IBM 4300 Series

MANAGEMENT SUMMARY

IBM's January 1979 announcement of the 4300 Series computers has had a striking impact upon virtually every sector of the EDP field. With one bold stroke, IBM reaffirmed its credentials as a technological leader, slashed the cost of medium-scale computing equipment, *raised* the cost of the associated software and support for most users, sounded the death knell for Itel Corporation's plug-compatible computer venture, and severely increased the competitive pressure on most of the other mainframe vendors.

The IBM 4300 Series, widely referred to as the "E Series" during its development period, initially consisted of two central processors, the 4331 and the 4341, together with five new peripheral devices and three enhanced operating systems. In May 1980, IBM filled the conspicuously large performance gap between the two original processors by adding the 4331 Model Group 2. The new processor features twice the processing power and up to four times the main memory capacity of the original 4331, which is now designated the 4331 Model Group 1.

The most noteworthy aspects of the 4300 Series product line are: 1) the strikingly improved price/performance it offers; 2) the advanced technology which IBM employed to achieve those price/performance gains; and 3) the accompanying changes in IBM software pricing and support policies.

In terms of hardware performance per dollar, the 4300 Series processors offer approximately a four-fold increase over the corresponding System/370 processors. Moreover, incremental main memory for both the 4331 and 4341 was initially priced at the startlingly low figure of $15,000 per megabyte, and is currently offered at $15,700 per megabyte. These IBM breakthroughs established impressive new price/performance standards for the entire mainframe industry, and other computer ➢

IBM has plugged the performance gap between the original 4331 and 4341 processors by adding the intermediate 4331 Model Group 2. The medium-scale 4300 Series computers use enhanced versions of three System/370 operating systems, provide full System/370 compatibility, and feature a fourfold price/performance advantage over their IBM predecessors.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

MODELS: 4331 Model Group 1 (Models I1 and J1); 4331 Model Group 2 (Models J2, K2, KJ2, and L2); and 4341 (Models K1 and L1).

DATE ANNOUNCED: 4331 Model Group 1 and 4341—January 30, 1979; 4331 Model Group 2—May 6, 1980.

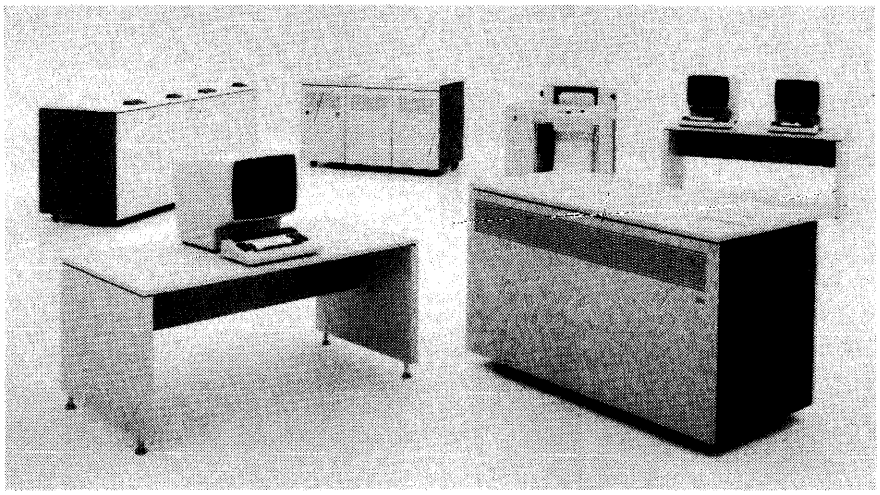
DATE OF FIRST DELIVERY: 4331 Model Group 1—2nd quarter 1979; 4331 Model Group 2—4th quarter 1980; 4341 Model K1—4th quarter 1979; 4341 Model L1—2nd quarter 1980.

DATA FORMATS

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

FLOATING-POINT OPERANDS: 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; 2 words, consisting of 56-bit fraction and 7-bit hexa- ➢



The 4331 Model Group 1 processor, at right foreground, is compact enough to fit easily into an office environment. The required 3278 Model 2A Display Console is in the left foreground, and behind it are four 3310 Direct-Access Storage Devices with a capacity of 64.5 megabytes each.

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vendors were forced to react hastily by introducing new processor models and slashing the prices of existing processors and memory modules.

IBM's pricing of the 4300 Series equipment also appears to be designed to encourage outright purchase as opposed to rental or leasing. Ironically, the advent of the 4300 Series has had the opposite effect on lease-versus-purchase decisions by users of IBM's larger 303X Series mainframes. These users, anticipating equally dramatic price/performance improvements in the forthcoming "H Series" large-scale mainframes, are becoming increasingly reluctant to make long-term commitments to the 303X hardware.

In achieving the new price/performance standards exhibited by the 4300 processors, IBM has confirmed its recently established position as a leader in electronic technology as well as marketing. The new hardware convincingly demonstrates the company's ability to utilize effectively such state-of-the-art developments as high-density packaging, thin-film technology, intelligent controllers, and advanced firmware.

The software announcements that accompanied the 4300 Series introduction indicate a continuing IBM commitment to improve both the functionality of its software and the support it provides to users of these products. At the same time, the new software pricing policy is clearly designed to ensure that increased software and support costs will at least partially offset the savings in hardware costs that the new computers will bring to IBM users.

PROCESSORS AND PERIPHERALS

The 4300 Series central processors can operate either in a System/370-compatible mode or in an extended control program (ECPS) mode. The latter mode takes full advantage of the extensive microcoding available in these machines to reduce operating system overhead and improve system throughput. The processors employ 64K-bit memory chips and logic chips that contain up to 704 circuits each. These logic chips are the same as the ones introduced with the IBM System/38, switching electrical signals at a rate of over 300 million times per second.

The memory technology used is also similar to that of the System/38. The density of packaging for both logic chips and memory chips, however, has been enhanced over that of the System/38. In the System/38, only one logic chip was mounted on a ceramic substrate, whereas on the 4331 and 4341, up to nine logic chips are mounted per substrate. Memory density has been doubled over that of the System/38 at the module level by stacking two ceramic substrates, where each substrate contains four chips. Since each chip stores 64K bits, each module contains 512K bits. Up to 524,288 bytes of memory can thus be contained on each 4.875-by-7.5-inch board. In comparison with the 370/138, memory packaging on the 4300 Series is 32 times denser. Because of the density of packaging, the 4331 Model Group 1 requires up to 70

decimal exponent, in "long" format; or 4 words in "extended precision" format.

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

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

MAIN STORAGE

STORAGE TYPE: SAMOS (silicon and aluminum metal oxide semiconductor) process N-channel FET (field effect transistor). The SAMOS process relies on silicon or silicon compounds to enhance gate reliability and to control chip surface leakage. Memory is composed of 64K-bit chips, with four chips mounted on each ceramic substrate. Maximum density is achieved by stacking pairs of substrates to form 8-chip modules.

Since each chip stores 64K bits, each module contains 512K bits. Up to 524,288 bytes of memory can thus be contained on each 4.875-by-7.5-inch board. In comparison with the 370/138, memory packaging on the 4300 Series is 32 times denser. Both timing and addressing functions are integrated on the memory chip, as well as two high-speed data registers. These registers act as a buffer, allowing up to eight bits to be sequentially read from the chip at a data rate of 100 nanoseconds for each access to the chip. Writing to the chip is also done through the same registers, thus eliminating the need for a read modify write cycle.

Because of chip supply problems, IBM used 16K-bit memory chips in place of the 64K chips in early 4341 processors. The company says there are no performance, programming, or power differences between 4341 processors using the two types of memory chips.

CYCLE TIME: The 4331 Model Group 1 has a fetch cycle time of 900 nanoseconds per 4 bytes and a store cycle time of 1300 nanoseconds per 4 bytes. The 4331 Model Group 2 replenishes its 8192-byte buffer storage unit from main storage at the rate of 2.6 microseconds per 64-byte fetch cycle and 3.1 microseconds per 64-byte store cycle. Storage cycle times for the 4341 have not been released, but the processor cycle time is 150 to 300 nanoseconds and the buffer storage cycle time is 225 nanoseconds per 8-byte access.

CAPACITY: 4331 Model Group 1—524,288 or 1,048,576 bytes; 4331 Model Group 2—1,048,576 to 4,194,304 bytes in 1,048,576-byte increments; 4341—2,097,152 or 4,194,304 bytes.

CHECKING: All data paths between the central processor and main storage are parity-checked by byte. When data is stored, an error-correcting code is substituted for the parity bits. (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 signalled so that appropriate program action can be taken.

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

CENTRAL PROCESSORS

The 4331 (Model Groups 1 and 2) and the 4341 are heavily microprogrammed processors that include these common features: LSI technology, one-level addressing facility, virtual storage capability by dynamic address translation, channels with virtual storage addressing, System/370 Uni-

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CHARACTERISTICS OF THE 4300 SERIES PROCESSORS

	4331 Model Group 1	4331 Model Group 2	4341
SYSTEM CHARACTERISTICS			
Date of introduction	January 1979	May 1980	January 1979
Date of first delivery	2nd quarter 1979	4th quarter 1980	4th quarter 1979
Number of CPU's per system	1	1	1
Principal operating systems	DOS/VSE, OS/VS1 Rel. 7, VM/370 Rel. 6	DOS/VSE, OS/VS1 Rel. 7, VM/370 Rel. 6	DOS/VSE, OS/VS1 Rel. 7, VM/370 Rel. 6
Purchase price of CPU with minimum main storage capacity	$68,250	$150,000	$257,250
MAIN STORAGE			
Storage type	MOS	MOS	MOS
Read cycle time, nanoseconds	900	2600	Not specified
Write cycle time, nanoseconds	1300	3100	Not specified
Bytes fetched per cycle	4	64	Not specified
Minimum capacity, bytes	524,288	1,048,576	2,097,152
Maximum capacity, bytes	1,048,576	4,194,304	4,194,304
Increment size, bytes	524,288	1,048,576	2,097,152
Error-correcting memory	Standard	Standard	Standard
BUFFER STORAGE			
Capacity, bytes	None	8,192	8,192
Cycle time, nanoseconds	—	200	225
Bytes fetched per cycle	—	4	8
CENTRAL PROCESSOR			
Performance relative to IBM 370/138	0.9	1.8	3.2
Performance relative to 4331 Model Group 1	1.0	2.0	3.4 to 4.0
Operating modes	ECPS:VSE, System/370	ECPS:VSE, System/370	ECPS:VSE, System/370
System/370 mode options	Basic Control, Extended Control, ECPS:VM/370	Basic Control, Extended Control, ECPS:VM.370	ECPS:VS/1, ECPS:VM/370
Instruction set	S/370 Universal	S/370 Universal	S/370 Universal
Reloadable control storage capacity, bytes	65,536 or 131,072	131,072	Not specified
Data path width, bytes	4	4	8
Direct Access Storage Compatibility	Optional	Optional	No
IBM 1401/1440/1460 Compatibility	Optional	Optional	No
I/O CHANNELS AND ADAPTERS			
No. of byte multiplexer channels	1	1	1 or 2
No. of block multiplexer channels	1	2	2, 4, or 5
No. of high-speed block multiplexer channels	0	1	0
Maximum total no. of channels	2	4	6
Maximum channel data rates, bytes/second:			
Byte multiplexer (byte mode)	18,000	36,000	16,000
Byte multiplexer (burst mode)	500,000	500,000	1,000,000
Block multiplexer	500,000	1,250,000	2,000,000
High-speed block multiplexer	—	1,860,000	—
Integrated DASD Adapter (for 3310, 3370, and/or 3340/3344)	Optional (1 only)	Optional (1 or 2)	No
Display/Printer Adapter	Standard	Standard	No
5424 Multi-Function Card Unit Adapter	Optional	Optional	No
8809 Magnetic Tape Unit Adapter	Optional	Optional	No
Integrated Communications Adapter (8 lines)	Optional	Optional	No
3704/3705 Communications Controllers	Optional	Optional	Optional
3880 Storage Control (for 3330/3333, 3340/3344, 3350, and/or 3370)	No	Optional	Optional
Channel-to-Channel Adapter	No	No	Optional

percent less power than the 370/138, and the 4341 requires over 50 percent less power than the 370/138.

Although IBM had planned to use the 64K-bit memory chips in all the 4300 Series processors, it was forced to employ 16K-bit chips in early 4341 CPU's when the demand for the new processors outstripped IBM's capability to produce or procure the 64K chips. IBM assured its users that there would be no performance, programming, or power differences between 4341 processors using the two types of memory chips. It appears that the 64K chip supply problems have now been resolved, and

versal Instruction Set, CE maintenance support functions including support processor and remote support facility, store and fetch storage protection, byte-oriented operands, clock comparator and CPU timer, time of day clock, interval timer, reloadable control storage, PSW key handling, control registers, extended precision floating point, machine check handling, and program event recording. An 8192-byte high-speed buffer storage unit is used in the 4341 and in the 4331 Model Group 2 processors to reduce effective main storage access times, but not in the 4331 Model Group 1.

Both processors feature logic chips that contain up to 704 circuits each. These logic chips are the same as those introduced for the IBM System/38, switching electrical signals at a a rate of over 300 million times per second. Density of

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deliveries of the 4300 Series processors are accelerating. The processors are being manufactured at IBM's facilities in Endicott, New York and Mainz, Germany.

All three of the 4300 Series processors share these common features: the System/370 Universal Instruction Set, channels with virtual storage addressing, CE maintenance support functions including a support processor and remote support facility, store and fetch storage protection, byte-oriented operands, clock comparator and CPU timer, time of day clock, interval timer, PSW key handling, control registers, extended-precision floating point, machine check handling, and program event recording. The distinguishing attributes of the three processors are described in the "Characteristics" table on the third page of this report and in the following paragraphs.

The *4331 Model Group 1* processor is offered in two models with main memory capacities of 524,288 and 1,048,576 bytes. It features a lower purchase price and up to four times the instruction execution rate of a System/370 Model 115 with 65,536 bytes of memory. It delivers performance in the same range as the System/370 Model 138 at a fraction of the 138's price. According to IBM, the 4331 Model Group 1 is designed for the first-time computer user, such as a department or branch office within a larger enterprise, that could benefit from data base/data communications, interactive, and distributed processing capabilities. It is also meant to replace many of the remaining IBM System/360 computers still in service. The 4331 Model Group 1 can operate as a stand-alone unit, or it can be linked to other 4300's or attached to a central System/370 host.

Peripheral and communications equipment can be connected to the 4331 Model Group 1 by means of one byte multiplexer channel, one block multiplexer channel, and several integrated adapters. Data rates on the two channels may not exceed 500K bytes per second, which precludes the connection of high-speed disk or tape units. The optional DASD Adapter, however, permits direct connection of up to four strings of 3310, 3370, and/or 3340 direct-access storage devices for a maximum on-line disk storage capacity of over nine billion bytes. The Display/Printer Adapter, a standard feature, permits attachment of the required 3278 Model 2A Display Console plus up to 7 (or 15 with an optional expansion feature) additional display units and/or printers. The optional Communications Adapter permits low-cost connection of up to eight lines with speeds ranging from 75 to 56,000 bits per second; the SDLC, BSC, and start/stop line disciplines are available. Other optional adapters accommodate a 5424 Multi-Function Card Unit and up to six 8809 Magnetic Tape Units.

The 4331 Model Group 1 processor with the basic 524K bytes of memory can be purchased for $68,250, rented for $1,992 per month, or leased on a 2-year term for $1,695 per month. The basic monthly maintenance charge is $157. Doubling the main memory capacity to one megabyte adds just $7,850 to the purchase price,

packaging for logic chips has been enhanced over that of the System/38. On the System/38, only one logic chip was mounted on a ceramic substrate, whereas on the 4331 and 4341, up to nine logic chips are mounted per substrate. The ceramic substrate is built from up to 23 layers, containing up to the equivalent of 33 feet of wire.

Microcode is loaded through the system diskette drive. The several diskettes supplied with the system contain field engineering diagnostics, basic system features, and optional system features elected by the user. The system diskette facility also allows storage of failure data from the 4300 Series processors. This data can be subsequently analyzed by field engineering for maintenance purposes.

The 4341 features an eight-byte-wide data flow within the processor as well as an eight-byte-wide data flow between the processor, storage, and channels. Data flow within the 4331 is four bytes wide.

There are two modes of operation available to the 4300 user. On the 4331, the mode is selected at initial program load (IPL) time; on the 4341, at initial microcode load (IML) time. One of the two operating modes is the Extended Control Program Support (ECPS:VSE) mode, which utilizes the extensive microcoding facilities of the 4300 to reduce DOS/VSE overhead and improve system throughput. The other operating mode, 370 mode, has three options on the 4331 and two options on the 4341. On the 4331, the Basic Control (BC) option provides for execution of System/360 programs, the Extended Control (EC) option provides for execution of programs that require dynamic address translation facilities, and the ECPS:VM/370 option provides improved system performance with VM/370. On the 4341, the one option is ECPS:VS1, which improves processor performance with OS/VS1, and the other is ECPS:VM/370.

With ECPS:VSE, a reduction of up to 20 percent of total CPU time has been measured by IBM when compared with the same version of DOS/VSE running in a typical DB/DC environment with ECPS:VSE. Likewise, with ECPS:VS1, a reduction of up to 7 percent of CPU busy time for the OS/VS1 supervisor has been measured by IBM when compared to the same version of OS/VS1 without ECPS:VS1. With ECPS:VM/370, a reduction of up to 84 percent of CPU busy time for the VM/370 control program has been measured by IBM when compared to the same version of VM/370 running without ECPS:VM/370.

Programs written to run on IBM 1401, 1440, or 1460 systems can be executed on the 4331 using the IBM Systems 1401/1440/1460 Emulator program product and can achieve improved performance with a special feature on the processor. Another optional feature allows programs written for DOS, DOS/VS, or DOS/VSE and 2311/2314/2319 disk drives to be executed, with only JCL changes, using IBM 3310 Direct Access Storage. The System/3 Data Import feature provides the capability, with attachment of 3340 Direct Access Storage, to read data from a 3348 Data Module previously recorded on an IBM System/3 Model 12 or 15 and store it on another 4331-attached DASD for subsequent processing.

SUPPORT PROCESSOR: A separately powered subsystem integrated within the processor housing and designed to automate and simplify failure diagnosis, the Support Processor provides failure monitoring, including environmental monitoring and recording capabilities for temperature fluctuations, power variances, and electrostatic discharges. Processor failures result in the generation of an eight-digit reference code logged on the system diskette and displayed on the console to alert the operator. The reference code contains information to guide the IBM customer engineer to the failing unit.

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$235 to the monthly rental, $200 to the monthly lease price, and $11 to the monthly maintenance charge. Customer deliveries of the 4331 Model Group 1 began in the second quarter of 1979. An overwhelming influx of early orders led to quoted delivery times of up to three years; but as a result of rising production rates and a dwindling order backlog, IBM is now quoting delivery times ranging from 3 to 12 months on new orders.

Comparisons are in order between the 4331 Model Group 1 and two other IBM computers, the System/38 and the 8100. The System/38, a product of IBM's General Systems Division, is closely comparable to the 4331-1 in price and performance. As described in Report 70C-491-29, the System/38 is a technically sophisticated machine that features interactive operation and integrated data base support; but it represents the top of the current GSD product line (and therefore a possible "dead end"), can be programmed only in RPG III, and has been plagued by software development problems. The 4331, by contrast, features full System/370 compatibility, uses modestly enhanced versions of the proven System/370 software, and offers an almost unlimited upward growth path.

The Data Processing Division's own 8100 Information System (Report 70C-491-11) is a 16-bit minicomputer system that can perform many of the same distributed and stand-alone processing functions as the 4331 Model Group 1 at about one-half the price. But the 4331's System/370 compatibility, once again, is such a powerful advantage that it is causing the 4331 to be selected for use in many of the distributed processing environments for which the 8100 was specifically designed.

The *4331 Model Group 2* processor made its long-awaited debut in May 1980. Featuring major improvements in performance, memory capacity, and input/output capabilities over the 4331 Model Group 1, it effectively plugs the sizeable performance gap that existed between the two original 4300 Series processors. The rated instruction execution speed of the 4331 Model Group 2 is twice that of the 4331 Model Group 1 and a little over one-half that of the 4341. The new processor is offered in four models with memory capacities of one, two, three, and four megabytes. Unlike the 4331 Model Group 1, the Group 2 processor also has an 8192-byte buffer storage unit with a cycle time of 200 nanoseconds per 4-byte access.

The 4331 Model Group 2 can be equipped with the same integrated peripheral adapters as the Group 1 processor, plus an optional second DASD Adapter and greatly improved I/O channel capabilities. The maximum Group 2 channel complement consists of one byte multiplexer channel, two standard block multiplexer channels, and one high-speed block multiplexer channel. The latter channel can handle a data transfer rate of up to 1.86 million bytes per second, permitting the attachment of high-speed disk storage units via the 3880 Storage Control.

The Support Processor also provides support functions for the operator/support console and a remote data link for the Remote Support Facility (RSF) software. RSF is implemented via a customer-supplied telephone line to an IBM field technical support center. After customer authorization, initiation of the data link connection can be made only from the customer's location while the system is in maintenance mode and only by IBM customer engineering personnel who have proper sign-on authority. Additionally, all remote console screen activity can be observed on the customer's console display. The remote connection can be completely broken at any time by depression of a console key on the customer's display console.

CONTROL STORAGE: The 4300 Series processors utilize reloadable control storage (RCS) to hold the microcode which controls their operations. The RCS is composed of 18K-bit SAMOS-process n-channel FET chips.

On the 4331 Model Group 1 processor, 65,536 bytes of RCS are standard and an additional 65,536 bytes are optional (feature #1901). On the 4331 Model Group 2 processor, 131,072 bytes of RCS are standard, as are 12,288 bytes of read-only control storage. The amount of microcode required is dependent upon the features installed and the functions required. In addition to the RCS, some main memory is used for microcode storage and is therefore unavailable to the user. The amount of main memory required for this purpose is at least 53,248 bytes in 4331 processors with 65K bytes of RCS, and at least 16,348 bytes in 4331 processors with 131K bytes of RCS. In configurations with numerous options, peripheral attachments, and/or communications lines, the amount of main memory required for microcode storage can be substantially larger.

On the 4341 processor, the microcode resides entirely in RCS but keeps dynamic tables in main memory, thereby reducing the amount of main memory available to the user by from 14K to 108K bytes, depending upon the configuration.

BUFFER STORAGE: An 8192-byte buffer storage unit is standard on the 4331 Model Group 2 and on the 4341, but is not available on the 4331 Model Group 1 processor. The buffer storage is transparent to all programs and significantly reduces the effective main memory access time. On the 4331 Model Group 2, the buffer storage has fetch and store cycle times of 200 nanoseconds each per 4-byte access, and is automatically replenished from main memory in 64-byte units; the 64-byte fetch cycle takes 2.6 microseconds, and the 64-byte store cycle takes 3.1 microseconds. On the 4341, the buffer storage has fetch and store cycle times of 225 nanoseconds each per 8-byte access.

ADDRESSING: Three types of addresses are recognized: absolute, real, and logical. In all 4300 Series processors, a one-level addressing facility provides for improved virtual storage control by DOS/VSE (ECPS:VSE mode).

DYNAMIC ADDRESS TRANSLATION: This facility, which is 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. All models can address 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 speeded up by a group of high-speed registers (translation look-aside buffer) which hold recently referenced virtual storage addresses and their real storage equivalents.

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A basic one-megabyte 4331 Model Group 2 processor can be purchased for $150,000, rented for $5,035 per month, or leased on a 2-year term for $4,285 per month. The minimum monthly maintenance charge is $230. Each megabyte of additional main memory adds $15,700 to the purchase price, $470 to the monthly rental, $400 to the monthly lease cost, and $20 to the monthly maintenance charge. An installed 4331 Model Group 1 processor can be field-upgraded to a Group 2 processor in approximately 13 to 16 hours. Model upgrade purchase prices are equal to the difference between the list prices of the new and old processor models; there are no additional installation charges. Customer shipments of the 4331 Model Group 2 are scheduled to begin in the fourth quarter of 1980. Field upgrades from Group 1 to Group 2 processors will begin in the third quarter of 1980.

The *IBM 4341* processor is available in two models with main memory capacities of two and four megabytes. It features a lower purchase price and an instruction execution speed up to 3.2 times as fast as a System/370 Model 138 with 1,048,576 bytes of memory. The 4341's performance capability falls between that of the 370/148 and the 370/158-3. IBM describes the 4341 as particularly suitable for experienced intermediate systems users who need increased processing power, and those who could benefit from distributed applications that require more capacity.

None of the integrated peripheral adapters used on the 4331 processors is available for the 4341. Instead, all peripheral and communications devices are connected via standard I/O channels and control units. Two block multiplexer channels and one byte multiplexer channel are standard on the 4341. An Optional Channel Group adds either three more block multiplexer channels or two block multiplexer channels and a second byte multiplexer channel.

A two-megabyte 4341 processor can be purchased for $257,250, rented for $7,508 per month, or leased on a 2-year term for $6,390 per month. The basic monthly maintenance charge is $498. A field upgrade from the two-megabyte 4341 to the four-megabyte model is purchase-priced at $31,400. Customer deliveries of the two-megabyte 4341 began in the fourth quarter of 1979, and the four-megabyte model in the second quarter of 1980.

Along with the 4300 Series processors, IBM introduced five new peripheral devices: the 3310 and 3370 Direct-Access Storage Devices, the 3880 Storage Control, and the 3205 Model 5 and 3262 Printers.

The 3310 is a low-cost fixed-disk storage unit, usable only on the 4331 Model Group 1 and 2 processors, with a storage capacity of 64.5 million bytes per drive. Up to sixteen 3310 drives, in four strings of four drives each, can be connected to the 4331's integrated DASD Adapter. Data is transferred at the rate of 1.031 million bytes per second.

INSTRUCTION REPERTOIRE: The 4300 Series processors employ 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, handle 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 Look-Aside Buffer, Store Then AND System Mask, and Store Then OR System Mask; the VTAM support instructions of Compare and Swap and Compare and Double Swap; the OS/VS support instructions of Insert PSW Key, Set PSW Key from Address, and Clear I/O; and the extended precision floating point instructions.

INSTRUCTION TIMES: Average execution times, in microseconds, for some representative instructions on the *IBM 4341* processor are as follows:

Add (32-bit binary)	0.600
Multiply (32-bit binary)	3.900
Divide (32-bit binary)	7.425
Load (32-bit binary)	0.375
Store (32-bit binary)	0.375
Add (6-digit packed decimal)	1.275
Compare (6-digit packed decimal)	1.275
Add (short floating-point)	1.472
Multiply (short floating-point)	4.350
Divide (short floating-point)	6.300
Add (long floating-point)	1.425
Multiply (long floating-point)	5.400
Divide (long floating-point)	10.950

IBM has released the following processor performance comparisons:

- **The 4331 Model Group 1 offers up to 4 times the instruction execution rate of the System/370 Model 115.**
- **The 4331 Model Group 1, when operating in ECPS:VSE mode with 3310 direct-access storage, has a measured instruction execution rate averaging 0.91 times that of a System/370 Model 138 running under DOS/VS Release 3 with 3330 direct-access storage.**
- **The 4331 Model Group 2 has an internal speed approximately twice as fast as the 4331 Model Group 1.**
- **The 4341 has an instruction execution speed up to 3.2 times as fast as the System/370 Model 138.**

Furthermore, it is generally agreed that the instruction execution speed of the 4341 is 3.4 to 4 times that of the 4331 Model Group 1, or 1.7 to 2 times that of the 4331 Model Group 2.

INTERRUPTS: 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 program status word (PSW) is stored and from which the new PSW is fetched.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The *4331 Model Group 1* processor can have two integrated channels: one 1421 Block Multiplexer Channel and one 5248 Byte Multiplexer Channel.

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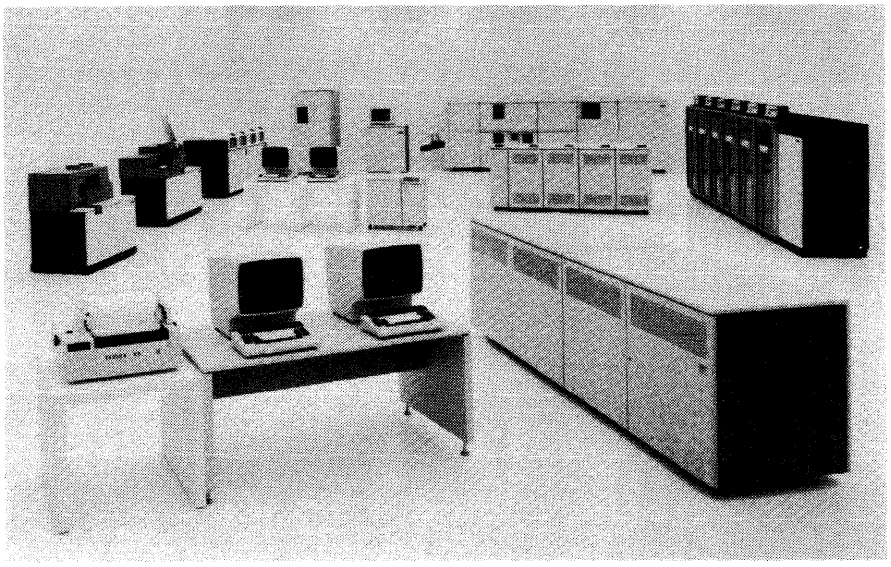

The IBM 4341 processor (right foreground) is priced below the System/370 Model 138 and delivers up to 3.2 times the CPU performance. It can utilize virtually all of the System/370 peripheral and communications equipment, as well as a number of devices introduced with the 4300 Series.

The 3370 Direct-Access Storage Device is a high-performance unit designed for use with any of the 4300 Series processors. Featuring more than twice the recording density of previous IBM disk storage devices, the 3370 can store up to 571 million bytes per spindle and has a data transfer rate of 1.859 million bytes per second. Up to sixteen 3370's can be attached to a 4331 Group 1 or 2 through each DASD Adapter. Up to thirty-two 3370's can be attached to the new 3880 Storage Control, which, in turn, can be channel-attached to the 4331 Group 2 or the 4341.

The 3880 Storage Control provides two independent data paths, called Storage Directors, between a 4331 Group 2 or 4341 processor and up to 32 disk drives. The 3880 can accommodate most of the current IBM high-performance disk units, including the 3330/3333, 3340/3344, 3350, and 3370. A pair of Two-Channel Switch Pair options enables up to eight I/O channels to access a single 3880 Storage Control and the associated disk drives.

The IBM 3262 Line Printer is a new unit designed for use only with the 4331 Group 1 and 2 processors. Attachable via the integrated Display/Printer Adapter, the 3262 operates at a speed of 650 lines per minute with a 48-character print set. The new 3203 Model 5 Printer, for use with any of the 4300 Series processors, operates at 1200 lines per minute with a 48-character set.

In addition to these new devices, IBM also announced that the 3289 Model 4 Printer, which operates at 400 lines per minute, is available for attachment to the 4331 processors, and that up to six IBM 8809 Magnetic Tape Units, previously announced with the IBM 8100 Information System, can also be used with the 4331 processors through an integrated adapter. The 8809's capability to transfer data in "streaming" mode at 160,000 bytes per second makes it an effective backup device for the nonremovable 3310 or 3370 disks.

The 1421 Block Multiplexer Channel provides the means of attaching I/O devices with data transfer rates up to 500K bytes per second, including 2311/2314/2319 Disk Drives, 3410/3411 Magnetic Tape Subsystems, and 3240 Model 3, 4, 5, and 7 Magnetic Tape Units. The 1421 provides 8 control unit positions and can be configured with up to 128 nonshared subchannels and up to 16 shared subchannels, each with up to 8 devices. (The maximum total number of devices is 128.)

The 5248 Byte Multiplexer Channel attaches the 3203-5 Printer and System/370 byte multiplex devices to the 4331 Model Group 1. With this channel, the single-byte interleaved mode provides a speed of 18K bytes per second, and the burst mode provides a speed of up to 500K bytes per second. The 5248 provides 8 control unit positions and up to 31 subchannels, 4 of which are shared subchannels supporting up to 16 devices each. The maximum number of subchannels is reduced by the addition of certain features.

The *4331 Model Group 2* processor can have up to four integrated channels: one 5248 Byte Multiplexer Channel, one 1421 Block Multiplexer Channel, one 1422 Additional Block Multiplexer Channel, and one 1431 High-Speed Block Multiplexer Channel.

The 5248 Byte Multiplexer Channel permits simultaneous operation of multiple low-speed devices at a combined data rate of up to 36K bytes per second in single-byte mode. It can also operate in burst mode at up to 500K bytes per second. The 5248 provides 8 control unit positions and up to 31 subchannels, 4 of which are shared subchannels that can support up to 16 devices each.

The 1421 and 1422 Block Multiplexer Channels can each accommodate a data transfer rate of up to 1.25 million bytes per second. The 1431 High-Speed Block Multiplexer Channel can handle a data transfer rate of up to 1.86 million bytes per second, permitting the attachment of high-speed peripheral devices such as the 3330/3333, 3340/3344, 3350, and 3370 via control units. If both the 1422 and the 1431 are installed on the same processor, the data transfer rate of the 1422 cannot exceed 600K bytes per second. Each of the Block Multiplexer Channels for the 4331 Model Group 2 provides 8 control unit positions and can be configured with up to 128 nonshared subchannels and up to 16 shared subchannels, each with up to 8 devices. The High-Speed Block Multiplexer Channel and the second DASD Adapter are mutually exclusive.

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Both the 4331 and 4341 processors use the IBM 3278 Model 2A Display Console, with a 1920-character display and keyboard, for operation and maintenance. Up to three additional consoles and/or 3287 Printers (for a total of four devices) can be attached to the 4341, and the Display/Printer Adapter on the 4331 processors can accommodate as many as 15 additional display units and/or printers.

SOFTWARE AND SUPPORT

Not since the System/360 unveiling in 1964 had IBM made an announcement that could impact users of its operating system software to such a magnitude as the software and support announcements that accompanied the January 1979 unveiling of the 4300 Series computer line. These announcements distinctly spelled out the operating environments of the future, and clearly identified the life spans of several existing operating systems.

First, IBM announced the operating systems for the 4300 Series computers. There are three new system control program environments: an extended version of DOS/VS called DOS/VS Extended, or simply DOS/VSE; a new version of OS/VS1 labeled Release 7; and Release 6 of the Virtual Machine Facility 370 (VM/370). These new system control programs (SCP's) will support a series of new program products, many geared specifically to support the 4300 Series computers.

What does this mean for current users? According to IBM, DOS/VS Release 34, OS/VS1 Release 6.7, and VM/370 Release 6 will be supported on existing System/370 and 303X hardware systems under current support arrangements until December 31, 1980. Inasmuch as DOS/VS Release 34 also runs in 370 mode on the 4300 Processors, it was supported via regional support efforts on those computers as well—but only until December 31, 1979. The same holds true for OS/VS1 Release 6.7 and VM/370 Release 5. There are no changes in existing SVS or MVS support plans.

Before getting into the makeup of the individual SCP environments, an important point should be made regarding the pricing of this software. For all practical purposes, all IBM software has now been price-tagged. Although there is no charge for the basic SPC, there is a support charge associated with all the software implemented on the 4300 systems, including the SCP. More will be said about the operations of IBM's expanded Support Centers later.

These changes in software pricing and support policies mean that, almost without exception, the combined future cost of IBM software and support will exceed the total cost of the free and extra-charge software running on earlier IBM systems. Support for the basic SCP (which doesn't offer the user as much as he previously received at no charge) is dependent on the model 4300 processor (or System/370) in use. With DOS/VSE, the user is required to append the Advanced Function facility

In addition to the I/O channels described above, the 4331 processor (both Model Groups 1 and 2) can be equipped with the following integrated I/O adapters: DASD Adapter (for 3310, 3370, and/or 3340/3344 Direct Access Storage Devices), 5424 Adapter (for a 96-column 5424 Multi-Function Card Unit), 8809 Adapter (for up to six 8809 Magnetic Tape Units), Display/Printer Adapter (a standard feature, for attaching the required 3278 Model 2A Display Console and up to 15 additional displays and/or printers), and Communications Adapter (for controlling up to 8 communications lines). A second DASD Adapter is optional on the 4331 Model Group 2. Details on these adapters can be found in the Mass Storage, Input/Output Units, and Communications Control sections of this report.

The *4341* processor can have up to six I/O channels in two three-channel groups, one standard and the other optional. The standard group consists of one Byte Multiplexer Channel and two Block Multiplexer Channels. The standard Byte Multiplexer Channel has a maximum data rate of 16K bytes per second in single-byte mode, 64K bytes per second in 4-byte mode, and 1.0 million bytes per second in burst mode. Each of the two standard Block Multiplexer Channels accommodates a maximum block transfer rate of 2.0 million bytes per second.

The Optional Channel Group (feature 1870) for the 4341 consists of two additional Block Multiplexer Channels and a third channel that can be configured as either a second Byte Multiplexer or a fifth Block Multiplexer Channel. The second Byte Multiplexer Channel has a maximum data rate of 22K bytes per second in single-byte mode, 88K bytes per second in 4-byte mode, and 2.0 million bytes per second in burst mode.

The aggregate data rate of the two standard Block Multiplexer Channels is 4 megabytes/second. The aggregate data rate of the five Block Multiplexer Channels including the optional group is 9 megabytes/second. If one of the three optional channels is configured as a second Byte Multiplexer Channel, the aggregate data rate of the remaining four Block Multiplexer Channels is 7 megabytes/second.

The capability for the attachment and automatic I/O power sequencing of up to 24 separate control units is standard on the 4341. Optionally, 48 control units can be accommodated through the addition of the 1890 Channel Control Unit Positions Feature. No one channel may attach and power-sequence more than eight control units.

A Channel-to-Channel Adapter (feature 1850) allows the interconnection of two channels, which may be on a 4341, System/360, or System/370. Only one of the interconnected processors needs to be equipped with this feature.

SIMULTANEOUS OPERATIONS: Concurrently with computing, a 4331 or 4341 can control one high-speed I/O data transfer operation per Block Multiplexer Channel and one low-speed I/O operation on each subchannel of a Byte Multiplexer Channel. Alternatively, a Byte Multiplexer Channel can operate in burst mode and handle a single higher-speed I/O operation.

CONFIGURATION RULES

The 4331 (Model Group 1 or 2) is a highly integrated system, with numerous peripheral adapters mounted in the processor cabinet, including those for 3310, 3370, and 3340 Direct-Access Storage Devices (optional, up to 9000 megabytes per adapter); 8809 Magnetic Tape Units (optional); diskette drive (optional); 5424 Multi-Function Card Unit (optional); and communications adapter (optional). Also optional are byte and block multiplexer channels, as decribed under the

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if he wishes to use any of the other new VSE program products and function with up to 12 partitions. According to IBM, the license fees for most of these program products will drop in proportion to the extra service charges being assessed, thereby "providing the program product at about the same price as before." However, according to most estimates, the actual cost will generally exceed the price that was previously paid for similar capabilities.

All of the software price changes took effect on January 1, 1980. An example of the price change algorithm shows a reduction in the basic monthly charge for DL/1 DOS/VS from the earlier $395 per month to a current license cost of $295 per month—plus a monthly support charge of $100 and an additional monthly support charge of $60, or a current total of $455 per month. Each licensed product will carry an additional support charge of 60 percent of the standard monthly support charge.

Effective January 1, 1980, local service or local assistance, as applicable, for many programs was discontinued, and the new licensed program support plan went into effect. Central service will continue to be available for some programs until discontinued by IBM upon 12 months' written notice. In addition, IBM Field Engineering local program support is also available at the applicable hourly rate.

The first new SCP environment is DOS/VS-Extended (DOS/VSE), which is said to be a major expansion of DOS/VS incorporating new functional and I/O support. Unfortunately, DOS/VSE provides only limited multiprogramming capabilities unless the user acquires the DOS/VSE/Advanced Function product, an independently priced adjunct that allows the DOS/VSE user to employ up to 12 partitions and also makes it possible to incorporate many of the new program products available with the system.

IBM says the OS/VS1 Release 7 support is of particular importance in a distributed data processing environment, since it will generally provide a high level of compatibility with an MVS host system. As with DOS/VSE and VM/370, OS/VS1 Release 7 can run in ECPS mode with the ECPS:VS1 feature on either the 4331 or 4341 processor or in 370 mode.

With VM/370 Release 6, the 4300 user can operate in mixed-mode environments where CMS interactive computing is combined with a guest SCP (DOS/VSE or OS/VS1) on the 4300 processors.

An important aspect of 4300 Series customer support is the expansion of the IBM Support Center activity. This approach to quick problem-solving via centralized telephone support is now the first level of support for the new software products announced with the 4300's as well as older IBM software products. According to IBM, this method of support was tested for over one year, and "67 percent of all problems during that time have been re-

"Input/Output Control" heading. The integrated Support Processor has a standard display/printer adapter for up to 8 devices, with optional expansion to 16 devices. These devices include a 3278-2A Console, 3278-2 Displays, 3287 Printers, Models 1 and 2; 3262 Printers, Model 1; and 3289 Printers, Model 4.

The 4341 is a more traditional mainframe, with only the Support Processor, three standard channels, three optional channels, and the optional Channel-to-Channel Adapter feature integrated into the processor cabinet. Up to four 3278-2A Consoles and/or 3287 Printers, Models 1 and 2, are attached to the Support Processor.

For information on channel configurability, see the Input/Output Control and Input/Output Units sections of this report. For native mass storage configurations, see the Mass Storage section of this report. For communications capabilities, see the Communications Control section of this report.

MASS STORAGE

The 4300 Series processors can utilize most of the System/360 and System/370 mass storage devices in addition to the new 3310 and 3370 subsystems that were announced with the 4300 Series. The available devices, their control units, and the manner of attachment can be summarized as follows:

- **2305 Fixed Head Storage Model 2, connected via the 2835 Storage Control Model to a block multiplexer channel on the 4341 only.**
- **2311 Disk Storage Drive Model 1, connected via the 2841 Storage Control Model 1 to a block multiplexer channel on the 4331 or 4341.**
- **2314 Direct Access Storage Facility, connected to a block multiplexer channel on the 4331 or 4341.**
- **3310 Direct Access Storage, connected to the DASD Adapter on the 4331 only.**
- **3330/3333 Disk Storage Models 1, 2, and 11, connected via either the 3830 Model 2 Storage Control or the 3880 Model 1 Storage Control to a block multiplexer channel on the 4341 or to a high-speed block multiplexer channel on the 4331 Model Group 2.**
- **3340/3344 Direct Access Storage, connected to the DASD Adapter on the 4331, or connected via either the 3830 Model 2 Storage Control or the 3880 Model 1 Storage Control to a block multiplexer channel on the 4341 or to a high-speed block multiplexer channel on the 4331 Model Group 2.**
- **3350 Direct Access Storage, connected via either the 3830 Model 2 Storage Control or the 3880 Model 1 Storage Control to a block multiplexer channel on the 4341 or to a high-speed block multiplexer channel on the 4331 Model Group 2.**
- **3370 Direct Access Storage, connected to the DASD Adapter on the 4331, or connected via the 3880 Model 1 Storage Control to a block multiplexer channel on the 4341 or to a high-speed block multiplexer channel on the 4331 Model Group 2.**
- **3540 Diskette Input/Output Unit, connected to either a byte or block multiplexer channel on the 4331 or 4341.**
- **Diskette Drive (feature #3401 for the 4331 processor), an integrated single-drive reader/recorder for IBM Type 1 diskettes.**

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solved via the remote centralized support center." The centralized support center provides 24-hour, 7-day customer access by telephone (via a toll-free 800 number). 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 he gets advice on temporary fixes or bypasses.

The new 4300 Series computers support four types of environments: stand-alone, distributed applications, distributed data applications, and distributed networks.

In the stand-alone system environment, compatible growth is provided from the 4331 to the 4341 or 303X systems operating under DOS/VSE, VM/370 Release 6, or OS/VS1 Release 7. Growth through intersystem connection can be achieved through VSE/POWER shared spooling support or through VM/370 RSCS Networking.

In a distributed applications environment, host-connect applications may vary from periodic transmission of summary data between the 4300 and the host system to a continuous connection offering RJE and/or pass-through capabilities. RJE is provided by DOS/VSE SNA and BSC program products plus VM/370 RSCS Networking and OS/VS1 HRNES IUP. Pass-through facilities are supported by ACF/VTAME, ACF/VTAM/MSNF, and VSE/3270 Bisync Pass-Through.

Data that is most frequently used locally may be stored on the 4300's own direct-access storage devices, with transaction-by-transaction access to the central host data base as needed in distributed data applications. Here, CICS/VS Intersystem Communications with DL/1 and IMS Multiple Systems Coupling provides support.

In a distributed network, communication can be established between local or remote 4300's to the host computer, or to IBM 8100 Information Systems. Transactions from the 8100's to CICS/VS Intersystem Communications are supported by the 8100 DPPX Host Transaction Facility. DPPX also supports RJE to OS/VS1 RES and VM/370 RSCS Networking systems.

With the advent of the 4300 Series, IBM has defined the standards for the next generation of computer equipment and software. The new IBM product line has already had, and will unquestionably continue to have, a momentous impact upon the entire data processing industry. Competitive mainframe makers must struggle more frantically than ever to remain competitive with the industry leader, while computer users will enjoy sharply lower data processing equipment costs which will be only partially offset by higher software and support costs.

USER REACTION

Datapro's 1980 survey of computer users drew responses from 46 users of the IBM 4331 and from 3 early users of

The 3310 and 3370 Direct Access Storage Devices and the 3880 Storage Control, which were introducd with the 4300 Series computers, are described in the following paragraphs. For details on the other equipment listed above, please refer to Report 70C-491-04 (IBM System/370).

3310 DIRECT-ACCESS STORAGE DEVICE: Provides 64.5 megabytes of disk storage for the 4331 processor only. The 3310 connects to the 4331 via an integrated DASD Adapter (see below). Each drive consists of a fixed and sealed head and disk assembly. The actuator is a swing-arm mechanism which moves in an arc over the disk surface.

The 3310 uses fixed block architecture providing linear contiguous data address space. Each 512-byte block can be addressed and accessed individually as well as in a contiguous string of arbitrary length. Rotational position sensing is standard. There are 512 bytes per sector (block), 352 sectors per cylinder, 180,224 bytes per cylinder, 358 cylinders per drive, and 64,520,192 bytes per drive.

Average head positioning time is 27 milliseconds. Average rotational delay is 9.6 milliseconds. Data transfer rate is 1031K bytes per second.

When the 2311/2314/2319/3310 Direct-Access Storage Compatibility Feature is installed on the 4331, up to seven 2311 volumes or two 2314/2319 volumes can be mapped onto one 3310 drive. Programs written for DOS, DOS/VS, or DOS/VSE and 2311/2314/2319 DASD's can be executed on the 4331 with this feature.

	3310 Fixed Block Mode Support	4331 Processor Mode
DOS/VSE	Yes	Native
VM/BSE Rel 2	Yes	S/370
VM/370 DOS/VSE AF	Yes	S/370

Access method support for the 3310 is VSE/VSAM, SAM, and ISAM through the ISAM interface program to VSE/VSAM. BDAM is not supported. Single data error bursts of up to 3 bits are corrected, while bursts of up to 14 bits are detected.

The 3310 Model A1 is a single drive with its associated control; the A2, dual drives with associated control; the B1, a single slave drive for attachment to the A2; and the B2, a dual-drive slave unit for attachment to the A2.

One integrated DASD Adapter is optional on all 4331 processors, and a second DASD Adapter is optional on the 4331 Model Group 2 only. These adapters permit the connection of 3310, 3370, and/or 3340 Direct Access Storage Devices without the need for separate control units. Each DASD Adapter can accommodate:

- **Up to four 3310 Model A1 units or Model A2 units with 3310 Model B1 or B2 units attached, up to a maximum of four drives per string (i.e., 16 drives total).**
- **Up to four 3370 Model A1 units with 3370 Model B1 units attached, up to a maximum of four units (eight actuators) per string (i.e., 16 units total).**
- **Up to two 3340 Model A2 units with 3340 and/or 3344 Model B units attached, up to a maximum of eight drives per string. (The 3340/3344 Direct Attach feature is required on the 4331, and a maximum of two strings of 3340/3344 storage may be used on a system.)**

The attachable device types may be intermixed on the DASD Adapter. The optional String Switch Capability allows strings of 3340 and/or 3370 drives to be shared between

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the IBM 4341. One of the 4331 users had 13 systems installed and another had two; all of the other respondents had one system each. The 4331 systems had been in use for an average of five months at the time of our survey, and the 4341's for an average of four months.

Eleven of the 49 responding users had purchased their 4300 Series equipment outright, while 8 were renting it and 30 were leasing it. Accounting was the most common application, checked by 31 of the users, followed by payroll/personnel with 21 mentions, manufacturing with 17, and transaction processing with 9.

In-house personnel wrote some or all of the applications programs for 47 of the 49 respondents. In addition, 12 were using proprietary software packages, 10 were using "ready-made" programs from IBM, and 6 had employed contract programming firms. COBOL was a primary programming language for 35 of the respondents, while 13 were using RPG and 9 were using assembly language.

DOS/VSE was the principal operating system for 30 of the 46 IBM 4331 users, followed by DOS/VS with 6 mentions and VM/370 with 5. Two of the three 4341 installations were using VM/370, while the third was an OS/VS1 shop. Twenty-four of the 4300 Series users were employing data base management systems, and IBM's DL/1 was the dominant DBMS product with 14 mentions. In similar fashion, 39 of the installations were using data communications monitors, and IBM's CICS was the specific product employed by 28 of them.

Planned acquisitions for 1980 included additional software from IBM (by 24 of the 49 respondents), proprietary software from other sources (by 21 respondents), expanded data communications facilities (by 23), distributed processing capabilities (by 15), and integrated word processing capabilities (by 4). Only five of the users expected to replace their 4300 Series systems during 1980, and all five were planning to install larger systems from IBM.

Here's how the 4300 Series users rated their systems in 14 important categories:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	14	28	5	0	3.2
Reliability of mainframe	26	16	4	2	3.4
Reliability of peripherals	14	26	8	0	3.1
Maintenance service:					
Responsiveness	21	22	4	1	3.3
Effectiveness	15	26	5	1	3.2
Technical support:					
Trouble-shooting	8	25	13	0	2.9
Education	6	26	13	1	2.8
Documentation	6	28	9	3	2.8
Manufacturer's software:					
Operating systems	11	30	4	3	3.0
Compilers and assemblers	15	30	0	0	3.3
Applications programs	5	28	1	1	3.0
Ease of programming	10	32	5	0	3.1
Ease of conversion	11	25	6	1	3.1
Overall satisfaction	10	34	4	0	3.1

*Weighted Average on a scale of 4.0 for Excellent.

the 4331 and another IBM processor or control unit; the String Switch Feature (#8150) is also required on each 3340 Model A2 or 3370 Model A1 to be switched. The System/3 Data Import option permits a 3340 Model A2 to read data from 3348 Data Modules which were recorded on a 3340 drive attached to an IBM System/3 Model 12 or 15.

3370 DIRECT-ACCESS STORAGE DEVICE: Provides up to 285.6 megabytes of storage per actuator and 571.3 megabytes per drive. The 3370 can be connected to an integrated DASD Adapter on the 4331 or to a 3880 Storage Control Model 1 on the 4331 Model Group 2 or the 4341. The integrated DASD Adapter is described under the 3310 heading above; the 3880 is described below.

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

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

Like the 3310, the 3370 makes use of fixed block architecture. Fixed block architecture provides for recording data in permanent pre-formatted 512-byte blocks on the disk surface. Each block of data is separately addressable and separately accessible, either singly or in contiguous strings of a variable number of blocks (maximum, approximately 65,000). One 3370 actuator (volume) spans 558,000 blocks of user space. User data is mapped, regardless of record size, to one or more 512-byte blocks on the disk.

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

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

A special feature (8150) allows the attachment of the 3370 Model A1 to a second Storage Director (data path on the 3880). The two Storage Directors may be connected to the same processor or two different processors. Switching between the two Storage Directors is under program control. The 3370 may also be dedicated to a single attachment with an enable/disable switch.

The 3370 is available in two models. The 3370 Model A1 contains the control adapter functions required for attachment to the 3880 or the 4331 DASD Adapter. The 3370 Model B1 attaches through an A1 unit. Up to three 3370 Model B1's can be attached to a 3370 Model A1 for a maximum of four units per string.

Programming support for the 3770 is provided by DOS/VSE on the IBM 4300 processors operating in ECPS:VSE mode.

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The categories rated highest by the 4300 Series users were reliability of mainframe, responsiveness of maintenance service, and compilers and assemblers. The lowest-rated areas, as in so many cases, were the three technical support categories of documentation, education, and trouble-shooting. It's worth noting, however, that the users' weighted average ratings in all 14 categories clustered within the relatively narrow range of 2.8 to 3.4, thereby falling squarely into the "good" range (i.e., better than fair but short of excellent). Thus, early indications are that the 4300 Series equipment, software, and vendor support will not be distinguished either by outstanding strength or by serious weakness in any of these important areas.

When we asked the 4300 Series users to check any significant problems they had encountered, 14 indicated that vendor enhancements and changes to the hardware and software were hard to keep up with; 13 noted that delivery and/or installation of their equipment was late; 10 said that delivery of required software was late; 9 indicated that IBM did not provide all the promised software or support; 8 said that the costs of their systems exceeded the expected totals; and 6 noted that program or data compatibility was not what the vendor promised.

On the positive side, 31 of the 49 users noted that programs and data carried over from other systems were compatible, as IBM promised; 31 also indicated that the systems are power/energy efficient; 22 said that users were happy with the system response time; 21 noted that terminals and peripherals carried over from other systems were fully compatible; 17 indicated that productivity aids help them keep programming costs down; and 16 noted that the systems are easy to expand and reconfigure.

A 4331 user in the Southwest commented that he had "converted from an IBM 370/115-2 and found the 4331 to be superior in all respects." He noted, however, that the DOS/VSE operating system "contained a large number of bugs." A Southern construction firm that replaced a 370/115 with a 4331 commented that "the hardware conversion was better than expected," but a scheduled change from DOS/VS to DOS/VSE "has brought about many questions to which IBM has failed to provide adequate answers." Other 4331 users complained that "IPO/E requires excessive machine and systems programmer time," that "IBM does not support asynchronous start/stop terminals well," and that the 4331 with 3340 disk storage is "slow, slow, slow."

A Southern 4331 user was ecstatic about IBM's Display Management System, a little-publicized but increasingly popular programming tool. In his words: "DMS allowed us to bring up applications in a very short time. Used with our DBMS (DL/1), this is a most productive system. We are operating with a DP staff of only four people and have programmed order entry, finished goods inventory, and customer information in just six weeks of coding, testing, and debugging."

The 3370 is also supported by VM/BSE Release 2 on the IBM 4300 processors operating in System/370 mode. When DOS/VSE is running as a guest operating system under VM/370, DOS/VSE with VSE/Advanced Functions supports the 3370 on the IBM 4300 processors in System/370 mode. The DOS/VSE access methods supported are VSE/VSAM, SAM, and ISAM through the ISAM interface program to VSE/VSAM; BDAM support is not provided.

The Direct Access Storage Compatibility Feature for the 4331 processor provides emulation of IBM 2311, 2314, 3330 (100 megabytes/volume), or 3340 data formats on 3370 drives, permitting programs written for the older disk types to be executed on a 3370-equipped 4331 system with only JCL modifications. The feature operates in System/370 mode under DOS, DOS/VS, OS/VS1, or VM/370, and in ECPS: VSE mode under DOS/VSE.

3880 STORAGE CONTROL: This control unit provides two completely independent paths for the transfer of file positioning commands and data between an IBM central processor channel and direct-access storage devices. Each path, called a Storage Director, attaches to a block multiplexer channel on a 4341 or to the high-speed block multiplexer channel on a 4331 Model Group 2. Both Storage Directors can be attached to the same channel, to different channels on the same processor, or to channels on two separate processors. The two-Storage Director design of the 3880 allows a faulty Storage Director to transmit diagnostic information (logging of failure information) through the other Storage Director.

Each Storage Director provides for the attchment of either up to four 3340 Model A2 units with 3340 and/or 3344 Model B units attached; up to four 3370 Model A1 units with 3370 Model B1 units attached; or up to four 3333 units (any model) with 3330 units attached and 3350 Model A2 or A2F units with 3350 Model B or C units attached, in any combination. The 3350, however, is not supported in 333X Model 1 or Model 11 compatibility mode.

The 3880 is built on a specialized LSI bipolar microcontroller chip which is signal-compatible with TTL circuitry. The chip is fabricated from a master slice of over 1400 gates and includes more than 14,000 components. The internal logic circuits utilize current switch technology. The chip can execute more than 5 million instructions per second and has 94 I/O signal lines, built-in error detection circuits, 16-bit microinstructions, and 8-bit data words. The instruction set is rich in branch and register-oriented instructions.

The 3880 provides multiple requesting, allowing a 3880 Storage Director and its attached drives to disconnect from the channel during mechanical delays resulting from actuator-positioning Locate, Seek, or Set Sector commands. Reconnection is attempted when the access mechanism is positioned at the desired track or when the specified rotational position has been reached. Other I/O operations can be initiated on other drives attached to the Storage Director during the period of disconnection.

The original 3880 announcement allowed for the attachment of a Two-Channel Switch Pair option. IBM has now increased the number of Switch Pair Options to two. A 3880 with both of the Two-Channel Switch Pair options installed allows up to four channels to be switched to each storage director. Therefore, a total of eight channels can have access to the 3880. Each Two-Channel Switch Pair may be connected to a configuration control panel via an optional Remote Switch Attachement.

A maximum of four 3333 Model 1 or Model 11 and/or 3350 Model A2 units can be attached to each Storage Director. Each 3333 can attach up to three 3330's, Model 1, 2, or 11. Each 3350 Model A2 or A2F can attach up to three 3350's, Model B2, B2F, C2, or C2F. A Storage Director can attach

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The only 4341 user who made any specific comments said that "the IBM 4341 is a nice machine, great for distributed engineering use." He complained, however, about slow response time (using 30 terminals under VM/370 CMS) and frequent system crashes.

Perhaps the most significant question in our survey was the final one: "Would you recommend this system to another user in your situation?" Forty-five of the 4300 Series users answered "yes," and only two said "no." Thus, the early evidence indicates that IBM's new computer family, though plagued by the kinds of software and support problems that are typically encountered with new product lines, is off to a reasonably good start and is likely to generate an increasingly high degree of satisfaction among its users as the early problems are resolved.□

up to four 3340 Model A2 units, and up to two of the 3340's can attach 3344's. If 3340's and 3344's are intermixed on a Storage Director, a maximum of 28 drives can be attached to that Director; if only 3340's are attached, up to 32 drives are allowed. Although 3340's and 3344's can be intermixed on a Storage Director, they cannot be intermixed with 3370's on the same Storage Director. For a Storage Director attaching 3370's, a maximum of four 3370 Model A1s, each with up to three 3370 Model B1's, may be attached.

INPUT/OUTPUT UNITS

The 4300 Series processors support most of the System/360 and System/370 peripheral devices, connectable to a byte multiplexer channel, a block multiplexer channel, and/or through integrated attachment features. In the following list, the type of connection appears in parentheses. If not otherwise specified, the device can be used with either the 4331 (Model Group 1 or 2) or the 4341. Devices that can be attached include:

- **3278 Display Station Model 2, 3287 Printer Models 1 and 2, 3289 Line Printer Model 4, and 3262 Line Printer Models 1 and 11 (attachment, on 4331).**
- **5424 Multi-Function Card Unit Model A1 or A2 (attachment, on 4331).**
- **8809 Magnetic Tape Unit Models 1A, 2, and 3 (attachment, on 4331).**
- **2415 Magnetic Tape Unit and Control Models 1 to 6 (byte or block on 4331 and block on 4341);**
- **2401 Magnetic Tape Unit Models 1 to 6 and 8 and 2420 Magnetic Tape Unit Models 5 and 7, all via the 2803 Tape Control Model 1, 2, or 3 (byte or block) or the 2804 Tape Control Model 1, 2, or 3 (block, on 4341);**
- **3420 Magnetic Tape Unit Models 3 to 8 via the 3803 Tape Control Model 1 or 2 (byte or block);**
- **3410/3411 Magnetic Tape Units and Control Models 1, 2, and 3 (byte or block);**
- **1403 Printer Models 2, 7, and N1 via the 2821 Control Unit Model 1, 2, 3, or 5 (byte or block);**
- **3211 Printer Model 1 via the 3811 Printer Control Unit Model 1 (byte or block);**
- **1443 Printer Model N1 (byte or block);**
- **3800 Printing Subsystem Model 1 (byte or block);**
- **2501 Card Reader Model B1 or B2 (byte or block);**
- **3505 Card Reader Model B1 or B2 (byte or block);**
- **2520 Card Reader Punch Model B1, B2, and B3 (byte or block);**
- **2540 Card Read Punch Model 1 via the 2821 Control Unit Model 1, 5, or 6 (byte or block);**
- **1442 Card Read Punch Model N1 (byte or block);**
- **1442 Card Punch Model N2 (byte or block);**
- **1017 Paper Tape Reader Models 1 and 2 and 1018 Paper Tape Punch Model 1 via the 2826 Paper Tape Control Model 1 (byte, on 4341);**
- **2671 Paper Tape Reader Model 1 via the 2822 Paper Tape Control Model 1 (block or byte);**
- **7770 Audio Response Unit Model 3 (byte);**
- **1255 Magnetic Character Reader Models 1, 2 and 3 (byte or block);**
- **1419 Magnetic Character Reader Model 1 (byte or block);**
- **1287 Optical Reader Models 1 to 5 (byte or block);**
- **1288 Optical Reader Model 1 (byte or block);**
- **3895 Document Reader/Inscriber Models 1 and 2 (byte or block);**
- **3890 Document Processor Models A1 to A6 and B1 to B6 (byte or block);**
- **2701 Data Adapter Unit Model 1 (byte or block);**
- **3704 Communications Controller (byte);**
- **3705-I and 3705-II Communications Controller (byte or block in NCP mode, byte in emulation mode);**
- **3791 Controller Models 1C, 2A, and 2B (byte or block);**
- **2250 Display Unit Model 1 (byte or block);**
- **2250 Display Unit Model 3 via the 2840 Display Control Model 2 (byte or block);**
- **3251 Display Station Model 1 via the 3255 Display Control Model 1 and 3258 Control Unit Model 1 (block);**
- **3277 Display Station Models 1 and 2, 3284 Printer Models 1 and 2, 3286 Printer Models 1 and 2, 3287 Printer Models 1 and 2, and 3288 Printer Models 1 and 2, all via the 3272 Control Unit Models 1 and 2 or 3274 Control Unit Models 1A, 1B, and 1D (byte or block);**
- **3289 Printer via the 3274 Control Unit Models 1A, 1B, and 1D (byte or block);**
- **3838 Array Processor Model 1, 2, or 3 (block, on 4341).**

For more information on most of these units, please refer to Report 70C-491-04 (IBM System/370).

Six input/output devices that were announced with the 4300 Series processors and/or are of particular interest to 4300 Series users are described in the following paragraphs.

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3278 DISPLAY CONSOLE, MODEL 2A: This unit is required with every 4331 or 4341 processor. It consists of a CRT display and a separately priced 75-key operator console keyboard. The anti-glare CRT displays 1920 characters in 24 rows of 80 characters each. The 96-character set provided on the 3278-2A consists of 26 upper case letters displayed through the use of a 7-by-9 dot matrix and 26 lower case alphabetic, 10 numeric, and 32 special characters displayed through the use of a 7-by-14 dot matrix. Rows 1 through 20 are usable by the operator, while rows 21 through 24 provide system status information.

The movable keyboard contains a typewriter layout with 12 program function keys available on the top row through use of the alternate shift key. Also provided are 49 data keys and 26 control keys including cursor move, tab, home, back tab, insert, delete, erase to end of field, and erase all input. In addition, the keyboard contains an operator control panel with four control keys—power off (4341 only), lamp reset, power on/IML (4341 only), and I/O interface—and 6 LED indicators (basic check, system wait, power in process, power complete, I/O interface disabled). The keyboard is available for the 4341 with I/O interface disabled). The keyboard is available for the 4341 with I/O interface (4631) or without I/O interface (4632). For the 4331, the keyboard is available without I/O interface or power-on (4634).

The console allows the operator to manually control such functions as storage display and operation, address comparing, and normal versus instruction step processing. The console indicates to the operator both proper operations and malfunctions. For maintenance and service, the console can display and store the status of the processor complex and other valuable servicing information as well as initiating and monitoring diagnostic tools. An audible alarm is a standard feature sounded under program control for special conditions.

The 3278-2A can operate in one of two modes. In *Display Mode*, the keyboard is used for input and the display with 20 lines of 80 characters/line for output, and DOS/VSE, DOS/VS Release 34, OS/VS1 Release 7, or VM/370 Release 6 support is required. The optional 3287 Printer Model 1 or 2 has a separate address. In *Printer-Keyboard Mode*, the 3278-2A uses the keyboard for input and the display and a recommended 3287 Printer Model 1 or 2 for output. The display/keyboard and 3278 Printer appear to the system as a console printer-keyboard. This allows the user to run an operating system which has been generated for use on a System/360 with a 1052 Printer-Keyboard or a System/370 with a 3210 or 3215 Console Printer-Keyboard.

The 3278-2A connects directly to a 4331 or 4341 processor. On the 4331 (Model Group 1 or 2), connection is via the standard Display/Printer Adapter, which permits connection of the required 3278-2A plus up to 7 (or 15 with the optional Display/Printer Adapter Expansion) additional devices chosen from the following list: 3278 Display Station Model 2, 3287 Printer Models 1 (80 cps) and 2 (120 cps), 3289 Line Printer Model 4 (400 lpm), and 3262 Line Printer Models 1 (650 lpm) and 11 (325 lpm). These devices may be installed in any combination, except that the number of system printers (3262 Model 1 and/or 3289 Model 4) may not exceed two.

3203 MODEL 5 PRINTER: Uses IBM's proven horizontal-train printing technology to produce high-quality printed output from either model of the 4300. The 3203 is an improved version of the 1403 Model N1 Printer and uses the same 1416 Interchangeable Train Cartridge. The 3203 Model 5 has a rated print speed of 1200 lpm with the standard 48-character set. The print speed can vary depending upon the frequency of character repetition on the cartridge. The Universal Character Set feature, with a 240-position buffer, is standard. All models have 132 print positions. Horizontal spacing is 10 characters/inch, and vertical spacing is 6 or 8 lines/inch. Forms ranging from 3.5 to 20 inches in width and from 3 to 24 inches in length can be fed. Normal skipping speed is up to 24 inches/second, with high-speed skipping at up to 55 inches/second after 6 lines have passed. A power-assisted stacker is standard.

Improvements over the 1403 Model N1 include: 1) an electronic forms control buffer that controls skipping and spacing, eliminating the need to change carriage control tapes; 2) a new tractor design to simplify forms loading; 3) higher print-hammer energy to produce copies of improved quality; 4) smaller size and reduced floor-space requirements; 5) quieter operation; and 6) a vacuum cleaning system that continually cleans the print train.

The 3203 Model 5 Printer contains an integrated controller and can be connected to any 4300 Series processor via an available control unit position on either a byte or block multiplexer channel.

3262 MODEL 1 PRINTER: An interchangeable-belt printer rated at 650 lpm with a 48-character belt, 625 lpm with a 64-character optimized set belt, 467 lpm with a 64-character belt, and 364 lpm with a 96-character belt. The character set height may be either 0.079 or 0.095 inch except for the 96-character belt, where the only available height is 0.095 inch. The 3262 can be attached to the the 4331 only via the display/printer adapter. The 3262 has 132 print positions, horizontal spacing of 10 characters per inch, and vertical spacing of 6 or 8 lines per inch under system control. Forms skipping and spacing are program-controlled. The carriage is a single-speed unit allowing skipping at up to 20 inches per second. Forms tractors are standard on the 3262, allowing the use of paper up to 16 inches wide. Also standard is a 288-character Universal Character Set buffer. The 3262 Model 1 connects to the 4331 Model Group 1 or 2 processor via the standard Display/Printer Adapter; it is not available with the 4341.

3289 MODEL 4 PRINTER: Provides printing at up to 400 lpm with a 48-character set, 300 lpm with a 64-character set, and 230 lpm with a 94-character set on the 4331. The 3289 is an interchangeable-belt printer that attaches to the 4331 via the display/printer adapter. The user may select either a 48-, 64-, or 96-character belt to be delivered with the system. A variable-width forms tractor for feeding marginally punched continuous forms (one to six parts) up to 15 inches in overall width is provided. The 3289 provides these standard functions: paper jam detection, front forms loading, Universal Character Set buffer, and vertical channel selection under 4331 control. The unit has 132 print positions, character spacing of 10 characters per inch, and line spacing of 6 or 8 lines per inch. The 3289 Model 4 connects to the 4331 Model Group 1 or 2 processor via the standard Display/Printer Adapter; it is not available with the 4341.

5424 MULTI-FUNCTION CARD UNIT (MFCU): For use with the 4331 only, via the 6510 attachment on the 5424 and the 3901 Adapter on the 4331. Combines the functions of a 96-column card reader/punch, collator, and interpreter in a single unit. Cosists of two 2,000-card feed hoppers, a read station, and four 600-card stackers. Cards fed from either or both hoppers can be read, punched, printed and fed into any of the four stackers under program control. Card sorting is also possible through the use of a multiple-pass sorting technique. The 5424 is offered in two models. Cards are read serially at 250 cpm in Model A1 and 500 cpm in Model A2. Punching is performed serially at 60 cpm in Model A1 and 120 cpm in Model A2 when printing in any or all of the first three line positions on each card. There is a fourth line position which, if used, causes the printing speed to drop to 48 cpm for Model A1 and 96 cpm for Model A2. Each of the 4 lines can hold up to 32 printed characters.

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8809 MAGNETIC TAPE UNIT: Introduced with the IBM 8100, this unit transports tape directly from reel to reel without capstans or vacuum columns, with tape tension and velocity controlled electronically. The 8809 uses standard ½-inch, 9-track tape on up to 10.5-inch reels (2400 feet). Recording density is 1600 bpi, phase-encoded. The 8809 works in one of two operating modes, selectable by the 4300 processor. In start/stop mode, the 8809 runs at 12.5 inches per second to achieve a data transfer rate of 20,000 bytes per second. In streaming mode, the 8809 runs at 100 inches per second to achieve a transfer rate of 160,000 bytes per second. Tapes written in either the start/stop or streaming mode have the same format. Up to six 8809 drives can be connected to the optional 8809 Magnetic Tape Unit Adapter on the 4331 Model Group 1 or 2 processor only. The first drive must be the 8809 Model A1; the second, fourth, and sixth drives must be the 8809 Model 2; and the third and fifth drives must be the 8809 Model 3.

COMMUNICATIONS CONTROL

The principal communications control unit for the IBM 4331 Model Group 1 or 2 is the integrated Communications Adapter, described below. The programmable 3704 and 3705 Communications Controllers, also described below, are the prime communications devices for the 4341 and can also serve as alternatives to the Communications Adapter when more than eight lines must be connected to a 4331. Other available communications control units for both the 4331 and the 4341 include the older 2701 Data Adapter Unit, which connects up to four lines; the 2715 Transmission Control Unit, which controls units of the 2790 Communication System; and the 3791 Controller, which serves as an intelligent base for local workstations of the 3790 Communication System.

4331 COMMUNICATIONS ADAPTER: This optional feature for the 4331 Model Group 1 or 2 processor provides for the direct attachment of up to eight BSC, start/stop, or SDLC communications lines in any combination. (At any given time, the "any combination may be two of the three available types.) The aggregate data rate capacity may not exceed 64,000 bits per second. For seven of the eight lines, the data rate per line may not exceed 9600 bps. The eighth line may be a BSC or SDLC high-speed line with data rate of up to 56,000 bps, operating concurrently with other lines provided that the data rate limitations are not exceeded. The adapter operates with start/stop and BSC lines in 2703 compatibility mode. SDLC is supported only by ACF/VTAME operating under DOS/VSE or by ACF/VTAME operating under VM/370 Release 6 with DOS/VSE running as a guest. The communications adapter provides auto answer, auto-poll operation, multipoint station functions, EBCDIC transparent mode for BSC only, and EBCDIC/ASCII code for BSC only.

The eight lines attached to the communications adapter may have these optional features in addition to the high-speed line feature (4720) already mentioned: up to eight line features without internal clock for attachment to external modems with (4695) or without (4696) clock (data circuit-terminating equipment); up to eight line features with integrated 1200-bps modems (nonswitched, 4781; switched with auto answer, 4782; nonswitched with switched network backup and manual answer, 4787; nonswitched with switched network backup and auto answer, 4788), up to eight line features with local attachments, (4801); up to eight line features with digital data service adapters (5650); and auto-call unit interfaces for up to two of the installed lines (1020).

The high-speed modem adapter (4720) is for the attachment of an external modem with clock having a CCITT V.35 interface. One non-switched point-to-point BSC or SDLC line may be operated at a speed of 19,200 to 56,000 bps.

The clock speed internal to the line attachment base for non-clocked modems is wired by default to 134.5 bps for start/stop operation and 1200 bps for BSC and SDLC operation. Otherwise, the clock speed can be wired at installation to one of the following: start/stop, 75, 300, 600, or 1200 bps; BSC, 600 bps; and SDLC, 600 bps. For BSC or SDLC operations, if 1200 bps is wired, then either full-speed operation (1200 bps) or half-speed operation (600 bps) may be selected from the operator console keyboard.

The local attachment interface provides circuits and controls for the local attachment of one BSC or SDLC remote station to the communications adapter without the use of modems at either device. Transmission speed can be strapped at installation time by the customer engineer at 1200, 2400, 4800, and 9600 bps. The feature provides clocking for both the communications adapter and the terminal. The attached terminal must be equipped with the EIA RS-232C or CCITT V.24/V.28 interface, have no business machine clocking, and have an external modem cable.

The digital data service adapter provides circuits and controls for attachment of one BSC or SDLC line and includes an internal Dataphone Digital Service (DDS) Adapter. This adapter will operate at synchronous speeds of 2400, 4800, 9600, or 56,000 bps. The speed must be set to the speed specified in the customer's order for service to the common carrier at installation time.

Certain configuration parameters for each line may be specified from the display console keyboard. These parameters include select stand-by, half-speed operation for synchronous lines only (for both clocked and nonclocked modems which have this capability), NRZI mode in SDLC mode, write interrupt (start/stop line), read interrupt (start/stop line), unit exception suppression (start/stop line), error index byte mode (BSC line), and ASCII code instead of EBCDIC (BSC line).

Certain configuration parameters can be selected at installation time and set by the IBM CE. These parameters include duplex instead of half-duplex connection (two-way alternate data flow transmission), switched network facility instead of nonswitched lines for external modems, new sync for BSC or SDLC in multipoint primary station function only, connect data set to line or data terminal ready procedure, and selection of WE202 or V.23 answer tone frequencies for 1200-bps integrated modems with automatic answering.

The 4331 Communications Adapter supports communications with virtually all of the current IBM terminals, systems, and communications controllers in one or more of the three transmission modes: SDLC, BSC, or start/stop.

3705 COMMUNICATIONS CONTROLLER: This programmable front-end network processor can be connected to either a byte or block multiplexer channel on a 4331 or 4341 processor.

Designed as IBM's evolutionary replacement for the hard-wired 2701, 2702, and 2703 transmission controls, the original 3705 Communications Controller is a mini-computer-based front-end processor that can have from 16K to 240K bytes of core memory and control up to 352 communications lines. It is available in 20 models with varying storage sizes and line capacities. Customer shipments began in July 1972.

The 3705 consists of a Basic Module and up to three Expansion Modules. The Basic Module houses the Central Control Unit and Control Panel. Also contained in these modules are the storage, Channel Adapters, Communications Scanners, Line Interface Bases, and Line Sets required

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to accommodate up to 352 communication lines. Configuration rules for the 3705 are quite complex. The maximum number of lines that can be connected is a function of the 3705 model, the line speeds and types, and the mode of operation. In the 2701/2/3 Emulation mode, a maximum of 255 lines can be controlled. Line speeds can range from 45.5 to 50,000 bits per second. In the NCP mode, data is transferred between the 3705 and the host computer via a single subchannel interface—a significant difference from the 2701/2/3 controls, which require a separate multiplexer subchannel for each communications line.

In November 1975, IBM announced an enhanced version of the 3705, the 3705-II, which offers significant price/performance improvements over the original model, now designated the 3705-I. (The 3705-I is no longer available from IBM.) The 3705-II has a storage capacity of from 32K to 256K bytes of metal oxide semiconductor (MOS) memory and has a faster processor cycle time of 1.0 microsecond (compared to 1.2 microseconds for the 3705-I). Other new features include a high-speed Communications Scanner, an upgraded Channel Adapter that transfers data in blocks of up to 32 characters, and increases in the supported transmission speeds to 9600 bits per second in synchronous mode and a maximum transmission rate of 56K bits per second. The 3705-II is available in 32 different models depending upon the storage capacity.

In November 1978, IBM announced 12 new models of the 3705-II Communications Controller. The new models (J1-J4, K1-K4, and L1-L4) feature memory beginning at 320K bytes, expandable to 512K bytes in 64K-byte increments; a memory cycle time of 0.9 microsecond (compared with 1.0 microsecond for the previous 3705-II models); and a Cycle Utilization Counter, which accumulates statistical data to assist in measuring machine performance.

All 12 of the new 3705-II Communications Controllers (Models, J, K, and L) hold 256K bytes of memory storage in their first frame and at least 64K bytes in the second. Additional storage is added in the second frame in 64K-byte increments, depending on the model, up to the maximum of 512K bytes. The new 3705-II's, like the old, are capable of physically attaching up to 352 communications lines, but are limited in concurrent operation by line speed, Channel Adapter type, memory size, software mode of operation, etc. One significant change in the new models is that the Type 1 Channel Adapter cannot be used, indicating that IBM is gradually moving its users away from the System/360 and 270X emulation mode of operation and toward the high-speed System/370 with SNA compliance.

Also included in the new models is a Cycle Utilization Counter which allows the ACF/NCP/VS (R2) software programming to accumulate statistical data on 3705 cycle utilization for user access. The specific cycles computed are instruction execution and operator panel maintenance cycles, and cycle sharing operations. With this data, ACF/NCP/VS (R2) provides information on the percentage of available cycles used.

Also in November 1978, IBM announced the availability of two new line interfaces, which permit high-speed local data transfer between any 3705 and either another 3705 or a 377X terminal without modems.

When connected to a host IBM processor, a 3704 or 3705 can use either the Network Control program (NCP) or the 2701/2/3 Emulation Program. NCP/VS, for virtual environments, includes all of the facilities of the original NCP and also has the Partitioned Emulation Programming Extension (PEP) capability which permits operation in the NCP Mode and Emulation mode concurrently.

The 370X Controllers are supported under VTAM, the principal access method for communications support under DOS/VS and OS/VS. The major advantages of NCP operation through VTAM include the capabilities for dynamic allocation of terminals, lines, and the 370X Controllers among multiple applications programs and for simultaneous operation in the Emulation and NCP modes within one 370X. In addition, the 370X can be configured and used as a remote concentrator. Communication between a remote 370X and a local 370X connected to the host computer is over a leased line operating synchronously in the full-duplex mode at 4800 bits per second or in half-duplex mode at up to 50,000 bits per second.

With the announcement of the 3705-II in November 1975, IBM also added an additional software enhancement that permits PEP to support concurrent operations in a dual-processor environment in which one central processor supports communications through VTAM (or TCAM through VTAM) in the NCP mode and the other central processor supports communications via a non-VTAM control program which operates under the Emulation Program. When NCP or NCP/VS is used, a 370X functions as a true "front-end" communications processor and relieves the central processor of many routine tasks such as line control, character and block checking, character buffering, polling, and error recovery.

The Advanced Communication Function for NCP, ACF/NCP/VS (and related Systems Support Programs, for all operating systems), announced in November 1976, added capabilities that are significant for multi-system users. Multiple processors can be interconnected via full- or half-duplex SDLC protocol lines linking their respective local 3705's. Any mix of VS operating systems is permissible. Transmission to a host CPU can be passed through interconnected 3705's to a down-stream CPU without any involvement of the host or intermediate CPU's. To utilize ACF/NCP/VS, an Advanced Communication Function for VTAM and TCAM is necessary.

ACF/VTAM supports CICS/VS, IMS/VS, Power/VS, JES1/RES, JES2/RJE, TSO, VSPC, SSS, and BTP user programs. ACF/TCAM supports CICS/VS, TSO, SSS, and user programs.

IBM plans to release new versions of ACF/TCAM (ACF/TCAM Version 2 R3), ACF/VTAM (ACF/VTAM/VS), NTO, and ACF/NCP (ACF/NCP/VS R3) beginning in mid-1980. The new versions will be available for users of the OS/VS1, MVS, and DOS/VSE operating systems. The aim of the new TCAM/VTAM versions is to provide increased flexibility through additional computer terminal links, improved reliability through user programming of alternate data paths, and enhanced functions in multi-processor networks through greater latitude in the placement of points of control. Automatic rerouting is an attractive feature of the packet-switched public networks (such as Telenet and Tymnet) that was previously unavailable with SNA networking. This, along with the other new features, may be seen as an effort by IBM the meet the needs of large-volume communications user who have been considering a move to the X.25-supported networks. Other features of the new TCAM and VTAM releases will add enhanced monitoring of network activity, error recording, and operator alert for possible problem areas.

The new Network Control Program release ACF/NCP/VS R3, operating in conjunction with ACF/TCAM Version 2 R3 and ACF/VTAM/VS, will reportedly enhance networking of 370X nodes and provide facilities for specializing communications lines and incorporating multiple data routes. Networking of 370X nodes is enhanced by the ability of up to eight IBM computers to control interconnected controllers and terminals. IBM claims that

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one or more computers or controllers may be taken out of service and returned with a minimum of disruption to data communications during the transition. With specialized lines, users would select a data path depending on the type of traffic (i.e., interactive, batch, etc.). Extensive interconnection between hosts and nodes includes parallel links between 3705 controllers and provides network backup if one node should fail. These two features should increase network efficiency and reliability.

The NTO Release 2 program product offers IBM large-system users a significant enhancement; support for start-stop terminals. The terminals supported include the IBM 2740 and 2741 and other teletypewriter devices. Since NTO Release 2 will be supported by CICS/VS, some terminals currently supported by BTAM can now also be supported by ACF/TCAM Version 2 R3, ACF/VTAM/VS, and ACF/NCP/VS R3. An intermediate release, ACF/NCP/VS R2.1, in conjunction with the IBM Network Problem Determination Application (NPDA), will provide facilities to collect and organize error statistics from the network.

3704 COMMUNICATIONS CONTROLLER: The 3704, introduced in February 1973, is a smaller version of the 3705 that can be connected to a byte multiplexer channel on either a 4331 or 4341 processor. The 3704 is available in only four models with a main memory capacity of 16K to 64K bytes. It can accommodate a maximum of 32 lines, just one-half the capacity of the basic 3705 configuration. The 3704 uses the same software as the 3705, as described in the preceding paragraphs, thereby ensuring upward compatibility for economic expansion of a small network into a large one.

SOFTWARE

COMPATIBILITY: Any program written for an IBM System/370 computer will operate on a 4300 Series processor in System/370 mode, provided that it is not time-dependent; does not depend on system facilities such as storage size, I/O equipment, optional features, etc., being present when the facilities are not included in the configuration; does not depend on system facilities such as interruptions, operation codes, etc., being absent when the facilities are included in the 4300 Processor; and does not depend on results or functions which IBM specifies to be unpredictable or model-dependent.

Any program written for a System/360 will operate on a 4300 Series processor in System/370 mode, provided that it follows the above rules and does not depend on functions that differ between the System/360 and System/370.

Any program written for the IBM 4331 Processor in ECPS:VSE mode or System/370 mode will operate on the 4341 Processor provided it follows the above rules.

OPERATING SYSTEMS: The 4300 Series processors are supported by DOS/VSE (a significant expansion of DOS/VS), VM/370 Release 6, and OS/VS1 Release 7. Both VM/370 Release 6 and OS/VS1 Release 7 provide new functions and complete support for the 4300 processors.

DOS/VSE: This extended disk-resident operating system provides enhancements over IBM's older DOS/VS in the specific areas of processor support, hardware features, device support, usability improvements, and serviceability.

DOS/VSE supports the System/370 mode and the ECPS:VSE mode of the 4300 processors. When operating in ECPS:VSE mode, DOS/VSE takes advantage of the 4300 processor's concept of relocating channels and page management. To support the hardware extensions to page management, the DOS/VSE assembler has additional privileged instructions.

DOS/VSE also provides full support for the IBM 3031 processor complex in uni-processor mode, as well as for System/370 processors, Models 115 through 158, with the clock comparator and CPU timer features.

The basic DOS/VSE system provides the capability for multiprogramming of five concurrent job streams, which will typically include the VSE/POWER spooler, a real-time subsystem such as CICS/VS, one or two batch job streams, and an unscheduled work partition for jobs that require fast turnaround. The system's capabilities can be significantly expanded through the addition of the VSE/Advanced Functions program product, described below.

New device support within DOS/VSE includes the 5424 Multi-Function Card Unit, the 3284/3286/3287/3288 Console Printers, 3289 Model 4 Line Printer, 3278 Model 2A Operator Console, the 8809 Magnetic Tape Unit, and the 3310/3370 DASD units. In conjunction with the new DASD's, DOS/VSE provides support for ISAM via VSAM and the ISAM Interface Program. Support of the 3310 and 3370 is provided in the ECPS: VSE mode only, unless operation is under VM/370. Support for the 3310 and 3370 is enhanced by utilities provided with DOS/VSE; these include the 3310 Surface Analysis Utility and the 3370 Surface Analysis Utility. Additional utility expansion is provided in the fast copy disk volume utility, where 2311/2314 support has been added. Changes in support for the 3800 Printing Subsystem include merging part of the 3800 ICR into DOS/VSE.

Unlike DOS/VS, where the interval timer is employed, DOS/VSE makes use of the time-of-day clock and the clock comparator. Job accounting times are calculated through the CPU timer. IBM claims these changes result in more accurate reporting without an effect on user interfaces.

DOS/VSE extends the use of alternate-path I/O from magnetic tape to DASD. If a DASD device is attached to a processor via two channels, DOS/VSE automatically switches to the second channel if the first one is busy. DOS/VSE also provides several improvements in user interfaces. These include simplified command syntax for IPL and JCL, reduction in the number of supervisor generation options, and a VOLUME JCL command for displaying DASD information. IBM has also added an Extent macro for DOS/VSE data management routines. This macro allocates extent information for all DASD types for DASD file protection.

The DOS/VSE supervisor has been enhanced in at least six specific areas. First, supervisor services for I/O operations have been improved by shortening the I/O interrupt path length. Second, the number of logical unit blocks has been increased; under DOS/VSE, up to 255 symbolic logical units per partition are available. Third, the use of job information blocks for file protection information has been eliminated. Fourth, a symbolic interface is provided to programs processing label information, such as OPEN and CLOSE routines. The interface provides a label area space that is dynamically managed to satisfy the individual requirements of each partition. This label area space is somewhat larger than in DOS/VS. Fifth, besides a channel command block, an I/O request block can be specified which contains a list of addresses (fixlist). By specifying the I/O area explicitly in the fixlist, the performance of the supervisor can be increased when running in ECPS:VSE mode. Finally, a system function now performs loading of modules into the SVA at IPL time without any user action. The user may add additional modules at any job control time.

Minimum main storage requirements for the DOS/VSE supervisor in System/370 mode are 84K bytes for the 4331 and 92K bytes for the 4341. In ECPS:VSE mode, the minimum requirements are 82K bytes for the 4331 and 86K

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bytes for the 4341. (These minimum sizes can be reduced by approximately 12K bytes if part of the supervisor is made pageable at IPL time.)

The MSHP (maintain system history program) is one of the numerous DOS/VSE serviceability improvements. MSHP creates a personalized history file (user's name, address, etc.), assists with the installation of new components and features, provides the function for application of preventive service packages, and records all program temporary fixes (PTF's) automatically in the history file. MSHP provides for sorting of entries by PTF, APAR, module name, component, and feature for a cross-referenced history file list. MSHP can also perform history searches for specific details. Other serviceability improvements include common EREP for DOS/VSE and OS/VS, improvements in the copy/merge operation for all DASD's except the 3310 and 3370, and the ability to execute the On-Line Test Executive Program (OLTEP) in any partition.

The VSE/Advanced Functions (AF), Release 1 and 2 (4746-XE8), add functions to DOS/VSE in the areas of performance, usability, and installation and maintenance. AF is required for most of the program products available with DOS/VSE.

Release 1 of AF provides seven partitions for all SYSRES DASD types, support of the 3310 and 3370 with VM/370 on 4331 and 4341 Processors in System/370 mode, and an implicit link function for reducing the number of job control statements an application programmer needs to code for program compilation and testing. AF Release 1 also provides a 256-byte area for job-to-job communication, multiple label areas on SYSRES, message retention on the console until answered or deleted by the operator, elimination of the LBLTYP statement, automated system initialization (IPL) and starting of subsystems in various partitions, and dump improvements including a high-speed dump taken each time a partition abends. Further, Release 1 provides fast B- and C-transient fetch, fast OPEN of hard-copy file, high-level SDL search (to one page), multiple extent page data sets, and JCL option for fast channel command and word translation. Importantly, AF Release 1 provides improved operation of DOS/VSE with VM/370 through job accounting improvements, CP commands SET PAGE X and SETRUN ON issued automatically at DOS/VSE IPL, and improvements of the speed of DOS/VSE IPL on VM/370.

AF Release 2, delivered late in 1979, provides all the functions of AF Release 1 plus DASD sharing across processors, support for up to 12 partitions and 208 user tasks, and extended label area support. This support provides labels on any DASD device, new Label ADD and Label DELETE functions, and permanent labels for foreground partitions loaded from the background partition. Improved librarian functions are another part of Release 2 of AF. These functions include multiple procedure libraries, shared libraries across partitions, library residence on disk devices other than SYSRES, and concatenation of up to 15 temporary and 15 permanent libraries within one job step. Release 2 of AF further provides on-line system generation in any DOS/VSE partition, DASD independence for SAM/DAM files, a list log utility for printing out SYSLOG messages on SYSLST at abnormal end of job, additional DLBL information for the SAM feature, SYSLNK in VSE/VSAM managed space with workfiles for the linkage editor dynamically allocated and deallocated in VSE/VSAM space, extended VOLUME command (by one parameter), new FREE command, 3262 Line Printer support, and system tailoring of IPL. IBM has designed AF Release 2 so that the B-transient area contention is reduced by marking frequently used system services (OPEN, end of job, attention routines) into SVA-resident code.

VM/370 RELEASE 6: Announced with the 4300 Series computers in January 1979, this is a new release of IBM's Virtual Machine Facility/370 (VM/370), an operating environment that manages a computer system's facilities in such a way that each of many users has at his disposal the functional equivalent of a dedicated computer system. A detailed description of VM/370 can be found in Report 70C-491-04 (IBM System/370).

VM/370 Release 6 provides support for the 4331 and 4341 processors in System/370 mode, as well as for the 3033 Attached Processor Complex and the channel-attached 3203 Model 5 Printer. The 3800 Printing Subsystem can be supported as either a dedicated device or a VM/370 spooling device. Journaling and security enhancements optionally track unsuccessful LOG ON and all LINK attempts. Masking of LOGON and LINK passwords can be forced as an installation option. A final enhancement provides a new CP command that allows messages to be sent to a virtual machine's storage.

ECPS:VM/370, an optional hardware assist feature for the 4331 or 4341 processor, reduces the CPU time required to execute certain frequently used supervisor functions of VM/370 Release 6.

The VM/Basic System Extensions, Release 2, include major CMS improvements such as an interactive "HELP" facility, file system enhancements, and the upgrade of CMS/DOS to DOS/VSE. Several Control Program enhancements are provided for improved system performance, and support is provided for the 3289 Model 4 Printer, the 8809 Magnetic Tape Unit, and the 3310 and 3370 Direct Access Storage Devices.

OS/VS1 RELEASE 7: This is a new release of IBM's OS/VS1 operating system, which is described in Report 70C-491-04 (IBM System/370). Release 7 provides support for the 4331 and 4341 processors in the System/370 mode, with the ECPS:VS1 hardware assist feature on the 4341 providing improved performance of certain frequently executed OS/VS1 supervisor functions through microcoding. Improvements to the OS/VS1 SCP include a new SYSOUT display command, concatenated procedure libraries, allocation deserialization, graphics console roll/delete, page supervisor preferred pages, non-zero memory VM/370 IPL, and enhanced automatic volume recognition. OS/VS1 has also been improved through message enhancements, list/search technique, RQE serviceability, and IOS short-term fix/long-term fix. Device support for the 3203 Model 3 Printer and the 3880 Storage Control is now a part of OS/VS1.

OTHER SOFTWARE FACILITIES: Enhancements to other IBM software products supplied with DOS/VSE, VM/370 Release 6, and OS/VS1 Release 7 are summarized below. Detailed descriptions of most of these products can be found in Report 70C-491-04 (IBM System/370).

Some of the facilities available in conjunction with *DOS/VSE* and *DOS/VSE AF* include a new version of ACF/VTAM, called ACF/VTAME; VSE/POWER for spooling; Job Entry and File Transfer programs; the VSE/3270 Bisync Pass Through, which allows a 4300 processor to appear as a remotely attached BSC 3271 control unit to an IBM System/370, 303X, or another 4300 host computer; a DOS/VSE Remote Job Entry Workstation facility; the VSE/IPCS (Interactive Problem Control System) required to aid in problem determination by the regional support centers in the new IBM support plans; BTAM-ES (Extended Support); 1400 Emulation; and the ability for DOS/VSE to run together with VM/370 to provide CMS interactive facilities and virtual machine functions.

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A whole new level of data management facilities is also available with DOS/VSE. A new version of DL/1 DOS/VS supports the new 3310 and 3370 disk devices, as well as supporting RPG II applications and running with the VSE/ICCF (Interactive Computing and Control Facility). Also available is a VSE/VSAM access method, a VSE/Fast Copy Data Set utility, VSE/DITTO, and support for CICS/DOS/VS Release 1.4 and the DB/DC Data Dictionary, Release 3.

To assist the DOS/VSE user in improving productivity, IBM offers the VSE/ICCF program product, mentioned above, which is the successor to the popular DOS/VS ETSS-II (Entry Time-Sharing System) field-developed product. DMS/CICS/VS (Development Management System) replaces the Display Management System program product available to DOS/VS users. VS/APL support has been extended to the 4300 Series computers, as has support for all standard and extended IBM programming language compilers, sort/merges, and utilities available with DOS/VS.

In the new System Installation Productivity Options/Extended (System IPO/E), the IPO concept has been extended to facilitate the installation, management, and use of the 4300 Series software products. IPO/E consists of a base set of integrated program products, pre-generated, pre-configured, and pre-tested with the latest service levels pre-applied, and ready to use in specific operating environments. IPO/E is provided for DOS/VSE, OS/VS1 Release 7, and VM/370 Release 6. Optional features, such as additional program products, can be integrated into the base IPO via an interactive prompter.

In addition to supporting DL/1 DOS/VS and VSE/VSAM, *VM/370 Release 6* supports VS/IFS (Interactive File Sharing), which allows multiple CMS users to share VSAM data sets; VM/Directory Maintenance, for management of the VM/370 directory; Display Management System/CMS; the Query-By-Example (QBE) interactive end-user query language; SPF/CMS (Structured Programming Facility/CMS); the DES (Display Editing System); high-level language support; and IPO/E. There is one IPO/E that supports a stand-alone and guest SCP environment, and a VM/DOS/VSE System IPO/E that supports DB/DC and DC environments.

Two of the communications-oriented enhancements available with *OS/VS1 Release 7* include: RES (Remote Entry Services), a component of OS/VS1 which allows jobs and commands to be submitted from remote terminals, with output returned; and HRNES (Host Remote Node Entry System), which allows an OS/VS1 system to be a remote job entry station to any MVS/JES2 or SVS/HASP system or to another OS/VS1 system. Operation is not dedicated; batch and on-line applications can be run concurrently.

ACF/VTAM and ACF/TCAM are both supported under Release 7, as is the NCCF (Network Communication Control Facility) and the Cryptographic Subsystem. OS/VS1 Release 7 will support IMS/VS Version 1.1.5, CICS/OS/VS Version 1.4, IMS and CICS Aids, the DL/1 Data Language, VSAM, and the DB/DC Data Dictionary. DMS/CICS/VS, CIS/VS, VSPC personal computing capabilities, and CADAM (Computer-Graphic Augmented Design and Manufacturing system) can be implemented under OS/VS1. The various compilers and utilities are also supported. The System IPO for OS/VS1 includes OS/VS1 Release 7, IMS/VS, ACF/NCP/VS, ACF/VTAM, and CICS/VS.

PRICING

POLICY: IBM offers the 4300 Series on a purchase, lease, or rental basis. The standard IBM lease or rental contract includes equipment maintenance and entitles the customer to unlimited usage each month.

Prime-shift maintenance is included in the rental or lease price. The purchase option accrual equals 60 percent of the monthly charge up to 50 percent of the purchase price.

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

MAINTENANCE: For purchased, leased, or rented systems, the IBM 4300 Series is under maintenance group D. The minimum period of maintenance service is 9 consecutive hours between 7:00 a.m. and 6:00 p.m. Monday through Friday. Charges for maintenance coverage outside this period are based upon the following percentages of the minimum monthly maintenance charge (MMC) added to the MMC:

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

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

For users without a maintenance contract, the 4300 Series is maintained under per-call class 3. Under this class, the per-call charge during regular hours is $83.00 per hour, and during off hours the charge is $96.00 per hour. The hourly rate for IBM Systems Engineering service is $66.00.

SOFTWARE: IBM 4300 Series users receive the basic DOS/VSE, OS/VS1 Release 7, or VM/370 Release 6 system control programs at no additional cost. All other IBM software, including the DOS/VSE Advanced Functions and other licensed program products, is priced separately. In addition, basic monthly charges have been established for maintenance of the IBM system control programs and other licensed program products. The minimum term of agreement is one year. A customer with multiple systems may choose to designate a single system for processor support. Each system control or licensed program run on a processor other than the designated processor is subject to an additional (but reduced) maintenance charge. For maintenance purposes, the problem program is transferred to the designated processor.

Support charges for the systems software products described in this report are listed at the end of the equipment price list. Local programming support for the DOS/VSE, OS/VS1 Release 7, or VM/370 Release 6 SCP is provided at the following monthly rates:

Processor	Program Support Charge	Additional Program Support Charge
4331	$220	$132
4341	627	376

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An alternative to contracted software maintenance is per-call service, charged at the applicable hourly rate. Program service/programming assistance costs $89 per hour during regular hours and $102 per hour at other times. The initial and prime interface for software problems and their solution is the IBM Support Center, described below.

SUPPORT CENTER: This approach to quick problem-solving via centralized telephone support is the first level of support for the new software products announced with the 4300's as well as older software products. Support for DOS/VS Release 34, OS/VS1 Release 6.7, and VM/370 Release 5 will also be provided from the Support Centers without separate charge until December 31, 1980, one year beyond the deadline for terminating local support. As of January 1, 1981, no further central or local support will be provided for these products. For OS/VS1 Release 6.0, centralized programming services will be available without separate charge until 12 months after the availability of OS/VS1 Release 6.7.

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 he gets advice on temporary fixes or bypasses.

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

PREVENTIVE SERVICE ASSISTANCE PROGRAM: This program has been enhanced to improve the handling of Program Update Tapes (PUT's). With the installation of DOS/VSE, OS/VS1 Release 7, and VM/370 Release 6, customers will be provided with integrated and customized Program Update Tapes for SCP's and specified licensed program products. In addition, a common service application vehicle will be provided for each system control program. For DOS/VSE it is MSHP, for OS/VS1 it is SMP4, and for VM/370 it is PLC. Each system PUT will be reached against a master service data base, synchronized to the applicable SCP, field-tested as one package, customized to the SCP and program product profile, and shipped directly to the customer.

Applying system PUT's within an established installation period (normally 75 days) is recommended to increase software stability. Distribution of customized preventive maintenance service tapes including both SCP and program product corrections will be provided only to users of IBM processors on which DOS/VSE, OS/VS1 Release 7, or VM/370 Release 6 is supported. Users of other licensed products will receive the licensed program portion of the preventive service updates directly from PID (Program Information Department) on a periodic basis.

EQUIPMENT: The indicated prices for the following typical configurations include all the required control units and adapters, but do not include software.

TYPICAL 4331 GROUP 1 SYSTEM: Includes a 4331 Model J1 Processor with 1,048,576 bytes of main memory; a 3262 Printer; two 3278 Displays; two 3310 DASD's (129 megabytes); an 8809 Magnetic Tape Unit; integrated disk, tape, and communications adapters; a 1200-bps communications line, and a 3278-2A Console/Keyboard. Purchase price is $123,151; 2-year lease, $3,441 per month; and monthly maintenance, $523.50.

TYPICAL 4331 GROUP 2 SYSTEM: Includes a 4331 Model K2 Processor with 2,097,152 bytes of main memory plus the same peripheral equipment as the 4331 Group 1 system above. Purchase price is $212,751; 2-year lease, $6,231 per month; and monthly maintenance, $605.50.

TYPICAL 4341 SYSTEM: Includes a 4341 Processor with 2,097,152 bytes of main memory; a 3203 Model 5 Printer; two 3370 DASD's (1,140 megabytes); four 3340 DASD's (280 megabytes); a 3880 Storage Control; a card reader; a card punch; and a 3278-2A Console/Keyboard. Purchase price is $527,490; 2-year lease, $13,932 per month; and monthly maintenance, $1,787.■

EQUIPMENT PRICES**

		Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (2-Year Lease)*
PROCESSORS					
4331 I1	Processor with 524,288 bytes of main memory	$ 68,250	$157.00	$1,992	$1,695
4331 J1	Processor with 1,048,576 bytes of main memory	76,100	168.00	2,227	1,895
4331 J2	Processor with 1,048,576 bytes of main memory	150,000	230.00	5,035	4,285
4331 K2	Processor with 2,097,152 bytes of main memory	165,700	250.00	5,505	4,685
4331 KJ2	Processor with 3,145,728 bytes of main memory	181,400	270.00	5,975	5,085
4331 L2	Processor with 4,194,304 bytes of main memory	197,100	290.00	6,445	5,485
4341 K1	Processor with 2,097,152 bytes of main memory	257,250	498.00	7,508	6,390
4341 L1	Processor with 4,194,304 bytes of main memory	288,650	540.00	8,448	7,190

*Rental/lease prices include equipment maintenance.
**See Report 70C-491-05 for prices of the System/370 peripheral equipment.
NC—No Charge.

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EQUIPMENT PRICES**

			Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (2-Year Lease)*
PROCESSOR FEATURES & CHANNELS						
Many of the features listed below include microcode as well as hardware. Microcode is supplied on diskettes.						
Features for the 4331:						
	1001	Adapter Power Prerequisite	2,520	7.00	75	64
	1002	Adapter Logic Prerequisite	4,620	12.50	137	117
	1421	Block Multiplexer Channel	4,620	1.50	137	117
	1422	Block Multiplexer Channel, Additional (Model Group 2 only)	4,620	1.50	137	117
	1431	High-Speed Block Multiplexer Channel (Model Group 2 only)	6,600	2.00	222	189
	1901	Control Store Expansion; 65,536 bytes (Model Group 1 only)	5,355	36.00	160	136
	2001	Display/Printer Adapter Expansion	1,275	1.50	33	28
	3201	DASD Adapter; for 3310/3340/3370	3,780	3.50	113	96
	3202	DASD Adapter, Additional (Model Group 2 only)	3,780	3.50	113	96
	3401	Diskette Drive; reads IBM Type 1 Diskettes	3,695	19.00	110	94
	3898	External Signals; for external interrupt	315	0.50	9	8
	3901	5424 Adapter	6,930	8.50	207	8
	3950	1401/1440/1460 Compatibility	NC	NC	NC	NC
	4910	8809 Mag Tape Unit Adapter	3,780	3.50	113	96
	5248	Byte Multiplexer channel	3,695	1.50	110	94
	5531	Power interface	2,310	1.00	68	58
	5532	Power Interface, Additional	1,115	1.00	34	29
	5550	Printer-Keyboard Mode	NC	NC	NC	NC
	6305	System/3 Data Import	NC	NC	NC	NC
	7851	3340 Direct Attachment	NC	NC	NC	NC
	7901	2311/2314/2319/3310 Direct-Access Storage Compatibility	NC	NC	NC	NC
	8701	ECPS:VM/370	NC	NC	NC	NC
Features for the 4341:						
	1850	Channel-to-channel adapter	22,050	24.50	659	561
	1870	Optional channel group; three additional channels	16,950	5.00	508	432
	1890	Channel control unit positions, additional	2,625	8.50	79	67
Console for the 4331 or 4341:						
3278 2A		CRT display/keyboard	2,680	24.50	87	74
	4633	75-key operator console keyboard (4341)	560	6.50	16	14
	4631	75-key operator console keyboard with I/O interface (4341)	1,160	7.00	36	31
	4632	Same as 4631 without I/O interface (4341)	1,080	7.00	34	29
	4634	Same as 4631 without I/O interface (4331)	1,080	7.00	34	29
	6340	Security keylock	35	NC	NC	NC
MASS STORAGE						
3310 A1		Single disk drive, 64.5 megabytes; with controller; for 4331 only	13,600	55.50	452	385
3310 A2		Two disk drives, 64.5 megabytes each; with controller; for 4331 only	22,600	94.50	751	639
3310 B1		Single disk drive, 64.5 megabytes (for attachment to Model A2)	10,770	42.00	357	304
3310 B2		Two disk drives, 64.5 megabytes each (for attachment to Model A2)	19,770	80.50	656	558
		Model A1 to A2 Upgrade	9,000	—	—	—
		Model B1 to B2 Upgrade	9,000	—	—	—
3340		Direct Access Storage Facility; 34.9 or 69.8 MB per drive:				
		Model A2; Two drives plus control	37,800	96.50	1,234	1,050
		Model B1; One drive	20,790	51.00	690	587
		Model B2; Two drives	26,460	82.50	870	740
3344 B2		Add-on Dual Disk Drive for 3340 Direct-Access Storage Facility; 279.6 MB per drive	31,680	128.00	1,106	941
3344 B2F		Add-on Dual Disk Drive for 3340 Direct-Access Storage Facility with 2 MB fixed-head storage; 279.6 MB per drive	41,600	179.00	1,451	1,235
	4301	Fixed-Head Feature (for 3340 A2 or B2)	1,795	1.50	52	44
	6201	Rotational Position Sensing (for 3340 B1)	718	0.50	21	18
	6202	Rotational Position Sensing (for 3340 or A2 or B2)	907	0.50	27	23
	6148	Remote Switch Attachment	NC	NC	NC	NC
	8150	String Switch	7,560	12.50	246	209

*Rental/lease prices include equipment maintenance.
**See Report 70C-491-05 for prices of the System/370 peripheral equipment.
NC—No Charge.

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EQUIPMENT PRICES**

			Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (2-Year Lease)*
MASS STORAGE (Continued)						
3348		Data Module (for 3340 drives):				
		Model 35; 34,944,768 bytes	1,600	Time & mat'l.	59	50
		Model 70; 69,889,536 bytes	2,200	Time & mat'l.	82	70
		Model 70F; 69,889,536 bytes, of which 502,080 are served by fixed heads	4,400	Time & mat'l.	165	140
3370 A1		Single Disk Drive, for 4331 or 4341; 571.3 megabytes	36,850	126.00	1,132	963
3370 B1		Add-On Single Disk Drive for attachment to Model A1; 571.3 megabytes	24,570	94.50	754	642
	8150	String Switch	4,095	1.50	126	107
3880		Storage Control, Model 1	65,460	168.00	1,821	1,550
	6148	Remote Switch Attachment	NC	NC	NC	NC
	6149	Remote Switch Attachment, additional	NC	NC	NC	NC
	8170	Two-Channel Switch Pair	6,450	10.50	188	160
	8171	Two-Channel Switch Pair, additional	17,200	36.50	502	427
MAGNETIC TAPE EQUIPMENT						
8809		Magnetic Tape Units (for 4331 only):				
	1A	First drive; connects to the I/O attachment feature of the 4331	10,960	50.00	364	310
	2	Second, fourth, or sixth drive that attaches to Model 1A or 3	9,730	45.00	324	276
	3	Third or fifth drive that attaches to Model 2	10,960	50.00	364	310
PRINTERS						
3203 5		Line Printer, 1200 lpm	38,320	391.00	1,651	1,405
3289 4		Line Printer, 230 to 400 lpm (print speed is character set-dependent)	13,910	187.00	623	530
	5821	48-char. EBCDIC Print Belt	160	—	—	—
	5822	64-char. EBCDIC Print Belt	160	—	—	—
	5823	94-char. EBCDIC Print Belt	160	—	—	—
3262 1		Line Printer; 650 lpm	14,700	157.00	439	373
	5951	0.079-inch char. height	—	—	—	—
	5950	0.095-inch char. height	—	—	—	—
	5940	48-char. EBCDIC Set	178	—	—	—
	5944	64-char. EBCDIC Set	178	—	—	—
	5946	64-char. EBCDIC Set	178	—	—	—
	5948	96-char. EBCDIC Set	178	—	—	—
PUNCHED CARD EQUIPMENT						
5424 A1		Multi-Function Card Unit, 96-col.	7,810	235.00	421	—
A2		Multi-Function Card Unit, 96-col.	10,340	350.00	634	—
	6510	5424 Multi-Function Card Unit Attachment; for 4331 only	2,670	6.00	60	—
COMMUNICATIONS EQUIPMENT						
For the 4331 Processor:						
	1020	Autocall Unit Interface	462	2.00	13	11
	1601	Communications Adapter, base	3,230	1.50	96	82
	3701	EIA/CCITT interface	462	2.00	13	11
	4695	Line Attachment Base; for clocked modems	462	0.50	13	11
	4696	Line Attachment Base; for non-clocked modems	546	0.50	15	13
	4720	High-Speed Modem Adapter	1,385	2.00	36	31
	4781	1200-bps Integrated Modem; non-switched	701	3.50	20	17
	4782	1200-bps Integrated Modem; switched, with auto-answer	903	3.50	26	22
	4787	1200-bps Integrated Modem; non-switched, with switch network backup and manual answer	955	3.50	27	23
	4788	1200-bps Integrated Modem; non-switched, with switch network backup and auto-answer	1,065	4.00	31	26
	4801	Local attachment interface	1,155	3.00	31	26
	5650	Digital data service adapter	882	2.50	25	21

*Rental/lease prices include equipment maintenance.
**See Report 70C-491-05 for prices of the System/370 peripheral equipment.
NC—No Charge.

IBM 4300 Series

SOFTWARE PRICES

		One-Time Charge	Monthly Charge	Monthly Licensed Program Support Charge	Monthly Additional Licensed Program Support Charge
5746-XE8	VSE/Advanced Functions, Releases 1 and 2	$ —	$ 143	$ 48	$ 28
5746-RC7	Advanced Communications Function for VTAM Entry ACF/VTAM	—	104	61	37
5746-TS1	VSE/Interactive Computing and Control Facility	—	66	22	13
5746-CE3	VSE/POWER Releases 1 and 2	—	40	12	7
5746-RC9	DOS/VSE Remote Job Entry Workstation	—	82	—	—
5746-AM5	VSE/3270 Bisync Pass Through	—	110	—	—
5746-AM2	VSE/VSAM Releases 1 and 22; VSE/VSAM Space Management for SAM feature	—	38	18/7	11/4
5746-AM4	VSE/Fast Copy Data Set Program	330	—	—	—
5746-UT3	VSE/Data Interfile Transfer, Testing and Operations Utility (VSE/DITTO)	—	28	5	3
5746-XE7	VSE/Access Control—Logging and Reporting	—	38	17	11
5746-SA1	VSE/Interactive Problem Control System	—	27	5	3
5746-RC5	Basic Telecommunications Access Method Extended Support	—	22	5	3
5746-AM3	VSE/IBM System/3-3340 Data Import	1,320	—	—	—
—	IBM Systems 1401/1440/1460 Emulator	—	100	5	3
5748-XX8	VM/Basic System Extensions	—	104	33	19
5748-XP1	Remote Spooling Communications Subsystem (RSCS) Networking	—	66	28	17
5748-XXC	VM/Interactive File Sharing	—	27	12	7
5748-XXB	Display Management System/CMS	—	22	7	4
5748-XE4	VM/Directory Maintenance	—	77	23	14
5478-XT3	VM/CMS-3270 Display Support and Structured Programming Facility	—	302	—	—
5748-SA1	VM/Interactive Problem Control System Extension	—	33	5	3
5748-MS1	Interactive Productivity Facility	—	33	5	3
5746-XX3	CICS/VS/DOS Enhanced	—	357	165	99
5740-XX1	CICS/OS/VS Enhanced	—	1,100	—	—
5740-XC5	Development Management System/CICS/VS-OS	—	253	—	—
5746-XC4	Development Management System/CICS/VS-DOS	—	110	57	34
5740-XXF	DB/DC Data Dictionary for OS/VS	—	638	—	—
5746-XXC	DB/DC Data Dictionary for DOS/VS	—	253	66	39
5746-LM3	DOS FORTRAN IV Library Option 1	—	30	5	3
5746-CB1	DOS/VS COBOL Compiler and Library	—	137	17	11
5746-LM4	DOS/VS COBOL Library	—	25	5	3
5736-PL1	DOS PL/1 Optimizing Compiler	—	187	44	26
5736-LM4	DOS PL/1 Resident Library	—	44	5	3
5736-LM5	DOS PL/1 Transient Library	—	25	5	3
5736-PL3	DOS PL/1 Optimizing Compiler and Library	—	256	55	33
5746-RG1	DOS/VS RPG II	—	104	5	3
5746-SM2	DOS/VS Sort/Merge (Version 2)	—	126	22	13