IBM 308X Series

MANAGEMENT SUMMARY

The 308X Series represents the top of IBM's large systems product line. The original model, the 3081 Model Group D, was announced in November 1980. In October 1981, IBM announced the 3081 Model Group K, which the company says offers a 30 to 40 percent performance improvement over the Model Group D. The improved performance has been achieved primarily by increasing the size of the high-speed buffer and by providing a more overlapped machine organization. The 3081 features a tightly-coupled dual-processor design and is compatible with both the System/370 and the 303X Series. The Model Group D can be upgraded to a Model Group K.

In March 1982, IBM announced three single-processor versions of the 3081 systems: the 3083 Model Group E, Model Group B, and Model Group J. The 3083 processors differ primarily in instruction execution rate and feature the same processor technology as the 3081 systems. The 3083 systems are seen as the successors to IBM's 303X Series.

The entry-level 3083 Model E has about 2.8 times the performance of the IBM 4341-2, and approximately half the power of the 3083 Model J. The 3083E is comparable in performance to the IBM 3033N, and costs about 11 percent less. The mid-range 3083 Model B has 1.4 to 1.5 times the power of the Model E, and is comparable in performance and costs about five percent less than the 3033U. The 3083 Model J has approximately half the performance of IBM's 3081 Model K processor, and about 1.3 times the power of the 3083B. The 3083J doesn't have a comparable 3033 model, unless either the 3033AP or 3033MP versions are considered. The 3083J has about 15 ▷

The 308X Series is a family of high-performance computer systems featuring single- and dual-processor configurations, flexible I/O capabilities, and System/370 and 303X Series compatibility. Models within the 308X Series can be upgraded, providing a growth path from the entry-level 3083E to the top-of-the-line 3081K.

MODELS: 3081 Model Groups D and K; 3083 Model Groups E, B, and J.
CONFIGURATION: One or two central processors with 8 to 32 megabytes of main memory, 32K or 64K bytes of buffer storage per processor (3081), and 8 to 24 integrated channels.
COMPETITION: Amdahl 470 and 580 Series, Burroughs B7800, Honeywell DPS 8/70, NAS AS/7000 and AS/9000 Series, NCR V-8600, and Sperry Univac 1100/80.
PRICING: Purchase prices range from $1,120,000 to $4,720,000.

CHARACTERISTICS

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

MODELS: 3081 Processor Complex Model Group D and Model Group K; 3083 Processor Complex Model Group E, Model Group B, and Model Group J.

DATE ANNOUNCED: Model Group D—November 12, 1980; 3081 Model Group K—October 21, 1981; 3083 Model Groups E, B, and J—March 31, 1982. ▶
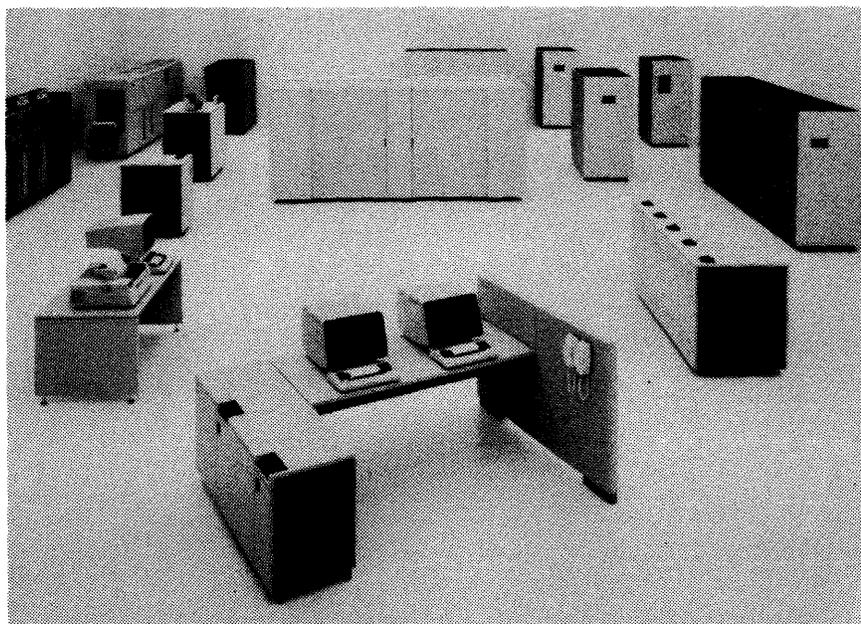
The 308X Series consists of the single-processor 3083 and the dyadic-processor 3081 systems. The 3083 is available with 8 to 32 megabytes of main memory and 8 to 24 integrated channels, while the 3081 comes with 16 to 32 megabytes of memory and 16 to 24 integrated channels.

▷ percent less power than these two systems, but costs about *half* the price of the two-processor 3033s.

CENTRAL PROCESSORS

The 3083 Model E has 8 megabytes of main memory as standard, and can be increased to 16 megabytes. Both the 3083 Models B and J start at 8 megabytes of memory, and can be expanded to 16, 24, or 32 megabytes. IBM states that the 3083 Model E can be field upgraded to the Model B, and the Model B can be field upgraded to the Model J, both in about five hours. The 3083 Model J can be field upgraded to the IBM 3081 Model K in about eight hours.

The 3081 systems are what IBM calls "dyadic" processors, consisting of two integrated CPUs operating under a single operating system. Each processor has access to 16, 24, or 32 megabytes of shared storage and its own set of channels. IBM states that although the 3081's dyadic structure is similar to the MP and AP complexes found in its 303X series, the new architecture is unique in that channels can be assigned to either CPU. Each Model Group D processor has a 32K-byte high-speed buffer, while each Model Group K processor has a 64K-byte buffer. The two-way integrated structure of the 3081 processors is said to offer greater system availability, since processing can continue in a reduced state even with one of the processors down. Channels can be automatically switched under program control to the functioning processor until the problem can be corrected. The 3081 cannot, however, be split into two uniprocessors executing simultaneously.

Main memory in all 308X Series processors has error checking and correction (ECC) code bits. All single-bit errors are corrected, and most double- and multiple-bit errors are detected. The memory access time is 312 nanoseconds using an eight-byte data path between processor and memory. Memory is added in eight-megabyte increments and costs $25,000 per megabyte.

A highlight of the 308X Series is the packaging of its logic components. The 308X uses the Schottky TTL logic chip, similar to that used in IBM's 4300 Series. While the chip technology is not new, the packaging is significant. Up to 118 chips are sealed in a helium-filled unit called the Thermal Conduction Module (TCM). The TCM is a field-replaceable unit (FRU) for ease of maintenance, and is designed to tie into the system's water-cooled environment. Each CPU is made up of eight TCMs, all mounted on a ceramic multi-layered board that contains all necessary connections.

IBM claims the new TCM affords increased computing power while reducing space requirements by about 21 percent, cooling by 70 percent, and power consumption by about 66 percent when compared to the company's 3033U processor with eight megabytes of memory.

All 308X systems include as standard the 3033 Extension feature, which improves processor execution times for functions such as I/O processing, paging, and real storage ▷

▶ DATE OF FIRST DELIVERY: 3081 Model Group D—fourth quarter 1981; 3081 Model Group K—second quarter 1982; 3083 Model Groups B and J—first quarter 1983; 3083 Model Group E—second quarter 1983.

DATA FORMATS

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

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format; or 4 words in "extended precision" format.

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

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

MAIN STORAGE

STORAGE TYPE: MOS (metal oxide semiconductor); 16K-bit RAM chips.

CAPACITY: 8, 16, 24, or 32 megabytes.

CYCLE TIME: 312 nanoseconds.

CHECKING: All data paths between the central processor and main storage are parity-checked by byte. When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and signalled so that appropriate program action can be taken.

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

RESERVED STORAGE: Similar to the System/370, main memory is reserved for interrupt routines, program status words, CPU timer logout area, machine-check interrupt code, and register save area.

CENTRAL PROCESSORS

The 3083 Processor Complexes represent the entry-level systems in the 308X Series. The basic Processor Complex consists of one central processor, main memory, an external data controller (EXDC) for channel control, and a system controller. Three 3083 model groups are available: the Model Group E, with 8 or 16 megabytes of main memory and 8 or 16 channels, the Model Group B, with 8, 16, 24, or 32 megabytes of memory and 8, 16, or 24 channels; and the Model Group J, with 8, 16, 24, or 32 megabytes of memory and 8, 16, or 24 channels. All models are identical in function, but vary in instruction rate. A Model Group E can be upgraded to a Model Group B, which in turn can be upgraded to a Model Group J. A Model Group J can be upgraded to a 3081 Model Group K.

The 3081 Processor Complex uses two central processors in a dyadic, or tightly coupled, arrangement. The basic processor unit includes the two integrated CPUs, shared central storage ▶

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CHARACTERISTICS OF THE 308X PROCESSORS

	3083 Model Group E	3083 Model Group B	3083 Model Group J	3081 Model Group D	3081 Model Group K
SYSTEM CHARACTERISTICS					
Date of introduction	March 1982	March 1982	March 1982	November 1980	October 1981
Date of first delivery	2nd qtr. 1983	1st qtr. 1983	1st qtr. 1983	4th qtr. 1981	2nd qtr. 1982
Number of central processors	1	1	1	2	2
Principal operating systems	MVS/SP, VM/SP	MVS/SP, VM/SP	MVS/SP, VM/SP	MVS/SP, VM/SP	MVS/SP, VM/SP
Monthly rental, basic system (4-year lease)	$37,400	$59,900	$79,300	$100,440	$124,000
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Read cycle time, nanoseconds	312	312	312	312	312
Write cycle time, nanoseconds	312	312	312	312	312
Bytes fetched per cycle	8	8	8	8	8
Storage interleaving	2-way	2-way	2-way	2-way	2-way
Minimum capacity, bytes	8,388,608	8,388,608	8,388,608	16,777,216	16,777,216
Maximum capacity, bytes	16,777,216	33,554,432	33,554,432	33,554,432	33,554,432
Increment size, bytes	8,388,608	8,388,608	8,388,608	8,388,608	8,388,608
Error correcting memory	Yes	Yes	Yes	Yes	Yes
BUFFER STORAGE					
Cycle time, nanoseconds	Not specified	Not specified	Not specified	26	26
Bytes fetched per cycle	Not specified	Not specified	Not specified	128	128
Capacity, bytes	Not specified	Not specified	Not specified	32,768 (each buffer)	65,536 (each buffer)
Time to fetch 8 bytes, nanoseconds	Not specified	Not specified	Not specified	52	52
PROCESSING UNIT					
Machine cycle time, nanoseconds	26	26	26	26	26
Processing unit features:					
Clock Comparator and CPU Timer	Standard	Standard	Standard	Standard	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard	Standard
Floating-Point	Standard	Standard	Standard	Standard	Standard
Extended-Precision Floating-Point	Standard	Standard	Standard	Standard	Standard
Direct Control	No	No	No	No	No
Virtual Machine Assist	Standard	Standard	Standard	Standard	Standard
OS/VS1 Extended Control Program Support	No	No	No	No	No
Instruction Retry Hardware	Standard	Standard	Standard	Standard	Standard
System/370 Extended Facility	Standard	Standard	Standard	Standard	Standard
3033 Extention	Standard	Standard	Standard	Standard	Standard
Extended Addressing	Standard	Standard	Standard	Standard	Standard
Multiprocessor systems:					
Tightly coupled	No	No	No	Yes	Yes
Loosely coupled	No	No	No	Yes	Yes
Attached Processor System	None	None	None	None	None
Integrated Storage Control	None	None	None	None	None
I/O CONTROL					
Integrated channels, standard	1 group of 8	1 group of 8	1 group of 8	2 groups of 8	2 groups of 8
Integrated channels, optional	1 group of 8	2 groups of 8	2 groups of 8	1 group of 8	1 group of 8
Selector channels	None	None	None	None	None
Data rates, bytes per second:					
Byte multiplexer	40,000 to 75,000	40,000 to 75,000	40,000 to 75,000	40,000 to 75,000	40,000 to 75,000
Block multiplexer	1.5 or 3.0 million	1.5 or 3.0 million	1.5 or 3.0 million	1.5 or 3.0 million	1.5 or 3.0 million
Maximum I/O data rate, bytes/second	72 million	72 million	72 million	72 million	72 million

▷ management. Extended Addressing, also standard, permits real storage capacity up to 32 megabytes.

In October 1981, IBM announced the System/370 Extended Architecture (370-XA), which provides extended addressing and additional channel capabilities for large MVS applications. Any 308X system can operate in either System/370 or 370-XA mode. In 370-XA mode, real and virtual storage addressing are expanded from 24 ▷

▶ (up to 32 megabytes), an EXDC for channel control, and a system controller. Two 3081 model groups are available: the Model Group D and the Model Group K. Both models are available with from 16 to 32 megabytes of main memory and from 16 to 24 channels. The primary difference between the two model groups is in the instruction execution rate. The 3081 Model Group K offers from 1.3 to 1.4 times the performance of the Model Group D.

Each of the 308X central processors is microcode-controlled and includes an instruction element (IE), variable field ▶

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bits (16 million bytes) to 31 bits (2 billion bytes). Bimodal operation permits the concurrent execution of 24-bit and 31-bit programs.

The 308X Processor Complexes are built around the 3081 or 3083 Processor Unit; a unique service and support component called the 3082 Processor Controller; the 3087 Coolant Distribution Unit (CDU), which regulates the flow of chilled water within the CPUs; a 3089 Power Unit (or any other suitable 415-Hz source); and two or three display consoles. An IBM 3278 Model 2A is required as the system console. A 327X or any appropriate IBM display can be designated the operator console, and optionally, a service support console. In addition, a 308X complex should include a card reader, printer, tape drives, and disk drives.

The 3082 Processor Controller, which extends the service processor concept of other IBM systems, provides the following functions: 1) monitors and controls the 308X complex, 2) houses the interface logic for each channel, 3) controls system reconfigurations, 4) performs automatic central storage validation testing and address assignment, and 5) provides system diagnostics and maintenance.

Input/output operations are controlled via the external data controller (EXDC), an integrated I/O processor that contains the system's channels. Eight integrated channels are standard in the 3083. Eight additional channels can be added to a 3083 Model Group E, while up to 16 additional channels can be added to a 3083 Model Group B or J. Sixteen integrated channels are standard on the 3081. Eight additional channels are optional. A new dynamic channel subsystem enables individual channels to operate with either central processor in a 3081 system.

Up to four channels can be byte multiplexer channels. Block multiplexer channels have the Data Streaming feature as standard, and can have both data streaming and non-data streaming devices intermixed on the same channel. Each block multiplexer channel, when operating in the data streaming mode, provides a maximum data transfer rate of 3 megabytes per second. Aggregate data rates of 72 megabytes per second across 24 channels are possible, according to IBM. Each channel can address up to 256 I/O devices or subchannels. Up to two Channel-to-Channel Adapters (feature #1850 for the first, 1851 for the second) are available to connect two processors (System/360, System/370, or 4300), via their channels, into "loosely-coupled" configurations.

This high-performance I/O capability permits a wide range of configurability in the 308X Series, particularly in the area of high-speed direct access storage devices. For example, IBM's 3380 DASD operates at the maximum 3-megabytes-per-second transfer rate, making it an ideal choice for the 308X user, particularly since all the system's block multiplexer channels support the data streaming feature. I/O devices available to the 308X user are summarized in the Characteristics section of this report and detailed in Report 70C-491-06.

element (VFE), execution element (EE), control storage element (CSE), and buffer control element (BCE). The central processor cycle time is 26 nanoseconds on all models.

Instruction sequencing, address generation for storage requests, and initiation of storage requests are handled by the instruction element (IE). The IE contains its own buffers, registers, and hardware to process instructions other than those executed in the VFE.

All storage-to-storage (SS and SSE) instructions are executed in the variable field element (VFE). The VFE has a decimal adder, two input (source) registers, and two output (sink) registers. While the IE is using data contained in one VFE input register, it can also be filling the other input register. Likewise, the IE moves data from the VFE output registers to the storage data register in the IE.

The execution element (EE) performs the following arithmetic operations: fixed point multiple/divide, convert to binary, convert to decimal, floating point, and extended precision floating point.

The control storage element (CSE), a logical component in the central processor that contains control storages and registers, controls microcode execution in the central processor. Microcode is paged in from the system area in main memory by the pageable part of control storage.

Immediate execution of in-place microinstructions is handled by a lookaside directory within control storage. Newly paged microinstructions overlay the least recently used (LRU) microcode.

Data movements between the central processors and memory are handled by the buffer control element (BCE). The BCE performs virtual-to-real address translation, controls the byte buffer (cache), and includes a 32K-byte cache, directory, directory lookaside table (DLAT), dynamic address translation (DAT) hardware, and a store-back array.

Each 3081 Model Group D central processor has a 32K-byte cache storage unit for high-speed access to instructions and data. Each 3081 Model Group K processor has a 64K-byte cache storage unit. The cache has a two-cycle access time for eight bytes of data. Address translation is performed in parallel. Lines of data in the cache are replaced using a least recently used (LRU) algorithm. The absolute addresses for lines of data contained in the cache are located in the directory. IBM has released no information on cache storage capacities for the 3083 processors.

Virtual-to-real address translation is performed by dynamic address translation (DAT) hardware. Once a virtual address is translated, the real address of the referenced page is stored in the directory lookaside table (DLAT), which contains up to 128 virtual/real address pairs. In System/370 mode, virtual addressing is limited to 16 megabytes. Using the standard extended addressing feature, addressing in excess of 16 megabytes of real storage can be achieved. In the new System/370 Extended Architecture (370-XA) mode, both real and virtual addressing are expanded to two billion bytes.

The 308X uses improved packaging techniques for its logic circuitry. Based on Schottky TTL in the form of gate arrays, the circuitry is contained in an enclosure called the thermal conduction module (TCM). The TCM is a helium-filled, encapsulated unit that has up to 118 silicon logic chips mounted on a multilayered ceramic substrate. Each central processor is made up of eight TCMs mounted on a multilayered board, which contains all chip and module interconnections. No external wiring or cabling is needed as a result of this design. The module is covered by a cold plate through which chilled water is circulated for heat dissipation. The TCM, according to IBM, provides increased computing

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▷ System reliability, availability, and serviceability (RAS) is assured through specific system features: 1) use of LSI circuitry packaged on thermal conduction modules (TCMs), 2) a checkpoint retry facility to detect processor errors, 3) automatic error data analysis with processor in continuous operation, and 4) several testing and monitoring facilities within the complex to keep a close eye on major system functions.

Data integrity and security in the 308X Series are maintained via key-controlled and low address storage protection, storage error checking, parity checking, Pageable Link Pack Area (PLPA) checking, and channel command and processor checkpoint retry facilities.

Additional standard features on the 308X include dynamic address translation (DAT), System/370 extended facility, the System/370 universal instruction set, virtual machine assist (VMA), the byte-oriented operand feature, and a new preferred machine assist feature that is designed to improve the performance of an MVS guest machine running under VM/SP.

SOFTWARE AND SUPPORT

The 308X Series is supported by the MVS/SP (Multiple Virtual Storage/System Product) and VM/SP (Virtual Machine/System Product) operating systems. To support the new System/370 Extended Architecture, IBM has announced MVS/Extended Architecture (MVS-XA). MVS-XA consists of two elements: MVS/SP Version 2 and the Data Facility Product (DFP). MVS/SP Version 2 includes all of the functions of Version 1 Release 3 plus the following enhancements: support for 31-bit real and virtual storage addresses, support for larger and more flexible I/O configurations, additional RAS features, and enhanced operator commands. The DFP provides data management, device support, program library management, and utility functions. New releases of MVS/SP Version 1 have also been announced.

In addition, IBM has announced VM/SP Release 2, which provides all of the functions of Release 1 plus a number of enhancements, including: programmable operator support, new CMS end-user functions, new CMS productivity aids, DIAL command support for remote BSC 3270 users, an enhanced query command, and enhanced ASCII support.

IBM states that any program written for the System/370 or 303X can be run on a 308X using MVS/SP or VM/SP provided the program 1) is not time-dependent, 2) is not dependent on the mix of system facilities and peripherals in the 308X, and 3) does not depend on results or functions as defined in the System/370 Principles of Operation. Details on these operating systems, as well as communications software and database management and applications programs, can be found in Report 70C-491-06. ▷

▶ power while reducing space requirements by 21 percent, cooling facilities by about 70 percent, and power requirements by about 66 percent when compared to the IBM 3033 Model U8. The TCM is a field-replaceable unit (FRU).

Memory in the 308X is implemented in monolithic and LSI technologies. A two-level design is used in each processor: central, or main, storage and the high-speed buffer (cache). Main storage in the 3083 is available in capacities of 8, 16, 24, or 32 megabytes. For the 3081, main storage is available in 16-, 24-, or 32-megabyte capacities, and is shared by both processors. The system area, typically an area of memory of at least 262K bytes, is designated at initial microcode load (IML) for system usage and is not available for user programs. Main memory is configured in two or more direct-access basic storage elements (BSEs) which have the logic for fetching or storing doublewords from or into the data arrays. Memory has two-way interleaving of contiguous 2K-byte blocks of storage. Error checking and correction (ECC) bits are stored with data in the data arrays.

The system controller is the switching point in the 308X, and interconnects the logical units of the complex: the central processor(s), central storage, and the external data controller (EXDC). It performs the following activities:

- Controls data transfers.

- Resolves conflicts between the two 3081 CPUs.

- Switches data flow between various processor components; CPUs, memory, and EXDC.

- Maintains the storage protection array and the time-of-day clock.

- Blocks access to central storage from a requesting 3081 processor until the processor in use has successfully completed a data transfer.

- Assigns priorities to and keeps track of storage module accesses.

Error handling in the 308X is provided on several levels for maximum efficiency. All recovery procedures are handled through the 3082 Processor Controller. Error correction and recovery are tried as the first step. Processor checkpoint retry in the CPU, channel error detection and recovery for the channels, and error checking and correction in central storage represent the specific methods used in the individual system elements. If an error cannot be pinpointed through normal routines, the 3082 initiates a probability calculation as to the most likely place an error could occur.

Processor checkpoint retry uses a series of error detection latches and backup facilities which are periodically tested by each processor for errors. If there are no errors, a checkpoint is taken by the CPU. A checkpoint is a reference marker, stored within the backup facilities, that retains information about the state of the CPU at the time the checkpoint was taken. If an error is detected by a CPU, instruction execution stops, the CPU generates an error logout, and returns to the last checkpoint. The processor can be restored to its operational state as of the checkpoint, and processing can be restarted from this point.

Retry is performed up to seven times by the CPU. If the error has not been corrected by the seventh retry, the processor either enters the check-stop state or takes a machine-check interruption. An interruption is also generated in the check-stop state. If the error is corrected by the seventh try, normal processing resumes. According to IBM, processor checkpoint retry is an improved recovery method over older systems because it involves a retry of a series of instructions, rather than of a single instruction. ▶

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▷ **COMPETITIVE POSITION**

Of the major plug-compatible mainframe (PCM) manufacturers, only Amdahl and National Advanced Systems (NAS) compete in the 3083/3081 performance range. In terms of processor performance, the 3083E competes with the Amdahl 470/V7A and the NAS AS/7000, the 3083B competes with the 470/V7 and the AS/7000 DPC, and the 3083J goes one-on-one with the 470/V8 and the AS/9000N. All systems are fairly close to one another in price. Among the major mainframe manufacturers, the Burroughs B 7800, Honeywell's DPS 8/70, NCR's V-8600, and Univac's 1100/80 Series can compete in the 3083 performance range.

The chief competitors to IBM's 3081 currently are the Amdahl 580 Series and National Advanced Systems' AS/9000 family. The Amdahl 580 consists of three models, the uniprocessor 5860 and the dual-processor 5870 and 5880. The AS/9000 comes in three versions: the entry level AS/9000N, the standard AS/9000-2, and the dual-processor AS/9000 DPC. The dual-processor Amdahl 5870 offers performance comparable to the 3081 Model Group K. The Amdahl 5880 and NAS AS/9000 DPC are substantially more powerful than the 3081.

Volume shipments of the 3081 Model Group D began in the fourth quarter of 1981. The Model Group K was scheduled for delivery in the second quarter of 1982. The 370-XA mode will be available for all 308X processors in the first quarter of 1983.

All models of the 3083 Model E will be available starting in the second quarter of 1983. The 3083 Models B and J (with more than 8 megabytes of memory and 8 channels) will be available in the first quarter of 1983. These same systems in 8-megabyte and 8-channel configurations will be available the second quarter of 1983. Field upgrades from Models E to B and Models B to J will start in the third quarter of 1983, while field upgrades from the 3083 Model J to the 3081 Model K are scheduled for the fourth quarter of 1983.

USER REACTION

Twenty-seven IBM 3081 users with 39 installed systems responded to Datapro's 1982 survey of general-purpose computer users. The average life of these systems was 8.7 months. Twenty of the users had converted to the 3081 from another system, in most cases an IBM 303X Series or System/370.

All 27 respondents developed applications programs in house, 16 also used packaged programs from IBM, and 19 used proprietary software packages from other vendors. Cobol was the primary programming language used in 24 of the installations. ▷

▶ Detecting channel errors can involve either the 3082 Controller or an I/O control unit, depending on the error. If the 3082 is involved, error recovery can be performed via the control program, or the 3082 can temporarily stop channel operation to investigate channel status information before reinitializing the I/O devices in use. If the error is detected by a control unit, the 3082 may not have to be used, since the control unit can issue a command retry to the channel without an I/O interruption occurring.

Within central storage, all single-bit errors are detected and corrected. Error checking and correction (ECC) also detects all double-bit and most multiple-bit errors but does not correct them.

The IBM 308X Series has a high level of reliability, availability, and serviceability (RAS) assured through several important system features:

● A central processor, made up of eight TCMs and associated board, that needs no external wiring or TCM-to-TCM cabling.

● In the 3081, an integrated two-way processor design that permits a failed CPU to be removed from the configuration, while processing can continue on the other CPU. This allows continued processing and deferred servicing.

● The ability to switch channels associated with a failed CPU to the functioning CPU in a dual-processor 3081 system.

● The 3082 Processor Controller, which provides a wide range of maintenance and diagnostic routines for on-site servicing, and has a data communication link for contacting IBM field support personnel.

● Remote diagnostics conducted by IBM support personnel using the field engineering RETAIN program.

3082 PROCESSOR CONTROLLER: This is a unique, free-standing processor that concurrently supervises and monitors all ongoing activities in the 308X complex. Three models are available, depending on the number of channels present: Model 8, for 8 channels; Model 16, for 16 channels, and Model 24, for 24-channel systems. The 3082 acts as the controller for the system console (an IBM 3278 Model 2A), the service support console, an optional printer, and an optional programming support console. The system console interacts directly with the 308X, displays system status, and performs all standard console functions. The service support console interacts with the diagnostic routines built into the 308X processor and can also function as a backup console. The programming support console is a 3278 Model 2 equipped with a switch to change from a programming support device to a diagnostic console. The optional printer can be a 3230 Model 2, 3268 Model 2, or 3287 Model 1 or 2.

The 3082 Processor Controller also functions as the system monitor and supervisor, providing the following services:

● Controls system power-on sequencing and initial microcode load (IML).

● Monitors voltage levels and coolant flow in the processors.

● Controls dynamic reconfiguration of processor elements such as CPUs, central storage arrays, channel groups, and interface adapter elements.

● Performs a system sampling operation that can extract specific system performance data.

● Initiates processor unit error recovery measures such as checkpoint retry and error analysis and isolation. ▶

The survey respondents were asked to rate their computer systems in 14 specific categories. Their ratings of the 3081 are summarized in the table below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	10	13	4	0	3.22
Reliability of mainframe	19	7	1	0	3.67
Reliability of peripherals	10	15	2	0	3.30
Maintenance service:					
Responsiveness	13	12	1	0	3.46
Effectiveness	13	12	1	0	3.46
Technical support:					
Trouble-shooting	10	14	2	0	3.31
Education	7	12	6	1	2.96
Documentation	9	11	6	0	3.12
Manufacturer's software:					
Operating system	8	17	1	1	3.19
Compilers & assemblers	7	16	4	0	3.11
Application programs	2	12	9	1	2.63
Ease of programming	5	16	6	0	2.96
Ease of conversion	11	11	5	0	3.22
Overall satisfaction	12	12	3	0	3.33

*Weighted Average on a scale of 4.0 for Excellent.

In order to gain further insight into users' experiences with the 3081, we interviewed five users and asked for their comments. (Three of these users were interviewed prior to our survey, and two were survey respondents.)

One user interviewed represented a large insurance company that converted in February 1982 from an Itel (now NAS) system to a 3081 system. Before making a decision, the company conducted an extensive survey to compare the 3081 with competitive systems from NAS and Amdahl. The 3081 was selected because it appeared to meet all of the company's needs through 1985. This user also stated that he "felt safer with IBM." He said the installation "went like clockwork." The 3081 was installed over a weekend and was up and running on Monday. He further commented that he has experienced no problems with the 3081 and that IBM has been very responsive to his needs. This user also stressed the importance of negotiating a good contract. Both he and his company have had many years of experience in dealing with various computer vendors, so they "knew what to ask for."

A Midwestern manufacturing firm replaced a 3033U12 with a 3081D16 system in February 1982. The company is still using a 3033N, but plans to replace it with another 3081 at the end of the year. The DP Manager said he had considered a plug-compatible mainframe, but chose the 3081 for its technology and performance. He said he had experienced no problems with the 3081 and was very well satisfied with it.

A Western scientific organization installed a 3081 in January 1981 as an upgrade to a System/370 Model 168, which was still in use. This user cited reliability and performance as the major strengths of the 3081, and said he was "super pleased" with it. He said he had experienced "almost no downtime."

• Provides a data communications link to IBM field support.

• Contains an integrated processor control file with system information libraries for microcode, I/O configuration, channel parameters, and diagnostics.

The 308X Processor Complex also requires a 3087 Coolant Distribution Unit (CDU) and a 3089 Power Unit (or other appropriate 415-Hz power supply). The 3087 CDU controls the temperature and flow of chilled water through the thermal conduction modules (TCMs). The CDU has two pumps, one of which is on stand-by for activation if the operating pump fails. In March 1982, IBM introduced the 3087 Model 2 for use with the new 3083 systems only. The 3087 Model 2 dissipates the heat generated by the 3083 into the air of the computer room, rather than transferring the heat into the building's chilled water supply.

OPERATIONAL MODE: The 308X Series processors operate in the Extended Control (EC) mode or in System/370 Extended Architecture (370-XA) mode. In the EC mode, the Program Status Word (PSW) and the layout of the permanently assigned lower main storage area are altered to support Dynamic Address Translation and other new system control functions; therefore, the virtual-storage-oriented operating systems must be used. The 370-XA mode supports 31-bit addressing, larger and more flexible I/O configurations, and channel path selection under hardware control.

INSTRUCTION REPERTOIRE: The 308X Series uses the System/370 Universal Instruction Set, which includes 156 instructions that provide binary, decimal, and floating-point arithmetic operations. The System/370 instruction set includes complete arithmetic facilities for processing variable-length decimal and fixed-point binary operands, as well as instructions which handle loading, storing, comparing, branching, shifting, editing, radix conversion, code translation, logical operations, packing, and unpacking. In addition, a group of "privileged instructions," usable only by the operating system, handle input/output and various hardware control functions.

INTERRUPTS: Two types of interrupts can be generated; normal and error. Normal interrupts include channel end, device end, attention status, and busy status. Error interrupts include those caused by data parity error, address parity error, invalid buffer address, keyboard, parity error, keyboard invalid address, command byte parity, and invalid command.

Additional key features standard on the 308X Processor Complex include:

• Channel indirect addressing, which permits contiguous areas of virtual storage to be mapped into noncontiguous areas of real storage.

• Channel set switching, which dynamically switches channel sets between processors under program control.

• A dynamic channel subsystem for the 3081, which enables individual I/O channels to operate with either central processor. Either CPU can initiate I/O requests to, or handle I/O interrupts from, any I/O device.

• Data streaming, which permits data transfer rates up to 3 megabytes/second on block multiplexer channels.

• Extended addressing, which permits the addressing of real storage in excess of 16 megabytes. With MVS/SP, user programs and portions of the control program can be located at real addresses up to 32 megabytes.

• A 31-bit addressing capability, which expands both real and virtual storage addressing to 2 billion bytes. Both 24-bit and 31-bit programs can execute concurrently.

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▷ An Eastern insurance company installed the 3081 in August 1981. The company was also using 3033 and System/370 Model 168 systems. This user stated that the 3081 provided better performance than the earlier systems and that he had experienced no downtime as yet. He said he was very well satisfied with the system. He further commented that the only disadvantage to the 3081 was availability. He would like to add additional systems, but must wait for delivery.

The fifth user represented an Eastern service company with two 3081 systems. One system was installed in October 1981, and one in December 1981. This installation was also using a 3033 and a System/370 Model 168. The user said that the major strengths of the 3081 were "speed and reliability." He said he was very well satisfied with the 3081, and would be even better satisfied when his 3380 disk drives were delivered. He commented that the 3350 disk drives he was using were "too slow" for his applications.

The users' ratings and comments show that most were quite well satisfied with their 3081 systems. Twenty-five of the 27 survey respondents said they would recommend the system to others, one said he would not recommend the system, and one was undecided.□

➤ • System/370 extended facility, which speeds up certain supervisor functions, improves the efficiency of dynamic address translation, and improves CPU availability by protecting certain low-address central storage locations, all while operating under MVS/SP.

• Byte-oriented operand feature, which allows byte boundary alignment of the operands of most unprivileged instructions.

• Virtual machine assist (VMA), which improves virtual system performance under VM/370 by reducing the time VM/370 spends in the real supervisor state. VMA has been enhanced to allow the segment protection function to be performed by VMA instead of by the VM control program.

• Preferred Machine Assist, which is designed to improve the performance of an MVS guest machine running under VM/SP. The feature provides the guest operating system with complete control of the processor, dedicated channels, and I/O devices.

• 3033 Extension, a microcode assist that improves MVS/SP performance via controlled, cross-address-space access.

Up to two channel-to-channel adapters are optional on the 308X to interconnect the 308X and another system via a channel from each unit. Additional eight-channel groups, which increase the number of channels from 8 to 16 or from 16 to 24, are also optional.

INPUT/OUTPUT CONTROL

The 308X uses an external data controller (EXDC) to handle all I/O operations. A fully integrated I/O processor, the EXDC contains 8 channels as standard on the 3083 and 16 channels as standard on the 3081. In 370 mode, channels on the 3081 are organized logically into two sets (one for each CPU), with a maximum of 16 channels permitted in one set.

In 370-XA mode, any channel can operate with either CPU. Physically, the channels on the 3081 are configured into two (standard) or three groups of 8 channels each. The 3083 Model Group E can have a maximum of two 8-channel groups, while the 3083 Model Groups B and J can have a maximum of three 8-channel groups.

Channels can be configured as either byte or block multiplexer channels. A maximum of four byte multiplexer channels per system is possible. Block multiplexer channels are generally used when byte multiplexer channels are not needed. Any channel in the system can be given a valid channel address, but the addresses must be contiguous within the channel set. Block multiplexer channels can operate in either the standard DC interlock or 3-megabytes-per-second data streaming mode. Up to eight I/O control units can be attached to either a byte or block multiplexer channel, and each channel can address up to 256 I/O devices (each on its own subchannel).

The EXDC has a microcode-controlled Channel Processing Element (CPE) that fetches channel command words (CCWs), starts and ends data server element (DSE) operations, analyzes status, posts interruptions, and assists DSEs in command chaining and indirect addressing. The CPE has up to three DSEs (each associated with a channel set) that control data transfers between the I/O devices and central storage. Each DSE operates with eight interface adapter elements (IAEs) that are connected to the channels in the DSE. An IAE performs service-in and service-out tagging, identifies incoming data transfers and signals the proper DSE, and provides data during data transfers.

MASS STORAGE

The 308X Series can use nearly all of the mass storage devices available in the 303X Series (Report 70C-491-06), including the following high-performance models in particular:

IBM 3370 DIRECT-ACCESS STORAGE: Provides up to 285.6 megabytes of storage per actuator and 571.3 megabytes per drive. The 3370 can be connected to a 3880 Storage Control unit. The 3370 was introduced in 1979 with the introduction of the IBM 4300 Series. The 3370 employs thin-film technology heads and high-density LSI circuitry. Each 3370 has a single 571.3-megabyte spindle of disks which are accessed by two independent, movable actuators. The 3370 makes use of fixed block architecture, which provides for recording data in permanent pre-formatted 512-byte blocks on the disk surface. Each block of data is separately addressable and separately accessible, either singly or in contiguous strings of a variable number of blocks (maximum, approximately 65,000). The 3370 has 558,000 blocks per actuator, 285,696,000 bytes per actuator, and 571,392,000 bytes per drive. Minimum, average, and maximum head movement times are 5, 20, and 40 milliseconds, respectively. Average rotational delay is 10.1 milliseconds, and the data transfer rate is 1,859 megabytes per second.

The 3370 is available in two models. The 3370 Model A1 contains the control adapter functions required for attachment to the 3880. The 3370 Model B1 attaches through an A1 unit. Up to three 3370 Model B1s can be attached to a 3370 Model A1 for a maximum of four units per string.

IBM 3375 DIRECT-ACCESS STORAGE: The 3375 is a newer count-key-data formatted disk drive that provides 819 million bytes of storage capacity. It was announced by IBM on June 11, 1980, and is designed primarily for use with IBM 303X, 308X, and 4300 processors. The 3375 is similar in most respects to the 3370 Direct-Access Storage. The principal differences between the two devices are in storage capacity and data format. The 3375's 819-megabyte capacity is 43 percent larger than the 3370's 571 megabytes, and the 3375 uses the count-key-data format employed in the 3380, the ➤

3350, and other large-capacity IBM disk drives in contrast to the fixed 512-byte blocks used in the 3370 and 3310.

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

The 3375 provides significant savings in floor space, power, heat output, and cost per byte when installed in place of existing IBM 3340 or 3350 disk storage. The 3375 subsystem also offers numerous improvements in reliability, availability, and serviceability. No scheduled preventive maintenance is required. Data error bursts of up to 16 bits are detected and corrected automatically if the bursts do not span more than two contiguous bytes.

IBM 3380 DIRECT-ACCESS STORAGE: Announced on June 11, 1980, the 3380 offers a significantly larger storage capacity, faster data transfer rate, and lower cost per byte than any previous IBM disk drive. Each 3380 drive unit has a data storage capacity of 2.52 billion bytes, an average seek time of 16 milliseconds, an average rotational delay of 8.3 milliseconds, and a data transfer rate of 3.0 megabytes per second. Each 3380 unit contains two 1.26-billion-byte head and disk assemblies (HDAs), which are permanently mounted and house the heads, disks, and access mechanisms in a sealed enclosure. Each HDA, in turn, has two actuators, and each actuator accesses 630 megabytes of data. A 3380 string can consist of up to 4 drive units and 16 actuators, with each actuator operating independently and overlapping its seeking and rotational position sensing operations with those of other actuators. There are three models of 3380 Direct Access Storage, all with the same 2.52-gigabyte storage capacity.

The 3380 can be used with the 308X Processor Complex. One of three models of the 3880 Storage Control, Model 2, Model 3, or Model 13, is a prerequisite. Up to two 4-unit strings of 3380 drives can be connected to one of the two storage directors on the 3880 Model 2, and to both storage directors on the 3880 Model 3 or 13. A 308X processor, equipped with the Data Streaming feature, can handle the full 3.0-megabytes/second data transfer rate of the 3380.

As compared to a 3350 disk subsystem of equivalent storage capacity, a 4-unit 3380 string offers savings of approximately 65 percent in floor space, 70 percent in power consumption, and 75 percent in heat load. IBM says the 3380 also incorporates major advances in reliability, availability, and serviceability.

3880 STORAGE CONTROL: This control unit provides two completely independent paths for the transfer of file positioning commands and data between an IBM central processor channel and direct-access storage devices. Each path, called a Storage Director, attaches to a block multiplexer channel on a 308X system. Both Storage Directors can be attached to the same channel, to different channels on the same processor, or to channels on two separate processors.

There are five models of the 3880. Model 1 can accommodate various combinations of 3330/3340/3350/ 3370/3375 storage units. Model 2 functions similarly to Model 1 except that one of the two storage directors can also attach 3380 disk drives. Model 3 supports 3380 drives only. Model 11 is a paging subsystem designed for use with 3350 storage units. It consists

of a conventional storage director and a paging storage director that dynamically manages an eight-megabyte solid-state storage unit for paging and swapping data. Model 13 is a non-paging subsystem for use with 3380 storage units. It consists of a cache unit attached to a 3880 Model 3 to form a two-level storage hierarchy. The Model 13 includes two cache storage directors with either four or eight megabytes of solid-state storage. A two-channel switch (#8170/8171) and eight-channel switch (#8172) can be selected to increase the number of channels connected to a storage director from two to eight.

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

INPUT/OUTPUT UNITS

The 308X Series can support a wide range of peripheral devices, several of which are listed below. Please refer to the I/O Units section of Report 70C-491-06 for specifications of the individual units.

- 3420 Magnetic Tape unit (through 3803 Tape Control)
- 1442 Card Read/Punch
- 1442 Card Punch
- 2501 Card Reader
- 2520 Card Read/Punch
- 2520 Card Punch
- 2540 Card Read/Punch (through 2821 control)
- 3505 Card Reader
- 3525 Card Punch (through 3525 Punch Adapter)
- 3203 Model 5 Printer
- 3211 Printer (through 3811 control)
- 3800 Printing Subsystem
- 1255 Magnetic Character Reader
- 1419 Magnetic Character Reader
- 1287 Optical Reader
- 1288 Optical Page Reader
- 3881 Optical Mark Reader
- 3886 Optical Character Reader
- 3890 Document Processor
- 3814 Switching Management System

TERMINALS: Numerous IBM display terminals, batch terminals, and typewriter terminals can be connected to a 308X system in remote and/or local configurations. For details, please refer to Reports 70D1-491-45, 70D2-491-11, 70D2-491-12, 70D3-491-46, 70D4-491-41, and 70D4-491-43 in the Peripherals section of DATAPRO 70 (Volume 2).

COMMUNICATIONS CONTROL

Remote communications in the 308X Processor Complex are handled via the IBM 3705-II Communications Controller

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and related SCPs. Please refer to Report 70C-491-06 for details on these facilities.

SOFTWARE

The 308X Processor Complex is supported natively by the MVS/SP and VM/SP operating systems. Any program written for the System/370 or 303X can be run on a 308X using MVS/SP or VM/SP provided the program 1) is not time-dependent, 2) is not dependent on the mix of system facilities and peripherals in the 308X, and 3) does not depend on results or functions as defined in the System/370 Principles of Operation. The 308X is not supported natively by either DOS/VSE with or without Advanced Functions or VS1/Basic Programming Extensions (BPE). IBM indicated it will provide local programming support to the following situations: 1) DOS/VSE Systems Control Programs executing in conjunction with Release 3 of VSE/Advanced Functions programs, and 2) VS1/BPE programs, both of which are running under VM/SP on a 308X.

MVS (MULTIPLE VIRTUAL STORAGE): MVS (OS/VS2) is IBM's large-scale operating system, designed to handle multiprocessor configurations. Its latest version is Release 3.8, onto which several major enhancements have been added. A detailed summary of MVS can be found in Report 70C-491-06. The current program product targeted for use in the 308X is the MVS/System Product (MVS/SP). Utilizing two versions of the Job Entry Subsystem, JES 2 and JES 3, MVS/SP is now available in two versions and several releases, which are described below.

MVS/SYSTEM PRODUCT—VERSION 1: MVS/SP is a generic term referring to the various announced releases of MVS/SP-JES 2 (5740-XYS) and MVS/SP-JES 3 (5740-XYN). MVS/SP Version 1 Release 1 includes all the functions of MVS/SE Releases 1 and 2 plus the following:

* Support for the IBM 3380 DASD operating through the 3880 Controller Models 2 or 3 using either the Data Streaming or the 3880 Speed Matching Buffer features.

* Support for the IBM 3375 DASD operating through the 3880 Controller Models 2 or 3 using the Data Streaming feature.

* Support for the Data Facility/Device Support Release 1 program product (5740-AM7), which provides data management control for the 3380 DASD and 3880 controllers.

* Support for 3278 and 3279 displays as multiple console support (MCS) consoles.

* Performance equivalent to a system running MVS Release 3.8 with MVS/SE Release 2.

MVS/SP-JES 2/3 Version 1 Release 1 was announced on June 11, 1980. It was updated on November 12, 1980 to provide support for the IBM 308X Processor Complex.

MVS/SP-JES 2/3 Version 1 Release 2: This product, announced on June 11, 1980, provides the following enhancements over Release 1:

* Cross memory services, which offers the potential to reduce system virtual storage requirements and improve data isolation. It utilizes the microcode-assisted 3033 Extension feature on the 308X.

* Global resource serialization, which improves the Enqueue/Dequeue (ENQ/DEQ) structure, extends the function to the multiprocessor environment, and can serialize access to system resources across processor boundaries.

* Improved reliability, accessibility, and serviceability (RAS) functions.

* Improved installation management of the paging subsystem by directing VIO pages to specific page data sets.

* Enhanced NJE job networking facilities in MVS/SP-JES 2.

* Support of the 3375 and 3380 DASD as spool and checkpointing devices.

MVS/SP-JES 2/3 Version 1 Release 3: The third update for MVS/SP was announced on November 12, 1980. It features the following enhancements over Release 2:

* Support for up to 32 megabytes of addressable storage, in conjunction with the Extended Addressing feature.

* Support for the 308X Processor Complex.

* Performance increases of about 10 percent on uniprocessors and 12 percent on attached/multiprocessors in TSO/batch environments.

* Improved memory management techniques; cross memory, paging, and swapping in particular.

* Enhanced JES3 global resources to provide greater processor potential.

* Improved RAS, particularly to reduce the number of unscheduled IPLs.

MVS/SP-JES 2/3 Version 1 Release 3.1: Announced on October 21, 1981 and scheduled for delivery in March 1982, Release 3.1 features the following enhancements over Release 3:

* Support for the 3880 Storage Control Models 11 and 13.

* Support for concurrently running multiple copies of ACF/TCAM Version 2 Release 4 in the same processor.

* JES3 support for the Interactive Data Transmission Facility of TSO Extensions.

* Enhancements to the output writer that enable a JES3 global to more effectively utilize tightly-coupled processors.

MVS/SP-JES2 Version 1 Release 3.2: Announced on October 21, 1981 and scheduled for delivery in September 1982, Release 3.2 offers the following enhancement to Release 3:

* Support for the MVS/Operator Communications Control Facility (MVS/OCCF), which allows one or more remote MVS systems to be operated from a user-designated MVS system.

MVS/SP-JES2 Version 1 Release 3.3: Announced on October 21, 1981 and scheduled for delivery in March 1983, Release 3.3, provides the following enhancements over Release 3:

* Ten new user exits.

* User control of SYSOUT data set grouping.

* The capability to dynamically add and delete spool data sets without warmstarts.

MVS/SYSTEM PRODUCT VERSION 2: Announced on October 21, 1981, MVS/SP Version 2 is scheduled for ►

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➤ availability in the first quarter of 1983. Version 2 includes all of the functions of Version 1 Release 3 plus the following enhancements:

- Support for 31-bit real and virtual storage addressing.

- Support for larger and more flexible I/O configurations. Some of the I/O processing previously performed by the operating system is now performed by the 3081 dynamic channel subsystem.

- Dynamic path selection, which permits a 3380 Model AA4 DASD to reconnect to any channel path identified by the originating MVS system.

- Improved RAS, including page protection for significant system areas, a new system trace facility, and improved dumping and formatting options.

Installation of MVS/SP Version 2 requires the Data Facility Product. The two programs are known collectively as MVS/Extended Architecture (MVS/XA) and are designed to support the new System/370 Extended Architecture. The Data Facility Product provides data management, device support, program library management, and utility functions. MVS/XA also requires Assembler H Version 2, a functional replacement for OS Assembler H Release 5, and SMP Release 4.

VM/SP Release 1: The 308X is also supported by VM/SP, which extends the capabilities of the VM/370 Release 6 product. A detailed summary of VM/370 and VM/SP can be found in Report 70C-491-06. VM/SP Release 1 was enhanced on June 11, 1980 to include the following:

- Support for multiprocessor configurations.

- Support for the 3380 DASD using the 3880 Model 2 or 3 Storage Controller as a paging, spooling, SYSRES, or mini-disk device.

- Support for the 3375 DASD.

- Support for the 3800 Printing Subsystem as a virtual spooling device.

- 3270 Display System enhancements.

- Improved RAS functions such as missing I/O interrupt detection, dynamic space allocation for a dump after IPL, and checkpoint limit expansion for spool files.

- Enhanced security functions.

- CMS/DOS upgrade to the VSE/Advanced Functions product, and support for VSE/VSAM Release 2 and VM/Interactive File Sharing.

- Support for MVS/SP-JES 2/3 as guest operating systems. Cross memory services of Release 2 of MVS/SP are supported, and the 3033 Extensions feature is not required in this situation.

- Support for the 308X Processor Complex.

VM/SP RELEASE 2: Announced on October 21, 1981 and scheduled for delivery in June 1982, VM/SP Release 2 contains all of the functions of Release 1 plus the following enhancements:

- A programmable operator support facility, which provides the capability to log messages, suppress messages, redirect messages, execute commands, and pre-program message responses.

- New CMS end-user functions, including an enhanced screen capability, a full screen capability, and enhanced command capabilities.

- DIAL command support for remote BSC 3270 users. The maximum number of communications lines has been increased to 256.

- Restructuring of the CMS nucleus.

- Enhanced ASCII support for 3101 terminal users.

- A trace table recording facility, which records a history of system operations on spool.

- An enhanced query command.

VM/SP HIGH PERFORMANCE OPTION: VM/SP HPO was announced on October 21, 1981 as an extension to VM/SP. VM/SP HPO will be issued in three releases. Release 1, which is currently available, provides performance enhancements for the CMS environment by supporting the segment protection extension to VMA on the 3081 Model D16. Release 2, which will be available in June 1982, supports the Preferred Machine Assist feature, supports all 308X models operating in the System/370 mode, and provides enhancements to facilitate transition to and from a single-processor mode. Release 3, which is scheduled for delivery in the first quarter of 1983, enables VM to utilize up to 32 megabytes of real memory and supports the 3880 Storage Control Model 11. VM/SP Release 1.1 is a prerequisite for VM/SP HPO Release 1 or 2, while VM/SP Release 2 is a prerequisite for VM/SP HPO Release 3.

VM/XA MIGRATION AID: Announced on October 21, 1981 and scheduled for delivery in the fourth quarter of 1983, the VM/XA Migration Aid is designed to ease the conversion from MVS/SP Version 1 to MVS/XA. The VM/XA Migration Aid concurrently supports one MVS/SP Version 1 preferred virtual machine and one or more MVS/XA test machines with test and debugging facilities.

Additional details on the compilers, assemblers, data base management systems, communications software, and applications software products available to 308X users are covered in Report 70C-491-06.

PRICING

MAINTENANCE: IBM offers both contract and on-call maintenance support. The basic monthly maintenance charge includes any period of 9 consecutive hours between 7:00 a.m. and 6:00 p.m. Monday through Friday. Customers may also purchase extended maintenance coverage that includes 12, 16, 20, or 24-hour coverage on weekdays, Saturdays, Sundays, and holidays. A premium is also charged for 9-hour, 5-day maintenance in which the 9-consecutive-hours period falls outside the 7:00 a.m. to 6:00 p.m. limits.

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

	Normal Working Hours	Outside Normal Working Hours
Class 1	$ 93.00	$108.00
Class 2	115.00	135.00
Class 3	126.00	145.00

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

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

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

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

The most significant change brought about by the new agreement was the ability to include equipment with differing lease terms on a single lease contract and the special long-term lease plans that had been offered under several amendments to the previous lease agreement. Specifically, the Extended Term Plan (ETP), Fixed Term Plan (FTP), Term Lease Plan (TLP), and Alternate Term Plan (ATP) were discontinued. However, the new agreement permits lease terms similar to those of the discontinued plans to be routinely implemented. Customers with existing term plan agreements can continue with those contracts and extend them in accordance with their provisions. IBM has stipulated final termination dates beyond which none of these discontinued plans may be extended. These dates are listed below.

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

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

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

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

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

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

In addition, basic monthly charges have been established for maintenance of the IBM system control programs and other licensed program products. The minimum term of agreement is one year. Customers with multiple systems will have a choice as to how they can have local programming support handled at their locations. Users who have IBM perform local program support at all computer sites pay the Basic Monthly License fee for all locations. Users who decide, however, to control the installation and support of designated licensed programs from a central site pay the Basic License Fee at the central site and a Distributed Systems License Option (DSLO) monthly fee for all other locations. The DSLO rates are lower than the basic monthly support charges.

Support charges for the systems software products described in this report are listed at the end of the equipment price list. Local programming support for 308X systems is provided in two categories: Category A, which includes support for VM/370 Release 6, and Category B, which includes all SCPs in Category A, MVS Release 3.8, and all supporting SCPs for MVS/SP. Refer to the following chart for monthly rates.

LOCAL PROGRAMMING SUPPORT CHARGES

Processor	Monthly Program Support Charge	Monthly Multiple Program Support Charge
3083E:		
Category A	$ 630	$1,008
Category B	900	1,440
3083B:		
Category A	800	1,280
Category B	1,140	1,824
3083J:		
Category A	910	1,456
Category B	1,300	2,080
3081D:		
Category A	1,085	1,735
Category B	1,550	2,480
3081K:		
Category A	1,325	2,120
Category B	1,890	3,025

All other programming service and assistance is charged at $135 per hour during regular hours and $155 per hour during non-regular hours.

Program Products include all language processors, communications support programs, and utility programs, and are licensed separately. Monthly license charges are listed under "Software Prices" in report 70C-491-06 and include full IBM software support. Application Programs (PPAs) are problem- and industry-oriented software packages that are also licensed separately, including full support. Also available on an individual-charge basis, but without centralized IBM programming support, are numerous Field-Developed Programs and Installed User Programs for the 308X Series.

SUPPORT CENTER: The centralized IBM Support Center provides 24-hour, 7-day customer access by telephone (an 800 number is provided). It utilizes the Software Support Facility data base, which incorporates every problem encountered ►

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▶ and resolved (or unresolved) by the central support group. The customer is assisted in making out any APAR (program problem report), and he gets advice on temporary fixes or bypasses.

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

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

EQUIPMENT: The following systems illustrate possible 308X configurations. They include all the necessary control units and adapters, and do not include any specialized software. Pricing for individual devices can be found in Report 70C-491-06.

3083 MODEL GROUP E SYSTEM: Consists of a 3083 Model Group E8 Processor Complex with 8 megabytes of main memory and 8 channels, the 3082 Processor Controller, the 3087 Model 1 Coolant Distribution Unit, the 3089 Power Supply, two 3278-2A consoles with associated keyboards, two 3370 DASD (1142 megabytes) and two 3380 DASD (5040 megabytes) with associated 3880 Model 2 Controller, a tape subsystem consisting of a 3803 Model 2 Controller and six 3420 Model 6 tape drives with dual density, an 800-cpm 3505-B1 card reader, two 120-cps 3287-2 printers, and a 2000-lpm 3211 printer and associated controller. The purchase price is $2,035,645, monthly maintenance is $8,618.50, and monthly rental is $78,676.

3081 MODEL GROUP D SYSTEM: Consists of a 3081 Model Group D16 Processor Complex with 16 megabytes of main memory and 16 channels, the 3082 Processor Controller, the 3087 Model 1 Coolant Distribution Unit, the 3089 Power Supply, three 3278-2A consoles with associated keyboards, four 3375 DASD (3280 megabytes of storage) and four 3380 DASD (10,000 megabytes) with associated 3880 Model 2 Controller, a tape subsystem consisting of two 3803 controllers and eight 3420 Model 6 tape drives with dual density, an 800-cpm 3505-B1 card reader, a 200-cpm 3525-P2 card punch, two 120-cps 3287-2 printers, a 3800 Printing Subsystem, and a 2000-lpm 3211 printer and associated controller. The purchase price is $5,251,920, monthly maintenance is $14,782, and monthly rental is $176,192.

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (4-year Lease)*
PROCESSORS					
3083E	Processor Complex; includes one CPU, buffer storage unit, 8 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model E8; 8,388,608 bytes	1,120,000	3,050	46,750	37,400
	Model E16; 16,777,216 bytes	1,320,000	3,375	53,700	42,960
3083B	Processor Complex; includes one CPU, buffer storage unit, 8 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model B8; 8,388,608 bytes	1,820,000	3,530	74,870	59,900
	Model B16; 16,777,216 bytes	2,020,000	3,855	81,820	65,460
	Model B24; 25,165,824 bytes	2,220,000	4,180	88,770	71,020
	Model B32; 33,554,432 bytes	2,420,000	4,505	95,720	76,580
3083J	Processor Complex; includes one CPU, buffer storage unit, 8 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model J8; 8,388,608 bytes	2,420,000	4,430	99,120	79,300
	Model J16; 16,777,216 bytes	2,620,000	4,755	106,070	84,860
	Model J24; 25,165,824 bytes	2,820,000	5,080	113,020	90,420
	Model J32; 33,554,432 bytes	3,020,000	5,405	119,970	95,980
3081D	Processor Complex; includes two CPUs, two 32K-byte buffer storage units, 16 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model D16; 16,777,216 bytes	3,720,000	7,050	125,550	100,440
	Model D24; 25,165,824 bytes	3,920,000	7,375	132,500	106,000
	Model D32; 33,554,432 bytes	4,120,000	7,700	139,450	111,560
3081K	Processor Complex; includes two CPUs, two 64K-byte buffer storage units, 16 integrated channels, and main memory as specified; requires a 3082 Processor Controller, 3087 Coolant Distribution Unit, 3089 Power Supply, and 3278-2A System Console:				
	Model K16; 16,777,216 bytes of main memory	4,320,000	8,050	155,000	124,000
	Model K24; 25,165,824 bytes of main memory	4,520,000	8,375	161,950	129,560
	Model K32; 33,554,432 bytes of main memory	4,720,000	8,700	168,900	135,120

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IBM 308X Series

PROCESSORS (Continued)		Purchase Price	Monthly Maint.	Monthly Rental Charge*	Monthly Lease Charge (4-year Lease)*
3082	Processor Controller; supports Processor Complex with				
	8 channels	170,000	1,025	5,735	4,590
	16 channels	220,000	1,080	7,425	5,940
	24 channels	270,000	1,135	9,110	7,290
3087	Coolant Distribution Unit				
	Model 1 (for 3081 or 3083)	60,000	65	2,025	1,620
	Model 2 (for 3083 only)	72,000	65	3,000	2,400
3089	Power Unit	38,000	70	1,282	1,025
1545	First additional channel group for 3083E, B, and J; includes eight block multiplexer channels	100,000	95	3,750	3,000
1550	Additional channel group for 3081 or 3083B and J; includes eight block multiplexer channels	100,000	95	3,750	3,000
	Channel-to-Channel Adapter; for 3082:				
1850	First unit	15,000	40	506	405
1851	Second unit	5,000	25	168	135
4650	I/O Power Sequence Control; for 3082	4,000	2	135	108
3278 2A	Display Console CRT	2,505	24.50	110	94**
4641	75-Key Keyboard	1,010	7	43	37**
	System upgrades:				
	Each additional 8-megabyte memory increment	200,000	—	—	—
	From 3083 Model E to Model B (no change in storage size)	700,000	—	—	—
	From 3083 Model B to Model J (no change in storage size)	600,000	—	—	—
	From 3083 Model J to 3081 Model K (no change in storage size or channel group)	1,600,000	—	—	—
	From 3081 Model D to Model K (no change in storage size)	600,000	—	—	—
	From 3082 8 to 16 or 16 to 24	50,000	—	—	—
	From 3082 8 to 24	100,000	—	—	—

*Includes equipment maintenance.
**Two-year lease only; includes equipment maintenance.

SOFTWARE PRICES

		Initial Charge Basic License	DSLO	Monthly Charges Basic License	DSLO	Monthly Licensed Program Support	Monthly Multiple Licensed Program Support
5740-XYS	MVS/SP-JES2 Version 1						
	Release 1	—	—	$1,700	$1,275	$85	$136
	Release 2	—	—	1,715	1,285	175	280
	Release 3	—	—	1,715	1,285	175	280
	Releases 3.1, 3.2, and 3.3	—	—	1,715	1,285	175	280
5740-XC6	MVS/SP-JES2 Version 2	12,000	9,000	4,000	3,000	500	800
5740-XYN	MVS/SP-JES3 Version 1						
	Release 1	—	—	1,700	1,275	85	136
	Release 2	—	—	1,880	1,410	375	600
	Release 3	—	—	1,880	1,410	375	600
	Release 3.1	—	—	1,880	1,410	375	600
5665-291	MVS/SP-JES3 Version 2	13,500	10,125	4,500	3,375	1,000	1,600
5665-284	Data Facility Product	1,350	1,010	450	337	60	96
5668-962	Assembler H Version 2 Release 1	435	326	145	108	5	8
5740-XY4	Resource Measurement Facility, Version 2	—	—	380	285	13	21
5665-274	Resource Measurement Facility, Version 3	2,100	1,575	700	525	50	80
5740-AM7	Data Facility/Device Support, Release 1	—	—	70	52	14	22
5664-167	VM/SP						
	Release 1	—	—	330	247	50	80
	Release 2	—	—	330	247	50	80
5664-169	VM/XA Migration Aid	10,500	7,875	3,500	2,625	500	800
5664-173	VM/SP High Performance Option	4,200	3,150	1,400	1,050	100	160
5665-285	TSO Extensions for MVS/370	1,305	978	435	326	65	104
5665-293	TSO Extensions for MVS/XA	1,560	1,170	520	390	80	128
5665-279	BTAM/SP	4,920	3,690	—	—	10	16
5735-RC3	ACF/TCAM Version 2 Release 4	—	—	535	401	71	114
5665-280	ACF/VTAM Version 2 for MVS	2,745	2,058	915	686	175	280

IBM System/370

EUROPEAN EQUIPMENT PRICES

TYPICAL CONFIGURATIONS

EQUIPMENT: The following systems illustrate typical System/370 configurations sold in Europe. Obviously, they comprise only a small sampling of the extensive configuration possibilities within the System/370 line. All necessary control units and adapters are included in the indicated purchase prices. Each system has been priced for a particular country and prices are given in local currency.

SMALL MODEL 115-2 DISK SYSTEM (NETHER-LANDS): This typical Model 115-2 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). The purchase price is 792,122 Guilders.

SMALL MODEL 125-2 DISK SYSTEM (SWEDEN): Consists of 98K Model 125-2 Processing Unit, 3340 Direct Access Storage Facility (2 drives, 140 million bytes), 3504 Model A1 Card Reader (800 cpm), 3525 Model P1 Card Punch (100 cpm), and 1403 Model 7 Printer (600 lpm). The purchase price is 1,754,390 Crowns.

MODEL 125-2 TAPE/DISK SYSTEM (ITALY): Consists of 131K Model 125-2 Processing Unit, 3340 Direct Access Storage Facility (4 drives, 280 million bytes), six 3410/3411 Model 3 Magnetic Tape Units and Control (80KB), 3504 Model A2 Card Reader (1200 cpm), 3525 Model P3 Card Punch (300 cpm), 1403 Model N1 Printer (1100 lpm), and 5213 Console Printer. The purchase price is 487,473,400 Lire.

SMALL MODEL 135 DISK SYSTEM (SPAIN): Consists of 98K Model 135 Processing Unit with Integrated File Adapter, 3340 Direct Access Storage Facility (2 drives, 140 million bytes), 3505 Model B1 Card Reader, 3525 Model P2 Card Punch, 3211 Printer, and 3210 Model 1 Console and Printer-Keyboard. The purchase price is 37,335,000 Pesetas.

MODEL 138 TAPE/DISK SYSTEM (BELGIUM): Consists of 524K Model 138 Processing Unit with 3330/3340 Integrated File Adapter, CRT console with 3286 Model 2 Printer, and 3046 Model 1 Power Unit; 3340 Model A2 Direct Access Storage Facility with Control Unit and Rotation Position Sensing (2 drives, 140 million bytes); 3340 Model B2 Direct Access Storage Facility with Rotation Position Sensing (2 drives, 140 million bytes); eight 3420 Model 3

Magnetic Tape Units (120KB, single density) with 3803 Model 1 Tape Control and Two-Channel Switch; 3505 Model B2 Card Reader; 3525 Model P3 Card Punch; and 3211 Model 1 Printer with 3216 Model 1 Interchangeable Train Cartridge and 3811 Model 1 Printer Control Unit. The purchase price is 37,914,276 Belgian Francs.

EXPANDED MODEL 145 TAPE/DISK SYSTEM (FRANCE): Consists of 524K Model 145 Processing Unit with four Selector Channels, Block Multiplexer Channel, 8810 Word Buffer, and 3047 Model 1 Power Unit; 3330 Model 11 Disk Storage Facility (8 drives, 1.6 billion bytes); twelve 3420 Model 5 Magnetic Tape Units with two 3803 Model 1 Tape Controls; two 2540 Model 1 Card Read Punches; two 3211 Model 1 Printers; and 3215 Model 1 Console Printer-Keyboard. The purchase price is 10,454,564 French Francs.

MODEL 148 TAPE/DISK SYSTEM (GERMANY): Consists of 1048K Model 148 Processor with Integrated File Adapter and CRT console, 3340 Direct Access Storage Facility (6 drives, 420 million bytes), eight 3420 Model 3 Magnetic Tape Units (120KB) and dual-channel controls, 2540 Card Read Punch, 3211 Printer, and 3286 Model 1 Printer (66 cps). The purchase price is 3,543,470 Deutsche Marks.

MODEL 158-3 TAPE/DISK SYSTEM (SWITZER-LAND): Consists of 1048K Model 158-3 Processor with four Block Multiplexer Channels and two Byte Multiplexer Channels, 3340 Direct Access Storage Facility (4 drives, 2 million bytes of fixed-head storage, 278 million bytes of moving-head storage), 3330 Model 1 Disk Storage Facility (4 drives, 400 million bytes), twelve 3420 Model 5 Magnetic Tape Units (200KB) and two tape controls, two 2540 Card Read Punches, and two 3211 Printers. The purchase price is 7,393,144 Swiss Francs.

MODEL 168 TAPE/DISK SYSTEM (ENGLAND): Consists of 2097K Model 168 Processor with Buffer Expansion and High-Speed Multiply Features, four Block Multiplexer Channels, two Byte Multiplexer Channels, 3340 Direct Access Storage Facility (6 drives, 3 million bytes of fixed-head storage, 416 million bytes of moving-head storage), 3330 Model 11 Disk Storage Facility (4 drives, 800 million bytes), twelve 3420 Model 6 Magnetic Tape Units (320KB) and two tape controls, two 2540 Card Read Punches, two 3211 printers, and 3066 System Console. The purchase price is 3,310,000 British Pounds.■