IBM 4300 Series

MANAGEMENT SUMMARY

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 featured 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. In September 1980, IBM announced the 4341 Model Group 2, which provided increased processing power and up to twice the main memory capacity of the original 4341, now designated the 4341 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 offered 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.

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

The 4300 Series is a family of versatile medium- to large-scale processors that can perform well as stand-alone systems, as distributed processing systems, or as nodes in a communications network. The 4300 processors use enhanced versions of four System/370 operating systems and provide full System/370 compatibility. IBM has installed more than 10,000 4300 systems worldwide.

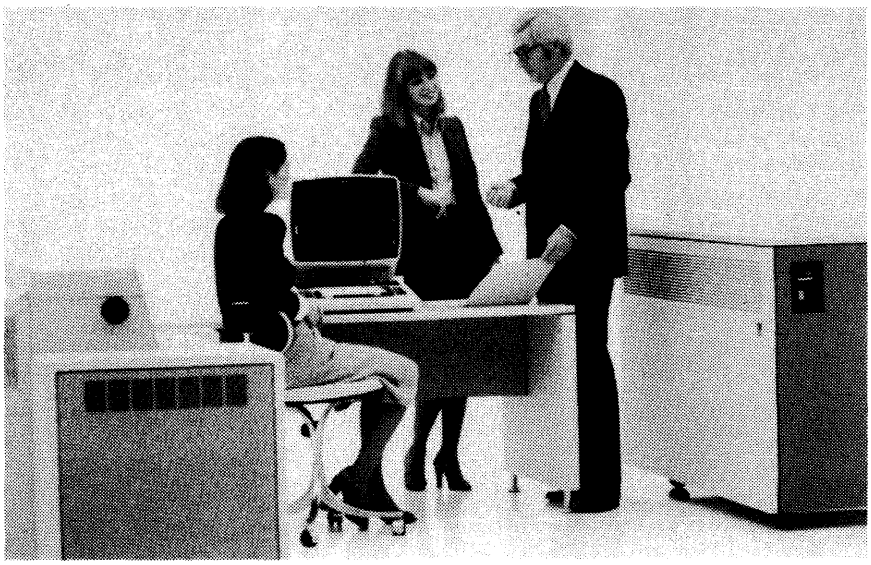
MODELS: 4331 I1, J1, J2, K2, KJ2, and L2; 4341 K1, L1, K2, L2, and M2.
CONFIGURATION: Uniprocessor systems with 0.5 to 8 megabytes of main memory, 8K or 16K bytes of buffer storage, and up to 6 I/O channels.
COMPETITION: Burroughs B 2900, B 3900, and B 5900; Honeywell DPS8, Level 64, and Level 66; Magnuson M80 Series; NCR 8500 Series; and Sperry Univac 90/60, 90/80, 1100/60, and System 80.
PRICE: Purchase prices for CPUs plus main memory range from $71,650 to $498,450.

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); 4341 Model Group 1 (Models K1 and L1); and 4341 Model Group 2 (Models K2, L2, and M2).

DATE ANNOUNCED: 4331 Model Group 1 and 4341 Model Group 1—January 30, 1979; 4331 Model Group 2—May 6, 1980; 4341 Model Group 2—September 15, 1980. ➢



The 4331 processor features from 512K to 4 megabytes of main memory, up to 4 optional I/O channels, and integrated adapters for display consoles, printers, disk drives, tape drives, and a multi-function card unit. A communications adapter is optional.

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technology, intelligent controllers, and advanced firmware.

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.

All four 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 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 or 3279 Model 2C Display Console plus up to 7 (or 15 with an optional expansion feature) additional display units or printers. The optional Communications Adapter permits

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; 4341 Model Group 2—2nd quarter 1981.

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 hexadecimal 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.

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 on the 4341 Model Group 1 is 150 to 300 nanoseconds and the buffer storage cycle time is 225 nanoseconds per 8-byte access. On the 4341 Model Group 2, the processor cycle time is 120 to 240 nanoseconds and the buffer storage cycle time is 120 nanoseconds per 16-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 Model Group 1—2,097,152 or 4,194,304 bytes; 4341 Model Group 2—2,097,152 to 8,388,608 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 or unauthorized reading of data in specified blocks of storage, are standard in all models.

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CHARACTERISTICS OF THE 4300 SERIES PROCESSORS

	4331 Model Group 1	4331 Model Group 2	4341 Model Group 1	4341 Model Group 2
SYSTEM CHARACTERISTICS				
Date of introduction	January 1979	May 1980	January 1979	September 1980
Date of first delivery	2nd quarter 1979	4th quarter 1980	4th quarter 1979	2nd quarter 1981
Number of CPU's per system	1	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, MVS	DOS/VSE, OS/VS1 Rel. 7, VM/370 Rel. 6, MVS
Purchase price of CPU with minimum main storage capacity	$71,650	$150,000	$270,100	$404,250
MAIN STORAGE				
Storage type	MOS	MOS	MOS	MOS
Read cycle time, nanoseconds	900	2600	Not specified	Not specified
Write cycle time, nanoseconds	1300	3100	Not specified	Not specified
Bytes fetched per cycle	4	64	Not specified	Not specified
Minimum capacity, bytes	524,288	1,048,576	2,097,152	2,097,152
Maximum capacity, bytes	1,048,576	4,194,304	4,194,304	8,388,608
Increment size, bytes	524,288	1,048,576	2,097,152	2,097,152
Error-correcting memory	Standard	Standard	Standard	Standard
BUFFER STORAGE				
Capacity, bytes	None	8,192	8,192	16,348
Cycle time, nanoseconds	—	200	225	120
Bytes fetched per cycle	—	4	8	16
CENTRAL PROCESSOR				
Performance relative to IBM 370/138	0.9	1.8	3.2	4.8 to 5.8
Performance relative to 4331 Model Group 1	1.0	2.0	3.4 to 4.0	5.1 to 7.2
Operating modes	ECPS:VSE, System/370	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, ECPS:MVS	ECPS:VS/1, ECPS:VM/370, ECPS:MVS
Instruction set	S/370 Universal	S/370 Universal	S/370 Universal	S/370 Universal
Reloadable control storage capacity, bytes	65,536 or 131,072	131,072	Not specified	Not specified
Data path width, bytes	4	4	8	8
Direct Access Storage Compatibility	Optional	Optional	No	No
IBM 1401/1440/1460 Compatibility	Optional	Optional	No	No
I/O CHANNELS AND ADAPTERS				
No. of byte multiplexer channels	1	1	1 or 2	1 or 2
No. of block multiplexer channels	1	2	2, 4, or 5	4 or 5
No. of high-speed block multiplexer channels	0	1	0	0
Maximum total no. of channels	2	4	6	6
Maximum channel data rates, bytes/second:				
Byte multiplexer (byte mode)	18,000	36,000	16,000 or 22,000	16,000 or 22,000
Byte multiplexer (burst mode)	500,000	500,000	1.0M or 2.0M	1.0M or 2.0M
Block multiplexer	500,000	1.25M	1.0M, 2.0M, or 3.0M	2.0M or 3.0M
High-speed block multiplexer	—	1.86M	—	—
Integrated DASD Adapter (for 3310, 3370, and/or 3340/3344)	Optional (1 only)	Optional (1 or 2)	No	No
Display/Printer Adapter	Standard	Standard	No	No
5424 Multi-Function Card Unit Adapter	Optional	Optional	No	No
8809 Magnetic Tape Unit Adapter	Optional	Optional	No	No
Integrated Communications Adapter (8 lines)	Optional	Optional	No	No
3704/3705 Communications Controllers	Optional	Optional	Optional	Optional
3880 Storage Control (for 3330/3333, 3340/3344, 3350, 3370/3375, or 3380)	No	Optional	Optional	Optional
Channel-to-Channel Adapter	No	No	Optional	Optional

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. 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

CENTRAL PROCESSORS

The 4331 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 Universal 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

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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 was 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 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.

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 now less than the difference between the list prices of the new and old processor models.

The *IBM 4341 Model Group 1* 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

handling, and program event recording. An 8192-byte high-speed buffer storage unit is used in the 4331 Model Group 2 and 4341 Model Group 1 processors to reduce effective main storage access times. The 4341 Model Group 2 processor has a 16,348-byte buffer. Buffer storage is not available on the 4331 Model Group 1.

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 three 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 ECPS/VS1 option improves processor performance with OS/VS1, the ECPS:VM/370 option provides improved system performance with VM/370, and the ECPS:MVS option allows the 4341 processor to be supported by MVS/SP-JES2 and-JES3. With the ECPS Expansion Feature, the 4341 Model Group 2 can support concurrent operation of ECPS:MVS and 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 without 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.

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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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.

The *4341 Model Group 2* processor features a 50 to 80 percent performance increase and up to twice the memory capacity of the 4341 Model Group 1. Distinguishing characteristics of the 4341 Model Group 2 include two, four, or eight megabytes of main memory; 16,384 bytes of high-speed buffer storage (compared to 8192 bytes for the 4341-1); a processor cycle time of 120 to 240 nanoseconds (compared to 150 to 300 nanoseconds for the 4341-1); and a standard complement of six I/O channels (compared to three standard and three optional channels on the 4341-1). IBM states that the internal performance of the 4341 Model Group 2 has been measured to be in the range of 1.5 to 1.8 times faster than an equivalently configured 4341 Model Group 1 processor when running selected DOS/VSE, VS1, MVS/SP, and VM/370 jobs. A purchased 4341-1 can be field-upgraded to a 4341-2 with the same memory capacity. Furthermore, the 4341 Model Group 2 should equal or surpass the performance of the IBM 3031 processor at roughly one-half the price.

Five peripheral devices were introduced along with the 4300 Series computers: the 64.5-megabyte 3310 Direct Access Storage Device (4331 only), the 571-megabyte 3370 Direct Access Storage Device, the 3880 Storage Control, the 650-lpm 3262 Line Printer (4331 only), and the 1200-lpm 3203 Model 5 Printer. In 1980, IBM announced the 3375 and 3380 Direct Access Storage Devices. The 3380 is available for use with the 4341 processors only.

The 3375 DASD is a count-key-data formatted disk drive that provides 819 megabytes of storage capacity. Each 3375 drive contains one non-removable head and disk assembly (HDA) with two actuators. Average seek time is 19 milliseconds, average rotational delay is 10.1 milliseconds, and data is transferred at the rate of 1.859 million bytes per second. There are two models of the 3375. Model A1 contains a storage control interface and connects to a 3880 Model 1 or 2 Storage Control. Up to three 3375 Model B1 drives can be attached to a 3375 Model A1 for a maximum string capacity of 3.27 billion bytes. The 3375 can be used with the 4331 Model Group 2 or 4341 processors.

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 64K bytes of RCS, and at least 16,348 bytes in 4331 processors with 128K 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 112K 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 Model Group 1, and a 16,348-byte buffer storage unit is standard on the 4341 Model Group 2. 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 Model Group 1, the buffer storage has fetch and store cycle times of 225 nanoseconds each per 8-byte access. On the 4341 Model Group 2, the cycle time is 120 nanoseconds per 16-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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The 3380 DASD, available for the 4341 processors only, offers a significantly larger storage capacity, faster data transfer rate, and lower cost per byte than any previous IBM disk drive. Each 3380 drive unit has a data storage capacity of 2.52 billion bytes, an average seek time of 16 milliseconds, an average rotational delay of 8.3 milliseconds, and a data transfer rate of 3.0 million bytes per second. Each 3380 unit contains two 1.26-billion-byte HDAs, each with two actuators. A 3380 string can consist of up to 4 drive units and 16 actuators. Up to two four-unit strings of 3380 drives can be connected to a 3880 Model 2 or 3 Storage Control.

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, 3370/3375, and 3380. 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 4331 and 4341 processors use the IBM 3278 Model 2A Display Console or 3279 Model 2C Color Display Console. Both consoles have a 1920-character display and keyboard, for operation and maintenance. Up to three additional consoles 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 or printers.

SOFTWARE AND SUPPORT

Three operating systems are available for all 4300 Series processors: DOS/VS Extended (DOS/VSE), OS/VS1 Release 7, and the Virtual Machine Facility 370 (VM/370) Release 6. In addition, OS/VS2 (MVS) can now be used with the 4341 processors.

DOS/VSE 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 com-

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 Double and 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 Model Group 1* 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, 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 Model Group 1 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 Model Group 1 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. The 4341 Model Group 2 is 1.5 to 1.8 times faster than the 4341 Model Group 1.

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.

3838 ARRAY PROCESSOR: A special-purpose scientific processor available for 4341 systems only. The 3838 processes single-precision floating-point vector operations independently of the host CPU. Three models are available:

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puting is combined with a guest SCP (DOS/VSE or OS/VS1) on the 4300 processors.

MVS support is provided on the 4341 through the ECPS: MVS option, which includes new privileged instructions that enable the 4341 to utilize either MVS/SP-JES2 or MVS/SP-JES3. MVS Release 3.8 with Processor Support 2 provides the required basic SCP code. MVS/SP-JES2 and -JES3 are separately priced products that provide major extensions and enhancements to the MVS Base Control Program plus JES2 and JES3, respectively.

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 resolved 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 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, OS/VS1 Release 7, or MVS. 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 or pass-through capabilities.

Data that is most frequently used locally may be stored on the 4300's own direct-access storage devices, with

the Model 1 with 256K bytes of bulk storage, the Model 2 with 512K bytes of bulk storage, and the Model 3 with 1024K bytes of bulk storage. The bulk storage provides independent data storage for up to seven concurrent users. The 3838 subsystem also includes an arithmetic processor with 16K bytes of control storage, a control processor, a data transfer controller, and a channel interface that attaches to a block multiplexer channel on the 4341 host.

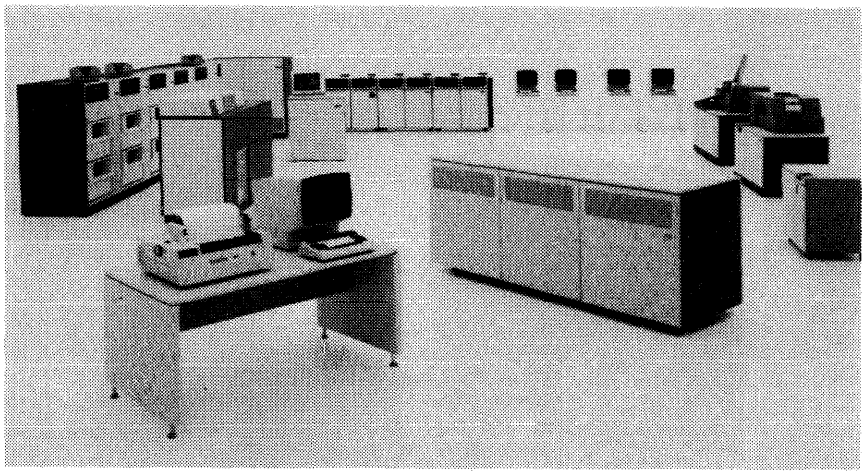
SYSTEM CONSOLES: A 3278 Model 2A Display Console or a 3279 Model 2C Color Display Console is required with every 4331 or 4341 processor. The 3278-2A and 3279-2C consoles consist of an anti-glare CRT display and a separately priced 75-key operator console keyboard with operator control panel. The CRT displays 1920 characters in 24 rows of 80 characters each. Both models have character sets of 96 characters. The 3279-2C displays console messages in four colors: white, red, blue, and green.

The 3278-2A or 3279-2C 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 or 3279-2C connects directly to a 4331 or 4341 processor. On the 4331 connection is via the standard Display/Printer Adapter, which permits connection of the required 3278-2A or 3279-2C 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), 3287 Color Printer Model 1C (80 cps) and 2C (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 or 3289 Model 4) may not exceed two. On the 4341, up to three optional 3278-2A display consoles, 3279-2C display consoles, or 3287 printers can be added.

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. The 5531 Power Interface Feature is required.



The 4341 processor provides 2 to 8 megabytes of main memory, 8K to 16K bytes of buffer storage, and up to 6 I/O channels. It can utilize virtually all of the System/370 communications and peripheral equipment, including the high-performance 3380 Direct Access Storage Device. The 4341 now supports the MVS operating system as well as OS/VS1, VM/370, and DOS/VSE.

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transaction-by-transaction access to the central host data base as needed in distributed data applications. In a distributed network, communication can be established between local or remote 4300's to the host computer, or to IBM 8100 Information Systems.

USER REACTION

In Datapro's 1981 survey of general-purpose computer users, 319 users reported on their experience with a total of 345 IBM 4300 Series processors. Of this total, 201 processors were 4331's and 144 were 4341's. The 4331 systems had been installed for an average of 9.0 months; the 4341 systems, for an average of 5.3 months.

The survey respondents represented nearly every type of business and organization, including manufacturing (93 responses), banking/finance (36 responses), retail/wholesale (34 responses), government (29 responses), and education (25 responses). The most frequently used programming language was COBOL (213 users), followed by Assembler (49 users) and RPG (34 users).

We asked the users to check off the most significant advantages of their computer systems, as well as any significant problems. The 4300 Series received 1232 specific mentions of advantages and 310 mentions of problems. The most frequently cited advantages were: the system is power and energy efficient (215 responses), programs and data carried over from other systems are compatible, as IBM promised (197 responses), users are happy with response time (185 responses), and the system is easy to expand and reconfigure (178 responses). On the negative side, 80 users said that vendor enhancements or changes to hardware and software were hard to keep up with, 59 said that IBM did not provide all the promised software or support, and 48 said that the delivery of the software was late.

The users' ratings are listed in the table below. Two separate weighted average columns are provided for the 4331 and 4341 systems, although the numbers of user responses for both systems have been combined:

	Excel.	Good	Fair	Poor	4331 WA*	4341 WA*
Ease of operation	115	186	11	2	3.30	3.35
Reliability of mainframe	238	74	6	1	3.76	3.66
Reliability of peripherals	126	165	22	4	3.39	3.17
Maintenance service:						
Responsiveness	125	154	35	3	3.29	3.22
Effectiveness	110	160	39	1	3.28	3.13
Technical support:						
Trouble-shooting	56	152	82	24	2.79	2.72
Education	35	174	79	21	2.73	2.71
Documentation	30	172	88	24	2.66	2.66
Manufacturer's software:						
Operating system	56	195	48	14	2.99	2.84
Compilers & assemblers	84	204	23	3	3.21	3.13
Application programs	24	153	46	12	2.86	2.72
Ease of programming	45	218	35	4	3.05	2.93
Ease of conversion	63	163	53	21	2.90	2.88
Overall satisfaction	64	228	16	6	3.09	3.16

*Weighted Average on a scale of 4.0 for Excellent.

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 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.

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 or 3279 Model 2C Display Console and up to seven additional displays or printers), and Communications Adapter (for controlling up to eight 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 Model Group 1* 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 3.0 million bytes per second.

The Optional Channel Group (feature 1870) for the 4341 Model Group 1 consists of three additional Block Multiplexer Channels. Two of the optional Block Multiplexer Channels have a data rate of 2.0 million bytes per second each. The data rate of the third channel is 1.0 million bytes per second. One of the three channels can

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In August we interviewed five of the survey respondents to gain additional insight into their experience with the 4300 Series. Two of these respondents were using 4331 systems and three were using 4341 systems.

The first user interviewed was a Southwestern manufacturer that had installed a 4331 Model J1 in July 1980. At the time of our survey, this user indicated that the 4331-1 system was "under-sized." He added the following comment: "Excessive paging between the TOTAL DBMS and CICS has resulted in disappointing response time with more than 10 concurrent users. The problem should be remedied with an upgrade to a Model Group 2 (2MB) in March 1981. IBM support has been excellent. Some IBM systems software has required several fixes, indicating that it may not have been thoroughly field-tested before release." When we talked with this user in August, he said that the response time had "improved dramatically since upgrading to the 4331 Model Group 2."

The other 4331 user was a Southwestern firm that had acquired a 4331 Model J1 as a replacement for an NCR 101. This user reported that the conversion was still in progress, although the 4331 was installed in September 1980. She said that they tried using IBM's NCR COBOL to IBM COBOL conversion package, but "it didn't work." Consequently, they are rewriting all of their programs. This user stated that the DOS/VSE operating system had "many short-comings" and that she intends to switch to a DOS package from an independent software vendor. She added, "Most of our problems have been with the software. IBM's software support has been poor."

One of the 4341 users with whom we spoke represented an Eastern manufacturer that had installed the 4341 as a replacement for an IBM 3031. He reported that he had experienced no conversion problems and was quite well satisfied with the 4341 processor and with the software. He said there have been frequent problems with the 3420 Model 5 and 6 magnetic tape units, but IBM is working to correct the situation.

A Midwestern bank had upgraded from a Magnuson M80-4 to an IBM 4341 in November 1980. This user said that he made the change because Magnuson couldn't provide the processing power he needed. He indicated that he was well satisfied with the 4341 and planned to upgrade to a Group 2 model. However, he termed DOS/VSE Release 1 "a disaster" and said he was now using Release 2, which was "much better."

The third 4341 user interviewed was an Eastern manufacturer that had installed the system in October 1980. The firm had previously been using a time-sharing service. This user said he had experienced no problems with the 4341 and would "probably upgrade to a Model Group 2."

All but one of the users interviewed said they would recommend the 4300 Series to other users. Overall, 280 of

optionally be configured as a second Byte Multiplexer Channel with 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 six million bytes per second. The aggregate data rate of the five Block Multiplexer Channels including the optional group is 11 million bytes per 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 nine million bytes per second. All of the Block Multiplexer Channels support the Data Streaming mode.

The *4341 Model Group 2* processor provides six channels as standard: one Byte Multiplexer Channel and five Block Multiplexer Channels. The transfer rate for the Block Multiplexer Channels is 3.0 million bytes per second for channels 1 and 2, and 2.0 million bytes for channels 3, 4, and 5. One of the Block Multiplexer Channels can be selected as a second Byte Multiplexer Channel.

The aggregate data rate of the five Block Multiplexer channels is 12 million bytes per second. If one of the channels is configured as a Byte Multiplexer Channel, the aggregate data rate of the remaining four channels is 10 million bytes per second. All Block Multiplexer Channels on the 4341 Model Group 2 support the Data Streaming Mode.

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 is a highly integrated system, with numerous optional peripheral adapters mounted in the processor cabinet, including those for 3310, 3370, and 3340 Direct-Access Storage Devices (up to 9,000 megabytes per adapter); 8809 Magnetic Tape Units; diskette drive; 5424 Multi-Function Card Unit; and communications adapter. Also optional are byte and block multiplexer channels, as described under the "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, 2, 1C, and 2C; 3262 Printers, Model 1; and 3289 Printers, Model 4.

The 4341 is a more traditional mainframe, with only the Support Processor, the byte and block multiplexer channels, and the optional Channel-to-Channel Adapter feature integrated into the processor cabinet. Up to four 3278-2A Consoles, 3279-2C Consoles, or 3287 Printers, Models 1, 2, 1C, and 2C, are attached to the Support Processor.

For information on channel configurability, see the Input/Output Control and Input/Output Units sections of this

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the 319 survey respondents said they would recommend the system to others, 12 said they would not recommend the system, and 27 were undecided.□

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 2 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.
- 3375 Direct Access Storage, 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.
- 3380 Direct Access Storage, connected via the 3880 Model 2 or 3 Storage Control to a block multiplexer channel on the 4341 only.

The 2305 Fixed-Head Storage, the 3370, 3375, and 3380 Direct Access Storage Devices, and the 3880 Storage Control are described in the following paragraphs. For details on the other equipment listed above, please refer to Report 70C-491-06 (303X Series).

2305 FIXED-HEAD STORAGE: Provides fast access to comparatively small quantities of information. Each 2305 Model 2 drive unit contains 6 non-removable disks with 12 recording surfaces. A fixed read/write head serves each track. One or two 2305 drive units can be connected to a 2835 Storage Control. A Two-Channel Switch can optionally be added to the 2835. The 2305, usable with the 4341 only, stores up to 11.2 million bytes of data. Each of the 768 addressable tracks can hold up to 14,660 bytes. Average access time is 5.0 milliseconds, and data transfer rate is 1.5 million bytes per second.

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. 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.

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. Each DASD Adapter accommodates up to four strings, each with up to four 3310 drives.

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

The 3370 is available in two models. The 3370 Model 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.

3375 DIRECT ACCESS STORAGE: The 3375 is a count-key-data formatted disk drive that provides 819 million bytes of storage capacity. The 3375 is similar in most respects to the 3370 Direct Access Storage. The principal differences between the two devices are in storage capacity and data format. The 3375's 819-megabyte capacity is 43 percent larger than the 3370's 571 megabytes, and the 3375 uses the count-key-data format employed in the 3380, the 3350, and

other large-capacity IBM disk drives in contrast to the fixed 512-byte blocks used in the 3370 and 3310.

Each 3375 drive contains one non-removable head and disk assembly (HDA). The HDA has two actuators, each providing independent access to approximately 409 million bytes of data. Average seek time is 19 milliseconds, average rotational delay is 10.1 milliseconds, and data is transferred at the rate of 1.859 million bytes per second. There are two models of the 3375. Model A1 contains a storage control interface and connects to a 3880 Model 1 or 2 Storage Control. Up to three 3375 Model B1 drives can be attached to a 3375 Model A1 for a maximum string capacity of 3.27 billion bytes. The 3375 can be used with the 4331 Model Group 2 or the 4341 processors.

3380 DIRECT ACCESS STORAGE: The 3380 offers a significantly larger storage capacity, faster data transfer rate, and lower cost per byte than any previous IBM disk drive. Each 3380 drive unit has a data storage capacity of 2.52 billion bytes, an average seek time of 16 milliseconds, an average rotational delay of 8.3 milliseconds, and a data transfer rate of 3.0 megabytes per second. The 3380 also uses the count-key-data format. Each 3380 unit contains two 1.26-billion-byte head and disk assemblies (HDAs), which are permanently mounted and house the heads, disks, and access mechanisms in a sealed enclosure. Each HDA, in turn, has two actuators, and each actuator accesses 630 megabytes of data. A 3380 string can consist of up to 4 drive units and 16 actuators, with each actuator operating independently and overlapping its seeking and rotational position sensing operations with those of other actuators. There are six models of 3380 Direct Access Storage, all with the same 2.52-gigabyte storage capacity.

The 3380 can be used with the 4341 processors only. One of two models of the 3880 Storage Control, Model 2 or Model 3, is a prerequisite. Up to two 4-unit strings of 3380 drives can be connected to one of the two storage directors on the 3880 Model 2, and to both storage directors on the 3880 Model 3. Operation at the 3.0-megabyte data transfer rate requires attachment to a 3.0-megabyte block multiplexer channel on the 4341.

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.

There are three models of the 3880. Model 1 can accommodate various combinations of 3330/3340/3350/3370/3375 storage units. The Model 2 functions similarly to the Model 1, but one of the storage directors can also attach 3380 disk drives. Model 3 is designed for the attachment of 3380 drives only. A two-channel switch (feature 8170/8171) and eight-channel switch (8172) can be selected to increase the number of channels connected to a storage director from two to eight.

Up to 14 3340/3344 disk drives can be configured on a storage director. As many as 16 3330/3333/3350 drives can be configured in various combinations on a director. At the high-performance end, a storage director can control a maximum of 16 3370/3375 or 8 3380 drives.

INPUT/OUTPUT UNITS

The 4300 Series processors support most of the System/360, System/370, and 303X Series 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 or the 4341. Devices that can be attached include:

- 3410/3411 Magnetic Tape Units and Control Models 1, 2, and 3 (byte or block).
- 3420 Magnetic Tape Unit Models 3 to 8 via the 3803 Tape Control Model 1 or 2 (byte or block).
- 8809 Magnetic Tape Unit Models 1A, 2, and 3 (attachment, on 4331).
- 3540 Diskette Input/Output Unit Model B1 or B2 (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).
- 3525 Card Punch Model P1, P2, or P3 (byte or block).
- 5424 Multi-Function Card Unit Model A1 or A2 (attachment, on 4331).
- 1403 Printer Models 2, 7, and N1 via the 2821 Control Unit Model 1, 2, 3, or 5 (byte or block).
- 1443 Printer Model N1 (byte or block).
- 3203 Printer Model 5 (byte or block).
- 3211 Printer Model 1 via the 3811 Printer Model 1 (byte or block).
- 3262 Printer Model 1 or 11 (attachment, 4331 only).
- 3287 Printer Model 1, 2, 1C, or 2C (attachment).
- 3289 Printer Model 4 (attachment, 4331 only).
- 3800 Printing Subsystem Model 1 (byte or block).
- 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).
- 3881 Optical Mark Reader Model 1, 2, or 3 (byte or attachment on 4331; byte or block on 4341).
- 3886 Optical Character Reader Model 1 or 2 (byte or block).
- 3890 Document Processor Models A1 to A6 and B1 to B6 (byte or block).

Many of these devices are described in the following paragraphs. For information on the other equipment listed above, please refer to Report 70C-491-06 (303X Series).

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3410/3411 MAGNETIC TAPE SUBSYSTEM: These compact, low-cost tape units, designed primarily to bring magnetic tape capabilities to the small-scale systems such as the IBM System/3 Model 10, are also available for use with the 4300 Series. The 3410 is a tape unit only, while the 3411 contains both a tape unit and the subsystem control unit. The 3410 and 3411 are available in three models, whose principal characteristics are as follows:

	Model 1	Model 2	Model 3
Tape speed, inches/sec.	12.5	25	50
Recording density, bpi	1600	1600/800	1600/800
Data rate, bytes/sec.:			
At 1600 bpi (phase-encoded)	20,000	40,000	80,000
At 800 bpi (NRZI)	Not avail.	20,000	40,000*

All three models use half-inch tape recorded in the standard IBM 9-track formats. A 3411 Model 1 Magnetic Tape Unit and Control can accommodate up to three additional 3410 Model 1 Magnetic Tape Units for a maximum subsystem capacity of four tape drives. A 3411 Model 2 can control up to five additional 3410 Model 2 units, and a 3411 Model 3 can control up to five additional 3411 Model 3 units. Models cannot be intermixed within a subsystem. Every 3410 and 3411 tape unit must be equipped with either the Single Density (1600 bpi) or Dual Density (1600 or 800 bpi) feature; the Dual Density capability is not available for the Model 1 units.

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.

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. Consists 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.

1403 PRINTER: Provides high-quality printed output by means of a horizontal chain or train mechanism. The standard character set contains 48 characters, and the Universal Character Set (a no-charge option for Model 2 or N1 only) permits up to 240 characters to be printed. Line spacing of 6 or 8 lines per inch is operator-controlled. Standard skipping speed is 33 inches per second; a dual-speed carriage in Models 2 and N1 permits a speed of 75 inches per second on skips of more than 8 lines.

Models 2, 7, and N1 of the 1403 Printer can be connected to any 4300 Series processor via the 2821 Control Unit. Characteristics of the three models are as follows:

- Model 2: 600 lpm (750 lpm maximum with UCS option), 132 print positions;
- Model 7: 600 lpm, 120 print positions; and
- Model N1: 1100 lpm (1400 lpm maximum with UCS option), 132 print positions; requires the 1416 Interchangeable Train Cartridge.

1443 PRINTER, MODEL N1: Uses a horizontally oscillating typebar. Rated speed is 240 lpm with the standard 52-character set. Standard model has 120 print positions, with 24 more positions available as an option. Selective Character Set Feature permits the use of other interchangeable typebars; speeds range from 200 lpm for a 63-character set to 600 lpm for a 13-character set. The 1443 N1 includes an integrated control unit.

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.

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 PRINTER: An interchangeable-belt printer that is available in two models. Model 1 is rated at 650 lpm with a 48-character belt, 467 lpm with a 64-character belt, and 364 lpm with a 96-character belt. Model 11 is rated at 325 lpm with a 48-character belt, 230 lpm with a 64-character belt, and 180 lpm with a 96-character belt. The 3262 has 132 print positions, horizontal spacing of 10 characters/inch, and vertical spacing of 6 or 8 lines/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 or 11 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: An interchangeable-belt printer that 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. 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/inch, and line spacing of 6 or 8 lines/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.

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3287 PRINTER: Bidirectional serial matrix printer available in four models. The Model 1 and 1C are rated at 80 cps, and the Model 2 and 2C are rated at 120 cps. Models 1C and 2C can print in black, blue, green, or red. Models 1 and 2 print in black only. Character spacing on all models is 10 characters/inch, and line spacing is 6 or 8 lines/inch. The printers have 132 print positions; however, when using the multicolor ribbon on Models 1C or 2C, only 120 print positions can be printed. The 3287 printers connect to the 4331 processor via the Display/Printer Adapter or to the 4341 processor as a console printer.

3814 SWITCHING MANAGEMENT SYSTEM: This facility is designed to aid in the management of complex EDP configurations by providing centralized control of control-unit switching. The 3814 uses an integrated microcode-driven processor and features password authorization, stored configurations, and extensive self-diagnostic functions. As compared to the earlier IBM 2914 Model 1 Switching Unit, the 3814 provides increased capacity, extended functions, and improved reliability. The system is covered in greater detail in Report 70D9-491-20 in Volume 2.

TERMINALS: Numerous IBM display terminals, batch terminals, and typewriter terminals can be connected to a 4300 system in remote and/or local configurations. For details, please refer to Reports 70D1-491-45, 70D2-491-11, 70D3-491-46, and 70D4-491-43 in the Peripherals section of DATAPRO 70 (Volume 2).

COMMUNICATIONS CONTROL

The principal communications control unit for the IBM 4331 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. Loop Adapters are also available for the 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, 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 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 or X.21 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-232-C 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.

4331 LOOP ADAPTERS: Provide the capability to attach certain terminals and control units to a 4331, either directly or via a data link. Loop Adapter 1 (feature 4830) and Loop Adapter 2 (4831) provide for direct attachment. The Data Link Adapter (4840) provides remote attachment capa-

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bilities for 3843 Loop Control Units. Each Data Link Adapter can be used as a point-to-point or multipoint connection to attach up to four 3843 Loop Control Units.

The following devices can be connected to direct attached loops at 9600 bps or to data link attached loops at 2400, 4800, or 9600 bps: the 3640 Plant Data Communications Terminals, the 8775 Display Terminal Model 1 or 2, the 3287 Printer Model 11 or 12, and the 3274 Control Unit Model 51C and 3276 Control Unit Display Station Models 11 to 14, with their associated terminals (3278 Display Station, 3279 Color Display Station, 3262 Line Printer, 3287 Printer, and 3289 Printer). In addition, the 8775, 3287 Models 11 and 12, and the 3274 control unit and associated terminals can also be attached at 38,400 bps.

Cable length for direct attached loops can be up to 1.25 miles (2000 meters) when operating at 38,400 bps or 2 miles (3200 meters) when operating at up to 9600 bps. Data link attached loops can be up to 2 cable miles in length. The 4331 supports one Loop Adapter 1, one Loop Adapter 2, and up to two Data Link Adapters. The loop and data link adapters are mutually exclusive with the 5424 Adapter.

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.

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

The 3705-II offers significant price/performance improvements over the original model, now designated the 3705-I. (The 3705-I is no longer available.) The 3705-II is available in 44 different models depending upon the number of frames and the storage capacity, which ranges from 32K to 512K bytes. Processor cycle time is 1.0 microsecond on Models E1-E8, F1-F8, G1-G8, and H1-H8, and 900 nanoseconds on Models J1-J4, K1-K4, and L1-L-4. Other 3705-II features include a high-speed Communications Scanner, an upgraded Channel Adapter that transfers data in blocks of 32 characters, transmission speeds to 9600 bps in synchronous mode, a maximum transmission rate of 56,000 bps, and a Cycle Utilization Counter that accumulates statistical data to assist in measuring machine performance.

In March 1981, IBM announced the entry-level 3705-80 series, which consists of Models 81, 82, and 83. The 3705-80 has 256K bytes of storage and supports 4, 10, or 16 communications lines. The 3705-80 can be used as a front-end communications processor or as a remote concentrator linked to a local 3705-II Controller.

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

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

For further details on the 3705 Communications Controllers, please refer to Report 70C-491-06 (303X Series).

3704 COMMUNICATIONS CONTROLLER: The 3704 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, thereby ensuring upward compatibility for economic expansion of a small network into a large one.

7770 AUDIO RESPONSE UNIT: Provides audio responses, in recorded human-voice form, to digital inquiries from pushbutton telephones or other inquiry-type terminals. Handles a maximum of 48 lines, any or all of which can be active simultaneously. Has a 32-word basic vocabulary, expandable in 16-word increments to a maximum of 128 words. Receives inquiry messages and forwards them to the processing unit, which processes each message and composes an appropriate reply. The 7770 then converts the reply into a sequence of English words which are read from its magnetic drum and transmitted to the inquirer.

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, OS/VS1 Release 7, and OS/VS2 (MVS). 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 manage-

ment, the DOS/VSE assembler has additional privileged instructions.

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.

The VSE/Advanced Functions (AF), Release 1 and 2 (5646-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 3310/3370/3375 DASD with VM/370 on 4300 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 2 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.

Device support within DOS/VSE includes the 5424 Multi-Function Card Unit, the 3287 Console Printers, 3289 Model 4 Line Printer, 3278 Model 2A Operator Console, 3279 Model 2C Color Display Console, the 8809 Magnetic Tape Unit, and the 3310/3370/3375 DASD units. In conjunction with the new DASDs, 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 Surface Analysis Utility and the VSE/Fast Copy Data Set Program. 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.

The minimum main storage requirement for the DOS/VSE supervisor in System/370 mode is 112K bytes of which 24K bytes can be made pageable. In ECPS:VSE mode, the minimum requirement is 106K bytes, of which 26K bytes can be made pageable. (These minimum sizes can be reduced by approximately 18K bytes if part of the supervisor is made pageable at IPL time.)

VM/370 RELEASE 6: Announced with the 4300 Series computers in January 1979, this release of IBM's Virtual Machine Facility/370 (VM/370) is 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-491-06 (IBM 303X Series).

VM/370 Release 6 provides support for the 4331 and 4341 processors in System/370 mode, as well as for 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,* (5748-XX8), include major Conversational Monitor System (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. In addition, the *VM/System Extensions* (5748-XE1) provide a resource manager function, enhanced shadow page and shadow segment table management, and support of MVS/SE.

The *VM/System Product* (VM/SP), 5664-167 contains all of the functions currently available in Release 2 of both the VM/Basic System Extensions and VM/System Extensions program products, as well as the following previously announced capabilities; multiprocessor support, enhanced support for attached processors, a new CMS editor and EXEC interpreter, an enhanced CMS HELP facility, a CMS OS LOADER capability, full screen console support via an SIO interface, enhanced CP spooling, a single console image facility, an IPL command enhancement, a new inter-user communication capability, and support for the 3278 Model 5 and 3279 display terminals. New VM/SP enhancements include support for the 4331 Model Group 2 Processor and the 3375 and 3380 Direct Access Storage devices; enhanced DASD support; enhanced support for the 3270 Information Display System; new functions to enhance the integrity, security, and reliability of the VM/SP system; enhanced SPTAPE command support; support for MVS/SP-JES2 and MVS/SP-JES3 as guest operating systems; CMS support for the LKED command for OS application program development; and an upgrade of

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CMS/DOS program execution support to the Release 2 levels of the VSE/Advanced Functions and VSE/VSAM.

OS/VS1 RELEASE 7: This release of IBM's OS/VS1 operating system, which is described in Report 70C-491-06 (IBM 303X Series), 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 5 Printer and the 3880 Storage Control is now a part of OS/VS1.

The *OS/VS1 Basic Programming Extensions* (5662-257) provide support for the 4331 and 4341 Model Group 2 processors, the 3262 Printer Model 1 and 11, and the 3375 Direct Access Storage unit. Additional enhancements include an improved dump facility, VM/VTAM Communications Network Applications support, and support for the Data Facility/Device Support program, which provides a new indexed volume table of contents (VTOC) for improved system performance.

OS/VS2 (MVS): In July 1980, IBM announced MVS support for the 4341 processors. A no-charge option, ECPS:MVS, provides new privileged instructions that enable the 4341 Processor to utilize either of two MVS/System Products, MVS/SP-JES2 or MVS/SP-JES3. MVS Release 3.8 with Processor Support 2 provides the required basic SCP code. MVS/SP-JES2 and MVS/SP-JES3 are separately priced products that provide major extensions and enhancements to the MVS Base Control Program plus JES2 and JES3, respectively. IBM has stated that the MVS/System Products will replace the earlier MVS/System Extensions product and serve as the base for future enhancements to MVS, JES2, and JES3.

RMF (Resource Measurement Facility) support for the 4341 is provided by RMF Version 2 Release 3. The ECPS:MVS, ECPS:VM/370, and ECPS:VS1 options on the 4341 are mutually exclusive—except that a 4341 Model Group 2 equipped with the ECPS Expansion feature can operate concurrently in ECPS:MVS and ECPS:VM/370 modes.

For additional details on MVS, please refer to Report 70C-491-06 (IBM 303X Series).

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-491-06 (IBM 303X Series).

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.

A whole new level of data management facilities is also available with DOS/VSE. A new version of DL/1 DOS/VS supports the 3310 and 3370/3375 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, the DB/DC Data Dictionary, Release 3, and support for IBM's relational data management system, SQL/Data System.

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.

OS/VS1 also supports the Direct Access Device Migration Aid, a tool that facilitates the migration of data and programs to the 3375 DASD, and the Data Facility/Data

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Set Services, a dump/restore program product that supports the 3375. (OS/VS1 does not support the 3380 DASD.)

Additional software facilities for *OS/VS2 (MVS)* include: Data Facility/Device Support, which provides an indexed VTOC for improved system performance; Data Facility/Extended Functions, a functional replacement for VSAM master catalogs, VSAM user catalogs, and OS control volumes; Data Facility/Data Set Services, a dump/restore program that supports the 3375 and 3380 direct-access storage devices; the Direct Access Storage Device Migration Aid, which facilitates the migration of MVS data and programs to the 3375 and 3380; and the Hierarchical Storage Manager, which manages 3330/3350/3375/3380 DASD devices, 3420 tape drives, and the 3850 Mass Storage System.

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 $115 per hour, and during off hours the charge is $132 per hour.

SOFTWARE: IBM 4300 Series users receive the basic DOS/VSE, OS/VS1 Release 7, VM/370 Release 6, or OS/VS2 (MVS) 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 has a choice in the selection of local programming support. Should the user have IBM perform local program support at all computer sites, he pays the Basic Monthly License fee for all locations. If the user decides, however, to control the installation and support of designated license programs from a central site, he pays the Basic License Fee at the central site and a Distributed Systems License Option (DSLO) monthly fee for all other locations. The DSLO rates are lower than the basic monthly support charges. Support charges for the systems software products described in this report are listed at the end of the equipment price list.

An alternative to contracted software maintenance is per-call service, charged at the applicable hourly rate. Program service/programming assistance costs $123 per hour during regular hours and $141 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: 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.

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 one megabyte of main memory and one I/O channel, a 3278-2A Operator Console with Keyboard, a 3310 DASD Model A2 (129 megabytes), two 8809 Magnetic Tape Units, a 2520 Card Read Punch, a 650 lpm 3262 Model 1 Printer, and integrated tape and disk adapters. Purchase price is $212,357 and the monthly charge on a two-year lease is $6,253.

TYPICAL 4331 GROUP 2 SYSTEM: Includes a 4331 Model K2 Processor with 2 megabytes of main memory and one I/O channel, a 3278-2A Operator Console with Keyboard, a 3310 DASD Model A2 with attached Model B2 (258 megabytes), four 8809 Magnetic Tape Units, a 2520 Card Read Punch, two 650 lpm 3262 Model 1 Printers, and integrated tape and disk adapters. Purchase price is $358,027 and the monthly charge on a two-year lease is $10,801.

TYPICAL 4341 GROUP 1 SYSTEM: Includes a 4341 Model L1 Processor with 4 megabytes of main memory and 3 I/O channels, a 3278-2A Operator Console with Keyboard, 3287 Model 1 Console Printer, two 3370 DASD's (1140 megabytes), a 3880 Storage Control, six 3420 Model 3 Magnetic Tape Units (120KBS), a 3803 Model 1 Tape Control, a 2520 Card Read Punch, and a 1200 lpm 3203 Model 5 Printer. Purchase price is $688,512 and the monthly charges on a two-year lease is $19,536.

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TYPICAL 4341 GROUP 2 SYSTEM: Includes a 4341 Model M2 Processor with 8 megabytes of main memory and 6 I/O channels, a 3278-2A Operator Console with Keyboard, 3287 Model 2 Control Printer, a 3380 DASD Model A4 (2.5 billion bytes), a 3880 Model 2 Storage Control, eight 3420 Model 3 Magnetic Tape Units (120KBS), a 3803 Model 1 Tape Control, a 2520 Card Read Punch, and a 1200 lpm 3203 Model 5 Printer. Purchase price is $941,117 and the monthly charge on a two-year lease is $26,282.

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	$ 71,650	$ 207.00	$ 2,379	$ 2,025
4331 J1	Processor with 1,048,576 bytes of main memory	79,500	220.00	2,637	2,245
4331 J2	Processor with 1,048,576 bytes of main memory	150,000	303.00	5,381	4,580
4331 K2	Processor with 2,097,152 bytes of main memory	165,700	329.00	5,897	5,020
4331 KJ2	Processor with 3,145,728 bytes of main memory	181,400	355.00	6,413	5,460
4331 L2	Processor with 4,194,304 bytes of main memory	197,100	381.00	6,929	5,900
4341 K1	Processor with 2,097,152 bytes of main memory	270,100	601.00	9,012	7,670
4341 L1	Processor with 4,194,304 bytes of main memory	301,500	653.00	10,044	8,550
4341 K2	Processor with 2,097,152 bytes of main memory	404,250	879.00	13,571	11,550
4341 L2	Processor with 4,194,304 bytes of main memory	435,650	931.00	14,603	12,430
4341 M2	Processor with 8,388,608 bytes of main memory	498,450	1,035.00	16,667	14,190
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 for Communications Adapter	2,520	9.00	83	71
	1002 Adapter Logic Prerequisite for 5424 Adapter	4,620	16.50	153	130
	1421 Block Multiplexer Channel	4,620	2.50	153	130
	1422 Block Multiplexer Channel, Additional (Model Group 2 only)	4,620	2.50	146	124
	1431 High-Speed Block Multiplexer Channel (Model Group 2 only)	6,600	3.00	237	202
	1901 Control Store Expansion; 65,536 bytes (Model Group 1 only)	5,355	47.50	177	151
	2001 Display/Printer Adapter Expansion	1,275	2.50	36	31
	3201 DASD Adapter; for 3310/3340/3370	3,780	4.50	126	107
	3202 DASD Adapter, Additional (Model Group 2 only)	3,780	4.50	120	102
	3401 Diskette Drive; reads IBM Type 1 Diskettes	3,695	25.50	122	104
	3898 External Signals; for external interrupt	315	1.50	11	9
	3901 5424 Adapter	6,930	11.50	230	196
	3950 1401/1440/1460 Compatibility	NC	NC	NC	NC
	4910 8809 Mag Tape Unit Adapter	3,780	4.50	126	107
	5248 Byte Multiplexer Channel	3,695	2.50	122	104
	5531 Power Interface	2,310	2.00	75	64
	5532 Power Interface, Additional	1,155	2.00	38	32
	7851 3340/3344 Direct Attachment	NC	NC	NC	NC
	7901 Direct-Access Storage Compatibility; provides 2311/2314 emulation on 3310 or 3370 DASDs and 3330 emulation on 3370 DASDs	NC	NC	NC	NC
	8701 ECPS: VM/370	NC	NC	NC	NC
Features for the 4341:					
	1601 ECPS Expansion Feature (for 4341 Model Group 2 Processors only)	26,250	22.00	907	722
	1805 Channel-to-channel adapter	23,150	29.00	790	672
	1870 Optional channel group; three additional channels (for 4341 Group 1 Processors only)	17,790	6.00	607	517
	1890 Channel control unit positions, additional	2,755	10.00	94	80
	3838 Array Processor:				
	Model 1; 256K bytes of bulk storage	532,350	1,810	21,472	19,520
	Model 2; 512K bytes of bulk storage	589,650	2,180	26,103	23,730
	Model 3; 1024K bytes of bulk storage	704,300	2,925	35,343	32,130
System Consoles:					
3278 2A	Display Console	2,410	24.50	103	88
3279 2C	Color Display Console	4,355	39.50	170	145
	4631 75-Key Operator Console Keyboard with channel-to-channel interface and operator control panel (for 4341)	1,045	7.00	41	35
	4632 Same as 4631 without channel-to-channel interface (for 4341)	972	7.00	40	34
	4633 Same as 4631 without operator control panel (for 4341)	504	6.50	19	16
	4634 Same as 4631 without channel-to-channel interface (for 4331)	972	7.00	40	34
	6340 Security Keylock	35	—	—	—

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NC—No Charge.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (2-Year Lease)*
MASS STORAGE					
2305	Fixed-Head Storage, Model 2; 11.2MB (4341 only)	73,150	331.00	5,615	4,717
2835	Storage Control, Model 2; for 2305	46,770	177.00	3,465	2,911
3310	Disk Storage (4331 only):				
	Model A1; 1 drive with controller; 64.5MB	14,280	80.50	507	432
	Model A2; 2 drives with controller; 64.5MB each	23,730	135.00	840	716
	Model B1; 1 drive; 64.5MB (for attachment to Model A2)	11,300	61.00	400	341
	Model B2; 2 drives; 64.5MB each (for attachment to Model A2)	20,750	117.00	733	625
3330	Disk Storage (for 4331-2 or 4341):				
	Model 1; 2 drives; 200MB	32,380	170.00	1,855	1,558
	Model 2; 1 drive; 100MB	19,340	100.00	1,106	941
	Model 11; 2 drives; 400MB	46,090	170.00	2,650	2,226
3333	Disk Storage and Control (up to three 3330 modules can be attached):				
	Model 1; 2 drives; 200MB	40,580	199.00	2,315	1,970
	Model 11; 2 drives; 400MB	54,290	199.00	3,108	2,645
3336	Disk Pack, Model 1	775	—	—	—
3336	Disk Pack, Model 11	1,150	—	—	—
3340	Direct Access Storage Facility; 34.9 or 69.8MB per drive:				
	Model A2; Two drives plus control	37,800	111.00	1,404	1,195
	Model B1; One drive	20,790	59.00	788	671
	Model B2; Two drives	26,460	95.00	994	846
	4301 Fixed-Head Feature (for 3340 A2 or B2)	1,795	2.00	59	50
	4302 Fixed-Head Feature (for 3340 B1)	897	1.50	31	26
	6201 Rotational Position Sensing (for 3340 B1)	718	1.00	24	20
	6202 Rotational Position Sensing (for 3340 or A2 or B2)	907	1.00	32	27
	6148 Remote Switch Attachment	NC	NC	NC	NC
	8150 String Switch for 3340 A2	7,560	14.50	280	238
3344	Direct Access Storage; 279.6MB per drive:				
	Model B2; Add-on Dual Disk Drive for 3340 Direct-Access Storage Facility	31,680	128.00	1,263	1,075
	Model B2F; Add-on Dual Disk Drive for 3340 Direct-Access Storage Facility with 2MB fixed-head storage	41,600	179.00	1,657	1,410
3348	Data Module (for 3340 drives):				
	Model 35; 34.9MB	1,600	Time & mat'l.	59	50
	Model 70; 69.8MB	2,200	Time & mat'l.	82	70
	Model 70F; 69.8MB of which 502,080 are served by fixed heads	4,400	Time & mat'l.	165	140
3350	Direct Access Storage; 317.5MB per drive (for 4331-2 or 4341):				
	Model A2; Dual Disk Drive	40,000	170.00	1,586	1,350
	Model A2F; Dual Disk Drive with 2MB fixed-head storage	49,920	221.00	1,986	1,690
	Model B2; Add-on Dual Disk Drive	31,680	128.00	1,263	1,075
	Model B2F; Add-on Dual Disk Drive with 2MB fixed-head storage per drive	41,600	179.00	1,657	1,410
	Model C2; Two-drive disk storage and associated control	41,380	179.00	1,651	1,405
	Model C2F; Two-drive disk storage and associated control	51,300	230.00	2,039	1,735
	1320 Primary Controller Adapter (permits selection of A2/AF controller as on-line controller via manual switch on the C2/C2F)	275	1.50	12	10
	8150 String Switch for 3350 A2, A2F, C2, C2F	4,610	9.00	196	167
3830	Storage Control, Model 2; for 3330/3333, 3340/3344, or 3350 disk drives	35,690	166.00	2,120	1,781
	2150 Control Store Extension	8,250	14.00	489	411
	2151 Expanded Control Store; requires 2150	5,050	14.00	299	251
	6111 Register Expansion	480	4.50	29	24
	6148 Remote Switch Attachment	NC	NC	NC	NC
	6149 Remote Switch Attachment, Additional	NC	NC	NC	NC
	8170 Two-Channel Switch	3,520	14.00	207	174
	8171 Two-Channel Switch, Additional	3,520	14.00	207	174
3370	Direct Access Storage; 571.3MB per drive:				
	Model A1; Single Disk Drive	42,650	126.00	1,357	1,155
	Model B1; Add-on Single Disk Drive for attachment to Model A1	28,420	94.50	905	770
	8150 String Switch for 3370 A1	4,505	1.50	140	119

*Rental/lease prices include equipment maintenance.
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)					
3375	Direct Access Storage; 819.7MB per drive (for 4331-2 or 4341):				
	Model A1; contains logic and power for up to three Model B1 units	48,770	130.00	1,357	1,155
	Model B1; connects to a 3375 Model A1	32,550	98.50	905	770
	Model D1; provides dual controller function in a 3375 string; requires one Model A1 and two Model B1s	46,540	120.00	1,293	1,100
	4951 Model D1 Attachment for Model A1	2,930	6.00	82	70
	4952 Model D1 Attachment for Model B1	NC	NC	NC	NC
	8150 String Switch Feature for 3375 A1	4,295	1.50	134	114
3380	Direct Access Storage; 2.52 billion bytes per unit (4341 only):				
	Model A4; connects to one 3880 storage director	97,650	285.00	2,550	2,170
	Model A4F; connects to one 3880 storage director; includes 5.6MB of fixed-head storage	128,250	415.00	3,349	2,850
	Model AA4; connects to one 3880 storage director	111,600	325.00	2,914	2,480
	Model AAF; connects to two 3880 storage directors; includes 5.6MB of fixed-head storage	142,200	455.00	3,713	3,160
	Model B4; connects to a Model A unit	81,000	240.00	2,115	1,800
	Model B4F; connects to a Model A unit; includes 5.6MB of fixed-head storage	111,600	370.00	2,914	2,480
3880	Storage Control; includes two storage directors:				
	Model 1; each storage director can attach up to four 3330/3333, 3340 A2, 3350 A2/A2F, 3370 A1, or 3375 A1 or D1 in any combination	75,760	176.00	2,180	1,855
	Model 2; provides one storage director for 3330/3333, 3340/3344, 3350, 3370, or 3375 storage and one for 3380 storage	75,760	176.00	2,180	1,855
	Model 3; provides two storage directors for 3380 storage	75,760	176.00	2,180	1,855
	6148 Remote Switch Attachment	NC	NC	NC	NC
	6149 Remote Switch Attachment, additional	NC	NC	NC	NC
	6150 Remote Switch Attachment for Eight-Channel Switch	NC	NC	NC	NC
	6550 Speed Matching Buffer for 3380	10,990	40.00	316	269
	8170 Two-Channel Switch Pair	7,830	11.00	224	191
	8171 Two-Channel Switch Pair, additional	20,890	38.50	600	511
	8172 Eight-Channel Switch	28,730	53.50	828	705
MAGNETIC TAPE EQUIPMENT					
3410	Magnetic Tape Unit:				
	Model 1; 20,000 bytes/sec.	6,230	98.00	245	206
	Model 2; 40,000/20,000 bytes/sec.	8,330	108.00	326	274
	Model 3; 80,000/40,000 bytes/sec.	10,310	119.00	409	344
3411	Magnetic Tape Unit and Control:				
	Model 1; 20,000 bytes/sec.	13,730	150.00	544	457
	Model 2; 40,000/20,000 bytes/sec.	17,370	162.00	692	581
	Model 3; 80,000/40,000 bytes/sec.	21,180	171.00	841	706
	3211 Single Density Feature (for 3410 & 3411)	2,020	13.00	70	59
	3221 Dual Density Feature (for 3410 & 3411)	2,910	45.50	105	88
	7360 System/360/370 Attachment (required on 3411)	5,095	31.50	197	165
3420	Magnetic Tape Units:				
	Model 3; 120,000 bytes/sec. at 1600 bpi; 75 ips	14,340	156.00	488	410
	Model 4; 470,000 bytes/sec. at 6250 bpi; 75 ips	18,440	156.00	681	572
	Model 5; 200,000 bytes/sec. at 1600 bpi; 125 ips	19,230	171.00	656	551
	Model 6; 780,000 bytes/sec. at 6250 bpi; 125 ips	21,540	171.00	788	662
	Model 7; 320,000 bytes/sec. at 1600 bpi; 200 ips	21,540	205.00	777	653
	Model 8; 1,250 bytes/sec. at 6250 bpi; 200 ips	23,890	251.00	936	786
	6420 6250 bpi Density Feature (for 3420 Models 4, 6, and 8)	1,925	47.00	67	56
	6425 6250/1600 bpi Density Feature (for 3420 Models 4, 6, and 8)	2,650	62.00	97	81
	6631 Single Density Feature (for Models 3, 5, and 7)	3,450	46.50	114	96
	3550 Dual Density Feature (for Models 3, 5, and 7)	4,455	78.00	149	125
	6407 7-Track Feature (for Models 3, 5, and 7)	3,450	68.00	114	96
3803	Tape Controller:				
	Model 1; for 3420 Model 3, 5, and 7 drives	24,850	120.00	849	713
	Model 2; for 3420 Model 3 through 8 drives	33,110	165.00	1,235	1,037
	5310 9-Track NRZI Feature (permits connection of 800-bpi drives to 3803-2)	3,705	1.50	121	102
	6320 7-Track NRZI Feature (permits connection of 7-track drives to 3803-2; 5310 is prerequisite)	1,820	1.50	59	50

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (2-Year Lease)*
MAGNETIC TAPE EQUIPMENT (Continued)					
	Multiple Tape Control Switches (for switching up to sixteen 3420 tape drives between up to four 3803 control units):				
	1792 For 2 Tape Controls	7,370	12.00	248	208
	1793 For 3 Tape Controls	9,400	19.00	320	269
	1794 For 4 Tape Controls	11,050	19.00	375	315
	3551 Dual Density Feature (for 3803-1)	2,760	3.00	91	76
	6148 Remote Switch Attachment	1,095	NC	36	30
	6408 7-Track Feature (for 3803-1)	2,760	3.00	91	76
	8100 Two-Channel Switch	5,525	6.00	185	155
8809	Magnetic Tape Unit (4331 only):				
	Model 1A; first drive; operates in start/stop mode at 20,000 bytes/sec. or in streaming mode at 160,000 bytes/sec.	11,500	66.50	436	371
	Model 2; second, fourth, or sixth drive; attaches to Model 1A or 3	10,210	60.00	388	330
	Model 3; third or fifth drive; attaches to Model 2	11,500	66.50	436	371
DISKETTE EQUIPMENT					
3540	Diskette Input/Output Unit:				
	Model B1; one drive; 242.9KB	27,520	67.50	948	807
	Model B2; two drives	41,910	94.00	1,422	1,210
PUNCHED CARD EQUIPMENT					
1442	Card Read Punch (with control), Model N1; 400/91 cpm	24,040	278.00	924	—
1442	Card Punch (with control), Model N2; 160 cpm	17,160	245.00	659	—
2501	Card Reader (with control):				
	Model B1; 600 cpm	19,610	139.00	468	—
	Model B2; 1000 cpm	19,920	151.00	576	—
2520	Card Read Punch (with control), Model B1; 500 cpm	53,460	547.00	1,640	—
2520	Card Punch (with control):				
	Model B2; 500 cpm	47,340	514.00	1,460	—
	Model B3; 300 cpm	46,950	411.00	1,125	—
2540	Card Read Punch; 1000/300 cpm (requires 2821 control unit)	44,420	374.00	1,275	—
2821	Control Unit:				
	Model 1; one 2540 and one 1403 printer	43,850	100.00	1,440	1,210
	Model 5; for one 2540 and two 1403's	71,050	175.00	2,345	1,970
	Model 6; for one 2540 only	14,920	219.00	661	555
	8100 Two-Channel Switch	9,895	16.50	296	249
	8637 Universal Character Set Adapter	718	5.50	18	15
3505	Card Reader:				
	Model B1; 800 cpm	36,030	255.00	1,020	—
	Model B2; 1200 cpm	37,270	347.00	1,205	—
	5450 Optical Mark Read	10,130	103.00	324	—
	6555 Selective Stacker	2,845	18.00	82	—
	8103 3525 Punch Adapter	6,370	7.50	178	—
	8105 3525 Read/Punch Adapter	7,010	9.50	223	—
	8100 3525 Card Print Control	3,810	9.50	99	—
3525	Card Punch:				
	Model P1; 100 cpm	25,520	158.00	721	—
	Model P2; 200 cpm	26,520	213.00	915	—
	Model P3; 300 cpm	27,520	266.00	1,100	—
	1533 Card Read Feature	7,645	39.50	213	—
	1421 Basic Card Print	16,750	157.00	466	—
	5273 Multi-Line Card Print	1,365	45.50	126	—
	8339 Two-Line Card Print	874	7.00	19	—
5424	Multi-Function Card Unit, 96 col. (4331 only):				
	Model A1; 60 cpm	8,950	263.00	524	—
	Model A2; 120 cpm	11,840	396.00	790	—
	6510 4331 Attachment	2,670	6.00	60	—

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (2-Year Lease)*
PRINTERS					
1403	Printer:				
	Model 2; 600 lpm; 132 print positions	23,100	539.00	1,240	1,042
	Model 7; 600 lpm; 120 print positions	22,190	419.00	1,045	878
	Model N1; 1100 lpm; 132 print positions	40,040	625.00	1,440	1,210
	1416 Interchangeable Train Cartridge (required for 1403 N1)	2,930	Time & mat'l.	134	—
	4740 Interchangeable Train Cartridge Adapter (for 1403-2 or -7)	2,030	NC	92	77
	8640 Universal Character Set Feature (for 1403 N1)	447	3.50	13	11
	8641 Universal Character Set Feature (for 1403-2)	313	3.50	13	11
2821	Control Unit:				
	Model 1; one 2540 card unit and one 1403 printer	43,850	100.00	1,440	1,210
	Model 2; for one 1403	27,190	75.50	905	760
	Model 3; for two 1403s	54,270	155.00	1,800	1,512
	Model 5; for one 2540 and two 1403s	71,050	175.00	2,345	1,970
	3615 1100 lpm Printer Adapter (for 2821; required for 1403 N1)	2,815	2.00	107	90
	7945 Third Printer Control for 2821 Model 3 or 5)	22,560	13.00	754	633
	8100 Two-Channel Switch	9,895	16.50	296	249
	8637 Universal Character Set Adapter	718	5.50	18	15
1443	Printer (with control), Model N1; 240 lpm	47,460	284.00	1,190	1,000
3203	Printer, Model 5; 1200 lpm, 132 print positions	38,320	391.00	1,733	1,475
	1416 Interchangeable Train Cartridge (required)	28,170	38.50	723	607
3211	Printer; 2000 lpm, 132 print positions	40,080	814.00	2,245	1,886
	3216 Interchangeable Train Cartridge	11,600	213.00	493	—
	5554 18 Additional Print Positions	2,150	14.50	69	58
3811	Control Unit for 3211 Printer	17,685	135.00	990	832
	5553 18 Additional Print Positions	789	6.00	23	19
3262	Line Printer (4331 only):				
	Model 1; 650 lpm	17,010	180.00	525	447
	Model 11; 325 lpm	12,140	132.00	368	313
	5951 0.079-inch char. height	NC	NC	NC	NC
	5950 0.095-inch char. height	NC	NC	NC	NC
	5940 48-char. EBCDIC Set	186	—	—	—
	5944 64-char. EBCDIC Set	186	—	—	—
	5946 64-char. EBCDIC Set (optimized)	186	—	—	—
	5948 96-char. EBCDIC Set	186	—	—	—
3287	Serial Printer:				
	Model 1; 80 cps	5,960	41.50	222	189
	Model 2; 120 cps	6,355	51.50	270	230
	Model 1C; 4 colors; 80 cps	6,430	47.00	274	233
	Model 2C; 4 colors; 120 cps	6,825	57.00	322	274
	1120 APL/Text	183	0.50	6	5
	3610 Extended Character Set Adapter	477	3.50	18	15
	3880 Extended Print Buffer	220	0.50	7	6
	4110 Friction Feed Paper Handling	168	0.50	6	5
	8330 3271/3272 Attachment for Models 1 and 2	955	3.00	39	33
	8331 3274/3276 Attachment for Models 1 and 2	183	0.50	6	5
	8700 Variable-Width Forms Tractor	168	0.50	6	5
3289	Line Printer, Model 4; 230 to 400 lpm	14,600	205.00	746	635
	5821 48-char. EBCDIC print belt	160	—	—	—
	5822 64-char. EBCDIC print belt	160	—	—	—
	5823 94-char. EBCDIC print belt	160	—	—	—
3800	Printing Subsystem; up to 20,040 lpm	358,800	938.00	9,905	8,430
	5401 Additional Character Generation Storage	4,305	26.50	106	91
	8170 Two-Channel Switch	9,415	20.50	283	241
	1490 Burster-Trimmer-Stacker	54,120	250.00	1,480	1,260
	7810 Tape to Print Subsystem Feature	11,570	46.50	393	335

*Rental/lease prices include equipment maintenance.
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IBM 4300 Series

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (2-Year Lease)*
OPTICAL AND MAGNETIC READERS					
1255	Magnetic Character Reader:				
	Model 1; 500 dpm, 6 stackers	41,040	332.00	1,210	—
	Model 2; 750 dpm, 6 stackers	46,970	531.00	1,480	—
	Model 3; 750 dpm, 12 stackers	63,960	699.00	1,945	—
	3215 Dash Symbol Transmission (for 1255 or 1419)	35	NC	56 (1-time)	—
	4380 51-Column Card Sorting (for 1255 or 1419)	661	NC	16	—
	4520 High-Order Zero and Bank Selection (for 1255 Model 3 only)	1,515	6.00	43	—
	7060 Self-Checking Numbers (for 1255)	2,465	2.50	70	—
	6360 System/360/370 Adapter (required on 1255)	22,910	48.50	681	—
1287	Optical Reader:				
	Model 1; reads documents only	108,450	1,280.00	3,935	—
	Model 3; reads documents only	163,550	1,835.00	6,075	—
	Model 5; reads handprinted digits from documents only	120,650	1,855.00	4,940	—
	3945 Farrington 7B Font	968	1.50	34	—
	4470 1428 and ANSCS OCR Font	968	1.50	34	—
	5300 NCR Optical Type Font	3,885	7.00	138	—
	5370 Numeric Handwriting	31,140	79.50	1,120	—
	5479 Optical Mark Reading	3,885	7.00	138	—
1288	Optical Page Reader	198,600	1,620.00	6,925	—
	3850 Expanded Symbol Set	2,710	4.00	97	—
	5370 Numeric Handwriting	46,710	99.00	1,405	—
	5479 Optical Mark Reading	4,575	8.50	138	—
	6550 Serial Numbering (for 1288 or 1287)	11,100	79.50	419	—
1419	Magnetic Character Reader; 1600 dpm	145,950	802.00	3,580	—
	7061 Self-Checking Number, Modulus 10	2,560	3.50	61	—
	7062 Self-Checking Number, Modulus 11	3,950	6.00	100	—
3881	Optical Mark Reader:				
	Model 1; for on-line use	62,420	228.00	2,015	1,715
	Model 2; for off-line use with 3410 Model 1 Magnetic Tape Unit	56,860	181.00	1,833	1,560
	Model 3; on-line use with IBM Diskette Unit	72,800	217.00	2,221	1,890
	1471 BCD Read	2,600	2.50	79	67
	3450 Document Counters	1,030	3.00	25	21
	3550 Dual Density (for Model 2 only)	6,565	1.50	207	176
	3801 Expanded Storage	2,600	1.50	79	67
	6451 Serial Numbering	7,680	40.50	243	207
3886	Optical Character Reader:				
	Model 1; on-line	101,500	497.00	3,484	2,965
	Model 2; off-line	109,200	497.00	3,748	3,190
	3210 Additional Data Storage	1,020	0.50	33	28
	4520 Additional Hopper and Stacker Capacity	8,235	26.00	278	237
	4610 Additional Instruction Storage	5,120	11.00	174	148
	4720 Line Marking	5,680	11.00	189	161
	5340 Numbering/Marking Adapter	1,545	0.50	43	37
	5360 Numeric Handprinting	6,685	30.00	224	191
	6450 Serial Numbering	8,235	26.00	278	237
3890	Document Processor; Model A has 13K bytes, Model B has 29K bytes memory:				
	Model A1; 6 pockets	269,600	281.00	5,939	5,055
	Model A2; 12 pockets	314,750	338.00	6,885	5,860
	Model A3; 18 pockets	359,900	392.00	7,831	6,665
	Model A4; 24 pockets	405,050	447.00	8,771	7,465
	Model A5; 30 pockets	450,200	501.00	9,723	8,275
	Model A6; 36 pockets	495,350	557.00	10,663	9,075
	Model B1; 6 pockets	315,800	342.00	7,390	6,290
	Model B2; 12 pockets	360,950	399.00	8,330	7,090
	Model B3; 18 pockets	406,100	453.00	9,276	7,895
	Model B4; 24 pockets	451,250	509.00	10,222	8,700
	Model B5; 30 pockets	496,400	563.00	11,168	9,505
	Model B6; 36 pockets	541,550	617.00	12,114	10,310

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IBM 4300 Series

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (2-Year Lease)*
SYSTEM MANAGEMENT					
3814	Switching Management System (requires one Model A):				
	Model A1; Controller; 4x4 switch	55,000	124.00	1,615	1,375
	Model A2; Controller; 4x8 switch	70,000	161.00	2,055	1,750
	Model A3; Controller; 8x4 switch	75,000	158.00	2,205	1,875
	Model A4; Controller; two 4x4 switches	80,600	173.00	2,365	2,015
	Model B1; Remote Unit; 4x4 switch	46,000	84.00	1,350	1,150
	Model B2; Remote Unit; 4x8 switch	61,000	122.00	1,790	1,525
	Model B3; Remote Unit; 8x4 switch	66,000	118.00	1,940	1,650
	Model B4; Remote Unit; two 4x4 switches	71,600	133.00	2,100	1,790
	Model C1; Expansion Unit; 4x4 switch	44,000	81.00	1,290	1,100
	Model C2; Expansion Unit; 4x8 switch	59,000	119.00	1,735	1,475
	Model C3; Expansion Unit; 8x4 switch	64,000	115.00	1,880	1,600
	Model C4; Expansion Unit; two 4x4 switches	69,600	130.00	2,040	1,740
	3604 Keyboard/Display, Model 6, one required	1,680	12.50	—	—
	1520 Channel Expansion Internal—4 Control Unit Interfaces	1,800	1.00	55	45
	1521 Channel Expansion Internal—8 Control Unit Interfaces	3,600	1.00	110	90
	1530 Channel Expansion External	6,200	1.00	180	155
	1810 Control Unit Power Sequencing	600	1.00	18	15
	6010 Remote Two-Channel Switch Control—Basic	6,000	17.00	175	150
	6011 Remote Two-Channel Switch Control—Additional	2,800	13.00	85	70
	6350 System Power Sequencing—Additional	240	—	7	6
DISPLAY AND DATA ENTRY TERMINALS					
A number of IBM terminals can be connected to a 4300 system in local or remote configurations. For details and prices please refer to Reports 70D1-491-45, 70D2-491-11, 70D3-491-46, and 70D4-491-43 in Volume 2 of DATAPRO 70.					
COMMUNICATIONS EQUIPMENT					
For the 4331 Processor:					
	1020 Autocall Unit Interface	462	3.00	14	12
	1601 Communications Adapter, base	3,230	2.50	107	91
	3701 EIA/CCITT Interface	462	3.00	14	12
	4695 Line Attachment Base; for clocked modems	462	1.50	14	12
	4696 Line Attachment Base; for non-clocked modems	546	1.50	16	14
	4720 High-Speed Modem Adapter	1,385	3.00	39	33
	4781 1200-bps Integrated Modem; non-switched	701	4.50	21	18
	4782 1200-bps Integrated Modem; switched, with auto-answer	903	4.50	29	25
	4787 1200-bps Integrated Modem; non-switched, with switch network backup and manual answer	955	4.50	31	26
	4788 1200-bps Integrated Modem; non-switched, with switch network backup and auto-answer	1,065	5.00	34	29
	4801 Local Attachment Interface	1,155	4.00	34	29
	5650 Digital Data Service Adapter	882	3.50	28	24
	3863 2400-bps Modem:				
	Model 1; non-switched	2,585	12.50	89	76
	Model 2; switched	2,825	15.00	96	82
	3864 4800-bps Modem:				
	Model 1; non-switched	4,245	22.00	154	131
	Model 2; switched	4,485	23.00	163	139
	3865 9600-bps Modem; non-switched	6,435	32.00	230	209
	4830 Loop Adapter 1; requires Adapter Power Prerequisite; cannot be installed with 5424 Adapter	11,165	45.00	450	383
	4831 Loop Adapter 2; requires 4830	2,260	23.00	85	72
	4840 Data Link Adapter; requires 4830	1,390	10.50	53	45
	3843 Loop Control Unit	5,410	28.00	181	154
7770	Audio Response Unit, Model 3 (up to 4 lines)	58,760	96.00	1,730	—
	4677 I/O Line Expander (up to 4 more lines)	8,575	30.00	253	—
	4679 I/O Line Panel (one required for each 8 lines beyond the first 8)	3,660	3.50	108	—
	4668 I/O Line Frame (required for over 16 lines)	9,790	4.00	289	—
	8721 16 Additional Vocabulary Words	4,890	4.00	143	—
3705-II	Communications Controller: For detailed pricing see Report 70C-491-06 (303X Series)				

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NC—No Charge

IBM 4300 Series

SOFTWARE PRICES

		Prior to 1/1/82		Effective 1/1/82			
		Basic License Charge	DSLO Charge	Basic License Charge	DSLO Charge	Monthly Licensed Program Support Charge	Monthly Additional Licensed Program Support Charge
5735-RC2	ACF/VTAM, OS/VS	333	—	280	210	42	25
	Networking Feature	834	—	673	504	127	76
5746-RC3	ACF/VTAM, DOS/VSE	117	87	—	—	42	25
	Networking Feature	221	165	—	—	127	76
5735-RC3	ACF/TCAM Version 2, OS/VS	625	—	535	401	71	43
	Networking Feature	1,010	—	900	675	88	53
5735-XX1	ACF/NCP/VS	166	—	135	101	24	14
5735-XX7	Network Terminal Option	139	—	127	95	9	5
5746-XE8	VSE/Advanced Functions, Releases 1 and 2	157	117	—	—	48	28
5746-RC7	Advanced Communications Function for VTAM Entry (ACF/VTAME)	114	86	—	—	61	37
5746-TS1	VSE/Interactive Computing and Control Facility	84	63	—	—	22	13
5746-XE3	VSE/POWER Releases 1 and 2	44	33	—	—	13	7
5746-RC9	DOS/VSE Remote Job Entry Workstation	90	—	—	—	—	—
5746-AM5	VSE/3270 Bisync Pass Through	139	—	—	—	—	—
5746-AM2	VSE/VSAM Releases 1 and 22	48	36	—	—	18	11
	VSE/VSAM Space Management for SAM feature	28	21	—	—	7	4
5746-AM4	VSE/Fast Copy Data Set Program	363*	—	—	—	—	—
5746-UT3	VSE/Data Interfile Transfer, Testing and Operations Utility (VSE/DITTO)	31	23	—	—	5	3
5746-XE7	VSE/Access Control—Logging and Reporting	42	31	—	—	17	11
5746-SA1	VSE/Interactive Problem Control System	27	20	—	—	5	3
5746-RC5	Basic Telecommunications Access Method Extended Support	28	21	—	—	5	3
5746-SU1	IBM Systems 1401/1440/1460 Emulator	133	99	—	—	5	3
5746-LM3	DOS FORTRAN IV Library Option I	33	24	—	—	5	3
5746-CB1	DOS/VS COBOL Compiler and Library	137	102	—	—	12	7
5746-LM4	DOS/VS COBOL Library	25	18	—	—	5	3
5736-PL1	DOS PL/1 Optimizing Compiler	205	154	—	—	31	19
5736-LM4	DOS PL/1 Resident Library	48	36	—	—	5	3
5736-LM5	DOS PL/1 Transient Library	28	20	—	—	5	3
5736-PL3	DOS PL/1 Optimizing Compiler and Library	281	—	—	—	41	25
5746-RG1	DOS/VS RPG II	114	86	—	—	5	3
5746-SM2	DOS/VS Sort/Merge (Version 2)	126	90	—	—	16	10
5746-XX1	DL/1 DOS/VS (Version 1)	324	243	—	—	110	66
5748-XXJ	SQL/Data System	300	225	—	—	105	63
5748-XX8	VM/Basic System Extensions	119	89	—	—	33	19
5748-XE1	VM/System Extensions	1,170	877	—	—	148	89
5664-167	VM/System Product	287	215	—	—	50	30
5748-XP1	Remote Spooling Communications Subsystem (RSCS) Networking	73	54	—	—	28	17
5748-XXC	VM/Interactive File Sharing	35	26	—	—	12	7
5748-XXB	Display Management System/CMS	26	19	—	—	7	4
5748-XE4	VM/Directory Maintenance	85	63	—	—	23	14
5748-XT3	VM/CMS-3270 Display Support and Structured Programming Facility	365	—	—	—	—	—
5748-SA1	VM/Interactive Problem Control System Extension	36	26	—	—	5	3
5748-MS1	Interactive Productivity Facility	36	27	—	—	5	3
5748-RC1	VM/Pass-Through Facility	121	90	—	—	65	39
5746-XX3	CICS/VS/DOS	392	294	—	—	116	70
5740-XX1	CICS/OS/VS	1,390	—	1,240	930	116	70
5740-XC5	Development Management System/CICS/VS-OS	278	—	234	174	40	24
5746-XC4	Development Management System/CICS/VS-DOS	121	90	—	—	40	24
5740-XXF	DB/DC Data Dictionary for OS/VS	806	—	700	525	84	50
5746-XXC	DB/DC Data Directory for DOS/VS	319	239	—	—	68	39
5662-257	OS/VS1 Basic Programming Extension	165	123	—	—	35	21
5740-XYW	OS/VS1 Job Networking Facility	200	—	—	—	—	—
5740-XE1	MVS/System Extension	1,580	—	1,480	1,110	85	51
5740-XYS	MVS/SP-JES2 Release 1	1,580	—	1,480	1,110	85	51
	Release 2 or 3	1,695	—	1,495	1,120	175	105
5740-XYN	MVS/SP-JES3 Release 1	1,580	—	1,480	1,110	85	51
	Release 2 or 3	2,070	—	1,635	1,225	375	225

*One-time charge.

IBM 4300 Series

SOFTWARE PRICES

		Prior to 1/1/82		Effective 1/1/82			
		Basic License Charge	DSLO Charge	Basic License Charge	DSLO Charge	Monthly Licensed Program Support Charge	Monthly Additional Licensed Program Support Charge
5740-XY4	RMF Version 2, Release 4	347	—	331	248	13	8
5740-XR8	JES2 NJE	695	—	603	452	72	43
5799-AZT	JES3 NJE	1,665	—	1,335	1,000	260	156
5740-XRB	MVS Hierarchical Storage Manager, Release 3	460	—	366	274	94	56
5748-FO3	VS FORTRAN Compiler and Library	185	138	—	—	15	9
5748-LM3	VS FORTRAN Library	55	41	—	—	5	3
5748-AP1	VS APL Release 4	266	199	—	—	33	19
5734-PL3	OS PL/1 Compiler and Library	341	—	295	221	41	25
5734-PL1	OS PL/1 Compiler	254	—	220	165	31	19
5734-LM4	OS PL/1 Resident Library	54	—	48	36	5	3
5734-LM5	OS PL/1 Transient Library	33	—	28	20	5	3
5740-SM1	OS/VS Sort/Merge Release 5	218	—	201	150	16	10
5740-CB1	OS/VS COBOL Compiler and Library	284	—	271	203	12	7
5740-LM1	OS/VS COBOL Library	94	—	88	66	5	3
5740-AM6	Data Facility/Device Support Release 1 (OS/VS1)	57	42	—	—	—	—
5740-UT3	Data Facility/Data Set Services Release 1 (OS/VS1 and MVS)	75	—	58	43	17	10
5740-XYQ	Data Facility/Extended Function (MVS)	140	—	90	67	50	30
5740-AM7	Data Facility/Device Support (MVS)	75	—	61	45	14	8
5668-002	Direct Access Storage Device Migration Aid Release 1 (OS/VS1 and MVS)	1,000*	—	—	—	—	—

*One-time charge.

CHARGES FOR LOCAL PROGRAMMING SUPPORT	Monthly Program Support Charge	Monthly Additional Program Support Charge
For Class 1 SCP on 4331 Model Group 1:		
Category A (DOS/VSE, OS/VS1 Release 7, VM/370 Release 6)	$154	$ 92
For Class 1 SCP on 4331 Model Group 2:		
Category A	220	132
For Class 1 SCP on 4341 Model Group 1:		
Category A	439	263
Category B (all SCP's in Category A, MVS Release 3.8, MVS corequisite SCP's)	627	276
For Class 1 SCP on 4341 Model Group 2:		
Category A	518	311
Category B	740	444■