NAS AS/66X0, AS/80X3, and AS/9XX0

CHARACTERISTICS

UPDATE: *National Advanced Systems (NAS) no longer markets the AS/66X0, AS/80X3, and AS/9XX0 Systems. These systems, marketed during the early 1980s, were replaced by the AS/VL and AS/XL lines of IBM plug-compatible mainframes. These two product lines have since been upgraded and merged. The combined series is now marketed as the AS/EX Series. For your convenience, we are reprinting the AS/66X0, AS/80X3, and AS/9XX0 CHARACTERISTICS section and the latest NAS hardware price list. For information and full pricing on NAS peripherals and operating systems software, please refer to the other NAS hardware reports appearing in this tab.*

MANUFACTURER: National Advanced Systems, 750 Central Expressway, P.O. Box 54996, Santa Clara, California 95054-0996. Telephone (408) 970-1000. Canadian address: NAS, Two Lansing Square, Suite 1101, Willowdale, Ontario M2J 4P8. Telephone (416) 494-4114.

MODELS: AS/6620, AS/6630, AS/6650, AS/6660, AS/8023, AS/8043, AS/8053, AS/8063, AS/8083, AS/9040, AS/9050, AS/9060, AS/9070, AS/9080.

DATA FORMATS

All processor data formats, instruction formats, and other architectural features evolved from IBM System/370 architecture. Implementation, however, may differ in ways that are software transparent. The processor-mode microcode loaded at Initial Microprogram Load (IML, or IMPL) time defines the predominant personality of a series and the range of operating systems it can support. The AS/66X0 Series can support VSE or 370 modes. The AS/80X3 and AS/9XX0 support 370 or 370 XA modes. All three modes differ in the instruction set they support (see INSTRUCTIONS), in their address translation algorithms and associated virtual memory paging logic and capacity (see MAIN MEMORY), and in their channel loading and channel addressing methods (see INPUT/OUTPUT CONTROL). The 370 mode, furthermore, 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 main storage area are altered to support Dynamic Address Translation and other system control functions; therefore, virtual storage-oriented operating systems must be used.

BASIC UNIT: Eight-bit byte, due to byte-oriented instructions. The basic word orientation of the instruction set, however, means there is a performance degradation if a byte is not on a word boundary. Each byte can represent one alphanumeric character, two BCD digits, or eight binary bits. Two consecutive bytes form a halfword of 16 bits, while four 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; one halfword (16 bits) or one word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: One word consisting of 24-bit fraction and 7-bit hexadecimal exponent, in short format; two words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in long format; or four words in extended precision format.

The National Advanced Systems (NAS) AS/66X0, AS/80X3, and AS/9XX0 Series consist of 14 IBM plug-compatible mainframes. These product lines have since been replaced by the NAS Alliance Series of mid-range and high-end mainframes.

MODELS: AS/6620, AS/6630, AS/6650, AS/6660, AS/8023, AS/8043, AS/8053, AS/8063, AS/8083, AS/9040, AS/9050, AS/9060, AS/9070, AS/9080.
CONFIGURATION: One or two Central Processing Units (CPUs) with 8 to 128 megabytes of main memory, 16 to 256 kilobytes of buffer storage per processor, and 5 to 48 I/O channels, depending on model.
COMPETITION: IBM 4341-2, 4341-12, 4361-5 (some configurations), 4381 Series, 308X Series, low-end 3090 Series, and Amdahl 580 Series.
PRICING: Purchase prices range from $255,000 to $3,878,000.

INSTRUCTIONS: Two, four, or six bytes in length, which usually specify zero, one, or two memory addresses, respectively. The basic System/370 mode in the AS/66X0 implements the 183 instructions of the System/370 Universal Instruction Set and adds instructions for handling extended precision (28 hexadecimal digits), floating-point operands on the AS/80X3 and AS/9XX0 Series. The instruction sets for the other two processor modes are somewhat modified forms of this core instruction set. ECPS:VSE mode implements 187 instructions which include the 12 instructions required to support VSE in native mode, and excludes others in the 370 set that are unnecessary for native-mode VSE operations. The 370 XA mode includes additional XA instructions, which substitute for and augment certain 370 instructions, and which are primarily needed to fully exploit the redesigned I/O subsystem. Some of the standard and optional microcode that assists in 370 mode, such as S/370 Extended Facility and ECPS:VM, also adds microcoded instructions to the base set, but these just build on the personality that is established by the processor-mode microcode.

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

MAIN MEMORY

Main memory modules are interleaved 2, 4, 8, or 16 ways (depending on model and configuration) to reduce intersystem contention in highly interactive environments. The entry-level AS/66X0 processors use a two-way interleaving technique that significantly reduces main storage contention and increases the aggregate data rate.

For the midrange AS/80X3 uniprocessor models, each eight-megabyte main storage extension comprises four ➤

NAS AS/66X0, AS/80X3, and AS/9XX0

TABLE 1. SYSTEM COMPARISON

MODEL	AS/6620	AS/6630	AS/6650	AS/6660	AS/8023
SYSTEM CHARACTERISTICS					
Date announced	Jan. 1983	Oct. 1982	Oct. 1982	Sep. 1984	April 1984
Date first delivered	July 1983	Oct. 1982	Nov. 1982	Dec. 1984	July 1984
Field upgradable to	AS/6630	AS/6650	AS/6660	—	AS/8043
Relative performance	Not specified	Not specified	Not specified	Not specified	Not specified
Number of processors	1	1	1	1	1
Cycle time, nanoseconds	60	60	50	43	35
Word size, bits	32	32	32	32	32
Operating systems	DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/SP V.1, OS/VS1, VM/370, VM/SP	DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/SP V.1, OS/VS1, VM/370, VM/SP	DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/SP V.1, OS/VS1, VM/370, VM/SP	DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/SP V.1, OS/VS1, VM/370, VM/SP	ACP, DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/SP V.1, OS/VS1, VM/370, VM/SP
MAIN MEMORY					
Type	64K-bit, 256K-bit NMOS	64K-bit, 256K-bit NMOS	64K-bit, 256K-bit NMOS	64K-bit, 256K-bit NMOS	64K-bit, 256K-bit NMOS
Minimum capacity, bytes	8M	8M	8M	8M	16M
Maximum capacity, bytes	16M	16M	16M	16M	64M
Increment size	4MB, 8MB	4MB, 8MB	4MB, 8MB	4MB, 8MB	8MB, 16MB
Cycle time, nanoseconds	420	420	350	301	360
BUFFER STORAGE					
Minimum capacity, bytes	64K	64K	64K	64K	32K
Maximum capacity, bytes	64K	64K	64K	64K	32K
Increment size	0	0	0	0	0
INPUT/OUTPUT CONTROL					
Number of channels:					
Byte multiplexer	1 or 2	1 or 2	1 or 2	1 or 2	0 to 6
Block multiplexer	4 or 6	4 or 6	4, 6, 8, or 10	4, 6, 8, or 10	6 to 24
Word	0	0	0	0	0
Other	0	0	0	0	0

banks, each bank having a two-megabyte capacity using an eight-byte data path. On the multiprocessor model, each processor's 16-megabyte main storage extension comprises four banks, each bank with a 4-megabyte capacity using an 8-byte data path. Main storage is interleaved (four-way on uniprocessor models and eight-way on multiprocessor models), four-bank, real storage using monolithic, integrated circuit memory elements. The four banks may be accessed independently.

In the AS/9XX0 Series, uniprocessor models implement 8-way, double-word interleaving, while the dual-processor models use 16-way, double-word interleaving. Each logical storage element of main storage is capable of supporting a memory access independent of other logical storage element activity.

STORAGE TYPE: See Table 1.

CAPACITY: See Table 1.

CYCLE TIME: See Table 1.

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 (0.5 million, 1 million, or 2 million bytes) and reconfigure the remaining memory for continuous operation.

The Store and Fetch Protection features, which guard against inadvertent overwriting or unauthorized reading of data, have an important role in circumscribing compatibility. Both XA and 370 modes implement key-oriented storage protection features. (Most IBM XA systems use 4K protect keys, while non-XA systems use 2K keys.) The NAS AS/80X3 and AS/9XX0 models support both key types, thus allowing for a greater range in the number of operating system versions that can run in standalone mode. In addition, the 370-Extended Facility feature provides protection for the first 512 bytes of storage for MVS/SE and MVS/SP Version 1 users. The PLPA segment protection feature protects portions of the MVS/SP Version 1 pageable length, packed area, and CMS for VM/HPO users. In Extended Architecture mode, any 4K page can be protected to enhance availability.

RESERVED STORAGE: Vendor does not supply information.

CENTRAL PROCESSORS

The basic implementation of all NAS Central Processing Units (CPUs) is fundamentally similar. Primary functional units are the Storage Control Unit (SCU), the Instruction Unit (IU), and the Execution Unit (EU). The SCU processes all fetch and store requests to main storage and translates real addresses to absolute addresses prior to accessing main storage. A high-speed buffer that reduces the apparent fetch time of main storage is included in the SCU. A Dynamic Address Translation Facility carries out all virtual-to-real address translations. The storage protection facility uses seven-bit-long keys to protect against unauthorized access or alteration of data during store or fetch operations.

The IU fetches and prepares instructions and operands for execution by the EU. It also tests for address exceptions prior to execution and buffers the current instruction stream and branch target stream. The IU comprises two sets of instruction buffers, one instruction register, three instruction queuing registers, an adder, three operand address registers, and a length incrementer for computing the end of addresses.

The EU is divided into two independently operable subunits: the floating-point execution unit (FEU) for executing floating-point instructions, and the general execution unit (GEU) for executing instructions other than those mentioned above.

NAS AS/66X0, AS/80X3, and AS/9XX0

TABLE 1. SYSTEM COMPARISON (Continued)

MODEL	AS/8043	AS/8053	AS/8063	AS/8083	AS/9040
SYSTEM CHARACTERISTICS					
Date announced	May 1983	May 1983	May 1983	April 1984	Sep. 1982 (9040) July 1982 (9140)
Date first delivered	May 1983	June 1983	Dec. 1983	Mar. 1985	Nov. 1982 (9040) July 1982 (9140)
Field upgradable to	AS/8053	AS/8063	AS/8083	Not applicable	9050 or 9140
Relative performance	1.5	2.2	2.5	4.6	1.0
Number of processors	1	1	1	2	1
Cycle time, nanoseconds	35	35	33	35	35
Word size, bits	32	32	32	32	32
Operating systems	ACP, DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/XA, MVS/SP V.1, OS/VS1, VM/SP, VM/370	ACP, DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/XA, MVS/SP V.1, OS/VS1, VM/SP, VM/370	ACP, DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/XA, MVS/SP V.1, OS/VS1, VM/SP, VM/370	ACP, DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/XA, MVS/SP V.1, OS/VS1, VM/SP, VM/370	ACP, DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/XA, MVS/SP V.1, TPF2, OS/VS1, VM/SP, VM/SP, VM/370, VM/XA
MAIN MEMORY					
Type	64K-bit, 256K-bit NMOS	64K-bit, 256K-bit NMOS	64K-bit, 256K-bit NMOS	64K-bit, 256K-bit NMOS	256K-bit NMOS
Minimum capacity, bytes	16M	16M	16M	32M	8M
Maximum capacity, bytes	64M	64M	64M	128M	64M
Increment size	8MB, 16MB	8MB, 16MB	8MB, 16MB	16MB, 32MB	8MB
Cycle time, nanoseconds	360	360	315	315	315
BUFFER STORAGE					
Minimum capacity, bytes	32K	64K	64K	64K/CPU	64K
Maximum capacity, bytes	32K	64K	64K	64K/CPU	64K
Increment size	0	0	0	0	0
INPUT/OUTPUT CONTROL					
Number of channels:					
Byte multiplexer	0 to 6	0 to 6	0 to 6	0 to 8	1 to 6
Block multiplexer	6 to 24	6 to 24	6 to 24	12 to 32	6 to 23
Word	0	0	0	0	0
Other	0	0	0	0	0

Aside from key differences in cycle times, data path widths, and cache buffer sizes, three CPU architectural features point to significant differences in performance range. The first is the word length used in the Reloadable Control Storage (RCS), the second is the degree of pipelining implemented, and the third is the presence or absence of a vector processor.

A longer RCS word length allows more complex operations to be performed in a single cycle than a shorter one would, and thus cuts back on the number of cycles needed to perform essential CPU tasks. The degree of pipelining affects how many instructions can be in various stages of execution at a given moment. The presence or absence of a vector processor can make a vast difference to programs that include sequences requiring the same, single operation to be performed over a large array of data.

The AS/66X0 Series uses a 72-bit RCS word length. Although the execution unit is not pipelined, it has an instruction prefetch facility that operates in parallel with instruction decoding and execution. This facility prefetches instructions, updates program counters, and provides associated units with instruction fields to be executed.

The AS/80X3 Series uses a 126-bit RCS word length. In addition to a dual prefetch, which handles branches more efficiently, it has a four-level pipeline that can simultaneously decode the instruction to obtain microinstruction and operand addresses, request the operand, load the operand and microword, and execute. This allows four instructions to be in process simultaneously.

The AS/9XX0 Series uses a 160-bit RCS word length. It has the same type of pipeline that the 80X3 Series has. In addition, the 90X0 units can attach an integral vector processor, which changes the series label to the 91X0 Series.

Whether a product line is oriented toward either 24-bit or 31-bit real memory addresses is a primary element of its identity. The AS/66X0 Series can only handle 24-bit addresses, and hence cannot run XA software. The other NAS processors can handle both types of addressing and a wider compatibility range.

The ECPS:VSE microcode, which establishes the native VSE operational mode on the AS/66X0 Series, has a single-level virtual memory addressing facility that is highly efficient for VSE systems. It excludes, however, the possibility of implementing other operating systems that need dual-level virtual memory addressing in order to handle multiple virtual storage areas or virtual machines. This operational mode allows addressing a total of up to 16 megabytes of real memory and 16 megabytes of virtual memory; it requires 2K storage protect keys. It is not available to AS/80X3 and AS/9XX0 Series systems.

The System/370 microcode, common to all the NAS processors, has a dual-level virtual memory addressing algorithm that is not only suited to MVS and VM systems but can also handle the simpler single-level VSE memory addressing. Of course, when VSE runs in 370 mode, the more elaborate addressing scheme means that it performs more slowly than when it runs in native VSE mode. The 370 mode, in its simplest form, can address up to 16 megabytes of real memory and 16 megabytes of virtual memory per user (given the proper operating system at the proper release level). An additional Extended Facility microcode assist allows addressing of more than 16 megabytes of real memory in 370 mode, but with no change to virtual memory limits. The Extended Facility for 370 mode should not be confused with the Extended Architecture microcode that provides the base for 370 XA mode.

The 370 XA (Extended Architecture) microcode expands and revises System/370 addressing to allow 31-bit addressing (up to 2 gigabytes). This mode also permits almost all

NAS AS/66X0, AS/80X3, and AS/9XX0

TABLE 1. SYSTEM COMPARISON (Continued)

MODEL	AS/9050	AS/9060	AS/9070	AS/9080
SYSTEM CHARACTERISTICS				
Date announced	Sep. 1982 (9050)	May 1982 (9060)	Jan. 1982 (9070)	May 1982 (9080)
Date first delivered	Sep. 1982 (9050)	Aug. 1982 (9060)	Sep. 1982 (9070)	Dec. 1982 (9080)
Field upgradable to	9060, 9070	9080	9080	—
Relative performance	1.25	1.55	2.25	2.8
Number of processors	1	1	2	2
Cycle time, nanoseconds	35	30	35	30
Word size, bits	32	32	32	32
Operating systems	ACP, DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/XA, MVS/SP V.1, TPF2, OS/VS1, VM/SP, VM/370, VM/XA	ACP, DOS/VS, DOS/VSE, MVS, MVS/SE, MVS/XA, MVS/SP V.1, TPF2, OS/VS1, VM/SP, VM/370, VM/XA	MVS/SE, MVS/SP V.1, MVS/XA, TPF2, VM/SP, VM/XA	MVS/SE, MVS/SP V.1, MVS/XA, TPF2, VM/SP, VM/XA
MAIN MEMORY				
Type	256K-bit NMOS	256K-bit NMOS	256K-bit NMOS	256K-bit NMOS
Minimum capacity, bytes	8M	16M	16M	16M
Maximum capacity, bytes	64M	64M	64M	64M
Increment size	8MB	8MB	16MB	16MB
Cycle time, nanoseconds	315	270	315	270
BUFFER STORAGE				
Minimum capacity, bytes	64K	256K	64K/CPU	256K/CPU
Maximum capacity, bytes	64K	256K	64K/CPU	256K/CPU
Increment size	0	0	0	0
INPUT/OUTPUT CONTROL				
Number of channels:				
Byte multiplexer	1 to 6	1 to 6	2 to 12	2 to 12
Block multiplexer	6 to 23	12 to 23	12 to 46	12 to 46
Word	0	0	0	0
Other	0	0	0	0

24-bit-based programs to run without requiring a change of processor mode. The change in both real and virtual memory ceilings requires XA operating systems to be fully exploited. Auxiliary microcode assists, such as the Extended Facility, allow operating systems originally designed for the 16-megabyte ceiling to handle larger memories (64 megabytes for MVS/SP V.1), but cannot change the virtual memory ceiling without affecting compatibility. XA mode runs on the AS/80X3 and AS/9XX0 Series but not on the AS/66X0.

SPECIAL FEATURES: The AS/66X0 and the AS/80X0 have the following special features in common with the AS/90X0. The System/370 architecture's *Timing Features* 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.

The *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. Direct Control is optional on all AS models.

The optional *Preferred Machine Assist* feature is a hardware/microcode assist that is used in conjunction with VM/HPO to provide a high-performance, "preferred" capability for one MVS/SP guest machine achieving near native performance.

The *Virtual Machine Assist* feature is a microcode enhancement that is designed to improve the performance of operating systems running under the control of VM/370. VMA handles system interrupts caused by privileged instruction execution and supervisor calls.

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

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

The *High-Speed Arithmetic* feature provides faster execution of fixed- and floating-point arithmetic instructions as well as certain packed decimal instructions on AS/66X0 Systems. Designed to improve system performance by up to 50 percent, this option is suited for engineering and scientific applications. The capability is standard on the larger AS/80X3 and AS/9XX0 product lines.

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 optional Channel-to-Channel Adapter, which is required on only one of the interconnected channels.

Dynamic Address Translation for calculating virtual memory addresses is standard on all AS processor models. Instruction retry, command retry, and channel retry are also standard on all models. The AS/80X3 and AS/9XX0 Series also feature enhanced I/O logout and a stage tracer for fault logging. On the AS/90X0, a Log-Out Analyzer speeds fault diagnosis and verification. In addition to the error-logging facility supported by the operating system, up to nine kilobytes of status information is logged to the console diskette whenever there is a CPU or channel malfunction. The status information can be recalled and analyzed by a field engineer without affecting normal system operation.

NAS AS/66X0, AS/80X3, and AS/9XX0

The AS/66X0, AS/80X3, and AS/9XX0 Series also have a remote support capability that allows information from a failing CPU to be accessed by a remote support site through a telecommunications link. This capability enables the remote support site to receive logout information from, and assume control of, the service processor of the failing CPU. The remote facility can then process the information to diagnose the problem.

PHYSICAL SPECIFICATIONS: NAS processor models' dimensions and weights follow:

	Width (in.)	Ht. (in.)	Depth (in.)	Wt. (lb.)
AS/66X0 Series:				
Models 6620, 6630	32	66	48	818
Models 6650, 6660	32	66	80	974
AS/80X3 Series:				
Models 8023, 8043, 8053, 8063	32	66	56	860
Model 8083	32	66	276	2,900
AS/9XX0 Series:				
Models 9040, 9050, 9060	94	66	179	9,607
Models 9070, 9080	156	66	181	16,683

The specifications given above are for the CPU and memory only. Additional floor space and loading requirements must be considered for the console display station(s), power distribution unit(s), and the input/output unit(s). Weights and dimensions of specific hardware configurations will vary with the amount of main memory, number of I/O channels, type and number of peripheral devices, and optional features that are added. Datapro suggests that the user work closely with the NAS customer engineer to ensure that sufficient floor space is available and that the floor's load rating is not exceeded.

CONFIGURATION RULES

The basic configuration for any of the single-processor AS Series complex includes a single CPU, a Main Storage Unit (MSU), an Input/Output Processor (IOP), a Power Distribution Unit (PDU), one or two system consoles, and a Multifunction Service Processor (MSP). The IOP handles all I/O operations to and from main storage and the I/O devices. The MSP is an independent processor that is linked to the CPU and controls the console display. The MSP also enables communication between the computer operator and the central processor for system maintenance and operator command functions. In addition to these basic components, system software usually requires disk storage, a magnetic tape drive, a printer, and sometimes either a card reader or a device emulating a card reader.

For multiprocessor configurations (Models AS/8083, AS/9170, AS/9180, AS/9070, and AS/9080), each complex consists of two independent processors that share a common main memory, and the appropriate number of IOPs, MSUs, PDUs, system consoles, and MSPs. All AS multiprocessor models are capable of running in a single-system mode or a partitioned two-system mode. If one processor fails, the system can be reconfigured as a uniprocessor system through the operator console or the operating system commands. A Channel Cross-Call feature allows control of input/output operations to be switched to the available processor.

INPUT/OUTPUT CONTROL

All I/O transfers that occur in VSE mode (AS/66X0) and 370 mode (AS/66X0, AS/80X3, AS/9XX0) employ cycle stealing to gain control of the CPU execution unit and perform I/O operations. This is because a high proportion of the logic needed for I/O resides in CPU microcode and programs, and relatively little in the channel control units or subsystem controllers. In the 370 XA mode (AS/80X3, AS/9XX0), the amount of this cycle-stealing activity has been greatly reduced because many of the operations performed by the central processor in other modes are performed in the I/O processor in 370 XA mode. There are other significant differences in the way that I/O channels are handled in the VSE, System/370, and 370 XA operational modes.

In VSE mode, the same single-level internal mapping function for address translation is used for both CPU and channels, and the same set of virtual addresses is used to address the translation facility. The CPU and channels do have different lookaside buffers to speed up address translation.

In System/370 mode, even though the I/O operation is largely handled by the CPU execution unit, the channels do not use the dual-level dynamic address translation facility used by CPU programs. Therefore, all virtual storage addresses have to be translated to real addresses before execution. System/370 mode is capable of addressing sets of up to 16 channels per CPU (two channel groups), but in multiprocessor configurations, a specific channel is always seen as part of one set or the other.

In 370 XA mode, the dynamic channel subsystem is activated and controlled by the CPU, but otherwise processes I/O requests with a great deal of independence. XA mode is inherently capable of handling up to 256 independent channels, which are not organized into sets related to a specific processor in multiprocessor configurations. This mode can potentially handle up to 4,096 devices concurrently, with eight paths to each device, although on these product lines, a maximum of four paths per device and 48 channels (Models AS/9070 and AS/9080) have been implemented.

The operator communicates with the system via the main console, which also serves as a diagnostic tool for maintenance purposes. The AS/80X3 and AS/9XX0 Systems include 2 seven-color display units, as well as a service processor console (two 20-inch, four-color display units) and two diskette drives. Additionally, a remote diagnostic capability and up to four service processor consoles are provided as standard.

The AS/66X0 Series basic processors have a single IOP and five integrated I/O channels: one or two byte multiplexer channels and three or four block multiplexer channels. The basic configuration is expandable to eight channels, using a maximum of two byte multiplexer and six block multiplexer channels.

The basic AS/80X3 Series processors have one IOP per CPU, with each IOP controlling eight channels. One or two channels can be byte multiplexer or all eight can be block multiplexer channels. This set is expandable to 24 channels; 0 to 6 can be byte multiplexer and the rest block multiplexer channels on single-processor models. The

NAS AS/66X0, AS/80X3, and AS/9XX0

dual-processor model is expandable to 32 channels; 0 to 8 can be byte multiplexer and the rest block multiplexer channels.

AS/90X0 and AS/91X0 Series models have one microprogram-controlled IOP per CPU, with each CPU attaching up to 24 I/O channels: one to six byte multiplexer channels and the remainder block multiplexer channels. The dual-processor model thus has a maximum of 48 I/O channels: 2 to 8 can be byte multiplexer and the remaining can be block multiplexer channels.

Expansion of channels on the AS/80X3 and /9XX0 Series processors is done through the extended channel group, which provides an additional I/O Processor with channels. The AS/66X0 System has a separate channel group that allows expansion up to 12 channels.

Datastreaming support is standard on all Advanced System models. Each I/O channel implements the standard IBM interface and is provided with 256 Unit Control Words. All systems support block multiplexer channels that can operate at up to three megabytes per second, although differences in the aggregate data rate supported by individual models may mean that certain block multiplexer channels will have to be implemented at slower speeds. The data transfer rate for byte multiplexer channels is 100 kilobytes per second for all processor models, except the 6620 and 6630, which use 80-kilobyte-per-second channels. The aggregate data rate for the combined maximum channels on a system varies, as follows:

- 13 megabytes per second: Models AS/6620 and AS/6630.
- 16 megabytes per second: Models AS/6650 and AS/6660.
- 37.3 megabytes per second: Models AS/8023, AS/8043, and AS/8053 (370 mode).
- 40 megabytes per second: Models AS/8063, AS/9X40, and AS/9X50 (370 mode).
- 48 megabytes per second: Model AS/9X60 (370 mode).
- 55.9 megabytes per second: Models AS/8023, AS/8043, and AS/8053 (XA mode).
- 60 megabytes per second: Models AS/8063, AS/9X40, and AS/9X50 (XA mode).
- 72 megabytes per second: Model AS/9X60 (XA mode).
- 80 megabytes per second: Models AS/9X70 (370 mode) and AS/8083 (either mode).
- 96 megabytes per second: Model AS/9X80 (370 mode).
- 120 megabytes per second: Model AS/9X70 (XA mode).
- 144 megabytes per second: Model AS/9X80 (XA mode).

MASS STORAGE

Please refer to NAS AS/XL and AS/VL Series reports in this tab and the "NAS 7380 Disk Storage Subsystem" report in Volume 2 for information about disk products.

INPUT/OUTPUT UNITS

Please refer to NAS AS/XL and AS/VL Series reports in this tab and the "NAS Tape Subsystem" report in Volume 2 for information about disk products.

TERMINALS

Although they are not available from the vendor, any IBM or IBM plug- compatible terminal may be used to support AS Series processors.

SOFTWARE

All AS Series processors are IBM plug compatible and can run any IBM-compatible software, providing the processor implements the operating mode (ECPS:VSE, S/370, or 370 XA) required by that software. For detailed information about the latest IBM software, please refer to the IBM 3090, 4381, and 9370 reports in this tab.

PRICING AND SUPPORT

For your convenience, we have listed the last available list pricing for AS mainframes. Please refer to the NAS AS/VL and AS/XL reports under this tab for the latest peripheral pricing and support policy.

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint.* ($)
PROCESSOR COMPLEXES			
AS/6000 Series:			
AS/6620	Processor with 8 megabytes of main memory, 64K bytes of buffer storage, 5 I/O channels, and a standalone operator console with color CRT	255,000	805
AS/6630	Processor with 8 megabytes of main memory, 64K bytes of buffer storage, 5 I/O channels, and a standalone operator console with color CRT	341,500	891
AS/6650	Processor with 8 megabytes of main memory, 64K bytes of buffer storage, 5 I/O channels, and a standalone operator console with color CRT	417,500	1,052
AS/6660	Processor with 8 megabytes of main memory, 64K bytes of buffer storage, 5 I/O channels, and a standalone operator console with color CRT	475,000	1,215

**Complete service for 24 hours/day, 7 days/week.*
NA—Not available.

NAS AS/66X0, AS/80X3, and AS/9XX0

		Purchase Price ($)	Monthly Maint.* ($)
AS/8000 Series:			
AS/8023	Processor with 16 megabytes of main memory, 64K bytes of buffer storage, 8 I/O channels, a single power distribution unit, and color CRT	475,000	2,433
AS/8043	Processor with 16 megabytes of main memory, 64K bytes of buffer storage, 8 I/O channels, a single power distribution unit, and color CRT	698,300	3,305
AS/8053	Processor with 16 megabytes of main memory, 64K bytes of buffer storage, 8 I/O channels, a single power distribution unit, and color CRT	939,500	3,410
AS/8063	Processor with 16 megabytes of main memory, 64K bytes of buffer storage, 8 I/O channels, a single power distribution unit, and color CRT	1,104,600	3,959
AS/8083	Dual processor with 32 megabytes of main memory, 64K bytes of buffer storage per processor, 16 I/O channels, a single power distribution unit, and color CRT	2,271,900	5,958
AS/9000 Series:			
AS/9040	Processor with 16 megabytes of main memory; 64K bytes of buffer storage; I/O processor; 16 I/O channels; and service processor console with dual 4-color CRTs, keyboards, and 2 diskette drives	1,602,000	4,942
AS/9050	Processor with 16 megabytes of main memory; 64K bytes of buffer storage; I/O processor; 16 I/O channels; and service processor console with dual 4-color CRTs, keyboards, and 2 diskette drives	2,012,000	5,706
AS/9060	Processor with 16 megabytes of main memory; 256K bytes of buffer storage; I/O processor; 16 I/O channels; and service processor console with dual 4-color CRTs, keyboards, and 2 diskette drives	2,156,000	5,865
AS/9070	Dual processors with 16 megabytes of main memory; 64K bytes of buffer storage per processor; 2 I/O processors; 16 I/O channels; and 2 service processor consoles with dual 4-color CRTs, keyboards, and 2 diskette drives	3,041,000	7,714
AS/9080	Dual processors with 16 megabytes of main memory; 256K bytes of buffer storage per processor; 2 I/O processors; 16 I/O channels; and 2 service processor consoles with dual 4-color CRTs, keyboards, and 2 diskette drives	3,878,000	9,644
PROCESSOR UPGRADES			
AS/6600 Series			
	AS/6620 to AS/6630 Upgrade	95,000	86
	AS/6630 to AS/6650 Upgrade	115,000	161
	AS/6630 to AS/6660 Upgrade	172,000	324
	AS/6650 to AS/6660 Upgrade	57,500	163
AS/8000 Series			
	AS/8023 to AS/8043 Upgrade	223,200	872
	AS/8043 to AS/8053 Upgrade	241,200	105
	AS/8053 to AS/8063 Upgrade	165,100	549
	AS/8063 to AS/8083 Upgrade	991,000	1,999
	"S" Upgrade (for AS/8023, /8043, /8053)	50,000	NA
AS/9000 Series			
	AS/9040 to AS/9050 Upgrade	392,000	764
	AS/9050 to AS/9060 Upgrade	144,000	159
	AS/9050 to AS/9070 Upgrade	1,152,000	2,008
	AS/9060 to AS/9080 Upgrade	1,845,000	3,779
	AS/9070 to AS/9080 Upgrade	837,000	1,930

**Complete service for 24 hours/day, 7 days/week.*
NA—Not available. ■