All About Mainframes

DEFINITION AND SCOPE

The term "mainframe" is used to identify a large, general-purpose processor. The term refers technically to the cabinet which houses the central processor and, very often, main memory. In some cases, however, systems with very large main memory capacities have memory modules housed in cabinets which are separate from the mainframe. The frame, also known as the rack, contains the electronic components that perform the computing. In the past, mainframes have changed more as a result of evolution than revolution. Users today, however, are placing greater demands on the machine which will, no doubt, result in some changes not too far down the road.

Pricing is a fluctuating measure of what constitutes a mainframe because of the technological advances, methods of manufacturing, and market strategy in configuring prices. Price is 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 large general-purpose equipment or "mainframes" are included. An explanation of equipment 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. In 1976, predictions were made that large systems would eventually be replaced by multiple configurations of smaller machines. Traditional minicomputers, however, have had difficulty handling all of the functions built into the same software designed for mainframes. When measuring a ma-

This report discusses the evolution of the mainframe from its beginning right up to the present. Comparisons are drawn among some of the newer systems on the market today. Also included in the form of handy comparison columns are the characteristics of 42 systems from 13 of the leading manufacturers.

chine'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 system being used.

Recently, with the advent of the supermini, a fine line exists between some minicomputers and mainframes. An example of this is in IBM's 4300 and 308X families. The 4361 was introduced by IBM as a supermini in order to emphasize its scientific-processing capabilities and its modularized packaging. Separate market segments which used to be identified in terms of processor power and system packaging and support are becoming harder to define with the announcement of new members in the IBM line. The IBM 4381 Model Group 3, unlike other 4300s which come in half-height, off-white cabinets, was introduced with an appearance very similar to the tall, blue-door 308X systems. The 4381-3, more importantly, is the only member of the 4300 Series to offer MVS/XA. The 43810-3, when used in a commercial environment, is rated at approximately 5 Mips (million instructions per second), while the new entry-level model of the 308X Series, the 3083 Model CX, is rated at around 3.3 Mips. IBM does not recognize Mips as a form of measurement; however, it is the only plausible method of measuring performance that we currently have. ▷
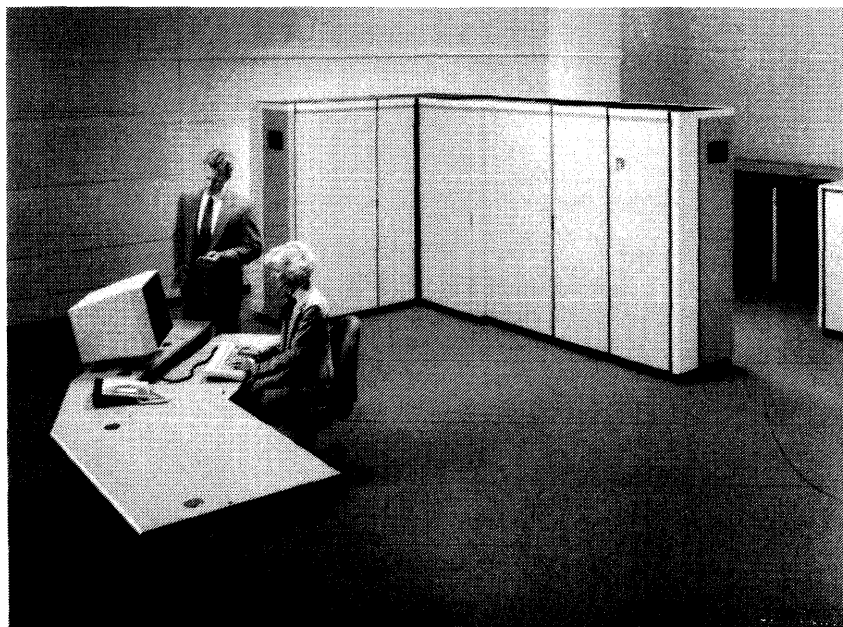
The Cyber 180 Model 840 from Control Data Corporation is a liquid-cooled, single-processor system with an interconnected three-section cabinet for the central processor, cache memory, and the input/output unit.

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▷ A radical change is not imminent for users of mainframe computers. Large investments have been made to date in the software used to run these systems, the hiring and training of skilled computer personnel and the time expended to plan and install the complex systems as well as distributed and data base networks.

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. IBM has already delivered almost three million of its Personal Computers, the majority of which probably have future hopes of being connected with a mainframe host. 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-000DB-101.

Because of a fluctuating 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. Most other computer types 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 work loads using the 370 instruction set; therefore, scientific work loads 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 most other computer types.

• Immense processing power. In addition to batch processing, timesharing, and multiprocessing, mainframes can also serve as data base machines, distributed processors, and communications processors.

• Expandability and flexibility with 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 a centralized or decentralized manner as needs and geography requirements dictate. Regardless of what operational strategy is selected, control is still the responsibility of 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.   ▷

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▷ • 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 1984 Annual Computer System User Survey, users were asked to rate their systems. Response was good with a total user count of 3,592.

The previous user satisfaction ratings of mainframes and plug-compatible mainframes showed very little change between 1981 and 1982. The 1983 survey indicated slightly higher user satisfaction ratings over the 1982 survey. The 1984 survey produced even higher ratings than the 1983 survey in almost every category. 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.

	Mainframes & PCMs			
	1984	**1983**	**1982**	**1981**
Ease of operation	3.4	3.3	3.2	3.3
Reliability of mainframe	3.5	3.6	3.5	3.5
Reliability of peripherals	3.2	3.2	3.1	3.1
Maintenance service:				
Responsiveness	3.4	3.3	3.2	3.2
Effectiveness	3.3	3.2	3.1	3.1
Technical support:				
Trouble-shooting	3.0	2.8	2.7	2.7
Education	2.8	2.7	2.7	2.7
Documentation	2.7	2.6	2.6	2.6
Manufacturer's software:				
Operating system	3.3	3.2	3.1	3.1
Compilers & assemblers	3.3	3.2	3.2	3.2
Applications programs	2.8	2.7	2.7	2.7
Ease of programming	3.1	3.0	3.0	3.1
Ease of conversion	3.0	3.0	3.0	3.0
Overall satisfaction	3.2	3.1	3.1	3.1

For details of the 1984 Annual Computer System Survey, please refer to the Datapro 70 Report 70C–010–50 titled "User Ratings of Mainframes."

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 1985 by 13 manufacturers. (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.

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.

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. ▷

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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 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 de-

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▷ vices 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.

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. ▷
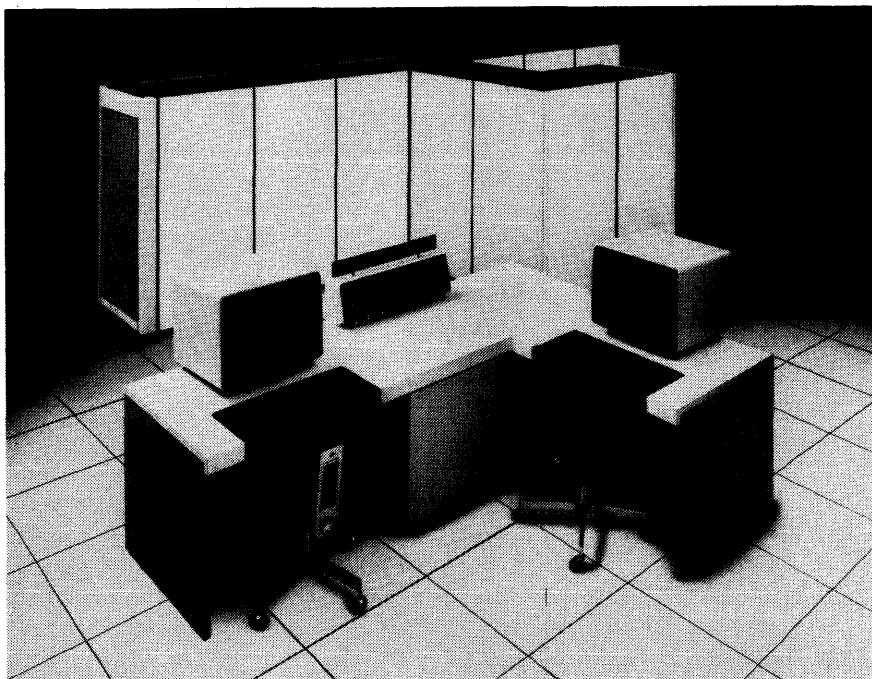
The National Advanced Systems AS/9000 Series is plug-compatible with IBM's 3083, 3081, and 3084 systems. It is available in five models with from 8 to 64 megabytes of main memory.

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▷ *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 nonredundant 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 1985.

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. ▷

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

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

Cambex Corporation, 360 Second Avenue, Waltham, MA 02254. Telephone (617) 890-6000.

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

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

Digital Equipment Corporation, 200 Baker Avenue, Maynard, MA 01754. Telephone (617) 264-1751.

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

Honeywell Information Systems, Inc., P.O. Box 8000, Phoenix, AZ 85066. Telephone (602) 862-6140.

International Business Machines Corporation, Old Orchard Road, Armonk, New York. Contact your local IBM representative.

IPL Systems, Inc., 360 Second Avenue, Waltham, MA 02254. Telephone (617) 890-6620.

National Advanced Systems, 800 East Middlefield Road, Mountain View, CA 94042. Telephone (415) 962-6000.

NCR Corporation, 1700 South Patterson Boulevard, Dayton, OH 45479. Telephone (513) 445-4145.

Sperry Corporation, P.O. Box 500, Blue Bell, PA 19424. Telephone (215) 542-4213. ☐

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MANUFACTURER AND MODEL	Amdahl 580 Series	Burroughs Corp. B 2925	Burroughs Corp. B 3955	Burroughs Corp. B 4925
MODELS	5840, 5850, 5860, 5867, 5868, 5870, 5880	B 2925	B 3955	B 4925
SYSTEM CHARACTERISTICS				
Number of CPUs	1-2	1-4	1-4	1-4
Number of I/O processors	1-4	1	1	1
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	IBM 308X, 303X, 370 line	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	Dynamic, NMOS	64K-MOS	64K-MOS	64K-MOS
Cycle time, nanoseconds	280	—	—	—
Access time, nanoseconds	120	571 (read)	571 (read)	440 (read)
Bytes fetched per cycle	8	4	4	5
Minimum capacity, bytes	16M	1M	2M	2.5M
Maximum capacity, bytes	128M	2M	5M	5.0M
Increment size, bytes	8M, 16M, or 32M	1M	1M	2.5M
Interleaving	8- or 16-way	Not applicable	Not applicable	2-way
BUFFER STORAGE				
Type	Bipolar RAM	Not applicable	Not applicable	Instruction
Cycle time, nanoseconds	—	—	—	110
Bytes fetched per cycle	32	—	—	5
Capacity, bytes	32K-64K	—	—	Contact vendor
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	24	143	143	110
Word length, bits	32	8-32	8-32	40
Number of instructions	S/370 Universal Set	Contact vendor	Contact vendor	Contact vendor
General registers	16	Not applicable	Not applicable	Not applicable
Addressing	Direct and indirect	Direct, indirect, index	Direct, indirect, index	Direct, indirect, index
Control storage	Distributed	Not applicable	Not available	Distributed in CPU
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	16-32	Not applicable	Not applicable	Not applicable
Other I/O channels	—	DLPs[1] up to 16	DLPs[1] up to 32	DLPs up to 32[1]
Maximum I/O data rate, bytes/sec.	72M	Aggregate 7M	Aggregate 7M	8M
COMMUNICATIONS				
Maximum number of lines	—	320-1280	320-1280	320 to 1280
Synchronous	Yes			—
Asynchronous	Yes			—
Protocols supported	SDLC, BSC, Async, X.25	Poll select, BDLC, Bisync	Poll select, BDLC, Bisync	Poll select, BDLC, Bisync
Network architectures supported	SNA	BNA	BNA	BNA
PERIPHERAL EQUIPMENT				
Disk drives	Can support all IBM 370,	5.5M-540M bytes	See B 2900	See B 2900
Magnetic tape drives	303X and 308X devices,	80KBS-1200KBS	See B 2900	See B 2900
Line printers	OEM, or plug-compatible	650-2000 lpm	650-2000 lpm	650-2000 lpm
Other peripheral devices supported		Microfilmer, card equipment, reader/sorter, terminals	Microfilmer, card equipment, reader/sorter, terminals	Microfilmer, card equipment, reader/sorter, terminals
SOFTWARE				
Operating systems	MVS,MVS/SP,VM/SP,VM/SP/ HPO	MCP-VI MCP-IX	MCP-VI MCP-IX	MCPIX
Programming languages	Cobol, Fortran, PL/1, Basic, APL, RPG, BAL; support all MVS/VM	Cobol, RPG II, Fortran, Basic, Pascal, BPL, LINC	Cobol, RPG II, Fortran, Basic, Pascal, BPL	Cobol, RPG II, Fortran, Basic, Pascal. LINC
Data base management system	Support IMS, DB/DC, all other IBM-compatible systems	DMS-II	DMS-II	DMS II
PRICING & AVAILABILITY				
Purchase price, basic system, $	1,700,000-4,260,000	125,000-190,000	198,000-275,000	395,000
Monthly maintenance, prime shift, $	5,350-12,600	370	531	1,300
Monthly rental, 1-year lease, $ (including maintenance)	102,045-224,180[1]	5,336	10,824	21,674
Purchase price of memory incre., $	130,000	10,000	10,000	25,000
Date of first delivery	August 1982	1st quarter 1983	3rd quarter 1981	2nd quarter 1984
Number installed to date	Over 400	Not available	Not available	—
COMMENTS	[1]One-year lease	Field-upgradable to B 3955	[1]Data Link Processor	[1]Data Link Processors Field-upgradable to B 4955
		[1]Data Link Processor	Ref.: 70C-112-10	Ref: 70C-112-10
	Ref.: 70C-044-03	Ref.: 70C-112-10		

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MANUFACTURER AND MODEL	Burroughs B 4955	Burroughs Corp. A3	Burroughs Corp. A9	Burroughs Corp. B 7900 Series
MODELS	B 4955	D, F, K	F	B 7900F, B 7900H, B 7900K, B 7900E, B 7900M
SYSTEM CHARACTERISTICS				
Number of CPUs	1-4	1-2	1	1-4
Number of I/O processors	2	1-2	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	256K RAM	64K-MOS	MOS
Cycle time, nanoseconds	—	150	72.5	Not applicable
Access time, nanoseconds	440 (read)	150	860 for first 6 bytes	Not applicable
Bytes fetched per cycle	5	6	Not applicable	Not applicable
Minimum capacity, bytes	5M	3M	6M	6M
Maximum capacity, bytes	5M	48M	24M	144M
Increment size, bytes	Not available	3M	6M	6M
Interleaving	4-way	Yes	Yes	8-way
BUFFER STORAGE				
Type	Instruction	Lookahead	—	Not available
Cycle time, nanoseconds	110	150	72.5	Not available
Bytes fetched per cycle	5	150	2-6	Not available
Capacity, bytes	Contact vendor	6	6K	Not available
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	110	—	72.5	—
Word length, bits	40	59	60	52
Number of instructions	Contact vendor	Not applicable	250+	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	Yes	Yes	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 40	DLPs up to 40	DLPs up to 128
Maximum I/O data rate, bytes/sec.	16M	3.2M	6M	24M per I/O processor
COMMUNICATIONS				
Maximum number of lines	320-1280	120	144	Contact vendor
Synchronous		—	—	
Asynchronous		—	—	
Protocols supported	Poll select, BDLC, Bisync	Fixed and programmable	Programmable	Poll select, BDLC, Bisync
Network architectures supported	BNA	BNA	BNA	BNA
PERIPHERAL EQUIPMENT				
Disk drives	See B 2900	Up to 6.2G bytes	Up to 1084M bytes	5.5M-1084M bytes
Magnetic tape drives	See B 2900	Up to 470 GCR	Up to 1250 OCR	80KBS-1250KBS
Line printers	650-2000 lpm	Up to 30 PPM	Up to 30 PPM	Up to 30 PPM
Other peripheral devices supported	Microfilmer, card equipment, read/sorter, terminals	Card readers, card punches, letter quality printers, terminals	Card readers, card punches, letter quality printers	Card equipment, terminals
SOFTWARE				
Operating systems	MCP-IX	MCP	MCP	MCP
Programming languages	Cobol, RPG II, Fortran, Basic, Pascal, LINC	Cobol, Fortran, PL/1, Pascal, Basic, RPG, Algol	Cobol, Fortran, PL/1, Pascal, Basic, RPG, Algol	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	95,500-180,000	618,900	1,000,000-4,600,000
Monthly maintenance, prime shift, $	1,300	485-812	1,325	Contact vendor
Monthly rental, 1-year lease, $ (including maintenance)	33,725	5,266-9,812	32,656	105,263
Purchase price of memory incre., $	Not applicable	6,000	10,000	17,000
Date of first delivery	2nd quarter 1983	November 1984	April 1984	3rd quarter 1983
Number installed to date	Not available	—	—	Not available
COMMENTS	[1]Data Link Processor Ref.: 70C-112-10	Models D & F are single processors; Model K is a dual processor. All models are field-upgradable to the next level.	—	[1]Plus one aux. processor/CPU Ref.: 70C-112-16

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MANUFACTURER AND MODEL	Cambex Corp. 1600 Series	Control Data Corp. CYBER 180	Control Data Corp. CYBER 180	Control Data Corp. CYBER 180
MODELS	1636-1, 1636-10, 1641-1, 1641-11, 1651-1	810 and 830	840, 850, 860	990
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1-2	1-2	1-2
Number of I/O processors	Not applicable	10-20	10-20	10-20
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	IBM 4300 and IBM 370	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	64K RAM dynamic	MOS	MOS	Bipolar
Cycle time, nanoseconds	400 (read)	400	384	64
Access time, nanoseconds	50	1350 (810), 550 (830)	320	208
Bytes fetched per cycle	16	8	8	8
Minimum capacity, bytes	2M	2M	16M	8M
Maximum capacity, bytes	16M	16M	128M	32M
Increment size, bytes	1M-2M	2M, 4M	16M, 32M	8M
Interleaving	Yes	Yes, 2- or 4-way	Yes, 8-way	Yes, 32-way
BUFFER STORAGE				
Type	Cache[1] bipolar RAM	—	Bipolar	Bipolar
Cycle time, nanoseconds	100[1]	—	64	16
Bytes fetched per cycle	16[1]	—	8	8
Capacity, bytes	8K[1]	—	16K-32K	32K
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	50	50	64	16
Word length, bits	32	64	64	64
Number of instructions	IBM 4300/370 inst. sets	64 (170 Mode), 131 (180)	85 (170 Mode), 167 (180)	85 (170 Mode), 167 (180)
General registers	16	24/32	24/32	24/32
Addressing	Direct and indirect	Direct	Direct	Direct
Control storage	144K bytes	8K 96-bit words	2K 128-bit words	1280 101-bit words
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	IBM 4300-compatible	8-16	12-24	12-24
Other I/O channels	2-5 block multiplexer (2 std.) (3 opt.), 1 byte multiplexer (std.)	—	—	—
Maximum I/O data rate, bytes/sec.	2M byte—block 180K byte—byte	40M	72M	192M
COMMUNICATIONS				
Maximum number of lines	IBM plug-compatible—256	Configuration dependent	Configuration dependent	Configuration dependent
Synchronous		2000-56000 bps	2000-56000 bps	2000-56000 bps
Asynchronous		1100-9600 bps	1100-9600 bps	1100-9600 bps
Protocols supported	IBM-compatible	X.25 Mode 4, HASP, 2780/3780, Async 3270 BSC	X.25 Mode 4, HASP, 2780/3780, Async 3270 BSC	X.25 Mode 4, HASP, 2780/3780, Async 3270 BSC
Network architectures supported	IBM-compatible	—	—	—
PERIPHERAL EQUIPMENT				
Disk drives	Support IBM or plug-comp.	126M-2444M bytes	1384M-2444M bytes	1384M-2444M bytes
Magnetic tape drives	Support IBM or plus-comp.	100-200 ips	100-200 ips	100-200 ips
Line printers	300-1000 lpm integrated	300-2000 lpm	200-2000 lpm	300-2000 lpm
Other peripheral devices supported	integrated channel-to-channel adapter	Card equipment, terminals, array processors	Card equipment, terminals array processors	Card equipment, terminals array processors
SOFTWARE				
Operating systems	DOS/VS, DOS/VSE, OS/VS1, SVS, MVS[1], VM/370, VM/SP, ACP, MVS/SP	NOS, NOS/VE	NOS, NOS/VE	NOS, NOS/VE
Programming languages	Compatible with IBM 360, 370 and 4300 systems	Fortran, Cobol, APL, Pascal, Basic, C, LISP, PL/1, Algol	Fortran, Cobol, APL, Pascal, Basic, C, LISP, PL/1, Algol	Fortran, Cobol, APL, Pascal, Basic, C, LISP, PL/1, Algol
Data base management system	All IBM database-compatible systems	IM/VE, TOTAL, DMS 170, IMF	IM/VE, TOTAL, DMS 170, IMF	IM/VE, TOTAL, DMS 170, IMF
PRICING & AVAILABILITY				
Purchase price, basic system, $	90,000-215,000	149,950-251,950	839,270-1,654,270	3,429,270
Monthly maintenance, prime shift, $	445-925	531-681	3,298-4,698	13,708
Monthly rental, 1-year lease, $ (including maintenance)	Not applicable	7,768-9,567	36,983-67,748	150,158
Purchase price of memory incre., $	7,500	7,500 per megabyte	12,500 per megabyte	60,000 per megabyte
Date of first delivery	4th quarter 1980	September 1984	March 1985	June 1985
Number installed to date	Over 50	—	—	—
COMMENTS	Excl. Model 1636	2 processors available on Model 830 only	2 processors available on 860 only	—

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MANUFACTURER AND MODEL	Control Data Corp. CYBER 205	Cray Research, Inc. X-MP/1 Series	Cray Research, Inc. X-MP/2	Cray Research, Inc. X-MP/48
MODELS	Series 600	X-MP/11, X-MP/12, X-MP/14[5]	X-MP/22, X-MP/24[5]	X-MP/48
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1	2	4
Number of I/O processors	1	2-4	2-4	4
Virtual storage capability	2^{47} bits	—	—	—
Plug-compatible with	STAR-100, CYBER 203, CYBER 205-100, -400	Not applicable	Not applicable	Not applicable
MAIN STORAGE				
Type	16K SRAM	MOS	Bipolar	Bipolar
Cycle time, nanoseconds	80	76	38	38
Access time, nanoseconds	120	162	133	133
Bytes fetched per cycle	64	48-64	48-64	64
Minimum capacity, bytes	8×10^6	8M	16M	64M
Maximum capacity, bytes	128×10^6	32M	32M	64M
Increment size, bytes	8×10^6	8M-16M	16M	—
Interleaving	8 banks x 64	16-way or 32-way	16-way or 32-way	64-way
BUFFER STORAGE				
Type	—	SSD[1]	SSD[1]	SSD[1]
Cycle time, nanoseconds	—	50	50	50
Bytes fetched per cycle	—	64-256	64-256	256-512
Capacity, bytes	—	1024M	64M-1024M	256M-1024M
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	20	—	—	—
Word length, bits	64	64	64	64
Number of instructions	223	128	128	128
General registers	256	657	657 (per CPU)	657 (per CPU)
Addressing	Virtual 2^{47} bits	Direct	Direct	Direct
Control storage	4K (64-bit words)	Not applicable	Not applicable	Not applicable
Extended precision floating point	96 bit	—	—	—
INPUT/OUTPUT CONTROL				
Integrated I/O channels	16	8-54[2]	11-54[2]	12-55[2]
Other I/O channels	Front-end dependent	—	—	—
Maximum I/O data rate, bytes/sec.	25M per channel	Aggregate 446M	Aggregate 1346M	2346M
COMMUNICATIONS				
Maximum number of lines	—	4	4	4
Synchronous	—	4	4	4
Asynchronous	—	4	4	4
Protocols supported	—	Cray	Cray	Cray
Network architectures supported	CDC LCN	NSC (local)	NSC (local)	NSC (local)
PERIPHERAL EQUIPMENT				
Disk drives	64	600M-38,400M bytes	600M-38,400M bytes	600M-38,400M bytes
Magnetic tape drives	128	3	3	3
Line printers	—	3	3	3
Other peripheral devices supported	—	3	3	3
SOFTWARE				
Operating systems	Virtual storage operating system (VSOS)	COS	COS	COS
Programming languages	Fortran, IMPL, META, Pascal	Fortran, Assembly, Pascal	Fortran, Assembly, Pascal	Fortran, Assembly, Pascal
Data base management system	—	Not applicable	Not applicable	—
PRICING & AVAILABILITY				
Purchase price, basic system, $	5,650,000	Contact vendor	Contact vendor	Contact vendor
Monthly maintenance, prime shift, $	30,000	Contact vendor	Contact vendor	Contact vendor
Monthly rental, 1-year lease, $ (including maintenance)	176,700	Contact vendor	Contact vendor	Contact vendor
Purchase price of memory incre., $	750,000 (10^6 words)	Contact vendor	Contact vendor	Contact vendor
Date of first delivery	June 1981	July 1984	July 1983	July 1984
Number installed to date	—	—	—	Over 5
COMMENTS	—	[1]Solidstate Storage Device [2]Depends on no. of I/O processors [3]Supplied by other mfrs. [4]Attach to channels of IBM, CDC, DEC, Honeywell, Sperry, Data Gen., Amdahl systems [5]Supercomputer	[1]Solidstate Storage Device [2]Depends on no. of I/O processors [3]Supplied by other mfrs. [4]Attach to channels of IBM, CDC, DEC, Honeywell, Sperry, Data Gen., Amdahl systems [5]Supercomputer	[1]Solidstate Storage Device [2]Depends on number of I/O processors [3]Supplied by other mfrs. [4]Attach to channels of IBM, CDC, DEC, Honeywell, Sperry, DG, Amdahl systems Supercomputer

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MANUFACTURER AND MODEL	Digital Equipment DECsystem-10	Digital Equipment DECSYSTEM-20 Model 2020	Digital Equipment DECSYSTEM-20 Models 2060 and 2065	Formation 4000 Series
MODELS	1090, 1090 SMP, 1091 SMP, 1095	2020	2060, 2065	100, 200, 300, 101, 201, 301
SYSTEM CHARACTERISTICS				
Number of CPUs	1-3	1	1	1-2
Number of I/O processors	1-4 per CPU	0	1-4	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	MOS	MOS	NMOS
Cycle time, nanoseconds	601 or 1201[1]	—	601 or 1201[1]	800
Access time, nanoseconds	467	900	467	200
Bytes fetched per cycle	1-4	1	1-4	4
Minimum capacity, bytes	256K words	384K words	384K words	256K-1M
Maximum capacity, bytes	4M words	512K words	2M words	8M
Increment size, bytes	128K-2M words	64K words	256K-1M words	256K or 1M
Interleaving	1-, 2-, or 4-way	1-way	4-way	Not applicable
BUFFER STORAGE				
Type	Bipolar	Bipolar	Bipolar	Not applicable
Cycle time, nanoseconds	133	133	133	—
Bytes fetched per cycle	4	1	4	—
Capacity, bytes	4096 words	512 words	4096 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, indexed	Direct, indirect, indexed	Direct, indirect, indexed	Direct and indirect
Control storage	2048 words[2]	2048 words[1]	2048 words[2]	8K words of 64 bits each
Extended precision floating point	—	—	—	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	2-8 per CPU	2	2-8 per CPU	Bus structure
Other I/O channels	1-2 hard copy controllers	1 hard copy controller	2 hard copy controllers[7]	Byte multiplexer
Maximum I/O data rate, bytes/sec.	6M words per second	1.9M words per second	6M words per second	5M
COMMUNICATIONS				
Maximum number of lines				100
Synchronous	12 per CPU	2	14	20[3]
Asynchronous	128 per CPU	32	128 per CPU	96[3]
Protocols supported	BSC, DDCMP	BSC, DDCMP, NCP	BSC, HDLC, DDCMP, TCP/IP	BSC, SDLC, Async
Network architectures supported	ANF-10, DECNet, 2780/3780/HASP, 2780/3780 ET	DECnet-10, 2780/3780/HASP, ARPANET, ANF-10, DECnet-20, 2780/3780/ET	DECnet, 2780/3780/HASP, ARPANET, 2780/3780/ET, PSI, RJE	SNA
PERIPHERAL EQUIPMENT				
Disk drives	176M-967M bytes	176M bytes	176M-967M bytes	70M-635M bytes per device
Magnetic tape drives	800-6250 bpi	800-6250 bpi	800-6250 bpi	72KBS-200KBS[2]
Line printers	600-1250 lpm	600-1250 lpm	600-1250 lpm	300-1000
Other peripheral devices supported	Card reader	Card reader	Card reader	Floppy disk, card reader (400 cps), IBM 370 byte mux
SOFTWARE				
Operating systems	TOPS-10	TOPS-10/TOPS-20	TOPS-20	DOS/VS, DOS/VSE, OS/VS1, MVS, VM/370, VM/SP
Programming languages	Cobol, Fortran, Basic, APL, Algol, CPL, Bliss-36	Cobol, Fortran, Basic+2, APL, Bliss-36, Algol, Pascal, CPL	Cobol, Fortran, Basic+2, APL, Bliss-36, Algol, Pascal, CPL	Cobol, Fortran, PL/1, RPG II, APL
Data base management system	DBMS-10	DBMS-10 or DBMS-20	DBMS-20	TMS
PRICING & AVAILABILITY				
Purchase price, basic system, $	396,000-425,000	63,000-135,000	375,000-405,000	47,000-97,400
Monthly maintenance, prime shift, $	2,493-2,918[3]	1,115[2]	2,493-2,918[3]	150-541
Monthly rental, 1-year lease, $ (including maintenance)	Not available	Not available	Not available	Not available
Purchase price of memory incre., $	20,000-80,000[4]	6,000	20,000 to 80,000	3300 for 256K to 10,000 for 1MB
Date of first delivery	March 1979	March 1979	March 1979	February 1981
Number installed to date	—	—	—	70
COMMENTS	[1]601 for 1-word fetch; 1201 for 4-word fetch [2]75-bit words [3]12-hour DECservice [4]Increment in 128K-word to 2M-word chunks —	[1]96-bit words [2]12-hour DECservice —	[1]601 for 1-word fetch; 1201 for 4-word fetch [2]75-bit words [3]12-hour DECservice —	[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

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MANUFACTURER AND MODEL	Honeywell DPS 7 Series	Honeywell DPS 8 Series	Honeywell DPS 88 Series	International Business Machines Corp. 4300 Series Model 4361
MODELS	DPS 7/35E, 7/45E, 7/55E, 7/65E	[2]DPS 8/47, 8/49, 8/52, 8/62, 8/70	DPS 88/41, /42, /42T, /81, /82, /82T	4361 Group 3, Group 4, Group 5
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1-6	1-2	1
Number of I/O processors	2-8	Not applicable	1-2 IOP	—
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	750	—
Access time, nanoseconds	250	225	225	—
Bytes fetched per cycle	4	16	32	4
Minimum capacity, bytes	1M-2M	4M	2-way to 4-way	2M
Maximum capacity, bytes	3M-4M	64M	128M	12M
Increment size, bytes	1M	2M	16M	2M or 4M
Interleaving	Not applicable	4-way	4-way	—
BUFFER STORAGE				
Type	Not applicable	Not applicable	Not applicable	—
Cycle time, nanoseconds	—	—	—	—
Bytes fetched per cycle	—	—	—	—
Capacity, bytes	—	—	—	8192-16,384 (4361)
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	330 and 140	—	Not available	100
Word length, bits	32	36	36	32
Number of instructions	221	289	316	System/370 Universal Set
General registers	16	Not applicable	Not applicable	—
Addressing	Indirect	Direct and indirect	Direct and indirect	—
Control storage	48K bytes	32K bytes per CPU (cache)	32K to 64K bytes/CPU(cache)	—
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	2[1]-4 multiplexer	—	—	—
Other I/O channels	2-4 multiplexer (opt.)	1-4 IOM[1]	1-2 IOP[1]	1 byte multiplexer 1-2 block multiplexer
Maximum I/O data rate, bytes/sec.	2.5M-10M	4M bytes/sec/IOM	48M bytes/sec/IOP	1.86M-3.0M
COMMUNICATIONS				
Maximum number of lines	12-268	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, Start/Stop
Network architectures supported	DSA	DSA	DSA	SNA
PERIPHERAL EQUIPMENT				
Disk drives	300M-21.6G bytes	626M to 1101M bytes/unit[3]	626M-1101M bytes/unit	64.5M-5.04G bytes
Magnetic tape drives	41.7KBS-200KBS	Up to 1250KBS	Up to 1250KBS	41.7KBS-160KBS
Line printers	600-1600 lpm	900-1600 lpm	1200-1600 lpm	325-3600 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	DOS/VSE, VM 370, SSX/VSE, MVS/370
Programming languages	Cobol, Fortran, RPG, Query, Basic	Cobol, Fortran, Basic, B, C, PL/1, RPG, Pascal, APL, GMAP, GPS, Simscript, LISP, DM-IV, IDS/II	Cobol, Fortran, Basic, B, C, Pascal, APL, PL/1, GMAP, GPS, Simscript, LISP, RPG DM-IV (I-D-S/II)	Same as S/370
Data base management system	I-D-S/II, DM-IV			—
PRICING & AVAILABILITY				
Purchase price, basic system, $	94,200-256,700	153,000-700,000	1,350,000-4,800,000	56,500-255,000
Monthly maintenance, prime shift, $	205-562	500-3,000	4,000-8,650	295-850
Monthly rental, 1-year lease, $ (including maintenance)	3,593-9,408	8,800-44,715	86,400-227,050	3,531-16,880
Purchase price of memory incre., $	10,000	20,000 to 40,000 (2M bytes)	260,000 (16M bytes)	—
Date of first delivery	1st quarter 1982	2nd quarter 1980	3rd quarter 1983	1st quarter 1984
Number installed to date	—	—	—	—
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]Controls up to 16 chan./ IOM [2]CP6 version avail. for all models. Multics only on 8/52, 8/62, and 8/70 [3]Formatted Ref.: 70C-480-11	[1]Controls up to 40 channels/IOP [2]Formatted Ref.: 70C-480-16	Ref.: 70C-504MK-301

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MANUFACTURER AND MODEL	Int'l Business Machines Corp. 4300 Series Models 4341/4381	International Business Machines Corp. 308X Series	International Business Machines Corp. 309X Series	IPL Systems, Inc. 4460
MODELS	4341 Grp. 1, 2, 9, 10, 11, 12; 4381 Grp. 1, 2, and 3	3083CX, EX, BX, JX; 3081GX, KX; 3084QX	200 and 400	4460
SYSTEM CHARACTERISTICS				
Number of CPUs	1-2	1-4	2 (Mdl. 200)or 4 (Mdl. 400)	1
Number of I/O processors	—	—		
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable	S/370 and 4300 Series
MAIN STORAGE				
Type	MOS	MOS	288K-bit MOS	NMOS (16K-bit)
Cycle time, nanoseconds	—	312 (read)	Not specified	500
Access time, nanoseconds	—	—	Not specified	500
Bytes fetched per cycle	8	8	Not specified	8
Minimum capacity, bytes	1M	8M-32M	64M (200), 128M (400)	4M
Maximum capacity, bytes	32M	32M-128M	64M (200), 128M (400)	8M
Increment size, bytes	1M, 2M, or 4M	8M, 16M, or 32M	Not applicable	1M
Interleaving	—	2-way	—	—
BUFFER STORAGE				
Type	—	—	Not specified	ECL
Cycle time, nanoseconds	120-225	—	Not specified	100
Bytes fetched per cycle	8-16	—	Not specified	4-8
Capacity, bytes	2048-32,768 per CPU	Up to 65,536 per CPU	65,536 per CPU	24K
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	68-300	24	18.5	50
Word length, bits	—	32	Not specified	32
Number of instructions	System/370 Universal Set	2, 4, or 6 bytes	Not specified	S/370 Univ. Inst. Set
General registers	—	—	Not specified	16
Addressing	—	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	—	—	Not specified	128K bytes
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	—	8-48 (1-6 groups of 8)	32-48 or 64-96	—
Other I/O channels	1-4 byte multiplexer 2-14 block multiplexer		None	1 byte, 5 block multiplexer
Maximum I/O data rate, bytes/sec.	Up to 16M	72M	3.0M	12M
COMMUNICATIONS				
Maximum number of lines	352	—	Not specified	—
Synchronous	—	—	—	—
Asynchronous	—	—	—	—
Protocols supported	—	—	SDLC, BSC	—
Network architectures supported	SNA	SNA	SNA	SNA
PERIPHERAL EQUIPMENT				
Disk drives	64.5M-5.04G bytes	317.5M-5.04G bytes	317.5M-5.04G bytes	Supports all S/360 S/370, 4300, 30XX, and plug-compatible peripherals
Magnetic tape drives	41.7KBS-160KBS	10KBS-1250KBS	10KBS-3000KBS	
Line printers	325-3600 lpm	1100-20,040 lpm	1100-20,040 lpm	
Other peripheral devices supported	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, MVS/370 SSX/VSE	MVS/370, VM/SP, MVS/XA	MVS/370, MVS/XA, VM/SP	DOS/VS, DOS/VSE, OS/VS1, SVS, MVS, MVS/SP, SSX/VSE, ACP
Programming languages	Same as S/370	System/370 languages	System/370 languages	Cobol, Fortran, APL, PL/1, Pascal, Algol, RPG, Basic
Data base management system	—	IMS	IMS	—
PRICING & AVAILABILITY				
Purchase price, basic system, $	81,000-1,065,000	635,000-6,410,000	4,600,000 (Mdl. 200)	195,800
Monthly maintenance, prime shift, $	388.00-1,160	1,445-10,990	5,900	964
Monthly rental, 1-year lease, $ (including maintenance)	6,786-70,990	38,000-462,130	383,350	—
Purchase price of memory incre., $	—	—	Extended storage costs 475,000 for 64MB	8,250
Date of first delivery	4th quarter 1979	February 1984	November 1985	—
Number installed to date	—	—	—	—
COMMENTS	Ref.: 70C-504MK-301	Ref.: 70C-504MK-601	Up to 128MB of opt. extended storage (cache) is available for Mdl. 200, up to 256MB for Mdl. 400; Mdl. 400 is available only as upgrade from Mdl. 200. Ref.: 70C-504MK-701	—

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MANUFACTURER AND MODEL	IPL Systems, Inc. 4480	National Advanced Systems (NAS) AS/66X0 Series	National Advanced Systems (NAS) AS/80X3 Series	National Advanced Systems (NAS) AS/90X0 Series
MODELS	4480	AS/6620, AS/6630, AS/6650, AS/6660	AS/8023, AS/8043, AS/8053, AS/8063, AS/8083	AS/9040, AS/9050, AS/9060, AS/9070, AS/9080
SYSTEM CHARACTERISTICS				
Number of CPUs	2	1	1-2	1-2
Number of I/O processors	—	—	—	—
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	S/370 and 4300 Series	IBM 4341, 308X, 370	IBM 4341, 303X, 308X, 370	IBM 4341, 303X, 308X, 370
MAIN STORAGE				
Type	NMOS (16K-bit)	NMOS (256K)	NMOS	NMOS
Cycle time, nanoseconds	500	301-420	360 (read)	270-342 (read)
Access time, nanoseconds	400	—	—	—
Bytes fetched per cycle	8	8	8	8
Minimum capacity, bytes	8M	4M	8M	8M-16M
Maximum capacity, bytes	16M	16M	32M	32M-64M
Increment size, bytes	2M	4M	4M	8M-16M
Interleaving	—	—	4-way or 8-way	8-way or 16-way
BUFFER STORAGE				
Type	ECL	Bipolar RAM	Bipolar RAM	Bipolar RAM
Cycle time, nanoseconds	100	50-60	18-20	15-19
Bytes fetched per cycle	4-8	8	8	8
Capacity, bytes	48K	64K	16K-64K	64K-256K per CPU
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	50	43-60	33-40	30-38
Word length, bits	32	32	32	32
Number of instructions	S/370 Univ. Inst. Set	S/370 Univ. Inst. Set	S/370 Univ. Inst. Set	S/370 AS/370XA
General registers	32	16	16	16
Addressing	Direct and indirect	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	2 x 128K bytes	—	—	—
Extended precision floating point	Yes	Yes	Yes	Yes
INPUT/OUTPUT CONTROL				
Integrated I/O channels	—	—	—	—
Other I/O channels	2 byte, 10 block multiplexer	5-8 block 1-2 byte	7-23 Block 1-6 byte	6-23, 12-30 block mux 1-6, 2-8 byte mux
Maximum I/O data rate, bytes/sec.	21M	Aggregate 13M	Aggregate 13M-56M	60M-96M
COMMUNICATIONS				
Maximum number of lines	—	Supports all communication controllers that are compatible with 370, 4300, 303X, and 308X.	Supports all communication controllers that are compatible with 370, 4300, 308X, and 308X.	Supports all communication controllers that are compatible with 370, 4300, 303X, and 308X
Synchronous	—			
Asynchronous	—			
Protocols supported	—			
Network architectures supported	SNA	Support network architectures that run 370, 4300, 303X, and 308X CPUs	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	Support IBM & IBM-compatible devices/controllers that attach to 370, 4300, 303X, and 308X CPUs	Support IBM & IBM-compatible devices/controllers that attach to 370, 4300, 303X, and 308X CPUs	Support 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	MVS, MVS/SP, VM/370, MV/SP, SSX/VSE, ACP, M/DOS, MVT/VSE	VM/370, OS/VS1, MVS	VM/370, OS/VS1, MVS	VM/370, OS/VS1, MVS, VM/XA, MVS/XA
Programming languages	Cobol, Fortran, APL, PL/1, Pascal, Algol, RPG, Basic	Functional compatibility with IBM 360, 370, 4300, 303X, and 308X	Functional compatibility with IBM 360, 370, 4300, 303X, and 308X	Functional compatibility with IBM 360, 370, 4300, 303X, and 308X
Data base management system	—	Same as above	Same as above	Same as above
PRICING & AVAILABILITY				
Purchase price, basic system, $	4430,000	255,000-475,000	754,238-4,210,868	1,422,000-4,140,000
Monthly maintenance, prime shift, $	1,084	7520-1135	3,930-9,637	4,821-10,437
Monthly rental, 1-year lease, $ (including maintenance)	—	Contact vendor	Contact vendor	—
Purchase price of memory incre., $	8,800	38,000 (4 megabytes)	139,106 (8 megabytes)	123,000 (8 megabytes)
Date of first delivery	—	August 1982	May 1983	December 1982
Number installed to date	—	—	—	—
COMMENTS	—	Ref.: 70C-638XM-201	Ref.: 70C-638XM-201	Ref.: 70C-638XM-201

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MANUFACTURER AND MODEL	National Advanced Systems (NAS) AS/91X0 Series	NCR Corp. 8500 Systems	NCR Corp. 8600 Systems	Sperry Corp. System 80 Models 4 and 6
MODELS	AS/9140, AS/9150, AS/9160, AS/9170, AS/9180	8545-II, 8555-II, 8565-IIE, 8575-II, 8595-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	—	Optional 2-4	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	1M	4M-16M	524,288
Maximum capacity, bytes	32M-64M	4-16M	16M-64M	4,194,308
Increment size, bytes	8M-16M	1M-4M	4M	262,144 or 524,288
Interleaving	16-way	2-way or 4-way[2]	4-way	Not applicable
BUFFER STORAGE				
Type	Bipolar RAM		Cache memory	Cache
Cycle time, nanoseconds	15-19	Not applicable	76	—
Bytes fetched per cycle	8	—	4-8	—
Capacity, bytes	256K per CPU	—	32K-512K	—
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	30-38	84-56	38	—
Word length, bits	32	32	32	32
Number of instructions	S/370 AS/370XA	108	108	128
General registers	16	64	104-416	16
Addressing	Direct and indirect	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	—	24K-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 mux 1-6, 2-8 byte mux	Contact vendor	Contact vendor	3 multiplexer
Maximum I/O data rate, bytes/sec.	96M	8M	8M-32M	Aggregate 6M
COMMUNICATIONS				
Maximum number of lines	Supports all communication controllers that are com- patible with 370, 4300, 303X, and 308X	253	Contact vendor	0-8
Synchronous				
Asynchronous				
Protocols supported		SDLC, BSC, TTY, X.25, 3270	SDLC, BSC, TTY, X.25, 3270	—
Network architectures supported	Support network architec- tures that run 370, 4300, 303X, and 308X CPUs	NCR/CNA, SNA	NCR/CNA, SNA	DCA
PERIPHERAL EQUIPMENT				
Disk drives	Support IBM & IBM- compatible devices/control- lers that attach to 370, 4300, 303X, and 308X CPUs	13M-1092M bytes per device	13M-1092M bytes per device	72M-491M bytes
Magnetic tape drives		80KBS-320KBS	80KBS-320KBS	40KBS-200KBS
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, VM/XA, MVS/XA	VRX, B1, B2, B3[3]	VRX	OS/3
Programming languages	Same as 6600 + vast pre- processor to vectorize F77 loops	Cobol 74, VRX Fortran 77, Neat VS, 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 above	Total	Total	DMS
PRICING & AVAILABILITY				
Purchase price, basic system, $	1,792,000-4,740,000	41,500-170,000	455,000-2,895,000	66,082 to 94,062
Monthly maintenance, prime shift, $	6,329-13,453	245-1,373	2,291-9,000	Contact vendor
Monthly rental, 1-year lease, $ (including maintenance)	—	3,115-16,890	14,667-88,378	Contact vendor
Purchase price of memory incre., $	123,000 (8 megabytes)	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-638XM-201	[1]V-8545-II is 2M bytes [2]V-8545-II does not use interleaving [3]V-8545-II and V-8555-II only Ref.: 70C-656-02	Ref.: 70C-656-02	[1]Plus 1024 words of read- only storage Ref.: 70C-780-02

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MANUFACTURER AND MODEL	Sperry Corp. System 80 Model 8	Sperry Corp. MAPPER 10/SYSTEM 11	Sperry Corp. 1100/60 System	Sperry Corp. 1100/70 System
MODELS	S/80-8	—	1100/61, 1100/62, 1100/63, 1100/64	1100/71, 1100/72, 1100/73, 1100/74
SYSTEM CHARACTERISTICS				
Number of CPUs	1	1-2	1-4	1-4
Number of I/O processors	—	—	1-4	1-4
Virtual storage capability	—	—	Yes	—
Plug-compatible with	Not applicable	—	Not applicable	Not applicable
MAIN STORAGE				
Type	MOS	64K NMOS	NMOS	64K MOS
Cycle time, nanoseconds	124	400	580	580
Access time, nanoseconds	496 (read)	300	—	—
Bytes fetched per cycle	8	4	—	—
Minimum capacity, bytes	1,048,576	4M	512K words (2M bytes)	524K words (2M bytes)
Maximum capacity, bytes	8,388,608	16M	4096K words (16M bytes)	8384K words (32M bytes)
Increment size, bytes	1,048,576 or 2,097,152	2M	262K words (1M byte)	524K words (2M bytes)
Interleaving	Not applicable	No	—	—
BUFFER STORAGE				
Type	Cache	—	IC semiconductor[1]	IC semiconductor
Cycle time, nanoseconds	—	—	116	116
Bytes fetched per cycle	—	—	4-word	4 words (16 bytes)
Capacity, bytes	—	—	2048 words in E models	2048 in E models (words)
			8192 words in H models	8192 in H models (words)
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	124	100	116	116
Word length, bits	32	36	36	36
Number of instructions	128	268	161	161
General registers	16	128	128	128
Addressing	Direct and indirect	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	90,000 bytes[1]	—	2000 words	2000 words
Extended precision floating point	Not available	Yes	—	—
INPUT/OUTPUT CONTROL				
Integrated I/O channels	1-2	7	—	—
Other I/O channels	1 byte multiplexer	2	1-12 block mux	1-12 block multiplexer
	1-5 selection		4-48 word	4-48 word
Maximum I/O data rate, bytes/sec.	Aggregate 8M	20.8M	—	6.3M
COMMUNICATIONS				
Maximum number of lines	0-28	Unlimited	No fixed limit	No fixed limit
Synchronous		Yes		
Asynchronous		Yes		
Protocols supported	—	Uniscore, TTY, UDLC	UDLC	UDLC
Network architectures supported	DCA	DCA	DCA	DCA
PERIPHERAL EQUIPMENT				
Disk drives	29M-491M bytes	230M bytes (max. 80 units)	77M-1.6G bytes	77M-1.6G bytes
Magnetic tape drives	40K-750K bytes	40KBS-780KBS	34KBS-1250KBS	34KBS-1250KBS
Line printers	180-2000 lpm, 200 cps	180-1200 lpm	760-2000 lpm	760-2000 lpm
Other peripheral devices supported	Diskettes, workstations, card equipment	Card reader, diskette	Card equipment, drum, terminals, diskette, laser printer	Card equipment, terminals, diskette, drum, laser printer
SOFTWARE				
Operating systems	OS/3	1100 OS	1100 OS	1100 OS
Programming languages	Cobol, Fortran IV, Basic, RPG II, Escort, BAL, MAPPER	MAPPER 10-MAPPER only; SYSTEM 11-Cobol, Fortran, RPG, APL, MAPPER	Cobol, Fortran, Algol, Basic, Jovial, PL/1, RPG, MACRO, Assembler, MAPPER	Cobol, Fortran, RPG, Basic, PL/1, MAPPER
Data base management system	DMS	MAPPER, DMS 1100	UDS 1100	UDS 1100
PRICING & AVAILABILITY				
Purchase price, basic system, $	123,900	154,540	336,519-1,076,816	188,000
Monthly maintenance, prime shift, $	Contact vendor	777	1,342-3,732	1,070
Monthly rental, 1-year lease, $ (including maintenance)	Contact vendor	6,231	8,007-25,637	6,320
Purchase price of memory incre., $	14,400 to 28,800	15,000	—	Contact vendor
Date of first delivery	1st quarter 1984	3Q, 4Q 1984	January 1980	June 1983
Number installed to date	—	—		
COMMENTS	Ref.: 70C-780-02	—	[1]Excl. 1100/61 C1 and C2 cache unit	
			Ref.: 70C-780-12	
				Ref.: 70C-846MM-301

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MANUFACTURER AND MODEL	Sperry Corp. 1100/80 System	Sperry Corp. 1100/90 System		
MODELS	1100/80, 1100/81, 1100/82, 1100/83, and 1100/84	1100/91, 1100/92, 1100/93, 1100/94		
SYSTEM CHARACTERISTICS				
Number of CPUs	1-4	1-4		
Number of I/O processors	1-4	1-4		
Virtual storage capability	—	Yes		
Plug-compatible with	Not applicable	Not applicable		
MAIN STORAGE				
Type	MOS	MOS		
Cycle time, nanoseconds	1250	360-600		
Access time, nanoseconds	—	—		
Bytes fetched per cycle	—	—		
Minimum capacity, bytes	512K words (2M bytes)	2,097,152 words (8M bytes)		
Maximum capacity, bytes	8192K words (32M bytes)	16,777,216 words(64M bytes)		
Increment size, bytes	262K words (1M bytes)	—		
Interleaving	—	2-way or 4-way		
BUFFER STORAGE				
Type	IC semiconductor	Cache memory		
Cycle time, nanoseconds	—	60		
Bytes fetched per cycle	—	—		
Capacity, bytes	16,384 to 131,072	65K		
CENTRAL PROCESSOR				
Machine cycle time, nanoseconds	200	—		
Word length, bits	36	36		
Number of instructions	219	271		
General registers	128	128		
Addressing	Indirect	Direct and indirect		
Control storage	—	—		
Extended precision floating point	—	Not available		
INPUT/OUTPUT CONTROL				
Integrated I/O channels	—	—		
Other I/O channels	Byte multiplexer, block multiplexer	Up to 96 block multiplexer[3] Up to 160 word[3]		
Maximum I/O data rate, bytes/sec.	—	37.5M		
COMMUNICATIONS				
Maximum number of lines Synchronous Asynchronous	No fixed limit	No fixed limit		
Protocols supported	—	UDLC		
Network architectures supported	DCA	DCA		
PERIPHERAL EQUIPMENT				
Disk drives	77M-16G bytes	77M-1.6G bytes		
Magnetic tape drives	34KBS-1250KBS	34KBS-1250KBS		
Line printers	760-2000 lpm	760-2000 lpm[2]		
Other peripheral devices supported	Drum, diskette, card equipment, terminals, laser printer	Card equipment, terminals, diskette, drum, laser printer		
SOFTWARE				
Operating systems	1100 OS	1100 OS		
Programming languages	Cobol, Fortran, APL, Pascal 1100, NU Algol, Basic, PL/1, RPG, MACRO, MAPPER	Cobol, Fortran, Algol, Basic, Pascal, PL/1, APL, RPG, Assembly, MAPPER		
Data base management system	UDS 1100	UDS 1100		
PRICING & AVAILABILITY				
Purchase price, basic system, $	1,389,628-6,128,808	2,865,660-8,851,539		
Monthly maintenance, prime shift, $	3,490-14,099	5,551-16,098		
Monthly rental, 1-year lease, $ (including maintenance)	35,431-159,738	—		
Purchase price of memory incre., $	Contact vendor	Contact vendor		
Date of first delivery	1977	June 1983		
Number installed to date	—	—		
COMMENTS	Ref.: 70C-846MM-401	[1]Only available on 90/80 [2]Laser printer 10,500-21,000 lpm [3]Either block or word channel Ref.: 70C-846MM-501		