

# Itel Advanced Systems

## MANAGEMENT SUMMARY

Itel became the second vendor to market IBM plug-compatible mainframe computers when it introduced its Advanced Systems computers in October 1976. Unlike the first plug-compatible processor manufacturer, Amdahl, which limited its initial offering to a replacement for IBM's 370/168, Itel immediately fielded a line of three systems that are direct replacements for IBM's 370/148, 370/158-1, and 370/158-3 systems, respectively, as well as effective replacements for older IBM System/360 models.

Aside from the different IBM systems that the two plug-compatible mainframe vendors have chosen as market targets, Itel and Amdahl also differ in the way each has defined its products. Amdahl chose to offer a system with significantly more performance at a price similar to that of its IBM target system. By contrast, with the exception of its AS/4 processor, Itel's marketing method is based on delivering the same performance levels as the target IBM systems at substantially lower costs. The AS/4 represents an exception to this marketing concept because it provides about 40 percent greater performance than the 370/148 at only about 2 percent greater cost.

The Itel Advanced Systems product line consists of three uniprocessor models designated the AS/4, AS/5-1, and AS/5-3, and three multiprocessor models designated the AS/4 MP, AS/5-1 MP, and AS/5-3 MP. All of the AS systems are field-upgradable without exchanging CPU's.

Itel claims that the AS/4 line has 1.4 times the performance capability of an IBM 148, and that the AS/5-1

Itel was the second company to market IBM plug-compatible mainframes. The Itel Advanced Systems Models AS/4, AS/5-1, and AS/5-3 are replacements for IBM's 370/148, 370/158-1, and 370/158-3 systems, respectively. They offer identical functionality and similar performance levels to their IBM counterparts while costing substantially less.

## CHARACTERISTICS

**SUPPLIER:** Itel Corporation, Data Products Group, One Embarcadero Center, San Francisco, California 94111. Telephone (415) 955-0000.

**MANUFACTURER:** National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, California 95051. Telephone (408) 737-5000.

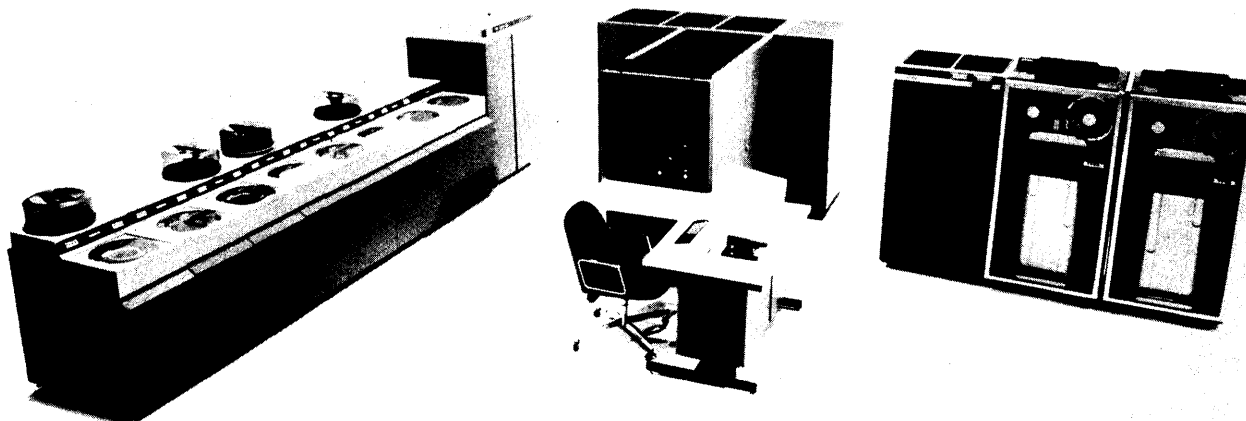
**MODELS:** AS/4, AS/4 MP, AS/5-1, AS/5-1 MP, AS/5-3, and AS/5-3 MP.

## DATA FORMATS

All data formats, instruction formats, and other architectural features completely follow the IBM System/370 architecture.

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

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



*Here's a complete IBM plug-compatible computer system from Itel. In addition to the Advanced Systems processors, Itel is a long-time supplier of IBM 3330-type disk drives and add-on main memory, as well as a major third-party lessor of IBM equipment. The system shown includes (from left) eight Itel 7330 disk drives*

*and the associated 7833 storage control unit, an AS/5 mainframe and CRT operator console, and a two-drive magnetic tape subsystem consisting of two 7420 tape drives and the associated 7803 controller. Users generally retain IBM's line printers for use in systems such as this one.*

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and AS/5-3 are equal in performance to the IBM 158-1 and 158-3, respectively. The AS/5-1 MP is rated equal in performance to a 158-1 MP, and the AS/5-3 MP equal to a 158-3 MP. The AS/4 MP offers slightly better performance than the AS/5-3 and the IBM 158-3, according to Intel.

Purchase prices for the Intel CPU's with the minimum one megabyte of main memory are \$812,000 for the AS/4, \$1,072,000 for the AS/5-1, and \$1,137,000 for the AS/5-3. The latter two prices represent reductions of 17 and 24 percent, respectively, from last year's prices.

Multiprocessor systems are implemented from special versions of the basic CPU's that are priced slightly higher than the standard uniprocessor versions. A multisystem unit, priced at \$35,250, is also required for tightly coupled MP configurations. Total multiprocessor system prices, including the multisystem unit, are \$1,939,250, \$2,371,250, and \$2,499,250 for the AS/4 MP, AS/5-1 MP, and the AS/5-3 MP, respectively.

Memory increments are available in one-megabyte modules priced at \$110,000 for AS/4 systems and \$83,000 for AS/5 systems.

Each AS CPU has a processor cycle time of 115 nanoseconds, seven I/O channels (one of which is a spare that can be used as either a byte or block multiplexer channel) and a minimum of one megabyte of main memory. Maximum memory capacity and number of I/O channels double in MP configurations. With the standard increments of one megabyte, memory capacity can be expanded to a maximum of four megabytes in the AS/4 and to eight megabytes in the AS/5-1 and AS/5-3. MP versions can be doubled to a maximum of 8 and 16 megabytes of memory for the AS/4 and AS/5 systems, respectively. Like their IBM counterparts, the AS/5 machines use bipolar buffer (or cache) memories, the AS/5-1 with 8K bytes and the AS/5-3 with 16K bytes. Standard features for all AS models include a console CRT with light pen and a 180-cps hard-copy printer.

Users confirm that IBM operating systems and program products, as well as all user-written programs that operate on an IBM 370/158 (except for those containing time-dependent code), will run on all the AS models. The IBM operating systems run in native mode, and any IBM or Intel plug-compatible peripheral device that is designed to attach to an IBM 370/158 can be used with all AS models. Principal operating systems for the three uniprocessor models are IBM's DOS/VS, OS/VS1, OS/VS2, and MVS, while MVS is the main operating system for the MP versions.

The AS/5 processing units have only about one-half the number of components found on an IBM 370/158, thus enabling them to utilize about 40 percent of the power required and be considerably smaller. The company also states that an AS/5 system runs about 9 degrees cooler than a 370/158, thereby increasing reliability, a claim that some users have confirmed. ➤

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

**INSTRUCTIONS:** 2, 4, or 6 bytes in length, which usually specify 0, 1, or 2 memory addresses, respectively.

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

### MAIN STORAGE

**STORAGE TYPE:** Metal oxide semiconductor (MOS).

**CAPACITY:** From 1 to 16 million bytes, in 1-million byte increments, housed in a single cabinet. (See table for capacities of the individual models.)

**CYCLE TIME:** See table.

**CHECKING:** Error checking and correction (ECC) circuitry in main memory performs automatic correction of all single-bit errors and detection of all double-bit and most other multiple-bit memory errors.

A reconfiguration capability is standard with all AS models. In the event of an unrecoverable error, or any other problem with a memory module, the operator can "dial out" the problem module (one-half million or one million bytes) and reconfigure the remaining memory for continuous operation.

**STORAGE PROTECTION:** The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard in all models.

### CENTRAL PROCESSOR

**INDEX REGISTERS:** Sixteen 32-bit general registers, used for indexing, base addressing, and as accumulators, plus four 64-bit floating-point registers per processor.

**INSTRUCTION REPERTOIRE:** The AS instruction set consists of the complete System/370 Universal Instruction Set, including the five S/370 instructions for Dynamic Address Translation.

**INSTRUCTION TIMES:** Intel states that individual instruction times are not currently available, but that average execution times for the AS systems will equal or exceed the performance of the comparable System/370 processors (see Management Summary).

**OPERATIONAL MODES:** Like the System/370, the Intel AS computers can operate in either the Basic Control (BC) mode or Extended Control (EC) mode. The BC mode maintains general upward compatibility with the System/360 architecture and programming. In the EC mode, the Program Status Word (PSW) and the layout of the permanently assigned lower main storage area are altered to support Dynamic Address Translation and other system control functions; therefore, the virtual-storage-oriented operating systems must be used.

**PROCESSOR FEATURES:** The timing features of the System/370 architecture are included in the AS central processors. These include a CPU timer and a Clock Comparator; the latter provides a means for causing an interrupt when the standard Time-of-Day Clock reaches a program-specified value. Additional instructions are provided to set and store the Time-of-Day Clock, Clock Comparator, and CPU Timer. ➤

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## CHARACTERISTICS OF THE ADVANCED SYSTEM PROCESSOR MODELS

	Model AS/4	Model AS/4 MP	Model AS/5-1	Model AS/5-1 MP	Model AS/5-3	Model AS/5-3 MP
<b>SYSTEM CHARACTERISTICS</b>						
Date of introduction	Oct. 1976	Oct. 1976	Oct. 1976	Oct. 1976	Oct. 1976	Oct. 1976
Virtual storage capability	Yes	Yes	Yes	Yes	Yes	Yes
Number of central processors	1	2	1	2	1	2
Principal operating systems	DOS/VS, OS/VS1, OS/VS2, MVS	MVS	DOS/VS, OS/VS1, OS/VS2, MVS	MVS	DOS/VS, OS/VS1, OS/VS2, MVS	MVS
<b>MAIN STORAGE</b>						
Storage type	Semiconductor (MOS)	Semiconductor (MOS)	Semiconductor (MOS)	Semiconductor (MOS)	Semiconductor (MOS)	Semiconductor (MOS)
Read cycle time, nanoseconds	1035	1035	1035	1035	920	920
Write cycle time, nanoseconds	690	690	690	690	690	690
Bytes fetched per cycle	16	16	16	16	16	16
Minimum capacity, bytes per system	1,048,576	2,097,252	1,048,576	2,097,252	1,048,576	2,097,252
Maximum capacity, bytes per system	4,194,304	8,388,608	8,388,608	16,777,216	8,388,608	16,777,216
Increment size, bytes	1,048,576	1,048,576	1,048,576	1,048,576	1,048,576	1,048,576
<b>BUFFER STORAGE</b>						
Cycle time, nanoseconds	—	—	115	115	115	115
Bytes fetched per cycle	—	—	4	4	4	4
Minimum capacity, bytes	None	None	8,192	16,384	16,384	32,768
Maximum capacity, bytes	None	None	8,192	16,384	16,384	32,768
<b>PROCESSING UNIT</b>						
Machine cycle time, nanoseconds	115	115	115	115	115	115
Processing unit features:						
Clock Comparator & CPU Timer	Standard	Standard	Standard	Standard	Standard	Standard
Direct Control	Standard	Standard	Standard	Standard	Standard	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard	Standard	Standard
Floating Point	Standard	Standard	Standard	Standard	Standard	Standard
Extended Precision Floating Point	Standard	Standard	Standard	Standard	Standard	Standard
High-Speed Multiply	Standard	Standard	Standard	Standard	Standard	Standard
Compatibility features:						
IBM 1401/1440/1460 Compatibility	Standard	Standard	Standard	Standard	Standard	Standard
IBM 1410/7010 Compatibility	Standard	Standard	Standard	Standard	Standard	Standard
IBM 7070/70704 Compatibility	Standard	Standard	Standard	Standard	Standard	Standard
OS/DOS Compatibility	Standard	Standard	Standard	Standard	Standard	Standard
<b>CHANNELS</b>						
No. of Selector Channels per system	None	None	None	None	None	None
No. of Block Multiplexer Channels	5 or 6	10 or 12	5 or 6	10 or 12	5 or 6	10 or 12
No. of Byte Multiplexer Channels	2 or 1	4 or 2	2 or 1	4 or 2	2 or 1	4 or 2

▷ The company sees its market for the AS systems as being four-tiered:

- Current single-system IBM System/370 Model 135 and 145 users considering an upgrade to a System/370 Model 148.
- Current single-system IBM Model 50, 65, and 155 users considering an upgrade to a System/370 Model 158.
- Current single-system IBM System/370 Model 158 users who want to reduce hardware costs while maintaining performance.
- Multiple-system users of two or three IBM computers who want to retain IBM support on their "prime" system, but who are willing to expose themselves on their "backup" systems to a non-IBM alternative.

For users concerned about the continued availability of IBM software and support, Intel offers some encouragement. The company has several letters from IBM, addressed jointly to Intel and National Semiconductor, ▷

▶ The Standard Direct Control feature provides six external interrupt lines which operate independently of the normal data channels, plus the Read Direct and Write Direct Instructions which provide for single-byte data transfers between an external device and main storage.

The Floating-Point Arithmetic feature provides instructions to perform floating-point arithmetic operations on both short (1-word) and long (2-word) operands.

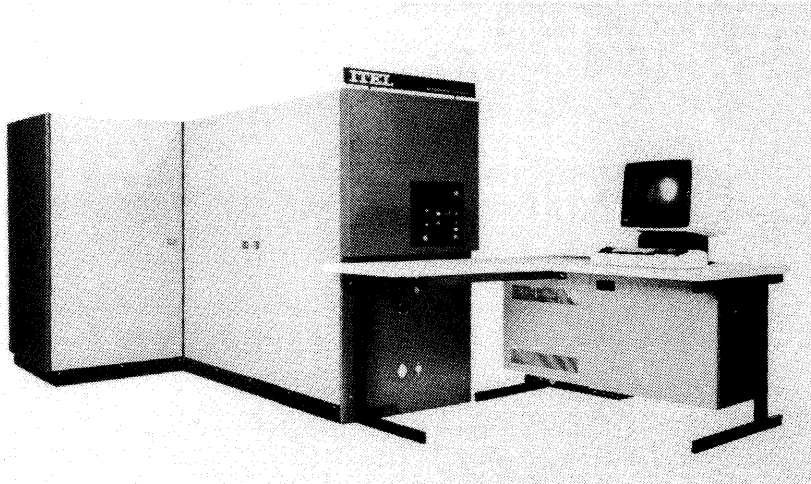
The Extended Precision Floating-Point feature provides seven instructions for performing floating-point arithmetic on 4-word (16-byte) operands that provide a precision of up to 28 hexadecimal or 34 decimal digits.

High-Speed Multiply reduces the time required for long-precision floating-point and fixed-point multiply instructions.

The Channel-to-Channel Adapter permits direct communication between an AS processor and a System/370 via a standard I/O channel. It can be attached to either a selector channel or a block multiplexer channel and uses one control unit position on either channel. Either system can be equipped with the Channel-to-Channel Adapter, and it is required on only one of the interconnected channels.

MULTIPROCESSING CONFIGURATIONS: The AS/4 MP (Multiprocessing), AS/5-1 MP, and AS/5-3 MP systems each consist of two identical uniprocessor models, ▶

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*The Intel AS/5 Advanced System mainframe is plug-compatible with IBM's 370/158. The AS/5 requires only one-half the components of its IBM counterpart and consumes only 40 percent of the power. This drastically reduced power requirement typically causes the system to run 9 degrees cooler than the IBM system. The basic AS/5 computer with one megabyte of memory, seven I/O channels, and a CRT operator console is priced at \$1,072,000. The system also includes a 180-cps serial printer (not shown) in addition to the CRT display.*

▷ which state that, for existing operating systems only, those systems are considered in the public domain and can be used by anyone on any system, whether of IBM or non-IBM manufacture.

Further, IBM's announcement of termination of support for the OS/MFT and OS/MVT operating systems makes Intel an excellent choice for users who wish to remain with proven control programs.

IBM documentation, tapes containing new releases, and systems engineering support are available to anyone for those current operating systems at fees commensurate with typical fees charged by IBM for similar services.

The March 1977 announcement of IBM's high-powered 3033 processor also brought with it a 35 percent reduction in purchase, lease, and rental prices for the IBM 370/158, the principal target of the Intel AS/5 processors. In addition, IBM's new 3033 processor implements several frequently used operating system functions within its firmware complement for increased operational efficiency. IBM has also made these firmware enhancements available for the 370/158, 370/158-3, 370/168, and 370/168-3 processors in the form of the 7730 System/370 Extended facility. In order to take advantage of the firmware enhancements, users must install the new MVS/SE enhancement program product that permits the MVS operating system to utilize the new improvements. While other plug-compatible processor manufacturers cannot, at this time, execute the MVS/SE enhancement, Intel claims that the Advanced Systems will be modified to allow execution of the upgrade program.

### COMPETITIVE POSITION

Aside from the declared IBM system targets, the Intel Advanced Systems' chief competition comes from the Omega/480 systems recently introduced by Control Data Corporation as direct replacements for IBM's 370/138 and 370/148 systems. For users not locked in to IBM hardware and software, there are numerous competing systems manufactured by vendors such as Honeywell, ▷

▷ coupled by means of an Intel 7058 Multisystem Unit. Memory sizes for the two CPUs need not be identical. Minimum main memory size for an MP system is 2 million bytes, while the maximum is 16 million bytes. Buffer storage capacity for the AS/5-1 MP is 16K bytes, and for the AS/5-3 MP, 32K bytes. The number of I/O channels available in every MP system is 14, including the spare channel in each CPU. The 7058 Multisystem Unit interconnects the two processing units and houses a configuration control panel which the operator can use to reconfigure the system.

### INPUT/OUTPUT CONTROL

The AS/4 and AS/5 Processing Units can include up to six I/O channels which can be configured as one or two byte multiplexer channels and four or five block multiplexer channels, plus one spare channel which can substitute for a failing byte or block multiplexer channel. In dual-processor configurations, up to 14 channels can be implemented.

Each byte multiplexer channel provides 256 nonshared subchannels or 8 shared and 120 nonshared subchannels. Each block multiplexer channel provides 16 shared and 480 nonshared subchannels and can accommodate a data rate of 1.5 million bytes per second.

### PERIPHERAL EQUIPMENT

The Intel systems can utilize all IBM System/360 and System/370 input/output and mass storage devices, as well as their plug-compatible counterparts from independent vendors.

### SOFTWARE

The AS systems offer complete functional compatibility with IBM System/360 and System/370 software. Intel intends to support users of current IBM system software by providing new releases of the software and supplying software support services for its customers.

### PRICING

Intel generally offers the Advanced Systems for purchase only, at the prices listed below. However, the vendor also offers a limited number of systems for lease under various leasing plans that can be arranged through the Intel marketing representatives.

All of the following maintenance prices include 24-hour, 7-day coverage. ■

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▷ Univac, Burroughs, and even CDC, competing with itself in terms of performance and throughput. Among the directly competitive systems are Honeywell's Level 66 Models 66/10, 66/20, and 66/40; the Burroughs B 6811 and B 6821; the Univac 1100/10, 90/60, and 90/80; and Control Data's Cyber 172 and Cyber 173. All offer roughly the same general throughput capabilities in the range of the IBM 370/148 and 370/158 systems and are competitively priced.

### USER REACTION

Although the Intel Advanced Systems were announced in October 1976, customer deliveries did not begin until April 1977. In view of this short installed life, Datapro elected not to conduct its usual formal survey of user experience. Instead, we conducted an informal survey consisting of short interviews that asked early users for their initial impressions of the systems. The five users we queried had a total of two AS/4's and three AS/5's installed. Four were running under OS/MVT and the fifth under VM/CMS.

All five users had substantially the same story to tell. They were highly impressed with the Intel systems. In all cases, installation was exceedingly simple, requiring only a few hours. The users stated that Intel's field support personnel are at least as good as IBM's if not superior in most instances, and that system availability ranged from 96 to better than 98 percent. The most important question about the Intel systems—the degree to which they are compatible with IBM's operating software—received a unanimous and unqualified response: "Totally."

Two users noted that the lower power consumption of the Advanced Systems had made a very noticeable difference in their computer room temperatures. These systems had replaced an IBM 370/155 and a 370/158, and they generated significantly less heat than the IBM systems.

Thus, early field experience with the Intel Advanced Systems indicates that these products are rapidly establishing themselves as viable, cost-effective alternatives to the IBM System/370 processors. □

## EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>PROCESSORS AND MAIN MEMORY</b>			
AS/4	Central Processing System; includes CPU, 1,048,576 bytes of main memory, 7 I/O channels, 8192 bytes of read-only storage, and one system console with a 180-cps serial printer	\$ 812,000	\$3,850
AS/4 MP	Dual-Processor AS/4 System; includes two CPU's, multisystem unit, 2,097,152 bytes of main memory, 14 I/O channels, and one system console with a 180-cps serial printer	1,939,250	7,700
AS/5-1	Central Processing System; includes CPU, 1,048,576 bytes of main memory, 7 I/O channels, 8192 bytes of read-only storage, and one system console with a 180-cps serial printer	1,072,000	4,000
AS/5-1 MP	Dual-Processor AS/5-1 System; includes two CPU's, multisystem unit, 2,097,152 bytes of main memory, 14 I/O channels, and one system console with a 180-cps serial printer	2,371,250	8,000
AS/5-3	Central Processing System; includes CPU, 1,048,576 bytes of main memory, 7 I/O channels, 8192 bytes of read-only storage, and one system console with a 180-cps serial printer	1,137,000	4,125
AS/5-3 MP	Dual-Processor AS/5-3 System; includes two CPU's, multisystem unit, 2,097,152 bytes of main memory, 14 I/O channels, and one system console with a 180-cps serial printer	2,499,250	8,250
<b>PROCESSOR OPTIONS AND MEMORY</b>			
	1,048,576 bytes of memory for AS/4 CPU's	110,000	280
	1,048,596 bytes of memory for AS/5 CPU's	83,000	280
	Multisystem Unit: for joining two uniprocessor systems into a dual-processor system	35,250	NC