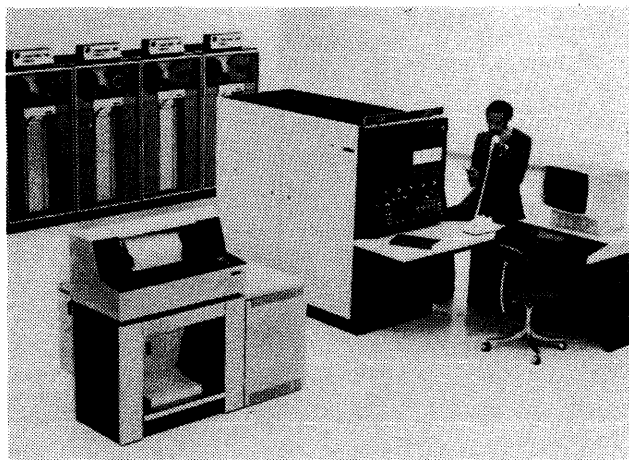# IBM System/370

MANAGEMENT SUMMARY

The System/370 has been one of IBM's most popular computer products since its introduction in 1970. It accounts for about one out of every five of the medium- to large-scale computers installed in the United States. At the height of the System/370's popularity, there were 23 models ranging from the Model 115 to the Model 195. Price/performance advances with newer IBM processors have caused IBM to supersede the System/370 product line, with only certain models now sold on an as-available basis. The upper end of the System/370 family, the Models 155 through 168, has been replaced by the 303X Series, and the lower-end systems, typified by the Models 138 and 148, have evolved into the 4300 Series.

While it's true that IBM has newer processors to replace the aging System/370, many users are staying with their present hardware. In Datapro's 1981 User Ratings of Computer Systems, better than half the 469 users surveyed said they were keeping their System/370, in large part because they owned the system, and further, because of the long lead times typical of the newer IBM products.

PROCESSOR MODELS

The System/370 had 23 distinct central processor models, including uniprocessor (UP), attached processor (AP), and multiprocessor (MP) models of the larger systems. During the past few years, these models have been withdrawn from production by IBM, which is now selling only certain models on an as-available basis, such as the Models 138 and 148.

The highlights of two of the more popular System/370 models are described in the following paragraphs.

The Model 138 is a popular System/370 processor model still sold, but only on an as-available basis.

The IBM System/370 accounts for about 8,000 systems installed in the U.S. today. Although no longer in production by IBM, the System/370 is still held in high regard by the user community.

MODELS: IBM System/370 Models 115, 115-2, 125, 125-2, 135, 135-3, 138, 145, 145-3, 148, 155, 155-II, 158, 158-3, 158 MP, 158-3 MP, 165, 165-II, 168, 168-3, 168 MP, 168-3 MP, and 195.

CONFIGURATION: The System/370 comes as a uniprocessor with AP and MP options. The systems have 64K bytes to 16 megabytes of main memory, and run under the DOS/VS, OS/VS1, SVS, MVS, or VM/370 operating systems.

COMPETITION: Amdahl 470; Burroughs B X700 and B X800; Control Data Omega/ 480; Digital Equipment DECsystem-10; Formation F4000; Honeywell Series 60; Magnuson M80; Univac Series 90 and 1100 Series.

PRICES: Purchase prices range from $78,150 for a Model 115 up to $2,861,000 for a 168-3 MP which include the central processors and console only.

CHARACTERISTICS

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

MODELS: System/370 Model 115 through Model 195. Models 115, 115-2, 125, 125-2, 138, 148, 158, 158MP, 158-3, 168, 168MP, and 168-3 are not in new production and are sold on an as-available basis only. Models 135, 135-3, 145, 145-3, 155, 155-II, 165, 165-II and 195 are no longer marketed by IBM. See the table on the following pages for a summary of all the processor models and their characteristics.

Beyond providing a listing in the table, processors no longer marketed are not covered in this report.

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: One word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" ▶

IBM System/370

CHARACTERISTICS OF THE SYSTEM/370 PROCESSOR MODELS

	Model 115	Model 115-2	Model 125	Model 125-2	Model 135	Model 135-3
SYSTEM CHARACTERISTICS						
Date of first introduction	March 1973	Nov. 1975	Oct. 1972	Nov. 1975	March 1971	June 1976
Date of first delivery	1st Qtr. 1974	Aug. 1976	April 1973	Feb. 1976	May 1972	1st qtr. 1977
Virtual storage capability	Standard	Standard	Standard	Standard	Standard	Standard
Number of central processors	1	1	1	1	1	1
Principal operating systems	DOS/VS	DOS/VS	DOS/VS	DOS/VS	DOS/VS, OS/VS1	DOS/VS
Production status	Not in new production	Not in new production	Not in new production	Not in new production	No longer marketed	No longer marketed
MAIN STORAGE						
Storage type	Semicond. (MOS	Semicond. (MOS)	Semicond. (MOS)	Semicond. (MOS)	Semicond. (bipolar)	Semicond. (bipolar)
Read cycle time, nanoseconds	480	480	480	480	770	540
Write cycle time, nanoseconds	480	480	480	480	935	608
Bytes fetched per cycle	2	2	2	2	2 or 4	2 or 4
Storage interleaving (maximum)	None	None	None	None	None	None
Minimum capacity, bytes per system	65,536	65,536	98,304	98,304	98,304	262,144
Maximum capacity, bytes per system	196,608	393,216	262,144	524,288	524,288	524,288
Increment size, bytes	32,768	32,768-131,072	32,768 or 65,536	32,768-131,072	49,152 to 131,072	65,536 or 131,072
BUFFER STORAGE						
Cycle time, nanoseconds	—	—	—	—	—	—
Bytes fetched per cycle	—	—	—	—	—	—
Minimum capacity, bytes	None	None	None	None	None	None
Maximum capacity, bytes	None	None	None	None	None	None
PROCESSING UNIT						
Machine cycle time, nanoseconds	480	480	480	480	275-1485	275-1485
Relative performance level (estimated)	1.00	1.40	1.45	1.80	2.90	3.80
Processing unit features:						
Control storage, bytes	20,480 to 28,672	12,288 to 20,480	12,288 to 20,480	16,384 to 24,576	24,576 to 49,152	131,072
Clock Comparator & CPU Timer	Standard	Standard	Standard	Standard	Optional	Optional
Direct Control	No	No	No	No	Optional	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard	Standard	Standard
Floating Point	Optional	Optional	Optional	Optional	Optional	Optional
Extended Precision Floating Point	Optional	Optional	Optional	Optional	Optional	Optional
High-Speed Multiply	No	No	No	No	No	No
3880 Storage Control for 3330/3333, 3340/3344, and 3350	No	No	No	No	No	No
Integrated 2319 Disk Control	No	No	No	No	Optional	Optional
Integrated 3330 Disk Control	No	No	Standard	Standard	Optional	No
Integrated 3340/3344 Disk Control	Std. 3340	Standard	Std. 3340	Standard	Optional	Optional
Integrated 3350 Disk Control	No	No	No	No	No	No
Integrated 1403 Printer Control	No	No	Optional	Optional	Optional	Optional
Integrated 3203 Printer	Optional	Optional	Optional	Optional	No	No
Integrated 5203 Printer	Optional	Optional	No	No	No	No
Integrated Card I/O	Optional	Optional	Optional	Optional	No	No
Integrated Communications Control	Optional	Optional	Optional	Optional	Optional	Optional
Compatibility features:						
IBM 1401/1440/1460 Compatibility	Optional	Optional	Optional	Optional	Optional	Optional
IBM 1410/7010 Compatibility	No	No	No	No	No	No
IBM 7070/7074 Compatibility	No	No	No	No	No	No
IBM 7080 Compatibility	No	No	No	No	No	No
IBM 709/7090/7094 Compatibility	No	No	No	No	No	No
IBM 360/20 Compatibility	Optional	Optional	Optional	Optional	Optional	Optional
OS/DOS Compatibility	No	No	No	No	Standard	Standard
IBM 1502 & 2311 Compatibility	Optional	Optional	Optional	Optional	No	No
CHANNELS						
No. of Selector Channels per system	None	None	None	None	0 to 2	None
No. of Block Multiplexer Channels	None	None	None	None	0 to 2	0 to 2
No. of Byte Multiplexer Channels	0 or 1	0 or 1	0 or 1	0 or 1	1	1
Maximum total I/O data rate, bytes/second	900,000	900,000	900,000	900,000	2,400,000	2,600,000

IBM System/370

CHARACTERISTICS OF THE SYSTEM/370 PROCESSOR MODELS (Continued)

	Model 138	Model 145	Model 145-3	Model 148	Model 155	Model 155-II
SYSTEM CHARACTERISTICS						
Date of introduction	June 1976	Sept. 1970	June 1976	June 1976	June 1970	Aug. 1972
Date of first delivery	Nov. 1976	July 1971	2nd qtr. 1977	Jan. 1977	Feb. 1971	April 1973
Virtual storage capability	Standard	Standard	Standard	Standard	No**	Standard
Number of central processors	1	1	1	1	1	1
Principal operating systems	DOS/VS, OS/VS1	DOS/VS, OS/VS1, OS/VS2	DOS/VS, OS/VS1	DOS/VS, OS/VS1, OS/VS2	DOS/VS, OS/MFT, OS/MVT	DOS/VS, OS/VS1, OS/VS2
Production status	Not in new production	No longer marketed	No longer marketed	Not in new production	No longer marketed	No longer marketed
MAIN STORAGE						
Storage type	Semicond. (MOS)	Semicond. (bipolar)	Semicond. (bipolar)	Semicond. (MOS)	Core	Core
Read cycle time, nanoseconds	710-770	540	540	405	2070	2070
Write cycle time, nanoseconds	935	608	608	540	2070	2070
Bytes fetched per cycle	2	4 or 8	4 or 8	4	16	16
Storage interleaving (maximum)	None	None	None	None	None	None
Minimum capacity, bytes per system	524,288	164,840	196,608	1,048,576	262,144	262,144
Maximum capacity, bytes per system	1,048,576	2,097,152	2,031,616	2,097,152	2,097,152	2,097,152
Increment size, bytes	524,288	49,152 to 262,144	126,976 to 524,288	1,048,576	131,072 to 524,288	131,072 to 524,288
BUFFER STORAGE						
Cycle time, nanoseconds	—	—	—	—	115	115
Bytes fetched per cycle	—	—	—	—	2	2
Minimum capacity, bytes	None	None	None	None	8,192	8,192
Maximum capacity, bytes	None	None	None	None	8,192	8,192
PROCESSING UNIT						
Machine cycle time, nanoseconds	275-1485	203-315	180-270	180-270	115	115
Relative performance level (estimated)	3.9	5.45	7.1	7.7	10.0	10.0
Processing unit features:						
Control storage, bytes	131,072	32,768 to 65,536	131,072	131,072	Not spec'd.	Not spec'd.
Clock Comparator & CPU Timer	Standard	Optional	Optional	Standard	No**	Standard
Direct Control	Optional	Optional	Optional	Optional	Optional	Optional
Dynamic Address Translation	Standard	Standard	Standard	Standard	No**	Standard
Floating Point	Standard	Optional	Optional	Standard	Standard	Standard
Extended Precision Floating Point	Standard	Optional	Optional	Standard	Optional	Optional
High-Speed Multiply	No	No	No	No	No	No
3880 Storage Control for 3330/3333, 3340/3344, and 3350	No	Optional	Optional	Optional	No	Optional
Integrated 2319 Disk Control	No	No*	Optional	No	No	No
Integrated 3330 Disk Control	No	Optional	No	No	No	No
Integrated 3340/3344 Disk Control	Optional	Optional	Optional	Optional	No	No
Integrated 3350 Disk Control	No	No	No	No	No	No
Integrated 1403 Printer Control	Optional	No	No	No	No	No
Integrated 3203 Printer	Optional	No	No	Optional	No	No
Integrated 5203 Printer	No	No	No	No	No	No
Integrated Card I/O	No	No	No	No	No	No
Integrated Communications Control	Optional	No	No	No	No	No
Compatibility features:						
IBM 1401/1440/1460 Compatibility	Optional	Optional	Optional	Optional	Optional	Optional
IBM 1410/7010 Compatibility	No	Optional	Optional	Optional	Optional	Optional
IBM 7070/7074 Compatibility	No	No	No	No	Optional	Optional
IBM 7080 Compatibility	No	No	No	No	No	No
IBM 709/7090/7094 Compatibility	No	No	No	No	No	No
IBM 360/20 Compatibility	Optional	No	No	No	No	No
OS/DOS Compatibility	Standard	Standard	Standard	Standard	Optional	Optional
IBM 1052 & 2311 Compatibility	No	No	No	No	No	No
CHANNELS						
No. of Selector Channels per system	None	1 to 4	None	None	None	None
No. of Block Multiplexer Channels	2	1 to 4	1 to 4	4	2 to 5	2 to 5
No. of Byte Multiplexer Channels	1	1	1	1	1 or 2	1 or 2
Maximum total I/O data rate, bytes/second	2,600,000	5,300,000	5,300,000	5,000,000	5,400,000	5,400,000

*Optionally available for Models GE through 1 of the 145 Processing Unit, which are no longer in production, but not for Models H2 through J2.

**Virtual storage capability can be added to a purchased Model 155 through field installation of the Dynamic Address Translation facility, which converts it into a Model 155-II.

IBM System/370

CHARACTERISTICS OF THE SYSTEM/370 PROCESSOR MODELS (Continued)

	Model 158	Model 158-3	Model 158 MP	Model 158-3 MP	Model 165	Model 165-II
SYSTEM CHARACTERISTICS						
Date of introduction	Aug. 1972	March 1975	Feb. 1973	March 1975	June 1970	Aug. 1972
Date of first delivery	April 1973	Sept. 1975	March 1974	Sept. 1975	April 1971	Dec. 1973
Virtual storage capability	Standard	Standard	Standard	Standard	No*	Standard
Number of central processors	1	1	2	2	1	1
Principal operating systems	DOS/VS, OS/VS1, OS/VS2	DOS/VS, OS/VS1, OS/VS2	OS/VS2, Release 2	OS/VS2, Release 2 & Release 3	OS/MFT, OS/MVT	OS/VS1, OS/VS2
Production status	Not in new production	Not in new production	Not in new production	Not in new production	No longer marketed	No longer marketed
MAIN STORAGE						
Storage type	Semicond. (MOS)	Semicond. (MOS)	Semicond. (MOS)	Semicond. (MOS)	Core	Core
Read cycle time, nanoseconds	1035	1035	1035	1035	2000	2000
Write cycle time, nanoseconds	690	690	690	690	2000	2000
Bytes fetched per cycle	8 or 16	8 or 16	8 or 16	8 or 16	8	8
Storage interleaving (maximum)	None	None	None	None	4-way	4-way
Minimum capacity, bytes per system	524,288	524,288	1,048,576	1,048,576	524,288	524,288
Maximum capacity, bytes per system	6,291,456	6,291,456	12,582,912	12,582,912	3,145,728	3,145,728
Increment size, bytes	524,288 or 1,048,576	524,288 or 1,048,576	524,288 or 1,048,576	524,288 or 1,048,576	524,288 or 1,048,576	524,288 or 1,048,576
BUFFER STORAGE						
Cycle time, nanoseconds	115	115	115	115	80	80
Bytes fetched per cycle	2	2	2	2	4	4
Minimum capacity, bytes	8,192	16,384	8,192	16,384	8,192	8,192
Maximum capacity, bytes	8,192	16,384	8,192	16,384	16,384	16,384
PROCESSING UNIT						
Machine cycle time, nanoseconds	115	115	115	115	80	80
Relative performance level (estimated)	15.0	16.4	27.0	29.4	34.5	34.5
Processing unit features:						
Control storage, bytes	Not spec'd.	Not spec'd.	Not spec'd.	Not spec'd.	Not spec'd.	Not spec'd.
Clock Comparator & CPU Timer	Standard	Standard	Standard	Standard	No*	Standard
Direct Control	Optional	Optional	Optional	Optional	Standard	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard	No*	Standard
Floating Point	Standard	Standard	Standard	Standard	Standard	Standard
Extended Precision Floating Point	Optional	Optional	Optional	Optional	Standard	Optional
High-Speed Multiply	No	No	No	No	Optional	No
3880 Storage Control for 3330/3333, 3340/3344, and 3350	Optional	Optional	Optional	Optional	No	Optional
Integrated 2319 Disk Control	No	No	No	No	No	No
Integrated 3330 Disk Control	Optional	Optional	Optional	Optional	No	No
Integrated 3340/3344 Disk Control	Optional	Optional	Optional	Optional	No	No
Integrated 3350 Disk Control	No	No	No	No	No	No
Integrated 1403 Printer Control	No	No	No	No	No	No
Integrated 3203 Printer	No	No	No	No	No	No
Integrated 5203 Printer	No	No	No	No	No	No
Integrated Card I/O	No	No	No	No	No	No
Integrated Communications Control	No	No	No	No	No	No
Compatibility features:						
IBM 1401/1440/1460 Compatibility	Optional	Optional	Optional	Optional	No	No
IBM 1410/7010 Compatibility	Optional	Optional	Optional	Optional	No	No
IBM 7070/7074 Compatibility	Optional	Optional	Optional	Optional	Optional	Optional
IBM 7080 Compatibility	No	No	No	No	Optional	Optional
IBM 709/7090/7094 Compatibility	No	No	No	No	Optional	Optional
IBM 360/20 Compatibility	No	No	No	No	No	No
OS/DOS Compatibility	Optional	Optional	Optional	Optional	No	No
IBM 1052 & 2311 Compatibility	*No	No	No	No	No	No
CHANNELS						
No. of Selector Channels per system	None	None	None	None	0 to 6	0 to 6
No. of Block Multiplexer Channels	2 to 5	2 to 5	4 to 10	4 to 10	0 to 11	0 to 11
No. of Byte Multiplexer Channels	1 or 2	1 or 2	2 to 4	2 to 4	0 to 2	0 to 2
Maximum total I/O data rate, bytes/second	Not spec'd.	Not spec'd.	7,500,000	7,500,000	8,000,000	8,000,000

*Virtual storage can be added to a purchased Model 165 through field installation of the Dynamic Address Translation facility, which converts it into a Model 165-II.

IBM System/370

CHARACTERISTICS OF THE SYSTEM/370 PROCESSOR MODELS (Continued)

	Model 168	Model 168-3	Model 168 MP	Model 168-3 MP	Model 195
SYSTEM CHARACTERISTICS					
Date of introduction	Aug. 1972	March 1975	Feb. 1973	March 1975	July 1971
Date of first delivery	Aug. 1973	June 1975	March 1974	June 1975	2nd qtr. 1973
Virtual storage capability	Standard	Standard	Standard	Standard	No
Number of central processors	1	1	2	2	1
Principal operating systems	OS/VS1, OS/VS2	OS/VS1, OS/VS2	OS/VS2 Release 2 & Release 3	OS/VS2 Release 2 & Release 3	OS/MVT
Production status	Not in new production	Not in new production	Not in new production	Not in new production	No longer marketed
MAIN STORAGE					
Storage type	Semicond. (MOS)	Semicond. (MOS)	Semicond. (MOS)	Semicond. (MOS)	Core
Read cycle time, nanoseconds	480	480	480	480	756
Write cycle time, nanoseconds	480	480	480	480	756
Bytes fetched per cycle	8	8	8	8	8
Storage interleaving (maximum)	4-way	4-way	4-way	4-way	16-way
Minimum capacity, bytes per system	1,048,576	1,048,576	2,097,152	2,097,152	1,048,576
Maximum capacity, bytes per system	8,388,608	8,388,608	16,777,216	16,777,216	4,194,304
Increment size, bytes	1,048,576	1,048,576	1,048,576	1,048,576	1,048,576
BUFFER STORAGE					
Cycle time, nanoseconds	80	80	80	80	54
Bytes fetched per cycle	4	4	4	4	8
Minimum capacity, bytes	8,192	32,768	8,192	32,768	32,768
Maximum capacity, bytes	16,384	32,768	16,384	32,768	32,768
PROCESSING UNIT					
Machine cycle time, nanoseconds	80	80	80	80	54
Relative performance level (estimated)	41.8	45.5	75.3	81.8	86.4
Processing unit features:					
Control storage, bytes	Not spec'd.	Not spec'd.	Not spec'd.	Not spec'd.	Not spec'd.
Clock Comparator & CPU Timer	Standard	Standard	Standard	Standard	No
Direct Control	Standfard	Standard	Standard	Standard	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard	No
Floating Point	Standard	Standard	Standard	Standard	Standard
Extended Precision Floating Point	Standard	Standard	Standard	Standard	Standard
High-Speed Multiply	Optional	Optional	Optional	Optional	Standard
3880 Storage Control for 3330/3333, 3340/3344, and 3350	Optional	Optional	Optional	Optional	No
Integrated 2319 Disk Control	No	No	No	No	No
Integrated 3330 Disk Control	Optional	Optional	Optional	Optional	No
Integrated 3340/3344 Disk Control	Optional	Optional	Optional	Optional	No
Integrated 3350 Disk Control	Optional	Optional	Optional	Optional	No
Integrated 1403 Printer Control	No	No	No	No	No
Integrated 3203 Printer	No	No	No	No	No
Integrated 5203 Printer	No	No	No	No	No
Integrated Card I/O	No	No	No	No	No
Integrated Communications Control	No	No	No	No	No
Compatibility features:					
IBM 1401/1440/1460 Compatibility	No	No	No	No	No
IBM 1410/7010 Compatibility	No	No	No	No	No
IBM 7070/7074 Compatibility	Optional	Optional	Optional	Optional	No
IBM 7080 Compatibility	Optional	Optional	Optional	Optional	No
IBM 709/7090/7094 Compatibility	Optional	Optional	Optional	Optional	No
IBM 360/20 Compatibility	No	No	No	No	No
OS/DOS Compatibility	No	No	No	No	No
IBM 1052 & 2311 Compatibility	No	No	No	No	No
CHANNELS					
No. of Selector Channels per system	0 to 6	0 to 6	0 to 12	0 to 12	0 to 6
No. of Block Multiplexer Channels	0 to 11	0 to 11	0 to 22	0 to 22	0 to 13
No. of Byte Multiplexer Channels	0 to 2	0 to 2	0 to 4	0 to 4	0 to 2
Maximum total I/O data rate, bytes/second	16,000,000	16,000,000	28,000,000	28,000,000	3,000,000

IBM System/370

▷ Additional information on the System/370 can be found in the Characteristics Section of this report. Also, a summary of the characteristics in chart form appears on the second through the fifth pages of this report.

Models 138 and 148, introduced in June 1976, offered increases in internal performance of approximately 28 to 43 percent over their respective predecessors, the 370/135 and 370/145, at prices much lower than those of the Model 135 and 145 mainframes—about 45 percent less for purchasing and some 22 percent less for rental. Both systems employ MOSFET main memories and control storage instead of the bipolar memories used in the 370/135 and 145. The reloadable control store in both the 138 and 148 is 128K bytes—five times the capacity of the 370/135 and four times that of the 370/145.

The Model 138 is offered with either 524K or one million bytes of main memory, 128K bytes of reloadable control store, a 1920-character display console, one byte multiplexer channel, one block multiplexer channel, extended control-program support, and VS APL performance assists. IBM claims the Model 138 offers approximately a 29 to 36 percent internal performance increase over the System/370 Model 135.

The standard Model 148 configuration consists of either one or two million bytes of main memory, 128K bytes of control store, a display console, one byte multiplexer channel, four block multiplexer channels, a word buffer, extended control-program support, and VS APL performance assists. The 148 is estimated to yield a 28 to 43 percent internal performance improvement over the System/370 Model 145.

The System/370 Models 138 and 148 both have a 1920-character input/output display console and keyboard for operator communications. The CRT can accommodate 24 80-character lines of information. In addition, two printers, the 3286-2 and 3287, may be added for hardcopy output. The 3286 is a 66-cps unit that provides storage for up to 1920 characters. The 3287 features bi-directional printing at speeds of 80 cps (Model 1) or 120 cps (Model 2).

Both the 138 and 148 also provide native attachment capability for one or two 3203 Model 4 Printers. The 3203-4 is a stand-alone version of the 1200-lpm 3200 Model 2 printer used with System/370 Models 115 and 125.

All I/O units that can be attached to a System/370 Model 135 are also available on the Model 138 with the exception of the 3210 and 3215 console printer-keyboards. Attachment of the 2319 disk storage units is available only as part of a 2314 Series B Direct Access Storage Facility. Similarly, all I/O units that can be attached to a System/370 Model 145 are also available on the Model 148 with the exception of the 3210 and 3215 console printer-keyboards.

Extended control-program support is a hardware assist that reduces the CPU time needed to execute certain ▷

▶ 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: See table.

CAPACITY: See table and price list for main storage and reloadable control storage capacities.

CYCLE TIME: See table. For Models 158 through 168-3, the effective main storage speeds are considerably higher than the figures would seem to indicate because of the semiconductor buffer storage (see table), which greatly reduces the number of main storage references required in most applications.

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

STORAGE PROTECTION: The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard in all models.

CENTRAL PROCESSORS

INDEX REGISTERS: Sixteen 32-bit general registers, used for indexing, base addressing, and as accumulators, plus four 64-bit floating-point registers.

INDIRECT ADDRESSING: None.

INSTRUCTION REPERTOIRE: The basic System/370 instruction set consists of all of the instructions that comprise the System/360 "commercial instruction set" (i.e., the standard System/360 set plus the decimal arithmetic instructions), together with from 13 to 27 new instructions.

The basic System/370 instruction set includes complete arithmetic facilities for processing variable-length decimal and fixed-point binary operands, as well as instructions which handle loading, storing, comparing, branching, shifting, editing, radix conversion, code translation, logical operations, packing and unpacking. In addition, a group of "privileged instructions," usable only by the operating system, handle input/output and various hardware control functions. Floating-point arithmetic instructions are standard in Models 138, 148, and the larger models (see table).

The 13 non-System/370 instructions in all System/370 processors are:

Compare Logical Characters Under Mask (CLM)
Compare Logical Long (CLCL)
Halt Device ▶

IBM System/370

▷ frequently used supervisor functions in both VM/370 and OS/VS1. This feature can reduce the amount of VM/370 supervisor-state time by up to 55 percent. A reduction of 13 to 18 percent in OS/VS1 supervisor-state time was measured on a Model 138, and a 9 to 20 percent savings was realized on a Model 148.

Both the Model 138 and Model 148 also provide an APL assist. This feature is, in effect, an APL emulator that replaces functions performed by the APL software interpreter to provide improved performance for applications when running in conjunction with the VS APL Program Product.

HARDWARE FEATURES

The System/370 processing units share many significant characteristics with the earlier System/360 processors (Models 25 and above). Reflecting their "all-purpose" design philosophy, they have a large, complex instruction set. They can perform fixed-point arithmetic in either fixed-length binary or variable-length decimal modes, and floating-point arithmetic on operands of three different sizes. In addition, they can perform radix conversions, code translations, and conversions between the packed (2 digits per byte) and unpacked (1 digit per byte) data formats. They have a comprehensive interrupt system that enables them to respond to a variety of special conditions, both internal and external. They have sixteen 32-bit general registers that can serve as accumulators, index registers, or base address registers, as well as four 64-bit floating-point registers. And finally, when operating in the System/360-style Basic control mode, they use a base-plus-displacement addressing scheme that permits direct addressing of up to 16 million bytes of core storage.

The System/370 adds from 13 to 27 new instructions to the System/360's already large instruction set. Thirteen of the new instructions help reduce execution time and program storage requirements by enhancing decimal arithmetic performance, eliminating the need for multiple "move" instructions, and facilitating the blocking and unblocking of records. System/370 processors with virtual storage also include five additional instructions that facilitate control of the Dynamic Address Translation facility. As many as nine more instructions are available for certain processor models to aid in implementing OS/VS2 Release 2 and above, VTAM, and/or multiprocessing.

PERIPHERAL EQUIPMENT

IBM developed a number of noteworthy mass storage and input/output units primarily for use with the System/370 which offered signficant improvements in performance and economy. One of the first examples was the high-performance 3330 Disk Storage Facility. This was followed by the double-density 3330 Model 11, and then by the 3340 Direct Access Storage Facility that incorporated both fixed and moving heads and a new removable sealed cartridge which incorporates the disks, access arms, read/write heads, and spindle. ▷

► Insert Characters under Mask (ICM)
Load Control (LCTL)
Move Long (MVCL)
Set Clock (SCK)
Shift and Round Decimal (SRP)
Store Channel ID (STIDC)
Store Characters under Mask (STCM)
Store Clock (TCK)
Store CPU ID (STIDP)
Store Control (STCTL)

These new instructions facilitate programming and reduce execution times for record blocking and unblocking, long move and compare operations, decimal arithmetic, and various hardware control functions.

In addition, all models with virtual storage capabilities have five instructions for Dynamic Address Translation:

Load Read Address
Reset Reference Bit
Purge Translation Look-Aside Buffer
Store Then ADD System Mask
Store Then OR System Mask

INSTRUCTION TIMES: Average execution times, in microseconds, for some representative instructions are as follows:

	115	125	138	148	168-3
Add (32-bit binary)	14.5	9.7	2.6	1.7	0.33
Multiply (32-bit binary)	189.9	143.4	25.2	16.0	0.66
Divide (32-bit binary)	210.3	245.5	40.9	31.1	3.28
Load (32-bit binary)	11.3	7.7	2.2	1.1	0.19
Store (32-bit binary)	11.8	82.0	2.2	1.2	0.21
Add (6-digit packed decimal)	107.6	47.8	36.2	8.2	1.17
Compare (6-digit packed decimal)	92.3	46.3	26.8	7.3	1.05
Add (short floating-point)	51.6	53.0	11.1	5.7	0.80
Multiply (short floating-point)	168.9	190.7	23.5	15.5	0.70
Divide (short floating-point)	231.5	231.0	31.8	25.7	2.95
Add (long floating-point)	64.8	66.9	10.0	7.1	0.83
Multiply (long floating-point)	472.5	565.8	28.4	38.5	1.29
Divide (long floating-point)	713.8	641.6	75.8	80.4	7.73

Instruction timings for the Model 168-3 were derived by scaling the times given for the no-longer-available Model 158-1. All floating-point instructions are data-dependent and may vary substantially from the average timings given. No allowance has been made for CPU degradation due to channel interference.

RELOADABLE CONTROL STORAGE: All System/370 central processor operations are controlled by micro-programming. In the Model 115 and 125, the microprograms for the Machine Instruction Processor (MIP) or Instruction Processing Unit (IPU), Service Processor (SVP), and Input/Output Processor (IOP) reside in discrete MOSFET Reloadable Control Storage (RCS) areas, which are separate from main storage. The microprograms are loaded into RCS by means of a small read/write disk drive, the Console File, which contains a removable magnetic "diskette." IBM supplies prewritten diskettes containing all the control microprograms and Field Engineering diagnostics required for a specific installation. ►

IBM System/370

▷ Other devices included the 3344 Direct Access Storage (which is equivalent to four 3340 Direct Access Storage drives), the ultra-large capacity 3850 Mass Storage System, the 3350 Direct Access Storage Facility (a large-capacity, fixed-disk replacement for the 3330 Disk Storage Facility), the 2,000-lpm 3211 Printer, the super-fast 3800 Printing Subsystem, the low-priced 3411 Magnetic Tape Subsystem, the highly cost-effective 3420 Magnetic Tape Units (including models that record at 6250 bytes per inch), the 96-column 2596 Card Read Punch, the 3881 Optical Mark Reader, the 3886 Optical Character Reader, the 3890 MICR Document Processor, and the 3505 Card Reader and 3525 Card Punch, which share a micropro-grammed control unit. Available only with the Model 115, 155-2, 125, 125-2, 138, and 148 systems was the 3203 printer, an improved replacement for the 1403 N1 Printer.

COMMUNICATIONS

In March 1972, IBM unveiled the 3705 Communications Controller, a minicomputer-based "front-end" processor that contains from 16K to 240K bytes of core storage and can control up to 352 communications lines. In February 1973, IBM added the smaller, program-compatible 3704, which handles up to 32 lines. In November 1975, IBM unveiled the 3705-II, an enhanced version that features MOS memory and improved performance at a lower cost than the original 3705.

When connected to a System/370 computer, the 3704 and 3705 can use either the Network Control Program (NCP) or the 2701/2/3 Emulation Program. When the NCP is used, the 3704 or 3705 relieves the central processor of many routine tasks such as line control, character and block checking, character buffering, polling, and error recovery.

Virtually the entire complement of IBM communications terminals can be connected to a System/370—as can literally hundreds of terminals from independent suppliers.

In September 1974, IBM announced its Advanced Function for Communications through Systems Network Architecture (SNA). This facility has become the foundation for developments in IBM's data communica-tions product line. The approach includes a single communications access method, the Virtual Telecom-munications Access Method (VTAM); a single, standardized line discipline, Synchronous Data Link Control (SDLC); a Network Control Program, operating on the IBM 3704 or 3705 Front-End Communications Controller in conjunction with VTAM to control the network; and a family of compatible terminals, such as the 3767 Communication System, the 3770 Data Communi-cation System, and models of the widely used 3270 Information Display System equipped to handle SDLC transmission. Also included in the System Network Architecture are the special-purpose IBM 3600 Banking System, the 3650 Retail System, the 3660 Supermarket System, and the 3790 Programmable Terminal, as well as ▷

▶ The basic Machine Instruction Processor (MIP) micro-program for the Model 115 and Model 115-2 resides in 20K 22-bit words of RCS. One or two additional 4,096-word increments may be added to support optional features such as System/360 Model 20 compatibility, 1401/1440/1460 compatibility, floating-point, or extended precision floating-point.

The basic IPU microprogram for the Model 125 and Model 125-2 resides in 12,288 22-bit words of RCS, and one or two additional 4,096-word increments may be added to support optional IPU features, such as the options for the 115, plus 2311 Model 2 compatibility.

In the Model 138, 148, and 158-3 Processing Units, the microprograms reside in a semiconductor memory unit also called Reloadable Control Storage (RCS) and are also loaded into RCS by means of a small read-only disk unit called the Console File.

Models 135-3, 138, 145-3, and 148 each have 131,072 bytes of RCS with expansion capabilities.

The control storage for a Model 168 or 168-3 consists of 2K 108-bit control words written in read-only storage (ROS) and 512 words of RCS. The IBM 7070/7074, 7080, or 7090/7094 compatibility feature adds 1024 additional control words to the RCS. The RCS is loaded from a console file or under microprogrammed control.

DYNAMIC ADDRESS TRANSLATION: This facility is the mechanism that translates the virtual storage addresses contained in instructions into real main storage addresses as each instruction is executed. All virtual models can address a virtual storage space of 16,777,216 bytes. A two-level address translation process divides the virtual storage space into segments of either 65,536 or 1,048,576 bytes, which are in turn divided into pages of either 2,048 or 4,096 bytes, depending upon the operating system.

OPERATIONAL MODES: All models can operate in either the Basic Control (BC) or Extended Control (EC) mode. The BC mode maintains general upward compatibility with the System/360 architecture and programming. In the EC mode, the Program Status Word (PSW) and the layout of the permanently assigned lower main storage areas are altered to support Dynamic Address Translation and other new system control functions; therefore, the virtual-storage-oriented operating systems must be used.

OPTIONAL FEATURES: The table on pages 70C-491-04b through -04e indicates which of the following features are standard or optional in each of the processor models.

The Clock Comparator and CPU Timer feature provides expanded system timing facilities. The Clock Comparator provides a means for causing an interrupt when the standard Time-of-Day Clock reaches a program-specified value. The CPU Timer is a binary counter that is decremented every microsecond and causes an interrupt when its value reaches zero. Additional instructions are provided to set and store both the Clock Comparator and the CPU Timer.

The Floating-Point Arithmetic feature, a no-cost option, provides instructions to perform floating-point arithmetic operations on both short (1-word) and long (2-word) operands.

The Extended Precision Floating-Point feature provides 7 instructions for performing floating-point arithmetic on 4-word (16-byte) operands that provide a precision of up to 28 hexadecimal or 34 decimal digits. The Floating-Point Arithmetic feature is a prerequisite. ▶

IBM System/370

the IBM 8100 series of smaller processors, and the System/32, System/34, and System/38 small business computer systems.

SOFTWARE

Users of the virtual-storage System/370 processors can choose from three operating systems: DOS/VS, OS/VS1, and OS/VS2. Another operating system, VM/370, manages the real resources of a System/370, including CPU time, to create and control multiple concurrent virtual machines by permitting the use of multiple operating systems.

DOS/VS is an upward extension of DOS that supports virtual storage, permits up to seven jobs to be processed simultaneously, includes a relocating loader, and features the POWER spooling facility as a built-in function. Although DOS/VS can theoretically support up to 16 million bytes of virtual storage, most installations will get better overall results by choosing to work within a far smaller virtual storage size. And, although DOS/VS provides automatic management of main storage allocation, it requires the user to divide the virtual storage space into a maximum of seven fixed partitions and predetermine the programs to be executed in each partition. DOS/VS also provides two access methods— Virtual Sequential Access Method (VSAM) and Virtual Telecommunications Access Method (VTAM).

The Operating System/Virtual Storage (OS/VS1) or VS1 is an extension of OS/MFT that supports virtual storage. VS1 is divided into two main areas: the Control Program area and the Problem Program area. The Problem Program area is divided into fixed partitions (with a maximum of 15 partitions) at 64K bytes or multiples of 64K bytes with a maximum of 52 partitions. The real storage in OS/VS1 is managed by the operating system in blocks of 2K bytes called pages. The Page Supervisor is responsible for allocating and deallocating pages in real storage and for initiating page-in and page-out operations between auxiliary storage and processor storage.

The Operating System/Virtual Storage 2 (OS/VS2) or VS2 is an improved version of OS/MVT which provides support of a full 16 million bytes of virtual storage. VS2 handles up to 63 protected batch user regions on 42 TSO user regions (compared with a maximum of 15 regions for MVT). Virtual storage is organized in pages of 4K blocks. TSO user regions are paged. The real storage utilization for TSO reflects actual requirements for program execution compared to the fixed MVT time-shared region.

An important distinction was made with the introduction of OS/VS2 Release 2. OS/VS2 was effectively divided into two operating systems and will be maintained as such. OS/VS2 versions prior to Release 2 are now known as OS/VS2 Single Virtual Systems, or SVS, while OS/VS2 Release 2 and above are now known as OS/VS2 Multiple Virtual Systems, or MVS.

The Direct Control Feature provides two additional instructions plus six external interrupt lines which are independent of the normal data channels, plus two instructions which provide for single-byte data transfers between an external device and main storage. (The External Signals feature provides only the six interrupts for Models 115, 115-2, 125, and 125-2.)

High-Speed Multiply is available only on the Model 168 and 168-3. It reduces the time required for long-precision floating-point and fixed-point multiple instructions. For Model 165, the times are reduced from 1.87 to 0.61 microseconds and from 0.78 to 0.42 microseconds, respectively.

The Channel-to-Channel Adapter permits direct communication between two System/370 processors via their standard I/O channels. The adapter occupies one control unit position on each of the two channels it interconnects.

Other processor options are described in the following sections on Compatibility Features, Input/Ouput Control, and Communications Control.

COMPATIBILITY FEATURES: The System/370 processors can be equipped with extra-cost compatibility features and associated emulator routines that enable them to execute programs written for earlier IBM computers, as listed in the table. In general, their use requires a System/370 with I/O devices equivalent to those of the system to be emulated (plus the devices required by the operating system), and with more core storage capacity and processing power. Only the more common peripheral devices can be emulated.

The OS/DOS Compatibility Feature facilitates DOS-to-OS conversions by making it possible to run DOS programs under control of the Operating System/360 (MFT or MVT). The DOS Emulator runs as a problem program under OS control. It can be multiprogrammed with other OS jobs, and it in turn can use the multiprogramming options of DOS. The DOS Emulator Program, the DOS Supervisor, and up to three DOS processing-program partitions are all executed in a single MFT partition or MVT region of at least 38K bytes; the DOS Emulator Program alone requires 22K to 26K bytes of main storage.

The 1401/1440/1460, 1410/7010 Compatibility Feature is a field-installable option that provides the capability to emulate IBM 1410 and 7010 programs in addition to all the facilities of the 1401/1440/1460 Compatibility Feature. The associated emulator routines require a minimum of 28K bytes of main storage under DOS and 22.5K bytes under OS.

The 7070/7074 Compatibility Feature is an option that provides the capability to execute programs written for an IBM 7070 or 7074 system.

An integrated emulator for IBM 7074 programs, which requires the 7070/7074 Compatibility Feature on a Model 158 CPU, is also available. It operates under OS or OS/VS to provide concurrent emulation with multiprogramming, tape formatting programs for conversions between 7074 and OS spanned variable-length record formats, and placement of 7074 and other jobs in a single job-stream.

The 7080 Compatibility Feature provides the capability to execute, under OS control, programs written for an IBM 7080 system.

The 709/7090/7094 Compatibility Feature provides the capability to execute, under OS control, programs written for an IBM 709, 7090, 7094, or 7094 II system.

The System/360 Model 20 Compatibility Feature enables a Model 125 or 125-2 to execute, under DOS control, programs written for a System/360 Model 20 card, tape, or disk system.

IBM System/370

▷ The SVS supervisor is responsible for interrupt handling, task dispatching, task supervision, contents supervision, timer supervision, storage supervision, I/O supervision, page supervision and main storage supervision. The MVS supervisor provides the same function as SVS supervisor plus resource management, multiprocessing, multiple address space supervision, service and recovery management.

The current release of OS/VS2 (MVS) now stands at Release 3.8. Instead of introducing new releases of a particular software package with several enhancements and new features, IBM will now make available various selectable units, thereby giving users the option of whether or not to take advantage of new developments as their needs dictate. Selectable units can be applied only to OS/VS2, Release 3.7 and above. This is the last "release" of this operating system due to IBM's recent introduction of the selectable unit. Selectable units are small microcode packages that add new features or enhance existing software systems. For more details on VS2 refer to the Characteristics Section.

The Virtual Machine Facility/370 is a system control program (SCP) that manages a computing system's resources (CPU, storage, and input/output devices) so that all are available to many users at the same time. Each user has at his disposal the functional equivalent of a real, dedicated computing system.

VM/370 is designed for use on System/370 models which have the Dynamic Address Translation feature and Extended Control Mode option. The operating systems that can run in VM/370 virtual machines include Batch or Single User Interactive, DOS, DOS/VS, OS/MFT, OS/MVT, OS/VS1, OS/VS2 and OS-ASP, as well as the multiple-access APL/DOS-360 and the Conversational Monitor System (CMS). CMS is virtual storage-based and provides a general-purpose time-sharing capability. CMS supports the BASIC, ANS COBOL, FORTRAN IV and PL/1 languages.

VM/System Product (VM/SP), an enhancement of VM/370 Release 6, extends VM/370 and is the base for several program products. VS/SP is a licensed program and it is anticipated that any future enhancement to VM/370 will be made in VM/SP. For more information see the Characteristics Section.

COMPATIBILITY

Designed as an evolutionary outgrowth of the System/360, the System/370 offers a high degree of program and data compatibility with the earlier IBM computer line. The hardware features of the System/370 represent extensions, rather than modifications, of the System/360. As a result, System/360 users can run their application programs on a System/370 in the Basic Control mode with little or no modification and, in most cases, without recompilation. Conversely, it is not possible to directly execute System/370 programs on a System/360 if they make use ▷

▶ The 1052 and 2311 Model 1 Compatibility Features are no-charge options that make it possible to use DOS, Version 3 or 4, on the Model 125 or 125-2. The 1052 Compatibility Feature (required for both Versions 3 and 4) permits emulation of the 1052 Printer-Keyboard by the 5213 Console Printer and the Model 125's standard console keyboard. The 2311 Model 1 Compatibility Feature (required for DOS Version 3 only) permits emulation of 2311 Model 1 disk files on 3333/3330 disk files connected to the Model 125. A single 3336 Disk Pack can hold the contents of up to eleven 1316 Packs.

The 1052 Compatibility Feature also is available at no charge for the Model 115 or 115-2. It permits the 5213 Console Printer and the Model 115 standard console keyboard to emulate a System/360 Model 1052 Printer-Keyboard. The 1052 Compatibility Feature, combined with the prerequisite 5213 Model 1 Console Printer, allows the Model 115 to operate as a remote job entry work system communicating with a host processor operating under HASP, ASP, and their virtual-storage remote job entry successors, Job Entry Subsystem 2 or 3 (JES2 or JES3) and Job Entry Subsystem/Remote Entry Services (JES/RES).

CONSOLE INPUT/OUTPUT: A keyboard/display operator console is an integral part of the Model 115, 115-2, 125, and 125-2 Processing Units. The console contains a typewriter-style keyboard, a CRT display, a complement of switches and lights, the Service Processor, and the Console File that loads the system's microprograms. A 5213 Printer, Model 1, can be connected to the Model 115 or 125 console via the Integrated 5213 Printer Attachment.

Models 138 and 148 use a display console consisting of a 1920-character CRT display and keyboard, with provisions for attaching a 3286 Model 2 Printer for hard-copy output. Both systems have three console modes; Printer-Keyboard Mode, Display Mode, and 115-125 Console-Display-Emulation Mode.

Printer-Keyboard Mode uses the keyboard for input and the CRT display for output. A 3286 Printer is recommended for this mode, but not required. The CRT, keyboard, and printer appear to the system as a 3215 Console Printer-Keyboard. This mode is supported by DOS, DOS/VS, OS/360, OS/VS, and VM/370.

Display Mode also uses the keyboard for input and the CRT display for output. The optional 3286 Model 2 Printer has a separate address and requires MCS support or equivalent. The printer appears to the Model 138 or 148 system as a 3213 Console Printer. Display mode is not supported by DOS/VS.

In 115/125 Console-Display-Emulation Mode, the keyboard and CRT display are used for input and output as in the other two modes. However, the CRT can display only 12 lines of 56 characters. When the 3286 Printer is employed, it emulates a 5213 Model 1 Printer and acts as a slave to the display console. For DOS/VS systems, the operating software must be Release 28 or greater.

Models 158 and 158-3 use an operator display console, which is supplied along with the Processing Unit as standard equipment. It contains a CRT display, keyboard, light pen, two Console Files, and microcode control storage. A standalone 3213 Printer, rated at 85 characters per second, can be added as an optional hard-copy output unit.

Every Model 168 and 168-3 system requires a 3066 System Console, which provides a CRT display with 4K buffer, an alphanumeric keyboard, a microfiche maintenance display to facilitate servicing, and a device for reading microprograms from a magnetic disk cartridge into writable control storage.

In addition to these standard console I/O units, other devices such as displays, card readers, punches, and printers can be used to provide additional console functions. ▶

IBM System/370

▷ of the System/370's new instructions or other new hardware features—but this type of downward compatibility is of far less importance to most users.

Integrated emulation is an optional System/370 capability that permits direct execution of most programs written for IBM's second-generation 1400 and 7000 Series computers. The table beginning on page 70C-491-04b shows which compatibility features are available for each of the System/370 processor models. These compatibility options run under control of the regular operating system, enabling emulator jobs to be processed as part of a multiprogramming mix.

The swing from the System/360 to System/370 was marked by a noteworthy *lack* of conversion problems, and the conversions from the System/370 to the 303X Series processors have been just as smooth.

USER REACTION

Datapro's 1981 survey of general-purpose computer users yielded 469 responses from System/370 users who collectively owned, rented, or leased 533 separate computer systems. The characteristics of the user population and composite of the ratings expressed by these users are presented in the following paragraphs and tables.

The system population was distributed as follows:

Model 115	9 systems
Model 125	20 systems
Model 135	47 systems
Model 138	100 systems
Model 145	41 systems
Model 148	80 systems
Model 155	22 systems
Model 158	141 systems
Model 168	73 systems

The weighted averages of the ratings supplied by these System/370 users in 14 important performance categories are presented in the "Users' Ratings" table or each processor model represented in the survey population.

About 44 percent of the systems were leased from a third party, 44 percent were purchased, and 9 percent were rented or leased from IBM. The systems were installed an average of 40 months.

The principal applications being run on the System/370 were accounting and payroll/personnel, with order processing/inventory control a close third. Manufacturing, purchasing, and sales distribution were practically a tie for fourth place. Just about everyone developed applications in-house, better than half bought proprietary packages, and about one-third used either IBM's software or had the packages developed by contract programmers. Data base management systems appeared more frequently in the larger System/370 models, with better than 80 ▷

▶ **INPUT/OUTPUT CONTROL**
(MODELS 115 to 125-2)

In place of conventional I/O channels, these models use internal Input/Output Processors (IOPs) to control I/O operations. Each IOP is implemented through microprograms in a discrete Reloadable Control Storage area and can access main storage independently. Thus, attached I/O devices can operate concurrently with devices attached to other IOPs and with internal computing. The number of IOPs depends upon the configuration and features of each installation.

A 3340 Direct Access Storage Facility with two to four (eight for the 115-2 and 125; 16 for the 125-2) disk drives can be connected directly to a Model 115 Processing Unit. A 4K DASF Control Storage Extension is required for configuring more than eight disk spindles on a Model 125-2 and is mutually exclusive with the 1403/3202 Carriage Control and any feature combination requiring the 8K Control Storage Extension. From two to four 3330 Series Disk Drives can be directly connected to a Model 125 Processing Unit. Optional integrated attachment features permit direct connection of any of the following I/O devices; no separate control units or I/O channels are required:

2560 Multi-Function Card machine (80-column)
5425 Multi-Function Card Unit (96-column)
3203 Printer, Model 1 (600 lpm) or Model 2 (1200 lpm)
5203 Printer, Model 3 (300 lpm) for Models 115 and 115-2
5213 Console Printer (85 char/sec)
3410/3411 Magnetic Tape Subsystem, Model 1 (20 KBS),
  Model 2 (40 KBS), or Model 3 (80 KBS)
3420 Magnetic Tape Subsystem, Model 3 (120 KBS) or
  Model 5 (200 KBS)
3504 Card Reader for Models 125 and 125-2
3525 Card Punch for Models 125 and 125-2
1403 Printer Models 2, 7, or N1 for Models 125 and 125-2.

The optional Byte Multiplexer Channel permits a wide variety of low-speed I/O devices to be connected to a Model 115. This channel is implemented by a microprogrammed IOP and is functionally similar to the Byte Multiplexer Channels in other System/360 and /370 models. It has 8 control unit positions and 32 subchannels. Eight of the subchannels can be shared (i.e., assigned to an I/O control unit that has up to 16 devices attached). The Byte Multiplexer Channel is designed to operate primarily in the byte-interleaved mode, which allows multiple low-speed devices on separate subchannels to operate concurrently. It can also operate in burst mode, which allows only one I/O operation at a time, but burst-mode operation of unbuffered devices is not recommended. The maximum I/O data rate for the Byte Multiplexer Channel is 19,000 bytes (115) or 25,000 bytes (115-2, 125, or 125-2) per second in byte-interleaved mode and 29,000 bytes per second in burst mode. No Block Multiplexer Channels or Selector Channels are available for Models 115, 115-2, 125, or 125-2.

INPUT/OUTPUT CONTROL
(MODELS 138 to 168-3)

I/O CHANNELS: The System/370 employs three distinct types of I/O channels in Models 138 and above:

• **Byte Multiplexer Channels** have a single data path that can be shared by a number of simultaneously operating low-to-medium-speed I/O devices (in "multiplex mode") or monopolized by a single faster device (in "burst mode"). In either case, one byte of data at a time is transferred between main storage and an I/O device. These channels are functionally compatible with the System/360 Multiplexer Channels. ▶

IBM System/370

USERS' RATINGS IN TERMS OF WEIGHTED AVERAGES

	Ease of Operation	Reliability of Mainframe	Reliability of Peripherals	Responsiveness	Effectiveness	Trouble-Shooting	Education	Documentation	Operating Systems	Compilers and Assemblers	Applications Programs	Ease of Programming	Ease of Conversion	Overall Satisfaction
Model 115	3.33	3.56	3.13	3.22	3.11	2.89	2.78	2.44	3.25	3.56	3.00	3.33	3.22	3.33
Model 125	2.95	3.50	3.30	2.95	2.79	2.55	2.85	2.75	2.90	3.15	2.71	2.80	2.65	3.10
Model 135	3.05	3.44	3.21	2.98	2.95	2.52	2.60	2.55	2.95	3.07	2.53	2.90	2.76	2.98
Model 138	3.21	3.68	3.26	3.23	3.19	2.91	2.86	2.74	3.05	3.18	2.87	2.97	2.89	3.09
Model 145	3.08	3.21	3.03	3.14	2.81	2.35	2.61	2.53	2.95	3.11	2.85	2.86	2.86	2.86
Model 148	3.25	3.53	3.20	3.20	3.15	2.56	2.58	2.55	2.99	3.09	2.65	2.83	2.82	3.11
Model 155	3.11	2.70	2.89	3.05	2.86	2.70	2.90	2.90	2.95	3.10	2.85	2.86	2.89	3.05
Model 158	3.10	3.40	3.20	3.26	3.20	2.90	2.88	2.86	3.06	3.15	2.81	2.91	2.94	3.13
Model 168	3.00	3.33	3.17	3.22	3.16	2.86	2.89	2.84	3.14	3.20	2.76	2.91	2.89	3.04

Basis for computing Weighted Average is 4 for each user rating of Excellent, 3 for Good, 2 for Fair, and 1 for Poor.

percent of 370/168 users running a DBMS. At least three-fourths were using a communications monitor, with IBM the most frequently mentioned supplier.

Of the respondents, 41 percent indicated they plan to replace their present system in 1981 with another IBM model. Less than one percent indicated they plan to replace their present system with a different manufacturer's computer system. Better than 53 percent said they had no plans to replace their System/370 in 1981.

Of the users planning to acquire or implement additional software in 1981, about 46 percent said they intended to acquire additional software from IBM and better than half said they planned to acquire proprietary software from other suppliers.

Slightly less than half the users surveyed plan to expand their data communications facilities, only about 15 percent anticipate increasing their distributed processing facilities, and less than 10 percent plan on implementing integrated word processing capabilities.

The users were asked if their System/370s lived up to their expectations. Better than 90 percent said "yes." When asked if they would recommend their present system to another user in their same situation, three out of four answered they would recommend their system, thirteen percent said they would not, and less than ten percent hadn't decided.

From a list of ten possible advantages to the system, the users were asked to check any or all significant ones. This list is presented in the order of relative importance to users.

1) Program/data carried over from other systems are compatible as vendor promised.

2) Terminals/peripherals carried over from other systems are compatible as vendor promised.

3) Users are happy with response time.

- Selector Channels permit high-speed data transfer operations by one peripheral device at a time. The channel remains busy throughout the time a channel program is in operation, even when no data is being transferred.

- Block Multiplexer Channels provide a single data path that can be shared by a number of high-speed peripheral devices which transfer data alternately in burst-mode fashion. While the channel is interleaving blocks of data to and from various devices, it can also control non-data transfer functions on other devices. These channels can also operate in Selector Channel mode, in which case they are functionally compatible with the System/360 Selector Channels.

The I/O channels are an integral part of the processing unit in Models 138 through 158, whereas Model 168 uses the separately packaged 2860 Selector Channels, 2870 Byte Multiplexer Channels, and/or 2880 Block Multiplexer Channels.

The Model 138 has one byte multiplexer channel, with 64 subchannels. The byte multiplexer channel can be expanded to 256 subchannels at no additional cost. The 138 does not have selector channels as such. Instead, it can have up to two block multiplexer channels. Devices that cannot use the block multiplexer capabilities will function as if attached to a selector channel.

Model 148 has channel configurations similar to those of the Model 138. Each has one byte multiplexer channel with 64 subchannels, which can be expanded to 256 subchannels at no extra cost. Both systems feature from one to four block multiplexer channels. These block multiplexer channels in the Model 148 differ slightly from those used in the Model 138 by permitting expansion up to 512 subchannels. The basic block multiplexer channel is supplied with 64 subchannels and can be expanded in groups of 16 at no extra charge. For the Model 148, four block multiplexer channels are standard and no expansion is possible. A word buffer is also standard.

The Model 158 Processing Unit includes one byte multiplexer channel and two block multiplexer channels as shared equipment. Up to three more block multiplexer channels and a second byte multiplexer channel (which take the place of one of the block multiplexer channels) are optional. (Selector channels are not used with the Model 158.) Each byte multiplexer channel provides 256 nonshared subchannels or 8 shared and 120 nonshared subchannels. Each block multiplexer channel provides 16 shared and 480 nonshared subchannels, and can accommodate data rates of over 1.5 million bytes per second.

IBM System/370

▷ 4) System is easy to expand/reconfigure.

5) Productivity aids help us keep programming cost down.

6) Database language is efficient and effective.

7) System costs were less than expected.

8) Delivery and/or installation of equipment was ahead of schedule.

9) System is power/energy efficient.

10) Delivery of required software was ahead of schedule.

The users were also requested to indicate problems they encountered with the system. The majority of users said they didn't have any problems. The three most frequently reported problem areas were excessive power and coding requirements (25%), vendor software/hardware enhancements hard to keep up with (18%), and excessive system costs (10%).

Datapro interviewed several System/370 users around the country for their comments. We first called on a mid-Atlantic manufacturing firm that just recently converted a 370/148 to a 4341 Model Group 1 and is in the process of converting a 370/145 to another 4341-1. Both 370s were very good, according to the company spokesman, but the 370/148 was "better by far" than the 145. Uptime on the 148 typically was better than 97 percent when running on-line. IBM service on both systems has been satisfactory. Although they have looked at plug-compatible mainframes, they were satisfied enough with IBM to remain an IBM shop.

We talked to another 148 user, a midwestern insurance firm, that is running batch, on-line, data collection, and batch update applications, and experiencing "99.9 percent" uptime, according to the firm's DP manager. Plans are underway for a substantial increase in data communications with various field organizations. While the system is quite good, IBM's service has been "spotty," owing in part to the fact they they lease their 148 from a third party. They are switching back to IBM for certain systems software, having had some negative experiences with proprietary packages.

A northeastern bank has a 370/158 MP configuration which has uptime of 98 percent or better. A number of applications are currently running on the MP, several of which were acquired outside of IBM. All are running smoothly on the system. IBM's maintenance has improved from the time of the survey, and they are holding off any major system changes at this time.

Our final call went to an eastern university that has a 370/168 MP configuration. The system runs both academic and administrative applications and generally ▷

▶ The Model 158-3 has an expanded subchannel capability on both byte and block multiplexer channels which permits 16 or 32 devices to be assigned to a shared subchannel. The total number of shared subchannels available for the Model 158-3 block multiplexer channel is 40, or 32 with a second byte multiplexer channel.

The optional Integrated Storage Control, available for the Model 158, 158-3, 168, or 168-3 Processing Unit, provides two separate data paths, each capable of accommodating up to 32 IBM 3330, 3340, or 3350 series disk drives.

A Model 168 or 168-3 system can include a maximum of six 2860 Selector Channels, two 2870 Byte Multiplexer Channels, and/or eleven 2880 Block Multiplexer Channels. The total number of I/O channels is limited to 7 in the basic system and 12 if the Extended Channels feature is installed.

Each 2860 Selector Channel handles one I/O operation at a time, at a data rate of up to 1.3 million bytes per second.

Each 2870 Byte Multiplexer Channel provides 192 subchannels. Optionally, selector subchannels can be added—up to 4 on the first 2870 in a system, and up to 2 on the second. Each selector subchannel can handle one I/O operation of up to 180,000 bytes per second at a time, concurrently with multiplexed I/O operations on the basic channel. The aggregate data rate for the basic multiplexer channel may not exceed 110,000 bytes per second, and the maximum total data rate for all operation on a 2870 Byte Multiplexer Channel is 670,000 bytes per second.

Each 2880 Block Multiplexer Channel provides up to 56 nonshared subchannels and one shared subchannel. Data is transferred in burst mode, to or from one device at a time, at up to 1.5 million bytes per second. The optional Two-Byte Interface permits a data rate of up to 3.0 million bytes per second.

CONFIGURATION RULES: In general, each System/370 channel can accommodate up to 8 peripheral control units and address as many as 256 devices. Most System/370 peripheral devices can be connected to any of the three types of channels. High-speed tape, disk, and drum units require either a Block Multiplexer or Selector Channel, and card readers, printers, and other low-speed devices are normally connected to a Byte Multiplexer Channel.

MULTIPROCESSING CONFIGURATIONS: A Model 158 MP (Multiprocessing) system consists of two 3158 MP Processing Units, a 3058 Multisystem Unit, and appropriate peripheral subsystems. Each of the two Processing Units in a system must have the same main storage capacity, which can range from 0.5 million to 4 million bytes per Processing Unit. The Model 158-3 can be configured with asymmetric storage capacities in combinations of 1, 2, 3, or 4 million bytes of main memory per processor. Each Processing Unit can have up to 6 I/O channels (5 Block Multiplexers and 1 Byte Multiplexer or 4 Block Multiplexers and 2 Byte Multiplexers). The 3058 Multisystem Unit interconnects the two Processing Units and houses a configuration control panel which the operator can use to reconfigure the system. Multiprocessor models of the Model 158 and Model 158-3 can be interconnected in multiprocessor configurations, although in this case asymmetric storage capacities are not supported. Model 158-3 MP Processing Units include an Alternate Power Down feature which allows a Processing Unit and its associated console and channels to be removed from operation and its main memory placed on-line to the remaining Processing Unit.

A Model 158 AP (Attached Processor) System consists of a Model 158 or Model 158-3 A-series central processor plus a Model 3052 Model 1 Attached Processing Unit and a 3056 Model 1 Remote Console. The 3052 APU is controlled by ▶

IBM System/370

▷ provides 90 percent or better uptime. It has heavy on-line usage, and although the school is in the process of increasing the number of terminals in use, the MP appears to have all the power they will need. IBM's service has been good, and the system has had few problems since installation. Keeping an eye to expenses, the school is presently holding off any major changes to the 168s other than in the area of peripheral equipment.□

▶ reloadable control storage and features a 115-nanosecond processing cycle and 16K bytes of high-speed buffer storage. Unlike the 3062 APU used in the Model 168 APS systems, the 3052 APU can execute all System/370 instructions, including Read Direct and Write Direct. It also has provisions for adding Extended Precision Floating-Point facilities. The unit also has dynamic address translation and can access 6,291,456 bytes of main storage on the host system. An integral storage control unit controls the shared-access environment between the host system and the APU. The 3052 also has provisions for the 1401/1440/1460, 1410/1470, and OS/DOS compatibility options. All system I/O functions are performed by the Model 158 host processor. Conversion to a Model 158 APS involves changing from a standard Model 158 processor to a Model 158 AP processor.

A model 168 MP (Multiprocessing) system consists of two 3168 MP Processing Units, a 3068 Multisystem Communication Unit, and appropriate peripheral subsystems. Each of the two Processing Units can have from 1 to 8 million bytes of main storage. The two Processing Units can have different storage capacities in a 168 MP system, but IBM recommends that the two systems be configured as symmetrically as possible for higher availability. Each Processing Unit can have up to 12 I/O channels, including a maximum of six 2860 Selector Channels, two 2870 Byte Multiplexer Channels, or eleven 2880 Block Multiplexer Channels. The 3068 Multisystem Communication Unit interconnects the two Processing Units and houses a configuration control panel which the operator can use to reconfigure the system. Multiprocessing features must be added to the 3066 Systems Console and the 3067 Power and Coolant Distribution Unit. Model 168 MP and Model 168-3 MP Processing Units can be interconnected in a multiprocessor configuration.

The Model 168-3 Attached Processor Sytems includes a Model 168-3 host central processor plus an additional Model 3062 Model 1 Attached Processing Unit and a Model 3067 Model 5 Power and Coolant Distribution Unit. The 3062 APU features an 80-nanosecond processing cycle, a 32K-byte high-speed buffer storage, and a Translation Lookaside Buffer, and has the capability to execute all System/370 instructions except those associated with the Direct Control facility. Also included in the APU are a storage control element for accessing up to 8 million bytes of system main memory and communications logic to control the shared accessing of main storage between the 168-3 central processor and the APU. All input/output operations are performed by the Model 168-3 central processor. Model 168-3 central processors can be field-upgraded to the Model 168 Attached Processor System, and Model 168 Attached Processor Systems can be intermixed with Model 168 single-processor and Model 168 MP systems in loosely-coupled configurations.

The 3838 Array Processor is an auxiliary processing unit for use with either a 370/158 or 370/168. The array processor performs high-speed vector arithmetic in parallel with the host processor. It is attached through a standard block multiplexer channel. Minimum system requirements include a 9-track, 1600-bpi magnetic tape subsystem plus MVS and selectable units for Scheduler, Supervisor 1, Supervisor 2, 3838 Vector Processing Subsystem Support (VPSS), Vector

Processing Subsystem and Job Entry Subsystem 2 (JES2) or Job Entry Subsystem 3 (JES3).

SIMULTANEOUS OPERATIONS: Concurrently with computing, a System/370 can control a maximum of one high-speed I/O data transfer operation per block multiplexer channel, one high-speed I/O operation per selector channel, one high-speed I/O operation on the Integrated File Adapter or Integrated Storage Control (if installed), 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. Maximum total I/O data rates for all channels are shown in the tables on the second through fifth pages of this report.

MASS STORAGE

A wide range of mass storage facilities are available for the System/370. Details on the 3330 Models 1, 2, and 11, 3340, and 3350 DASD systems can be found in Report 70C-491-06. Two older mass storage subsystems, the 2305 Fixed Head Storage and the 3850 Mass Storage System, are detailed in this report.

2305 FIXED-HEAD STORAGE: Provides fast access to comparatively small quantitites of information. Fixed-head storage is no longer marketed by IBM. Each 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. This storage control is no longer marketed by IBM. A Two-Channel Switch can optionally be added to the 2835.

The 2305 Model 1, usable only with Models 168 and above, stores up to 5.4 million bytes of data. Each of the 384 addressable tracks can hold up to 14,136 bytes. Average access time is 2.5 milliseconds, and data transfer rate is 3.0 million bytes per second.

The 2305 Model 2, usable with Models 148 and above, 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.

3850 MASS STORAGE SYSTEM: This system combines both magnetic tape and disk storage technologies to provide on-line access to very large collections of data. The 3850 uses a cylindrical data cartridge, approximately 2 inches in diameter and 4 inches long, containing a 771-inch length of 3-inch-wide magnetic tape as the primary storage medium. Each cartridge can contain up to 50 million bytes of data, which is recorded in a format identical with that of the IBM 3336 Model 1 Disk Pack. One data cartridge, thus, can contain the equivalent of up to 202 cylinders, with 19 tracks per cylinder and 13,030 characters per track; and two data cartridges, according to IBM terminology, equal one "mass storage volume" (i.e., one 3336 Model 1 Disk Pack). The 3850 can provide from 35.3 to 472 gigabytes of storage.

The data cartridges are stored in honeycomb-like cells in the 3851 Mass Storage Facility. Also included in the 3851 are from two to eight Data Recording Devices that transcribe the data between the magnetic tape cartridge and a group of dedicated 3333/3330 Disk Storage Drives. The data transfer rate from the magnetic tape cartridge to the Data Recording Device is 874,000 bytes per second, and the transfer rate between the 3830 Model 3 Disk Control and the central processor is 806,000 bytes per second.

The 3851 Mass Storage Facility is available in twenty models. The ten A models have one mass storage control (MSC) per unit, and the ten B models have two MSCs per unit. Each 3851 has two accessor controllers and two accessor ▶

IBM System/370

mechanisms. There must be one or two 3851 MSF A models per 3850 MSS or one 3851 MSF B model per 3850 MSS. One 3850 MSS may be attached to one to four host systems. A host system may be a UP, AP, or MP.

Model	Cartridges	Storage Capacity (Gigabytes)
A01, B01	706	35
A11, B11	2044	102
A21, B21	3382	169
A31, B31	4720	236
A02, B02	2044	102
A12, B12	3382	169
A22, B22	4720	236
A03, B03	3382	169
A13, B13	4720	236
A04, B04	4720	236

A 3850 MSS dual library consisting of two 3851 size four A models provides storage capacity of 472 gigabytes. The size four 3851 A model can be a Model A31, A22, A13, or A04.

INPUT/OUTPUT UNITS

The System/370 can attach numerous different input/output devices, a list of which follows. For details on these devices, please refer to Report 70C-491-06. We've also included descriptions of several mature I/O products from IBM immediately afterwards.

- 3420 Magnetic Tape Subsystems, Models 2 through 8

- 3540 Diskette Input/Output Unit

- 1442 Card Punch, Models N1 and N2

- 2501 Card Reader

- 2520 Card Read Punch, Model B1

- 2520 Card Punch, Models B2 and B3

- 2540 Card Read Punch

- 3504 Card Reader

- 3505 Card Reader

- 3525 Card Punch

- 3203 Printer

- 3211 Printer

- 3800 Printing Subsystem

- 1255 Magnetic Character Reader

- 1419 Magnetic Character Reader

- 1287 Optical Reader

- 1288 Optical Page Reader

- 3881 Optical Mark Reader

- 3886 Optical Character Reader

- 3890 Document Processing Unit

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 System/370 Models 115 through 158. The 3410 is a tape unit only, while the 3411 contains both a tape unit and the subsystem control unit. The compact, waist-high cabinets are cable-connected to one another at the front corners, making it possible to place them side by side or at any angle up to 90 degrees to one another. 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*
Inter-block gap, inches	0.6	0.6	0.6
Rewind time, minutes/2400' reel	3	3	2

*Requires Dual Density feature.

All three models use half-inch tape recorded in the standard IBM 9-track formats. On a System/370, 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. A System/360/370 Attachment is required on the 3411 Control Unit.

2560 MULTI-FUNCTION CARD MACHINE (MFCM), MODEL A1: Combines the functions of an 80-column card reader, punch, collator, and interpreter in one unit. Reads at 500 cpm, punches at 160 columns per second, and (with the optional Card Print feature) prints on the cards at 140 print positions per second. Has two 1200-card feed hoppers and five 1300-card radial stackers. Cards can be fed from either hopper and directed to any stacker. One 2560 can be directly connected to a Model 115, 115-2, 125, or 125-2 via the Integrated 2560 Attachment; it cannot co-exist with a directly connected 3525 Card Punch or 5425 MFCU.

The optional Card Print feature enables the 2560 to print 2, 4, or 6 lines on a card, operator-adjustable to any of 25 line positions. There are 64 alphanumeric print positions per line, spaced 10 to the inch. The 2560 Card Print Control feature is a prerequisite on the Model 115, 115-2, 125, or 125-2.

5425 MULTI-FUNCTION CARD UNIT (MFCU): Combines the functions of a 96-column card reader, punch, collator, and interpreter in a single unit. Has two 2000-card feed hoppers and four 600-card radial stackers. Cards fed from either or both hoppers can be read, punched, printed, and directed to any of the four stackers under program control. One 5425 can be directly connected to a Model 115, 155-2, 125, or 125-2 via the Integrated 5425 Attachment; it cannot coexist with a directly-connected 3525 Card Punch or 2560 MFCM. Either the 1403 Printer/5425 MFCU Power Prerequisite or the 5425 MFCU Power Prerequisite is required on the Model 125 or 125-2, depending on whether or not a 1403 Printer is also installed.

The 5425 is available 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

IBM System/370

▶ Model A2. Printing occurs at a speed of 60 cpm in Model A1 and 120 cpm in Model A1 when printing in any or all of the first three line positions on each card. If the fourth (lower) line position is used, the printing speed drops to 48 cpm for Model A1 and 96 cpm Model A2. Each of the 4 lines can hold up to 32 printed characters.

1017 PAPER TAPE READER: Reads 5- to 8-track punched tape at up to 120 char/sec. Model 1 reads strips of tape, while Model 2 includes supply and take-up reels. Usable with currently available Models 115 through 158. Requires 2826 Paper Tape Control, which controls up to two 1017 Readers and two 1018 Punches.

1018 PAPER TAPE PUNCH: Punches 5- to 8-track tape at up to 120 char/sec. Usable with currently available Models 115 through 158. Requires 2826 Paper Tape Control.

2671 PAPER TAPE READER: Reads 5- to 8-track punched tape in strip form at up to 1000 char/sec. Optional facilities permit center-roll or reel feeding and reel take-up at 500 char/sec. or more. Usable with currently available Models 115 through 158. Requires 2822 Paper Tape Reader control.

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 speeds 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 System/370 processor via the 2821 Control Unit, or directly to a Model 125 via the integrated attachment and power features listed below, or directly to a Model 135 via the optional Integrated Printer Adapter. Characteristics of the three models are as follows:

Model 2: 600 lpm (750 lpm maximum with UCS option), 132 print positons; Features 4505, 4662, and 4667 are required on a Model 125 for direct connection.

Model 7: 600-lpm, 120 print positions; Features 4505 and 4667 are required on a Model 125 for direct connection.

Model N1: 1100 lpm (1400 lpm maximum with UCS option), 132 print positions; Features 4505, 4662, 4667, and 4668 are required on a Model 125 for direct connection.

1443 PRINTER, MODEL N1: Uses a horizontally oscillating typebar. Rated speed is 240 lpm with 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 interchangeble typebars; speeds range from 200 lpm for 63-character set to 600 lpm for 13-character set. Usable with currently available Models 125 through 168-3; includes an integrated control unit.

5203 PRINTER MODEL 3: Uses an interchangeable, horizontal-chain cartridge to produce high-quality printed output from a System/370 Model 115 or 115-2. Rated speed is 300 lpm with the standard 48-character set. The standard 96-position print line can optionally be expanded to 120 or 132 positions. Horizontal spacing is 10 characters/inch, and vertical spacing is 6 or 8 lines/inch. Skipping speed is 16.7 inches/second at the usual spacing of 6 lines/inch. Vertical format is under program control; there is no carriage control tape. The standard 48-character chain cartridge can be replaced by other operator-changeable cartridges. The Universal Character Set feature, which is standard when the 5203 is used with a 370/115, permits the use of cartridges containing up to 120 different characters. A single 5203

Model 3 Printer can be connected to a Model 115 or 115-2 Processing Unit via the 4653 Integrated 3203/5203 Printer Attachment.

2250 DISPLAY UNIT: Displays data in both alphanumeric and graphic (line drawing) form in a 12-by-12-inch area on the face of a CRT. Displays up to 52 lines of 74 characters each, and provides format flexibility to position characters, points, and vector end-points anywhere on a 1024-by-1024-position grid. Optional light pen allows program detection of specific displayed points or characters indicated by the operator. Optional keyboard permits entry of alphanumeric data. Model 1 has a built-in control unit and 4K or 8K bytes of buffer storage. Model 3 requires a 2840 Display Control, which has a 32K buffer and can control up to four display units. Both models are designed for direct connection to any currently available System/370 Models 115 through 168-3.

TERMINALS: Numerous IBM display terminals, batch terminals, and typewriter terminals can be connected to a System/370 in remote and/or local configurations. for details, please refer to Reports 70D1-491-45, 70D2-491-11, 70D2-491-12, 70D3-491-46, 70D4-491-41, and 70D4-491-43 in Volume 2 of DATAPRO 70.

COMMUNICATIONS CONTROL

Remote communications in the System/370 are handled by the 3705 Communications Controllers, a large family of front end processors with memory sizes ranging from 32K to 512K bytes and a capacity of up to 352 communications lines. Details on the 3705, as well as the software required, can be found in Report 70C-491-06. We've included a description of the System/370 Integrated Communications Adapter and the 7770 Audio Response Unit in this report.

INTEGRATED COMMUNICATIONS ADAPTER (ICA): This optional feature for the Model 115, 155-2, 125, 125-2, and 138 Processing Unit provides the basic control storage and common circuits for direct connection of synchronous (BSC) communications lines and/or asynchronous lines. The exact number is line speed dependent. For the 115 and 115-2, up to five synchronous or up to four synchronous and eight asynchronous communications lines can be configured. For the 125 and 125-2, up to six synchronous and 16 asynchronous communications lines can be configured.

The Model 138 ICA provides up to eight line adapters in any combination of the following three types:

IBM Terminal Adapter Type I, Model II—supports communication, at either 134.5 or 600 bits/second, with an IBM 1050, 2740, 2741, or System/7.

IBM Terminal Adapter Type III—supports communication, at either 1200 or 2400 bits/second, with 2260 or 2265 Display Stations and their associated control units.

Synchronous Data Adapter Type II—supports communication, in BSC mode at up to 4800 bits/second, with an IBM 2770, 2780, 2790, 3735, or any of the following IBM computers equipped for BSC transmission: System/3, System/360, 1130, or 1800. Each BSC line can operate in any of three codes: EBCDIC, ASCII, or Six-Bit Transcode. The Autoanswer feature is available for the ICA, but the Autocall feature is not.

The ICA for the 115, 155-2, 125, and 125-2 combines the functions of a Byte Multiplexer Channel and a communications control unit. Lines connected via the ICA are addressed and controlled as if they were connected to the Byte Multiplexer Channel via a 2703 Transmission Control. All combinations of BSC and asynchronous lines require the ICA Extension feature. Additional features are required to create appropriate line interfaces for the individual lines, and the associated configuration rules are quite complex. ▶

IBM System/370

► Standard facilities of the ICA for BSC lines include Autopoll, multipoint central station functions, multipoint tributary station functions, EBCDIC transparent mode, and either EBCDIC or ASCII code; the Autopoll and multipoint central station functions are provided for asynchronous lines as well.

On the 115 through 125-2 ICA, asynchronous line speeds can range from 45.5 to 600 bits/second (though the maximum number of 600-bps lines on the ICA cannot exceed four on the 115 and 115-2 and eight on the 125 and 125-2). Synchronous line speeds can range from 600 to 50,000 bits/second; but only one high-speed line (above 7200 bps) can be connected, and it must not be operated concurrently with any other line on the ICA. An ICA-equipped Model 115 through 125-2 can communicate with virtually all IBM computers and communications terminals.

The ICA for the Model 138 is controlled by a combination of microcode and hardware logic. The amount of control storage required for the ICA microcode varies with the number of lines, the types of terminal adapters, and the features employed.

7770 AUDIO RESPONSE UNIT: Provides audio responses, in recorded human-voice form, to digital inquiries from pushbutton telephones or other inquiry-type terminals. Usable with Models 115 through 195. 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

GENERAL: Software support for the System/370 Models 115 through 168-3 can be basically the same as that provided for the System/360, and, in most cases, the 303X Series. Models 115 through 168-3 can (and usually do) operate in an Extended Control (EC) or virtual mode that utilizes Dynamic Address Translation (DAT) hardware features. A multiprocessing capability is supported for the 158 MP and 168 MP systems operating in EC mode.

In Basic Control (BC) or real mode, either the Disk Operating System (DOS) or the Operating System (OS) can be used, as on the System/360. Two of the original versions of OS support provided were Multiprogramming with a Fixed Number of Tasks (MFT) and Multiprogramming with a Variable Number of Tasks (MVT). The newer, virtual-mode counterparts of these systems are the Disk Operating System/Virtual Storage (DOS/VS), the Virtual Storage 1 option of the Operating System (OS/VS1 or VS1), and the Virtual Storage 2 option of the Operating System (OS/VS2, or VS2). VS2 Release 2 goes a step further and includes support for either tightly-coupled or loosely-coupled multiprocessing networks.

In addition to the above virtual-storage extensions of existing operating systems, a higher-level control system called Virtual Machine Facility/370 (VM/370) is also available. VM/370 provides support for the Conversational Monitor System (CMS)—a general purpose time-sharing facility—as well as for all of the other real and/or virtual operating systems. The table at the beginning of this report shows which operating systems are available on which computer systems.

The full complement of existing System/370 Program Products is also available for the virtual machines, although a number of these programs must be run in a "virtual=real" or non-paged mode. (Any program that modifies active channel programs, contains I/O appendage routines, uses EXCP coding, or is highly time-dependent may not be pageable.)

The basic characteristics of the System/370 operating systems are included in this report. The newer system control programs, such as MVS/SP and VM/SP, are covered in greater detail in Report 70C-491-06.

DISK OPERATING SYSTEM: DOS is a disk-oriented operating system for installations with at least 16K bytes of main memory and one 2311 Disk Storage Drive or 2314 or 2319 Direct Access Storage Facility. It was the most widely used of the System/360's eight operating systems, and has been discontinued in favor of DOS/VS. It is still in use on a few of the installed System/370 computers and on many of the earlier System/360s.

DOS can control concurrent processing of one "background" program and one or two "foreground" programs, each in a fixed "partition" or program area within core storage. Partition sizes can be varied by the operator, in 2K increments. Programs in the background partition are executed sequentially, in automatic stacked-job fashion. Programs in one or both of the foreground partitions can be loaded and executed in similar stacked-job fashion if sufficient storage and I/O facilities are available; if not, each foreground program must be explicitly initiated by the operator. Foreground programs always have priority over the background program.

Several Input/Output Control Systems are available with DOS, providing macros to handle the following types of I/O: consecutive processing of tape or disk files, indexed sequential access method (for either random or sequential processing of sequentially organized disk files), direct access method (for randomly organized disk files), MICR or OCR input, and telecommunications. DOS provides two distinct types of communications support: the Basic Telecommunications Access Method (BTAM), which performs basic line and message control functions, and the Queued Telecommunications Access Method (QTAM), which extends the techniques of IBM's logical Input/Output Control Systems into the communications environment. BTAM requires a minimum of 24K bytes of main memory, while QTAM requires at least 65K bytes.

DOS provides language translators for Assembler, RPG, COBOL, FORTRAN, and PL/1. Service routines include both disk and tape sort/merge programs, Autotest, and a wide variety of utility programs.

DISK OPERATING SYSTEM/VIRTUAL STORAGE: DOS/VS was designed: (1) to extend to DOS a number of features that were previously reserved exclusively for OS, and (2) to implement support of virtual storage. Among the OS-type features added, DOS/VS allows the user to have: five problem program partitions (F1-F4 and BG) instead of three as in DOS (F1, F2, and BG); single or multi-phase user programs that are self-relocating through the use of a relocating loader; POWER (for spooling) with RJE capability as a built-in function at Sysgen time; procedure library support that allows JCL sets to be cataloged with extended support for procedures with Job Control, service program, and utility program statements; and a Dynamic Partition Priority adjustment capability to specify partition dispatching priority at Sysgen time and alter it at IPL or during system operation. Virtual storage support for the System/370 under DOS/VS recognizes up to 16 million bytes of virtual storage in pages of 2K bytes each.

The minimum supervisor required for execution of DOS/VS is 26K bytes for the System/370 Models 115, 115-2, 125, and 125-2; 30K bytes for the System/370 Models 138 and 158; and 32K bytes for the System/370 Model 148.

Through the years, IBM has continued to enhance DOS/VS with new releases coming at least once a year. Some of the more important enhancements are as follows: ►

IBM System/370

▶ ● Generic Device Assignment feature that allows input/output to be assigned by device type, device class, or an address list to provide a limited degree of device independence in user programs and permit pooling of I/O devices.

● Shared Virtual Area (SVA) that contains relocatable and re-entrant program phases that can be shared by all partitions in the system.

● Support for Rotational Position Sensing on System/370 Models 115 through 158 through a link to a Rotational Position Sensing module located in the Shared Virtual Area.

● The use of alternate indexes in VSAM, which allows applications programs to access records through keys other than prime keys, to reduce requirements for sorting and maintaining data in multiple sequence.

● Relative Record Data Sets, in which records are accessed through VSAM using the record number as the key in place of an index.

● An optional fast CCW translate feature to improve DOS/VS performance.

● Expansion of VTAM support for remote 3704/3705 communications controllers to include leased and switched connection of SNA/SDLC terminals.

● Installation Productivity Option, a program product developed by IBM to reduce the time required to install future DOS/VS enhancements.

● DOS/VS Advanced Functions signficantly improve the operating system by expanding the number of user partitions to seven and providing dynamic partition balancing.

DOS/VS provides a superset Assembler and two access methods not found in DOS.

Among the additions to the Assembler are the following: COPY statements are permitted anywhere in the program; the PRINT statement is effective in macro expansions; and a NOALIGN option allows utilization of the System/370 Byte-Oriented Operand feature by 360-type Assembly programs without recoding.

The Virtual Sequential Access Method (VSAM) is a major, optional data management extension that is available for both DOS/VS and OS/VS as an extension and replacement for ISAM. Data sets created by DOS/VS, OS/VS1, or OS/VS2 can be freely interchanged among the three operating systems. Among the features of VSAM are: (1) five types of indexing, including non-dense, key compression, replication, high-level main storage, and low-level with data; (2) distributed free space at the time the data set is created to eliminate ISAM-like overflow and automatically reclaim deleted record space; (3) master catalog with device independence; (4) password data set security protection; and (5) a variety of utility services, including an ISAM/SAM data set conversion facility and an ISAM Interface Program that maps ISAM requests into corresponding VSAM requests. VSAM has Class A support as an SCP component of DOS/VS, and was released in June 1973.

The Virtual Telecommunications Access Method (VTAM) is IBM's primary terminal access method and the base for future developments of teleprocessing support under DOS/VS and OS/VS. As a replacement for BTAM, TCAM, and QTAM, VTAM controls communications terminal connections and data transfers between those terminals and the user's application programs via a 370X Communications Controller. Upward compatibility is provided among all of the IBM virtual storage operating systems. Among the features of VTAM are (1) Network Control Program (NCP) support of the 370X Communications Controllers, including dynamic sharing of terminals, lines, and the controllers themselves among user programs; (2) support of TCAM under VTAM for OS/VS only; (3) terminal monitoring facilities to handle log-on requests and collect communications network accounting information; and (4) integration of the Teleprocessing On-Line Text Executive Program (TOLTEP). VTAM has Class A support as an SCP component of DOS/VS. The minimum DOS/VS System required for VTAM is 96K bytes.

POWER/VS: An extension of the earlier POWER spooling system available for DOS, POWER/VS executes under DOS/VS on a System/370 computer with at least 96K bytes of main memory. In contrast to the previous version of POWER, POWER/VS executes in the virtual mode and acquires real processor storage on an as-needed basis. It can control programs operating in both the real and virtual modes.

POWER/VS resides in one DOS/VS partition and can provide spooling of unit record input/output and priority scheduling for from one to four programs with lower dispatching priority. POWER/VS can control multiple partitions (two less than the maximum on the system). Jobs to be scheduled for execution are queued in user-assigned classes by priority within each class. Jobs can be assigned by class to specific partitions for execution, or partition-independent job classes can be utilized to achieve more balanced scheduling of all partitions. Operator commands permit the operator to modify the order in which jobs in the job queues are scheduled for execution. Job input can be retained in the queues to permit repeated execution of a job.

Printer and punched card output can be spooled to magnetic tape or disk drives, and is grouped into output classes that can be the same or different from the parent job class. A segmented output capability allows large columns of output from a job to be segmented to permit the output to be overlapped with the completion of processing of the job. Multiple copies of output can be requested, and job output can be retained for production of additional copies.

The POWER/VS remote job entry facility can support concurrent operation of 25 terminals, including the 3780 Data Communication Terminal, the 3741 Model 2 or 4 (functioning as a 2780), 2780 Data Transmission Terminal, 2770 Data Communication System, 3770 Data Communication System, and the System/32 computer (functioning as a 3770). All terminal types can operate concurrently. Remote entry support for transmission via the Synchronous Data Link Control (SDLC) is provided for the 3771, 3773, 3774, 3775, and 3776 Communications Terminals, 3790 Communication System, 8100/DCPX Information System, and the System/32 (as a 3770). The 3784 Line Printer, 3521 Card Punch, 3501 Card Reader, and 2502 Card Reader are also supported, although concurrent operation of the printer and card punch on a single transmission from POWER/VS to the terminal is not allowed. The VTAM application program interface is used to support the SDLC terminals which permits multiple applications to transmit to and from a terminal on a per-session basis. Multi-point operation is also supported.

OPERATING SYSTEM/360: OS was a comprehensive and general-purpose operating system for the larger System/360 and 370 computers. It was designed for installations with disk and/or drum storage facilities and sizeable main memory capacities. Two basic versions of OS were available for the System/370: Multiprogramming with a Fixed Number of Tasks (MFT), and Multiprogramming with a Variable Number of Tasks (MVT). They differed primarily in the ▶

IBM System/370

amount and flexibility of the multiprogramming operations they could control. IBM discontinued support for both OS/MFT and OS/MVT in 1976, placing all of its software support emphasis upon the virtual storage operating systems.

OPERATING SYSTEM/VIRTUAL STORAGE: OS/VS is the true System/370 Version of OS/360. It consists of two versions—OS/VS1 (or VS/1) and OS/VS2 (or VS/2)—that directly extend the capabilities of and are highly compatible with OS/MFT and OS/MVT, respectively.

OS/VS2, in turn, was effectively divided into two separate operating systems with the introduction of OS/VS2 Release 2. OS/VS2 releases prior to Release 2 are now known as OS/VS2 Single Virtual Systems (or SVS), while OS/VS2 Release 2 and above are now known as OS/VS2 Multiple Virtual Systems (or MVS).

I/O control under all OS versions is accomplished by an extensive array of "data management" facilities. OS, like earlier IBM input/output control systems, supports two fundamental types of data access techniques: basic and queued. The queued access technique deals with individual logical records, provides automatic blocking and buffering facilties, and applies only to sequentially organized files. The basic access technique deals with blocks of I/O data rather than logical records, provides direct programmer control of blocking, buffering, and I/O device functions, and is usable with direct (random) and sequential file organizations.

In addition to the basic facilities offered as a carry-over from OS/MFT, OS/VS1 can support a system total of up to 16 million bytes of virtual storage that is divided into 64K-byte segments and 2K-byte pages. Other facilities of VS1 include: a Job Entry Subsystem (JES1) that provides many of the most important functions of HASP, including Remote Entry Service (RES) and high-volume I/O spooling and scheduling, and supersedes HASP under VS1; additional control block protection; a Centralized Queue Manager facility with Scheduler Word Area Data Sets (SWADS) to improve utilization of the job queue allows more jobs to be put into queue; and the Dynamic Support System (DSS), an interactive debugger used to identify and correct VS1 programming failures.

OS/VS2 is a significantly improved version of OS/MVT. The enhancements of OS/VS2 (SVS) include support of a maximum of 16 million bytes of virtual storage that is divided into 64K-byte segments and 4K-byte pages; virtual storage support of TSO in foreground regions, including native-mode support for the 3704 and 3705 Communications Controllers under TSO; up to 63 protected batch user regions or 42 TSO user regions (instead of 15 under MVT); Dynamic Priority Scheduling, including I/O load balancing based upon respective I/O data rates; Dynamic Support System (DSS) as in VS1; and a variety of virtual storage support features, including enhancements to the Linkage Editor, Systems Management Facilities (SMF), Link Pack Area (LPA), etc.

The Time-Sharing Option (TSO) permits interactive timesharing operations to be run concurrently with teleprocessing and batch processing on a 52K-byte or larger system. Programmers at remote terminals can develop, execute, store, and modify programs written in any OS-supported language.

The Houston Automatic Spooling Priority System (HASP II) is a high-volume spooling package that can handle an essentially unlimited number of peripheral devices, including high-speed remote batch terminals, using direct-access devices for intermediate storage.

The Asymmetric Multiprocessing System (ASP-III) (formerly Attached Support Processor) is an application program that works in conjunction with OS/VS2 to control a

multiprocessing system with up to 32 processors—one of which is the host processor for ASP residence.

OS/VS2 (MVS) is a major functional enhancement over OS/VS2 (SVS) that features support of: 1) multiprocessing for Model 158 MP and 168 MP systems; 2) larger virtual storage, with up to 16 million bytes of addressable space for each of up to 63 concurrent users; 3) a HASP-like version of the Job Entry System (JES2); 4) an ASP-III-like verison of the Job Entry System (JES3); and 5) Virtual Telecommunications Access Method (VTAM) support of the 370X Communications Controllers in Network Control Program (NCP) mode.

OS/VS2 operates on all the currently marketed models starting with the System/370 Model 148 and extending through the 168 MP virtual storage system. MVS operates with reduced functional capabilities and restricted performance in a system with 768K bytes of main memory, can perform the minimum batch processing funcitons in a system with 1,024 bytes of memory, and requires 1,536K bytes of main memory to perform concurrent batch and TSO operations with JES2.

VIRTUAL MACHINE FACILITY/370: VM/370 is a system control program (SCP) that manages a computing system's resources (CPU, storage, and input/output devices) so that all are available to many users at the same time. Each user has at his or her disposal the functional equivalent of a real, dedicated computing system. VM/370 is designed for use on currently available System/370 Models 138, 148, 158, and 168, which have the Dynamic Address Translation feature and Extended Control Mode option.

VM/370 has two major elements: the control program (CP), which controls the resources of the real computer to provide multiple virtual machines, and the Conversational Monitor System (CMS), a subsystem that gives users a wide range of conversational time-sharing facilities, including creation and management of files and compilation, testing, and execution of problem programs.

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

Each virtual machine has its own virtual storage space, which may be as small as 8K bytes or as large as 16 million bytes, or any size in between that is a multiple of 4K bytes. Each virtual machine can refer only to its own virtual storage; this restriction protects each virtual machine's storage from the activities of other virtual machines. The size of each virtual storage space is defined in the virtual machine's director entry and may differ among virtual machines.

The VM/System Product (VM/SP), an enhancement of VM/370 Release 6, extends VM/370 and is the base for several program products. VM/SP is a licensed program and it is expected that any future enhancements to VM/370 will be made in VM/SP. The VM/System Product is designed to run on the currently available System/370 Models 138, 148, 158, and 168.

VM/SP will support the 158 MP and 168 MP with as many as 16 channels per processor and a maximum of 32 channels per MP configuration. VM/SP does not simulate multiprocessing for virtual machines other than under single processor mode. Systems Network Architecture (SNA) console communication services will provide full VM/370 operator console interface capabilities for SNA terminal users to any virtual machine. SNA console communications services will

IBM System/370

▶ provide the necessary interface between the Virtual Machine/VTAM Communications Network Application (VM/VCNA) program product and ICP or virtual machines.

INFORMATION MANAGEMENT SYSTEMS: IMS provides the capabilities for generating and accessing a data base, with automatic cross referencing among data records. IMS/VS operates under the OS/VS1 or OS/VS2 operating systems. IMS/VS offers on-line message processing with the optional on-line inquiry with IQF (Interactive Query Facility) or GIS/VS (General Information System) and batch inquiry with GIS or GIS/VS are available. In addition, a data language (DL/1), whose function is to register user I/O coding with simpler commands to IMS, is provided. Report 70C-491-06 has more details on IMS and other System/370 data management systems.

CUSTOMER INFORMATION CONTROL SYSTEM: CICS is a general purpose data communications monitor that operates in a single partition or region of an IBM System/370 under DOS or OS (or their VS counterparts) to control multiple on-line user terminals and applications. By consolidating the required communications interfaces and I/O control functions, CICS isolates the user's applications programs from the communications environment and, to a considerable degree, from the operating system itself.

IBM offers support for a wide variety of programming languages, including COBOL, FORTRAN, BASIC, PL/1, APL, ALGOL, RPG II, and Assembler. Details can be found in Report 70C-491-06.

UTILITY ROUTINES: Sort/Merge programs are offered at all levels of software support for the System/370. All are generalized programs which are controlled by user-supplied parameters, and all can accommodate either fixed or variable-length records.

8100 SIMULATOR SOFTWARE: A new IBM software aid is the Distributed Product Development System (DPDS), an 8100 simulator that runs on the System/370 computers.

RETAIN/370: This is a system maintenance software package introduced with the System/370. Its acronym stands for "Remote Technical Assistance and Information Network." Its purpose is to provide special assistance to the IBM Customer Engineers when they encounter unusual difficulties in solving complex hardware maintenance problems.

APPLICATION PROGRAMS: An enormous number of "packaged" application programs—more than 2500—are now available for the System/370 at no charge from IBM as "Prior Use" Type I, II, III, or IV software. These programs were in general use on the System/360 prior to unbundling on December 31, 1969. While many of these programs are rather simple utilities, others are major systems representing dozens of man-years of effort that have subsequently been made available in improved and maintained versions for a fee as IBM Program Products. The Prior Use programs are provided with no free IBM support. Information concerning these programs is available in the *Catalog of Programs for IBM System/360 Models 25 and Above* (GC20-1619).

In the separately priced application programs category, three types of programs are available: Program Products, Field Developed Programs (FDPs), and Installed User Programs (IUPs). Limited support is provided for the FDPs and IUPs (which were first made available in August and October 1971, respectively); it consists only of pertinent error-correction information during the first six months after initial general availability of the programs. A full list of FDPs and IUPs with prices, dates when support ends, and reference manual numbers can be found in the *IBM Computer Information Card for FDPs and IUPs* (GB21-9949).

A list of the currently available System/370 Program Products can be found in the price list at the end of this report. Also see detailed reports on the two IBM Program Products of broadest general interest: IMS (Report 70E-491-01) and CICS (Report 70E-491-02).

PRICING

EQUIPMENT: The following systems illustrate typical System/370 configurations. Obviously, they comprise only a small sampling of the extensive configuration possibilities within the System/370 line. All necessary control units and adapters are included in the indicated prices, and the quoted rental prices are for short-term leases and include equipment maintenance.

MODEL 138 TAPE/DISK SYSTEM: Consists of 524K Model 138 Processing Unit with Integrated File Adapter and CRT console, 3340 Direct Access Storage Facility (four drives, 280 million bytes), eight 3420 Model 3 Magnetic Tape Units (120KB) and dual-channel tape controls, 3505 Model B2 Card Reader, 3525 Model P3 Card Punch, 3211 Printer, and 3286 Model 1 66-cps Printer. Monthly rental and purchase prices are approximately $24,644 and $552,220, respectively.

MODEL 148 TAPE/DISK SYSTEM: Consists of 1048K Model 148 Processor with Integrated File Adapter and CRT console, 3340 Direct Access Storage Facility (six drives, 420 million bytes), eight 3420 Model 3 Magnetic Tape Units (120KB) and dual-channel controls, 2540 Card Read Punch, 3211 Printer, and 3286 Model 1 66-cps Printer. Monthly rental and purchase prices are approximately $38,526 and $785,500, respectively.

On-call maintenance service is charged at hourly rates that are shown in the following table. The majority of System/370 equipment is in Maintenance Class 3.

	Normal Working Hours	Outside Normal Working Hours
Class 1	$ 85.00	$ 99.00
Class 2	105.00	123.00
Class 3	115.00	132.00

In addition, DPD Systems Engineering Services (SES) are available at $79.00 per hour.

LEASE TERMS: The IBM *Agreement for Lease or Rental of IBM Machines,* instituted in April 1977, defines three usage plans by which monthly charges are determined. IBM assigns each machine to one of these three plans.

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

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

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

The most significant change brought about by the new agreement was the ability to include equipment with differing lease terms on a single lease contract and the special long-term lease plans that had been offered under several amendments to the previous lease agreement. Specifically, the Extended ▶

IBM System/370

➤ Term Plan (ETP), Fixed Term Plan (FTP), Term Lease Plan (TLP), and Alternate Term Plan (ATP) were discontinued. However, the new agreement permits lease terms similar to those of the discontinued plans to be routinely implemented. Customers with existing term plan agreements can continue with those contracts and extend them in accordance with their provisions. IBM has stipulated final termination dates beyond which none of these discontinued plans may be extended. These dates are listed below.

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

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

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

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

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

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

In addition, basic monthly charges have been established for maintenance of the IBM system control programs and other licensed program products. The minimum term of agreement is one year. A customer with multiple systems will have a choice as to how he can have local programming support handled at his locations. 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.

Program Products include all language processors, communications support programs, and utility programs, and are licensed separately. Monthly license charges are listed under "Software Prices" and include full IBM software support. The MVS/System Extension and the VM/System Extensions enhancements to the OS/VS2(MVS) and VM/370 SCPs are designated as Program Products and are also licensed separately. Application Programs (PPAs) and industry-oriented software packages are also licensed separately, including full support. Also available on an individual-charge basis, but without centralized IBM programming support, are numerous Field-Developed Programs and Installed User Programs for the System/370.

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