, logical operations, packing, and unpacking. In addition, a group of privileged instructions, usable only by the operating system, handles input/output and various hardware control functions.

Also standard are some instructions that were optional on some models of the System/370. These include the dynamic address translation instructions of Load Read Address, Reset Reference Bit, Purge Translation Lookaside Buffer, Store Then AND System Mask, and Store Then OR System Mask; the VTAM support instructions of Compare and Swap and Compare Double and Swap; the OS/VS support instructions of Insert Program Status Word (PSW) Key, Set PSW Key from Address, and Clear I/O; and the extended-precision floating-point instructions.

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

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TABLE 1. SYSTEM COMPARISON (Continued)

MODEL	Model Group 24	Model Group 91E	Model Group 92E
<b>SYSTEM CHARACTERISTICS</b>			
Date announced	May 1987	February 1988	February 1988
Date first delivered	First Quarter 1988	November 1988	November 1988
Field upgradable to	4381-92E	4381-92E	Not applicable
Relative performance	6.1	3.5	6.1
Number of processors	2	1	2
Cycle time, nanoseconds	52	52	52
Word size, bits	32	32	32
Operating systems	DOS/VSE, OS/VS1, MVS/SP, VM/SP, MVS/XA, VM/XA, VM/SP HPO, AIX/370	DOS/VSE, OS/VS1, MVS/ESA, MVS/SP, VM/SP, MVS/XA, VM/XA, VM/SP HPO, AIX/370	DOS/VSE, OS/VS1, MVS/ESA, MVS/SP, VM/SP, MVS/XA, VM/XA, VM/SP HPO, AIX/370
<b>MAIN MEMORY</b>			
Type	MOS	MOS	MOS
Minimum capacity, bytes	16M	16M	16M
Maximum capacity, bytes	64M	64M	64M
Increment size, increment	16M	16M	16M
Cycle time, nanoseconds	Not specified	Not specified	Not specified
<b>BUFFER STORAGE</b>			
Minimum capacity	128KB	64KB	128KB
Maximum capacity	128KB	64KB	128KB
Increment size	0	0	0
<b>INPUT/OUTPUT CONTROL</b>			
Number of channels:			
Byte multiplexer	2 std., 2 opt.	1 std., 1 opt.	2 std., 2 opt.
Block multiplexer	10 std., 12 opt.	5 std., 6 opt.	10 std., 12 opt.
Word	0	0	0
Other	0	0	0

▷ bytes, 8,000 times the previous MVS/XA limit of 2 gigabytes. ES/4381 users, of course, are still limited to 64 megabytes of real memory.

With the addition of ESA, IBM presents the concept of Expanded Storage to ES/4381 users. Expanded Storage, first introduced on the 3090 Series in 1985, is a separate area of processor memory designed to enhance throughput by relieving the paging load in virtual environments. With ESA, IBM added new Expanded Storage functions. ES/4381 users operating in ESA/370 mode can establish an Expanded Storage capability by dividing real memory. At initial microcode load time, users with 64 megabytes of main memory can allocate up to half that amount for Expanded Storage. Users with 48 megabytes of memory can allocate up to 16 megabytes.

In addition to ESA, IBM announced new VSE enhancements towards the end of 1988. This led some observers to believe IBM was once again resurrecting its beleaguered VSE operating environment while sounding less insistent about migrating to MVS.

The future of VSE appeared particularly uncertain when IBM chose not to make it a participant in Systems Application Architecture (SAA), a long-range strategy for making key software applications compatible across designated mainframe, mini, and micro hardware platforms. While there are no plans to make VSE a full SAA participant, IBM has made it possible for VSE to interface SAA systems indirectly. In September 1988, IBM announced plans to define common SAA programming interfaces between CICS under VSE and SAA-compliant CICS/MVS and OS/2, IBM's PS/2 operating environ- ▷

▶ **MAIN STORAGE**

**STORAGE TYPE:** Models within the 4381 Series use 64K-bit and 256K-bit MOSFET (Metal Oxide Semiconductor Field Effect Transistor) chips. They are based on SAMOS (silicon and aluminum metal oxide semiconductor) technology. The SAMOS process relies on silicon or silicon compounds to enhance gate reliability and to control chip surface leakage. The newest 4381 models use 1-megabit chip technology.

**CAPACITY:** See Table 1.

Model Group 91E and 92E models have an Expanded Storage capability when operating in Enterprise Systems Architecture (ESA)/370 mode. Expanded Storage memory helps reduce paging and swapping loads to channel-attached paging devices in heavy paging environments with storage limitations. Controlled by the system control program, expanded storage transfers 4-kilobyte pages to and from central storage. At the 4381 level, users can create Expanded Storage at initial microcode load (IML) time by dividing up main memory. Systems with up to 64 megabytes of main memory can allocate 16 to 32 megabytes of Expanded Storage. Systems with 48 megabytes of main memory can allocate up to 16 megabytes of Expanded Storage.

**CYCLE TIME:** See Table 1 for CPU cycle time; IBM does not release data on memory cycle time.

**CHECKING:** All data paths between the central processor and main storage are parity checked by byte. When data is stored, an error-correcting code is substituted for the parity bits. (An 8-bit modified Hamming code is appended to each 8-byte "doubleword" of data.) When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and signaled so that appropriate program action can be taken. ▶

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► ment. Ultimately, the VSE-SAA relationship will let users write intelligent workstation-to-CICS applications in a VSE environment.

Along with the September SAA announcement, IBM announced other VSE environment enhancements, many of which relate to communications and networking. VSE/System Package (VSE/SP) Version 4 Releases 1.0 and 1.1 and VSE/Advanced Functions (AF) Version 4 Release 1 now provide for unattended node support in a network of VSE-based machines. This allows for unattended operation in a network using NetView, IBM's comprehensive network management product; VSE/OCCF Version 1 Release 3, and DSNX. VSE/OCCF supports NetView Release 2 in a private space in addition to unattended operation. DSNX is a facility for transferring data to and from a host.

### COMPETITIVE POSITION

Throughout much of last year, IBM watchers were fully expecting the company to do something with its aging 4381 line. According to recent speculation, IBM was either going to replace the 4381s with a new model line or expand the range of its ES/9370 supermini line upward, overlapping 4381 line performance. Neither scenario has yet come to pass. The 9370 theory was dashed, at least for now, when IBM did not bring out any new high-end 9370s in September 1988. Disappointing 9370 sales and a continued lukewarm reception among users may have precluded this option for now. Instead of new high-end models, the company brought out three additional 9370 intermediate models to close price/performance gaps within the existing line.

Through 1988, IBM made few major competitive changes to the 4381 line except for the addition of the new specialized 91E and 92E models that bring ESA architecture down to the 4381 level.

For the moment, 4381 users who need more raw horsepower can do one of three things: wait for IBM to bring out a follow-on product; acquire additional 4381s and run more applications at one time; or go to a rival such as NAS, the IBM plug-compatible manufacturer (PCM), which remarkets Hitachi mainframes. For many 4381 users, particularly users committed to DOS/VSE, a migration to more costly water-cooled 3090s and MVS is not an option.

NAS could be an option for 4381 users looking for a quick MIPS fix. An NAS Model AS/EX 40 performance rates at 21.7 MIPS compared to a top-end 4381 92E, at 8.1 MIPS. The advantage here is obvious. By buying a PCM, a user can acquire more horsepower while continuing to use air-cooled, software-compatible machines. It also lets users put off a move to a water-cooled 3090 engine just a bit longer.

► The 4381 Series provides double-bit error detection and correction when the double-bit error consists of one solid failure and one intermittent failure.

The Store and Fetch Protection features, which guard against inadvertent overwriting or unauthorized reading of data in specified blocks of storage, are standard in all models.

Segment protection is provided in System/370 mode and page protection in System/370-XA mode. All models support system control program use of 2K or 4K storage protect keys when the processor storage is no more than 16 megabytes. Only 4K storage protect keys are supported when processor storage is more than 16 megabytes.

RESERVE STORAGE: Information is not available.

### CENTRAL PROCESSORS

The 4381s are heavily microprogrammed processors that feature large-scale integration (LSI) technology, one-level addressing facility, virtual storage capability by dynamic addressing, channels with virtual storage, and System/370 Universal Instruction Set. CE maintenance support functions include support processors and remote support facilities. Other standard 4381 features include store and fetch storage protection, byte-oriented operands, clock comparator and CPU timer, time-of-day clock, interval timer, control storage, PSW Key handling, control registers, extended-precision floating point, machine check handling, and program event recording.

Microcode is loaded through the system diskette drive. The several diskettes supplied with the system contain field engineering diagnostics, basic system features, and optional user-selected system features. The system diskette facility also allows storage of failure data from the processors. This data can be subsequently analyzed by field engineering for maintenance purposes.

The no-charge Problem Analysis Feature allows users to identify valid hardware problems as the cause of system interruptions. Screen-prompted instructions lead the user through the steps required to solve the problem. Using the Remote Support Facility, service information can be sent to and received from IBM Field Engineering. The Remote Operator Console Facility (ROCF) is used to run a subset of Problem Analysis from the user installation.

The 4381 Series features an 8-byte (64 bit)-wide data flow within the processor, as well as an 8-byte-wide or 16-byte (128 bit)-wide data flow among the processor, storage, and channels.

Mode of operation is selected at IML time. One operating mode is the Extended Control Program Support (ECPS:VSE) mode, which uses the extensive microcoding facilities of the 4381 to reduce DOS/VSE overhead and improve system throughput.

The 4381 Series supports System/370, 370-XA, and ESA/370 operational modes. In 370 mode, the 4381 supports MVS/SP JES2 or MVS/SP JES3, VM/SP, VM/SP HPO, VM/IS, DOS/VSE with VSE/AF, AIX/370, and OS/VS1 with Basic Programming Extensions. In 370-XA mode, the 4381 supports MVS/SP JES2 and MVS/SP JES3 and VM/XA SF and VM/XA SP. In ESA/370 mode, the 4381 Models 91E and 92E support MVS/SP Version 3. In 370-XA and ESA/370 modes, the 4381 supports Expanded Storage, 31-bit addressing, bimodal addressing, larger and more flexible I/O configurations, channel path selection under hardware control, and support for Start Interpretive Execution instructions for guest

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▷ At the moment, however, NAS is in a state of transition. At this writing, National Semiconductor, the NAS parent company, was preparing to sell 50 percent of its interest in the PCM to Memorex Telex in exchange for cash and stock.

Digital Equipment Corporation, meanwhile, IBM's chief midrange rival, continues to bolster its popular VAX Series. Like NAS, Digital offers more raw power, larger memory capacities, and better price/performance.

In 1988, Digital announced two new VAX lines, the midrange 6200 Series and the high-end 8800 Series. The 6200 Series ranges in power from 2.9 MIPS to 11.6 MIPS and costs between \$131,600 for a base configuration to \$470,600. Main memory ranges from 32 megabytes to 128 megabytes. Comparable NAS machines are rated between 4.7 MIPS and 21.7 MIPS and cost between \$489,200 and \$2,243,350. IBM machines have a rated performance range of between 1.5 MIPS and 8.1 MIPS and cost between \$175,000 and \$1,160,000. In a three-way price/performance comparison, the top-end Digital 6600 model sells for \$40,569 per MIPS. The top-end NAS machine in this range (the Model AS/EX 40) sells for \$103,380 per MIPS. The top-end IBM 4381 92E comes out the highest at \$143,209 per MIPS.

Of course, mainframe users don't live on raw processing power alone. During the last several years, IBM has begun to implement new connectivity and open systems strategies in response to competitive pressures from Digital. With its highly successful VAX line, Digital has won respect as a vendor that can deliver fully compatible systems that use a common I/O architecture, run the same operating system, and can be interconnected with non-Digital systems in multivendor environments.

IBM first responded with SAA, a software architecture that will eventually impact all major IBM hardware and proprietary software platforms. If successful, SAA will let IBM continue to market machines with dissimilar architectures, but with applications portability. Although IBM midrange machines are dissimilar in many respects (in contrast to Digital offerings), IBM has long believed it was more important to market machines to distinct market segments having specialized needs and operating environments.

For users who want open systems, particularly users in the technical computing world, IBM has brought out AIX, its implementation of UNIX. IBM now has AIX versions that run on the PS/2 Model 80 PC, the IBM RT technical workstation, and a version for the System/370 environment, which includes the 4381 Series. AIX users can work in a compatible operating system environment from IBM PCs to mainframes, making it possible to port applications from one AIX-based hardware platform to another. The UNIX-based system is also compatible with industry-recognized standard interfaces such as TCP/IP and the Network File System. ▷

▷ S/370 or 370-XA virtual machines. SIE improves performance for V = R preferred guests under the Virtual Machine/Extended Architecture (VM/XA) Systems Facility.

The 4381 consists of four separate functional units, a memory subsystem, an instruction processing unit, a channel subsystem, and a maintenance subsystem. The memory subsystem features main storage, a high-speed buffer, a swap buffer, and a memory control unit. The instruction processing unit includes a shifter (to and from memory), a storage address register, an arithmetic logic unit, local storage, control storage, and an instruction buffer; it also includes a 56-bit wide, high-speed hardware multiplier in 4381 Model Groups 22, 23, 24, 91E, and 92E. The channel subsystem includes channel data buffers, a channel controller, and standard and optional channels. The maintenance subsystem includes a service processor, a service panel, a power-up microprocessor, a direct console attachment, diskette drives, a modem (which connects to the Remote Operator Console Facility and the Remote Service Facility), a direct instruction processor link, and a channel link for operator consoles.

The 4381 Model Group 24 and 92E dual processors incorporate standard 4381 processor features in addition to two integrated instruction processors under a single control program. Each processor has access to a shared central storage facility. Each processor also has its own set of channels. The 4381 dual-processor models cannot be partitioned into two distinct uniprocessor systems.

The 4381 processors use reloadable control storage (RCS) to hold the microcode that controls their operations. The RCS is composed of 18K-bit, SAMOS-process N-channel FET chips; however, IBM does not specify the amount of control storage.

Three types of addresses are recognized, absolute, real, and logical. In all 4381 Series processors, a one-level addressing facility provides for improved DOS/VSE virtual storage control.

The dynamic address translation facility, standard in all models, is the mechanism that translates the virtual storage addresses contained in instructions into real main storage addresses as each instruction is executed. With VSE/SP Version 3.2, 4381 systems can access up to 128 megabytes of virtual memory and nine address spaces. Before the enhancement, processors operating under VSE were limited to a virtual storage space of 16,777,216 bytes.

Translation between the virtual and real addresses is accomplished by a hardware-implemented table-lookup procedure that accesses tables in main storage which are created and maintained by the operating system. The translation process is sped up by a group of high-speed registers (translation lookaside buffer) which hold recently referenced virtual storage addresses and their real storage equivalents.

Model Groups 11, 22, 23, and 91E support system control programs with either 2K or 4K virtual page sizes. However, only half of the high-speed buffer is employed when 2K virtual pages are used. The 4381 Model Groups 24 and 92E dual-processors support only 4K virtual pages.

Classes of interrupts include I/O, external, program, supervisor call, machine check, and restart. Classes of interrupts are distinguished by the storage locations at which the old PSW is stored and from which the new PSW is fetched.

SPECIAL FEATURES: The *Engineering/Scientific Assist*, a standard 4381 feature, is designed to improve the ▷

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TABLE 2. MASS STORAGE

MODEL	3370	3375	3380	3380
Cabinets per subsystem	1 to 4	1 to 4	1 to 4	1 to 8
Disk packs/HDA's per cabinet	1	1	2	2
Capacity	729.8MB	819.7MB	2520/5040MB	2520/7560MB
Tracks/segments per drive unit	—	—	—	—
Average seek time, msec.	19	19	15/17	12/16
Average access time, msec.	29.1	29.1	23.3/25.3	20.3/24.3
Average rotational delay, msec.	10.1	10.1	8.3	8.3
Data transfer rate	1.859MB/sec.	1.859MB/sec.	3.0MB/sec.	3.0MB or 4.5MB/sec.
Controller model	3880 Models 1, 21	3880 Model 1	3880/3990	3880/3990
Comments	Models A2, B2, A12, B12	Models A1, B1, D1	Models AD4, BD4, AE4, BE4	Models AJ4, BJ4, AK4, BK4

A dash (—) indicates information was not available.

### ▶ ADVANTAGES AND RESTRICTIONS

The 4381 provides users with many of the advantages of IBM's 370 extended architecture without the heavier overhead costs associated with IBM's much larger 3090 mainframes. The addition of new model groups last year—ranging from the Model Group 21 to the top-end Model Groups 24 and 92E—closed the performance gap between the 4381 midrange line and the high-end ES/3090 Series and extended the migration path. The high end of the 4381 line now overlaps the performance of the 3090 low end. The 4381s also run a variety of operating systems that are tailored to the specific needs of medium-scale environments.

Many of IBM's midrange users prefer the relatively less complex 4381 environment to the company's larger 3090 environment. The 4381 systems, for instance, continue to use impingement air-cooling technology that allows the systems to be housed in room-temperature, air-conditioned offices without raised floors as well as in computer rooms. By contrast, IBM 3090 systems require chilled water cooling through the addition of a \$111,000 to \$121,000 power and coolant distribution unit in addition to user-supplied plumbing.

New IBM circuitry technology has also been incorporated into the 4381 processor line, allowing for faster CPU cycle times and larger and denser main memory configurations. Additional channel capacity and the availability of more 3-megabyte-per-second channels deliver more I/O options. The availability of a SOEMI interface enhances connectivity options.

The 4381 systems support most of the same DASDs and other peripherals, so users converting from one 4381 grouping to another can, in most cases, transport peripherals from older to newer systems. In addition, IBM's top-end 3380 DASD family supports double- and triple-density storage capacities. At the system level, 4381 processors have a real memory capacity of only 64 megabytes, which appears rather limited compared to competing systems that offer more than twice as much real memory.

In addition, all 4381 systems incorporate System/370 architecture and can run System/370 software—features

▶ performance of certain mathematical computations, such as matrix inversion, decomposition, and multiplication. The Assist reduces processor busy time by up to 65 percent for assisted functions. It includes a Multiply and Add Facility that provides vector/scalar capability for all models, a Square Root Facility on all models, and a Mathematical Function Facility (MFF) on Model Groups 22, 23, 24, 91E, and 92E. The MFF includes short- and long-precision versions of exponentiation, common logarithm, and natural logarithm. The Assist is supplied on a microcode diskette and installed as part of the IML process.

The *High Accuracy Arithmetic Facility (ACRITH)*, standard on all models, comprises a set of subroutines called from VS Fortran or Assembler language programs. ACRITH implements floating-point instructions for the computation of the basic arithmetic operations (add, subtract, multiply, and divide) and the scalar (dot) product with maximum accuracy, providing direct rounding for the short and long floating-point hexadecimal formats. Maximum accuracy is defined as having no floating-point number between the rounded result and the exact result (at infinite precision).

The ACRITH Subroutine Library includes complex extensions for standard functions (23 for short and 23 for long format); inclusion of complex zeroes of polynomials with complex coefficients; complex vector and matrix operations; and a linear system solver for complex matrices. Also included are a linear system solver for sparse matrices, a nonlinear system solver for systems of nonlinear equations, and MVS/XA 31-bit mode support.

**PHYSICAL SPECIFICATIONS:** The air-cooled processors have a system footprint of 14.33 square feet. With service clearances, they require 125.61 square feet of space. Single-processor models weigh 1,700 pounds and dual-processor models weigh 2,000 pounds. Uniprocessor power consumption is 4.47kVA at 50 Hz or 60 Hz; dual-processor power consumption is 7.2kVA at 50 Hz or 60 Hz. Heat output on uniprocessors is 13,650 Btu per hour; 22,500 Btu per hour on dual processors. The processors can operate in both a computer room and office environment at a room temperature ranging between 50 degrees and 90 degrees Fahrenheit at a relative humidity of between 8 and 80 percent. Noise level is rated at 54.2 dB for the single processors and 55.3 dB for the dual processors.

### CONFIGURATION RULES

Single-processor models come with 4 to 64 megabytes of memory and 6 to 24 channels, depending on model. Dual-processor models come with 16 to 64 megabytes of memory and 12 to 24 channels, depending on model. All systems also come with a high-speed buffer. The two dual-processor systems feature a high-speed buffer for each instruction

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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.
3422	—	1600/ 6250	—	— 125	200,000 780,000
3430	9 9	1600 6250	PE GCR	50 50	80,000 312,500
3480 Model B22	18	38,000 (bytes)	—	79	3,000,000
Model B11	18	38,000 (bytes)	—	79	1,500,000
Printers	Printing Speed	Print Positions	Horizontal Spacing, Chars./Inch	Vertical Spacing, Lines/Inch	Form Size, Inches
3262: Model 3	252-650 lpm	132	10	6 or 8	3½ to 16 wide, 6 to 14 long
Model 5	252-650 lpm	132	10	6 or 8	3½ to 16 wide, 6 to 14 long
Model 13	125-325 lpm	132	10	6 or 8	3½ to 16 wide, 6 to 14 long
3800: Model 3	215 ppm	136, 163, 204	10, 12, 15	6, 8, 10, 12	6½ to 14¾ wide, 3½ to 11 long
Model 6	134 ppm	136, 163, 204	10, 12, 15	6, 8, 10, 12	6½ to 14¾ wide, 3½ to 11 long
3820	20 ppm	—	10, 12 other	—	7 to 8½ wide, 10½ to 14 long
3827: Model 1	92 ppm	—	Vari- able	Vari- able	8 to 8½ wide, 10 to 14 long
3835: Model 1	88 ppm	—	Vari- able	Vari- able	6.5 to 16 wide, 3 to 14 long
4245 Models 12 & D12	1,200 lpm (48 char. set)	132	10	6 or 8	3½ to 22 wide, 3 to 24 long
4245 Models 20 & D20	2,000 lpm	132	10	6 or 8	3½ to 22 wide, 3 to 24 long
4248 Model 2	2,200 to 4,000 lpm	132 std.; 168 opt.	10	6 or 8	3½ to 18¾ wide, 3 to 17 long
6262: Models D12, T12	1,200 lpm	132	10	3, 4, 6, or 8	3½ to 17.7 wide, 3 to 14 long
Model 14	1,400 lpm	132	10	6 or 8	3½ to 17.7 wide, 3 to 14 long
Models D14 & T14	1,400 lpm	132	10	3, 4, 6, or 8	3½ to 17.7 wide, 3 to 14 long

A dash (—) indicates information was not available.

➤ which provide application compatibility not only within the 4381 family, but also between the 4381 Series, the new 9370 superminis, and 3090 large-scale mainframe.

While the 4381 line can run under quite a few operating systems, MVS/XA and ESA/370 are inherently capable of fully exploiting the 4381's 31-bit addressing mode. Despite the obvious advantages of MVS/XA and ESA, many 4381 users continue to stay with DOS/VSE. VSE makes ➤

➤ processor. A Model 3205 Color Display Console, a 3278 2A Display Console, or a 3279 Model 2C Color Display is required for all 4381 models. IBM recommends that the 3205 console use a separate operator control panel supplied with the processor. The 3278 should be equipped with a keyboard and an integrated operator control panel. ➤

## IBM ES/4381 Series

TABLE 4. TERMINALS

MODEL	316X	8775	3179	3180	3191
<b>DISPLAY PARAMETERS</b>					
Max. chars./screen	1,920	960, 1,920, 2,560, or 3,440	1,920 to 2,560	1,920 to 3,564	1,920
Screen size (lines x chars.)	24 x 80	12 x 80, 24 x 80, 32 x 80, 43 x 80	24 x 80, 32 x 80	24 x 80 to 27 x 132	24 x 80
Symbol formation	8 x 16	9 x 16, 9 x 15, or 9 x 12 dot matrix	7 x 14 dot matrix	8 x 11 to 8 x 8 dot matrix	7 x 14
Character phosphor	Amber or green	—	—	Monochrome	Green or amber
Total colors/no. simult. displayed	8 foreground/ 8 background	—	8 displayed	None	Monochrome
<b>KEYBOARD PARAMETERS</b>					
Style	102-key and opt. 84- key; 3162 only	Typewriter	Typewriter	Data entry or typewriter	102, 122, 104 key
Character/code set	128/ASCII	75 or 94/EBCDIC	94	—	94
Detachable	—	Yes	Yes	Yes	Yes
Program function keys	12 to 24	10, 12, or 24	24	24	24
<b>OTHER FEATURES</b>					
Buffer capacity	—	—	—	—	—
Tilt/swivel	Standard	—	Standard	Standard	Standard
Graphics capability	—	—	—	—	—
<b>TERMINAL INTERFACE</b>					
	RS-232, RS-422A	3725 Communica- tions Controller	3174, 3274 Controllers	3174, 3274, 3276 Controllers	3174, 3274 Controllers

A dash (—) indicates information was not available.

► up the largest segment of the IBM operating system user community and has even been gaining new users.

Getting users to migrate to XA over the years has met with much resistance, since XA software tends to be more expensive and the conversion of applications from other operating environments, particularly VSE, is no small task. To encourage more conversions to XA, IBM extended graduated software pricing to MVS/XA and Cross System products and also brought out MVS Migration System (MVS-MS) and VSE/MVS Migration Assistant SolutionPac, which includes project initiation services and optional switch-over assistance.

Users planning to stay with VSE got some welcome news in 1988 when IBM extended virtual memory addressing space from 16 megabytes to 128 megabytes and brought out other enhancements in response to requests from GUIDE, an IBM midrange user group. Nonetheless, IBM has no plans to make VSE an SAA participant. As noted in the Management Summary section, VSE can only support SAA indirectly under CICS. Of course, VM and MVS products that run on the 4381 come under the SAA umbrella.

SAA will make it possible to port software from designated hardware and software products that conform to SAA interfaces. This means applications meeting SAA specifications will be transportable from the 4381 to other SAA machines.

Users at the 4381 level converting to MVS/XA will be charged less for XA software than 3090 users. Graduated software charges are now based on central processor size and its designated processor group. The 4381 model groups are charged Processor Group 18, 20, and 30 rates, making many software products less expensive than the same products running on 3090 machines, which mostly are charged at Group 40 and 50 rates. ►

### ► INPUT/OUTPUT CONTROL

Single-processor systems feature six standard channels and six optional channels, while the dual processors feature 12 standard channels and 12 optional channels.

The Model Groups 11, 21, 22, 23, and 91E come equipped with six standard channels: five block multiplexer and one byte multiplexer. Four of the block multiplexer channels have data rates of up to three megabytes per second in datastreaming mode. The fifth block multiplexer channel has a data rate of up to two megabytes per second; this channel may alternatively be selected as a byte multiplexer channel. With the addition of six more optional block multiplexer channels, maximum aggregate data rates increase to 22 megabytes per second on the Model Group 11; 24 megabytes per second on the Model Groups 21 and 22; and 32 megabytes per second on the Model Groups 23 and 91E.

Optional channels on the Model Group 11 consists of two 2-megabyte and four 1-megabyte datastreaming block multiplexer channels; two 3-megabyte and four 1-megabyte channels on the Model Groups 21 and 22; and six 3-megabyte channels on the Model Groups 23 and 91E.

The 4381 Model Groups 24 and 92E dual processors come with 12 standard channels: two byte multiplexer channels, eight 3-megabyte-per-second, block multiplexer channels, and two 2-megabyte-per-second channels. Two of the standard block multiplexer channels can be configured as byte multiplexer channels for a system total of four byte multiplexer channels. The 12 additional block multiplexer channels, each with a data transfer rate of three megabytes per second, can be configured with the Model Groups 24 and 92E. Both model groups have an aggregate data rate of 60 megabytes per second.

In all, up to twenty 3-megabyte-per-second channels can be configured with the Model Groups 24 and 92E to support peripherals, such as the 3380 Direct Access Storage Device (DASD) subsystem and the 3480 cartridge tape subsystem.

A Channel-to-Channel Adapter (feature 1850) allows the interconnection of two channels, which may be on a 4381 or System/370. Only one of the interconnected processors needs to be equipped with this feature.

The 3088 Multisystem Channel Communication Unit is a standalone I/O Control Unit that provides channel- ►



## IBM ES/4381 Series

TABLE 4. TERMINALS (Continued)

MODEL	3192-G, -C	3192-D	3193	3194	3278	3279
<b>DISPLAY PARAMETERS</b>						
Max. chars./screen	1,920 or 2,560	1,920, 2,560, 3,440, 3,564	3,840	1,920, 2,560, 3,440, 3,564	960 to 3,564	1,920 to 2,560
Screen size (lines x chars.)	24 x 80, 32 x 80	24 x 80, 32 x 80, 43 x 80, 27 x 132	48 x 80	24 x 80, 32 x 80, 43 x 80, 27 x 132	12 x 80 to 27 x 132	24 x 80 to 32 x 80
Symbol formation	—	—	11 x 24	—	7 x 12 or 7 x 14 dot matrix	9 x 12
Character phosphor	—	Green	Black or white background	Green	—	—
Total colors/no. simult. displayed	7 colors	None	Monochrome	7 colors (C and H models)	None	4 to 7 colors
<b>KEYBOARD PARAMETERS</b>						
Style	Typewriter	Typewriter; modifiable	Typewriter; modifiable	Typewriter, data entry	Data entry or typewriter	Typewriter
Character/code set	EBCDIC	EBCDIC	EBCDIC	EBCDIC	—	—
Detachable	Yes	Yes	Yes	Yes	Yes	Yes
Program function keys	24	24	10/12	10/12	10/12	12
<b>OTHER FEATURES</b>						
Buffer capacity	—	—	—	—	—	—
Tilt/swivel	Standard	Standard	Standard	Standard	No	Standard
Graphics capability	Standard (3192 G models)	—	—	No	—	Standard (S3G model)
<b>TERMINAL INTERFACE</b>						
	3174, 3274 Controllers	3174, 3274 Controllers	3174, 3274 Controllers	3174, 3274/76 Controllers	3274, 3276 Controllers	3274, 3276 Controllers

A dash (—) indicates information was not available.

▷ Of course, this has its drawbacks. A 4381 user, for instance, will pay a \$117,165 graduated charge for MVS/XA with JES3. This same user planning to migrate at some point to an IBM 3090 Model 150E, a Group 40 machine, will be hit with a \$104,220 increase for the right to use this same software product. While the hardware price/performance gap between 4381 and 3090 systems has been eliminated, the pricing rift at the software level will still be difficult for many mid-level users to bridge.

## USER REACTION

Datapro's 1988 Computer Users Survey drew responses from 71 IBM 4381 users. The 4381s had an average installed life of 23.4 months as of third quarter 1988 when the survey was taken. Of the 4381 users surveyed, 66.2 percent said they purchased their systems from IBM, 16.9 percent rent from IBM, and 16.9 percent lease from a third party.

Traditional business data processing applications continue to dominate within sites surveyed. For instance, accounting/billing was the principal application Series 4381 users cited most often (74.6 percent). This was followed in popularity by Payroll/Personnel (60.6 percent), Purchasing (47.9 percent), Order Processing/Inventory (39.4 percent), Sales/Distribution (29.6 percent), and Manufacturing (21.1 percent). Applications areas cited less often include Education and Engineering/Scientific (both 18.3 percent), Insurance (12.7 percent), and Math/Statistics (9.9 percent).

Other responses yielded some interesting information about the relative sizes of system configurations. With the introduction of four new 4381 models, IBM increased maximum memory capacity from 32 megabytes to 64 ▷

▶ to-channel communications facilities for multiple IBM 3090 or 4381 processors. The 3088 permits interconnection of four to eight processor channels. The channel interfaces can be configured with 32 or 64 contiguous unit addresses that provide the function of a Channel-to-Channel Adapter. The device provides from 126 to 252 logical Channel-to-Channel Adapter links. The 3088 requires one control unit position on each processor channel to which it is attached. One unshared subchannel is required on each attached channel for each unit address.

IBM 4381 processors support the Device Attachment Control Unit (DACU), an option that permits configuration of high-performance, non-IBM input/output devices on 4381 block multiplexer channels. The DACU provides simulated direct memory access (DMA) transfers to and from host main storage; such transfers are buffered in DACU storage. The DACU supports both RS-232-C and Digital Unibus interfaces.

The availability of a Serial Original Equipment Manufacturer Interface (SOEMI) lets users attach OEM devices to the 4381s.

## MASS STORAGE

For information about 4381 Series mass storage devices, please refer to Table 2.

## INPUT/OUTPUT UNITS

For information about 4381 Series tape drives and printers, please refer to Table 3.

## TERMINALS

For information about IBM terminals, please refer to Table 4. ▶

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▷ megabytes. Of the 4381 users surveyed, 57 said they have between 8 and 32 megabytes of main memory and 11 said they have between 32 and 64 megabytes. In the auxiliary storage category, 59 have between 1.2 and 50 gigabytes of disk storage and six have more than 50 gigabytes. Most respondents (68) use IBM drives, while five use plug-compatible products.

At the software level, most of the respondents, not surprisingly, operate in VM (43) and VSE (40), the native 4381 operating environment. Twenty-two operate under MVS and one runs AT&T's UNIX.

Cobol continues to be the dominant popular programming language as would be expected in predominantly business data processing environments. Scientific languages, such as Fortran, ranked near the bottom. As part of future acquisition and implementation plans, 38 respondents said they plan to purchase more software from IBM and 47 said they plan to purchase software from other suppliers. Two plan to implement UNIX.

Additionally, 23 users surveyed said they have established an information center, but 39 do not have any such plans. Only nine said they planned to establish a center in 1989.

In other acquisition plans, 47 said they plan to expand hardware; 43 plan data communications expansions, 27 plan to buy laser printers, and two each plan to purchase optical disk devices and image processing systems.

As part of the survey, respondents were asked to rate hardware, software, and vendor support using a 10-point scale. One is the lowest possible score and 10 is the highest. The following table lists scores in the form of a weighted average; the larger the weighted average, the higher the score. The 10-point scale replaces the four-point scale used in previous years.

In comparison to other vendors and product lines, 4381 users rated their systems above average in hardware and support categories and average or below average in software categories. In virtually all categories, users gave competing products higher marks. Amdahl and NAS, vendors which sell IBM plug-compatible equipment, did exceptionally well in most categories. Amdahl and NAS out-ranked IBM in Ease of Operation, Maintenance, and Technical Support categories and all software categories. That Amdahl and NAS should do so well in software categories seems ironic, since PCM machines run IBM software. Maintenance and support issues may be key factors here. When users receive better than average vendor support—as PCM users attest—they also tend to feel better about IBM system software.

## ▶ COMMUNICATIONS

The 4381 is a host system in the IBM communications hierarchy, which involves the host mainframe with front-end communications controllers, terminal controllers, and terminal networks. Within the typical IBM communications hierarchy, terminals and remote systems communicate with the software residing within the communications processor, which in turn, communicates with the access method residing in the central processor. The 4381 family supports the 3720 and 3745 communications processors.

The *3720 Communication Controller* and *3721 Expansion Unit* are entry-level offerings within the 3725 family. The 3720 can have up to four duplex 56K or 64K bps lines per scanner. The product line supports ACF/NCP Version 4 subset and supports IBM and non-IBM data terminal equipment (DTE) with X.25 interface when the X.25 SNA Interconnection PRPQ is used.

The 3720 features a main storage capacity of up to 2 megabytes and up to 10 megabytes of hard disk storage. Up to 28 lines can be attached to the 3720 Models 1 and 2, expandable to up to 60 lines with the addition of the 3721 Expansion Unit. Additionally, up to 16 lines and up to two IBM Token-Ring Networks can be attached to the 3720 Models 11 and 12. With the 3721 Expansion Unit, up to 48 lines and up to two IBM Token-Ring Networks can be attached. The 3720 Models 1 and 11 can have a maximum of four host attachments using one or two channel adapters and up to 2 two-processor switches.

The *3745 Communication Controller* consists of the Model 210 and Model 410, 3746 expansion units, 3727 Operator Console, and the 7427 Console Switching Unit. A 3745/3746 combination can accommodate up to 512 duplex lines. Up to 128 duplex lines can be attached to a 3745 Model 210 or 410, and 256 duplex lines can be attached to the 3746 Model L13 or 128 duplex lines can be attached to the 3746 Model L14. The controller also supports up to 16 T1 connections and up to eight Token-Ring attachments

The *7171 ASCII Device Attachment Control Unit* supports up to 64 ASCII devices. The 7171 attaches to a 4381 Series block multiplexer channel and appears to the host as one or two 3274 Model D control units. Supported devices must feature point-to-point connection, 7-bit ASCII code, full-duplex character mode transmission, absolute cursor positioning, and the ability to clear the screen. Data can be transmitted at up to 19,200 bps.

The *Remote Operator Console Facility (ROCF)*, an extension of the 4381 Remote Support Facility, is designed to facilitate dial-up and initialization of a remote 4381 Series processor from a real or emulated 3275 Model 2 Display Station at the host site. A network can include a 4381 processor with ROCF installed and an IBM System/370, 3090 or 4381 Series host processor running either of two software products that provide 3275 emulation, the MVS/Operator Communications Control Facility (MVS/OCCF) or the VM/Pass-Through Facility. MVS/OCCF is designed to operate on any IBM host computer that supports MVS/SP, while the VM/Pass-Through Facility requires the VM/SP program product.

▷ System operations that can be performed from the host site include initial microcode load, reset, restart, compare/trace, and alter/display. Power-on for the remote 4381 processor must be performed at the remote site. ROCF provides a password verification function to help protect against unauthorized access to the remote 4381 system. The product also supports bisynchronous communications at 1200 bps.

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➤ The 4381 results are summarized below.

Ease of operation	7.2
Reliability of system	9.3
Reliability of peripherals	8.5
Maintenance service:	
Responsiveness	8.6
Effectiveness	8.4
Technical support:	
Troubleshooting	7.7
Education	7.5
Documentation	7.2
Vendor's software:	
Operating system	7.6
Compilers & assemblers	8.1
Application programs	6.5
Ease of programming	6.9
Ease of conversion	6.8
Overall satisfaction	8.1

\*Average based on a scale from 1 (Poor) to 10 (Excellent).

When asked if their systems performed as expected, 95.8 percent said "Yes," 2.8 percent said "No," and 1.4 percent were undecided. When asked if they would recommend the system to another user, 90.1 percent said "Yes," 8.5 percent said "No," and 1.4 percent were undecided. □

➤ After a remote 4381 is initialized from the host, communications control should continue through the existing network facilities of the host processor. ROCF is not designed to perform interactive jobs. When MVS/OCCF is used to initialize a remote 4381 MVS or DOS/VSE system, continued control can be provided by MVS/OCCF. After a remote 4381 VM system has been initialized, continued control can be provided by the Programmable Operator Facility of VM/SP.

## SOFTWARE

**OPERATING SYSTEMS:** The 4381 Series is supported by DOS/VSE (a significant expansion of DOS/VS), OS/VS1, MVS/SP, MVS/XA, ESA/370, VM/370, VM/XA SF, VM/XA SP, VM/IS, VM/SP High Performance Option, and Advanced Interactive Executive/370 (AIX/370), IBM's implementation of UNIX for the System/370 environment. Please refer to the IBM 3090 report in this tab and reports on IBM operating systems in Volume 3 for further information about MVS, ESA, VM, and AIX product families. The following describes DOS/VSE operating system software and VM products and functions relevant to 4381 users.

*DOS/VSE* is a disk-resident operating system designed to control system resources and job processing; it is a prerequisite for VSE-related program products.

DOS/VSE is enhanced by the VSE/Advanced Functions (VSE/AF) and VSE/System Product (VSE/SP) programs, which provide functional and performance-related capabilities. Both programs provide support for 4K pages in S/370 mode supervisor, allowing VSE to run as a VM guest using virtual address space extensions on IBM processors which only supports 4K pages. The 4K paging capabilities allow these two programs to use the full cache storage on IBM 4381 processors.

VSE Performance Tool (VSE/PT) is a software system monitor for measuring and evaluating the performance of a DOS/VSE system.

DOS/VSE supports 4381 processors operating in System/370 or ECPS:VSE mode. The components of DOS/VSE

are stored in DASD-resident system libraries and can be loaded into main storage when needed. The functions of DOS/VSE include initial program load, resource management, job control, linkage editing, paging management, library management, data management, system-to-operator communications, system utilities, system serviceability, and debugging aids.

The 4381 is currently supported by VSE/SP Version 1 Release 1, or the individual component VSE/AF Release 1.3.5 for the single-processor models; VSE/SP Version 2 Releases 1 or the individual component VSE/AF Version 2 Release 1 for the single processors; VSE/SP Version 3 Release 1 or the individual component VSE/AF Version 2 Release 1 for the single processors; and VSE/SP Version 4 Releases 1.0 and 1.1 and VSE/SF Version 4 Release 1.

*VSE/AF Version 4 Release 1* includes unattended node support, MVS migration support, and SQL/DS guest sharing. It also supports the 3745 Communication Controller.

*VSE/SP Version 4 Release 1 and 1.1* contain functions that support unattended nodes in a network of VSE operated processors. Functions include automatic subsystem recovery, message routing and centrally managed installation, operation, and maintenance services. Release 4.1.0 supports the 3745 controller, a new version of VSE/Power, VSE/AF, and Data Inter-file Transfer, Testing and Operations (DITTO). Additionally, it supports a new release of VSE/VSAM, ACF/VTAM 3.2 Integration, NetView 1.2 Optional Product, SQL Guest Sharing, and DITTO Version 3 Release 1. Release 4.1.1 contains enhanced support for unattended VSE nodes; OCCF 1.3; improvements to continuous operation; and VSE/Interactive Computer Control Facility enhancements.

The *VM/XA Systems Facility* supports guest production, testing, maintenance, and migration, allowing the migrating customer to continue production with the current operating system (MVS, VSE, VS1) while installing and testing MVS/XA. Full Conversational Monitor System (CMS) support can be obtained by running VM/SP or VM/SP HPO as a guest of the VM/XA Systems Facility. The CMS component is supported only for installation and maintenance. (Please refer to the "IBM 3090 Series" report in this tab and the "VM Operating System" report on Page SW35-504MK-701 in Volume 3 for more information about this product.)

*VM/XA SP Release 1* supersedes all releases of VM/XA SF and provides a migration path for VM/XA SF users. Enhancements include an interactive environment capable of supporting large numbers of users. It also supports a bimodal CMS which will operate in either System/370 mode with 24-bit addressing or 370-XA mode with 24- or 31-bit addressing. Additionally, program interfaces have been defined to allow the development of applications which are portable between System/370 and 370-XA CMS virtual machines. IBM believes the product enhancements will be an attractive growth path to VM/SP HPO users requiring larger processors running in single-image mode and relief to user growth constraints.

VM/XA SP Release 2 lets VM/XA SP users participate in SNA networks and also offers native support for SNA devices. VM/SP Release 2 no longer requires a guest such as VM/SP HPO or VCNA to handle SNA functions. (Please refer to the "IBM 3090 Series" report in this tab and the "VM Operating System" report on Page SW35-504MK-701 in Volume 3 for more information about this product.)

Two specialized versions of VM/SP are *VM/Integrated System (VM/IS)* and *VM/IS Base*. VM/IS is an entry-level system that provides load-and-go facilities for both

## IBM ES/4381 Series

► 9370 and 4381 users. VM/IS BASE is intended for new departmental and distributed enterprise installations where data processing skills are minimal while the VM/IS is intended for more knowledgeable personnel.

Under VM/IS and VM/IS BASE Release 6, IBM merged VM/IS and VM/SP System Offering into one package, giving users a choice. Additionally, VM/IS BASE now includes VM/SP Release 6. VM/IS also participates in SAA.

*OS/VS1* provides support for 4381 processors in System/370 mode. IBM plans no further releases of *OS/VS1*. However, *OS/VS1* is highly compatible with MVS, used on large systems. The four major functions of the control program routines of *OS/VS1* are job management through operator commands and job control statements; task management, which monitors and controls the entire system; data management, which controls all operations associated with input and output devices; and recovery management, which attempts to overcome the effects of a processor, channel, or I/O device malfunction. Additional features of *OS/VS1* include automatic partition redefinition, dynamic dispatching or time slicing, concatenated procedure libraries, and I/O load balancing. The 4381 line is supported by *OS/VS1* Release 7 with Basic Programming Extensions and Release 4 for single processors.

**PROGRAMMING LANGUAGES:** Languages available for the 4381 Series include Ada, Algol, APL2, Assembler H, Basic, C, Cobol, Common LISP under MVS, DSL/VS, Fortran, Intellect, Lisp/VM, Pascal/VS, PL/1, Prolog, and RPG II.

**DATA BASE MANAGEMENT:** DBMS products for the 4381 Series include Database 2 (DB2), Data Language/1 (DL/1), Information Management System/VS Data Base Facility (IMS/VS-DB), and SQL/Data System (SQL/DS). For further information about these products, please refer to individual reports appearing within the Data Base Management section of Volume 3, Tab 25.

**DATA COMMUNICATIONS:** IBM offers a range of data communications products for systems interconnection, multisystem networking, and distributed processing.

The *Advanced Communications Function/Virtual Telecommunications Access Method (ACF/VTAM)* is the base for the major IBM communications subsystems. It runs under MVS/XA, MVS/370, and VSE, and provides an "operating system" for the network. Its functions are the same as those of a host operating system in terms of resource sharing and logical handling of user requests. ACF/VTAM allows creation of networks with multiple 4381, System/370, 9370, and 3090 processors. Under MVS/XA, ACF/VTAM provides virtual storage constraint relief by supporting 31-bit addressing. In MVS/XA and MVS/370 environments, ACF/VTAM provides integrated encrypt/decrypt capabilities. Under VSE, this product supports extended network addressing capabilities to expand SNA network size.

*VSE/Virtual Storage Access Method (VSE/VSAM)* is a VSE access method for direct and sequential processing of fixed, variable length, and spanned records on direct access devices. VSE/VSAM is the access method of DL/1 and can also be used under VM/CMS. VSE/VSAM Version 1 Release 4 contains usability and serviceability enhancements.

*NetView* is a comprehensive network management product and is the basis for central control of both systems and network operations. *NetView* Release 2 for VSE automates network console operation and system console operation in conjunction with VSE/Operator Communication Control

*Facility (OCCF) Version 1 Release 2 or Version 1 Release 3.* It also supports distributed systems. This includes message and alert notification routing to a central system. It also includes an installation option that reduces *NetView* DASD library storage requirements. For more information about the *NetView* product family, please refer to the full *NetView* report (Page SW20-504MK-301) in Volume 3.

The *Customer Information Control System/VS (CICS/VS)* is a general-purpose data communications monitor for terminal-oriented transaction processing environments. CICS/VS, available for both the DOS/VS and OS/VS operating environments, interfaces between user-written application programs and transaction processing access methods (BTAM, VTAM, TCAM, ACF/VTAM, ACF/TCAM) and data base managers (DL/1 DOS/VS, SQL/DS in DOS/VS, IMS/VS/DB, and DB2 in MVS). The user can generate a CICS/VS system configuration applicable to specific needs and define the environment in which the system is to execute.

*Multiregion Operation (MRO)* allows multiple connected CICS/VS regions to run within a system (partitions in DOS/VSE and address spaces in OS/VS2) while sharing terminals, transactions, and other resources. In addition, the Intersystem Communications (ISC) facility provides the capability for connecting CICS/VS systems through ACF/VTAM or ACF/TCAM so that a transaction running in one system can access files and DL/1 data bases, initiate transactions, queue messages, or communicate directly with another transaction running in a connected CICS/VS system. (For more information about CICS, please refer to the CICS report on Page SW20-504MK-101 in Volume 3.)

The *File Transfer Program (FTP)* for VM is an SNA-based facility that enables a VM installation to transfer or extend files between FTP network nodes without the aid of a spooling subsystem. It provides high-performance data transmission, file handling, and checkpoint-restart facilities. By supporting the native VM SNA environment, it complements the cross-systems bulk data transfer capabilities of FTP for MVS and VSE.

FTP for VM offers transmission functions for CMS files and VSAM data sets. A programmable interface allows the user to access other, not directly supported, file organizations for remote data transmission.

**PROGRAM DEVELOPMENT:** IBM offers many tools to help programmers and end users develop and maintain applications. IBM packages for the MVS/SP and MVS/XA environments include Application Prototype Environment (APE), the Screen Definition Facility/Custom Information Control System (SDF/CICS), Cross System Product Set (CSPS), Cross System Product/Application Development (CSP/AD), Cross System Product/Application Execution (CSP/AE), Interactive Instructional Authoring System (IIAS), Interactive System Productivity Facility/Program Development Facility (ISPF/PDF), IMS Application Development Facility II, Query Management Facility (QMF), Time Sharing Option (TSO), TSO/Extensions, CMS, and Interactive System Productivity Facility (ISPF).

Facilities available for VM/SP, VM/XA, and VM/IS environments include APE, CSP/AD, CSP/AE, Cross System Product/Query (CSP/Q), IIAS, Interactive Instructional Presentation System (IIPS), ISPF, ISPF/PDF, VM/Interactive Productivity Facility, and VM/IS-PF.

Products for the VSE environment include CSP/AD, CSP/AE, Decision and Information Productivity Facility (DIPF/VSE), IIAS, IIPS, ISPF, and ISPF/PDF. ►

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► **UTILITIES:** 4381 utilities and special functions are handled both through intrinsic operating system capabilities and through specialized software products supplied with the operating systems.

Operating system utility functions include device configuration tasks, such as tape and DASD initialization; copying and restoring of DASD volumes; and functional recovery routines for system components.

The specialized adjuncts to the operating systems are discussed in the following paragraphs.

In the System Installation Productivity Options/Extended (System IPO/E), the IPO concept has been extended to facilitate the installation, management, and use of 4381 Series software products. IPO/E consists of a base set of integrated program products pregenerated, preconfigured, and pretested with the latest service levels preapplied, and ready to use in specific operating environments.

The *Data Base Edit Facility (DBEdit)* is a data maintenance tool that allows users to add, delete, update, and display records in relational data base tables. DBEdit takes advantage of the catalog facilities of DB2 in the MVS environment and of SQL/DS in the VM/SP environment.

The *Fortran Utilities for VM/370* program offering provides a set of Fortran-compatible system functions for programmers writing Fortran programs for the CMS of VM/370. The subroutines can execute with other programs written in either Fortran 77 or Fortran 66.

**OTHER SOFTWARE:** IBM offers several host-based office applications, described in the following paragraphs.

*Advanced Text Management System III (ATMS III)* provides facilities for entry, editing, and management of textual material. It runs under DOS/VSE, OS/VS1, and MVS/XA.

*Storage and Information Retrieval System (Stairs)* provides facilities for storage and contextual retrieval of large amounts of text as well as for creation of Stairs data bases from machine-readable formats. It runs under DOS/VSE, OS/VS1, and MVS/XA.

Two products which can be installed and used in conjunction are *Document Composition Facility (DCF)* and *Document Library Facility (DLF)*. DCF provides for markup, full-page composition, and printing of text documents on remote or local system printers. DLF is a data repository that can store input from numerous sources, including text prepared on interactive systems using a submit-to-batch facility, text prepared by ATMS and other text processors, and input to or from application programs. The products can run under MVS, MVS/XA, DOS/VSE, and OS/VS1.

*Distributed Office Support System/370 (DISOSS/370)* is an office system support product that provides electronic mail and document processing facilities. It runs in MVS/VSE and DOS/VSE environments under CICS/VS.

The *Document Interchange Facility (DIF)* comprises two complementary program products. DIF/Central executes in the host computer and processes requests from distributed system users to file documents in the DLF, format them through the DCF, and retrieve them from the library. DIF/Distributed executes in the distributed system, preparing user requests to file, format, and retrieve documents, and sending those requests to the host for processing. DIF runs in both DOS/VSE and MVS/XA environments.

*Professional Office System (PROFS)* provides facilities for document entry, processing, and distribution within a single system or across multiple systems; calendar management; and other end-user services, such as conference room scheduling and electronic messaging. PROFS runs in the VM/SP environment.

*DisplayWrite/370* provides word processing functions for professional end users. It operates under MVS/SP (MVS/370 or MVS/XA) or VSE and CICS/VS, or as a VM/SP application.

A broad range of commercial, scientific/engineering, and technical applications is available for 4381 systems both from IBM and from third-party vendors.

One noteworthy aid is the *VM/SP End User Software Support System (VM/SP ES<sup>3</sup>)*, a family of software offerings that provide general business, office, and engineering/scientific application solutions. Eight optional packages offer application solutions.

## PRICING AND SUPPORT

**POLICY:** The 4381 is available for purchase or monthly rental only. The standard rental contract includes equipment maintenance and entitles the customer to unlimited usage each month. The purchase option accrual equals 40 percent of the monthly charge, up to 50 percent of the purchase price. Some peripherals and other devices for the 4381 Series are available for purchase, lease, and rent.

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

Volume discounts are given for purchase of multiple 4381 systems; discounts vary from one system grouping to another.

Charges for most software products are based on a continuous monthly charge. A onetime license fee is available for an increasing number of programs, particularly those aimed at entry-level users. In some cases this is offered as an alternative to monthly licensing. In other cases, it is the only license arrangement possible.

A new charge structure, introduced in October 1986, provides for graduated onetime charges. Under this approach, the price of the software depends on the model group to which a processor belongs. The defined groups (10, 15, 18, 20, 30, 40, and 50) allow for a multiple-tier processing structure for each applicable product. The 4381 Model Group 11 belongs to processor Group 18; Model Group 21 belongs to processor Group 20; and the Model Groups 22, 23, 24, 91E, and 92E belong to processor Group 30. Users who upgrade to larger model groups will have to pay an upgrade charge for the software.

Users who have multiple systems controlled from a central site can pay the Basic License Fee for the central site and the Distributed Systems License Option (DSLLO) fee for all other locations. Central Service, including the IBM Support Center, is provided through the customer location designated for the Basic License. ►

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► **SUPPORT:** 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.

IBM 4381 systems were covered under Plan D. On December 1, 1987, all Plan D machines were redesignated Plan B machines. Under Plan B, users are entitled to unlimited use of the machine, as was the case under Plan D. If the type of service is IBM On-Site Repair or IBM On-Site Exchange, the Period of Maintenance Service is 24 hours a day, 7 days a week. The IBM Maintenance Agreement provides at no additional charge 24-hour, 7-day coverage for machines for which Optional Periods of Maintenance Service (OPMS) were available. This change eliminates all OPMS charges for those machines and expands the Base Period of Maintenance Service from the current 11-hour period (7 a.m. to 6 p.m., Monday through Friday) to 24 hours per day, 7 days per week.

IBM hourly service is limited to normal business hours, Monday through Friday. Service outside normal hours will be available if machine failure is related to a federal, state, or local government emergency; if the failure is life or health threatening; or if proprietary IBM engineering information is required.

For users without a maintenance contract, the 4381 Series is maintained under per-call Class 3. Under this class, users are charged an hourly rate during regular hours and a higher hourly rate during off-hours.

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

**RETAIN** is a data base which serves as the heart of service support. It is available to 4381 customers as an on-line service. It is scanned for existing solutions to a problem as it occurs. RETAIN is also used as a place to store solutions to new problems so that others will not rediscover the same problems. If the Support Center 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 user finds that the problem still cannot be resolved, the Program Support Representative (PSR) from the customer's local office is dispatched to assist. Under the support plan, many of the facilities that were previously provided by IBM support personnel at no charge have become billable activities.

**EDUCATION:** IBM offers a variety of technically and conceptually oriented training programs covering a variety of subjects, from large-system operating environments to information systems use and management. Educational methods include classroom instruction, self-study, program offerings (computer-based training products running on the 4381 Series and other systems), and technical update videotapes. Courses are usually given at IBM Education Centers nationwide; some are held at IBM branch offices and, by special arrangement, at user sites.

IBM offers several systems, applications, and operations courses for DOS/VSE, OS/VS1, MVS, and VM environments; courses on communications systems, data base management systems, and distributed processing, among other subjects, are also offered. IBM also makes available the

4381 Operator Training Series, a multimedia, self-study curriculum for system operations.

**TYPICAL CONFIGURATIONS:** Sample configurations for IBM 4381 Series systems are shown below. Complete equipment and software prices follow these configurations.

### SMALL CONFIGURATION:

IBM 4381 L11 single processor with 4 megabytes of main memory and 6 channels	\$175,000
Two 3205 color display consoles	5,790
One 3287 Model 2 console printer	3,580
One 3380 DASD Model AE4 (5.04 gigabytes)	113,000
One 3380 Model BE4 (5.04 gigabytes)	90,000
One 3880 Model 3 Controller	51,000
One 3480 A11 Cartridge Tape Controller	49,080
Two 3480 B11 Cartridge Tape Units (two drives per unit)	77,620
Four 2511 Automatic Cartridge Loaders	35,600
12 Model 3178 Model C30 display terminals (1,920 characters each with 87-key keyboard and numeric pad)	13,140
One 3174-51R Cluster Controller	5,900
One 4245 Model 20 Impact Printer (2000 lpm)	35,000
<b>TOTAL PURCHASE PRICE:</b>	<b>\$654,710</b>

### MEDIUM CONFIGURATION:

IBM 4381 P23 single processor with 16 megabytes of main memory and 6 channels	\$ 530,000
Two 3205 color display consoles	5,790
One 3287 Model 2 console printer	3,580
One 3380 DASD Model AE4 (5.04 gigabytes)	113,000
Three 3380 Model BE4s (5.04 gigabytes)	270,000
One 3880 Model 3 Controller	51,000
One 3480 A22 Cartridge Tape Controller	65,430
Four 3480 B22 Cartridge Tape Units (two drives per unit)	172,480
Eight 2511 Automatic Cartridge Loaders	71,200
12 Model 3178 Model C30 display terminals (1,920 characters each with 87-key keyboard and numeric pad)	13,140
One 3174-51R Cluster Controller	5,900
One 4245 Model 20 Impact Printer (2000 lpm)	35,000
<b>TOTAL PURCHASE PRICE:</b>	<b>\$1,336,520</b>

### LARGE CONFIGURATION:

IBM 4381 T92 dual processor with 64 megabytes of main memory and 12 channels	\$1,160,000
Two 3205 color display consoles	5,790
One 3287 Model 2 console printer	3,580

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One 3380 DASD Model AE4 (5.04 gigabytes)	113,000	3211 Dual Control Unit Communication Coupler	4,045
Three 3380 Model BE4s (5.04 gigabytes)	270,000	24 Model 3178 Model C30 display terminals (1,920 characters each with 87-key keyboard and numeric pad)	26,280
One 3880 Model 3 Controller	51,000	One 3174-01L Cluster Controller	12,950
Two 3480 A22 Cartridge Tape Controller	130,860	Two 4245 Model 20 Impact Printers (2000 lpm)	70,000
Eight 3480 B22 Cartridge Tape Units (two drives per unit)	344,960		
Eight 2511 Automatic Cartridge Loaders	71,200		
		<b>TOTAL PURCHASE PRICE:</b>	<b>\$2,263,665</b>

## EQUIPMENT PRICES

PROCESSORS		Purch. Price (\$)	Monthly Maint. (\$)	Monthly Rental (\$)
<b>Model Group 11</b>				
4381 L11	Processor with 4-kilobyte buffer and 4 megabytes of main memory	175,000	450.00	20,650
4381 M11	Same as L11, but with 8 megabytes of main memory	195,000	475.00	23,790
4381 P11	Same as L11, but with 16 megabytes of main memory	235,000	525.00	30,060
<b>Model Group 21</b>				
4381 M21	Processor with eight megabytes of main memory and eight-kilobyte buffer	225,000	450.00	26,785
4381 P21	Same as M21, but with 16 megabytes of main memory	265,000	462.00	32,485
<b>Model Group 22</b>				
4381 P22	Processor with 16 megabytes of main memory and 32-kilobyte buffer	350,000	550.00	41,665
4381 R22	Same as P22, but with 32 megabytes of main memory	430,000	574.00	53,065
<b>Model Group 23</b>				
4381 P23	Processor with 16 megabytes of main memory and 64-kilobyte buffer	530,000	640.00	63,095
4381 R23	Same as P23, but with 32 megabytes of main memory	610,000	644.00	74,495
4381 S23	Same as P23, but with 48 megabytes of main memory	690,000	688.00	85,895
4381 T23	Same as P23, but with 64 megabytes of main memory	770,000	712.00	97,295
<b>Model Group 24</b>				
4381 P24	Processor with 16 megabytes of shared main memory and a 128-kilobyte buffer	890,000	810.00	105,950
4381 R24	Same as P24, but with 32 megabytes of main memory	970,000	834.00	117,350
4381 S24	Same as P24, but with 48 megabytes of main memory	1,050,000	858.00	128,750
4381 T24	Same as P24, but with 64 megabytes of main memory	1,130,000	882.00	140,150
<b>Model Group 91E</b>				
4381 P91	Processor with 16 megabytes of main memory and 64-kilobyte buffer	550,000	665.00	70,060
4381 R91	Same as P91, but with 32 megabytes of main memory	630,000	689.00	82,310
4381 S91	Same as P91, but with 48 megabytes of main memory	710,000	713.00	94,560
4381 T91	Same as P91, but with 64 megabytes of main memory	790,000	737.00	106,800
<b>Model Group 92E</b>				
4381 P92	Processor with 16 megabytes of shared main memory and a 128-kilobyte buffer	920,000	835.00	117,150
4381 R92	Same as P92, but with 32 megabytes of main memory	1,000,000	859.00	129,450
4381 S92	Same as P92, but with 48 megabytes of main memory	1,080,000	883.00	141,700
4381 T92	Same as P92, but with 64 megabytes of main memory	1,160,000	907.00	153,950
<b>Additional 4381 Features and Options</b>				
3205	Model 1 Console; 1,920 characters, 122-key keyboard, 4 colors	2,895	320.00	NA
1850	Channel-to-Channel Adapter	23,150	31.00	1,650
1870	Additional Block Multiplexers Channels for single-processor models	35,580	12.50	2,535
1871	Additional Block Multiplexers Channels for dual-processor models	35,580	12.50	2,535
1872	Second Additional Block Multiplexer Channels for Model Group 24 only	35,580	12.50	2,535

NA—Not applicable.

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SYSTEM UPGRADES	Purch. Price (\$)
<b>Model Group 11 Upgrades</b>	
4381 L11 to 4381 M11	20,000
4381 L11 to 4381 P11	60,000
4381 L11 to 4381 M21	60,000
4381 L11 to 4381 P21	100,000
4381 L11 to 4381 P22	175,000
4381 L11 to 4381 R22	255,000
4381 M11 to 4381 P11	40,000
4381 M11 to 4381 P21	80,000
4381 M11 to 4381 P22	155,000
4381 M11 to 4381 R22	235,000
4381 P11 to 4381 P21	40,000
4381 P11 to 4381 P22	115,000
4381 P11 to 4381 R22	195,000
<b>Model Group 21 Upgrades</b>	
4381 M21 to 4381 P21	40,000
4381 M21 to 4381 P22	125,000
4381 M21 to 4381 R22	205,000
4381 P21 to 4381 P22	85,000
4381 P21 to 4381 R22	165,000
<b>Model Group 22 Upgrades</b>	
4381 P22 to 4381 R22	80,000
4381 P22 to 4381 P23	180,000
4381 P22 to 4381 R23	260,000
4381 P22 to 4381 S23	340,000
4381 P22 to 4381 T23	420,000
4381 R22 to 4381 R23	180,000
4381 R22 to 4381 S23	260,000
4381 R22 to 4381 T23	340,000
<b>Model Group 23 Upgrades</b>	
4381 P23 to 4381 R23	80,000
4381 P23 to 4381 S23	160,000
4381 P23 to 4381 T23	240,000
4381 P23 to 4381 P91	20,000
4381 P23 to 4381 R91	100,000
4381 P23 to 4381 S91	180,000
4381 P23 to 4381 T91	260,000
4381 R23 to 4381 S23	80,000
4381 R23 to 4381 T23	160,000
4381 R23 to 4381 R91	20,000
4381 R23 to 4381 S91	100,000
4381 R23 to 4381 T91	180,000
4381 S23 to 4381 T23	80,000
4381 S23 to 4381 S91	20,000
4381 S23 to 4381 T91	100,000
4381 P23 to 4381 P24 with Feature 1870	324,420
4381 P23 to 4381 R24 with Feature 1870	404,420
4381 P23 to 4381 S24 with Feature 1870	484,420
4381 P23 to 4381 T24 with Feature 1870	564,420
4381 R23 to 4381 R24 with Feature 1870	324,420
4381 R23 to 4381 S24 with Feature 1870	404,420
4381 R23 to 4381 T24 with Feature 1870	484,420
4381 S23 to 4381 S24 with Feature 1870	324,420
4381 S23 to 4381 T24 with Feature 1870	404,420
4381 T23 to 4381 T24 with Feature 1870	324,420
4381 T23 to 4381 T91	20,000
4381 P23 to 4381 P24 without Feature 1870	360,000
4381 P23 to 4381 R24 without Feature 1870	440,000
4381 P23 to 4381 S24 without Feature 1870	520,000
4381 P23 to 4381 T24 without Feature 1870	600,000
4381 R23 to 4381 R24 without Feature 1870	360,000
4381 R23 to 4381 S24 without Feature 1870	440,000
4381 R23 to 4381 T24 without Feature 1870	520,000



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Model Group 23 Upgrades (Continued)	Purch. Price (\$)
4381 S23 to 4381 S24 without Feature 1870	360,000
4381 S23 to 4381 T24 without Feature 1870	440,000
4381 T23 to 4381 T24 without Feature 1870	360,000
4381 P24 to 4381 R24	80,000
4381 P24 to 4381 S24	160,000
4381 P24 to 4381 T24	240,000
4381 P24 to 4381 P92	30,000
4381 P24 to 4381 R92	110,000
4381 P24 to 4381 S92	190,000
4381 P24 to 4381 T92	270,000
4381 R24 to 4381 S24	80,000
4381 R24 to 4381 T24	160,000
4381 R24 to 4381 R92	30,000
4381 R24 to 4381 S92	110,000
4381 R24 to 4381 T92	190,000
4381 S24 to 4381 T24	80,000
4381 S24 to 4381 S92	30,000
4381 S24 to 4381 T92	110,000
4381 T24 to 4381 T92	30,000

Model Group 91 Upgrades

4381 P91 to 4381 P92 with feature 1870	334,420
4381 P91 to 4381 R92 with feature 1870	414,420
4381 P91 to 4381 S92 with feature 1870	494,420
4381 P91 to 4381 T92 with feature 1870	574,420
4381 R91 to 4381 R92 with feature 1870	334,420
4381 R91 to 4381 S92 with feature 1870	414,420
4381 R91 to 4381 T92 with feature 1870	494,420
4381 S91 to 4381 S92 with feature 1870	334,420
4381 S91 to 4381 T92 with feature 1870	414,420
4381 T91 to 4381 T92 with feature 1870	334,420
4381 P91 to 4381 P92 without feature 1870	370,000
4381 P91 to 4381 R92 without feature 1870	450,000
4381 P91 to 4381 S92 without feature 1870	530,000
4381 P91 to 4381 T92 without feature 1870	610,000
4381 R91 to 4381 R92 without feature 1870	370,000
4381 R91 to 4381 S92 without feature 1870	450,000
4381 R91 to 4381 T92 without feature 1870	530,000
4381 S91 to 4381 S92 without feature 1870	370,000
4381 S91 to 4381 T92 without feature 1870	450,000
4381 T91 to 4381 T92 without feature 1870	370,000

SOFTWARE PRICES\*\*

Operating Systems		Initial Basic License Charge (\$)	Monthly Basic* License Charge (\$)	Graduated Onetime Charge (\$)	Licensed Program Support Charge (\$)
5685-001	MVS/SP Version 3 Release 1.1; Enterprise Systems Architecture/370 (ESA/370 with JES2)				
	Graduated Charge: Processor Group 30	NA	4,080	163,200	122,400
	Graduated Charge: Processor Group 40	NA	4,800	259,200	194,400
5685-002	MVS/SP Version 3 (ESA/370 with JES3)				
	Graduated Charge: Processor Group 30	5,400	4,050	183,600	137,700
	Graduated Charge: Processor Group 40	4,800	4,050	291,600	218,700

\*Includes equipment maintenance.  
NA—Not applicable.

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Operating Systems (Continued)		Initial Basic License Charge (\$)	Monthly Basic* License Charge (\$)	Graduated Onetime Charge (\$)	Licensed Program Support Charge (\$)
5665-XA3	MVS/Data Facility Product (MVS/DFP) Version 3				
	Graduated Charge: Processor Group 20	1,800	1,350	54,000	40,500
	Graduated Charge: Processor Group 30	1,800	1,350	54,000	40,500
	Graduated Charge: Processor Group 40	1,800	1,350	86,400	64,800
5740-XC6	MVS/SP Version 2 Releases 1.2 through 1.7, Release 2.0 and up (MVS/XA with JES2)				
	Graduated Charge: Processor Group 20	12,840	4,280	157,645	673
	Graduated Charge: Processor Group 30	12,840	4,280	157,645	673
	Graduated Charge: Processor Group 40	12,840	4,280	250,380	673
5740-XYN	MVS/SP Version 1 Releases 3 through 6 and up (MVS/370 with JES3)	NA	2,150	NA	117
5740-XY5	MVS/SP Version 1 Releases 3 through 6 and up (MVS/370 with JES2)	NA	2,150	NA	240
5665-291	MVS/SP Version 2 Releases 1.2 through 1.7 and up (MVS/XA with JES3)				
	Graduated Charge: Processor Group 20	14,430	4,810	177,165	1,335
	Graduated Charge: Processor Group 30	14,430	4,810	177,165	1,335
	Graduated Charge: Processor Group 40	14,430	4,810	281,385	1,335
5665-432	SRTOS Special Realtime Operating System Version 2; Version 2 requires MVS/SP or MVS/XA				
	Graduated Charge: Processor Group 20	NA	NA	40,000	NA
	Graduated Charge: Processor Group 30	NA	NA	40,000	NA
	Graduated Charge: Processor Group 40	NA	NA	—	NA
5664-167	VM/SP Releases 3 through 6 and up				
	Graduated Charge: Processor Group 18	NA	525	12,190	69
	Graduated Charge: Processor Group 20	NA	525	14,210	69
	Graduated Charge: Processor Group 30	NA	525	20,310	69
	Graduated Charge: Processor Group 40	NA	525	32,490	69
5664-169	VM/XA Systems Facility Release 1 and up	11,220	4,110	NA	623
5664-308	VM/XA System Product Release 2				
	Graduated Charge: Processor Group 30	NA	3,825	112,500	NA
	Graduated Charge: Processor Group 40	NA	4,500	216,000	NA
5664-173	VM/SP HPO High Performance Option Releases 3.2 through 5.0 and up; optional on 4381, but really needed if VM/SP is to fully utilize 4381 characteristics				
	Graduated Charge: Processor Group 20	5,325	1,775	NA	136
	Graduated Charge: Processor Group 30	5,325	1,775	57,665	136
	Graduated Charge: Processor Group 40	5,325	1,775	92,265	136
5662-257	OS/VS1/BPE Release 4 with 5652-VS1 OS/VS1 Release 7 SCP	NA	259	NA	48
5664-301	VM/IS BASE Release 6 and up				
	Graduated Charge: Processor Group 18	NA	1,050	44,200	NA
	Graduated Charge: Processor Group 20	NA	1,050	51,830	NA
	Graduated Charge: Processor Group 30	NA	1,050	73,160	NA
5666-301	VSE/AF Version 2 Release 1 and up				
	Graduated Charge: Processor Group 20	NA	438	8,000	108
	Graduated Charge: Processor Group 30	NA	438	11,430	108
5666-316	VSE/SP Version 2 Release 1.6				
	Graduated Charge: Processor Group 20	NA	2,160	40,440	433
	Graduated Charge: Processor Group 30	NA	2,160	57,805	433
5666-345	VSE/SP Version 3 Release 1.0 and up				
	Graduated Charge: Processor Group 20	NA	2,608	51,305	NA
	Graduated Charge: Processor Group 30	NA	2,608	51,305	NA
5750-AFB	VSE/SP Version 4 Release 1.0 and 1.1				
	Graduated Charge: Processor Group 18	NA	2,752	56,249	NA
	Graduated Charge: Processor Group 20	NA	2,942	65,437	NA
	Graduated Charge: Processor Group 30	NA	3,646	107,226	NA
5686-007	VSE/AF Version 4 Release 1				
	Graduated Charge: Processor Group 18	NA	380	9,500	NA
	Graduated Charge: Processor Group 20	NA	445	11,120	NA
	Graduated Charge: Processor Group 30	NA	688	20,640	NA

Utilities, Installation Management, Performance Analysis

5664-301F	VM/IS Performance Reporting Feature ("UMMAP")				
	Graduated Charge: Processor Group 20	NA	270	2,800	NA
	Graduated Charge: Processor Group 30	NA	270	4,000	NA
5664-301F	VM/IS Shared User Files Feature ("FSF")				
	Graduated Charge: Processor Group 20	NA	44	770	NA
	Graduated Charge: Processor Group 30	NA	44	1,100	NA
5664-301F	VM/IS Performance Monitor Feature ("Real Time Monitor")				
	Graduated Charge: Processor Group 20	NA	50	700	NA
	Graduated Charge: Processor Group 30	NA	50	1,000	NA
5664-301F	VM/IS Background Execution Feature ("Batch")				
	Graduated Charge: Processor Group 20	NA	44	770	NA
	Graduated Charge: Processor Group 30	NA	44	1,100	NA
5664-301F	VM/IS Graphics Support Feature ("GDDM/PGF")				
	Graduated Charge: Processor Group 20	NA	413	8,670	NA
	Graduated Charge: Processor Group 30	NA	413	12,390	NA

\*Includes equipment maintenance.  
NA—Not applicable.

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		Initial Basic License Charge (\$)	Monthly Basic* License Charge (\$)	Graduated Onetime Charge (\$)	Licensed Program Support Charge (\$)
<b>Utilities, Installation Management, Performance Analysis (Continued)</b>					
5664-301F	VM/IS Text Formatter Feature ("DCF/FEF")	NA	417	8,735	NA
	Graduated Charge: Processor Group 20	NA	417	12,480	NA
	Graduated Charge: Processor Group 30				
5664-301F	VM/IS General Language Support Routines ("PL/1")	NA	37	775	NA
	Graduated Charge: Processor Group 20	NA	37	1,100	NA
	Graduated Charge: Processor Group 30				
5686-005	VSE/POWER Version 4 Release 1	NA	138	3,450	NA
	Graduated Charge: Processor Group 18	NA	162	4,050	NA
	Graduated Charge: Processor Group 20	NA	250	7,500	NA
	Graduated Charge: Processor Group 30				
5668-917	DITTO Data Interfile Transfer Test and Operations Utility; for VSE, VM/SP				
	Graduated Charge: Processor Group 20	231	94	935	7
	Graduated Charge: Processor Group 30	231	94	1,340	7
5668-919	INFO/VM-VSE Information/MVS; for VM/SP, MVS/370, MVS/XA, VSE	NA	165	NA	91
5746-XE7	VSE/Access Control Logging and Reporting; for VSE	NA	63	2,360	24
5787-MVS	MVS Migration System (from VSE); for MVS/370, MVS/XA	NA	NA	65,000	NA
5796-PLQ	VSE/PT Performance Tool; for VSE	NA	313	6,930	NA
5798-DAA	DOS/GPAR Generalized Performance Analysis Reporting; for VSE	NA	66	1,365	NA
5798-DPH	JCL Conversion Aid; for VSE, MVS/370, MVS/XA	NA	500	11,000	NA
<b>Data Base Management and File Handling</b>					
5746-XX1	DL/I Data Language I Version 1 Release 8; for VSE	NA	481	17,320	NA
5688-004	SQL-DS Version 2 Release 2 Additional Enhancements and SQL/DS Application Interface for VSAM Feature				
	Graduated Charge: Processor Group 18	NA	761	13,700	NA
	Graduated Charge: Processor Group 20	NA	761	15,980	NA
	Graduated Charge: Processor Group 30	NA	761	22,830	NA
5746-AM2	VSE/VSAM Version 1 Release 4				
	Graduated Charge: Processor Group 18	NA	86	1,190	NA
	Graduated Charge: Processor Group 20	NA	86	1,275	NA
	Graduated Charge: Processor Group 30	NA	86	1,820	NA
<b>Data Communications, Time Sharing, Transaction Processing, Terminal Control</b>					
5666-343	NetView Release 2 for VSE				
	Graduated Charge: Processor Group 18	NA	687	12,370	NA
	Graduated Charge: Processor Group 20	NA	687	14,430	NA
	Graduated Charge: Processor Group 30	NA	687	20,610	NA
5668-854	ACF/NCP Version 4 Release 3; for VSE/AF and VSE/SP	2,185	729	NA	NA
5664-188	RSCS Networking Version 2 Release 2; for VM/IS, VM/SP				
	Graduated Charge: Processor Group 20	NA	337	6,300	38
	Graduated Charge: Processor Group 30	NA	337	6,300	38
5664-289	ACF/SSP System Support Program Version 3 Release 1.0; for VM/IS, VM/SP	960	320	NA	44
5664-298	PC Bond: PC Connectivity to VM, Release 2.0; for VM/IS, VM/SP	NA	135	2,000	NA
5666-280	ACF/VTAM Virtual Telecomm. Access Method Version 3 Release 2; for VSE				
	Graduated Charge: Processor Group 18	1,010	337	6,570	NA
	Graduated Charge: Processor Group 20	1,010	337	7,665	NA
	Graduated Charge: Processor Group 30	1,010	337	10,950	NA
5666-284	VSE/DSNX Distributed Systems Node Executive Version 1 Release 2; for VSE				
	Graduated Charge: Processor Group 20	NA	253	3,800	41
	Graduated Charge: Processor Group 30	NA	253	3,800	41
5666-285	NCCF Network Comm. Control Facility Version 2 Release 2.0; for VSE				
	Graduated Charge: Processor Group 20	1,110	203	4,530	22
	Graduated Charge: Processor Group 30	1,110	203	6,470	22
5666-295	NPDA Network Problem Determination Application Version 3 Release 2; for VSE				
	Graduated Charge: Processor Group 20	825	132	3,250	16
	Graduated Charge: Processor Group 30	825	132	4,645	16
5666-322	ACF/SSP System Support Program Version 3 Release 4; for VSE	377	112	5,380	NA
5740-XYF	SDF/CICS Screen Definition Release 3.0; for MVS/370, MVS/XA	NA	349	7,675	50
5746-XC5	VSE/OCCF Operator Communications Control Facility; for VSE				
	Graduated Charge: Processor Group 18	NA	162	2,915	NA
	Graduated Charge: Processor Group 20	NA	162	3,400	NA
	Graduated Charge: Processor Group 30	NA	162	4,860	NA
5746-XX3	CICS/DOS/VS Customer Information Control System Version 1 Release 7; for VSE				
	Graduated Charge: Processor Group 20	NA	686	14,405	149
	Graduated Charge: Processor Group 30	NA	686	20,580	149
5746-XXT	SDF/CICS VSE Screen Definition Facility Version 1 Release 5; for VSE	NA	243	5,345	44

\*Includes equipment maintenance.  
NA—Not applicable.

IBM ES/4381 Series

Departmental/Office System

		Initial Basic License Charge (\$)	Monthly Basic* License Charge (\$)	Graduated Onetime Charge (\$)	Licensed Program Support Charge (\$)
5664-309	PROFS with Applications Support Feature, Version 2 Release 2 for VM/IS, VM/SP 4574/4599 pricing features for PROFS: support up to 100 currently signed-on terminal users (CSTUs) Graduated Charge: Processor Group 20 Graduated Charge: Processor Group 30	NA NA	995 995	22,400 32,000	NA NA
	4630/4631 pricing features for PROFS: support more than 100 CSTUs; requires 4574/4599 Graduated Charge: Processor Group 20 Graduated Charge: Processor Group 30	NA NA	200 200	400 10,000	NA NA
5664-370	DisplayWrite/370 Version 1 Release 1.1; for VM/IS, VM/SP Graduated Charge: Processor Group 20 Graduated Charge: Processor Group 30	NA NA	665 665	9,800 14,000	42 42
5666-270	DISOSS Distributed Office Support System Version 3 Release 3; for VSE	NA	627	NA	176
5666-318	Personal Services/370 Release 2; for VSE	NA	412	NA	99
5666-338	DisplayWrite/370 Version 1 Release 1.1; for VSE Graduated Charge: Processor Group 20 Graduated Charge: Processor Group 30	NA NA	285 285	4,200 6,000	42 42
5666-339	Document Management Release 1.1; for VSE Graduated Charge: Processor Group 20 Graduated Charge: Processor Group 30	NA NA	158 158	2,850 2,850	28 28
5748-XXE	DLF Document Library Facility; for VS1, VSE, MVS/370, MVS/XA	480	160	NA	NA
5748-XX9	DCF Document Composition Facility (SCRIPT/VS) Release 3.1; for VM/SP, VM/ XA, VSE, MVS/370, MVS/XA Graduated Charge: Processor Group 20 Graduated Charge: Processor Group 30	972 972	324 324	7,370 10,530	NA NA
5799-BKE	HDDI Host to Displaywriter Document Interchange Release 2.0 PRPQ; for VM/IS, VM/SP Graduated Charge: Processor Group 20 Graduated Charge: Processor Group 30	1,165 1,165	265 265	6,240 8,920	NA NA

\*Includes equipment maintenance.

\*\*The following software price list contains pricing for operating systems software that runs on the 4381 Series. The balance of the list contains pricing primarily for DOS/VSE-based products, such as utilities, database packages, and communications software. For additional pricing information about MVS and VM-related products, please refer to the "IBM 3090 Series" software price list in this tab.

\*Includes equipment maintenance.

NA—Not applicable. ■