

Revised 8/73

IBM System/370 Addenda

MANAGEMENT SUMMARY

March 1973 was another busy month for IBM—and an even busier one for the competitors who are faced with the awesome task of attempting to match or surpass the continuing onslaught of new products and technologies from the industry giant.

IBM's March announcements included:

- The System/370 Model 115 Processing Unit, a virtual-storage computer that represents another comparatively small step toward filling the gap between the System/3 and System/370 computer families.
- The 3340 Direct Access Storage Facility, a new disk subsystem that provides high-performance, medium-capacity storage for DOS/VS systems and uses sealed Data Modules that contain read/write heads and access arms as well as disks.
- New models of the 3803/3420 Magnetic Tape Subsystem that read and record information at 6250 bytes per inch—nearly four times IBM's previous maximum density of 1600 bpi.
- The 3203 Printer, an improved version of the 1403 Model N1 Printer that provides output speeds of 600 or 1200 lines per minute for Model 115 or 125 systems only.

This report describes and analyzes the important additions to the System/370 computer line that IBM announced during March 1973: the Model 115 CPU, 3340 Direct Access Storage Facility, 3203 Printer, 6250-bpi magnetic tape units, 48-month Term Lease Plan, and other new developments.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, 1133 Westchester Avenue, White Plains, New York 10604.

MODELS:

System/370 Model 115 Processing Unit
3340 Direct Access Storage Facility
3803/3420 Magnetic Tape Subsystem
3203 Printer
5203 Printer

DATA FORMATS: Same as for the other System/370 models; see page 70C-491-04a.

MAIN STORAGE (MODEL 115)

TYPE: Monolithic integrated circuits (MOSFET).

CAPACITY: Two models of the 3115 Processing Unit are available:

Model F – 65,536 bytes
Model FE – 98,304 bytes



The Model 115, like the architecturally similar Model 125, includes a standard operator console with CRT display. The operator in the background is mounting a 3348 Data Module on a 3340 Disk Storage drive.

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- ● A new Term Lease Plan that permits unlimited usage of the virtual storage central processors at no additional monthly charge in return for a 48-month lease commitment.

Each of these important developments is briefly described and evaluated in the following paragraphs. For more details on each item, please refer to the Characteristics and Equipment Prices sections of this report. Also, please note that this Addendum covers *only* the IBM announcements of March 1973; for the details about all System/370 equipment and software announced through February 1973, please refer to the main IBM System/370 report, 70C-491-04.

SYSTEM/370 MODEL 115

The small-scale Model 115 Processing Unit joined the System/370 family on March 13, 1973, only five months behind the Model 125, which it strongly resembles in architecture and performance.

The Model 115 is upward-compatible with the larger System/370 processors, offers most of the same processing facilities, has the same virtual storage capabilities, and can use the same DOS/VS software facilities. It continues the IBM trends to MOSFET main memory and toward integrated controllers for most peripheral units, including up to 280 million bytes of high-performance 3340 Disk Storage and 12 data communications lines. Moreover, the Model 115, along with the Model 125, boasts two significant facilities that are not present in the larger Model 135 and 145 systems: a standard operator console with CRT display, and independent "satellite" processors that permit simultaneous instruction processing, input/output processing, and diagnostic/maintenance processing.

The Model 115 provides approximately two-thirds of the internal processing power of the Model 125 at a substantially lower cost. Monthly rental prices for typical Model 115 systems will range from \$5,891 to \$8,155, with purchase prices ranging from \$265,165 to \$352,115. Customer shipments are scheduled to begin in March 1974. The Model 115 was developed at IBM's laboratories in Boeblingen, Germany, and will be manufactured in Poughkeepsie, New York.

MOSFET (metal-oxide semiconductor field-effect transistor) main memory is featured in the Model 115, as in the larger Model 125, 158, and 168 Processing Units announced during the past year. The Model 115's main memory cycle time is a fast 480 nanoseconds per 2-byte access—exactly the same as that of the Model 125. Unlike most of today's computers, the Model 115 is available in only two main memory capacities: 65,536 or 98,304 bytes.

- CYCLE TIME: 480 nanoseconds per 2-byte access.

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. 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 Model 115.

CENTRAL PROCESSOR (MODEL 115)

REGISTERS: Sixteen 32-bit general registers, used for indexing, base addressing, and as accumulators, plus 4 floating-point arithmetic registers and 16 control registers.

INDIRECT ADDRESSING: None.

INSTRUCTION REPERTOIRE: Consists of the full System/370 instruction set as described in Report 70C-491-04. (Floating-point arithmetic, including extended-precision floating-point, is a no-cost optional feature.)

PERFORMANCE: Typical instruction execution rate of the Model 115 is approximately 1.0 to 1.5 times that of the System/360 Model 22 or Model 30, 1.5 to 3.0 times that of the System/360 Model 25, and 0.6 to 0.7 times that of the System/370 Model 125.

RELOADABLE CONTROL STORAGE: All Model 115 central processor operations are controlled by microprogramming. The microprograms for the Machine Instruction Processor (MIP), Service Processor (SVP), and Input/Output Processors (IOP's) reside in MOSFET Reloadable Control Storage (RCS) areas, which are separate from main storage. The MIP contains 20K words of RCS, each 22 bits wide, and holds the microprograms for instruction processing, disk input/output, and the optional Floating-Point and/or System/360 Model 20 Compatibility features. 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.

DYNAMIC ADDRESS TRANSLATION: This facility, standard in the Model 115, is the mechanism that translates the virtual storage addresses contained in instructions into real main storage addresses as each instruction is executed. A virtual storage space as large as 16,777,216 bytes can be addressed. A two-level address translation process divides the virtual storage space into segments of 65,536 bytes, which are in turn divided into 2,048-byte pages. Translation between the virtual and real addresses is accomplished by a hardware-implemented table-lookup procedure that accesses tables in main storage which are created and maintained by the operating system.

OPERATIONAL MODES: Model 115 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 new EC mode, the Program Status Word (PSW) and the layout of the permanently assigned lower main storage area are

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➤ One must seriously question the viability of a 65K real main memory capacity in a system designed for virtual storage operation—particularly since the required DOS/VS operating system has an absolute minimum residence requirement of 24K bytes and a *practical* minimum residence requirement of about 36K bytes. Even with the larger 98K memory size, it is likely that real main memory capacity will turn out to be the principal limiting factor on the throughput of most Model 115 installations.

Virtual storage in the Model 115 is handled in the same manner, and with the same 16-million-byte addressing capability, as in the larger System/370 models. Please refer to the main IBM System/370 report, 70C-491-04, for a detailed discussion of the operation, advantages, and disadvantages of virtual storage.

The Model 115, like the Model 125, employs distributed processing techniques. The CPU includes a Machine Instruction Processor (MIP), a Service Processor (SVP), and Input/Output Processors (IOP's), all of which can operate independently and simultaneously. The MIP interprets the program instructions and executes the internal operations of the system. The SVP controls the console operations and handles a variety of diagnostic and error-recovery functions. The IOP's control the system's I/O operations in place of conventional input/output channels; the number of IOP's varies with the configuration of each installation.

The microprograms that control all the internal operations of the Model 115 Processing Unit reside in Reloadable Control Storage (RCS), a MOSFET memory that is separate from main storage. The microprograms are loaded into RCS via the Console File, a small read/write disk drive that holds a removable magnetic "diskette."

There are some significant limitations on the peripheral equipment that can be used in a Model 115 system. The only available high-performance peripheral subsystem is the new 3340 Direct Access Storage Facility. From two to four 3340 drives, each capable of storing either 35 or 70 million bytes of data in a removable 3348 Data Module, can be connected directly to a Model 115 Processing Unit. Optional integrated I/O attachments permit direct connection of the following I/O devices:

- Either a 2560 Multi-Function Card Machine (for 80-column cards) or a 5425 Multi-Function Card Unit (for 96-column cards).
- One of three line printers: the 300-lpm 5203 Model 1, the 600-lpm 3203 Model 1, or the 1200-lpm 3203 Model 2.
- A 5213 Console Printer (85 char/sec).
- Up to 4 synchronous (BSC) and 8 asynchronous (start-stop) communications lines.

➤ altered to support Dynamic Address Translation and other new system control functions; therefore, the virtual-storage-oriented DOS/VS operating system must be used.

STANDARD FEATURES: All of the following features and facilities are standard on the Model 115 Processing Unit: Commercial Instruction Set, Extended Control Mode, Dynamic Address Translation, Channel Indirect Data Addressing, Program Event Recording, Monitor Call, Interval Timer, Time-of-Day Clock, CPU Timer and Clock Comparator, Store and Fetch Protection, Byte-Oriented Operand, and Audible Alarm.

OPTIONAL FEATURES: The Floating-Point feature, a no-cost option, adds 44 instructions to perform floating-point arithmetic in three different modes: short (1-word), long (2-word), and extended precision (4-word).

The External Signals feature provides six distinct external interrupt lines which are independent of the normal data channels and can be used to request and identify an external interrupt response from the processor.

The System/360 Model 20 Compatibility Feature is a no-charge option that, in combination with a special emulator routine, enables a Model 115 to execute programs written for the IBM System/360 Model 20.

Other Model 115 processor options are described in the sections on Input/Output Control and Communication Control, which follow.

CONSOLE: The Display Operator Console (DOC) is an integral part of the Model 115 Processing Unit. The console contains a typewriter-style keyboard, a CRT display, and a complement of switches and lights. The CRT can display sixteen 56-character lines of data. Data can be entered via the keyboard, displayed on the CRT for verification, and then directed into main storage or the CPU registers. Storage or register contents are displayed in hexadecimal notation. The keyboard and CRT can also be used as an inquiry terminal.

The 5213 Printer, Model 1, can be connected to the console via the Integrated 5213 Printer Attachment. The 5213 produces printed copies of input and output messages displayed on the CRT at a speed of 85 characters per second. Print line length is a maximum of 125 characters, spaced 10 to the inch, and vertical spacing is 6 lines per inch.

INPUT/OUTPUT CONTROL (MODEL 115)

In place of conventional I/O channels, Model 115 uses internal Input/Output Processors (IOP's) to control its I/O operations. Each IOP is implemented through microprograms in Reloadable Control Storage and can access main storage independently. The number of IOP's depends upon the configuration of each Model 115 installation.

A 3340 Direct Access Storage Facility with two to four disk drives can be connected directly to a Model 115 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)

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- ● A 3410/3411 Magnetic Tape Subsystem, Model 1 (20KB), Model 2 (40KB), or Model 3 (80KB), consisting of a control unit and up to four (Model 1) or six (Model 2 or 3) tape drives.

In addition, an optional Byte Multiplexer Channel permits the connection of a variety of other low-speed I/O devices, including paper tape readers and punches, optical mark readers, magnetic character readers, and additional card readers and punches. But the maximum data rate of the Byte Multiplexer Channel is only 19,000 bytes/second in byte mode or 29,000 bytes/second in burst mode, and no Block Multiplexer Channels nor Selector Channels are currently available for the Model 115.

Software support for the Model 115 centers on DOS/VS. Announced in August 1972 for delivery in June 1973, DOS/VS is an upward extension of the widely used System/360 DOS that supports virtual storage, permits up to five jobs to be processed simultaneously (compared with the previous three), includes a new 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, users will invariably 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 five fixed partitions and predetermine the programs to be executed in each partition. Thus, DOS/VS simply shifts the fixed-partition requirement of DOS from real storage into virtual storage—and thereby falls far short of delivering all the promised benefits of virtual-storage operation.

Model 115 users can take advantage of numerous compilers, assemblers, utility routines, and application programs available for use under DOS/VS. But the Model 115's limited main storage capacity precludes the use of IBM's more powerful OS/VS1, OS/VS2, or VM/370 operating systems and their associated facilities. And, unlike the larger Model 125, 135, and 145 systems, the Model 115 cannot operate under the older DOS system.

IBM is marketing the Model 115 as a growth system for current users of the IBM System/3, 1130, and System/360 Models 20, 22, and 25. Conversion to the Model 115 should be relatively simple for System/360 Model 22 and 25 users, reasonably straightforward for 360/20 users (thanks to the availability of an integrated 360/20 emulator for the Model 115), and far from easy for users of the architecturally dissimilar System/3 and 1130 computers.

Instruction execution rates of the Model 115 in typical applications will be approximately 1 to 1.5 times faster ➤

- 5213 Console Printer (85 char/sec)
3410/3411 Magnetic Tape Subsystem, Model 1 (20KB), Model 2 (40KB), or Model 3 (80KB)

Only one card unit and one line printer can be connected to a Model 115 by the integrated attachment method.

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/second in byte-interleaved mode and 29,000 bytes/second in burst mode. The Byte Multiplexer Channel and the Integrated Card I/O Attachment (for the 2560 MFCM or 5425 MFCU) are mutually exclusive unless RPQ Features 7B0141 and 7B0132 are installed.

No Block Multiplexer Channels nor Selector Channels are available for the Model 115.

MASS STORAGE

3340 DIRECT ACCESS STORAGE FACILITY: Provides fairly rapid random access to large quantities of data stored in interchangeable 3348 Data Modules. Usable with System/370 Models 115 through 158 under DOS/VS.

The 3340 drives are available in three models: A2, B1, and B2. Model A2 contains two drives and a control; it can be connected to a System/370 Model 115 or 125 via direct attachment, to a System/370 Model 135 via the Integrated File Adapter, to a System/370 Model 145 or 158 via the Integrated Storage Control, or to a System/370 Model 135, 145, 155-II, or 158 via a 3830 Model 2 Storage Control. The 3340 Models B1 and B2 contain one and two drives, respectively; they can be connected to a 3340 Model A2 to form a string of up to eight drives. The maximum numbers of 3340 drives that can be connected via the integrated attachments are 4 drives on a Model 115, 8 on a Model 125, 16 on a Model 135 or 145, and 32 on a Model 158. Up to 16 drives (2 strings of 8) can be connected to a 3830 Model 2 Storage Control. It is not possible to intermix 3330 and 3340 drives on the same attachment or control.

Each 3340 drive accommodates one 3348 Data Module, either Model 35 or Model 70, at a time. The Data Module is a self-contained unit that includes not only the magnetic disks, but also the associated access arms and read/write heads. Since the same heads always serve the same tracks, head alignment problems should be reduced and data reliability enhanced. Each Data Module is a sealed unit 8 inches high, 16 inches wide, 18 inches long, and 16 pounds (Model 35) or 18 pounds (Model 70) in weight. Loading of the Data Module is an automatic process; the operator simply places the Data Module on a drive, closes the drive cover, and turns on a switch. Processing can begin in less than 20 seconds. ➤

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▷ than those of the 360/22 and 1.5 to 3 times faster than those of the 360/25. Moreover, a 65K Model 115 system with 140 million bytes of 3340 Disk Storage can be rented for about the same price as a 32K 360/25 system with only 15 million bytes of 2311 Disk Storage.

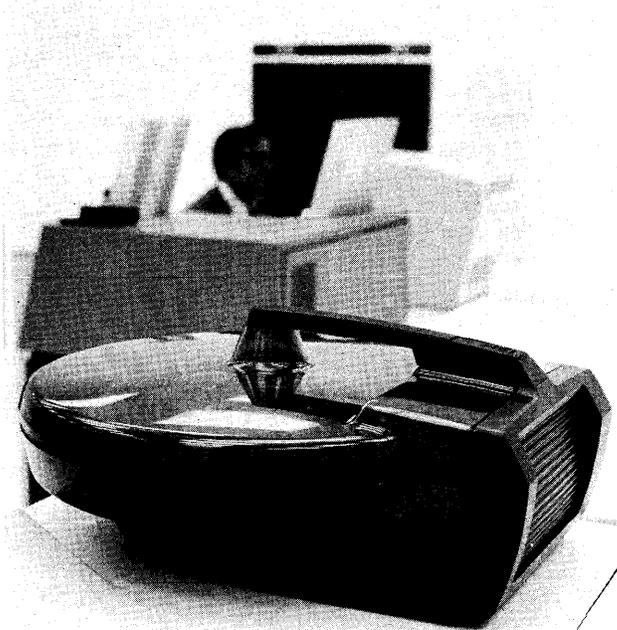
Users of the System/360 Model 30 will naturally view the Model 115 with great interest. For them, the new model offers somewhat higher internal performance together with significant reductions in equipment costs. IBM, of course, is not likely to encourage this type of conversion unless the alternative is loss of the account to another manufacturer. (Before moving to the System/370, users of all current IBM computers—and especially Model 30 users—owe it to themselves to carefully investigate the numerous possibilities for upgrading their present systems and/or reducing their costs by utilizing independent disk and tape drives, add-on main memories, proprietary software enhancements, third-party leasing, etc.)

Although IBM is billing the Model 115 as a logical growth system for large System/3 and 1130 installations, no emulation features have been announced to help smooth the conversion process for users of these systems. IBM does offer upward-compatible RPG II and FORTRAN compilers for the Model 115, but System/3 and 1130 users will encounter numerous differences in system control, data management, and operational characteristics which could hamper conversions to the System/370. What's more, the minimum Model 115 system rental of about \$5,900 per month still represents a large step upward for most System/3 and 1130 installations.

The appeal of the Model 115, like that of the larger System/370 models, is by no means limited to current users of IBM computers. The Model 115 offers a combination of virtues that few buyers of small-scale computers can afford to ignore: impressive price/performance, virtual storage, advanced hardware technology, high-performance mass storage, and largely proven software—plus the IBM nameplate and reputation, whose importance to many buyers could hardly be over-emphasized. Against these virtues, the prospective buyer must weigh the disadvantages of the Model 115's unbundled support, limited main storage capacity, restricted complement of I/O equipment, and relatively inefficient software.

3340 DIRECT ACCESS STORAGE FACILITY

Concurrently with the Model 115 announcement, IBM unveiled its long-awaited "Winchester" disk drive, officially named the 3340 Direct Access Storage Facility. Usable with System/370 Models 115 through 158 under DOS/VS, the 3340 features a totally new approach to interchangeable-cartridge disk storage: the disks, access arms, and read/write heads are all sealed into a removable



Weighing in at 16 or 18 pounds, the two models of IBM's new 3348 Data Module store up to 35 million or 70 million bytes of data, respectively, and combine the disks, access arms, and read/write heads into a single sealed cartridge.

▶ The 3348 Model 35 Data Module has 348 cylinders and a total storage capacity of 34.9 million bytes. Model 70 has 696 cylinders and a total storage capacity of 69.8 million bytes. Both models have 12 tracks per cylinder and can store up to 8368 bytes in each track. Both models exhibit the same performance: average head movement time is 25 milliseconds, average rotational delay is 10.1 milliseconds, and data transfer rate is 885,000 bytes/second.

In addition to the sealed 3348 Data Modules, the 3340 subsystem includes other features that should contribute to improved reliability. An error correction code permits automatic correction of an error up to 3 bits long and detection of an error up to 11 bits long in each record. A closed-loop air filtration system reduces airborne contaminants that might cause read/write errors. A read-only switch on every 3340 drive is activated by inserting a latch in the Data Module; when the latch is not inserted, the data is protected against erasure or overwriting.

The command set for the 3340 subsystem is essentially the same as the 2314/3330 command set with minor modifications. Customer shipments of the 3340 will begin in November 1973 for System/370 Model 125 systems and in March 1974 for other System/370 models. Software support will be furnished under DOS/VS for System/370 Models 115 through 158 (but not for the non-virtual-storage Model 155-I). The DOS/VS support will be available in November 1973, but support of the Rotational Position Sensing (RPS) feature will be delayed until June 1974. (RPS is an optional feature that reduces the load imposed on a channel by 3340 I/O operations; it is not supported on the System/370 Model 115.) ▶

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➤ cartridge called the 3348 Data Module. Because the same heads always serve the same data tracks within the same air-tight environment, the 3348 can provide reliable data storage at a recording density of more than 1.5 million bits per square inch—twice the density of the 3330 drives and nearly eight times that of the 2314. Detailed specifications of the 3340 subsystem can be found in the Characteristics section of this report, under the “Mass Storage” heading.

The principal characteristics of the new 3340 drives can be compared with those of the high-performance 3330 and the older 2314 drives as follows:

	<u>3340</u>	<u>3330</u>	<u>2314</u>
Maximum on-line data per spindle (millions of bytes)	35 or 70	100	29
Average head movement time (milliseconds)	25	30	60
Average rotational delay (milliseconds)	10.1	8.3	12.5
Maximum data rate (bytes per second)	885,000	806,000	312,000

The 3340 subsystem is priced at a somewhat lower cost per byte stored, and a much lower cost per spindle, than the 3330 subsystem. Thus, it is likely that most new DOS/VS installations will choose the 3340 in preference to the 3330. On the larger OS/VS systems, IBM has ensured the continued use of the 3330 drives by withholding software support for the 3340.

Clearly, the 3340's greatest impact will be on IBM's earlier 2311 and 2314-style drives and on their many plug-compatible counterparts from the independent peripheral makers. The 3340 subsystem provides huge improvements in performance over these older drives at a much lower cost per byte stored, and should therefore displace them at a rapid rate. Meanwhile, the independent peripheral firms will be rushing to design their plug-compatible replacements for the 3340 drives, while the independent disk pack manufacturers will be confronted with the formidable, if not impossible, task of retooling to produce the complex 3348 Data Modules.

The complexity—and resultant high cost—of those Data Modules represent the one critical flaw in the 3340 subsystem. At IBM'S purchase price of \$1600 for the 35-million-byte 2848 Model 35 and \$2200 for the 70-million-byte 2848 Model 70, these units are the most expensive interchangeable storage media to reach the EDP marketplace in many years. Thus, the high cost of the Data Modules may tend to cancel out the significant price/performance advantages of the 3340 drives themselves. At the very least, it will be economically impractical for an installation to use Data Modules in the same manner as magnetic tape reels—as so many installations are now using disk packs. Instead, the utilization,

➤ A System/370 Model 125 with 3340 Disk Storage can be equipped with a no-charge compatibility feature that enables it to execute DOS programs written for either IBM 2311 Model 1 or 2314 disk files. The data from four 2311 Model 1 disk packs or one 2314 disk pack can be contained in a single 3348 Model 35 Data Module, and a 3348 Model 70 Data Module holds twice as much data. Emulation of the 2311 Model 1 and the 2314 are mutually exclusive, and emulation can be performed only under DOS (Release 21 or later). Under DOS Release 21 through 27, the 1052 Compatibility Feature and the 5213 Model 1 Console Printer are prerequisites.

INPUT/OUTPUT UNITS

3803/3420 MAGNETIC TAPE SUBSYSTEM: New, high-performance models of the 3420 Magnetic Tape Units and 3803 Tape Control, announced on March 7, 1973, provide data transfer rates of up to 1.25 million bytes per second for System/370 Models 135 through 195. The new models employ a proprietary recording method called Group Coded Recording (GCR), which permits data to be recorded on standard 1/2-inch tape at an effective density of 6250 bytes per inch. Information to be written on the tape is segmented into groups of characters to which a special coding character is added. When GCR-coded data is read from the tape, the uniquely coded information is restored to its original form.

The three new models of the 3420 Magnetic Tape Unit—Models 4, 6, and 8—provide maximum data transfer rates of 470,000, 780,000, and 1,250,000 bytes per second, respectively. All three models can be equipped to operate either at the new 6250 bpi density only or at both 6250 and 1600 bpi. Unlike the earlier 3420 Models 3, 5, and 7, however, the new models cannot handle either 7-track tape or the 800-bpi 9-track format. The characteristics of the three new tape units are summarized in the following table.

	<u>Model 4</u>	<u>Model 6</u>	<u>Model 8</u>
Tape speed, inches/sec.	75	125	200
Data transfer rate, bytes/sec:			
At 6250 bpi	470,000	780,000	1,250,000
At 1600 bpi	120,000	200,000	320,000
Access time, milliseconds:			
Read, at 6250 bpi	2.3	1.6	1.1
Write, at 6250 bpi	2.1	1.5	0.95
Read, at 1600 bpi	4.0	2.6	1.7
Write, at 1600 bpi	3.0	2.0	1.3
Nominal inter-block gap, inches:			
At 6250 bpi	0.3	0.3	0.3
At 1600 bpi	0.6	0.6	0.6
Maximum rewind time, seconds/2400-ft reel	60	60	45

➤ The new 3803 Model 2 Tape Control provides the power and signal connections for the 3420 Magnetic Tape Units. Up to eight 3420 drives of any model can be signal-connected to a 3803 Model 2. A 3803 Tape Control (either Model 1 or Model 2) provides power for up to eight 3420 Model 3, 4, 5, 6, or 7 drives or for a maximum of six 3420 Model 8 drives. Seven-track and nine-track tape drives with

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➤ storage, and retention of all Data Modules will need to be carefully planned and controlled in order to minimize the total number required.

6250-BPI MAGNETIC TAPE UNITS

On March 7, 1973, IBM advanced the state of the art in magnetic tape recording by introducing new, high-performance models of its 3420 Magnetic Tape Units and 3803 Tape Control. The new models employ a new recording technique called Group Encoded Recording (GCR), which permits data to be recorded at an effective density of 6250 bytes per inch on standard 1/2-inch computer tape. Details of the new equipment can be found in the Characteristics section of this report, under "Input/Output Units."

IBM's new 6250-bpi recording density roughly triples the amount of information that can be stored on a single reel of tape. At an average block length of 2000 bytes, for example, a standard 2400-foot reel holds about 31 million bytes at 1600 bpi and about 93 million bytes at 6250 bpi. Thus, the higher density can yield major reductions in tape handling time, tape costs, and tape library storage requirements. These savings, coupled with the much faster data transfer rates and access times of the new units, should help to ensure the continued widespread utilization of magnetic tape equipment despite the ever-increasing popularity of disk pack drives.

Once again a major IBM technological advance has forced the independent peripheral manufacturers to play catch-up. It is worth noting, though, that on the day after IBM's announcement, Storage Technology Corporation announced a new 3600/3800 series of plug-compatible tape drives and control units that match the capabilities of the new IBM units and undercut their prices.

3203 PRINTER

Along with the System/370 Model 115, IBM introduced the 3203 Printer. This improved version of the popular 1403 Model N1 Printer employs the same horizontal-train printing technique and adds a number of new features that make it smaller, quieter, more reliable, and easier to operate than the 1403. Available in two models with rated printing speeds of 600 and 1200 lines per minute, the 3203 is currently usable only with System/370 Models 115 and 125. Detailed specifications of the 3203 can be found in the Characteristics section of this report, under "Input/Output Units."

At 1200 lpm, the 3203 Model 2 Printer is 100 lpm faster than the 1403 Model N1, while the 3203 Model 1 matches the 600 lpm speed of the 1403 Models 2 and 7. Both models of the 3203 also offer numerous worthwhile improvements over their 1403 counterparts. Unfortu- ➤

➤ various recording densities can be intermixed on a single 3803 Model 2, and a pool of up to 16 tape drives can be switched between 2, 3, or 4 control units.

At the new 6250-bpi recording density, IBM employs a more powerful encoding/checking technique that permits in-flight correction of errors occurring in any single track or in two track simultaneously. Moreover, errors in all nine tracks of a single data block can be corrected if they occur on no more than two tracks at a time. Long tape blocks are subdivided by "resynch bursts", which are inserted to allow error tracks to return to full operation when reading forward, thereby restoring the maximum error correction capability.

The 3420 Model 4, 6, and 8 Magnetic Tape Units employ a new tape cleaning mechanism and a high-precision tape motion control system. The cleaning mechanism is engaged during auto-threading, rewinding, and unloading operations to remove loose contaminants from the tape surface and protect the recording head. The improved tape motion control system permits a 50 percent reduction, from 0.6 inch to 0.3 inch, in the length of the gap between blocks of recorded data and also reduces the read/write access times. Other features of the previous 3420 models, such as automatic threading, cartridge loading, digital tachometers, and a radial interface, are retained in the new models.

The new 3803/3420 units can be used with System/370 Models 135 through 195. Software support will be provided under DOS/VS, OS, OS/VS1, and OS/VS2. Customer shipments are scheduled to begin in the fourth quarter of 1973, and field conversions of existing 3420 Magnetic Tape Units to the new models will begin in the first quarter of 1974. The new equipment is available under both IBM's Extended-Term and Fixed-Term Lease Plans.

3203 PRINTER: Uses IBM's proven horizontal-train printing technology to produce high quality printed output from either a System/370 Model 115 or Model 125 system. The 3203 is an improved version of the widely used 1403 Model N1 Printer and uses the same 1416 Interchangeable Train Cartridge. The 3203 is available in two models; rated print speeds with the standard 48-character set are 600 lpm for Model 1 and 1200 lpm for Model 2. Certain preferred character set arrangements permit speeds of up to 770 lpm for Model 1 and 1550 lpm for Model 2. Character sets containing from 30 to 240 characters can be used. The Universal Character Set feature, with a 240-position buffer, is standard. Both models have 132 print positions. Horizontal spacing is 10 characters/inch, and vertical spacing is 6 or 8 lines/inch. Forms ranging from 3.5 to 20 inches in width and from 3 to 24 inches in length can be fed. Normal skipping speed is up to 24 inches/second, with high-speed skipping at up to 55 inches/second after 6 lines have passed.

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

A single 3203 Printer, Model 1 or 2, can be connected to either a Model 115 or Model 125 Processing Unit via the appropriate Integrated 3203 Printer Attachment (#4650 on ➤

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➤ nately, this progress comes at a high cost to the user: purchase and rental prices of the 3203 models range from 26 to 44 percent higher than those of the corresponding 1403 models.

TERM LEASE PLAN

This new plan effectively marks IBM's entry into the long-term leasing business. The plan has a base term of 48 months and is currently available only for System/370 virtual storage processing units and their associated mainframe components. Monthly charges under the Term Lease Plan are the same as the basic rental charges under IBM's standard short-term lease—but the new plan permits unlimited use of the equipment at no additional charge. Details of the Term Lease Plan can be found in the Characteristics section of this report, under the "Pricing" heading.

In essence, the Term Lease Plan enables System/370 users who lease their equipment directly from IBM to eliminate overtime use charges on their central processors in return for a 4-year lease commitment. Thus, IBM has neatly eliminated one of the principal incentives for dealing with third-party leasing firms. Users, however, should not overlook the lower monthly charges and more flexible lease arrangements available from many of the independent leasing companies. □

➤ the 125, or #4650 and #4653 on the 115). First customer shipments are scheduled for March 1974. Software support for the 3203 will be provided under DOS/VS.

5203 PRINTER, MODEL 3: Uses an interchangeable, horizontal-chain cartridge to produce high-quality printed output from a System/370 Model 115 or a System/3 Model 10. 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 Processing Unit via the #4653 Integrated 3203/5203 Printer Attachment.

OTHER MODEL 115 I/O UNITS: Please refer to Report 70C-491-04 for detailed descriptions of the 2560 MFCM, the 5425 MFCU, the 3410/3411 Magnetic Tape Subsystem, and other I/O devices that can be used in a Model 115 system.

COMMUNICATION CONTROL (MODEL 115)

INTEGRATED COMMUNICATIONS ADAPTER (ICA): This optional feature for the Model 115 Processing Unit provides the basic control storage and common circuits for direct connection of up to 5 synchronous (BSC) communi-

cations lines or for up to 4 synchronous and 8 asynchronous lines, depending on the line speeds. The ICA 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 Model 115's Byte Multiplexer Channel via a 2703 Transmission Control.

The basic ICA can control either up to 8 asynchronous lines or up to 5 BSC lines. 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. 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.

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 4). 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 can communicate with virtually the full gamut of IBM computers and communications terminals.

SOFTWARE

Software support for the Model 115 will be provided by DOS/VS (Disk Operating System/Virtual Storage). Please refer to Report 70C-491-04 for a detailed description of DOS/VS and the associated compilers, assemblers, utility routines, and application programs.

DOS/VS will be extended to support the Model 115, the 3340 Disk Storage Facility, the 3203 and 5203 Printers, and—for the larger System/370 computers—Block Multiplexer Channels and Rotational Position Sensing. (RPS is not supported on the Model 115.)

The following System/370 Program Products will be supported for use on a Model 115 with 3340 Disk Storage under DOS/VS. All will be available with the first hardware delivery in March 1974 except for CICS (April 1974) and Coursewriter III (May 1974).

ANS Subset COBOL
CFO II
CICS/DOS/VS
Coursewriter III Version 3
DL/I DOS/VS
DOS/VS COBOL Compiler and Object Library
DOS/VS Sort/Merge
EPIC: Socrates, Fast, Budget/Finance, and Student
FORTRAN IV Library Option 1
HCS/Accounting, ECG, Lab. Info. System
HPPF II
PL/I Optimizing Compiler and Libraries
PL/I Resident and Transient Libraries
Planning System Generator II
RPG II
System/7 FORTRAN IV Host Compiler and Library
SL-Math
VANDL-I
AML/7 (in Virtual = Real mode)

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- Along with the Model 115, IBM announced two new System/370 Program Products: DOS/VS COBOL and DOS/VS Sort/Merge.

DOS/VS COBOL is an improved version of the DOS Full ANS COBOL Compiler, designed for operation exclusively under DOS/VS. It will provide support for VSAM and the following new devices: 3340 Disk Storage, 3203 Printer, 5203 Printer, 3540 Diskette I/O Unit (part of the 3740 Data Entry System), and 3886 Optical Character Reader. In addition, DOS/VS COBOL will provide an FIPS Flagger (which identifies each non-standard COBOL statement in a source program), a new syntax checking feature, and improved object-time performance. The monthly use charge is \$125 for the DOS/VS COBOL Compiler and Library or \$25 for the DOS/VS COBOL Library only. Both will be available in November 1973. The design point for the new compiler is 60K bytes of virtual storage.

DOS/VS Sort/Merge is an improved version of the DOS Sort/Merge, designed for operation exclusively under DOS/VS. It will support VSAM files, 3340 Disk Storage, and the RPS feature for both 3330 and 3340 Disk Storage. Several new control statements will give the new sort/merge package considerably more flexibility than its predecessor. The monthly use charge is \$60, and availability is planned for November 1973.

PRICING

Please refer to Report 70C-491-04 for details of IBM's pricing policies with respect to software, technical support, education, contract terms, and the Fixed-Term and Extended-Term Lease Plans.

SMALL MODEL 115 DISK SYSTEM: This typical Model 115 configuration consists of a 65K Processing Unit, 3203 Model 1 Printer (600 lpm), 5425 Model A2 MFCU (reads 500 cpm, punches 120 cpm), 3340 Model A2 Direct Access Storage Facility (2 drives plus control), and two 3348

Model 70 Data Modules (140 million bytes total capacity). Monthly rental and purchase prices are \$6,180 and \$264,510, respectively. The quoted rental price is for a short-term lease and includes equipment maintenance.

TERM LEASE PLAN: This new long-term leasing plan, announced in March 1973, has a base term contract period of 48 months. It is currently available only for the System/370 virtual storage central processors (Models 115, 125, 135, 145, 158, and 168) and their associated channels, consoles, power units, power and coolant distribution units, and multisystem units. For all these machines, the monthly charges under the Term Lease Plan are the same as the basic monthly rental charges under IBM's standard short-term lease.

The key advantage of the Term Lease Plan is that it permits unlimited use of the equipment with no additional use charges. Other significant provisions include: unlimited one-year extensions after the initial 48-month contract period; a single extension of less than one year; protection against increases in lease or purchase prices for the term of the contract; and purchase option accruals of up to 50 percent of the purchase price. Field-installable feature and model changes can be made at any time during the contract period. Termination charges for early discontinuance of a machine or feature are equal to the lesser of: (1) 25 percent of the Term Lease Plan monthly charge multiplied by the remaining months of its base term, or (2) 12.5 percent of the Term Lease Plan monthly charge multiplied by the total number of months in its base term (i.e., 48). IBM's 10 percent Educational Allowance applies to the Term Lease Plan.

The Term Lease Plan is offered under the terms of a new amendment and supplement to the Agreement for IBM Machine Service. These agreements can be executed at the time of the order, at any time during the on-order cycle, or after the equipment is installed. ■

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (short-term lease)*	Rental (12-month lease)*	Rental (24-month lease)*
MODEL 115 PROCESSING UNIT AND FEATURES						
3115	Processing Unit (for Model 115 systems):					
	Model F; 65,536 bytes	142,900	250.00	2,945		
	Model FE; 98,304 bytes	152,600	255.00	3,145		
3898	External Signals Feature	4,850	1.00	100		
3900	Floating Point Feature	No charge	No charge	No charge		
4650	Integrated 3203 Printer Attachment	3,700	6.00	75		
4653	Integrated 3203/5203 Printer Attachment (prerequisite for Feature 4650 or 4690)	3,800	7.00	80		
4670	Integrated 2560 MFCM Attachment	6,800	10.00	140		
4674	2560 Card Print Control	1,450	2.00	30		
4675	3411 Magnetic Tape Adapter	4,850	3.00	100		
4690	Integrated 5203 Model 3 Printer Attachment	3,700	6.00	75		
4692	Integrated 5213 Model 1 Printer Attachment	4,850	3.00	100		
4695	Integrated 5425 MFCU Attachment	6,800	16.00	140		
5248	Byte Multiplexer Channel	9,250	17.00	190		
7520	System/360 Model 20 Compatibility	No charge	No charge	No charge		
MODEL 115 COMMUNICATION FEATURES						
4640	Integrated Communications Adapter	9,950	21.00	205		
4641	Integrated Communications Adapter Extension	3,650	1.50	75		
1201	Asynchronous Line Group	1,950	3.00	40		
1231	Asynchronous Line, Medium Speed	1,950	2.50	40		
1241	Asynchronous Line Pair, Low Speed	2,650	3.50	55		
1291, 1292	Auto Call Adapter (line position A1 or A2)	950	1.50	20		
1295, 1296	Auto Call Adapter (line position S1 or S2)	950	1.50	20		
4743	IBM Leased Line Adapter	490	2.50	14		
IBM 1200-bps Line Adapters:						
4781	Non-switched	525	2.50	15		
4782	Switched with autoanswer	700	3.00	20		
4791	Switched with autocal and autoanswer	2,275	10.00	65		
4792	Line Adapter Base 2	1,200	2.00	25		
4793	Line Adapter Base 3	1,200	2.00	25		
7100	Synchronous Line Group	1,950	3.00	40		
7121	Synchronous Line, High Speed	4,850	7.00	100		
7141-7144	Synchronous Line, Medium Speed, with Clock	2,650	3.50	55		
7151-7154	Synchronous Line, Medium Speed	2,200	3.00	45		
7881	Telegraph Line Pair	2,650	7.50	55		
3340 DIRECT ACCESS STORAGE FACILITY						
3340	Model A2; Two drives plus control	40,000	74.00	999	—	850
3340	Model B1; One drive	22,000	40.00	558	—	475
3340	Model B2; Two drives	28,000	64.00	705	—	600
6201	Rotational Position Sensing (for 3340 B1)	760	0.50	19	—	16
6202	Rotational Position Sensing (for 3340 A2 or B2)	960	0.50	24	—	20
3348	Data Module (for 3340 drives):					
	Model 35; 34,944,768 bytes	1,600	Time & mat'l.	59		50
	Model 70 69,889,536 bytes	2,200	Time & mat'l.	82		70
3803/3420 MAGNETIC TAPE SUBSYSTEM						
3803	Tape Control, Model 2	43,000	130.00	1,130	1,040	949
5310	9-Track NRZ1 Feature (permits connection of 800-bpi drives to 3803-2)	3,850	1.50	100	92	84
6320	7-Track NRZ1 Feature (permits connection of 7-track drives to 3803-2; 5310 is prerequisite)	1,900	1.50	50	46	42
Tape Switching Features (for 3803-2):						
1792	2-Control Switch	7,650	10.00	200	184	168
1793	3-Control Switch	9,760	15.00	255	235	214
1794	4-Control Switch	11,480	15.00	300	276	252
8100	2-Channel Switch (for 3803-2)	5,740	5.00	150	138	126
3420	Magnetic Tape Units:					
	Model 4; 470,000 bytes/sec at 6250 bpi	24,000	50.00	625	575	525
	Model 6; 780,000 bytes/sec at 6250 bpi	28,000	55.00	720	662	605
	Model 8; 1,250,000 bytes/sec at 6250 bpi	31,000	80.00	805	741	676
6420	6250 bpi Density Feature (for 3420)	2,500	25.00	65	60	55
6425	6250/1600 bpi Density Feature (for 3420)	3,450	30.00	90	83	76
7850	3803-2 Attachment for 2860 Selector Channel	1,025	1.00	22	—	—
3203 PRINTER						
3203	Model 1; 600 lpm	38,000	185.00	940	—	800
3203	Model 2; 1200 lpm	49,000	240.00	1,234	—	1,050
1416	Interchangeable Train Cartridge (required on 3203 Model 1 or 2)	2,910	Time & mat'ls.	97	—	—
4650	Integrated 3203 Printer Attachment for Model 125 Processing Unit	7,500	13.00	155	—	—

* Rental prices include equipment maintenance; 3803/3420 Magnetic Tape Subsystem is available under either Extended-Term or Fixed-Term Lease; all other 24-month lease prices are for Extended-Term Plan only.