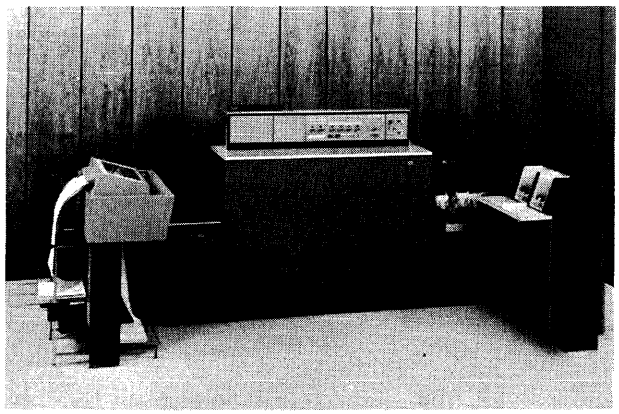
IBM System/360 Model 20



Basic Model 20 card system, with 2203 Printer at left and 2560 MFCM at right.

Once the world's most widely used small-scale business data processing system, the Model 20 has been largely superseded by IBM's newer System/3. The Model 20 is available in six processor models and in card, tape, and disk-oriented configurations, but its compatibility with the larger System/360 models is limited.

MANAGEMENT SUMMARY

The Model 20 is the smallest member of IBM's ubiquitous System/360 computer line. From its introduction in November 1964 until the July 1969 announcement of the System/3, the Model 20 was also IBM's lowest-priced business data processing system. Primarily for that reason, the Model 20 achieved the status of the most widely used small-scale computer, with nearly 15,000 installations around the world. The Model 20 has since surrendered its title to the fast-selling System/3, which offers considerably more speed, versatility, and economy.

IBM introduced the Model 20 seven months after the April 1964 unveiling of the larger System/360 models. As originally announced, the Model 20 was strictly a punched-card-oriented system, designed to serve as a low-cost entry into System/360-style computing for companies ready to move up from tabulating equipment.

Since then, the Model 20 hardware and software has been progressively expanded and improved, so that it now offers a fairly wide choice of processor models, peripheral equipment, and software support. Magnetic tape capabilities were introduced in 1965, and disk storage in 1966. Appropriate software facilities were added in each case.

Then, in March 1968, IBM announced slowed-down versions of the Model 20 Processor, the 2203 Printer and the unique 2560 Multi-Function Card Machine. These "Submodel 3 and 4" systems cost about 20 to 25 percent less than the original "Submodel 1 and 2" systems and yield roughly 30 percent less throughput in typical applications. The new models further reduced the cost of entry into System/360 data processing. Thus, they served as an effective counter-attack to the small, low-cost ➢

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, 1133 Westchester Avenue, White Plains, N.Y. 10604.

MODELS: System/360 Model 20, Submodels 1, 2, 3, 4, 5, and 6.

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," while four consecutive bytes form a "word."

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

FLOATING-POINT OPERANDS: No facilities for floating-point arithmetic are provided.

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: Magnetic core.

CAPACITY: 4,096, 8,192, 12,288, or 16,384 bytes in Submodels 1 thru 4; 8,192, 12,288, 16,384, 24,576, or 32,768 bytes in Submodel 5; 8,192, 12,288, or 16,384 bytes in Submodel 6.

CYCLE TIME: 3.6 microseconds per 1-byte access in Submodels 1 thru 4; 2.0 microseconds per 2-byte access in Submodel 5; 3.6 microseconds per 2-byte access in Submodel 6.

CHECKING: Parity bit with each byte is generated during writing and checked during reading.

STORAGE PROTECTION: None.

CENTRAL PROCESSORS

INDEX REGISTERS: 8 general registers are used for indexing, base addressing, and as accumulators.

INDIRECT ADDRESSING: None. ➤

REFERENCE EDITION. This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no future update is planned.

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computers that had recently been introduced by several of IBM's major competitors.

An even more significant announcement in June 1968 wiped out the advantage that several competitors had established by marketing comparably-priced processors that were far faster than the original Model 20. The new Submodel 5 Processor changed the picture by offering internal speeds about three times as fast as those of Submodels 1 and 2 at a price increase of only about $100 per month. Submodel 5 accesses two bytes of data in each 2-microsecond core storage cycle, whereas the earlier models required 3.6 microseconds to access a single byte. Moreover, Submodel 5 offers up to 32,768 bytes of core storage, whereas the previous maximum was 16,384 bytes. Finally, Submodel 5 is the only Model 20 processor that can be equipped with 60KB magnetic tape units, with an emulator for the second-generation IBM 1401 and 1440 computer systems, and with up to four (rather than two) disk units.

In January 1971, IBM announced 30 percent reductions in the purchase prices of the Submodel 1, 2, 3, and 4 Processors, which were no longer in new production. These price cuts were intended to prolong the economic lives of the slower Model 20 Processors by inducing many users to purchase the equipment they were previously renting.

Then, in May 1971, IBM rounded out the Model 20 line by introducing the Submodel 6 Processor. The Submodel 6 has the same 3.6-microsecond core storage cycle time as Submodels 1 and 2, but the newer model accesses two bytes per cycle and boasts 70 percent higher internal speed and improved I/O simultaneity, coupled with significantly lower rental prices. At the time of its announcement, a 16K Submodel 6 Processor, for example, rented for $1,000 per month, compared with $1,200 for a 16K Submodel 1, $1,275 for a Submodel 2, and $1,375 for the faster Submodel 5. Submodel 6 core storage capacities are limited to 8K, 12K, or 16K bytes, and the 1401/1440 Compatibility Feature and 60KB magnetic tape units cannot be attached.

Thus, the Submodel 6 was introduced as an attractive upgrade system to enable many current users of Submodels 1 through 4 to gain significant performance improvements at little or no increase in cost. Programs written for Submodels 1 through 4 run without change on a similar Submodel 6 configuration, but it is necessary to alter and recompile the programs to take advantage of the improved overlap capabilities of the Submodel 6. Although the Submodel 6 Processor uses "reconditioned major elements," it is not possible to field-upgrade one of the earlier processors to a Submodel 6.

Customer deliveries of Model 20 systems began early in 1966. Initial deliveries of the low-cost Submodel 3 and 4 systems were made in the fourth quarter of 1968. Submodel 5 deliveries began in the second quarter of 1969, and Submodel 6 deliveries began in October 1971. User reactions to both the hardware and software were, on the whole, quite favorable.

INSTRUCTION REPERTOIRE: 36 instructions, including decimal add, subtract, multiply, and divide; binary add and subtract; edit; code translate; compare; etc. Most of the Model 20 instructions are the same as those of the larger System/360 models, but the input/output and some control instructions are different.

INSTRUCTION TIMES: See table below; the times shown are for 2-address decimal addition of signed 5-digit (3-byte) fields and for 1-address binary addition of halfword (16-bit) fields. All times are expressed in microseconds.

	Decimal Addition	Binary Addition
Submodels 1 & 2	473	209
Submodels 3 & 4	739	209
Submodel 5	160	58
Submodel 6	289	104

Overall internal processing speed of the Submodel 3 and 4 Processors is rated as 70 percent of that of Submodels 1 and 2.

Overall internal processing speed of the Submodel 5 Processor is rated as 3 times that of Submodels 1 and 2.

Overall internal processing speed of the Submodel 6 Processor is rated as approximately 1.7 times that of Submodels 1 and 2 and 0.55 times that of Submodel 5.

OPTIONAL FEATURES: Extra-cost features, called attachments, controls, or channels, must be added to the Model 20 Processor to accommodate each of the standard peripheral devices; these are listed in the "Equipment Prices" section.

1401/1440 COMPATIBILITY: This optional feature, available only for the Submodel 5 Processor, enables a Model 20 system to execute programs written for the earlier IBM 1401 and 1440 computers. The feature is a free-standing emulator that does not function under any operating system. It requires the loading of a special emulator microprogram deck that replaces the standard Model 20 microprograms in control storage. Internal speed of the Submodel 5 Processor in compatibility mode averages 95 percent of the 1401's speed, while overall throughput naturally depends upon the emulating I/O devices used. All standard 1401 and 1440 instructions and most of the special features can be emulated, though the Processing Overlap feature cannot. The following 1401/1440 I/O devices can be emulated by the functionally equivalent Model 20 I/O units: 1401 or 1442 Card Read Punch, 1442 Card Reader, 1444 Card Punch, 1403 or 1443 Printer, 1407 or 1447 Console, 1311 Disk Storage Drives, and 729, 7330, or 7335 Magnetic Tape Units. The Model 20 system must have at least as much core storage as the 1401 or 1440 system it emulates (e.g., an 8K Model 20 can execute a program that required 8,000 characters in a 1401 or 1440).

INPUT/OUTPUT CONTROL

CONFIGURATION RULES: A maximum of 3 card I/O units, 1 printer, 1 magnetic character reader, 1 magnetic tape control with up to 6 tape drives, 2 or 4 disk storage drives, 1 printer-keyboard, and 1 communications adapter can be connected. Not all I/O devices can be used with all processor submodels, however, and only 1 unit of any given machine type (except disk and tape drives) can be connected. See the descriptions of the individual peripheral devices for details.

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Although IBM maintained a high degree of program and data compatibility among all of the System/360 processors from Model 22 through Model 195, there are some significant imcompatibilities between the Model 20 and these larger models. The Model 20's limited instruction repertoire is largely a subset of that of the larger processors, but the input/output instructions and certain control instructions are different. Furthermore, the Model 20 has 8 general registers which are one half-word (16 bits) in length, whereas the larger System/360 processors have 16 general registers which are a full word (32 bits) in length. These differences are not fully resolved by the assemblers for the respective models. Moreover, differences in disk recording formats make it impossible for a larger System/360 model to read disk packs written by a Model 20, or vice versa, though the packs are physically interchangeable. (An extra-cost option for the System/360 Model 25 enables it to emulate the Model 20.)

These hardware incompatibilities between Model 20 and the larger System/360 models made it necessary for IBM to develop a completely separate set of software for the Model 20. There is no integrated operating system analogous to those for the larger models, but adequate complements of software are provided at three different levels—for card, tape, and disk-oriented systems with at least 4K, 8K, and 12K bytes of core storage, respectively. IBM has placed less emphasis on the development of generalized programs for specific applications than some competing manufacturers, such as Honeywell and NCR.

Ever since the Model 20 was introduced, IBM has promoted the use of its Report Program Generator (RPG) as the basic programming language. As a result, most Model 20 users do nearly all of their programming in RPG, thereby avoiding the notorious complexities of the System/360 Assembler Language. RPG is comparatively easy to learn and is well suited for the routine business data processing applications that form the bulk of the workload for most Model 20 installations. Unfortunately, RPG has also been pressed into service in many applications where it is cumbersome and inefficient (e.g., where complex calculations or data management operations are required).

On the positive side of the compatibility ledger is the fact that most programs written in RPG for a Model 20 system can be re-generated and executed on a larger System/360 processor with little or no change. Exceptions include programs that take advantage of the unique capabilities of the 2560 Multi-Function Card Machine, which is not available for System/360 models above Model 25.

For the first four years of Model 20's life, no compiler for a procedure-oriented language was offered; RPG and Assembler were the only available programming languages. IBM has now developed a compiler for PL/I, a language that offers impressive facilities for both business and scientific programming but has not gained widespread acceptance to date. The PL/I compiler requires at least 16,384 bytes of core storage and a disk unit, which rules out its use on most of the installed Model 20 systems. Compilers for COBOL and FORTRAN, the most popular

SIMULTANEOUS I/O OPERATIONS: In Submodels 1 thru 4, computing, printing, card reading, and punching can all occur simultaneously. Magnetic tape, disk file, and high-speed communications data transfers, however, occur in "burst mode"; computing and other I/O operations (except on the buffered 1403 Printer) cannot occur at the same time.

In Submodel 5, one of each of the following functions can be executed simultaneously: computing, printing, card reading, punching, typing, magnetic tape input or output, disk file input or output, and communications input or output.

The Submodel 6 Processor has overlap capabilities similar to those of Submodel 5, except that if a 2203 Printer is used, tape and disk read/write operations cannot always be overlapped with other I/O operations.

I/O INTERFERENCE: Fairly low during card reading, punching, and printing operations; e.g., the 2501 Model A1 Card Reader delays the processor for 5.5 milliseconds per 100-millisecond card read cycle. (But note that in Submodels 1 thru 4, processing is halted for the entire duration of a magnetic tape or disk file I/O operation.)

MASS STORAGE

2311 DISK STORAGE DRIVE, MODELS 11 AND 12: These are lower-capacity versions of the 2311 Model 1 Drives used in the larger System/360 models. All models use the same 1316 Disk Pack, but format differences make it impossible for a 2311 Model 11 or 12 to read data written by a 2311 Model 1, or vice versa.

Model 11 stores up to 5.4 million bytes and has an average head movement time of 75 milliseconds. Model 12 stores up to 2.7 million bytes and has an average head movement time of 60 milliseconds.

For both models average rotational delay is 12.5 milliseconds and data transfer rate is 156,000 bytes/second. Data is stored in 270-byte sectors, 10 sectors per track. Up to 27,000 bytes can be read or written at each position of the comb-type access mechanism. One read/write head serves each disk surface. Model 11 can access all 200 data tracks on each disk surface, while Model 12 can access only 100 of the tracks.

Up to two 2311 Drives (Model 11 or 12, not intermixed) can be connected to a Submodel 2 or 4 Processor; up to four 2311 Drives (models 11 and/or 12 in any combination) to a Submodel 5 Processor: and up to two 2311 Drives (Models 11 and/or 12) to a Submodel 6 Processor. Disk storage cannot be used with a Submodel 1 or 3 Processor.

INPUT/OUTPUT UNITS

2415 MAGNETIC TAPE UNIT AND CONTROL: One 2415 unit, containing 2, 4, or 6 tape drives and an integral controller, can be connected to a Submodel 2, 5, or 6 Processor only. All models use standard 1/2-inch, 9-track tape and can read backward as well as forward. Optional features permit reading and writing of 7-track tape by all models, and of 800-bpi tape by the 1600-bpi models. The following models are available:

Model 1: 2 drives; 800 bpi; 15,000 bytes/sec.
Model 2: 4 drives; 800 bpi; 15,000 bytes/sec.
Model 3: 6 drives; 800 bpi; 15,000 bytes/sec.
Model 4: 2 drives; 1600 bpi; 30,000 bytes/sec.

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business and scientific programming languages, are still notably absent from the repertoire of IBM-supplied software for Model 20.

The System/3 has long since displaced the Model 20 as IBM's lowest-priced and fastest-selling business data processing system. The 1969 announcement of the System/3 Model 10 introduced a system that was considerably less expensive and easier to use than the System/360 Model 20, and many users of small Model 20's took advantage of the opportunity to "upgrade" into the System/3. Three years later, in 1972, some of the returned Model 20 Processors reappeared as the basis for the IBM 2922 Programmable Terminal.

Those Model 20 users who continued to view even the smallest System/370 configuration as too rich an upgrade were provided with a more attractive growth system with the July 1973 announcement of the System/3 Model 15. The Model 15 supports the 2560 Multi-Function Card Machine, which is the key peripheral device in most 360/20 installations, and a field-developed program was made available to aid in converting 360/20 RPG programs into Model 15 RPG II.

Mention of the System/360 has been conspicuously absent from recent IBM announcements of enhancements and new peripheral products for both the System/3 and the smaller System/370 models. Obviously IBM has recognized that the System/3, as planned, has superseded the Model 20 as its small general-purpose computer system. Since most Model 20's were rented from IBM, a large percentage of the remaining System/360 Model 20 users can be expected to follow IBM's lead either into the System/3 family or up to the System/370 Model 115, where Model 20 emulation is available. Users would do well, however, to examine the competitive offerings from Burroughs, Honeywell, NCR, and UNIVAC, all of which offer attractive products in this lucrative market. □

Model 5: 4 drives; 1600 bpi; 30,000 bytes/sec.
Model 6: 6 drives; 1600 bpi; 30,000 bytes/sec.

2401 MAGNETIC TAPE UNITS: These free-standing tape units, usable only with the Submodel 5 Processor, have the following basic characteristics:

Model 1: 800 bpi; 30,000 bytes/sec at 37.5 in/sec.
Model 2: 800 bpi; 60,000 bytes/sec at 75.0 in/sec.
Model 4: 1600 bpi; 60,000 bytes/sec at 37.5 in/sec.

All models use standard 1/2-inch, 9-track tape, have 0.6-inch inter-record gaps, and can read backward as well as forward. Models 1 and 2 can alternatively be equipped with a 7-track head, making them compatible with the second-generation IBM 729 tape units. Model 4 can be equipped with a Dual Density feature that enables it to operate at 800 bpi as well as 1600 bpi. The 5301 Native Tape Attachment connects up to six 2401 Model 1 and/or 2 drives to a Submodel 5 Processor. The 5302 Native Tape Attachment connects up to six Model 4 drives to a Submodel 5 Processor and, with the addition of the 9-Track Compatibility feature, can also accommodate 2401 Model 1 and/or 2 drives.

2560 MULTI-FUNCTION CARD MACHINE (MFCM): Combines the functions of a card reader/punch, collator, and interpreter in a single unit. Consists of two 1,200-card feed hoppers, a solar-cell read station, a punch station, an optional print station, and five 1,300-card stackers. Cards fed from either or both hoppers can be read, punched, printed, and fed into any of the five stackers under program control.

The 2560 is offered in two models. Model A1 can be used only with a Submodel 1, 2, 5, or 6 Processor, while Model A2 can be used only with Submodel 3 or 4.

Cards are read serially by column, at 500 cpm in Model A1 and 310 cpm in Model A2. Punching is at the rate of 160 columns per second in Model A1 and 120 columns per second in Model A2. When all 80 columns of each card are punched, the speed is 91 cpm in Model A1 and 65 cpm in Model A2.

The optional Card Print feature, for the 2560 Model A1 only, provides 2, 4, or 6 printing heads, each adjustable to print in any one of 25 line positions on the cards. Each line can be up to 64 characters long. Printing speed, regardless of the number of lines printed, is 150 print positions per second.

2501 CARD READER: Reads 80-column cards serially by column at either 600 cpm (Model A1) or 1000 cpm (Model A2). Usable only with Submodel 1, 2, 5, and 6 Processors.

2520 CARD READ PUNCH, MODEL A1: Can read cards in column-by-column fashion, punch cards in row-by-row fashion, or read and punch simultaneously, at the rate of 500 cpm. Usable only with Submodel 1, 2, 5, and 6 Processors.

2520 CARD PUNCH, MODELS A2 and A3: Punches 80-column cards in row-by-row fashion at either 500 cpm (Model A2) or 300 cpm (Model A3). Usable only with Submodel 1, 2, 5, and 6 Processors.

1442 CARD PUNCH, MODEL 5: Punches 80-column cards in column-by-column fashion at 160 columns per second (or 91 cpm when all 80 columns are punched). Usable only with Submodel 1, 2, 5, and 6 Processors.

2203 PRINTER: Uses interchangeable, horizontally oscillating typebars. Character sets containing 13, 39, 52, and 63 characters are available. A 120-character line is standard, with 24 additional print positions available as an option. The 2203 Model A1 can be used only with a Submodel 1, 2, 5, or 6 Processor, while Model A2 can be used only with Submodel 3 or 4. Rated printing speeds for the different character sets and models are as follows:

	Model A1	Model A2
13-character set	750 lpm	600 lpm
39-character set	425 lpm	300 lpm
52-character set	350 lpm	260 lpm
63-character set	300 lpm	230 lpm

1403 PRINTER: Provides high-quality, buffered printing by means of a horizontal chain or train mechanism. Usable only with Submodel 1, 2, 5, and 6 Processors. Standard character set contains 48 characters, expandable to up to 240 with the optional Universal Character Set feature (for Models 2 and N1 only). Three models are available:

Model 2:	600 lpm;	132 print positions.
Model 7:	600 lpm;	120 print positions.
Model N1:	1100 lpm;	132 print positions.

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2152 PRINTER-KEYBOARD: Provides keyboard input and typed output. Rated output speed is 15.5 char/sec. Usable only with Submodel 2, 4, 5 and 6 Processors.

1255 MAGNETIC CHARACTER READER: Reads and sorts MICR-encoded documents from 5.75 to 8.875 inches in length, 2.5 to 4.25 inches in width, and 0.003 to 0.007 inch in thickness. Three models are available. Model 1 reads up to 500 six-inch documents per minute, while Models 2 and 3 read up to 750 six-inch documents per minute. Models 1 and 2 have six horizontal stackers arranged in a single vertical bay and require one and one-half sort passes for each digit position. Model 3 has twelve horizontal stackers in two vertical bays. All three models can also be used for off-line sorting. The optional Self-Checking Number, 51-Column Card Sorting, and Dash Symbol Transmission features are available for all three models. Model 3 can also be equipped with the High-Order Zero and Blank Selection feature, which reduces off-line sorting times. One 1255 can be connected to a Submodel 2, 5, or 6 Processor by means of a System/360 Model 20 Adapter and the Serial I/O Channel.

1259 MAGNETIC CHARACTER READER: Reads and sorts MICR-encoded documents at up to 600 per minute. Has 11 pockets. Usable only with Submodel 2, 5, or 6 Processor. Also usable for off-line sorting.

1419 MAGNETIC CHARACTER READER: Reads and sorts MICR-encoded documents at up to 1600 per minute. Has 13 pockets. Usable only with Submodel 2, 5, or 6 Processor. Also usable for off-line sorting.

COMMUNICATION CONTROL

BINARY SYNCHRONOUS COMMUNICATIONS ADAPTER (BSCA): Enables a Model 20 to communicate with a suitably equipped IBM System/360, System/370, System/3, 1130, or 1800 computer, or with a 2770 Data Communications System or a 2780 Data Transmission Terminal. The BSCA can be installed only on a Submodel 2, 4, 5, or 6 Processor with at least 8K bytes of core storage. Transmission is in half-duplex binary synchronous communications (BSC) mode over a single switched or leased line. Either ASCII or EBCDIC transmission code can be used. Transmission speed can be set at 600, 1200, 2000, 2400, 4800, 19,200, 40,800, or 50,000 bps; a High Speed feature is required for operation at or above 19,200 bps.

Several optional features are available to enhance the capabilities of the BSCA. The Full Transparent Text Mode feature permits transmission and reception of data in 8-bit binary image form as well as in EBCDIC or ASCII code. The Station Selection feature enables the BSCA-equipped Model 20 to operate as one of a number of BSC terminals on a multipoint line. The Internal Clock feature generates timing signals for use with modems that lack a clocking facility. The Automatic Calling feature enables the Model 20 to dial and initiate a call to a remote BSC terminal under program control.

SOFTWARE

PROGRAMMING SYSTEMS: No integrated operating system is available for the Model 20, but IBM offers software facilities at 3 basic levels:

CARD PROGRAMMING SUPPORT (CPS): A set of stand-alone, card-oriented programs that require 4K bytes of storage and support a maximum of 16K. Principal components are a Report Program Generator, Basic Assembler, Input/Output Control System, and a group of utility programs.

TAPE PROGRAMMING SUPPORT (TPS): A set of control, processing, and service programs for tape-oriented Model 20 systems. At least 8K bytes of core storage, 4 magnetic tape drives, card equipment, and a printer are required for full utilization of the TPS facilities. Principal components include a Report Program Generator, Assembler, Input/Output Control System, Sort/Merge Program, Initial Program Loader, Basic Monitor, Job Control, and various service and utility routines. The Basic Monitor and Job Control routines facilitate operations by providing automatic job-to-job transition and selective retrieval of programs from a system tape. The service programs handle maintenance of the system tape.

DISK PROGRAMMING SUPPORT (DPS): A set of control, processing, and service programs for disk-oriented Model 20 systems. At least 12K bytes of core storage, one 2311 Disk Storage Drive, card equipment, and a printer are required. Principal components include a Report Program Generator, Assembler, PL/I Compiler, Input/Output Control System, Sort/Merge Program, Initial Program Loader, Basic Monitor, Job Control, and various service and utility routines. The Basic Monitor and Job Control routines provide automatic job-to-job transistion and selective retrieval of programs from a system disk. The service programs facilitate maintenance of the system disk.

PL/I: The Model 20 PL/I Compiler supports a subset of OS/360 PL/I, a high-level language designed to handle both business and scientific problems. The Model 20 PL/I language is also a subset of the DOS/360 "Basic PL/I" language, except that one Model 20 facility, "arrays of structures," is not available in the DOS version. The Model 20 version accommodates data structures of up to eight levels, arrays of up to three dimensions, character strings, floating-point data items, variable-length tape records, sequential and indexed sequential disk files, free-form input, and built-in functions. Extensive diagnostic and debugging aids are provided. The PL/I compiler requires at least 16K bytes of core storage, one 2311 Disk Drive, card reader, and printer.

ASSEMBLERS: The three Model 20 Assemblers permit programs to be coded in a symbolic assembly language that is largely, though not completely, compatible with the Assembler language for the larger System/360 models.

The Basic Assembler is a one-for-one assembler that requires two passes and offers no macro facilities. Separate versions are available for card and tape systems with at least 4K bytes of core storage.

The TPS and DPS Assemblers provide macro-instruction facilities, literals, and other significant language extensions. The TPS version requires an 8K Processor and at least 3 tape drives, while the DPS version requires a 12K Processor and at least 1 disk drive.

REPORT PROGRAM GENERATORS: RPG is the most widely used programming language in Model 20 installations. The programmer prepares a set of specifications describing the input data, calculations, and desired output. The RPG then generates a program to perform the required functions. The Model 20 RPG's are of the "compile and go" type, but the object program can be punched into cards for future use if desired. Language facilities include

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multiple I/O files, table look-up, branching, report headings, and comprehensive diagnostics. A high degree of upward compatibility with the RPG's for the larger System/360 models is provided.

CPS (4K Card) RPG generates programs that handle card files and produce printed reports. Input records can be obtained from up to 3 different files.

TPS (8K Tape) RPG can generate programs that process multiple card and tape files. Up to 3 input files, 3 output files, and a printer can be used. Tape records can be fixed or variable in length and blocked or unblocked.

DPS (12K Disk) RPG can generate programs to process up to 29 card, tape, and disk files in any combination. Disk files can be organized in either sequential or indexed sequential fashion, and indexed sequential files can be processed either sequentially or randomly. Disk records are of fixed length, blocked or unblocked, while tape records may be either fixed or variable in length and blocked or unblocked. Recent additions to the facilities of DPS RPG include: (1) a CHAIN function that permits immediate retrieval of records from indexed sequential files; (2) an EXCPT function that allows multiple or exception records to be output during detail or total calculations; (3) edit codes that simplify the editing of output fields; and (4) a subroutine facility that reduces the need to write repetitive coding.

INPUT/OUTPUT CONTROL SYSTEM (IOCS): A set of macro-instructions that facilitate the coding of input/output operations. Available for use with all three Model 20 programming systems (CPS, TPS, and DPS), and in special versions designed to simplify control of the communications adapters and magnetic character readers.

SORT/MERGE PROGRAMS: Available for both 8K Tape and 12K Disk systems. These are generalized programs which require input specifications defining the parameters of each sort or merge. User-coded routines can be inserted into the input and output phases. The sort keys can be contained in up to 12 different fields with a total length of up to 256 bytes. The tape version uses from 3 to 6 tape drives and handles fixed or variable length, blocked or unblocked records. The disk version uses from 1 to 4 disk drives and handles blocked or unblocked records of fixed length.

UTILITY ROUTINES: A broad range of useful utility routines is available. They perform program loading, data transcription, file maintenance, diagnostic, and other commonly-required functions. Four Punched-Card Utility Programs enable a Model 20 system equipped with a 2560 MFCM to perform most of the functions of punched-card tabulating machines: collating, matching, sequence checking, gang-punching, reproducing, listing, summary punching, sorting, etc.

The Remote Job Entry (RJE) Work Station Programs enable a Model 20 equipped with the Binary Synchronous Communications Adapter to submit OS/360 jobs to a remote System/360 or 370 computer for execution and to receive the resulting output. RJE support for Model 20 is provided under CPS, TPS, and DPS.

APPLICATION PROGRAMS: The limited number of fully supported application packages currently available from IBM includes Wholesale IMPACT (inventory management), Bill of Material Processor, Requirements Planning and Inventory Control System, Hospital Patient Billing, Hospital Accounts Receivable, and Telephone Revenue Accounting.

PRICING

Prices for the following typical Model 20 configurations include all necessary attachments and control units. Monthly rental prices include equipment maintenance and are based on IBM's short-term rental rates. Savings of 8 or 16 percent on some peripheral devices are possible through IBM's new fixed-term leases, as described below.

MINIMUM CARD SYSTEM: Consists of 4K Submodel 3 Processor, 2560 Model A2 MFCM, and 2203 Model A2 Printer. Monthly rental and purchase prices are approximately $1,380 and $50,200, respectively.

For the above configuration with the faster Submodel 1 Processor, 2560 Model A1 MFCM, and 2203 Model A1 Printer, monthly rental and purchase prices are approximately $1,780 and $66,800, respectively.

TYPICAL DISK SYSTEM: Consists of 12K Submodel 6 Processor, 2501 Model A2 Card Reader, 1442 Model 5 Card Punch, 1403 Model 7 Printer, and two 2311 Model 11 Disk Storage Drives. Monthly rental and purchase prices are approximately $3,620 and $140,890, respectively.

For the above configuration with the faster Submodel 5 Processor, monthly rental and purchase prices are approximately $3,920 and $167,930, respectively.

SOFTWARE: Nearly all of the Model 20 software was in use before IBM's June 1969 unbundling announcement and is still available to users at no extra cost. No separately priced IBM Program Products for the Model 20 have been announced to date. Most of the CPS, TPS, and DPS software facilities are (or soon will be) in Programming Service Classification C; this means that the programs are now considered essentially bug-free and will no longer receive central programming support, although users can still get Field Engineering help on a billable basis.

SUPPORT: IBM Systems Engineering assistance is available to Model 20 users at a basic rate of $26 per hour.

EDUCATION: IBM "Professional Courses" are now 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.

CONTRACT TERMS: The standard IBM rental contract includes equipment maintenance and entitles the customer to up to 176 hours of billable time per month. Time used in excess of that amount is charged for, on all machines equipped with meters, at an extra-use rate. This rate, for most Model 20 components, is 10% of the basic hourly rate (i.e., 10% of 1/176 of the monthly rental for each hour of extra use).

IBM's Fixed-Term Lease Plan, applicable to the magnetic tape, disk, and printing equipment for the Model 20, allows an 8% price reduction for a contract period of 12 to 23 months or a 16% price reduction for a 24-month contract. Extra-use charges for overtime operation are eliminated under this plan, and up to two years of purchase option accruals are available. ■

IBM System/360 Model 20

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (short-term lease)*	Rental (12-month lease)*	Rental (24-month lease)*
PROCESSORS AND MAIN STORAGE						
2020	Processing Unit, Submodel 1					
	B1; 4,096 bytes	16,300	37.50	510		
	C1; 8,192 bytes	22,490	42.75	714		
	BC1; 12,288 bytes	30,550	48.75	969		
	D1; 16,384 bytes	37,990	53.00	1,220		
2020	Processing Unit, Submodel 2					
	B2; 4,096 bytes	18,700	40.75	586		
	C2; 8,192 bytes	24,900	45.75	790		
	BC2; 12,288 bytes	32,950	52.00	1,050		
	DC; 16,384 bytes	40,400	56.00	1,300		
2020	Processing Unit, Submodel 3					
	B3; 4,096 bytes	11,400	37.50	362		
	C3; 8,192 bytes	14,400	42.75	459		
	BC3; 12,288 bytes	19,380	48.75	617		
	D3; 16,384 bytes	24,100	53.00	775		
2020	Processing Unit, Submodel 4					
	B4; 4,096 bytes	12,800	40.75	402		
	C4; 8,192 bytes	15,640	45.75	499		
	BC4; 12,288 bytes	20,560	52.00	657		
	D4; 16,384 bytes	25,300	56.00	816		
2020	Processing Unit, Submodel 5					
	C5; 8,192 bytes	45,100	91.00	892		
	BC5; 12,288 bytes	57,300	102.00	1,140		
	D5; 16,384 bytes	71,900	107.00	1,400		
	DC5; 24,576 bytes	90,700	117.00	1,740		
	E5; 32,768 bytes	105,790	132.00	2,090		
2020	Processing Unit, Submodel 6					
	C6; 8,192 bytes	19,900	102.00	586		
	BC6; 12,288 bytes	30,100	112.00	816		
	D6; 16,384 bytes	40,800	117.00	1,020		
3901	1401/1440 Compatibility Feature (for 2020 Submodel 5 only)	14,000	29.50	280		
MASS STORAGE						
7495	Disk Storage Control for 2020 Submodel 2	7,550	5.00	229		
7496	Disk Storage Control for 2020 Submodel 4	5,650	5.00	175		
7497	Disk Storage Control for 2020 Submodel 5	7,550	5.00	229		
7498	Disk Storage Control for 2020 Submodel 6	7,550	5.00	229		
2311	Disk Storage Drive					
	Mod. 11; 5.4 million bytes	21,390	56.00	580	534	487
	Mod. 12; 2.7 million bytes	18,700	35.50	356	328	299
1316	Disk Pack	360		15		
MAGNETIC TAPE INPUT/OUTPUT						
4658	Input/Output Channel (required on 2020 for 2415)	5,030	4.75	153		
2415	Magnetic Tape Unit and Control					
	Mod. 1; 2 tape drives; 800 bpi	29,900	110.00	764	703	642
	Mod. 2; 4 tape drives; 800 bpi	47,800	197.00	1,220	1,122	1,025
	Mod. 3; 6 tape drives; 800 bpi	65,700	285.00	1,680	1,546	1,411
	Mod. 4; 2 tape drives; 800/1600 bpi	36,300	126.00	923	849	775
	Mod. 5; 4 tape drives; 800/1600 bpi	58,300	225.00	1,480	1,362	1,243
	Mod. 6; 6 tape drives; 800/1600 bpi	80,300	324.00	2,040	1,877	1,714
3228	Data Conversion Feature (for 2415; either 7125, 7127, or 7135 is a prerequisite)	1,760	1.00	45	41	38
5320	Nine-Track Compatibility (for 2415 Mod. 4, 5, or 6)	5,290	10.00	137	126	115
7125	Seven-Track Compatibility (for 2415 Mod. 1, 2, or 3)	1,950	1.25	50	46	42
7127	Seven-Track Compatibility (for 2415 Mod. 4, 5, or 6)	3,710	3.50	96	88	81
7135	Seven and Nine-Track Compatibility (for 2415 Mod. 4, 5, or 6)	6,060	13.25	157	144	132
5301	Native Tape Attachment (required on 2020 for 2401 Models 1, 2)	22,400	173.00	448		
5302	Native Tape Attachment (required on 2020 for 2401 Model 4)	27,200	316.00	545		
5320	9-Track Compatibility (for 2020)	7,650	43.75	153		
7125	7-Track Compatibility (for 2020 with 5301)	2,550	22.25	51		
7126	7-Track Compatibility (for 2020 with 5302)	5,610	33.50	112		
7135	7- and 9-Track Compatibility (for 2020 with 5302)	12,400	33.50	249		
2401	Magnetic Tape Unit					
	Mod. 1; 800 bpi, 30KB/sec	13,100	67.00	341	314	286
	Mod. 2; 800 bpi, 60KB/sec	19,000	76.00	494	454	415
	Mod. 4; 1600 bpi, 60KB/sec	15,000	80.00	392	361	329
3471	Dual Density Feature (for 2401 Mod. 4)	1,000	1.75	25	23	21
5121	Mode Compatibility Feature (for 2401 Mod. 1 or 2 when used with 5302)	387	No charge	10	9	8
CARD INPUT/OUTPUT						
Attachments for 2020 Processing Unit:						
4460	1442 Model 5 Attachment	1,000	2.50	30		
8090	2501 Attachment	683	2.00	20		
8092	2520 Model A1 Attachment	1,670	6.00	51		
8095	2520 Model A2 or A3 Attachment	867	3.00	25		

* Rental prices include equipment maintenance.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (short-term lease)*	Rental (12-month lease)*	Rental (24-month lease)*
CARD INPUT/OUTPUT (cont)						
8099	2560 Model A1 Attachment	2,510	4.75	76		
8100	2560 Model A2 Attachment	2,510	4.75	76		
1580	Card Print Control (required for 1575 on 2560)	831	2.25	25		
1442	Card Punch; 160 col/sec	12,600	53.00	260		
1501	Card Reader					
	Mod. A1; 600 cpm	11,200	35.50	198		
	Mod. A2; 1000 cpm	11,400	49.75	260		
2520	Card Read Punch; 500 cpm (Mod. A1)	33,100	99.00	744		
2520	Card Punch					
	Mod. A2; 500 cpm	28,700	94.00	663		
	Mod. A3; 300 cpm	28,500	73.00	479		
2560	Multi-Function Card Machine					
	Mod. A1; reads 500 cpm, punches 160 col/sec	27,500	98.00	627		
	Mod. A2; reads 310 cpm, punches 120 col/sec	20,200	98.00	489		
Card Print Feature for 2560 Mod. A1:						
1575	First Two Lines (requires 1580 on 2020)	5,990	14.25	137		
1576	Second Two Lines	5,990	14.25	137		
1577	Third Two Lines	5,990	14.25	137		
PRINTERS						
Attachments for 2020 Processing Unit:						
4442	1403 Mod. 2 Attachment	7,550	22.75	229		
4447	1403 Mod. 7 Attachment	7,380	22.75	204		
4448	1403 Mod. N1 Attachment	7,890	22.75	280		
5575	Printer Features Control (for 6410 or 6411 on 1403)	1,770	2.00	56		
8637	Universal Character Set Adapter (for 8640 or 8641 on 1403)	515	3.50	15		
8082	Attachment for standard 2203 Mod. A1	1,950	5.00	56		
8083	Attachment for 2203 Mod. A1 with 5558	1,850	5.00	56		
8084	Attachment for standard 2203 Mod. A2	1,850	5.00	56		
8085	Attachment for 2203 Mod. A2 with 5558	1,850	5.00	56		
3480	Dual Feed Carriage Control (for 3475 on 2203)	357	1.50	10		
1403	Printer					
	Mod. 2; 600 lpm; 132 print positions	28,500	174.00	764	703	642
	Mod. 7; 600 lpm; 120 print positions	27,400	135.00	642	591	539
	Mod. N1; 1100 lpm; 132 print positions	34,600	200.00	892	821	749
1376	Auxiliary Ribbon Feeding Feature (for 1403 Mod. 2 or 7)	2,590	16.00	74	68	62
4740	Interchangeable Chain Cartridge Adapter (for 1403 Mod. 2 or 7)	2,630	No charge	74	68	62
6410	Selective Tape Listing Feature (for 1403 Mod. N1)	6,810	10.00	187	172	157
6411	Selective Tape Listing Feature (for 1403 Mod. 2)	6,810	10.00	187	172	157
8640	Universal Character Set Feature (for 1403 Mod. N1)	387	1.75	10	9	8
8641	Universal Character Set Feature (for 1403 Mod. 2)	387	1.75	10	9	8
1416	Interchangeable Train Cartridge (for 1403 Mod. N1)	2,960		98		
2203	Printer					
	Mod. A1; 300 to 750 lpm	18,700	72.00	519	469	428
	Mod. A2; 230 to 600 lpm	14,300	72.00	397	359	328
5558	24 Additional Print Positions (for 2203)	2,010	4.00	45	41	38
3475	Dual Feed Carriage (for 2203)	4,080	8.50	101	92	84
7815	Tape Channels, 6 Additional (for 2203; 3475 is a prerequisite)	346	1.00	10	9	8
MISCELLANEOUS INPUT/OUTPUT						
2152	Printer-Keyboard	5,350	62.00	133		
8070	2152 Attachment (for 2020)	3,110	4.50	88		
1259	Magnetic Character Reader; 600 dpm	48,900	255.00	1,080		
1419	Magnetic Character Reader; 1600 dpm	109,000	245.00	2,420		
1255	Magnetic Character Reader					
	Mod. 1; 500 dpm, 6 stackers	39,400	214.00	821		
	Mod. 2; 750 dpm, 6 stackers	45,100	341.00	999		
	Mod. 3; 750 dpm, 12 stackers	61,400	448.00	1,320		
3215	Dash Symbol Transmission (for 1255)	35	No charge	50 (1-time)		
4380	51-Column Card Sorting (for 1255)	734	No charge	15		
4520	High-Order Zero & Blank Selection (for 1255 Mod. 3 only)	1,460	5.00	30		
7060	Self-Checking Numbers (for 1255)	2,370	2.50	49		
6360	System/360 Model 20 Adapter (required on 1255)	7,200	18.00	150		
7081	Serial I/O Channel (required on 2020 for 1255, 1259, or 1419)	3,550	6.50	102		
COMMUNICATIONS EQUIPMENT						
2074	Binary Synchronous Communications Adapter (for 2020 Processing Unit)	11,700	16.75	418		
1315	Automatic Calling (for 2074)	851	0.75	34		
4100	Full Transparent Text Mode (for 2074)	499	0.50	20		
4500	High Speed; 19,200 bps (for 2074)	1,210	0.75	49		
4501	High Speed; 40,800 or 50,000 bps (for 2074)	1,210	0.75	49		
4703	Internal Clock (for 2074)	627	0.50	25		
7477	Station Selection (for 2074)	729	0.50	29		

* Rental prices include equipment maintenance.