All About Mainframes

DEFINITION AND SCOPE

Categorically, mainframe is a term that has been used to refer to a general-purpose processor. It is the "grandaddy" of all computers today. Technically, mainframe refers to the cabinet that houses the central processor and often main memory. (With very large memories today, some memory modules are housed in cabinets separate from the mainframe.) The frame, also known as a rack, holds the electronics that does the computing. Since it was originally the largest component in not only size but cost, it was called the "mainframe," a term still used today but adapted to the times since minicomputers, small business computers and superminis have entered the scene. These are excluded from the mainframe reference in this report. For a review of these computer types, please refer to the following Datapro 70 reports:

- All About Minicomputers   70C-010-20

- All About Small Business Computers   70C-010-30

- All About Superminis   70C-010-40

Pricing is a fluctuating measure of what constitutes a mainframe because of the changes in technology, methods of manufacturing, and market strategy in configuring prices. As the reader has heard so often, advances in technology have permitted the power of computers to go up, as respective costs have dropped. However, in spite of its fluctuating nature, prices are still an important factor in the selection criteria established by a user, and is one of the measures considered for classifying a manufacturer's equipment for this report. For the most part, a manufacturer with general-purpose equipment or "mainframes" which cost more than

> All About Mainframes profiles, by type, important characteristics and features of 136 mainframes from 13 of the leading manufacturers. This report is designed to put into perspective the present and future of mainframes.
>
> What are mainframes? Who are the manufacturers? How do these mainframes differ? What is their market? What trends are perceived in the future? These are some of the questions that this report will attempt to answer.

$100,000 are included. An explanation of these prices is given in the section headed Pricing and Availability.

MAINFRAME MARKET PRESENT AND FUTURE

General-purpose mainframes still represent the greatest dollar value of systems installed worldwide today. The value of installed mainframes is projected to reach $145 billion by 1986.

Activity in the mainframe marketplace indicates that their future should be quite secure. In 1976, predictions were made that large systems would eventually be replaced by multiple configurations of smaller machines. Minicomputers, however, have had difficulty handling all of the functions built into the same software designed for mainframes. When measuring a machine's throughput potential, some considerations should be made, including: million instructions per second (depending on the instruction set used), ports, word size, and the characteristics of the operating ▷
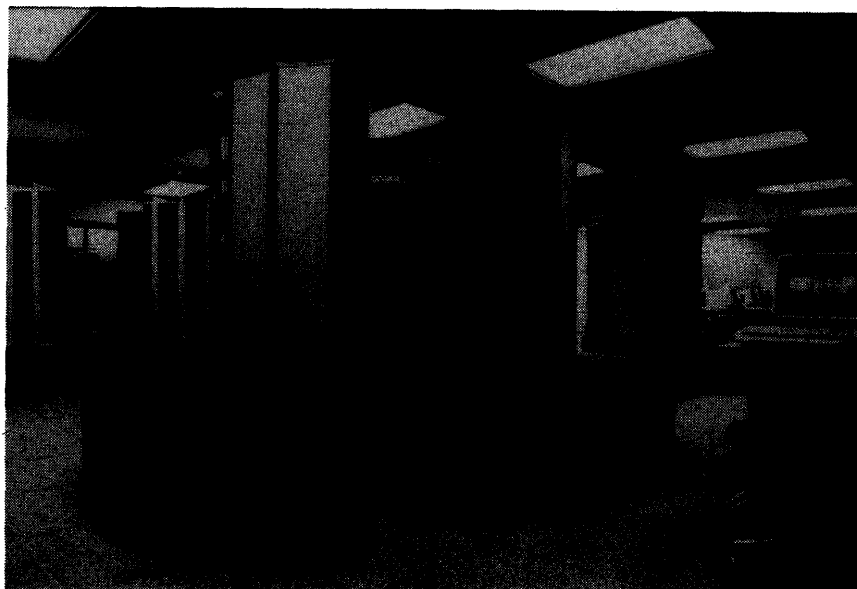
The Cray X-MP family of computers includes two models, the X-MP22 and the X-MP25. The X-MP configuration shown here includes the mainframe with its Solid-state Storage Device in the foreground and its I/O Subsystem in a matching cabinet in the right background.

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▷ system being used. When a large minicomputer or multiple minicomputers are used with an extensive terminal network, huge files or a large number of transactions to be processed, the performance usually does not measure up to that of a mainframe. In addition, most smaller systems are significantly limited as to the amount of total on-line storage that can be attached. The largest minicomputers can support only a few billion characters and microcomputers can usually support only a few million. In contrast, a mainframe the size of the IBM 3081 can accommodate 60 to 80 billion characters of on-line storage.

The reasons mainframes will be around for a while include: the large investment made to date in software to run these systems, the expensive investment in the hiring and training of skilled computer personnel, and the time expended to plan and install the complex systems existing now, and planned for distributed and data base networks. Furthermore, manufacturers would never permit the immediate erosion of their customer base by a revolutionary new computer. Migration is normally part of their plan.

With the integration of microcomputers in the mainframe environment will come the need for even more power at the mainframe level than exists today. Micros are appearing on desktops at an alarming rate and with their number of instructions per second on the rise, the mainframe will assume more of a role as a data base manager in the near future. Setting up information centers will help to get the information stored on the mainframe to the right people and will provide them with the tools they need to manipulate it. There are a lot of software packages available to "link" the micro to the mainframe and they are increasing in number very fast. For further information on this aspect of the market, please refer to the Datapro 70 report, "All About Integrating Micros in the Mainframe Environment", 70C–010–10.

Because of a weak economy and the demands placed on cash flow, companies are looking for answers to more efficient operation, and at the hub of their solutions is certainly the mainframe. Standalone minis and micros do not have the power today to handle, in a timely manner, the volume of data and information that must be processed. They are an important complement to, but for the near future will not replace, the need for mainframes particularly in medium- to large-sized companies.

MAINFRAMES THEN AND NOW

With the power offered by today's mainframes, huge communication networks with a wide range of sophisticated peripheral devices are possible. When the computer first entered the marketplace, companies had to adapt their operation to the equipment if they wanted to use the mainframe at all. All processing was batch, and users in the organization waited in a queue. Little thought was given to the organization and usability of the data; more thought was given to the time and dollars saved and the accuracy achieved over manual procedures (which was easily measured).

The industry has matured since first generation mainframes used vacuum tubes. Second generation computers with transistors completely replaced vacuum tubes as the active components of the computer back in 1959. As technology grew, so did the need for larger and more powerful mainframes that could do more and more processing.

Today's mainframes are at the late end of the third generation, for the most part using integrated circuits and large-scale integration (LSI), and in some cases very large-scale integration (VLSI). An important characteristic of third generation computers is their adaptability to data communications. Large data bases have been created or are planned with nationwide or even worldwide access by way of communication lines. The third generation, however, which is almost ten years old, is ready for a major change.

Prior to 1976, there was little competition in the large systems market. Users were very much committed to the architecture of their installed systems. This changed with the first volume shipments of plug-compatible mainframes. At lower prices, it became obvious that a larger number of systems could be sold. With the introduction of the IBM 3033 in 1977, came an increasing demand for better performance at a lower price. With this came the need to measure the performance of a system, which led to the use of the Mips (million instructions per second) rating. Mips ratings are based on commercial mixed workloads using the 370 instruction set; therefore, scientific workloads or the use of other instruction sets can produce Mips ratings that vary by factors of up to three or more for systems with the same throughput. Caution should be taken when evaluating a system based on its Mips rating alone.

The value of in-house information is becoming more important to companies year after year. The ability to share knowledge about this information and to control it will lead to even larger, more powerful central computing facilities.

ADVANTAGES OF A MAINFRAME

It is important when considering mainframes to also determine what advantages they offer. The list is quite lengthy, but only some of the major pluses will be reiterated here. Mainframes offer:

- Faster response time than other computer types.

- Greater processing power. Users can perform functions too big and too complicated for smaller machines. In addition to batch processing, timesharing, and multiprocessing, mainframes can also serve as data base machines, distributed processors, and communications processors.

- Expandability and flexibility when growth demands. Manufacturers have always provided for migration and upgrading of a mainframe when the need demanded.

- Increased data base capacity and organizational impact. Mainframes permit companies to function effectively in ▷

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a centralized or decentralized manner as needs and geography requirements dictate. Regardless of what operational strategy is selected, control is still the responsibility at the corporate level. Thus bigger, centralized and dynamic data bases are and continue to be required for control purposes by such organizations as banks, insurance companies, transportation companies, etc.

- Decision support systems. Mainframes have the power to integrate company-wide information systems into a decision support network.

- Distributed networks.

- Communications networks.

- Access to skilled personnel. Such personnel are more likely to be found at the mainframe location, since it is here that most of the complex problems are resolved and much of the interesting work resides.

- Software support from the manufacturer. Standardization of software is at a high level with mainframes.

USER SATISFACTION RATINGS

It is important when evaluating mainframes to determine what experiences users have had to date with them. As part of Datapro's 1983 Annual Computer System User Survey, users were asked to rate their systems. Response was good with a total user count of 3592.

The previous user satisfaction ratings of mainframes and plug-compatible mainframes showed very little change between 1980 and 1982. The 1983 survey indicated slightly higher user satisfaction ratings over the 1982 survey. Users were asked to rate their computer systems and the associated software and vendor support by assigning a rating of Excellent, Good, Fair, or Poor. All ratings are expressed in terms of weighted averages, which were calculated by assigning a weight of 4 to each user rating of Excellent, 3 to Good, 2 to Fair and 1 to Poor. The total was then divided by the sum of the number of users who rated each factor. The results of these calculations are found in Table 1.

For details of the 1983 Annual Computer System Survey, please refer to the Datapro 70 Report 70C-010-50 titled "User Ratings of Computer Systems."

THE COMPARISON CHARTS

In order to help you assess the major mainframes on the market today, their differences, and their relative costs, comparison charts detailing important functional characteristics are provided. These functional characteristics were supplied and/or verified in January 1984 by 13 manufacturers for their 136 models. (Manufacturers who did not respond to Datapro's requests for information have been excluded.) An explanation of each chart entry follows.

Models include those mainframes in a manufacturer's series.

	Mainframes & PCMs			
	1983	1982	1981	1980
Ease of operation	3.3	3.2	3.3	3.4
Reliability of mainframe	3.6	3.5	3.5	3.3
Reliability of peripherals	3.2	3.1	3.1	2.8
Maintenance service:				
Responsiveness	3.3	3.2	3.2	3.1
Effectiveness	3.2	3.1	3.1	2.9
Technical support:				
Trouble-shooting	2.8	2.7	2.7	2.7
Education	2.7	2.7	2.7	2.6
Documentation	2.6	2.6	2.6	2.1
Manufacturer's software:				
Operating system	3.2	3.1	3.1	3.2
Compilers & assemblers	3.2	3.2	3.2	3.0
Applications programs	2.7	2.7	2.7	2.7
Ease of programming	3.0	3.0	3.1	3.2
Ease of conversion	3.0	3.0	3.0	3.0
Overall satisfaction	3.1	3.1	3.1	3.1

Table 1. Results of user satisfaction ratings.

Number of CPUs indicates the number of central processing units or mainframes that can be supported at one time by a system. The CPU is the heart of all computer activity normally consisting of three parts: 1) the memory, 2) the arithmetic and logic control, and 3) the control unit. In very large systems, memory may be designed as a separate unit. As processing needs dictate, the user often has the flexibility of adding elements modularly, even to configuring multiple hosts or CPUs. This affords the user large processing capability. The more CPUs supported, the more complex the operating systems required, but the more capability offered.

Number of I/O processors. Because of expanding demands by such functions as multiprogramming, timesharing, etc. the use of a peripheral device far exceeds simply reading and writing of data. Some manufacturers have elected to meet the servicing requirements of the peripherals with an input/output processor dedicated to that purpose.

Virtual storage capability refers to the presence of a hardware/software feature that enables the accessing and utilization of memory space without regard to its existence in real main memory or auxiliary memory space.

Plug-compatible with indicates those computers with which the mainframe is interchangeable without modification. Compatibility may be hardware and/or software.

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⊳ **MAIN STORAGE**

Main storage or memory in a computer is usually the fastest and most accessible storage in the system, and the one from which most instructions are executed.

Types refers to the memory used by the manufacturer. Most of the memories under study for this report were semiconductor memories. There are two types of semiconductor memories—bipolar and MOS (metal-oxide semiconductor) with MOS being the most popular. MOS refers to the three layers used in forming the gate structure of a field-effect transistor. MOS memories are reliable and compact.

The *Cycle time* for main storage or memory is the time interval which is needed between the initiation of two successive, independent memory operations. For a technology such as bipolar, the read cycle and write cycle are almost equal.

Access time of memory refers to the time in nanoseconds to read out any randomly selected word in memory. Access time equals latency plus transfer time.

Bytes fetched per cycle. A byte is a binary character operated upon as a unit. Since a cycle is the smallest time quantum in the process, the more bytes fetched per cycle, generally the more efficient the system.

The Minimum/Maximum capacity in *bytes* of main storage demonstrates the total quantity of data that a manufacturer's system can hold or process. For the mainframes under review, K represents thousands and M (mega) represents millions. Most mainframes were in the megabyte (MB) range.

Increment size in *bytes* is applicable to those systems which permit the size of memory to be expanded in some designated fixed increment without requiring increased processor capability.

Interleaving is a feature which improves memory speed by permitting overlapped accesses to two or more independently operating banks of main storage. Some manufacturers under review offered two-way, four-way, and six-way interleaving. Two-way interleaving, for example, can effectively double the maximum rate at which data can be transferred between a CPU and its associated main storage.

Buffer Storage is defined as the storage used to compensate for a difference in the rate of flow of data, or time of occurrence of events when transferring data from one device to another. Some manufacturers use cache. This is a *type* of high-speed buffer memory that permits higher operating speed by improving effective memory transfer rates.

Cycle time, nanoseconds is the time interval required between two successive buffer operations.

Bytes fetched per cycle refers to the number of bytes operated on during a set time interval.

Capacity in *bytes* of buffer storage can range from a single byte to a large block and is defined by the manufacturer.

CENTRAL PROCESSOR

Machine cycle time in *nanoseconds* refers to the time interval in which the CPU performs a number of operations. It is the time required to change the information in a set of registers. The internal cycle time may be synchronous (fixed or variable) or asynchronous. Most systems are synchronous with some asynchronous operations being used for some parts of the machine.

Word length, bits expresses the number of binary elements or bit string considered as an entity and handled by the CPU. A bit is a binary digit. Generally, the longer the word length, the greater the efficiency of the CPU. The mainframes reviewed in this report had word lengths which ranged from 32 bits to 64 bits.

Number of instructions provides an indication of the number of operations offered by a mainframe's instruction set. Systems with large, powerful instruction sets generally offer the user greater flexibility in programming. However, higher-level languages are commonly used today; thus, instructions which are present in the machine but which are difficult to include in the code produced by one of these higher-level compilers will probably have limited use.

General registers are internal addressable registers in the CPU that can be used for different purposes such as temporary storage, as an accumulator, an index register, or for any other general-purpose function. Listed in this entry is the number available with the system.

Addressing in the mainframes reviewed is either direct and/or indirect for the most part. When *direct addressing* is employed the direct address of an instruction is the number representing the storage location. In the case of *indirect addressing,* the address part of an instruction specifies a storage location that contains another address rather than the desired operand itself. This second address may, in turn, be either the address of the desired operand or another indirect address; the latter is called multilevel indirect addressing.

Control storage provides an indication of the microprogrammability of a computer. Microprogrammability or firmware is a trait that enables the vendor and/or user to tailor a computer's internal processing capabilities to suit the particular needs. In place of conventional hard-wired logic, sequences of microinstructions can be stored in a special read-only memory (PROM) or bipolar read-only memory (BROM) unit to define the effects of each instruction in its repertoire. In some cases, the microprograms can ⊳

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be altered by the user, while in others, they are accessible only to the vendor. Control storage can increase the flexibility of the computer. One advantage of microprogramming is that it is possible to produce an emulator.

Extended precision floating point refers to expanded floating point precision beyond double precision.

INPUT/OUTPUT CONTROL

Integrated I/O channels. These are normally in an integrated I/O processor that contains and controls channels. The channels can be configured for either byte- or block-multiplexer operation.

Other I/O channels. The two types of channels available are selector and multiplexer channels. High-speed input/output devices such as tapes and disks are usually connected to selector channels. Card readers and other low speed devices usually are connected to multiplexer channels. Many low-speed I/O devices connected to a multiplexer channel may operate essentially simultaneously. Should high-speed equipment be attached to a multiplexer channel, only one device will be able to operate at a time because of the high transmission rates and short crisis time. The multiplexer channel is then said to be operating in a burst mode. Because of the demands being made on channels, such as in the case of multiprogramming and timesharing, it is becoming more common for channel units to be small programmed processors or minicomputers. This permits extension of the channel functions.

Maximum I/O data rates, bytes/second is the maximum rate at which data can be transferred to or from main storage. Data rates are expressed as K (thousands) or M (millions) of bytes per second.

COMMUNICATIONS

Maximum number of lines indicates how many data communications lines can be handled by a system.

Synchronous communication implies that all equipment in the system is in step. That is, the data characters and bits are transmitted at a fixed time interval.

Asynchronous implies there is no regular time relationship as with synchronous. The time intervals may be of unequal length.

Protocols supported indicate which of the common data communications protocols are supported. A protocol is a set of conventions on the format and contents of messages to be exchanged. Protocols range in complexity.

Network architecture supported refers to those standardized data communications network architectures supported by a system. It is the architecture used to interconnect a number of points by communications facilities.

PERIPHERAL EQUIPMENT

Most mainframe vendors offer a variety of peripheral equipment. Summarized on the comparison charts is the capability of the major types offered and mention of the additional peripherals available.

Disk drives of two types are generally the most popular 1) fixed head, multiple-platter and 2) moving head. Typical random access devices are the highly reliable moving head disks. The comparison charts detail the minimum and maximum capacity offered by all of the disk types in a vendor's product line.
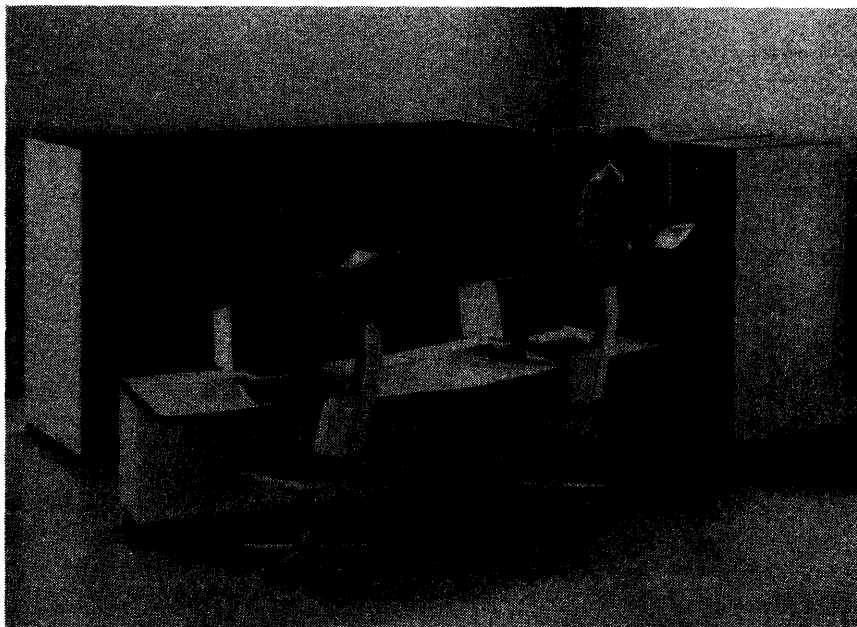
NCR's 8600 Systems include seven models that can have from one to eight CPUs, 4 to 64 megabytes of main memory, and a wide assortment of I/O devices. This family of computers can support batch, transaction and distributed processing environments.

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▷ Under *Magnetic tape drives*, we list the transfer rate, in thousands of bytes per second (KBS) of tape drives that accommodate industry-standard magnetic tape. Magnetic tape continues to be the least expensive storage medium.

Line printers are generally available with speeds ranging from low to high. Normally printing on continuous form paper, these printers have speeds of 100 lines per minute (lpm) to 200 lines per minute at the low end; from 200 lpm to less than 1000 lpm in the medium range with an average of 600 lpm; and between 1000 and 2000 lpm at the high-speed end. These rates are generally for a full alphanumerical character set of about 64 characters. When reduced character sets, i.e., a 48-character set is used, often higher rates of speed can be obtained.

Other peripheral devices supported. Listed here are other types of equipment attachable to a system and in which a reader might have interest. Included would be card equipment, plotters, terminals, etc.

SOFTWARE

Today's users for the most part are sophisticated. They have experienced both the good and the bad of today's software—those programming packages and languages used to program the computer and direct its operation. They are alert to the potential pitfalls. Datapro, however, would only like to reiterate caution when the user investigates available software. Prospective buyers should carefully note whether the software they will require is included in the cost of the system or offered at an extra cost. Discretion should be exercised concerning availability and capability of recently announced software. Particular attention should be paid to the flexibility of Data Base Management Systems.

Operating System is the systems software which controls the overall operation of a multipurpose mainframe. Today's operating systems are complex and often require teams of personnel to develop. It is the operating system which handles such functions as scheduling, loading and supervising the execution of programs, allocation of storage and input and output devices, data management, the sharing and protection of information, analyzing interrupt signals, and dealing with errors, handling communications between systems, etc. Listed in this entry on the comparison charts are those operating systems under which the respective mainframe will function.

Programming languages usually follow industry standards. By using one of the standardized procedure-oriented languages available today, users can run their applications on most manufacturers' systems with little change. Users, therefore, are not locked into a specific manufacturer's equipment, nor are they forced to reprogram when changing equipment. Three major programming languages in the marketplace today are Cobol, Fortran, and PL/1.

A *data base management system* (DBMS) is a software facility designed to manage and maintain data in a non-redundant structure so that the data will be conveniently available for processing by multiple applications. The DBMS organizes data elements in some predefined structure and keeps track of the relationships among the data elements, thereby facilitating information retrieval and report generation. The availability of an effective DBMS can greatly simplify the applications programming task and increase the overall value of a data processing system.

It also provides the mechanism for controlling and maintaining the accuracy of data maintained and distributed.

PRICING AND AVAILABILITY

Purchase price, basic system. This entry provides a price range for a basic system and is not intended to represent all of the configurations possible. Prices are only intended to give the readers an indication of whether the power they are considering falls into the low, medium or high ranges. In some cases, systems will cross ranges depending on how they are configured. For a detailed breakdown, the reader is referred to the detailed system reports indicated at the bottom of each column. However, these charts will assist the reader in screening what systems are available from the various manufacturers in equivalent ranges.

Competitively, system prices tend to cluster themselves. There may be some apparent discrepancies in systems screened, but this will generally be due to what a manufacturer includes as part of the basic system price. For example, one manufacturer may include an I/O processor in the basic price, another may not. The reader is cautioned to use a price range only for the initial screening of systems.

The general-purpose equipment presented in this report tends to cluster in the low, medium, and high ranges. Mainframe systems $1,000,000 and under will, for classification purposes, be considered at the low end. Systems over $1,000,000 but less than $5,000,000 will be considered in the medium range, while over $5,000,000 include the high range systems with full power capability. At the high end are also included the supercomputers.

Monthly maintenance, prime shift normally includes service by the manufacturer for a 5-day work week. An additional charge is normally made for 7-day, 24-hour service.

Monthly rental, 1 year lease (including maintenance) is the manufacturer's charge for a basic system on a monthly basis. Maintenance service, if excluded, will be indicated.

Purchase price of memory increment is the purchase price associated with the memory increment allowed on a particular manufacturer's mainframe system. This increment is indicated under *Main Storage* heading.

Date of first delivery indicates when the first production model of each computer was delivered (or is scheduled to be delivered) to a customer.

Number installed to date shows how many systems of each type have been delivered to customers as of approximately January 1984. ▷

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▷ **Comments**

This final entry on the comparison charts is used to explain or amplify the preceding entries and to provide other qualifying pertinent information about each system.

MAINFRAME MANUFACTURERS

When you have narrowed your choice of manufacturers, you will undoubtedly require additional information. To assist you, the names, addresses and telephone numbers of the 13 major mainframe manufacturers, reviewed for this report, are listed below.

Amdahl Corporation, 1250 E. Arques Avenue, Sunnyvale, California 94086. Telephone (408) 746-6000.

Burroughs Corporation, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7000.

Cambex Corporation, 360 Second Avenue, Waltham, Massachusetts 02154. Telephone (617) 890-6000.

Control Data Corporation, 8100 34th Avenue South, P.O. Box 0, Minneapolis, Minnesota 55440. Telephone (612) 853-8100.

Cray Research, Inc., 1440 Northland Drive, Mendota Heights, Minnesota 55120. Telephone (612) 452-6650.

Digital Equipment Corporation, 129 Parker Street, Maynard, Massachusetts 01754. Telephone (617) 897-5111.

Formation, Inc., 823 Eastgate Drive, Mt. Laurel, New Jersey 08054. Telephone (609) 234-5020.

Honeywell Information Systems, Inc., 200 Smith Street, Waltham, Massachusetts 02154. Telephone (617) 895-6000.

International Business Machines Corporation, Armonk, New York. Telephone (914) 765-1900.

IPL Systems, Inc., 1370 Main Street, Waltham, Massachusetts 02154. Telephone (617) 890-6620.

National Advanced Systems, 800 E. Middlefield Road, Mountain View, California 94043. Telephone (415) 962-6000.

NCR Corporation, Dayton, Ohio 45479. Telephone (513) 445-5000.

Sperry Corporation, P.O. Box 500, Blue Bell, PA 19424. Telephone (215) 542-4011. □

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MANUFACTURER AND MODEL	Amdahl 470 Series	Amdahl 580 Series	Burroughs B 2925	Burroughs B 3955
MODELS	470V/7A, -V/7B, -V/7C, -V/7, -V/8	5840, 5850, 5860, 5870, 5880	B 2925	B 3955
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1-2	1-4	1-4
Number of I/O processors	Not applicable	1-4	1	1
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	IBM 303X, 308X	IBM 308X, 303X, 370 line	Not applicable	Not applicable
MAIN STORAGE				
Type	Dynamic, NMOS	Dynamic, NMOS	64K-MOS	64K-MOS
Cycle time, nanoseconds	320	280	—	—
Access time, nanoseconds	—	120	571 (read)	571 (read)
Bytes fetched per cycle	4	8	4	4
Minimum capacity, bytes	8M bytes	16M bytes	1M byte	2M byte
Maximum capacity, bytes	32M bytes	64M bytes	2M byte	5M bytes
Increment size, bytes	4M bytes	8M bytes	1M byte	1M byte
Interleaving	16-way	8- or 16-way	Not applicable	Not applicable
BUFFER STORAGE				
Type	Bipolar RAM	Bipolar RAM	Not applicable	Not applicable
Cycle time, nanoseconds	52-58	24	—	—
Bytes fetched per cycle	4	32	—	—
Capacity, bytes	32K-64K	2^1 x 32K-4^1 x 32K	—	—
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	26-29	24	143	143
Word length, bits	32	32	8-32	8-32
Number of instructions	Executes 370 or XA inst. s	S/370 Universal Set	Contact vendor	Contact vendor
General registers	—	16	Not applicable	Not applicable
Addressing	Direct and indirect	Direct and indirect	Direct, indirect, index	Direct, indirect, index
Control storage	—	Distributed in CPU	Not applicable	Not available
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	8-32[1]	16-32	Not applicable	Not applicable
Other I/O channels	—	None	DLPs[1] up to 16	DLPs[1] up to 32
Maximum I/O data rate, bytes/sec.	Aggregate 18M-20M	6M aggregate 32 channels	Aggregate 7M bytes	Aggregate 7M bytes
COMMUNICATIONS				
Maximum number of lines	—	352[2]	320-1280	320-1280
Synchronous	—	Yes		
Asynchronous	—	Yes		
Protocols supported	BSC, SDLC	All SNA	Poll select, BDLC, Bisync.	Poll select, BDLC, Bisync.
Network architectures supported	SNA	SNA	BNA	BNA
PERIPHERAL EQUIPMENT				
Disk drives	Can Support most IBM 360	Can support all IBM 370,	5.5MB-540M bytes	See B 2900
Magnetic tape drives	and 370 devices, OEM,	303X and 308X devices,	80KBS-1200KBS	See B 2900
Line printers	or plug compatible	OEM, or plug compatible	650 lpm-2000 lpm	650-2000 lpm
Other peripheral devices supported			Microfilmer, card equipment, reader/sorter, terminals	Microfilmer, card equipment, reader/sorter, terminals
SOFTWARE				
Operating systems	OS/VS1, SVS, MVT, MVS, MVS/SF, VM 370, VM/SP, ACP, MFT, DOS/VSE	MVS/SP, VM/SP, OS/VS, ACP, VM 370, all IBM-compatible compilers support all MVS/VM	MCP-VI MCP-IX	MCP-VI MCP-IX
Programming languages			Cobol, RPG II, Fortran, Basic, Pascal, BPL, LINC	Cobol, RPG II, Fortran, Basic, Pascal, BPL
Data base management system	—	Support IMS, DB/DC, all other IBM-compatible systems	DMS-II	DMS-II
PRICING & AVAILABILITY				
Purchase price, basic system, $	Contact vendor	2,000,000-5,940,000	125,000-190,000	198,000-275,000
Monthly maintenance, prime shift, $	Contact vendor	8,200-20,315	370	531
Monthly rental, 1-year lease, $ (including maintenance)	Not available	89,124[3]-272,945[3]	5,336	10,824
Purchase price of memory increment, $	Contact vendor	160,000	10,000	10,000
Date of first delivery	June 1975	4th quarter, 1982	1st quarter 1983	3rd quarter 1981
Number installed to date	Over 800	Over 180	Not available	Not available
COMMENTS	[1]16 on V/7C Ref.: 70C-044-01	[1]No. of high speed buffers [2]Utilizes front end processor [3]2-year lease Ref.: 70C-044-03	Field upgradable to B 3955 [1]Data Link Processor Ref.: 70C-112-10	[1]Data Link Processor Ref.: 70C-112-10

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MANUFACTURER AND MODEL	Burroughs B 4955	Burroughs B 5900 Series	Burroughs B 6925	Burroughs B 7900 Series
MODELS	B 4955	B 5920, B 5930, B 5935	B 6925	B 7900F, B 7900H, B 7900K
SYSTEM CHARACTERISTICS				
Number of CPUs	1-4	1-4	1-4	1-3
Number of I/O processors	2	1	1	1-2
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	64K-MOS	64K-MOS	MOS	MOS
Cycle time, nanoseconds	—	720	720	Not applicable
Access time, nanoseconds	440 (read)	600 per word	450 per word	Not applicable
Bytes fetched per cycle	5	6	6	Not applicable
Minimum capacity, bytes	5M bytes	3M-6M bytes	1.5M-6M bytes	12M bytes
Maximum capacity, bytes	5M bytes	6M bytes per CPU	6M bytes per CPU	96M bytes
Increment size, bytes	Not available	3M bytes	1.5M bytes	6M bytes
Interleaving	4-way	Not applicable	Not applicable	8-way
BUFFER STORAGE				
Type	Instruction	Lookahead	Lookahead	Not available
Cycle time, nanoseconds	110	720	720	Not available
Bytes fetched per cycle	5	6	6	Not available
Capacity, bytes	Contact vendor	Not applicable	Not applicable	Not available
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	110	—	—	—
Word length, bits	40	52	52	52
Number of instructions	Contact vendor	Not applicable	Not applicable	Not applicable
General registers	Not applicable	Not applicable	Not applicable	Not applicable
Addressing	Direct, indirect, index	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	Distributed in CPU	Not available	Not available	Not available
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	Not applicable	Not applicable	Not applicable	Not applicable
Other I/O channels	DLPs[1] up to 64	DLPs up to 32	DLPs up to 32	DLPs up to 128
Maximum I/O data rate, bytes/sec.	16M bytes	2.3M bytes	6.7M bytes	24M bytes per I/O processor
COMMUNICATIONS				
Maximum number of lines	320-1280	256	256	Contact vendor
Synchronous				
Asynchronous				
Protocols supported	Poll select, BDLC, Bisync.	Poll select, BDLC, Bisync.	Poll select, BDLC, Bisync.	Poll select, BDLC, Bisync.
Network architectures supported	BNA	BNA	BNA	BNA
PERIPHERAL EQUIPMENT				
Disk drives	See B 2900	5.5M bytes to 402M bytes	5.5M bytes to 402M bytes	5.5M bytes to 402M bytes
Magnetic tape drives	See B 2900	80KBS-470KBS	80KBS-1250KBS	80KBS-1250KBS
Line printers	650-2000 lpm	650-2000 lpm	650-2000 lpm	650-2000 lpm
Other peripheral devices supported	Microfilmer, card equipment, read/sorter, terminals	Card reader, card punch terminals	Card reader, terminals	Card equipment, terminals
SOFTWARE				
Operating systems	MCP-IX	MCP	MCP	MCP
Programming languages	Cobol, RPG II, Fortran, Basic, Pascal, BPL, LINC	Cobol, Fortran, Algol, APL, Basic, PL/1, RPG, LINC	Cobol, Fortran, Algol, PL/1, APL, Basic, RPG, LINC	Cobol, Fortran, Algol, APL, Basic, RPG, PL/1, LINC
Data base management system	DMS-II	DMS-II	DMS-II	DMS-II
PRICING & AVAILABILITY				
Purchase price, basic system, $	780,000-900,000	180,000-225,000	417,000-437,000	2,000,000-2,100,000
Monthly maintenance, prime shift, $	1,300	650	1,060	Contact vendor
Monthly rental, 1-year lease, $ (including maintenance)	33,725	7,532	15,260	105,263
Purchase price of memory increment, $	Not applicable	45,000	30,000	25,000
Date of first delivery	2nd quarter 1983	2nd quarter 1982	4th quarter 1981	3rd quarter 1983
Number installed to date	Not available	Not available	Not available	Not available
COMMENTS	[1]Data Link Processor Ref.: 70C-112-10	Ref.: 70C-112-14	Ref.: 70C-112-15	[1]Plus one aux. processor/CPU Ref.: 70C-112-16

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MANUFACTURER AND MODEL	Cambex 1600 Series	Control Data Cyber 170 Series 800	Cray X-MP	Cray M Series
MODELS	1636-1, 1636-10, 1641-1, 1641-11, 1651-1	Cyber 170 models 815, 825, 835, 845, 855, 865, 875	X-MP22, X-MP24[5]	M/1200, M/2200, M/4200[5]
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1 or 2	2	1
Number of I/O processors	Not applicable	10-20	2-4	2-4
Virtual storage capability	Yes	—	Not available	Not available
Plug-compatible with	IBM 4300 and IBM 370	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	64K RAM dynamic	MOS or bipolar[2]	Bipolar	MOS
Cycle time, nanoseconds	400 (read)	75-448	38	100
Access time, nanoseconds	50	200-1200	133	163
Bytes fetched per cycle	16	1 word	48-64	32
Minimum capacity, bytes	2M bytes	262K[3]-524K[3]	16M bytes	8M bytes
Maximum capacity, bytes	16M bytes	1048K[3]-2097K[3]	32M bytes	32M bytes
Increment size, bytes	1M-2M bytes	262K[3] or 524K[3]	16M bytes	8M bytes-16M bytes
Interleaving	Yes	2-, 4-, 8-, 16-way	16-way or 32-way	8-way or 16-way
BUFFER STORAGE				
Type	Cache[1] bipolar RAM	Bipolar[1]	SSD[1]	SSD[1]
Cycle time, nanoseconds	100[1]	64-112[1]	50	50M bytes (transfer rate)
Bytes fetched per cycle	16[1]	1 word[1]	8-32	8-32
Capacity, bytes	8K[1]	4096 words[1]	64M-256M bytes	64M-256M bytes
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	50	25-64	Not available	Not available
Word length, bits	32	60	64	64
Number of instructions	IBM 4300/370 inst. sets	76-80	128	128
General registers	16	24	657	657
Addressing	Direct and indirect	Direct	Direct	Direct
Control storage	144K bytes	2048 128 bit words	Not applicable	Not applicable
Extended precision floating point	Yes	Yes	Not available	Not available
INPUT/OUTPUT CONTROL				
Integrated I/O channels	IBM 4300 compatible	12 to 24	13-51[2]	13-51[2]
Other I/O channels	2-5 block multiplexers (2 std.) (3 opt.), 1 byte multiplexer (std.)	0-8 DEMA (865 & 875)	—	—
Maximum I/O data rate, bytes/sec.	2M byte—block 180K byte—byte	180-600M bits	Aggregate 148M bytes-1248M bytes	Aggregate 148M-248M bytes
COMMUNICATIONS				
Maximum number of lines	IBM plug-compatible—256	Configuration dependent	[4]	[4]
Synchronous		2000-56,000 bps	[4]	[4]
Asynchronous		110-9600 bps	[4]	[4]
Protocols supported	IBM compatible	X.25, Mode 4, HASP, 2780/3780, Async.	Cray	Cray
Network architectures supported	IBM compatible	—	NSC (local)	NSC (local)
PERIPHERAL EQUIPMENT				
Disk drives	Support IBM or plug comp.	237M bytes-1384M bytes	600M bytes-19,200M bytes	600M bytes-19,200M bytes
Magnetic tape drives	Support IBM or plus comp.	100-200 ips	[3]	[3]
Line printers	300-1000 lpm integrated	1200 to 2000 lpm	[3]	[3]
Other peripheral devices supported	integrated channel-to-channel adapter	Card equipment, terminals, array processors[5]	[3]	[3]
SOFTWARE				
Operating systems	DOS/VS, DOS/VSE, OS/VS1, SVS, MVS[1], VM/370, VM/SP, ACP, MVS/SP	NOS	COS	COS
Programming languages	Compatible with IBM 360, 370 and 4300 systems	Cobol, Fortran, Algol, APL, PL/1, Basic, Pascal	Fortran, Assembly, Pascal	Fortran, Assembly, Pascal
Data base management system	All IBM database-compatible systems	DMS-170, Total, IMF	Not applicable	Not applicable
PRICING & AVAILABILITY				
Purchase price, basic system, $	95,000-227,000	195,000-2,850,000	Contact vendor	Contact vendor
Monthly maintenance, prime shift, $	445-925	900-9,000	Contact vendor	Contact vendor
Monthly rental, 1-year lease, $ (including maintenance)	Not applicable	7,490-105,550	Contact vendor	Contact vendor
Purchase price of memory increment, $	9,000	25,000-320,000	Contact vendor	Contact vendor
Date of first delivery	4th quarter 1980	April 1982	July 1983	July 1983
Number installed to date	Over 30	—	—	—
COMMENTS	,Excl. Model 1636	[1]Cache memory on 835, 845, and 855 only [2]Model 875 only [3]60 bit words [4]Excl. 865 and 875 [5]Extended mem. & high performance disk on 865 & 875 only Ref.: 70C-263-10	[1]Solid state storage device [2]Depends on no. of I/O processors [3]Supplied by other mfrs. [4]Attach to IBM, CDC, DEC, Hon., Sperry, Data Gen., Amdahl channels [5]Super computer MIPS 210 MFLOPS 420	[1]Solid state storage device [2]Depends on no. of I/O processors [3]Supplied by other mfrs. [4]Attach to IBM, DCD, DEC, Hone., Sperry, Data Gen., Amdahl channels [5]Super computer MFLOPS 140

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MANUFACTURER AND MODEL	Digital Equipment DECsystem-10	Digital Equipment DECsystem-20 Model 2020	Digital Equipment DECsystem-20 Models 2040 and 2060	Formation 4000 Series
MODELS	1090, 1090 SMP, 1091 SMP	2020	2040, 2060, 2060 Cluster	100, 200, 300, 101, 201, 301
SYSTEM CHARACTERISTICS				
Number of CPUs	1-3	1	1-4	1-2
Number of I/O processors	1-12	0	1-3[7]	Bus Structure[1]
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable	370 byte multiplexer
MAIN STORAGE				
Type	MOS or Core	MOS	MOS	NMOS
Cycle time, nanoseconds	667[2] or 1200[2]	—	667[2] for 1 word fetch	800
Access time, nanoseconds	467 or 745	900 for 1 word fetch	467	200
Bytes fetched per cycle	1-4 words	1	4 words	4
Minimum capacity, bytes	256K words-1536K words	256K words	512K words	256K to 1M
Maximum capacity, bytes	3072K words-4096K words	512K words	3072K words	8M
Increment size, bytes	256K words	64K words	256K words	256K or 1M
Interleaving	1-, 2-, or 4-way	1-way	4-way	Not applicable
BUFFER STORAGE				
Type	Bipolar	Bipolar	Bipolar[3]	Not applicable
Cycle time, nanoseconds	133	300	133[3]	—
Bytes fetched per cycle	4 words	1 word	4 words[3]	—
Capacity, bytes	2048 words	512 words	2048 words	—
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	33	150	33	200
Word length, bits	36	36	36	32 & byte parity
Number of instructions	398	396	398	176 & 370VM assist
General registers	8 sets of 16	8 sets of 16	8 sets of 16	16
Addressing	Direct, indirect, indexing	Direct, indirect, indexing	Direct, indirect, indexing	Direct and indirect
Control storage	2048[5] words	2048[4] words	2048 words	8K words of 64 bits each
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	2-24	2	2-8[7]	Bus structure
Other I/O channels	3 to 6 hard copy controllers	1 hard copy controller	2 hard copy controllers[7]	Byte multiplexer
Maximum I/O data rate, bytes/sec.	14M bytes	4.5MB	14M bytes	5 megabytes
COMMUNICATIONS				
Maximum number of lines				100
Synchronous	36 max.	2 .	14[7] .	20[3]
Asynchronous	384-512[1] max.	32	128[7]	96[3]
Protocols supported	BSC, DDCMP	BSC, DDCMP, NCP	BSC, HDLC, DDCMP, TCP/IP	BSC, SDLC, Async.
Network architectures supported	ANF10, DECnet, 2780/3780 HASP	DECnet X.25, 2780/3780 HASP, ARPANET	DECnet X.25, 2780/3780 HASP, ARPANET	SNA
PERIPHERAL EQUIPMENT				
Disk drives	176M bytes-1.2G bytes	176MB	176M bytes-1.5G bytes	70MB-635MB per device
Magnetic tape drives	800 to 6250 bpi	800, 1600 bpi	800 to 6250 bpi	72-200KBS[2]
Line printers	600-1250 lpm	600-900 lpm	600-1250 lpm	300 to 1000
Other peripheral devices supported	Card reader	Card reader	Card reader, paper tape units[4]	Floppy disk, card reader (400 cps), IBM 370 byte MUX
SOFTWARE				
Operating systems	TOPS-10	TOPS-20/TOPS-10	TOPS-20	DOS/VS, DOS/VSE, OS/VS1, MVS, VM/370, VM/SP
Programming languages	Cobol, Fortran, Basic, APL, Algol, CPL, IQL, Bliss-36	Cobol, Fortran, Basic+2, PL, BLiss, Algol, Pascal	Cobol, Fortran, Basic+2, PL, BLiss, Algol, Pascal, CPL, IQL	Cobol, Fortran, PL/1, RPG II, APL
Data base management system	DBMS-10	DBMS-10 or DBMS-20	DBMS-20, Datatrieve-20	TMS
PRICING & AVAILABILITY				
Purchase price, basic system, $	466,000-639,800	109,000	250,000-446,000	47,000 to 97,400
Monthly maintenance, prime shift, $	2,470-3,275[4]	923[3]	2,257-2,546[5]	150 to 541
Monthly rental, 1-year lease, $ (including maintenance)	Not available	Not available	Not available	Not available
Purchase price of memory increment, $	22,500[3] or 50,000[3]	19,000[2]	22,500	3300 for 256K to 10,000 for 1MB
Date of first delivery	March 1979	July 1978	July 1978	February 1981
Number installed to date	—	—	—	50
COMMENTS	[1]Not impossible if a mix of lines [2]1 word fetch [3]MOS or core [4]12-hr. DEC service [5]96-bit words Ref.: 70C-384-01	[1]12 hr. DEC service [2]For 256K words, 6000 for 64K words [3]12-hr. DEC service [4]96-bit words Ref.: 70C-384-03	[2]Megawords [3]Not on 2040 [4]2060 only [5]12-hr. DEC service [6]96-bit words [7]Per processor Ref.: 70C-384-03	[1]I/O Processor functions provided in integrated control units, up to 22 controllers maximum [2]1000 bits/second [3]Combinations are restricted by hardware configurations Ref.: 70C-400-02

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MANUFACTURER AND MODEL	Honeywell DPS 7 Series	Honeywell DPS 8 Series	Honeywell DPS 88 Series	IBM 4300 Series Model 4321
MODELS	DPS 7/35E, 7/45E, 7/55E, 7/65E	[2]DPS 8/47, 8/49, 8/52, 8/62, 8/70	DPS 88/81, DPS 88/82	4321
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1 to 6	1 to 2	1
Number of I/O processors	2-8	Not applicable	Not applicable	—
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	MOS	MOS	MOS	MOS
Cycle time, nanoseconds	355 (read)	—	750	—
Access time, nanoseconds	250	750	225	—
Bytes fetched per cycle	4	16	8 words of 36 bits	4
Minimum capacity, bytes	1M-2M bytes	4M bytes	16M bytes	1M byte
Maximum capacity, bytes	3M-4M bytes	64M bytes	128M bytes	1M byte
Increment size, bytes	1M byte	2M bytes	16M bytes	—
Interleaving	Not applicable	4-way	4-way	—
BUFFER STORAGE				
Type	Not applicable	Not applicable	2 cache memories	—
Cycle time, nanoseconds	—	—	—	—
Bytes fetched per cycle	—	—	—	—
Capacity, bytes	—	—	2 x 32K bytes	—
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	330 and 140	36	Not available	300 to 1600
Word length, bits	32	36	36	32
Number of instructions	221	289 & 91 EIS[1]	351	System/370 universal set
General registers	16	Not available	24	—
Addressing	Indirect	Direct and indirect	Direct and indirect	—
Control storage	48K bytes	32K bytes (cache)	Not applicable	131,072 (reloadable)
Extended precision floating point	Yes	Yes	—	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	2[1]-4 multiplexers	—	—	—
Other I/O channels	2-4 multiplexer (opt.)	1.4 IOM	1-2 IOX[1]	1 byte multiplexer 1 block multiplexer
Maximum I/O data rate, bytes/sec.	2.5M to 10M bytes	4M bytes/IOM	48M bytes/IOX	—
COMMUNICATIONS				
Maximum number of lines	12 to 268	1024	2048	8
Synchronous	—	1024	2048 (72,000 bps)	—
Asynchronous	—	1024	2048 (9600 bps)	—
Protocols supported	BISC, HDLC, Sync., Async.	BISC, HDLC, Sync., Async.	BISC, HDLC, Sync., Async.	BSC, SDLC
Network architectures supported	DSA	DSA	DSA	—
PERIPHERAL EQUIPMENT				
Disk drives	300M bytes-21.6G bytes	300M bytes-21.6G bytes	78M bytes-1101M bytes[2]	129M bytes to 2.52G bytes
Magnetic tape drives	41.7KBS-200KBS	Up to 1250KBS	Up to 1250KBS	120KBS to 1250KBS
Line printers	600-1600 lpm	900-1600 lpm	1200-1600 lpm	240 lpm to 2000 lpm
Other peripheral devices supported	Diskette drives, terminals, card equipment	Card equipment, document handler, page printers	Card equipment, terminals, page printers	S/360 and S/370 peripherals
SOFTWARE				
Operating systems	GCOS	GCOS 8, CP6, MULTICS	GCOS 8	SSX/VSE, VM 370 with CM
Programming languages	Cobol, Fortran, RPG, Query, Basic	Cobol, Fortran, Basic, PL/1, RPG, Pascal, APL	Cobol, Fortran, Basic, Pascal, APL, PL/1, GMAP, GPS, Simscript, disp., RPG	Same as S/370
Data base management system	I-D-S/II, DM-IV	DM-IV	DM-IV (I-D-S/II)	—
PRICING & AVAILABILITY				
Purchase price, basic system, $	94,200 to 256,700	149,350 to 900,000	2,850,000 to 4,050,000	64,000
Monthly maintenance, prime shift, $	205 to 562	321 to 3,000	5,950 to 7,050	281.50
Monthly rental, 1-year lease, $ (including maintenance)	3,593 to 9,408	6,320 to 42,070	116,500 to 179,500	4,455
Purchase price of memory increment, $	10,000	34,500 to 40,000	320,000 (16M bytes)	—
Date of first delivery	1st quarter 1982	2nd quarter 1980	3rd quarter 1983	March 1982
Number installed to date	Not available	Not available	Not available	—
COMMENTS	[1]7/35E can only have 4 mux, 7/45E can expand to 6, and 7/55E and 7/65E to 8 Ref.: 70C-480-09	[1]Extended instruction set—decimal [2]C version avail. for up all models. M only on 8/52, 8/62 and 8/70 Ref.: 70C-480-11	[1]Controls up to 48 channels/IOX [2]Formatted Ref.: 70C-480-16	Ref.: 70C-491-08

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MANUFACTURER AND MODEL	IBM 4300 Series Models 4331 and 4361	IBM 4300 Series Models 4341 and 4381	IBM 303X Series	IBM 308X Series
MODELS	4331-Group 2, Group 11; 4361 Group 4, Group 5	4341 Grp. 1, 2, 9, 10, 11, 12; 4381 Grp. 1, and 2	3033S, 3033N, 3033U, 3042AP, 3033MP	3083E, 3083B, 3083F, 3083J, 3081D, 3081G, 3081K, 3084
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1	1-2	1-4
Number of I/O processors	—	—	—	—
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	MOS	MOS	MOS	MOS
Cycle time, nanoseconds	—	—	348 (read)	312 (read)
Access time, nanoseconds	—	—	Not available	Not available
Bytes fetched per cycle	4	8	8	8
Minimum capacity, bytes	1M or 2M bytes	1M byte	4M to 8M bytes	8M to 32M bytes
Maximum capacity, bytes	4M to 12M bytes	16M bytes	16M to 32M bytes	16M to 64M bytes
Increment size, bytes	1M (4331), 2M or 4M (4361)	1M, 2M or 4M	4M bytes	8M or 32M bytes
Interleaving	—		4-way or 8-way	2-way
BUFFER STORAGE				
Type	—	—		
Cycle time, nanoseconds	200	120 to 225	57	26[1]
Bytes fetched per cycle	4	8 to 16	48	128[1]
Capacity, bytes	4096 to 8192 (4331) 8192 to 16,384 (4361)	2048 to 32,768	16,384 to 131,072	Up to 65,536[1]
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	200-1600 (4331), 100 (4361)	68 to 300	57	26
Word length, bits	32	—	32	—
Number of instructions	System/370 universal set	System/370 universal set	System 370 universal set	—
General registers	—	—	16	—
Addressing	—	—	Direct and indirect	Direct and indirect
Control storage	—	—	4096 words[1]	—
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	—	—	1-4 groups of 6 (integrated optional), 1-2 groups of 4 and 6	8-24 (integrated optional), 1-4 groups of 8
Other I/O channels	1 byte multiplexer 1 to 4 block multiplexer	1 or 2 byte multiplexer 2 to 11 block multiplexer		
Maximum I/O data rate, bytes/sec.	500K to 1.86M bytes	Up to 3.0M bytes	26-52M bytes	72M bytes
COMMUNICATIONS				
Maximum number of lines	8	352	352	—
Synchronous	—	—		
Asynchronous	—	—		
Protocols supported	BSC, SDLC, Start/Stop	—	—	—
Network architectures supported	—	—	—	—
PERIPHERAL EQUIPMENT				
Disk drives	129M bytes to 2.52G bytes	129M bytes to 2.52G bytes	635M bytes to 2.52G bytes	635M bytes to 2.52G bytes
Magnetic tape drives	120KBS to 1250KBS	120KBS to 1250KBS	120KBS to 1250KBS	120KBS to 1250KBS
Line printers	240 lpm to 2000 lpm	240 lpm to 2000 lpm	1100 lpm to 2000 lpm	1100 lpm to 2000 lpm
Other peripheral devices supported	S/360 and S/370 peripherals	S/360 and S/370 peripherals	S/360 and S/370 peripherals	S/360 and S/370 peripherals
SOFTWARE				
Operating systems	DOS/VSE, VM 370, SSX/VSE, OS/VS1, MVS/370, JES2 and JES3	DOS/VSE, OS/VS1, VM/370, OS/VS2, MVS, MVS/SP, SSX/VSE, ACP/TPF	VM/370, MVS/SP, VM/SP	MVS/SP, VM/SP, VM/XA, MVS/XA
Programming languages	Same as S/370	Same as S/370	Cobol, Fortran, PL/1, Basic, APL, RPG, BAL	System/370 or 303X languages
Data base management system	—	—	IMS	—
PRICING & AVAILABILITY				
Purchase price, basic system, $	82,420 to 150,000	81,000 to 370,000	990,000 to 2,412,500	960,000 to 3,680,000
Monthly maintenance, prime shift, $	335.00 to 490.00	388.00 to 564.00	4,605 to 8,735	3,050 to 12,845
Monthly rental, 1-year lease, $ (including maintenance)	5,176 to 8,500	6,345 to 24,665	64,900 to 179,349	46,750 to 376,300
Purchase price of memory increment, $	—	—	—	200,000
Date of first delivery	3/82 (4331), 1Q 84 (4361)	4th quarter 1979	March 1978	2nd quarter 1982
Number installed to date	—	—	—	—
COMMENTS	Ref.: 70C-491-08	Ref.: 70C-491-08	Limited production status [1]3072 (108 bit) words plus 1024 (126 bit) words Ref.: 70C-491-06	[1]Excl. 3083 Model Groups E, B, J, F Ref.: 70C-491-02

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MANUFACTURER AND MODEL	IPL 4400 Series Models 4436, 4443, 4445 and 4446	IPL 4400 Series Models 4460 and 4480	National Advanced Systems (NAS) AS/6600 Series	National Advanced Systems (NAS) AS/8000 Series
MODELS	4436, 4443, 4445, 4446	4460, 4480	AS/6620, AS/6630, AS/6650	AS/8040, AS/8050, AS/8060
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1 or 2	1	
Number of I/O processors	Not applicable	Not applicable	Not applicable	1
Virtual storage capability	Yes	Yes	Yes	—
Plug-compatible with	S/370 and 4300 Series	S/370 and 4300 Series	IBM 4341, 303X, 308X, 370	Yes IBM 4341, 303X, 308X, 370
MAIN STORAGE				
Type	NMOS (16K-bit)	NMOS (16K-bit)	NMOS	NMOS
Cycle time, nanoseconds	500	500	350-420 (read)	
Access time, nanoseconds	500	500	—	360 (read)
Bytes fetched per cycle	8	8	8	—
Minimum capacity, bytes	1M byte	1M byte	2M-4M bytes	8
Maximum capacity, bytes	16M bytes	16M bytes	16M bytes	8M bytes
Increment size, bytes	1M byte	1M byte	2M-4M bytes	32M bytes
Interleaving	Not applicable	Not applicable	—	4M bytes 4-way
BUFFER STORAGE				
Type	ECL	ECL	Bipolar RAM	Bipolar RAM
Cycle time, nanoseconds	100	100	50-60	18-20
Bytes fetched per cycle	4 to 8	4 to 8	8	8
Capacity, bytes	0 to 24K	24K to 48K	64K	16K-64K
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	50	50	50-60	35-40
Word length, bits	32	32	32	32
Number of instructions	S/370 Universal Instr. Set	S/370 Universal Instr. Set	S/370 universal instr. set	S/370 universal instr. set
General registers	16	16-32	16	16
Addressing	Direct and indirect	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	128K bytes	128K, 2 x 128K	—	—
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	Not Applicable	Not Applicable	—	—
Other I/O channels	1 byte multiplexer channel 2-5 block mult. channels	1 byte multiplexer channel 2-5 block mult. channels	5-8 block mux, 1-2 byte mux	7-23 block multiplexers 1-6 byte multiplexers
Maximum I/O data rate, bytes/sec.	12 megabytes per second	21 megabytes per second	Aggregate 13M	Aggregate 13M-56M
COMMUNICATIONS				
Maximum number of lines	Not Applicable	Not Applicable	Supports all communication controllers that are compatible with 370, 4300, 303X and 308X	See AS/6600
Synchronous	—	—		
Asynchronous	—	—		
Protocols supported	—	—		
Network architectures supported	SNA	SNA	Support network architectures that run 370, 4300, 303X and 308X CPUs	Support network architectures that run 370, 4300, 303X and 308X CPUs
PERIPHERAL EQUIPMENT				
Disk drives	Supports all S/360, S/370, 4300, 30XX and plug-compatible peripherals	Supports all S/360, S/370, 4300, 30XX and plug-compatible peripherals	Supports IBM & IBM-compatible devices/controllers that attach to 370, 4300, 303X and 308X CPUs	Supports IBM & IBM-compatible devices/controllers that attach to 370, 4300, 303X and 308X CPUs
Magnetic tape drives				
Line printers				
Other peripheral devices supported				
SOFTWARE				
Operating systems	DOS/VS,DOS/VSE,DS/VS1,SVS, MVS,MVS/SP,VM/370,MV/SP, SSX/VSE,ACP,NI/DOS,MVT/VSE	DOS/VS,DOS/VSE,DS/VS1,SVS, MVS,MVS/SP,VM/370,MV/SP, SSX/VSE,ACP,NI/DOS,MVT/VSE	VM/370, OS/VS1, MVS	VM/370, OS/VS1, MVS
Programming languages	Cobol, Fortran, APL, PL/1, Pascal, Algol, RPG, Basic	Cobol, Fortran, APL, PL/1, Pascal, Algol, RPG, Basic	Functional compatibility with IBM 360, 370, 4300, 303X and 308X	Same as AS/6600
Data base management system	Same as 4300	Same as 4300	Same as above	Same as AS/6600
PRICING & AVAILABILITY				
Purchase price, basic system, $			225,000-417,500	1,349,000-2,251,000
Monthly maintenance, prime shift, $			668-927	5,624-6,494
Monthly rental, 1-year lease, $ (including maintenance)	128,000	265,000	—	—
Purchase price of memory increment, $	510	960	38,000	76,000
Date of first delivery	5,950 (2-year lease)	11,770 (2-year lease)	August 1982	May 1983
Number installed to date	7,500	15,000	—	—
			Ref.: 70C-655-01	
COMMENTS	4th quarter 1980 Over 300 worldwide	2nd quarter 1983 Over 300 worldwide		Ref.: 70C-655-01
	Ref.: 70C-542-01	Ref.: 70C-542-01		

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MANUFACTURER AND MODEL	National Advanced Systems (NAS) AS/9000 Series	NCR 8500 Systems	NCR 8600 Systems	Sperry System 80 Models 4 and 6
MODELS	AS/9040, AS/9050, AS/9060 AS/9070, AS/9080	8545-II, 8555-II, 8565-IIE, 8575-II, 8695-II	8635, 8645, 8655, 8665, 8675, 8685, 8695	S/80-4, S/80-6
SYSTEM CHARACTERISTICS				
Number of CPUs	1-2	1-4	1-8	1
Number of I/O processors	—	Not applicable	4-16	—
Virtual storage capability	Yes	Yes	Yes	—
Plug-compatible with	IBM 4341, 303X, 308X, 370	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	NMOS	MOS	MOS	MOS
Cycle time, nanoseconds	270-342 (read)	380	380	400
Access time, nanoseconds	—	370 (read)	370 (read)	—
Bytes fetched per cycle	8	4-16	4-16	4
Minimum capacity, bytes	8M-16M bytes	1M byte	4M-16M bytes	524,288
Maximum capacity, bytes	32M-64M bytes	4-16M bytes	16M-64M bytes	4,194,308
Increment size, bytes	8M-16M bytes	1M-4M bytes	4M bytes	262,144 or 524,288
Interleaving	8-way or 16-way	2-way or 4-way[2]	4-way	Not applicable
BUFFER STORAGE				
Type	Bipolar RAM	[4]	Cache memory	Cache
Cycle time, nanoseconds	15-19	Not applicable	190	—
Bytes fetched per cycle	8	—	4-8	—
Capacity, bytes	64K-256K per CPU	—	32K-512K	—
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	30-38	84 to 56	38	—
Word length, bits	32	32	32	32
Number of instructions	S/370 universal instr. set	202	147	128
General registers	16	64	104-416	16
Addressing	Direct and indirect	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	—	24K to 128K bytes	96K-768K	32,768 words[1]
Extended precision floating point	Yes	Not available	Yes	Not available
INPUT/OUTPUT CONTROL				
Integrated I/O channels	—	1-8	16-64	4
Other I/O channels	6-23, 12-30 block multiplexers 1-6, 2-8 byte multiplexers	Contact vendor	Contact vendor	3 multiplexer
Maximum I/O data rate, bytes/sec.	60M-96M bytes	8M bytes	8M-32M	Aggregate 6M
COMMUNICATIONS				
Maximum number of lines	See AS/6600	253	Contact vendor	0 to 8
Synchronous				
Asynchronous				
Protocols supported		SDLC, BSC, TTY, X.25, 3270	SDLC, BSC, TTY, X.25, 3270	—
Network architectures supported	Supports network architecture that runs on 370, 4300, 303X and 308X CPUs	NCR/CNA, SNA	NCR/CNA, SNA	DCA
PERIPHERAL EQUIPMENT				
Disk drives	Support IBM & IBM compatible devices/controllers that attach to 370, 4300, 303X and 308X CPUs	13M-1092M bytes per device	13M-1092M bytes per device	72M-491M
Magnetic tape drives		80KBS-320KBS	80KBS-320KBS	40K-200K
Line printers		300-2000 lpm	300-2000 lpm	200 cps to 1200 lpm
Other peripheral devices supported		Card equipment, MICR, floppy disks	Card equipment, MICR, floppy disks	Diskettes, workstations, card equipment
SOFTWARE				
Operating systems	VM/370, OS/VS1, MVS	VRX, B1, B2, B3[3]	VRX	OS/3
Programming languages	Same as AS/6600	Cobol 74, VRX Fortran 77, Neat 3, Neat V5, Basic, RPG	Cobol 74, VRX, Fortran 77, Neat VS, Basic, RPG	Cobol, Fortran IV, Basic, RPG-11, Escort, BAL, MAPPER
Data base management system	Same as AS/6600	Total	Total	DMS
PRICING & AVAILABILITY				
Purchase price, basic system, $	1,804,000-4,908,000	41,500 to 170,000	465,000-2,895,000	66,082 to 94,062
Monthly maintenance, prime shift, $	5,646-14,200	245 to 1,373	2,291-9,000	Contact vendor
Monthly rental, 1-year lease, $ (including maintenance)	—	3,115 to 16,890	14,667-88,378	Contact vendor
Purchase price of memory increment, $	152,000-304,000	7,500	16,200	5,821 to 11,642
Date of first delivery	December 1982	1982	—	July 1982
Number installed to date	—	176	—	—
COMMENTS	Ref.: 70C-655-01	[1]V-8545-11 is 2M bytes [2]V-8545-11 does not use interleaving [3]V-8545-11 and V-8555-11 only [4]System R has instruction storage unit of 24K Ref.: 70C-656-02	Ref.: 70C-656-02	[1]Plus 1024 words of read-only storage Ref.: 70C-877-02

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MANUFACTURER AND MODEL	Sperry System 80 Model 8	Sperry 1100/60 System	Sperry 1100/70 System	Sperry 1100/80 System
MODELS	S/80-8	1100/61, 1100/62, 1100/63, 1100/64	1100/71, 1100/72, 1100/73, 1100/74	1100/80, 1100/81, 1100/82, 1100/83 and 1100/84
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1 to 4	1-4	1-4
Number of I/O processors	—	1 to 4	1-4	1-4
Virtual storage capability	—	Yes	—	—
Plug-compatible with	Not applicable	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	MOS	NMOS	64K MOS	MOS
Cycle time, nanoseconds	124	580	580	1250
Access time, nanoseconds	496 (read)	—	—	—
Bytes fetched per cycle	8	—	—	—
Minimum capacity, bytes	1,048,576	512K words (2M bytes)	524K words (2M bytes)	512K words (2M bytes)
Maximum capacity, bytes	8,388,608	4096K words (16M bytes)	8384K words (32M bytes)	8192K words (32M bytes)
Increment size, bytes	1,048,576 or 2,097,152	262K words (1M byte)	524K words (2M bytes)	262K words (1M bytes)
Interleaving	Not applicable	—	—	—
BUFFER STORAGE				
Type	Cache	IC semiconductor[1]	IC semiconductor	IC semiconductor
Cycle time, nanoseconds	—	116	116	
Bytes fetched per cycle	—	4-word	4 word (16 bytes)	
Capacity, bytes	—	2048 words in E models 8192 words in H models	2048 in E models (words) 8192 in H models (words)	16,384 to 131,072
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	124	116	116	200
Word length, bits	32	36	36	36
Number of instructions	128	161	161	219
General registers	16	128	128	128
Addressing	Direct and indirect	Direct and indirect	Direct and indirect	Indirect
Control storage	90,000 bytes[1]	2000 words	2000 words	—
Extended precision floating point	Not available	—	—	—
INPUT/OUTPUT CONTROL				
Integrated I/O channels	1-2	—	—	—
Other I/O channels	1 byte multiplexer 1 to 5 selection channels	1 to 12 block mux. 4 to 48 word channel	1 to 12 block multiplexers 4 to 48 word channel	Byte multiplexer, block multiplexer
Maximum I/O data rate, bytes/sec.	Aggregate 8M bytes	—	6.3M bytes per second	—
COMMUNICATIONS				
Maximum number of lines Synchronous Asynchronous	0-28	No fixed limit	No fixed limit	No fixed limit
Protocols supported	—	UDLC	UDLC	—
Network architectures supported	DCA	DCA	DCA	DCA
PERIPHERAL EQUIPMENT				
Disk drives	29M bytes-491M bytes	77M bytes to 1.6G bytes	77M bytes to 1.6G bytes	77M bytes to 16G bytes
Magnetic tape drives	40K bytes-750K bytes	34KBS-1250KBS	34KBS to 1250KBS	34KBS to 1250KBS
Line printers	180-2000 lpm, 200 cps	760-2000 lpm	760-2000 lpm	760-2000 lpm
Other peripheral devices supported	Diskettes, workstations, card equipment	Card equipment, drum, terminals, diskette, laser printer	Card equipment, terminals, diskette, drum, laser printer	Drum, diskette, card equipment, terminals, laser printer
SOFTWARE				
Operating systems	OS/3	1100 OS	1100 OS	1100 OS
Programming languages	Cobol, Fortran IV, Basic, RPG II, Escort, BAL, MAPPER	Cobol, Fortran, Algol, Basic, Jovial, PL/1, RPG, MACRO, Assembler	Cobol, Fortran, RPG, Basic, PL/1	Cobol, Fortran, APL, Pascal 1100, NU Algol, Basic, PL/1, RPG, MACRO
Data base management system	DMS	UDS 1100	UDS 1100	UDS 1100
PRICING & AVAILABILITY				
Purchase price, basic system, $	123,900	336,519 to 1,076,816	188,000	1,389,628 to 6,128,808
Monthly maintenance, prime shift, $	Contact vendor	1,342 to 3,732	1,070	3,490 to 14,099
Monthly rental, 1-year lease, $ (including maintenance)	Contact vendor	8,007 to 25,637	6,320	35,431 to 159,738
Purchase price of memory increment, $	14,400 to 28,800	—	Contact vendor	Contact vendor
Date of first delivery	1st quarter 1984	January 1980	June 1983	1977
Number installed to date	—			
COMMENTS	Ref.: 70C-877-02	[1]Excl. 1100/61 C1 and C2 cache unit Ref.: 70C-780-12	Ref.: 70C-780-13	Ref.: 70C-780-14

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MANUFACTURER AND MODEL	Sperry 1100/90 System			
MODELS	1100/91, 1100/92, 1100/93, 1100/94			
SYSTEM CHARACTERISTICS				
Number of CPUs	1-4			
Number of I/O processors	1-4			
Virtual storage capability	Yes			
Plug-compatible with	Not applicable			
MAIN STORAGE				
Type	MOS			
Cycle time, nanoseconds	360-600			
Access time, nanoseconds	—			
Bytes fetched per cycle	—			
Minimum capacity, bytes	2,097,152 words (8M bytes)			
Maximum capacity, bytes	16,777,216 words(64M bytes)			
Increment size, bytes	—			
Interleaving	2-way or 4-way			
BUFFER STORAGE				
Type	Cache memory			
Cycle time, nanoseconds	60			
Bytes fetched per cycle	—			
Capacity, bytes	65K			
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	—			
Word length, bits	36			
Number of instructions	271			
General registers	128			
Addressing	Direct and indirect			
Control storage	—			
Extended precision floating point	Not available			
INPUT/OUTPUT CONTROL				
Integrated I/O channels	—			
Other I/O channels	Up to 96 block multi-plexers[3] Up to 160 word channels[3]			
Maximum I/O data rate, bytes/sec.	37.5M bytes			
COMMUNICATIONS				
Maximum number of lines	No fixed limit			
Synchronous				
Asynchronous				
Protocols supported	UDLC			
Network architectures supported	DCA			
PERIPHERAL EQUIPMENT				
Disk drives	77M bytes to 1.6G bytes			
Magnetic tape drives	34KBS to 1250KBS			
Line printers	760-2000 lpm[2]			
Other peripheral devices supported	Card equipment, terminals, diskette, drum, laser printer			
SOFTWARE				
Operating systems	1100 OS			
Programming languages	Cobol, Fortran, Algol, Basic, Pascal, PL/1, APL, RPG, Assembly			
Data base management system	UDS 1100			
PRICING & AVAILABILITY				
Purchase price, basic system, $	2,865,660 to 8,851,539			
Monthly maintenance, prime shift, $	5,551 to 16,098			
Monthly rental, 1-year lease, $ (including maintenance)	—			
Purchase price of memory increment, $	Contact vendor			
Date of first delivery	June 1983			
Number installed to date	—			
COMMENTS	[1]Only available on 90/80 [2]Laser printer 10,500 to 21,000 lpm [3]Either block or word channel Ref.: 70C-780-16			