All About Plug-Compatible Mainframes

If your organization is currently using one or more medium-to-large-scale IBM computers and looking for ways to increase its computing power and/or reduce its equipment costs, plug-compatible mainframes (PCM's) deserve your serious consideration. The PCM industry, which got off the ground less than five years ago when Amdahl Corporation installed its first 470V/6 computer, has quickly grown to a billion-dollar-a-year business as a result of widespread user acceptance of the feasibility and effectiveness of the PCM concept. And, despite widely expressed doubts about their long-term viability in the face of increasingly aggressive moves by IBM, the PCM vendors seem likely to capture increasingly large shares of the mainframe market for at least the next few years.

The PCM's have definitely arrived. Datapro's user surveys make it clear that the current PCM's can be installed easily, can replace or augment IBM mainframes with little or no need for changes in software or operating procedures, and can be expected to perform reliably and efficiently. What's more, some (but by no means all) of the PCM suppliers have demonstrated their ability to provide first-class field maintenance and software support.

Should your organization install a PCM? And if so, which one? This report is designed to help you answer those questions by assessing the pros and cons of PCM's in general, profiling their current suppliers, and presenting the characteristics of 22 PCM's from 7 vendors in detailed comparsion charts.

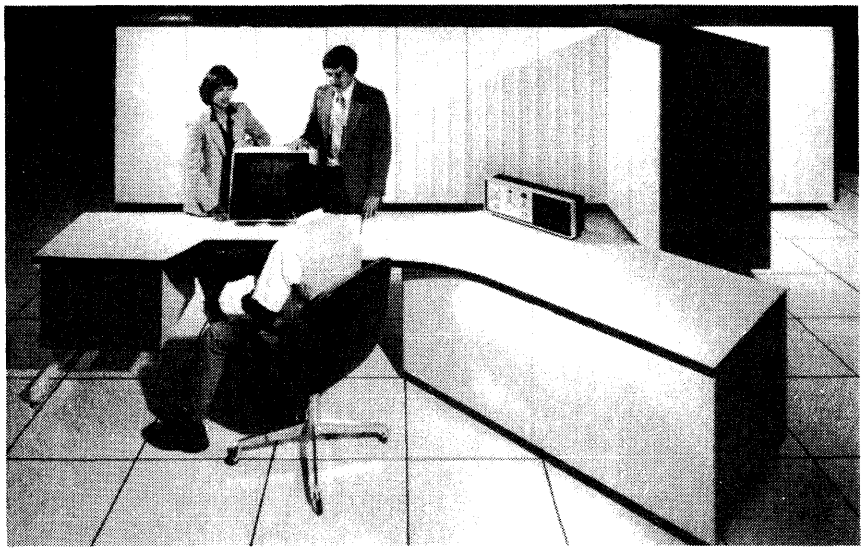
This report features detailed comparison charts covering 22 plug-compatible mainframes (PCM's) that can directly replace IBM System/370, 3030 Series, or 4300 Series computers. You'll also find profiles of the current PCM vendors and a discussion of the pros and cons of the PCM route to lower data processing costs.

The PCM Concept

Plug-compatible mainframes can be defined, for the purposes of this report, as computer mainframes that can directly execute all application programs and systems software written for the IBM System/370, 3030 Series, and/or 4300 Series computers and can utilize the peripheral equipment available for these computers. The PCM concept would, of course, be equally applicable to the computers made by Burroughs, Honeywell, Univac, or any other mainframe supplier; but to date only IBM enjoys a sufficiently large user base to attract serious attention from the PCM vendors.

The PCM industry resulted from the confluence of two important trends:

- The widespread availability and user acceptance of plug-compatible peripherals designed to directly replace IBM's own magnetic tape units, disk storage units, printers, terminals, and even main memory units. From there, the next logical step was to offer replacements for the IBM central processors themselves.
- The increasing recognition that the instruction set employed by the IBM System/360 and System/370 computers has become a sort of de facto standard for the industry, and that most IBM computer users will not seriously consider switching to a computer that requires extensive reprogramming. RCA recognized this back in 1964 when it introduced the Spectra Series (now the Univac Series 70), and Univac followed suit when it introduced its own Series 90 computers two years later. Each of these computer families utilized the same user instruction set as the System/360 but employed a different set of privileged instructions. Thus, they could run System/360 application programs with little or no change, but they used completely different (and incompatible) systems



Plug-compatible mainframes can be defined as computer mainframes that can directly execute all application programs and systems software written for the IBM System/370, 3030 Series, and/or 4300 Series computers. The PCM concept actually got its start when RCA (Spectra Series, 1964) and later Univac (Series 90, 1966) announced systems utilizing the same user instruction set as the IBM System/360. The industry's first plug-compatible mainframe was Amdahl's 470V/6. Shown here is the Amdahl 470/6-II, successor to the 470/V-6 and providing performance levels that are 5 to 15 percent higher than its predecessor system.

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Magnuson Systems, a relatively new PCM supplier, announced its first mainframes in May 1978. The firm's first product line consisted of two models, the M80 Series Model 3, which competes with IBM's 370/138, and the Model 4, which competes with the IBM 370/148. In 1979, the firm expanded its M80 family to include the Model 32, with performance comparable to the IBM 4341, and the Models 42 and 43, which are similar in capability but offer improved performance over the 4341. Shown here is the basic M80 system, which contains a central processor with up to 4 million bytes of main storage, up to 8 data channels to 256,000 bytes of firmware. The systems can expand to more than 16 million bytes and 16 channels.

software and peripheral equipment. The next logical step, which was first taken by Amdahl Corporation, was to build computers which exhibited total functional compatibility with the IBM mainframes and could use all the same software and peripheral equipment.

After Amdahl demonstrated the feasibility and saleability of the PCM concept in the mid-seventies, it was soon joined by Itel, Control Data, and a host of other suppliers, and the PCM race was on.

User Reaction

Users of plug-compatible mainframes from three major vendors—Amdahl, Control Data, and Itel (now NAS)—responded to Datapro's latest survey of computer users, which was conducted late in 1978. There were 13 responses from users of Amdahl's 470V/5 and 470V/6, 6 responses from users of the Control Data Omega processors, and 11 responses from users of the Itel AS/4, AS/5, and AS/6. Here are the weighted average ratings these users assigned to 12 different aspects of their PCM's, expressed in terms of our usual scale of 4.0 for Excellent, 3.0 for Good, 2.0 for Fair, and 1.0 for Poor. The ratings assigned by 418 responding users of the IBM System/370 computers are also shown for comparative purposes.

	Amdahl	CDC	Itel	IBM
Ease of operation	3.4	3.4	3.5	3.3
Reliability of mainframe	3.3	3.5	3.6	3.5
Reliability of peripherals	3.1	3.2	3.1	3.2
Responsiveness of maintenance service	3.5	3.7	3.6	3.3
Effectiveness of maintenance service	3.5	3.2	3.5	3.2
Technical support	3.2	3.2	3.4	3.0
Operating systems	3.1	3.0	3.0	3.0
Compilers and assemblers	3.3	3.2	3.2	3.2
Applications programs	3.0	3.0	3.5	2.8
Ease of programming	3.1	3.2	3.3	3.0
Ease of conversion	3.4	3.6	3.7	2.9
Overall satisfaction	3.3	3.3	3.5	3.1

As you can see, the user ratings earned by all three PCM vendors compared favorably with those of IBM in all 12 categories. What's more, the PCM vendors were generally rated well above IBM in such important categories as overall satisfaction, ease of conversion, technical support, and both responsiveness and effectiveness of maintenance service. Equipment reliability was essentially a stand-off between IBM and the PCM's, with all the parties earning impressively high ratings. Thus, it seems clear that a wisely chosen PCM can yield worthwhile cost savings without imposing offsetting penalties in any of the other areas that help to determine overall user satisfaction.

PCM Pros and Cons

The first and foremost advantage of plug-compatible mainframes is, of course, the prospect of substantial *increases in processing power per dollar.* Unless the PCM vendors can maintain a significant price/performance advantage over the comparable IBM mainframes, their long-term survival will be highly doubtful. The user can elect to realize this price/performance gain in either of two distinct ways: 1) by choosing a PCM that delivers performance comparable to that of a certain IBM mainframe but is offered at a lower price; or 2) by choosing a PCM that has a price tag comparable to that of a certain IBM mainframe but offers more processing power. The PCM vendors tend to position their product offerings so that users can elect either approach or, in some cases, a combination of the two (i.e., somewhat more power at a somewhat lower cost).

Faster delivery is another significant advantage that the PCM vendors will enjoy over IBM for at least the next two years. The great superiority of the IBM 4300 Series computers over IBM's earlier medium-scale computers has resulted in an avalanche of orders that IBM is woefully ill-equipped to fulfill. As a result, many prospective 4300 Series users face waits of two to three years before IBM can deliver their systems and have therefore become prime prospects for the PCM vendors. Other IBM users face lengthy waits for the 3030 Series processors, and the delivery situation is likely to worsen when IBM unveils its long-awaited H Series of large-scale computers. Thus, IBM's inadequate manufacturing capabilities promise bright prospects for the PCM vendors during the next few years.

Becoming a *multiple-vendor shop* can be viewed as either an advantage or disadvantage of installing a PCM. Some

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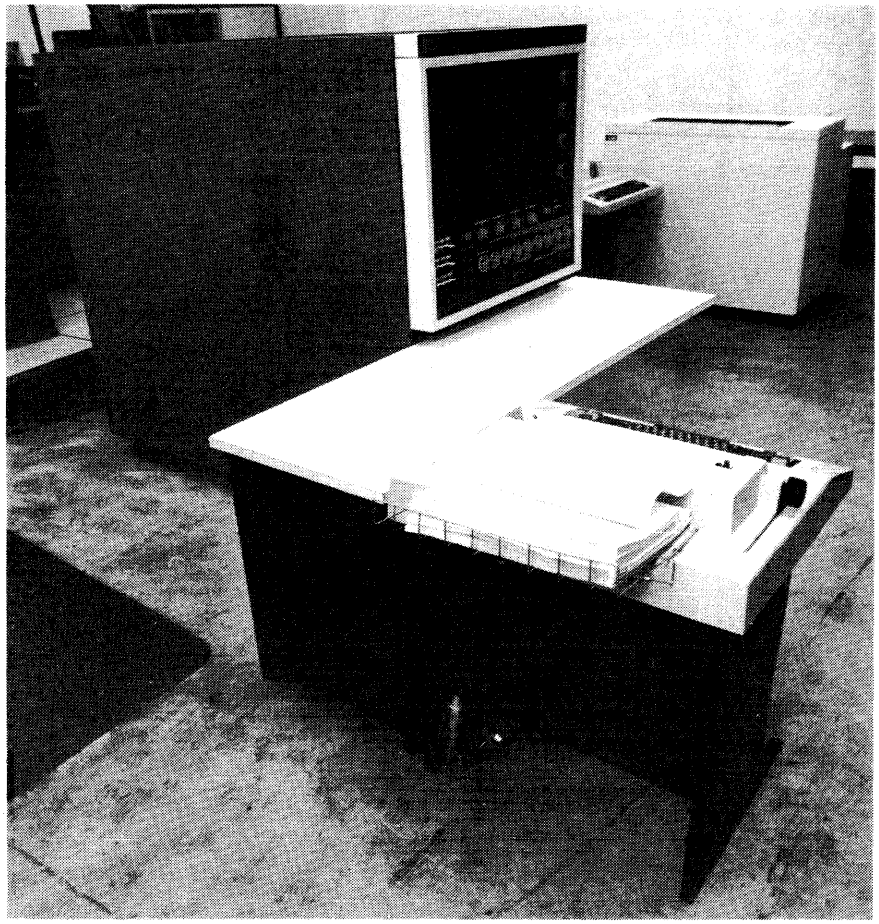

One of the converging trends which created the plug-compatible mainframe industry was the widespread availability and user acceptance of plug-compatible peripherals designed to directly replace IBM's own magnetic tape units, disk storage units, printers, terminals, and even main memory unit. Cambridge Memories Inc. (CMI), is an 11-year old company best known as a supplier of add-on memory for IBM System/360 and System/370 computers and for various minicomputers. CMI entered the plug-compatible mainframe business in 1977. The current CMI PCM product line consists of two processors—the 1638 and 1640—and three multiprocessor configurations—the 1642, 1643, and 1644. Shown here is the CMI 1638.

users are still "true-blue" IBM loyalists, who fear that their IBM service will deteriorate and every hardware problem will result in a nasty "finger-pointing" session if they allow any non-IBM equipment into their shops. Conversely, other users are convinced that dealing with multiple vendors helps to "keep IBM honest" and leads to better overall service and support. The opinions of experienced PCM users on this point are also widely divergent, but our survey results make it clear that these multiple-vendor installations are generally well pleased with the overall results they are achieving.

Three potential disadvantages are commonly cited by prospective PCM users: the possibility of hardware or software incompatibilities, the possibility of weak vendor support, and the possibility that their PCM vendor may not survive. Each of these problems may be more imagined than real, and each can be minimized through careful selection of a well-qualified vendor.

Incompatibilities in hardware or software were widely feared by early PCM users, but Datapro's user surveys have clearly shown that users who choose to deal with well-established PCM suppliers such as Amdahl or Control Data need have no fears. What's more, Amdahl and Itel (now NAS) have demonstrated their ability to develop the specialized hardware and/or software needed to maintain full compatibility when IBM adds new functions such as the microcoded System/370 Extended Facilities of the 3030 Series processors. Conversely, a user who decides to deal with one of the newer and relatively untried PCM vendors should demand proof (in the form of a rigorous benchmark test) and/or an iron-clad guarantee that the new mainframe will be totally compatible with his IBM equipment, systems software, and application programs.

Poor vendor support is another frequently expressed worry of prospective PCM users—and their fears might well be realized if they selected the wares of some of the newly established, poorly staffed, and woefully underfinanced PCM vendors. But once again our user survey results make it clear that Amdahl, Control Data, and Itel have all established excellent field service and support organizations whose effects are judged to be superior to those of IBM in most respects. (The Itel results may no longer be applicable now that the Itel organization has become a part of NAS and has suffered from layoffs, defections, and reorganizations.) Magnuson Systems, a relatively new PCM supplier, also appears to be making sincere efforts to establish solid support for its products. Once again, it's up to the buyer to determine the amount of service and support he needs and is willing to pay for, and then to select a PCM vendor that can and will provide it.

Vendor survival has always been a topic of concern to PCM buyers, and Itel's recent defection makes the question especially pertinent. Of course, it's important to note that Itel's customers have not been left out in the cold;

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NAS, a new National Semiconductor subsidiary, has assumed full responsibility for servicing and supporting the Itel installations. The other established PCM vendors have revamped and repriced their product lines to reflect the impact of the IBM 4300 Series, and they seem destined not only to survive but to prosper for at least the next two years as a serendipitous result of the monumental IBM delivery backlog noted above. Their long-term survival will depend upon their continued ability to maintain full compatibility together with a worthwhile price/performance advantage over the steadily improving mainframes that IBM will undoubtedly offer. The best of them will probably make it.

The PCM Suppliers

Amdahl Corporation, which was formed in 1971 and delivered its first computer in June 1975, has grown rapidly since then to become the leading supplier (in terms of dollar volume) of IBM-compatible mainframes. By the end of 1978, the company had delivered just under 200 of its large-scale systems. Amdahl netted $48.2 million in 1978 on revenues of $321 million. Its 1979 profits will be substantially lower, however, because (as in the case of IBM) an increasing ratio of leases to sales has caused both revenues and earnings to be deferred to future periods. Nonetheless, the company remains solidly profitable, boasts a strong balance sheet, and recently signed a $260 million credit agreement with 13 large banks. Fujitsu Limited of Japan provided venture funding for Amdahl Corporation and is still a principal stockholder.

Amdahl has prospered by focusing on the upper end of IBM's mainframe product line and developing advanced technology that enables its computers to deliver more performance per dollar than the comparable IBM models. The current Amdahl processor line ranges from the 470V/5, which is comparable in performance to the IBM 3032, to the 470V/8, which is comparable to the dual-processor IBM 3033MP. Amdahl has also developed software that corresponds to IBM's Advanced Function microcode and enables its computers to utilize the latest IBM software products. As long as Amdahl can maintain its technological advantage, it appears to be well positioned to capture a sizeable share of the ever-increasing market for large-scale mainframes that can execute programs developed for System/370-style computers.

Cambridge Memories Inc. is an 11-year-old company that is best known as a supplier of add-on memory for IBM System/360 and System/370 computers and for various minicomputers. CMI entered the PCM market in 1977 with replacements for the System/370 Model 115 and 125, but the firm is now concentrating its attention on mainframes in the Model 138 and 148 class. The current product line consists of two processors—the 1638 and 1640—and three multiprocessor configurations—the 1642, 1643, and 1644. CMI's rights to market these systems in the U.S., however, are restricted by the fact that a CMI official still holds a major interest in IPL Systems, the CMI spinoff that manufactures the Omega processors which are marketed by Control Data. IPL's commitment to Control Data precludes CMI from marketing systems within a certain performance range in the U.S., so the 1640 and 1642 are currently available only in Europe. CMI is currently directing its principal marketing efforts toward OEM's rather than end users, and toward the European market rather than the domestic one.

Control Data Corporation is the only established mainframe manufacturer that has chosen to offer a line of IBM-compatible processors in addition to its own proprietary computer systems. CDC became the third major contender in the PCM market when it introduced its Omega family of System/370-compatible mainframes in June 1977. These mainframes represent the logical culmination of CDC's extensive line of plug-compatible peripheral equipment for IBM computers, and the company's nationwide service and support organization gives it an important advantage over most of the competing PCM vendors. Yet CDC's PCM marketing campaign has been a curiously low-keyed effort to date. Instead of developing and building its own hardware, CDC is marketing processors manufactured by IPL Systems. By the end of 1978, CDC had installed only 50 of the Omega 480-I and 480-II systems, which bracket the IBM 370/148 in performance.

Early in 1979, CDC responded to the IBM 4300 Series announcement and simultaneously assumed a more aggressive posture by slashing the prices of the 480-I and 480-II, instituting a new direct leasing plan, and announcing the Omega 480-III, a more powerful processor that nearly matches the IBM 3031's performance level. Control Data's conservative but increasingly determined approach to the PCM market, coupled with its strong corporate resources, should bring it a growing share of the market.

Magnuson Systems Corporation is a 3-year-old company whose claim to fame and fortune is based on a family of IBM-compatible processors that utilize an unusually flexible design architecture. Magnuson's "Strategic Architecture" is said to permit easy field upgrading of the processor, memory, and I/O channels, as well as rapid adaptation to maintain compatibility with new IBM functions or features. The Magnuson M80 Series was introduced in May 1978, and initial customer deliveries were made less than three months later. The system's principal designer is Carl Amdahl, whose father, Dr. Gene Amdahl, founded Amdahl Corporation. The company raised nearly $10 million in its latest round of venture capital funding and appears to be soundly financed.

Magnuson responded to the IBM 4300 Series announcement by introducing three new models in March 1979. Its product line currently consists of five models: the M80 Model 3, with about 1.5 times the power of the 370/138; the Model 4, with about 1.3 times the power of the 370/148; the Model 32, with about the same power as the Model 4 at a much lower price; the Model 42, with up to 1.1 times the power of the IBM 4341; and the Model 43, with up to 1.3 times the power of the 4341. Unfortunately,

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the Model 42 and Model 43 are missing from the comparison charts that follow because the company declined to provide detailed specifications for these systems.

In addition to Magnuson's own marketing efforts, the company's mainframes are also being marketed by Boothe Computer Corporation and Scientific Time Sharing Corporation (STSC).

MegaSystems Associates is an affiliate of Time Sharing Resources, a remote computing service vendor headquartered in Great Neck, New York. In March 1979 Megasystems announced its plans to market the Mega I/8, a 370/138-class processor manufactured by Two Pi Company, Inc. The company is emphasizing its "Offsite" approach to on-line computing, which is based on clusters of the Mega computers located at its headquarters. A cluster would typically consist of six computers. Five of these would be owned or leased by Megasystems customers and dedicated to their applications. The sixth computer would be a backup machine capable of being switched into service in the event of a malfunction in any of the others. Only one of the Mega I/8 computers is in operation at this writing, but the company's cluster concept is a novel and potentially effective solution to the computing needs of many organizations.

Multiprocessors Inc. is the successor to Citel Corporation, a firm that was established to market a family of plug-compatible mainframes manufactured by a related company called Instrument Technology Incorporated. These mainframes employ a flexible architecture that makes extensive use of microprogramming, and they can easily be adapted to emulate other computer systems. The company's financing and marketing plans were disrupted by the IBM 4300 Series announcement, and none of its processors has been delivered to date. The current product line consists of the Model 30/4, rated at 1.5 times the power of the 370/148, and the Model 30/5, rated equal to the IBM 3031 in performance.

National Advanced Systems Corporation (NAS) is the wholly owned subsidiary of National Semiconductor Corporation that was formed in October 1979 to take over nearly all of Itel Corporation's IBM-compatible mainframe business. Under the terms of the agreement between the two companies:

- NAS took over Itel's computer activities in the United States, Canada, Europe, and Singapore; absorbed approximately 1600 Itel marketing and field engineering personnel; and acquired Itel's inventory of unsold computers.
- Itel assumed all financial responsibilities for the first three months' operations of the transferred computer activities and advanced $7.5 million to NAS to provide net working capital for this period.
- National Semiconductor released Itel from its contractual commitments to accept more of the AS/3, AS/4, and AS/5 computers which National had been building for Itel.
- NAS assumed the maintenance and support responsibilities for all of Itel's installed computers, including the larger models manufactured by Hitachi Ltd.

NAS is currently marketing products both from the warehouse stocks gained from Itel's former operations (including both National- and Hitachi-made products) and from National's own assembly line. The current NAS product line includes the AS/5-3, AS/6, AS/7031, and AS/7, which span the performance range from the IBM 370/158-3 to the IBM 3033. It is far too early to tell whether NAS will market its products as aggressively or keep its customers as happy as Itel did—or whether NAS will fare better than Itel in terms of financial viability over the years to come.

Among the Missing

Four companies that have attracted varying degrees of attention in the PCM field are missing from both the preceding list of PCM suppliers and the comparison charts that conclude this report. Here's why:

Itel Corporation, which made an all-out effort to become the dominant force in the PCM industry, ran into serious financial difficulties and was forced to sell its mainframe activities to National Semiconductor Corporation in October 1979. Itel's customers are now receiving support from National Advanced Systems Corporation (NAS), the new National Semiconductor subsidiary described earlier. Itel's troubles resulted mainly from the unexpectedly large price/performance improvements exhibited by IBM's new 4300 Series computers and the ensuing user reluctance to make new equipment commitments, together with Itel's own overly ambitious growth plans and its inflexible contracts with its computer suppliers, National Semiconductor and Hitachi.

Nanodata Corporation, established in 1971, is a small manufacturer of "universal emulators" that can be programmed to emulate the instruction set of the IBM System/370 or any other mainframe. In fact, a Nanodata system could concurrently execute a mix of programs written for IBM, Honeywell, Burroughs, and other computers. The systems employ a modular, multiple-bus, multiple-processor architecture that is said to provide great flexibility, easy expandability, and insurance against obsolescence. Nanodata, however, is no longer actively marketing its systems as direct replacements for System/370 computers in the Model 138 and 148 class; the company's current emphasis is on distributed processing applications.

National CSS Inc., a leading remote computing service company, offers the NCSS 3200, a 370/138-class system based on a plug-compatible processor manufactured by Two Pi Company (see below). National CSS does not view the system as a direct System/370 replacement and

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declined to supply the information needed for inclusion in our comparsion charts. The company markets the NCSS 3200 both as a turnkey business system and as a vehicle for a number of proprietary software packages that were originally developed for its time-sharing customers. National CSS recently introduced two specialized 3200 Series hardware/software offerings: a communications-oriented processor called the 3200/Remote III and a back-end processor called the 3200/Server III. Details on the NCSS 3200 hardware and software can be found in Report 70C-650-01.

Two Pi Company, Inc., a subsidiary of U.S. Philips Corporation, views its V32 processor as a "System/370-compatible minicomputer" with performance in the 370/138 class. The company, however, has chosen not to become a PCM supplier. Instead, it sells the V32 to system builders and service bureaus who use it as the basis for IBM-compatible value-added systems. National CSS and MegaSystems are two of Two Pi's OEM customers.

The Comparison Charts

The principal characteristics of 22 processors that are plug-compatible with the IBM System/370 computers are presented in the accompanying comparison charts. The entries for each model are spread across two facing pages to maximize the amount of useful information in the charts. All information in the charts was furnished by the seven vendors whose products are represented.

The entries on the left-hand pages of the comparison charts and their significance are explained in the following paragraphs:

Model refers to the product number as known in the equipment price book or list of the vendor or manufacturer.

Date of introduction indicates when the processor was first announced to the public in the U.S.

Production status indicates whether the processor is now in new production or being sold from returned and refurbished stocks.

Operating systems indicates the IBM monitoring software that will run on the processor. All operating systems that apply to a particular processor are specified.

Virtual storage capability defines the presence of a hardware/software feature enabling the user to access and utilize memory space without regard to its existence in real main memory or auxiliary memory space.

The *Clock comparator* is a hardware feature that causes an interruption when the time-of-day equals or exceeds the value specified by a program or virtual machine.

The CPU timer measures the elapsed processing unit time and causes an interruption when a previously specified amount of time has elapsed.

Control registers are used for operating systems control of relocation, priority interruption, program event recording, error recovery, and masking operations.

CPU one-level addressing is a synonym for direct addressing, where the instruction contains the actual address of the data being requested.

A doubleword buffer consists of a 64-bit area temporarily reserved for data used in performing an I/O operation.

The *interval timer* is a 32-bit decremental counter that is reduced by one several hundred times per second. The timer generates an interrupt when the contained value is decremented from a positive to a negative number.

Machine check handling analyzes errors and attempts recovery by retrying the failed instruction if possible. If retry is unsuccessful, it attempts to correct the malfunction or to isolate the affected task.

Multiple bus architecture implies that the various segments of the processor (namely, memory, arithmetic and logic, central control, etc.) are tied together by more than one central bus.

Storage protection determines the right of access to main storage by matching a protection key associated with a store or fetch reference to main storage with a storage key associated with each block of main storage.

The *time-of-day-clock* is incremented once every microsecond and provides a consistent measure of elapsed time suitable for the indication of date and time.

Some channels have the capability to perform *channel command retry,* a channel and control-unit procedure that causes a command to be retried without requiring an I/O interruption.

Channel indirect addressing (CIA) is a companion feature to dynamic address translation, providing data addresses for I/O operations. CIA permits a single channel command word to control the transmission of data that crosses noncontiguous pages in real main storage. If CIA is not indicated, then channel one-level (direct) addressing is employed.

The *byte oriented operand feature* permits storage operands of most non-privileged operations to appear on any byte boundary. Instructions must appear on even byte boundaries. The feature does not pertain to instruction addresses.

The *extended precision floating point* feature provides instructions to handle floating point numbers with a fraction of 28 hexadecimal digits. The characteristic is seven bits plus sign in short and extended floating point numbers.

The *high speed floating point feature* provides a means for improved execution of the floating point instruction set.

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The *System/370 Universal Instruction set* is composed of storage protection, standard instruction set, decimal arithmetic, extended precision, dynamic address translation, and instructions to facilitate programming and reduce execution times for record blocking and unblocking.

The *console audible alarm* is a device activated when predetermined events occur that require operator attention or intervention for system operation.

The *integrated console printer* is an integral part of the system console, furnishing hard copy output from the console display.

A *light pen* is a photosensitive stylus used to detect and identify elements displayed on the console CRT.

A *remote console* is a console attached to a system through a data link. The remote console is configured in addition to the standard console.

The *remote data link* allows establishment of communications with a technical data center to remotely diagnose system malfunctions.

The *console file* is the basic microprogram loading device for the system, containing a read-only file device. The medium read by this device contains all the microcode for field engineering device diagnostics, basic system features, and any optional system features.

The *CPU activity monitor* can be either hardware or software. It provides a measure of CPU utilization by various hardware or software elements.

ECPS:VS1 provides an assist to OS/VS1 by firmware emulation of certain supervisor functions.

The *extended control mode* (EC) is a mode in which all features of the System/370 computing system, including dynamic address translation, are operational.

Program event recording is a hardware feature used to assist in debugging programs by detecting and recording program events.

The *virtual machine assist* feature provides an assist to VM/370 firmware emulation of certain privileged operations. The feature causes a reduction in real supervisor time used by VM/370 to control the operation of virtual storage operating systems such as DOS/VS and OS/VS1.

1401/1440/1460 compatibility provides the system with the ability to execute 1401/1440/1460 instructions under specific conditions of minimum and matching configurations.

Under *other features and comments* any additional information that may help to give you a feel for the distinctive attributes of each unit is included.

The right-hand pages of the charts compare Processor Performance, I/O Channels, Control Storage, Pricing, and Availability, and identify the manufacturer and vendor of each processor. These entries are all believed to be self-explanatory.

Manufacturers/Vendors

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

Cambridge Memories Incorporated
360 Second Avenue
Waltham, Massachusetts 02154
Telephone (617) 890-6000

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

Magnuson Systems Corporation
2500 Augustine Drive
Santa Clara, California 95051
Telephone (408) 988-1450

Mega Systems Associates
777 Northern Boulevard
Great Neck, New York 11021
Telephone (212) 895-7880

Multiprocessors Incorporated
1161 North Tustin Avenue
Orange, California 92667
Telephone (714) 524-5734

National Advanced Systems
3145 Porter Drive
Palo Alto, California 94304
Telephone (415) 856-5000□

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MODEL	Amdahl 470V/5	Amdahl 470V/5-II	Amdahl 470V/6	Amdahl 470V/6-II
SYSTEM PARAMETERS				
Date of introduction	3/28/77	10/17/78	9/11/74	2/9/77
Date of first delivery	9/77	4/79	6/75	8/77
Number installed to date	Proprietary information	Proprietary information	Proprietary information	Proprietary information
Production status	Active	Active	Not in new production	Active
Operating systems				
DOS/VS	No	No	No	No
DOS/VSE	No	No	No	No
OS/VS1	Yes	Yes	Yes	Yes
SVS	Yes	Yes	Yes	Yes
MVS	Yes	Yes	Yes	Yes
VM/370	Yes	Yes	Yes	Yes
PROCESSING FEATURES				
Virtual storage capability	Standard	Standard	Standard	Standard
Processor arrangements				
Uniprocessor	Yes	Yes	Yes	Yes
Attached processor	—	—	—	—
Front end to	—	—	—	—
Back end to	—	—	—	—
Multiprocessor	—	—	—	—
Minimum in complex	—	—	—	—
Maximum in complex	—	—	—	—
Clock comparator	Standard	Standard	Standard	Standard
CPU timer	Standard	Standard	Standard	Standard
Control registers	Standard	Standard	Standard	Standard
CPU one-level addressing	Standard	Standard	Standard	Standard
Doubleword buffer	Standard	Standard	Standard	Standard
Interval timer	Standard	Standard	Standard	Standard
Machine check handling	Standard	Standard	Standard	Standard
Multiple bus architecture	Standard	Standard	Standard	Standard
Storage protection	Standard	Standard	Standard	Standard
Time-of-day-clock	Standard	Standard	Standard	Standard
Channel command retry	Standard	Standard	Standard	Standard
Channel indirect addressing	Standard	Standard	Standard	Standard
Byte oriented operand feature	Standard	Standard	Standard	Standard
Extended precision floating point	Standard	Standard	Standard	Standard
High speed floating point	Standard	Standard	Standard	Standard
System/370 Universal Instruction set	Standard	Standard	Standard	Standard
Console audible alarm	Standard	Standard	Standard	Standard
Integrated console printer	No	No	No	No
Light pen	No	No	No	No
Remote console	Standard	Standard	Standard	Standard
Remote data link	Standard	Standard	Standard	Standard
Console file	Standard	Standard	Standard	Standard
CPU activity monitor	Optional	Optional	Optional	Optional
External control mode	Standard	Standard	Standard	Standard
Program event recording	Standard	Standard	Standard	Standard
Virtual machine assist	No	No	No	No
1401/1440/1460 compatibility	No	No	No	No
OTHER FEATURES & COMMENTS	470 accelerator; air cooled; two-byte channel interface; software: MVS/SEA; VM/PE; AIDS	470 accelerator; air cooled; two-byte channel interface; software: MVS/SEA; VM/PE; AIDS	Air cooled; two-byte channel interface; software: MVS/SEA; VM/PE; AIDS	Air cooled; two-byte channel interface; software: MVS/SEA; VM/PE; AIDS

All About Plug-Compatible Mainframes

Amdahl 470V/5	Amdahl 470V/5-II	Amdahl 470V/6	Amdahl 470V/6-II	MODEL
				PROCESSOR PERFORMANCE
32.5	32.5	32.5	32.5	Machine cycle time, nanoseconds
IBM 370 Mod. 168-3 or 3032	IBM 370 Mod. 168-3 or 3032	IBM 370 Mod. 168-3 or 3032	IBM 370 Mod. 168-3 or 3032	Relative performance*
.9 to 1.1	1.0 to 1.2	1.3 to 1.5	1.4 to 1.6	To
—	—	—	—	Performance of
—	—	—	—	To
—	—	—	—	Performance of
—	—	—	—	To
				Performance of
				MAIN STORAGE
Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	Storage type
—	—	—	—	Checking
Yes	Yes	Yes		Parity
9/16 bytes	9/16 bytes	9/16 bytes	9/16 bytes	Error detection & correction
—	—	—	—	No. of check bits per byte
N/A	N/A	N/A	N/A	No. of check bits per word
N/A	N/A	N/A	N/A	Read cycle, nanoseconds
4	4	4	4	Write cycle, nanoseconds
4M	4M	4M	4M	Bytes fetched per cycle
8M	8M	8M	8M	Minimum capacity, bytes
2M	2M	2M	2M	Maximum capacity, bytes
Yes	Yes	Yes	Yes	Increment size, bytes
2	2	2	2	Interleaving
4	4	4	4	Minimum number of ways
				Maximum number of ways
Yes	Yes	Yes	Yes	BUFFER (CACHE) STORAGE
Bipolar RAM	Bipolar RAM	Bipolar RAM	Bipolar RAM	Storage type
65	65	65	65	Cycle time, nanoseconds
4	4	4	4	Bytes fetched per cycle
16K	32K	16K	32K	Minimum capacity, bytes
16K	32K	16K	32K	Maximum capacity, bytes
				I/O CHANNELS
8	8	8	8	Selector channels standard
16	16	16	16	Selector channels optional
8	8	8	8	Block multiplexers standard
16	16	16	16	Block multiplexers optional
8	8	8	8	Byte multiplexers standard
16	16	16	16	Byte multiplexers optional
256	256	256	256	Subchannels per channel
256	256	256	256	On a block multiplexer
256	256	256	256	On a byte multiplexer
Yes	Yes	Yes	Yes	On a selector
				Channel to channel adapter
1.9M	1.9M	1.9M	1.9M	Maximum channel data rates
110K	110K	110K	110K	Block multiplexer, bytes/sec.
1.9M	1.9M	1.9M	1.9M	Byte multiplexer, bytes/sec.
7M	7M	7M	7M	Selector channel, bytes/sec.
				Aggregate data rate, bytes/sec.
N/A	N/A	N/A	N/A	CONTROL STORAGE
—	—	—	—	Storage type
—	—	—	—	Access time, nanoseconds
—	—	—	—	Word size, bits
—	—	—	—	Minimum number of words
—	—	—	—	Maximum number of words
—	—	—	—	Control storage usage
				PRICING & AVAILABILITY
$1,840,000	$1,940,000	$2,070,000	$2,170,000	Purchase of CPU with min. memory
Yes	Yes	Yes	Yes	Lease terms offered
Yes	Yes	Yes	Yes	Vendor's
—	—	—	—	Third party
$408,000	$436,800	$474,600	$503,400	Lease of CPU with min. memory (1-yr.)
2MB	2MB	2MB	2MB	Memory increment size
$140,000	$140,000	$140,000	$140,000	Memory increment purchase
Yes	Yes	Yes	Yes	Vendor offered maintenance
—	—	—	—	Prime time
—	—	—	—	Additional hours
Yes	Yes	Yes	Yes	24 hour
—	—	—	—	Other plans
Amdahl	Amdahl	Amdahl	Amdahl	Manufacturer
Amdahl	Amdahl	Amdahl	Amdahl	Vendor

*As rated by the PCM vendor.

All About Plug-Compatible Mainframes

MODEL	Amdahl 470V/7	Amdahl 470V/7A	Amdahl 470V/8	Cambridge 1638
SYSTEM PARAMETERS				
Date of introduction	3/28/77	8/1/79	10/17/78	9/78
Date of first delivery	8/78	9/79	9/79	12/78
Number installed to date	Proprietary information	Proprietary information	Proprietary information	12
Production status	Active	Active	Active	Active
Operating systems				
DOS/VS	No	No	No	Yes
DOS/VSE	No	No	No	Yes (mid 1980)
OS/VS1	Yes	Yes	Yes	Yes
SVS	Yes	Yes	Yes	Yes
MVS	Yes	Yes	Yes	Yes
VM/370	Yes	Yes	Yes	Yes
PROCESSING FEATURES				
Virtual storage capability	Standard	Standard	Standard	Standard
Processor arrangements				
Uniprocessor	Yes	Yes	Yes	Yes
Attached processor	—	—	—	—
Front end to	—	—	—	—
Back end to	—	—	—	—
Multiprocessor	—	—	—	—
Minimum in complex	—	—	—	—
Maximum in complex	—	—	—	—
Clock comparator	Standard	Standard	Standard	Standard
CPU timer	Standard	Standard	Standard	Standard
Control registers	Standard	Standard	Standard	Standard
CPU one-level addressing	Standard	Standard	Standard	Standard
Doubleword buffer	Standard	Standard	Standard	Standard
Interval timer	Standard	Standard	Standard	Standard
Machine check handling	Standard	Standard	Standard	Standard
Multiple bus architecture	Standard	Standard	Standard	No
Storage protection	Standard	Standard	Standard	Standard
Time-of-day-clock	Standard	Standard	Standard	Standard
Channel command retry	Standard	Standard	Standard	Standard
Channel indirect addressing	Standard	Standard	Standard	Standard
Byte oriented operand feature	Standard	Standard	Standard	Standard
Extended precision floating point	Standard	Standard	Standard	Standard
High speed floating point	Standard	Standard	Standard	Standard
System/370 Universal Instruction set	Standard	Standard	Standard	Standard
Console audible alarm	Standard	Standard	Standard	Standard
Integrated console printer	No	No	No	Standard
Light pen	No	No	No	No
Remote console	Standard	Standard	Standard	No
Remote data link	Standard	Standard	Standard	No
Console file	Standard	Standard	Standard	Standard
CPU activity monitor	Optional	Optional	Optional	Standard
External control mode	Standard	Standard	Standard	Standard
Program event recording	Standard	Standard	Standard	Standard
Virtual machine assist	No	No	No	Standard
1401/1440/1460 compatibility	No	No	No	No
OTHER FEATURES & COMMENTS	Air cooled; two-byte channel interface; software: MVS/SEA; VM/PE; AIDS	470 accelerator; air cooled; two-byte channel interface; software: MVS/SEA; VM/PE; AIDS	Air cooled; two-byte channel interface; software: MVS/SEA; VM/PE; AIDS	

All About Plug-Compatible Mainframes

Amdahl 470V/7	Amdahl 470V/7A	Amdahl 470V/8	Cambridge 1638	MODEL
				PROCESSOR PERFORMANCE
29	29	26	—	Machine cycle time, nanoseconds
				Relative performance*
IBM 370 Mod. 168-3 or 3032	IBM 370 Mod. 168-3 or 3032	IBM 370 Mod. 168-3 or 3032	IBM 370 Mod. 138	To
2.1 to 2.4	1.7 to 1.9	2.6 to 3.0	1.03	Performance of
—	—	—	IBM 4331	To
—	—	—	1.1	Performance of
—	—	—	—	To
—	—	—	—	Performance of
				MAIN STORAGE
MOS	Dynamic NMOS	Dynamic NMOS		Storage type
—	—	—	—	Checking
Yes	Yes	Yes	Yes	Parity
1.0	1.0	1.0	—	Error detection & correction
—	—	—	8/doubleword	No. of check bits per byte
N/A	N/A	N/A	650	No. of check bits per word
N/A	N/A	N/A	450	Read cycle, nanoseconds
4	4	4	8	Write cycle, nanoseconds
4M	4M	4M	512K	Bytes fetched per cycle
16M	16M	16M	2048K	Minimum capacity, bytes
2M	2M	2M	512K	Maximum capacity, bytes
Yes	Yes	Yes	No	Increment size, bytes
8	8	8	—	Interleaving
16	16	16	—	Minimum number of ways
				Maximum number of ways
Yes	Yes	Yes	No	BUFFER (CACHE) STORAGE
Bipolar RAM	Bipolar RAM	Bipolar RAM	—	Storage type
58	58	52	—	Cycle time, nanoseconds
4	4	4	—	Bytes fetched per cycle
32K	32K	64K	—	Minimum capacity, bytes
32K	32K	64K	—	Maximum capacity, bytes
				I/O CHANNELS
12	12	12	—	Selector channels standard
16	16	16	—	Selector channels optional
12	12	12	2	Block multiplexers standard
16	16	16	2	Block multiplexers optional
12	12	12	1	Byte multiplexers standard
16	16	16	0	Byte multiplexers optional
				Subchannels per channel
256	256	256	256	On a block multiplexer
256	256	256	256	On a byte multiplexer
256	256	256	—	On a selector
Yes	Yes	Yes	Yes (mid 1980)	Channel to channel adapter
				Maximum channel data rates
1.9M	1.9M	1.9M	1,800,000	Block multiplexer, bytes/sec.
110K	110K	110K	50,000	Byte multiplexer, bytes/sec.
1.9M	1.9M	1.9M	—	Selector channel, bytes/sec.
18M	18M	18M	5,000,000	Aggregate data rate, bytes/sec.
N/A	N/A	N/A		CONTROL STORAGE
—	—	—	Bipolar	Storage type
—	—	—	50	Access time, nanoseconds
—	—	—	36	Word size, bits
—	—	—	12K	Minimum number of words
—	—	—	16K	Maximum number of words
—	—	—	Instruction microcode, operating system assist	Control storage usage
				PRICING & AVAILABILITY
$2,820,000	$2,450,000	$3,020,000	$96,000	Purchase of CPU with min. memory
Yes	Yes	Yes	Yes	Lease terms offered
Yes	Yes	Yes	Contact vendor	Vendor's
—	—	—	—	Third party
$604,200	$583,800	$652,800	—	Lease of CPU with min. memory (1-yr.)
2MB	2MB	2MB	512KB	Memory increment size
$140,000	$140,000	$140,000	$15,000	Memory increment purchase
Yes	Yes	Yes	Yes	Vendor offered maintenance
—	—	—	—	Prime time
—	—	—	—	Additional hours
Yes	Yes	Yes	Yes	24 hour
—	—	—	Third party	Other plans
Amdahl	Amdahl	Amdahl	Cambridge	Manufacturer
Amdahl	Amdahl	Amdahl	Cambridge	Vendor

*As rated by the PCM vendor.

All About Plug-Compatible Mainframes

MODEL	Cambridge 1640	Control Data Omega 480-I	Control Data Omega 480-II	Control Data Omega 480-III
SYSTEM PARAMETERS				
Date of introduction	9/78	6/77	6/77	1979
Date of first delivery	1/78	6/77	1978	1979
Number installed to date	14	100	100	100
Production status	Active	Active	Active	Active
Operating systems				
DOS/VS	Yes	Yes	Yes	Yes
DOS/VSE	Yes (mid 1980)	No	No	No
OS/VS1	Yes	Yes	Yes	Yes
SVS	Yes	Yes	Yes	Yes
MVS	Yes	Yes	Yes	Yes
VM/370	Yes	Yes	Yes	Yes
PROCESSING FEATURES				
Virtual storage capability	Standard	—	—	—
Processor arrangements				
Uniprocessor	Yes	Yes	Yes	Yes
Attached processor	—	—	—	—
Front end to	—	—	—	—
Back end to	—	—	—	—
Multiprocessor	Yes	—	—	—
Minimum in complex	3; see comments	—	—	—
Maximum in complex	4; see comments	—	—	—
Clock comparator	Standard	Standard	Standard	Standard
CPU timer	Standard	Standard	Standard	Standard
Control registers	Standard	Standard	Standard	Standard
CPU one-level addressing	Standard	No	No	No
Doubleword buffer	Standard	Standard	Standard	Standard
Interval timer	Standard	Standard	Standard	Standard
Machine check handling	Standard	Standard	Standard	Standard
Multiple bus architecture	No	No	No	No
Storage protection	Standard	Standard	Standard	Standard
Time-of-day-clock	Standard	Standard	Standard	Standard
Channel command retry	Standard	Standard	Standard	Standard
Channel indirect addressing	Standard	Standard	Standard	Standard
Byte oriented operand feature	Standard	No	No	No
Extended precision floating point	Standard	Standard	Standard	Standard
High speed floating point	Standard	Standard	Standard	Standard
System/370 Universal Instruction set	Standard	No	No	No
Console audible alarm	Standard	No	No	No
Integrated console printer	No	Standard	Standard	Standard
Light pen	No	No	No	No
Remote console	No	No	No	No
Remote data link	No	No	No	No
Console file	Standard	Standard	Standard	Standard
CPU activity monitor	Standard	—	No	No
External control mode	Standard	Standard	Standard	Standard
Program event recording	Standard	Standard	Standard	Standard
Virtual machine assist	Standard	Standard	Standard	Standard
1401/1440/1460 compatibility	No	No	No	No
OTHER FEATURES & COMMENTS	Sold only outside the US but listed here because the 1640 is the basis of two multiprocessor complexes sold in the US, the 1643 and 1644, offering three and four processors respectively. The 1643 and 1644 cost somewhat less than double and triple of the 1640.			

All About Plug-Compatible Mainframes

Cambridge 1640	Control Data Omega 480-I	Control Data Omega 480-II	Control Data Omega 480-III	MODEL
—	400	400	400	PROCESSOR PERFORMANCE Machine cycle time, nanoseconds
IBM 370 Model 148	IBM 370 Model 138	IBM 370 Model 148	IBM 370 Model 158	Relative performance*
1.05	1.5 to 1.9	1.15	1.9	To
IBM 4331	—	—	—	Performance of
1.9	—	—	—	To
—	—	—	—	Performance of
—	—	—	—	To
				Performance of
Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	MAIN STORAGE Storage type
—	Yes	Yes	Yes	Checking
Yes	Yes	Yes	Yes	Parity
—	—	—	—	Error detection & correction
8/doubleword	—	—	—	No. of check bits per byte
650	400	400	400	No. of check bits per word
450	400	400	400	Read cycle, nanoseconds
8	—	—	—	Write cycle, nanoseconds
1024K	.5M	1M	2M	Bytes fetched per cycle
4096K	2M	4M	8M	Minimum capacity, bytes
1024K	.5M	1M	2M	Maximum capacity, bytes
No	No	No	No	Increment size, bytes
—	—	—	—	Interleaving
—	—	—	—	Minimum number of ways
				Maximum number of ways
No	No	Yes	Yes	BUFFER (CACHE) STORAGE
—	—	—	—	Storage type
—	—	100	100	Cycle time, nanoseconds
—	—	—	—	Bytes fetched per cycle
—	—	8K	8K	Minimum capacity, bytes
—	—	8K	8K	Maximum capacity, bytes
—	—	—	—	I/O CHANNELS Selector channels standard
—	—	—	—	Selector channels optional
2	2	4	4	Block multiplexers standard
2	2	0	1	Block multiplexers optional
1	1	1	1	Byte multiplexers standard
0	0	0	0	Byte multiplexers optional
				Subchannels per channel
256	256	256	256	On a block multiplexer
256	256	256	256	On a byte multiplexer
	—	—	—	On a selector
Yes (mid 1980)	—	—	—	Channel to channel adapter
				Maximum channel data rates
1,800,000	1.85M	1.85M	1.85M	Block multiplexer, bytes/sec.
50,000	50K	50K	50K	Byte multiplexer, bytes/sec.
	—	—	—	Selector channel, bytes/sec.
5,000,000	5M	5M	5M	Aggregate data rate, bytes/sec.
Bipolar	Bipolar R/W	Bipolar R/W	Bipolar R/W	CONTROL STORAGE Storage type
50	50	50	50	Access time, nanoseconds
36	8	8	8	Word size, bits
12K	54K	72K	72K	Minimum number of words
16K	144K	144K	144K	Maximum number of words
instruction microcode operating system assist	—	—	—	Control storage usage
$166,000	$188,000	$279,000	$360,000	PRICING & AVAILABILITY Purchase of CPU with min. memory
Yes	Yes	Yes	Yes	Lease terms offered
Contact vendor	Yes	Yes	Yes	Vendor's
—	Yes	Yes	Yes	Third party
—	—	—	—	Lease of CPU with min. memory (1-yr.)
1024K	.5MB	1MB	2MB	Memory increment size
$30,000	$17,500	$35,000	$70,000	Memory increment purchase
Yes	Yes	Yes	Yes	Vendor offered maintenance
—	Yes	Yes	Yes	Prime time
—	Yes	Yes	Yes	Additional hours
Yes	Yes	Yes	Yes	24 hour
Third party	Weekend, holiday	Weekend, holiday	Weekend, holiday	Other plans
Cambridge	IPL Systems	IPL Systems	IPL Systems	Manufacturer
Cambridge	Control Data	Control Data	Control Data	Vendor

*As rated by the PCM vendor.

All About Plug-Compatible Mainframes

MODEL	Magnuson M80 Model 3	Magnuson M80 Model 4	Magnuson M80 Model 32	MegaSystems MEGA 1/8
SYSTEM PARAMETERS				
Date of introduction	5/30/78	5/30/78	3/30/79	3/1/79
Date of first delivery	6/12/79	9/30/78	5/80	5/21/79
Number installed to date	—	—	—	1
Production status	Active	Active	Active	Active
Operating systems				
DOS/VS	Yes	Yes	Yes	Yes
DOS/VSE	Yes	Yes	Yes	No
OS/VS1	Yes	Yes	Yes	Yes
SVS	Yes	Yes	Yes	Yes
MVS	Yes	Yes	Yes	Yes
VM/370	Yes	Yes	Yes	Yes
PROCESSING FEATURES				
Virtual storage capability	Standard	Standard	—	Standard
Processor arrangements				
Uniprocessor	Yes	Yes	Yes	Yes
Attached processor	—	—	—	—
Front end to	—	—	—	—
Back end to	—	—	—	—
Multiprocessor	—	—	—	—
Minimum in complex	—	—	—	—
Maximum in complex	—	—	—	—
Clock comparator	Standard	Standard	Standard	Standard
CPU timer	Standard	Standard	Standard	Standard
Control registers	Standard	Standard	Standard	Standard
CPU one-level addressing	No	No	Standard	Standard
Doubleword buffer	Standard	Standard	Standard	No
Interval timer	Standard	Standard	Standard	Standard
Machine check handling	Standard	Standard	Standard	Standard
Multiple bus architecture	Standard	Standard	No	Standard
Storage protection	Standard	Standard	Standard	Standard
Time-of-day-clock	Standard	Standard	Standard	Standard
Channel command retry	Standard	Standard	Standard	Standard
Channel indirect addressing	Standard	Standard	Standard	Standard
Byte oriented operand feature	Standard	Standard	Standard	Standard
Extended precision floating point	Standard	Standard	Standard	Standard
High speed floating point	No	No	No	Standard
System/370 Universal Instruction set	Standard	Standard	Standard	Standard
Console audible alarm	Standard	Standard	Standard	Standard
Integrated console printer	Optional	Optional	Optional	Optional
Light pen	Standard	Standard	Standard	Optional
Remote console	Optional	Optional	Optional	Optional
Remote data link	Standard	Standard	Standard	Standard
Console file	Standard	Standard	Standard	No
CPU activity monitor	Standard	Standard	Standard	Optional
External control mode	Standard	Standard	Standard	Standard
Program event recording	Standard	Standard	Standard	Standard
Virtual machine assist	Standard	Standard	Standard	No
1401/1440/1460 compatibility	No	No	No	No
OTHER FEATURES & COMMENTS	Redundant floppy discs; power and temperature sensing and reporting; PF key pad; memory alter/display scrolling; remote power on sensing and reporting; CPU performance monitor; mneumonic assembler/disassembler	Identical channels which allow user to specify in which mode they will function; no quantity minimums by type		Software: Mega APL, SHELL, INSIGHT, GRAFIT, QED, MAIL, PPC, STATPAK

All About Plug-Compatible Mainframes

Magnuson M80 Model 3	Magnuson M80 Model 4	Magnuson M80 Model 32	MegaSystems MEGA 1/8	MODEL
100	100	100	250	PROCESSOR PERFORMANCE Machine cycle time, nanoseconds
IBM 370 Model 138 1.50 IBM 4331 1.60 IBM 4341 .38	IBM 370 Model 148 1.30 IBM 4331 2.82 IBM 4341 .84	IBM 370 Model 148 1.30 IBM 4331 3.0 IBM 4341 .89	IBM 370 Model 138 1 IBM 4331 1 to 1.25 — —	Relative performance* To Performance of To Performance of To Performance of
Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	MAIN STORAGE Storage type
— Yes 1 4 600 600 8 1024K 8M 512K No — —	— Yes 1 4 600 600 8 2M 8M 512K No — —	— Yes 1 4 600 600 8 1M 8M 1024K — — —	Yes Yes 1 — 250 750 4 256K 4M 256K No — —	Checking Parity Error detection & correction No. of check bits per byte No. of check bits per word Read cycle, nanoseconds Write cycle, nanoseconds Bytes fetched per cycle Minimum capacity, bytes Maximum capacity, bytes Increment size, bytes Interleaving Minimum number of ways Maximum number of ways
No — — — — —	Yes Static TTL 400 8 16K 32K	Yes Static TTL 400 8 16K 32K	No — — — — —	BUFFER (CACHE) STORAGE Storage type Cycle time, nanoseconds Bytes fetched per cycle Minimum capacity, bytes Maximum capacity, bytes
0 5 3 4 1 5	0 5 4 1 1 5	0 7 2 6 1 7	1 5 0 0 1 —	I/O CHANNELS Selector channels standard Selector channels optional Block multiplexers standard Block multiplexers optional Byte multiplexers standard Byte multiplexers optional
256 256 256 Yes	256 256 256 Yes	256 256 256 Yes	— — — —	Subchannels per channel On a block multiplexer On a byte multiplexer On a selector Channel to channel adapter
2.5M 100K 2.5M 11M	2.5M 100K 2.5M 11M	2.5M 100K 2.5M 13.3M	— — — —	Maximum channel data rates Block multiplexer, bytes/sec. Byte multiplexer, bytes/sec. Selector channel, bytes/sec. Aggregate data rate, bytes/sec.
Static TTL 45 32 8K 64K Instruction microcode, operating system assist	Static TTL 45 32 8K 64K Instruction microcode, operating system assist	Static NMOS 45 32 4K 16K Instruction microcode, operating system assist	Prom 55 80 4K 16K Instruction microcode, operating system assist	CONTROL STORAGE Storage type Access time, nanoseconds Word size, bits Minimum number of words Maximum number of words Control storage usage
$180,000 Yes — Yes $6,667 2 bytes $30,000 Yes Yes Yes Yes —	$295,000 Yes — Yes $10,927 — — Yes Yes Yes Yes —	$185,000 Yes — Yes $6,852 1 byte $15,000 Yes Yes Yes Yes —	$62,400 Yes Yes — $2,184 256 KB $7,000 Yes — — — Offsite concept	PRICING & AVAILABILITY Purchase of CPU with min. memory Lease terms offered Vendor's Third party Lease of CPU with min. memory (1-yr.) Memory increment size Memory increment purchase Vendor offered maintenance Prime time Additional hours 24 hour Other plans
Magnuson Magnuson	Magnuson Magnuson	Magnuson Magnuson	Two Pi MegaSystems	Manufacturer Vendor

*As rated by the PCM vendor.

All About Plug-Compatible Mainframes

MODEL	Multiprocessor 30/4	Multiprocessor 30/5	NAS AS/5-3
SYSTEM PARAMETERS			
Date of introduction	12/78	12/78	10/14/76
Date of first delivery	3/80	1/80	4/1/77
Number installed to date	0	0	210
Production status	Active	Active	—
Operating systems			
DOS/VS	Yes	Yes	Yes
DOS/VSE	No	No	No
OS/VS1	Yes	Yes	Yes
SVS	Yes	Yes	Yes
MVS	Yes	Yes	Yes
VM/370	Yes	Yes	Yes
PROCESSING FEATURES			
Virtual storage capability	Optional	Standard	Standard
Processor arrangements			
Uniprocessor	Yes	Yes	—
Attached processor	—	—	—
Front end to	—	—	—
Back end to	—	—	—
Multiprocessor	—	—	—
Minimum in complex	—	—	—
Maximum in complex	—	—	—
Clock comparator	Optional	Optional	Standard
CPU timer	Optional	Optional	Standard
Control registers	Standard	Standard	Standard
CPU one-level addressing	No	No	Standard
Doubleword buffer	Optional	Optional	Standard
Interval timer	Optional	Optional	Standard
Machine check handling	Optional	Optional	Standard
Multiple bus architecture	Standard	Standard	Standard
Storage protection	Standard	Standard	Standard
Time-of-day-clock	Standard	Standard	Standard
Channel command retry	Standard	Standard	Standard
Channel indirect addressing	Optional	Optional	Standard
Byte oriented operand feature	Standard	Standard	Standard
Extended precision floating point	Standard	Standard	Standard
High speed floating point	Standard	Standard	No
System/370 Universal Instruction set	Standard	Standard	Standard
Console audible alarm	Standard	Standard	Standard
Integrated console printer	Optional	Optional	Standard
Light pen	No	No	Standard
Remote console	Optional	Optional	Optional
Remote data link	Standard	Standard	—
Console file	Standard	Standard	Standard
CPU activity monitor	Optional	Optional	No
External control mode	Standard	Standard	Standard
Program event recording	Standard	Standard	Standard
Virtual machine assist	Optional	Optional	Standard
1401/1440/1460 compatibility	Optional	Optional	Standard
OTHER FEATURES & COMMENTS			

All About Plug-Compatible Mainframes

Multiprocessors 30/4	Multiprocessors 30/5	NAS AS/5-3	MODEL
—	—	—	PROCESSOR PERFORMANCE
IBM 370 Model 148	IBM 370 Model 3031	IBM 370 Model 158-3	Machine cycle time, nanoseconds
1.5	1.0	1	Relative performance*
—	—	—	To
—	—	—	Performance of
—	—	—	To
—	—	—	Performance of
			To
			Performance of
Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	MAIN STORAGE
			Storage type
—	—	—	Checking
Yes	Yes	Yes	Parity
2	2	—	Error detection & correction
—	—	8/doubleword	No. of check bits per byte
400	300	920	No. of check bits per word
400	300	690	Read cycle, nanoseconds
4	4	16	Write cycle, nanoseconds
1M	2M	1M	Bytes fetched per cycle
2M	16M	8M	Minimum capacity, bytes
1M	1M	1M	Maximum capacity, bytes
Yes	Yes	No	Increment size, bytes
0	0	—	Interleaving
4	4	—	Minimum number of ways
			Maximum number of ways
No	No	Yes	BUFFER (CACHE) STORAGE
—	—	ECL	Storage type
—	—	115	Cycle time, nanoseconds
—	—	4	Bytes fetched per cycle
—	—	16K	Minimum capacity, bytes
—	—	16K	Maximum capacity, bytes
—	0	—	I/O CHANNELS
—	—	—	Selector channels standard
4	5	5	Selector channels optional
—	—	0	Block multiplexers standard
1	1	1	Block multiplexers optional
—	—	1	Byte multiplexers standard
			Byte multiplexers optional
64	256	256	Subchannels per channel
64	256	256	On a block multiplexer
—	—	—	On a byte multiplexer
Yes	Yes	Yes	On a selector
			Channel to channel adapter
2M	2M	1.5M	Maximum channel data rates
150K	150K	100K	Block multiplexer, bytes/sec.
—	—	—	Byte multiplexer, bytes/sec.
3M	4M	6.75M	Selector channel, bytes/sec.
			Aggregate data rate, bytes/sec.
Static NMOS	Static NMOS	ECL	CONTROL STORAGE
55	35	115	Storage type
32	32	72	Access time, nanoseconds
4K	4K	8K	Word size, bits
16K	16K	8K	Minimum number of words
Instruction microcode, operating system assist	Instruction microcode, operating system assist	Instruction microcode, operating system assist	Maximum number of words
			Control storage usage
$250,000	$750,000	$1,144,000	PRICING & AVAILABILITY
No	No	No	Purchase of CPU with min. memory
—	—	—	Lease terms offered
—	—	—	Vendor's
—	—	—	Third party
—	—	—	Lease of CPU with min. memory (1-yr.)
—	—	1M	Memory increment size
—	—	$7,500	Memory increment purchase
No	No	Yes	Vendor offered maintenance
—	—	Yes	Prime time
—	—	Yes	Additional hours
—	—	Yes	24 hour
—	—	—	Other plans
Instrument Technology Multiprocessors	Instrument Technology Multiprocessors	National Semiconductor NASCO	Manufacturer
			Vendor

*As rated by the PCM vendor.

All About Plug-Compatible Mainframes

MODEL	NAS AS/6	NAS AS/7031	NAS AS/7
SYSTEM PARAMETERS			
Date of introduction	10/1/77	11/16/77	7/9/79
Date of first delivery	3/1/78	12/1/78	4th qrt. 1979
Number installed to date	63	45	See comments
Production status	Active	Active	Active
Operating systems			
DOS/VS	Yes	Yes	No
DOS/VSE	No	No	No
OS/VS1	Yes	Yes	No
SVS	Yes	Yes	No
MVS	Yes	Yes	Yes
VM/370	Yes	Yes	Yes
PROCESSING FEATURES			
Virtual storage capability	Standard	Standard	Standard
Processor arrangements			
Uniprocessor	Yes	Yes	—
Attached processor	—	—	Yes
Front end to	—	—	—
Back end to	—	—	—
Multiprocessor	—	—	—
Minimum in complex	—	—	—
Maximum in complex	—	—	—
Clock comparator	Standard	Standard	Standard
CPU timer	Standard	Standard	Standard
Control registers	Standard	Standard	Standard
CPU one-level addressing	Standard	Standard	Standard
Doubleword buffer	Standard	Standard	Standard
Interval timer	Standard	Standard	Standard
Machine check handling	Standard	Standard	Standard
Multiple bus architecture	Standard	Standard	Standard
Storage protection	Standard	Standard	Standard
Time-of-day-clock	Standard	Standard	Standard
Channel command retry	Standard	Standard	Standard
Channel indirect addressing	Standard	Standard	Standard
Byte oriented operand feature	Standard	Standard	Standard
Extended precision floating point	Standard	Standard	Standard
High speed floating point	Standard	No	Standard
System/370 Universal Instruction set	Standard	Standard	Standard
Console audible alarm	Standard	Standard	Standard
Integrated console printer	Standard	Standard	Standard
Light pen	Standard	Standard	Standard
Remote console	No	Optional	No
Remote data link	No	No	No
Console file	Standard	Standard	Standard
CPU activity monitor	Standard	No	Standard
External control mode	Standard	Standard	Standard
Program event recording	Standard	Standard	Standard
Virtual machine assist	Standard	Standard	Standard
1401/1440/1460 compatibility	No	Standard	No
OTHER FEATURES & COMMENTS			As of this writing NAS had not completed an agreement with Hitachi; sales are from warehouse stocks only.

All About Plug-Compatible Mainframes

NAS AS/6	NAS AS/7031	NAS AS/7	MODEL
			PROCESSOR PERFORMANCE
—	—	72	Machine cycle time, nanoseconds
			Relative performance*
IBM 3032	IBM 3031	IBM 3033	To
1.1 to 1.2	Equal	1.0 to 1.2	Performance of
—	—	—	To
—	—	—	Performance of
—	—	—	To
—	—	—	Performance of
			MAIN STORAGE
Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	Storage type
—	—	—	Checking
Yes	Yes	Yes	Parity
8/8	—	8/8 bytes	Error detection & correction
—	8/doubleword	—	No. of check bits per byte
360	644	360	No. of check bits per word
360	552	360	Read cycle, nanoseconds
8	32	8	Write cycle, nanoseconds
2M	1M	4M	Bytes fetched per cycle
16M	8M	16M	Minimum capacity, bytes
1M	1M	2M	Maximum capacity, bytes
Yes	No	Yes	Increment size, bytes
4	—	4	Interleaving
—	—		Minimum number of ways
			Maximum number of ways
Yes	Yes	Yes	BUFFER (CACHE) STORAGE
Bipolar, static	ECL	Bipolar, static	Storage type
144	92	144	Cycle time, nanoseconds
8	4	8	Bytes fetched per cycle
64K	32K	64K	Minimum capacity, bytes
64K	32K	64K	Maximum capacity, bytes
			I/O CHANNELS
—	—	—	Selector channels standard
—	—	—	Selector channels optional
5	5	10	Block multiplexers standard
7	0	2	Block multiplexers optional
1	1	2	Byte multiplexers standard
3	1	2	Byte multiplexers optional
			Subchannels per channel
256	256	256	On a block multiplexer
256	256	256	On a byte multiplexer
—	—	—	On a selector
Yes	Yes	Yes	Channel to channel adapter
			Maximum channel data rates
1.86M	1.5M	1.86M	Block multiplexer, bytes/sec.
100K	100K	100K	Byte multiplexer, bytes/sec.
—	—	—	Selector channel, bytes/sec.
20M	6.75M	20M	Aggregate data rate, bytes/sec.
			CONTROL STORAGE
Bipolar, static	ECL	Bipolar, static	Storage type
25	92	25 (on chip)	Access time, nanoseconds
99	72	99	Word size, bits
4K	16	6K	Minimum number of words
6K	16	—	Maximum number of words
Instruction microcode, operating system assist	Instruction microcode, operating system assist	Instruction microcode, operating system assist	Control storage usage
			PRICING & AVAILABILITY
$1,940,000	$600,000	$3,240,000	Purchase of CPU with min. memory
No	No	No	Lease terms offered
—	—	—	Vendor's
—	—	—	Third party
—	—	—	Lease of CPU with min. memory (1-yr.)
1M	1M	1M	Memory increment size
$110,000	$40,000	$75,000	Memory increment purchase
Yes	Yes	Yes	Vendor offered maintenance
Yes	Yes	Yes	Prime time
Yes	Yes	Yes	Additional hours
Yes	Yes	Yes	24 hour
—	—	—	Other plans
Hitachi	National Semiconductor	Hitachi	Manufacturer
NASCO	NASCO	NASCO	Vendor

*As rated by the PCM vendor.