

# All About Mainframes

What are mainframes, who are the manufacturers, how do these mainframes differ, what is their market, and what trends are perceived in the future. These are just some of the questions that this report will attempt to answer.

## DEFINITION AND SCOPE

Categorically, mainframe is a term that has been used to refer to a general purpose processor. It is the "granddaddy" 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, the reader is referred 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 both 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 fall in upward of \$100,000 are included. An explanation of these prices is given in the section headed Pricing and Availability.

## MAINFRAME MARKET PRESENT AND FUTURE

Standing at approximately \$120 billion, general purpose mainframes still represent the greatest dollar value of systems installed worldwide today. Mainframes are projected to reach \$145 billion by 1986.

Though their growth rate is decreasing (users appear to be in a retrenching mode), the future of mainframes is secure. Several reasons why mainframes will be around for awhile is the large investment made to date in software to run these systems, the expensive investment in hiring and training of skilled computer personnel, and the time expended to plan and install the complex systems existing

**All About Mainframes is a new report feature for Datapro. It profiles by type important characteristics and features of 184 mainframes from 14 of the leading manufacturers. This report is designed to put in perspective the present and future for mainframes.**

now and planned for distributed and database networks. Not the least to mention is the fact that manufacturers would never permit the immediate erosion of their customer base by a revolutionary new computer. Migration is normally always part of their plan.

The evolution of the integration of the computer into the organization has been gradual, though with the introduction of minis and microcomputers, organizations have become more dynamic because of experimentation with new ways of doing business. Because of the weak economy over the past two years 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. 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 size companies.

## MAINFRAMES THEN AND NOW

With the power offered by today's mainframes, huge communication networks are possible with a range of sophisticated peripheral devices also 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 information value of the data, only the time and dollars saved, and the accuracy achieved over manual procedures; all of which was easily measured.

The industry has matured since then, when first generation mainframes used vacuum tubes. 1959 marked the beginning of second generation computers with transistors completely replacing vacuum tubes as the active components of the computer. 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 third generation, for the most part using integrated circuits and large-scale integration (LSI), and in some cases very large-scale integration (VLSI). It is a generation which is almost ten years old, and is ready for a major change.

An important characteristic of third-generation computers is their adaptability to data communications. ➤

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▷ Large databases have been created or are planned with nationwide or even worldwide access by way of communication lines.

Users are now retrenching. They are re-thinking the use of the computer in their organizations. They know the value of information, and interest is growing in decision support systems. To control, companies realize they must manage the power that mainframes can offer them, and manage they will because the company's survival depends on it.

### 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 1982 Annual Computer System User Survey, users were asked to rate their systems. Response was good with a total user count of 4,783.

In 1982 the overall user satisfaction ratings of mainframes and plug compatible mainframes showed virtually no changes in 3 years. 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, and then dividing the total by the sum of the number of users who rated each factor. The results were as follows:

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

For details of the 1982 Annual Computer System Survey, the reader is referred to the Datapro 70 report 70C-010-50 titled User Ratings of Computer Systems.

### 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 turn-around 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 database 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 database 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 at the corporate level. Thus bigger, centralized and dynamic databases 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.

### 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 1983 by 14 manufacturers for their 184 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.

*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, ▷

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➤ 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 of memory* used by a manufacturer may be ferrite core, plated wire, thin film, or the more recent semiconductor. 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 in this report were found to use cache. This is a *buffer type* of high speed 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, it goes without saying that 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 ➤

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▷ 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 multi-level 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 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. K expresses thousands or millions (M) 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. Transmission in which 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.

*Magnetic tape drives* on the comparison charts lists 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 from low, medium to high speed. 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 at the medium end with an average of 600 lpm; and between 1000 and 2000 lpm at the high speed end. These rates are generally for a full alphanumeric character set of about 64 characters. When reduced character sets ie. 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, ▷

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▷ would only like to re-iterate 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 in 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* today are for the most part adhering to standardization because of the huge investment in software that users make. 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/I.

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, maintaining, the accuracy of data maintained and distributed.

### PRICING AND AVAILABILITY

*Purchase price, basic system.* The reader will appreciate the price difference between systems when he or she steps through the comparison charts that follow. Please note, however, these are only ranges. They are not intended to represent all of the configurations possible. They are only intended to give the reader an indication of whether the power he is 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, it will be noted that system prices tend to cluster themselves. There may be some discrepancies in systems screened, but this will generally be due to what a manufacturer considers is included as part of their basic system price. For example, one manufacturer may include an I/O processor in their price, another may not. The reader is cautioned to use a price range for his initial screening of systems.

It will be noted that the general purpose equipment presented in this report will tend 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 had been delivered to customers as of approximately January 1982.

### 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 following names, addresses and telephone numbers of the 14 major mainframe manufacturers, reviewed for this report, are listed below.

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

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▷ **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, 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.

**Magnuson Computer Systems**, 2902 Orchard Park Way, San Jose, California 94303. Telephone (408) 964-8100.

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

**NCR Corporation**, 1700 S. Patterson Boulevard, Dayton, Ohio 45479. Telephone (513) 445-5000.

**Sperry Univac Corporation**, 1290 Avenue of the Americas, New York, New York 10104. Telephone (212) 484-4444. ▶

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MANUFACTURER AND MODEL	Amdahl 470 Series	Amdahl 580 Series	Burroughs B 1900 Series	Burroughs B 2900 Series
<b>MODELS</b>	470V/7A, -V/7B, -V/7C, -V/7, -V/8	5850, 5860, 5870, 5880	B 1905, B 1910, B 1955, B 1985	B 2925
<b>SYSTEM CHARACTERISTICS</b>				
Number of CPUs	1	1-2	1-2	1-4
Number of I/O processors	Not applicable	1-2	1	1
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	IBM 303X and 308X	IBM 308X, 303X, 370 line	Not applicable	Not applicable
<b>MAIN STORAGE</b>				
Type	Dynamic, NMOS	NMOS	16K-MOS	16K-MOS
Cycle time, nanoseconds	320	280	500 or 333 (read)	—
Access time, nanoseconds	—	120	Contact vendor	571 (read)
Bytes fetched per cycle	4	8	<sup>1</sup>	4
Minimum capacity, bytes	8MB	16MB	131,072 or 524,288	1MB
Maximum capacity, bytes	32MB	32MB	1,048,576 or 2,097,152	2MB
Increment size, bytes	4MB	8MB	131,072-1MB	1MB
Interleaving	16-way	8- or 16-way	Not applicable	Not applicable
<b>BUFFER STORAGE</b>				
Type	Bipolar RAM	Bipolar RAM	Cache	Not applicable
Cycle time, nanoseconds	52-58	24	—	—
Bytes fetched per cycle	4	32	—	—
Capacity, bytes	32K-64K	2 <sup>1</sup> x 32K-4 <sup>1</sup> x 32K	8,192	—
<b>CENTRAL PROCESSOR</b>				
Machine cycle time, nanoseconds	26-29	24	167 or 250	143
Word length, bits	32	32	<sup>1</sup>	8-32
Number of instructions	Executes 370 or XA inst. set	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 available
Extended precision floating point	Yes	Yes	—	Yes
<b>INPUT/OUTPUT CONTROL</b>				
Integrated I/O channels	8-32 <sup>1</sup>	16-32	7 or 8	Not applicable
Other I/O channels	—	None	7 or 8 with I/O expan. unit	DLPs <sup>1</sup> up to 16
Maximum I/O data rate, bytes/sec.	Aggregate 18MB-20MB	6MB/sec., 50MB aggregate, 16 channels	Not available	Aggregate 7MB
<b>COMMUNICATIONS</b>				
Maximum number of lines	—	352 <sup>2</sup>	8-32	320-1280
Synchronous	—	Yes	—	—
Asynchronous	—	Yes	—	—
Protocols supported	BSC, SDLC	All SNA	Poll select, BDLC, Bisync. <sup>3</sup>	Poll select, BDLC, Bisync. <sup>3</sup>
Network architectures supported	SNA	SNA	BNA	BNA
<b>PERIPHERAL EQUIPMENT</b>				
Disk drives	Can support most IBM 360 and 370 devices, OEM, or plug compatible	Can support all IBM 370, 303X and 308X devices, OEM, or plug compatible	65.2MB-130.4MB 40KBS or 80/120KBS 320 lpm-2000 lpm	5.5MB-4026MB 80KBS-1200KBS 650 lpm-2000 lpm
Magnetic tape drives	—	—	Floppy disks, cassette tapes, card reader/punch/printer, MICR/OCR, terminals	Microfilmer, card equip- ment, reader/sorter, terminals
Line printers	—	—	—	—
Other peripheral devices supported	—	—	—	—
<b>SOFTWARE</b>				
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-TCS III MCP-TCS IV	MCP-VI MCP-IX
Programming languages	—	—	ANSI 74 Cobol, ANSI 77, Fortran, RPG II, Basic	Cobol, RPG II, Fortran, Basic, Pascal, BPL
Data base management system	—	Support IMS, DB/DC, all other IBM-compatible systems	DMS-II	DMS-II
<b>PRICING &amp; AVAILABILITY</b>				
Purchase price, basic system	Contact vendor	2,750,000-6,190,000	62,500-132,135	145,000-190,000
Monthly maintenance, prime shift	Contact vendor	8,500-18,715	407-426	430
Monthly rental, 1-year lease (including maintenance)	Not available	109,744 <sup>3</sup> -265,484 <sup>3</sup>	2,317-4,377	6,287
Purchase price of memory increment	Contact vendor	200,000	3,623-24,152	12,000
Date of first delivery	—	4th quarter 1982	1st quarter 1980	1st quarter 1983
Number installed to date	—	14-50	Not available	Not available
<b>COMMENTS</b>				
	<sup>1</sup> 16 on V/7C Ref.: 70C-044-01	<sup>1</sup> No. of high speed buffers <sup>2</sup> Utilizes front end processor <sup>3</sup> 2-year lease Ref.: 70C-044-03	<sup>1</sup> Instruction set dependent <sup>2</sup> Bit level addressability <sup>3</sup> Contact vendor Ref.: 70C-112-06	<sup>1</sup> Data Link Processor <sup>3</sup> Contact vendor <sup>4</sup> Field upgradable to 3955 Ref.: 70C-112-10

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MANUFACTURER AND MODEL	Burroughs B 3900 Series	Burroughs B 4900 Series	Burroughs B 5900 Series	Burroughs B 6900 Series
<b>MODELS</b>	B 3955	B 4955	B 5920, B 5930, B 5935	B 6925
<b>SYSTEM CHARACTERISTICS</b>				
Number of CPUs	1-4	1-4	1-4	1-4
Number of I/O processors	1	2	1	1
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable	Not applicable
<b>MAIN STORAGE</b>				
Type	16K-MOS	64K-MOS	64K-MOS	MOS
Cycle time, nanoseconds	—	—	720	720
Access time, nanoseconds	571 (read)	440 (read)	600 per word	450 per word
Bytes fetched per cycle	4	5	6	6
Minimum capacity, bytes	2MB	5MB	3MB-6MB	1.5MB-6MB
Maximum capacity, bytes	5MB	5MB	6MB per CPU	6MB per CPU
Increment size, bytes	1MB	Not available	3MB	1.5MB
Interleaving	Not applicable	4-way	Not applicable	Not applicable
<b>BUFFER STORAGE</b>				
Type	Not applicable	Instruction	Lookahead	Lookahead
Cycle time, nanoseconds	—	110	720	720
Bytes fetched per cycle	—	5	6	6
Capacity, bytes	—	Contact vendor	Not applicable	Not applicable
<b>CENTRAL PROCESSOR</b>				
Machine cycle time, nanoseconds	143	110	—	—
Word length, bits	8-32	40	52	52
Number of instructions	Contact vendor	Contact vendor	Not applicable	Not applicable
General registers	Not applicable	Not applicable	Not applicable	Not applicable
Addressing	Direct, indirect, index	Direct, indirect, index	Direct and indirect	Direct and indirect
Control storage	Not available	Not available	Not available	Not available
Extended precision floating point	Yes	Yes	Yes	Yes
<b>INPUT/OUTPUT CONTROL</b>				
Integrated I/O channels	Not applicable	Not applicable	Not applicable	Not applicable
Other I/O channels	DLPs <sup>1</sup> up to 32	DLPs <sup>1</sup> up to 64	DLPs up to 32	DLPs up to 32
Maximum I/O data rate, bytes/sec.	Aggregate 7MB	16MB	2.3MB	6.7MB
<b>COMMUNICATIONS</b>				
Maximum number of lines	320-1280	320-1280	256	256
Synchronous				
Asynchronous				
Protocols supported	Poll select, BDLC, Bisync. <sup>3</sup>	Poll select, BDLC, Bisync. <sup>3</sup>	Poll select, BDLC, Bisync. <sup>3</sup>	Poll select, BDLC, Bisync. <sup>3</sup>
Network architectures supported	BNA	BNA	BNA	BNA
<b>PERIPHERAL EQUIPMENT</b>				
Disk drives	See B 2900	See B 2900	5.5MB to 402MB	5.5MB to 402MB
Magnetic tape drives	See B 2900	See B 2900	80KBS-470KBS	80KBS-1250KBS
Line printers	650-2000 lpm	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	Card reader, card punch terminals	Card reader, terminals
<b>SOFTWARE</b>				
Operating systems	MCP-VI MCP-IX	MCP-IX	MCP	MCP
Programming languages	Cobol, RPG II, Fortran, Basic, Pascal, BPL	Cobol, RPG II, Fortran, Basic, Pascal, BPL	Cobol, Fortran, Algol, APL, Basic, PL/1, RPG	Cobol, Fortran, Algol, PL/1, APL, Basic, RPG,
Data base management system	DMS-II	DMS-II	DMS-II	DMS-II
<b>PRICING &amp; AVAILABILITY</b>				
Purchase price, basic system	304,500-350,000	780,000-850,000	180,000-225,000	417,000-437,000
Monthly maintenance, prime shift	621	1,300	650	1,060
Monthly rental, 1-year lease (including maintenance)	11,551	33,725	7,532	15,260
Purchase price of memory increment	12,000	Not applicable	45,000	30,000
Date of first delivery	3rd quarter 1981	3rd quarter 1983	2nd quarter 1982	4th quarter 1981
Number installed to date	Not available	Not available	Not available	Not available
<b>COMMENTS</b>	<sup>1</sup> Data Link Processor <sup>3</sup> Contact vendor  Ref.: 70C-112-10	<sup>1</sup> Data Link Processor <sup>3</sup> Contact vendor  Ref.: 70C-112-11	Ref.: 70C-112-14	<sup>3</sup> Contact vendor  Ref.: 70C-112-13



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MANUFACTURER AND MODEL	Burroughs B 7900 Series	Cambex 1600 Series	Control Data Cyber 170 Series 800	Cray X-MP
<b>MODELS</b>	B 7900F, B 7900H, B 7900K	1636-1, 1636-10, 1641-1, 1641-11, 1651-1	Cyber 170 models 815, 825, 835, 855, 865, 875	X-MP22, X-MP24 <sup>5</sup>
<b>SYSTEM CHARACTERISTICS</b>				
Number of CPUs	1-3 <sup>1</sup>	1	1 or 2	2
Number of I/O processors	1-2	Not applicable	10-20	2-4
Virtual storage capability	Yes	Yes	—	Not available
Plug-compatible with	Not applicable	IBM 4300 and IBM 370	Not applicable	Not applicable
<b>MAIN STORAGE</b>				
Type	MOS	64K RAM dynamic	MOS or bipolar <sup>2</sup>	Bipolar
Cycle time, nanoseconds	Not applicable	400 (read)	75-448	38
Access time, nanoseconds	Not applicable	50	200-1200	133
Bytes fetched per cycle	Not applicable	16	1 word	48-64
Minimum capacity, bytes	12MB	2MB	262K <sup>3</sup> -524K <sup>3</sup>	16MB
Maximum capacity, bytes	96MB	16MB	1048K <sup>3</sup> -2097K <sup>3</sup>	32MB
Increment size, bytes	6MB	1MB-2MB	262K <sup>3</sup> or 524K <sup>3</sup>	16MB
Interleaving	8-way	Yes	2-, 4-, 8-, 16-way	16-way or 32-way
<b>BUFFER STORAGE</b>				
Type	Not available	Cache <sup>1</sup> bipolar RAM	Bipolar <sup>1</sup>	SSD <sup>1</sup>
Cycle time, nanoseconds	Not available	100 <sup>1</sup>	64-112 <sup>1</sup>	1000MB (transfer rate)
Bytes fetched per cycle	Not available	16 <sup>1</sup>	1 word <sup>1</sup>	8-32
Capacity, bytes	Not available	8K <sup>1</sup>	4096 words <sup>1</sup>	64MB-256MB
<b>CENTRAL PROCESSOR</b>				
Machine cycle time, nanoseconds	—	50	25-64	9.5
Word length, bits	52	32	60	64
Number of instructions	Not applicable	IBM 4300/370 inst. sets	76-80	128
General registers	Not applicable	16	24	16
Addressing	Direct and indirect	Direct and indirect	Direct	Direct
Control storage	Not available	144KB	2048 128 bit words	Not applicable
Extended precision floating point	Yes	Yes	Yes	Not available
<b>INPUT/OUTPUT CONTROL</b>				
Integrated I/O channels	Not applicable	IBM 4300 compatible	12 to 24	20-52 <sup>2</sup>
Other I/O channels	DLPs up to 128	2-5 block multiplexers (2 std.) (3 opt.), 1 byte multiplexer (std.)	0-8 DEMA (865 & 875)	—
Maximum I/O data rate, bytes/sec.	24MB per I/O processor	2MB—block 180KB—byte	180-600M bits	Aggregate 48MB-1048MB
<b>COMMUNICATIONS</b>				
Maximum number of lines	Contact vendor	IBM plug-compatible—256	Configuration dependent	4
Synchronous			2000-56,000 bps	4
Asynchronous			110-9600 bps	4
Protocols supported	Poll select, BDLC, Bisync. 3	IBM compatible	X.25, Mode 4, HASP, 2780/3780, Async.	Cray
Network architectures supported	BNA	IBM compatible	—	NSC (local)
<b>PERIPHERAL EQUIPMENT</b>				
Disk drives	5.5MB-402MB	Support IBM or plug comp.	237MB-1384MB	600MB-28,800MB
Magnetic tape drives	80KBS-1250KBS	Support IBM or plug comp.	100-200 ips	3
Line printers	650-2000 lpm	300-1000 lpm integrated	1200 to 2000 lpm	3
Other peripheral devices supported	Card equipment, terminals	Integrat. chan.-to-chan. adapter	Card equipment, terminals, array processors <sup>5</sup>	3
<b>SOFTWARE</b>				
Operating systems	MCP	DOS/V.S, DOS/VSE, OS/ VS1, SVS, MVS <sup>1</sup> , VM/370, VM/SP, ACP, MVS/SP	NOS	COS
Programming languages	Cobol, Fortran, Algol, APL, Basic, RPG, PL/1	Compatible with IBM 360, 370 and 4300 systems	Cobol, Fortran, Algol, APL, PL/1, Basic, Pascal	Fortran, Assembly, Pascal
Data base management system	DMS-II	All IBM database-compatible systems	DMS-170, Total, IMF	Not applicable
<b>PRICING &amp; AVAILABILITY</b>				
Purchase price, basic system	2,000,000-2,100,000	95,000-227,000	195,000-2,850,000	Contact vendor
Monthly maintenance, prime shift	Contact vendor	445-925	900-9,000	Contact vendor
Monthly rental, 1-year lease (including maintenance)	105,263	Not applicable	7,490-105,550	Contact vendor
Purchase price of memory increment	25,000	9,000	25,000-320,000	Contact vendor
Date of first delivery	3rd quarter 1983	4th quarter 1980	April 1982	July 1983
Number installed to date	Not available	Over 30	—	—
<b>COMMENTS</b>				
	<sup>1</sup> Plus one aux. proc- essor/CPU <sup>2</sup> Contact vendor  Ref.: 70C-112-16	<sup>1</sup> Excl. Model 1636  Ref.: —	<sup>1</sup> Cache memory on 835 and 855 only <sup>2</sup> Model 875 only <sup>3</sup> 60 bit words <sup>4</sup> Excl. 865 and 875 <sup>5</sup> Extended mem. & high performance disk on 865 & 875 only  Ref.: —	<sup>1</sup> Solid state storage device <sup>2</sup> Depends on no. I/O proc- essors <sup>3</sup> Supplied by other mfrs. <sup>4</sup> Attach to IBM, CDC, DEC, Hon., Univ., Data Gen. channels <sup>5</sup> Super computer MIPS 210 MFLOPS 420  Ref.: —

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MANUFACTURER AND MODEL	Cray M Series	Digital Equipment DECsystem-10	Digital Equipment DECSYSTEM-20	Digital Equipment DECSYSTEM-20
<b>MODELS</b>	M/1200, M/2200, M/4200 <sup>5</sup>	1090, 1090 SMP, 1091	2040, 2060	2020
<b>SYSTEM CHARACTERISTICS</b> Number of CPUs Number of I/O processors Virtual storage capability Plug-compatible with	1 2-4 Not available Not applicable	1-3 1-12 Yes Not applicable	1 1-4 Yes Not applicable	1 0 Yes Not applicable
<b>MAIN STORAGE</b> Type Cycle time, nanoseconds Access time, nanoseconds Bytes fetched per cycle Minimum capacity, bytes Maximum capacity, bytes Increment size, bytes Interleaving	MOS 100 156 8 8MB 32MB 8MB-16MB 8-way or 16-way	MOS or Core 667 <sup>2</sup> or 1200 <sup>2</sup> 467 or 745 1-4 words 256KW-1536KW 3072KW-4096KW 256KW 1-, 2-, or 4-way	MOS 667 <sup>3</sup> for 1 word fetch 467 4 words 512K words 3072KW 256KW 4-way	MOS — 900 for 1 word fetch 1 256K words 512K words 64K words 1-way
<b>BUFFER STORAGE</b> Type Cycle time, nanoseconds Bytes fetched per cycle Capacity, bytes	SSD <sup>1</sup> 100MB (transfer rate) 8-32 64MB-256MB	Bipolar 133 4 words 2048 words	Bipolar <sup>3</sup> 133 <sup>3</sup> 4 words <sup>3</sup> 2048 words	Bipolar 300 1 word 512 words
<b>CENTRAL PROCESSOR</b> Machine cycle time, nanoseconds Word length, bits Number of instructions General registers Addressing Control storage Extended precision floating point	12 64 128 16 Direct Not applicable Not available	33 36 398 8 sets of 16 Direct, indirect, indexing 2048 words Yes	33 36 398 8 sets of 16 Direct, indirect, indexing 2048 words Yes	150 36 396 8 sets of 16 Direct, indirect, indexing 2048 words Yes
<b>INPUT/OUTPUT CONTROL</b> Integrated I/O channels Other I/O channels	20-52 <sup>2</sup> —	2-24 3 to 6 hard copy con- trollers	2-8 2 hard copy controllers	2 1 hard copy controller
Maximum I/O data rate, bytes/sec.	Aggregate 48MB-148MB	14MB	14MB	4.5MB
<b>COMMUNICATIONS</b> Maximum number of lines Synchronous Asynchronous Protocols supported Network architectures supported	4 4 4 Cray NSC (local)	36 max. 384-512 <sup>1</sup> max. BSC, DDCMP	14 128 BSC, HDLC, DDCMP, TCP/IP DECnet, X.25, 2780/ 3780 HASP, ARPANET	2 32 BSC, DDCMP, NCP DECnet, 2780/3780 HASP, ARPANET
<b>PERIPHERAL EQUIPMENT</b> Disk drives Magnetic tape drives Line printers Other peripheral devices supported	600MB-28,800MB 3 3 3	176MB-1.2GB 800 to 6250 bpi 600-1250 lpm Card reader	176MB-1.2GB 800 to 6250 bpi 600-1250 lpm Card reader, paper tape units <sup>4</sup>	176MB 800, 1600 bpi 600-900 lpm Card reader
<b>SOFTWARE</b> Operating systems Programming languages Data base management system	COS Fortran, Assembly, Pascal Not applicable	TOPS-10 Cobol, Fortran, Basic, APL, Algol, CPL, IQL, Bliss-36 DBMS-10	TOPS-20 Cobol, Fortran, Basic+2, APL, Bliss, Algol DBMS-20, DBM-20, CPL	TOPS-20/TOPS-10 Cobol, Fortran, Basic+2, APL, Bliss, Algol DBMS-10 or DBMS-20
<b>PRICING &amp; AVAILABILITY</b> Purchase price, basic system Monthly maintenance, prime shift Monthly rental, 1-year lease (including maintenance) Purchase price of memory increment Date of first delivery Number installed to date	Contact vendor Contact vendor Contact vendor Contact vendor July 1983 —	466,000-639,000 2,465-2,699 <sup>4</sup> Not available 30,000 <sup>3</sup> or 70,000 March 1979 —	342,000-416,000 2,306-2,464 <sup>5</sup> Not available 30,000 July 1978 —	109,000 923 <sup>3</sup> Not available 19,000 <sup>2</sup> July 1978 —
<b>COMMENTS</b>	<sup>1</sup> Solid state storage device <sup>2</sup> Depends on no. I/O pro- cessors <sup>3</sup> Supplied by other mfrs. <sup>4</sup> Attach to IBM, CDC, DEC, Hon., Univ., Data Gen. channels <sup>5</sup> Super computer MIPS 210 MFLOPS 420 Ref.: —	<sup>1</sup> Not possible if a mix of lines <sup>2</sup> 1 word fetch <sup>3</sup> MOS or Core <sup>4</sup> 12-hr. DEC service Ref.: 70C-384-01	<sup>2</sup> Megawords <sup>3</sup> Not on 2040 <sup>4</sup> 2060 only <sup>5</sup> 12-hr. DEC service <sup>6</sup> 96 bit words Ref.: 70C-384-03	<sup>1</sup> 12 hr. DEC service <sup>2</sup> For 256K words, 6000 for 64K words <sup>3</sup> 12-hr. DEC service Ref.: 70C-384-03

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MANUFACTURER AND MODEL	Formation 4000	Honeywell DPS 7 Series	Honeywell DPS 8 Series	Honeywell DPS 88 Series
<b>MODELS</b>	100, 200, 300, 101, 201, 301	DPS 7/35, 7/45, 7/55, 7/65	<sup>2</sup> DPS 8/20, 8/44, 8/44CD, 8/47,8/49,8/52,8/62,8/70	DPS 88/81, DPS 88/82
<b>SYSTEM CHARACTERISTICS</b>				
Number of CPUs	1-2	1	1 to 6	1 to 2
Number of I/O processors	Not applicable	2-8	Not applicable	Not applicable
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	370 byte multiplexer	Not applicable	Not applicable	Not applicable
<b>MAIN STORAGE</b>				
Type	NMOS	MOS	MOS	MOS
Cycle time, nanoseconds	800	355 (read)	—	750
Access time, nanoseconds	200	250	750	225
Bytes fetched per cycle	4	4	16	8 words of 36 bits
Minimum capacity, bytes	256K to 1MB	1024KB-2048KB	2MB	16MB
Maximum capacity, bytes	8MB	2048KB-4096KB	64MB	128MB
Increment size, bytes	256K or 1MB	1MB	2MB	16MB
Interleaving	Not applicable	Not applicable	4-way	4-way
<b>BUFFER STORAGE</b>				
Type	Not applicable	Not applicable	Not applicable	2 cache memories
Cycle time, nanoseconds	—	—	—	—
Bytes fetched per cycle	—	—	—	—
Capacity, bytes	—	—	—	2 x 32K bytes
<b>CENTRAL PROCESSOR</b>				
Machine cycle time, nanoseconds	200	330 and 140	—	Not available
Word length, bits	32 & byte parity	32	36	36
Number of instructions	176 & 370VM assist	221	289 & 91 EIS <sup>1</sup>	351
General registers	16	16	Not available	24
Addressing	Direct and indirect	Indirect	Direct and indirect	Direct and indirect
Control storage	8K words of 64 bits ea.	48K bytes	32K bytes (cache)	Not applicable
Extended precision floating point	Yes	Yes	Yes	—
<b>INPUT/OUTPUT CONTROL</b>				
Integrated I/O channels	Bus structure	3 <sup>1</sup> -4 multiplexers	—	—
Other I/O channels	—	3-4 multiplexer (opt.)	1-4 IOM	1-2 IOX <sup>1</sup>
Maximum I/O data rate, bytes/sec.	5MB	3.75MB to 10MB	4MB/IOM	48MB/IOX
<b>COMMUNICATIONS</b>				
Maximum number of lines	100	15 to 271	1024	2048
Synchronous	20 <sup>2</sup>	—	1024	2048 (72,000 bps)
Asynchronous	96 <sup>2</sup>	—	1024	2048 (9600 bps)
Protocols supported	BSC, SDLC, Async.	BISC, HDLC, Sync., Async.	BISC, HDLC, Sync., Async.	BISC, HDLC, Sync., Async.
Network architectures supported	SNA	DSA	DSA	DSA
<b>PERIPHERAL EQUIPMENT</b>				
Disk drives	70MB-635MB per device	300MB-21.6GB	300MB-21.6GB	78MB-1101MB <sup>2</sup>
Magnetic tape drives	72-200KBS <sup>1</sup>	41.7KBS-200KBS	Up to 1250KBS	Up to 1250KBS
Line printers	300 to 1000	600-1600 lpm	900-1600 lpm	1200-1600 lpm
Other peripheral devices supported	Floppy disk, card reader (400 cps), IBM 370 byte MUX	Diskette drives, terminals, card equipment	Card equipment, document handler, page printers	Card equipment, terminals, page printers
<b>SOFTWARE</b>				
Operating systems	DOS/V5, DOS/V5E, OS/V51, MVS, VM/370, VM/SP	GCOS 64	GCOS, GCOS 8, CP6, MULTICS	GCOS 8
Programming languages	Cobol, Fortran, PL/1, RPG II, APL	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 DM-IV (I-D-S/II)
Data base management system	TMS	I-D-S/II, DM-IV	—	—
<b>PRICING &amp; AVAILABILITY</b>				
Purchase price, basic system	47,000 to 97,400	284,211 to 920,382	149,350 to 1,191,000	2,850,000 to 4,050,000
Monthly maintenance, prime shift	150 to 541	1,386	321 to 4,331	5,950 to 7,050
Monthly rental, 1-year lease (including maintenance)	Not available	10,521 to 27,972	6,320 to 42,070	116,500 to 179,500
Purchase price of memory increment	3300 for 256K to 10,000 for 1MB	15,700	34,500 to 50,000	400,000 (16MB)
Date of first delivery	February 1981	1st quarter 1982	2nd quarter 1980	3rd quarter 1983
Number installed to date	50	Not available	Not available	Not available
<b>COMMENTS</b>				
	<sup>1</sup> 1000 bits/second	<sup>1</sup> 7/35 can only have 3 mux, 7/45 and 7/55 can expand to 6 and 7/65 up to 8	<sup>1</sup> Extended instruction set—decimal	<sup>1</sup> Controls up to 48 channels/IOX
	<sup>2</sup> Combinations are restricted by hardware configurations		<sup>2</sup> C version avail. for all models, M only on 8/52, 8/62 and 8/70	<sup>2</sup> Formatted
	Ref.: 70C-400-02	Ref.: 70C-480-09	Ref.: 70C-480-11	Ref.: 70C-480-16

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MANUFACTURER AND MODEL	IBM 303X Series	IBM 308X Series	IBM 4300 Series	IBM 4300 Series
<b>MODELS</b>	3033S, 3033N, 3033U, 3042AP, 3033MP	3083E, 3083B, 3083J, 3081G, 3081K, 3084	4321	4331—Group 2, 4331— Group 11
<b>SYSTEM CHARACTERISTICS</b>				
Number of CPUs	1-2	1-4	1	1
Number of I/O processors	—	—	—	—
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable	Not applicable
<b>MAIN STORAGE</b>				
Type	MOS	MOS	MOS	MOS
Cycle time, nanoseconds	348 (read)	312 (read)	—	—
Access time, nanoseconds	Not available	Not available	—	—
Bytes fetched per cycle	8	8	4	4
Minimum capacity, bytes	4,194,304 to 8,388,608	8,388,608 to 16,777,216	1,048,576	1,048,576
Maximum capacity, bytes	16,777,126 to 33,554,432	16,777,126 to 33,554,432	1,048,576	4,194,304
Increment size, bytes	4,194,304	8,388,608	—	1,048,576
Interleaving	4-way or 8-way	2-way	—	—
<b>BUFFER STORAGE</b>				
Type	—	—	—	—
Cycle time, nanoseconds	57	26 <sup>1</sup>	—	200
Bytes fetched per cycle	48	128 <sup>1</sup>	—	4
Capacity, bytes	16,384 to 131,072	Up to 65,536 <sup>1</sup>	—	4096 to 8192
<b>CENTRAL PROCESSOR</b>				
Machine cycle time, nanoseconds	57	26	300 to 1600	200 to 1600
Word length, bits	32	—	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 <sup>1</sup>	—	131,072 (reloadable)	—
Extended precision floating point	Yes	Yes	Yes	Yes
<b>INPUT/OUTPUT CONTROL</b>				
Integrated I/O channels	1-4 groups of 6 (integrated optional), 1-2 groups of 4 and 6	16-24 (integrated optional), 1-2 groups of 8 and 6	—	—
Other I/O channels	—	—	1 byte multiplexer 1 block multiplexer	1 byte multiplexer 1 to 3 block multiplexer
Maximum I/O data rate, bytes/sec.	26-52MB	72MB	—	500K to 1.86MB
<b>COMMUNICATIONS</b>				
Maximum number of lines	352	—	8	8
Synchronous	—	—	—	—
Asynchronous	—	—	BSC, SDLC	BSC, SDLC
Protocols supported	—	—	—	—
Network architectures supported	—	—	—	—
<b>PERIPHERAL EQUIPMENT</b>				
Disk drives	247,570 bytes to 2.52GB	—	Supports most S/360, S/370, 303X Series and 308X Series peripherals	Supports most S/360, S/370, 303X Series and 308X Series peripherals
Magnetic tape drives	120KB to 1250KB	—	—	—
Line printers	1200 to 2000 lpm	To 2000 lpm	—	—
Other peripheral devices supported	Floppy disks, card equipment, OCR	Card equipment, MCR, OCR	—	—
<b>SOFTWARE</b>				
Operating systems	VM/370, MVS/SP, VM/SP	MVS/SP, VM/SP, VM/XA	SSX/VSE, VM 370 with CM	DOS/VSE, VM 370, SSX/VSE
Programming languages	Cobol, Fortran, PL/1, Basic, APL, RPG, BAL	System/370 or 303X languages	Same as S/370	Same as S/370
Data base management system	IMS	—	—	—
<b>PRICING &amp; AVAILABILITY</b>				
Purchase price, basic system	990,000 to 2,412,500	1,120,000 to 4,260,000	64,000	64,000 to 172,100
Monthly maintenance, prime shift	4,605 to 8,735	3,050 to 6,690	281.50	281.50 to 381.00
Monthly rental, 1-year lease (including maintenance)	64,900 to 179,349	46,750 to 184,400	4,455	4,455 to 7,460
Purchase price of memory increment	—	200,000	—	—
Date of first delivery	March 1978	2nd quarter 1982	March 1982	March 1982
Number installed to date	—	—	—	—
<b>COMMENTS</b>	Limited production status 13072 (108 bit) words plus 1024 (126 bit) words Ref.: 70C-491-06	<sup>1</sup> Excl. 3083 Model Groups E, B, J Ref.: 70C-491-02	Ref.: 70C-491-08	Ref.: 70C-491-08

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MANUFACTURER AND MODEL	IBM 4300 Series	IBM 8100 Series	IBM System/38	IPL 4400 Series
<b>MODELS</b>	Grp. 1, Grp. 2, Grp. 9, Grp.-10, Grp.-11, Grp.-12	8130A(4 md.),8140A (20 md.), 8140B(6 md.),8140C(3 md.)	S/38-3, -4, -5, -7, 92 submodels	4436, 4443, 4445, 4446, 4460, 4480
<b>SYSTEM CHARACTERISTICS</b>				
Number of CPUs	1	1 to 2	—	1-2
Number of I/O processors	—	—	—	Not applicable
Virtual storage capability	Yes	Yes	Yes	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable	S/370 and 4300 Series
<b>MAIN STORAGE</b>				
Type	MOS	MOS	MOS	NMOS (16K-bit)
Cycle time, nanoseconds	—	1500 to 800	400 to 1100	50
Access time, nanoseconds	—	—	—	400 (read)
Bytes fetched per cycle	8	4	4	8
Minimum capacity, bytes	2,097,152	262,144	768MB	1024KB
Maximum capacity, bytes	16,777,216	2,097,152	4096MB	16,384KB
Increment size, bytes	2,097,152 or 4,194,304	128K to 256K	—	1024KB or 2048KB
Interleaving	—	—	—	Not applicable
<b>BUFFER STORAGE</b>				
Type	—	—	—	Cache
Cycle time, nanoseconds	120 to 225	—	—	0 to 100
Bytes fetched per cycle	8 to 16	—	—	4 to 32
Capacity, bytes	4096 to 16,348	—	—	0 to 24K
<b>CENTRAL PROCESSOR</b>				
Machine cycle time, nanoseconds	120 to 300	—	200 to 500	50
Word length, bits	—	32	32	32
Number of instructions	System/370 universal set	112	—	192-251
General registers	—	48 sets of 8	—	16
Addressing	—	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	1,048,576 to 16,777,216	—	4K to 12K words	64KB
Extended precision floating point	Yes	Yes <sup>1</sup>	—	Yes
<b>INPUT/OUTPUT CONTROL</b>				
Integrated I/O channels	—	—	1 high speed	1 byte multiplexer
Other I/O channels	1 or 2 byte multiplexer 2, 4 or 5 block multiplexer	—	—	2-5 block multiplexer
Maximum I/O data rate, bytes/sec.	Up to 12.0MB	—	2.5MB	Aggregate 12MB
<b>COMMUNICATIONS</b>				
Maximum number of lines	352	—	—	—
Synchronous	—	—	—	—
Asynchronous	—	—	—	—
Protocols supported	—	BSC, SDLC, S/S, up to 11 ports	—	—
Network architectures supported	—	—	—	—
<b>PERIPHERAL EQUIPMENT</b>				
Disk drives	Supports most S/360, S/370, 303X Series and 308X Series	—	64.5MB to 571.3MB 200 to 1600 bpi 1400 to 200 lpm	Can utilize all S/370, 303X Series and 4300 Series peripherals and plug compatibles <sup>1</sup>
Magnetic tape drives	—	—	—	—
Line printers	—	—	—	—
Other peripheral devices supported	peripherals	Card equipment, terminals	Card equipment, terminals	—
<b>SOFTWARE</b>				
Operating systems	DOS/VSE, OS/VS1, VM 370, OS/VS2, MVS, MVS/SP, SSX/VSE, ACP/TPF Same as S/370	DPCX, DPPX	CPF	Support DOS/VS, DOS/ VSE, OS/VS, VM/370
Programming languages	—	Cobol, Fortran, APL, PL/1, Assembler	Cobol, RPG	Cobol, Fortran, APL, PL/1, Pascal, Algol, RPG, Basic
Data base management system	—	DTMS	—	IMS, DL1, Syst. 2000, TOTAL, IDMS, ADABUS, RAMIS II, FOCUS, DATA- COM, same as IBM 4300 Ser.
<b>PRICING &amp; AVAILABILITY</b>				
Purchase price, basic system	81,000 to 578,800	28,890 to 125,450	61,000 to 213,990	140,000 to 509,765
Monthly maintenance, prime shift	388 to 1,243	161 to 358	463 to 923	485 to 1265
Monthly rental, 1-year lease (including maintenance)	6,345 to 25,437	1,055 to 4,890	2,450 to 8,958	4885 to 15,420 (3-yr. lease)
Purchase price of memory increment	—	5,190 to 6,540	—	—
Date of first delivery	4th quarter 1979	August 1979	August 1980	4th quarter 1980
Number installed to date	—	—	—	Approx. 300 worldwide
<b>COMMENTS</b>	Ref.: 70C-491-08	<sup>1</sup> 8140 models Ref.: 70C-491-11	Ref.: 70C-491-29	<sup>1</sup> Except those requiring integrated controllers or adapters Ref.: 70C-542-01

## All About Mainframes

MANUFACTURER AND MODEL	Magnuson M80 Series	Magnuson M80 Series	National Advanced Systems (NAS) AS/6600	National Advanced Systems (NAS) AS/7000
<b>MODELS</b>	M80/30, M80/20, M80/31, M80/32	M80/41, M80/42, M80/43	AS/6620, AS/6630, AS/6650	AS/7000N, AS/7000, AS/7000DPC
<b>SYSTEM CHARACTERISTICS</b> Number of CPUs Number of I/O processors Virtual storage capability Plug-compatible with	1 Not applicable Yes IBM 360, 370, 4300	1 Not applicable Yes IBM 360, 370, 4300	1 Not applicable Yes IBM 4341, 303X, 308X, 370	1-2 1-2 Yes IBM 4341, 303X, 308X, 370
<b>MAIN STORAGE</b> Type Cycle time, nanoseconds Access time, nanoseconds Bytes fetched per cycle Minimum capacity, bytes Maximum capacity, bytes Increment size, bytes Interleaving	MOS DRAM 600-700 500-600 8 512K-1024K 8192K 1024K Not applicable	MOS DRAM 800-2200 700 8-64 2048K 16,384K 1024K Not applicable	NMOS 300-375 (read) 480-600 8 4MB 16MB 4MB 2-way	NMOS 360 (read) 648 8 2MB-4MB 8MB-16MB 2MB 4-way
<b>BUFFER STORAGE</b> Type Cycle time, nanoseconds Bytes fetched per cycle Capacity, bytes	Cache <sup>1</sup> 300 <sup>1</sup> 8 <sup>1</sup> 16K <sup>1</sup>	2 cache 100 4 16K-48K	ECL 50-60 8 64K	ECL 144 8 16K-64K
<b>CENTRAL PROCESSOR</b> Machine cycle time, nanoseconds Word length, bits Number of instructions General registers Addressing Control storage Extended precision floating point	100 32 S/370 universal set 16 Direct and indirect 64K bytes Yes	51 32 S/370 universal set <sup>1</sup> 16 Direct and indirect 32K-64K bytes Yes	50-60 32 S/370 universal instruction set 16 Direct and indirect 16K 72-bit words Yes	72 32 S/370 universal Instr. set 16 Direct and indirect 6K 99-bit words Yes
<b>INPUT/OUTPUT CONTROL</b> Integrated I/O channels Other I/O channels  Maximum I/O data rate, bytes/sec.	— 2-14 byte multiplexers, block multiplexers  Aggregate 10MB	— 3-14 byte multiplexers, block multiplexers  Aggregate 10MB	4-8 block mux, 1-2 byte mux  Aggregate 13MB-16MB	Not applicable 5-23 block multiplexers 7-8 byte multiplexers  8MB <sup>1</sup> -20MB
<b>COMMUNICATIONS</b> Maximum number of lines Synchronous Asynchronous Protocols supported  Network architectures supported	Depends on mfrs. controller used  Async., Bisync., SDLC, X.25 SNA	Depends on mfrs. controller used  Async., Bisync., SDLC, X.25 SNA	Supports all communication controllers that are compatible with 370, 4300, 303X and 308X  Support network architectures that run 370, 4300, 303X and 308X CPUs	See AS/6600  Support network architectures that run 370, 4300, 303X and 308X CPUs
<b>PERIPHERAL EQUIPMENT</b> Disk drives Magnetic tape drives Line printers Other peripheral devices supported	Support 360, 370, 4300 channel attached equipment	Support 360, 370, 4300 channel attached equipment	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
<b>SOFTWARE</b> Operating systems  Programming languages  Data base management system	DOS/VS, DOS/VSE, OS/VS, VM 370, MVS, MVS/SP, VM/SP Cobol, Fortran, Basic, RPG, PL/1, 370 Assembler  IDMS, Total, DL1, IMS	DOS/VS, DOS/VSE, OS/VS, VM 370, MVS, MVS/SP, VM/SP Cobol, Fortran, Basic, RPG, PL/1, 370 Assembler  IDMS, Total, DL1, IMS	DOS, VM, MVS, ACP, VS1  Functional compatibility with IBM 360, 370, 4300, 303X and 308X Same as above	DOS <sup>4</sup> , VM, VS1, MVS, SVS, ACP  Same as AS/6600  Same as AS/6600
<b>PRICING &amp; AVAILABILITY</b> Purchase price, basic system Monthly maintenance, prime shift Monthly rental, 1-year lease (including maintenance) Purchase price of memory increment  Date of first delivery Number installed to date	59,000 to 105,000 316 to 397 3,391 to 6,505  12,000  April 1980 200	135,000 to 228,000 656 to 848 7,548 to 9,405  12,000  March 1981 150	370,000-580,000 1,150-1,725 12,770-18,560  60,000  August 1982 24	950,000-1,700,000 5,445-7,965 32,850 <sup>3</sup> -56,945 <sup>3</sup>  40,000  January 1980 150
<b>COMMENTS</b>	<sup>1</sup> Available only on M80/32  Ref.: 70C-010-60	<sup>1</sup> Plus VSE, ECPS  Ref.: 70C-010-60	<sup>2</sup> 24 hr./da. 7 da./wk.  Ref.: 70C-655-01	<sup>1</sup> AS/7000N only <sup>2</sup> 4-year lease <sup>3</sup> 9 hr./da., 5 da./week <sup>4</sup> Excl. AS/7000 DPC  Ref.: 70C-655-01

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MANUFACTURER AND MODEL	National Advanced Systems (NAS) AS/9000	NCR 8500 Systems	NCR 8600 Systems
<p><b>MODELS</b></p> <p><b>SYSTEM CHARACTERISTICS</b> Number of CPUs Number of I/O processors Virtual storage capability Plug-compatible with</p> <p><b>MAIN STORAGE</b> Type Cycle time, nanoseconds Access time, nanoseconds Bytes fetched per cycle Minimum capacity, bytes Maximum capacity, bytes Increment size, bytes Interleaving</p> <p><b>BUFFER STORAGE</b> Type Cycle time, nanoseconds Bytes fetched per cycle Capacity, bytes</p> <p><b>CENTRAL PROCESSOR</b> Machine cycle time, nanoseconds Word length, bits Number of instructions General registers Addressing Control storage Extended precision floating point</p> <p><b>INPUT/OUTPUT CONTROL</b> Integrated I/O channels Other I/O channels</p> <p>Maximum I/O data rate, bytes/sec.</p> <p><b>COMMUNICATIONS</b> Maximum number of lines Synchronous Asynchronous Protocols supported</p> <p>Network architectures supported</p> <p><b>PERIPHERAL EQUIPMENT</b> Disk drives Magnetic tape drives Line printers Other peripheral devices supported</p> <p><b>SOFTWARE</b> Operating systems</p> <p>Programming languages</p> <p>Data base management system</p> <p><b>PRICING &amp; AVAILABILITY</b> Purchase price, basic system Monthly maintenance, prime shift Monthly rental, 1-year lease (including maintenance) Purchase price of memory increment</p> <p>Date of first delivery Number installed to date</p> <p><b>COMMENTS</b></p>	<p>AS/9040, -/9050, -/9060, -/9070, -/9080</p> <p>1-2 1-4 Yes IBM 4341, 303X, 308X, 370</p> <p>NMOS 270-342 (read) 330-418 8 8MB-16MB 32MB-64MB<sup>2</sup> 8MB-16MB 8-way<sup>3</sup> or 16-way<sup>4</sup></p> <p>ECL 30-38 8 64K-256K per CPU</p> <p>30-38 32 S/370 universal instruction set 16 Direct and indirect 16K 160-bit words Yes</p> <p>Not applicable 6-23<sup>5</sup>, 12-30<sup>6</sup> block multiplexers 1-6<sup>3</sup>, 2-8<sup>4</sup> byte multiplexer</p> <p>60MB-96MB</p> <p>See AS/6600</p> <p>Supports network architecture that run 370, 4300, 303X and 308X CPUs</p> <p>Support IBM &amp; IBM-compatible devices/controllers that attach to 370, 4300, 303X and 308X CPUs</p> <p>VM, MVS, VS1<sup>1</sup>, ACP</p> <p>Same as AS/6600</p> <p>Same as AS/6600</p> <p>2,000,000-5,250,000 6,235<sup>7</sup>-14,200<sup>7</sup> 54,240-139,490—4 yr. lease</p> <p>200,000-400,000</p> <p>December 1982 80</p> <p><sup>1</sup>Excluding AS/9070 and AS/9080 <sup>2</sup>AS/9080 only <sup>3</sup>AS/9040, -/9050, -/9060 <sup>4</sup>AS/9070, -/9080 <sup>5</sup>AS/9040, -/9050 only <sup>6</sup>AS/9060 limit of 23 <sup>7</sup>24-hr./da., 7 da./week</p> <p>Ref.: —</p>	<p>V-8545-11, V-8555-11, V-8565-11, V-8575-11, V-8585-11, V-8595-11</p> <p>1-4 Not applicable Yes Not applicable</p> <p>MOS 380 370 (read) 4 1MB 3<sup>1</sup>-12MB 1MB-4MB 2-way or 4-way<sup>2</sup></p> <p><sup>4</sup> Not applicable —</p> <p>84 to 56 32 202 64 Direct and indirect 24 to 128KB Not available</p> <p>1-8 Contact vendor</p> <p>8MB</p> <p>253</p> <p>SDLC, BSC, TTY, X.25, 3270 NCR/CNA, SNA</p> <p>13MB-1092MB per device 80KBS-320KBS 300-2000 lpm Card equipment, MICR, floppy disks</p> <p>VRX, B1, B2, B3<sup>3</sup></p> <p>Cobol 74, VRX Fortran 77, Neat 3, Neat V5, Basic, RPG</p> <p>Total</p> <p>56,936 to 240,420 245 to 1,373 3,115 to 16,890</p> <p>10,000</p> <p>1982 176</p> <p><sup>1</sup>V-8545-11 is 2MB <sup>2</sup>V-8545-11 does not use interleaving <sup>3</sup>V-8545-11 and V-8555-11 only <sup>4</sup>System R as instruction storage unit of 24K</p> <p>Ref.: 70C-656-02</p>	<p>V-8650, V-8670</p> <p>1 or 2 Not applicable Yes Not applicable</p> <p>MOS 380 370 (read) 4-8 4MB or 8MB 8MB or 16MB 4MB 4-way</p> <p>Cache memory 190 4-8 32K or 128K</p> <p>38 32 147 104 Direct and indirect 96KB Yes</p> <p>16-32 Contact vendor</p> <p>16MB</p> <p>255</p> <p>SDLC, BSC, TTY, X.25, 3270 NCR/CNA, SNA</p> <p>13MB-1092MB per device 80KBS-320KBS 300-2000 lpm Card equipment, MICR, floppy disks</p> <p>VRX</p> <p>Cobol 74, VRX, Fortran 77, Neat VS, Basic, RPG</p> <p>Total</p> <p>1,120,000-1,675,000 5,931-6,225 43,580-62,060</p> <p>34,500</p> <p>— —</p> <p>Ref.: 70C-656-02</p>

### All About Mainframes

MANUFACTURER AND MODEL	Sperry Univac System 80	Sperry Univac System 80	Sperry Univac 90 Series
<b>MODELS</b>	S/80-4, S/80-6	S/80-8	90/60, 90/80-2, 90/80-3, 90/80-4
<b>SYSTEM CHARACTERISTICS</b>			
Number of CPUs	1	1	1 or 2
Number of I/O processors	—	—	1 <sup>4</sup>
Virtual storage capability	—	—	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable
<b>MAIN STORAGE</b>			
Type	MOS	MOS	MOS
Cycle time, nanoseconds	400	124	490 or 600
Access time, nanoseconds	—	496 (read)	—
Bytes fetched per cycle	4	8	4 or 8
Minimum capacity, bytes	524,288	1,048,576MB	524,288 to 2,097,152
Maximum capacity, bytes	4,194,308	8,388,608MB	2,097,152 to 8,388,608
Increment size, bytes	262,144 or 524,288	1,048,576 or 2,097,152	262,144 to 2,097,152
Interleaving	Not applicable	Not applicable	2 to 1 <sup>1</sup>
<b>BUFFER STORAGE</b>			
Type	Cache	—	Bipolar <sup>1</sup>
Cycle time, nanoseconds	—	—	150 <sup>1</sup>
Bytes fetched per cycle	—	—	—
Capacity, bytes	—	—	32,768 <sup>1</sup>
<b>CENTRAL PROCESSOR</b>			
Machine cycle time, nanoseconds	—	—	98 to 200
Word length, bits	32	32	32
Number of instructions	128	128	144 or 154
General registers	16	16	16
Addressing	Direct and indirect	Direct and indirect	Direct and indirect
Control storage	32,768 words <sup>1</sup>	80,000 bytes <sup>1</sup>	Yes
Extended precision floating point	Not available	Not available	Yes
<b>INPUT/OUTPUT CONTROL</b>			
Integrated I/O channels	4	1-2	—
Other I/O channels	3 multiplexer	1 byte multiplexer	4 to 7 block mux. <sup>2</sup> 1 to 5 selector <sup>3</sup>
Maximum I/O data rate, bytes/sec.	Aggregate 6MB	Aggregate 200KB	Aggregate 5.7MB to 8MB
<b>COMMUNICATIONS</b>			
Maximum number of lines	0 to 8	0-28	128 <sup>5</sup> or 64 <sup>6</sup>
Synchronous	—	—	—
Asynchronous	—	—	—
Protocols supported	—	—	—
Network architectures supported	DCA	DCA	DCA
<b>PERIPHERAL EQUIPMENT</b>			
Disk drives	72MB-491MB	29MB-491MB	3.1MB-307MB per drive
Magnetic tape drives	40KB-200KB	40KB-200KB	12KBS-96KBS
Line printers	200 cps to 1200 lpm	180-2000 lpm, 200 cps	760-2000 lpm
Other peripheral devices supported	Diskettes, workstations, card equipment	Diskettes, workstations, card equipment	Card equipment
<b>SOFTWARE</b>			
Operating systems	OS/3	OS/3	VS/9
Programming languages	Cobol, Fortran IV, Basic, RPG 11, Escort, BAL	Cobol, Fortran IV, Basic, RPG 11, Escort, BAL	Cobol, Fortran, Basic, RPG 11, Assembler
Data base management system	DMS	DMS	DMS/90
<b>PRICING &amp; AVAILABILITY</b>			
Purchase price, basic system	66,082 to 94,062	123,900	284,184 to 972,064
Monthly maintenance, prime shift	416 to 468	Contact vendor	1,391 to 3,709
Monthly rental, 1-year lease (including maintenance)	2,080 to 3,050	Contact vendor	8,289 to 26,544
Purchase price of memory increment	5,821 to 11,642	14,400 to 28,800	—
Date of first delivery	July 1982	1st quarter 1984	1973
Number installed to date	—	—	—
<b>COMMENTS</b>			
	<sup>1</sup> Plus 1024 words of read-only storage Ref.: 70C-877-02	Ref.: 70C-877-02	<sup>1</sup> Model 90/80-4 only <sup>2</sup> Excl. Model 90/80-4 <sup>3</sup> Model 90/60 only <sup>4</sup> Model 90/80 series only <sup>5</sup> Half-duplex <sup>6</sup> Full-duplex Ref.: —



## All About Mainframes

MANUFACTURER AND MODEL	Sperry Univac 1100/60 System	Sperry Univac 1100/80 System	Sperry Univac 1100/90 System
<b>MODELS</b>	1100/61, 1100/62, 1100/63, 1100/64	1100/80, 1100/81, 1100/82, 1100/83 and 1100/84	1100/91, 1100/92, 1100/93, 1100/94
<b>SYSTEM CHARACTERISTICS</b>			
Number of CPUs	1 to 4	1-4	1-4
Number of I/O processors	—	—	1-4
Virtual storage capability	Yes	—	Yes
Plug-compatible with	Not applicable	Not applicable	Not applicable
<b>MAIN STORAGE</b>			
Type	NMOS	MOS	MOS
Cycle time, nanoseconds	580	1250	360-600
Access time, nanoseconds	—	—	—
Bytes fetched per cycle	—	—	—
Minimum capacity, bytes	512K to 1024 words	512K to 2048K words	2,097,152 words (8MB)
Maximum capacity, bytes	—	8192K words	16,777,216 words (64MB)
Increment size, bytes	1024K-word	—	—
Interleaving	—	—	2-way or 4-way
<b>BUFFER STORAGE</b>			
Type	IC semiconductor <sup>1</sup>	IC semiconductor	Cache memory
Cycle time, nanoseconds	116	—	60
Bytes fetched per cycle	4-word	—	—
Capacity, bytes	2048 words in E models 192 words in H models	16,384 to 131,072	65K
<b>CENTRAL PROCESSOR</b>			
Machine cycle time, nanoseconds	116	200	—
Word length, bits	36	36	36
Number of instructions	161	219	271
General registers	128	128	128
Addressing	Direct and indirect	Indirect	Direct and indirect
Control storage	2000 words	—	—
Extended precision floating point	—	—	Not available
<b>INPUT/OUTPUT CONTROL</b>			
Integrated I/O channels	—	—	—
Other I/O channels	2 to 5 block mux. 4 to 12 word channel	Byte multiplexer, block multiplexer	Up to 96 block multiplexers <sup>3</sup> Up to 160 word channels <sup>3</sup>
Maximum I/O data rate, bytes/sec.	—	—	37.5MB
<b>COMMUNICATIONS</b>			
Maximum number of lines	32	—	156
Synchronous	—	—	—
Asynchronous	—	—	—
Protocols supported	UDLC	—	UDLC
Network architectures supported	DCA	DCA	DCA
<b>PERIPHERAL EQUIPMENT</b>			
Disk drives	—	100MB to 403.2MB	77MB to 1.6GB
Magnetic tape drives	96KBS-200KBS	12KBS to 1250KBS	34KBS to 1250KBS
Line printers	800-2000 lpm	800 lpm-2000 lpm	760 lpm-2000 lpm <sup>2</sup>
Other peripheral devices supported	Card equipment, drum, terminals	Drum, diskette, card equipment, terminals	Card equipment, terminals, diskette, drum
<b>SOFTWARE</b>			
Operating systems	—	1100 OS	1100 OS
Programming languages	Cobol, Fortran, Algol, Basic, Jovial, PL/1, RPG, MACRO, Assembler	Cobol, Fortran, APL, Pascal 1100, NU Algol, Basic, PL/1, RPG, MACRO	Cobol, Fortran, Algol, Basic, Pascal, PL/1, APL, RPG, Assembly
Data base management system	DMS 1100	UDS 1100	UDS 1100
<b>PRICING &amp; AVAILABILITY</b>			
Purchase price, basic system	336,519 to 1,076,816	1,389,628 to 6,128,808	2,865,660 to 8,851,539
Monthly maintenance, prime shift	1,342 to 3,732	3,490 to 14,099	5,551 to 16,098
Monthly rental, 1-year lease (including maintenance)	8,007 to 25,637	35,431 to 159,738	—
Purchase price of memory increment	—	Contact vendor	Contact vendor
Date of first delivery	January 1980	1977	June 1983
Number installed to date	—	—	—
<b>COMMENTS</b>			
	<sup>1</sup> Excl. 1100/61 C1 and C2 cache unit  Ref.: 70C-877-12	Ref.: 70C-877-14	<sup>1</sup> Only available on 90/80 <sup>2</sup> Laser printer 10,500 to 21,000 lpm <sup>3</sup> Either block or word channel  Ref.: 70C-877-16