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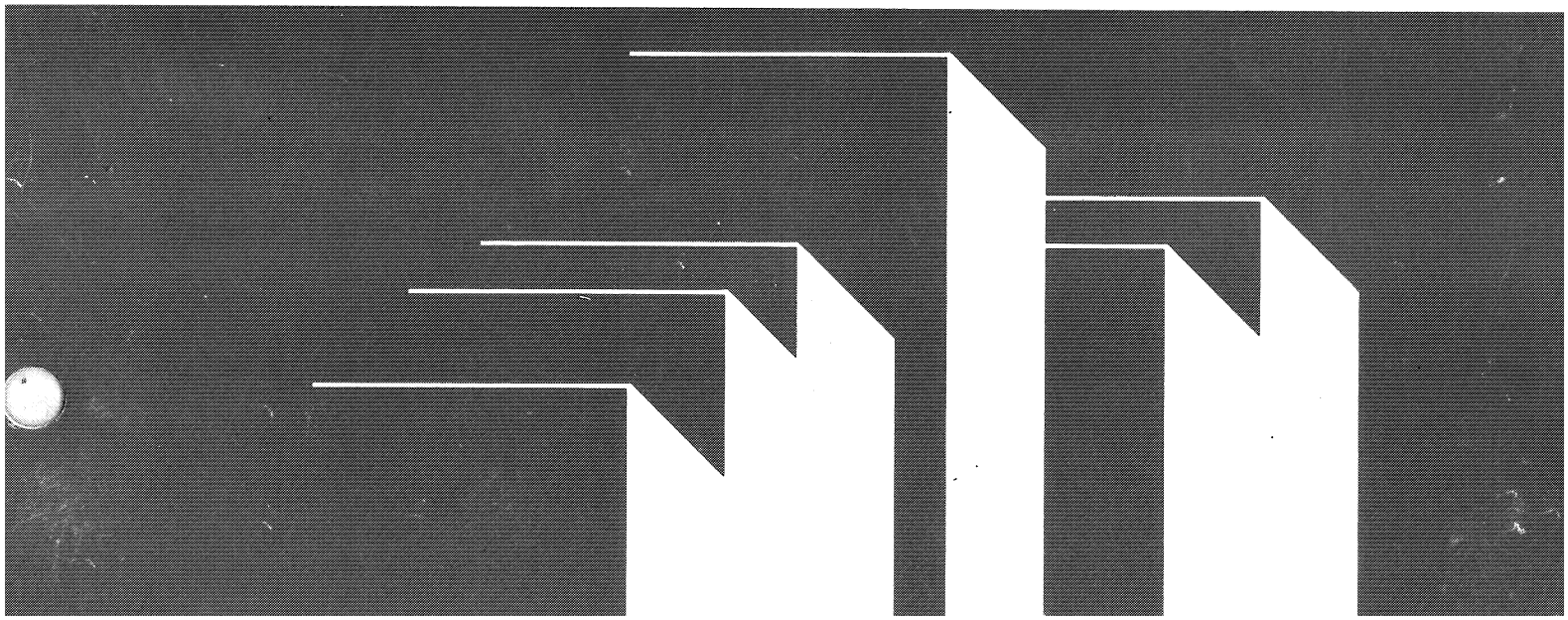
IBM System/370

System Summary: Processors

IBM



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Seventeenth Edition (October 1985)

This major revision obsoletes GA22-7001-15 and Technical Newsletter GN22-0681. A description of the vector facility of the IBM 3090 Processor Complex has been added. This major revision also includes the following:

- "Chapter 1. System/370 Introduction and Basic Structure" incorporates the information in Sections 1 and 2 of the Sixteenth Edition.
- "Chapter 2. System/370 Models" incorporates the information in Section 5 of the Sixteenth Edition.
- "Section 4. Programming Systems" in the Sixteenth Edition has been removed.
- "Chapter 3. System/370 Features" incorporates information formerly described in Section 3 of the Sixteenth Edition.

This revision should be read in its entirety because the format has changed and material has been removed.

Changes are made periodically to the information herein; before using this publication in connection with the operation of IBM equipment, refer to the latest *IBM System/370 and 4300 Processors Bibliography*, GC20-0001, for the editions that are applicable and current.

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Preface

This publication provides basic information about IBM System/370, including system concepts, individual models, and features as follows:

- Chapter 1 introduces System/370 and describes its basic structure.
- Chapter 2 describes the various models and processor complexes as follows:
  - A short introduction
  - A list of components in the complete system followed by a description of components in the System/370 model or processor complex
  - A list of standard and optional features
  - A list of supporting programs
- Chapter 3 describes the features of System/370.
- Appendix A describes abbreviations and terms that do not appear in the *IBM Vocabulary for Data Processing, Telecommunications, and Office Systems*, GC20-1699.

Where it is important in this publication to point out that the arithmetic, logical, and control functions of a processor are directly affected during an operation, the term *CPU* is used instead of *processor* because a processor may physically contain a CPU and storage, and sometimes channels. Also, where it is important to refer only to storage that is directly addressable, the term *main storage* is used instead of *processor storage* because in certain cases not all of processor storage is directly addressable.

A basic knowledge of data processing systems, as described in the *Introduction to IBM Data Processing Systems,* GC20-1684, is assumed.

More detailed information about System/370 is available in the *IBM System/370 Principles of Operation*, GA22-7000, and the *IBM System/370 Extended Architecture Principles of Operation*, SA22-7085.

This publication is a companion to the *IBM Input/Output Device Summary*, GA32-0039, which describes input/output devices for local operation with System/370, and to the *IBM Data Communication Device Summary*, GA27-3185, which describes data communication devices for remote operation with System/370.

All three publications can be ordered together under order number GBOF-4550, or separately as follows:

- *IBM System/370 System Summary: Processors*, GA22-7001
- *IBM Data Communication Device Summary*, GA27-3185
- *IBM Input/Output Device Summary*, GA32-0039

Information about publications describing the IBM 4300 Processors is available in the *IBM System/370 and 4300 Processors Bibliography*, GC20-0001.

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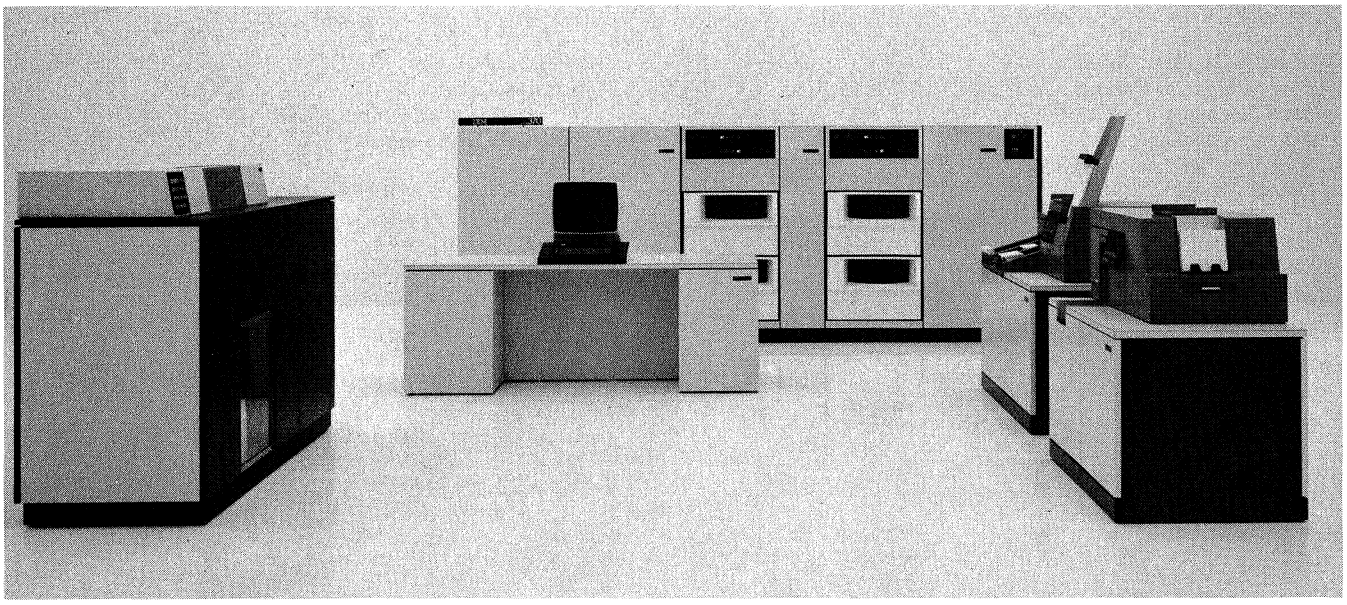
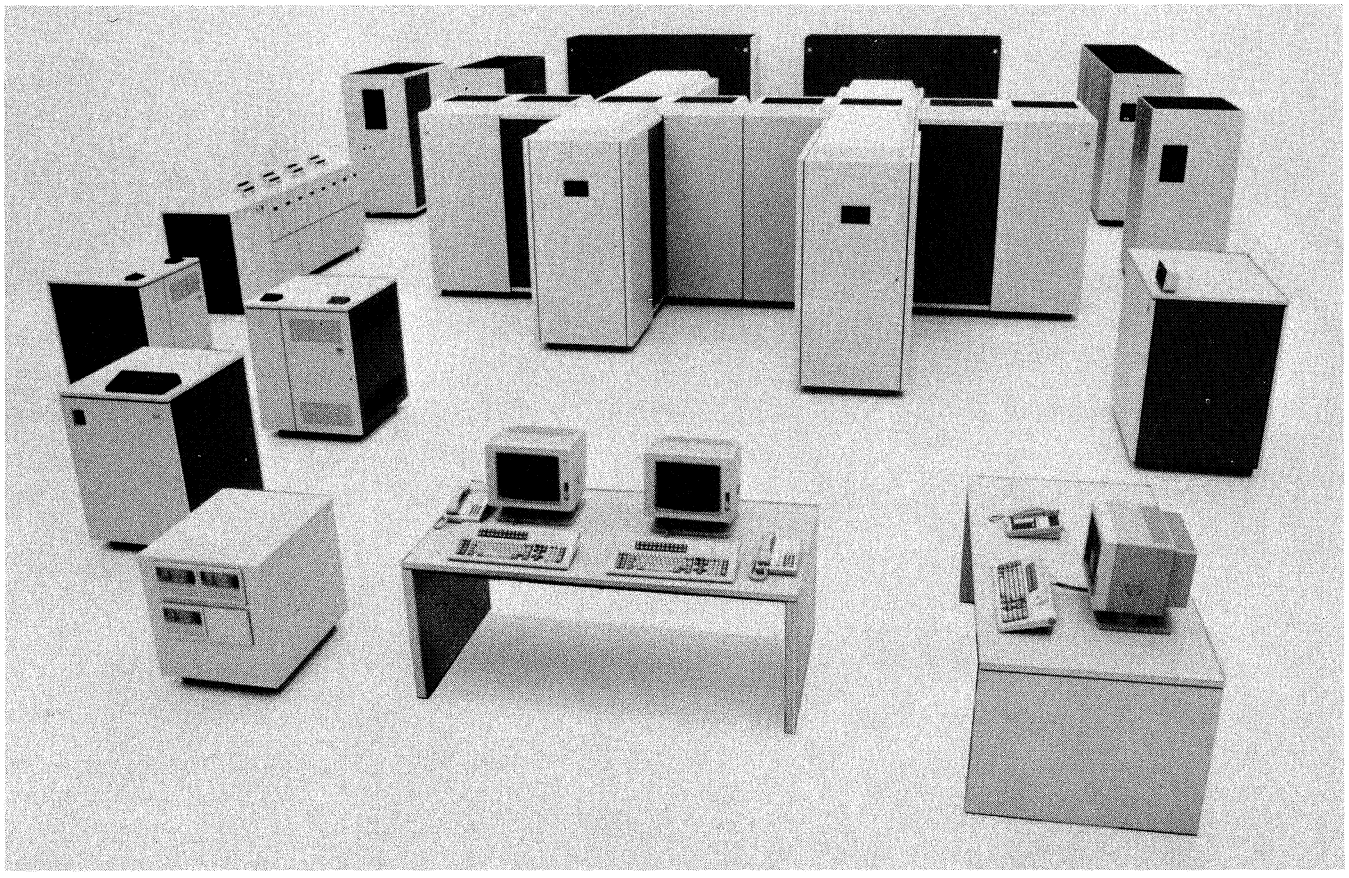


System/370 Model 125 with Other Devices (Design Model)



IBM 3090 Processor Complex Model 400 with Other Devices (Design Model)

Chapter 1. System/370 Introduction and Basic Structure

IBM System/370 (frontispiece) is a family of upward-compatible general-purpose computers that provides a wide range of performance levels and processor storage capacities for a variety of data processing applications. The individual computers of this family are referred to as models (for example, System/370 Model 158) or processor complexes (for example, 3081 Processor Complex) and each System/370 data processing system includes the System/370 model or processor complex and locally attached input/output devices.

Logically, System/370 consists of at least one central processing unit (CPU), main storage, operator facilities, channels, and input/output devices that are generally connected to the channels by means of control units.

The references to and physical grouping of these logical parts may vary. In some System/370 models, the central processing unit (CPU) is referred to as a *central processor* (CP) and main storage is referred to as *processor storage* or *central storage*. In addition, the CPU and main storage may be packaged together as a *processing unit*; or the CPU, main storage, and channels may be packaged together as a *processor* or *processor unit*. When a processor or processor unit is grouped with the appropriate operator facilities and power and cooling units, it is referred to as a *processor complex*. For convenience in discussion, a processor complex is referred to as a *model*. Figure 1-1 shows the logical organization of a representative System/370 model. System/370 offers:

- Fast internal performance
- A choice of processor storage capacities
- A choice of channel capabilities
- Virtual storage capability
- Data communication capability with compatible remote input/output devices of other systems
- Integrated emulation of other IBM systems (depending on System/370 model or processor complex)
- Reliability, availability, and serviceability (RAS)
- On certain processor complexes, two architectural modes of operation: System/370 (S/370) mode and System/370 extended architecture (370-XA) mode.

Data Formats

The system transmits data in multiples of eight bits. Each eight-bit unit of data is called a *byte*, the basic building block of all formats in System/370. In CPU's and buffers, a ninth bit, the *parity* or *check* bit, is transmitted with each byte and carries odd parity in the byte. The parity bit cannot be affected by the program; its only purpose is to cause an interruption condition when a parity error is detected. In this manual, references to data exclude the mention of the associated parity bits.

A *field* is composed of one or more bytes. The *halfword, word,* and *doubleword* are fields of consecutive bytes; a halfword has two bytes, a word has four bytes, and a doubleword has eight bytes. These fields make up the basic fixed-length data formats (Figure 1-2).

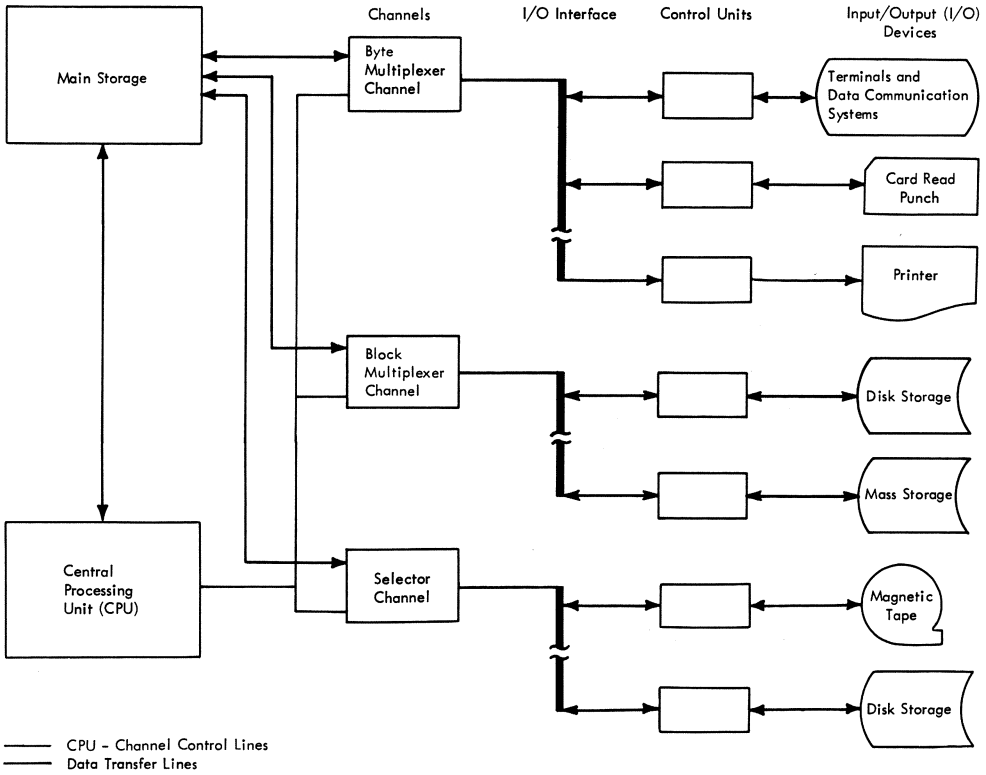


Figure 1-1. Organization of a Representative System/370 Model

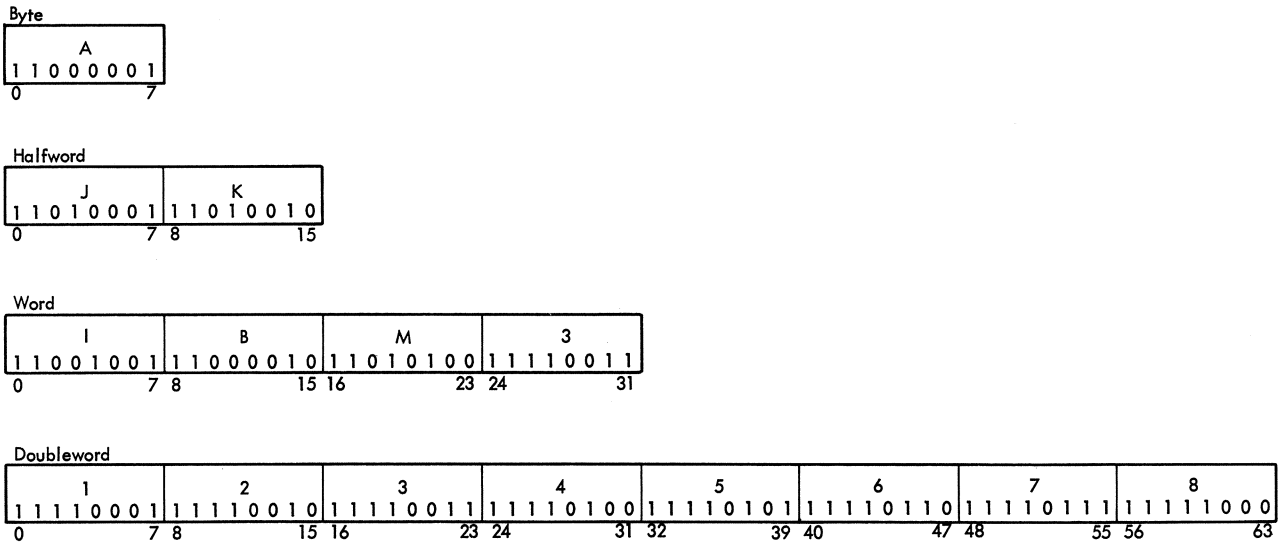


Figure 1-2. Basic Fixed-Length Data Formats (with EBCDIC-Coded Data)

Data formats are either fixed-length or variable-length. During processing, the field length is either implied by the operation to be performed, or it is stated explicitly as part of the instruction.

Data Representation

In System/370, data (whether numeric, alphabetic, or alphameric) is processed in multiples of an eight-bit byte. The data may be in binary form, or it may be in a binary *code*. Coding permits data to be represented by characters (for example, 1, 2, A, B, and *) on devices such as card readers, visual display units, and printers. These devices are code-dependent; that is, their operation depends on the code used to represent the characters.

The eight-bit byte provides for as many as 256 characters, which allows for future code expansion and permits System/370 to accept most present and future codes. The character code used internally in System/370 processing is the extended binary-coded-decimal interchange code (EBCDIC). The bit positions in EBCDIC (Figure 1-3) are numbered the same as those of bytes (left to right, 0-7).

Main Storage

Main storage provides the system with directly addressable fast-access storage of data. Both data and programs must be loaded into main storage from input devices before they can be processed. Some low-address locations are reserved for special purposes.

In System/370, the physical packaging of main storage is referred to as *processor storage* or central storage, but in certain instances not all of processor storage or central storage is directly addressable. Therefore, where it is important to refer only to directly addressable storage, the term *main storage* is used.

Addressing

Byte locations in main storage are consecutively numbered starting with 0; each number is the address of a different byte location. A group of bytes in storage is addressed by the lowest-numbered byte location of the group. The number of bytes in the group is either implied by the instruction format or explicitly defined by the instruction itself. The addressing arrangement uses a 24-bit binary address (26-bit real addressing on some models), which gives System/370 the capability of addressing as many as 16,777,216 bytes of storage while operating in System/370 (S/370) mode, and a 31-bit address for addressing as many as 2,147,483,648 bytes of storage while operating in System/370 extended architecture (370-XA) mode.

Data Positioning

Restrictions on data positioning in main storage depend on several factors, such as whether the data field is variable or fixed length. A variable-length field may be positioned on any byte boundary in main storage, but a fixed-length field (such as a halfword, word, or doubleword) may or may not, depending on the type of reference made to the data field.

The *byte-oriented operand* feature allows some fixed-length-field storage operands to be positioned on byte boundaries rather than only on *integral boundaries* without causing a specification exception and a program interruption. For optimum performance, however, these operands should be located on integral boundaries. A boundary is integral for a unit of data when its main storage address is a multiple of that unit's length in bytes. For example, halfwords (two bytes) have main storage addresses that are multiples of 2. Figure 1-4 shows integral boundaries for the common units of data, with main storage addresses as four-digit decimal numbers (0000, 0001, 0002, etc.) rather than as the 24-, 26- or 31-digit binary numbers that are actually used. Sequential halfword addresses are shown in Figure 1-4 as 0000, 0002, 0004, etc. Words (four bytes) have addresses that are multiples of 4 (shown in Figure 1-4 as 0000, 0004, 0008, etc.), and doublewords (eight bytes) have addresses that are multiples of 8 (shown in Figure 1-4 as 0000, 0008, etc.).

The byte-oriented operand feature applies to fixed-point, floating- point, and logical operands. It does not apply to instruction addresses, privileged instructions, or channel command words (CCWs).

Performance Factors

Processor storage or central storage, each of which contains main storage, provides a variety of storage sizes, permitting the system to be tailored to suit the individual needs of the user. Processor storage, or central storage, differs in sizes, access widths, cycle times, and type of interleaving (2-way or 4-way) depending on the processor installed. Depending on model, processor storage or central storage capacities range from 64K (65,536) bytes to 128M (134,217,728)

bytes. (In this manual, 1K = 1,024, and 1M = 1,048,576).

Storage Access Width is the number of bytes transferred to or from main storage in each access. As access width increases, the quantity of data that may be transferred per unit of time increases. The width, which is model-dependent, ranges from 2 to 16 bytes.

Storage Cycle Time is a measure of storage speed and is defined as the length of time that main storage is busy whenever a reference is made to it. Generally, the shorter the cycle time, the greater the number of operations that can be performed in any time interval.

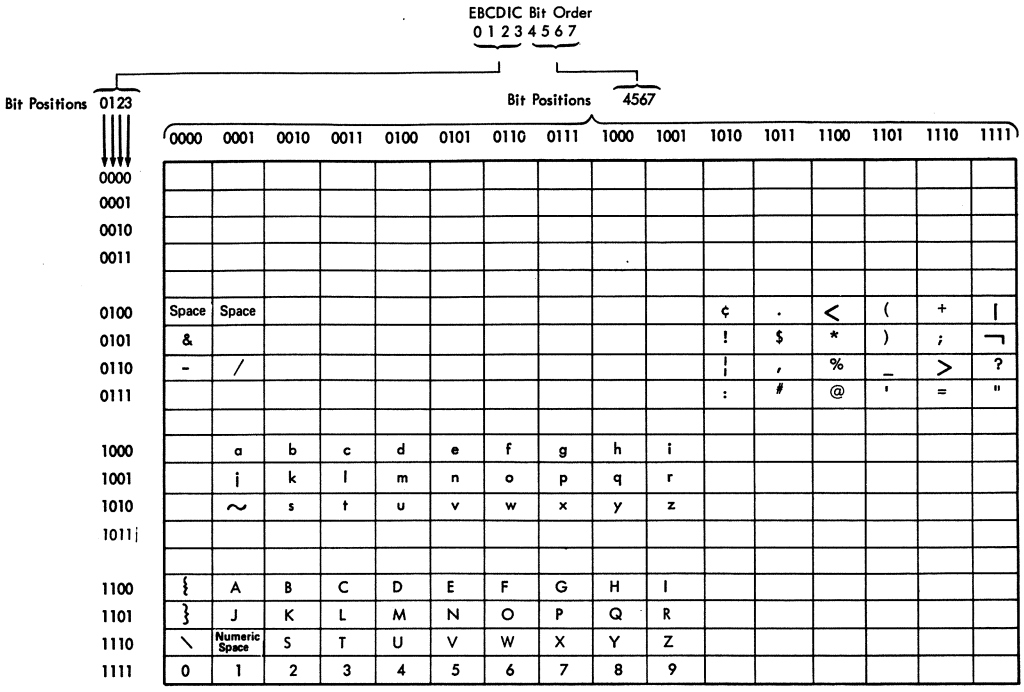


Figure 1-3. EBCDIC Character Codes (Excluding Control Characters)

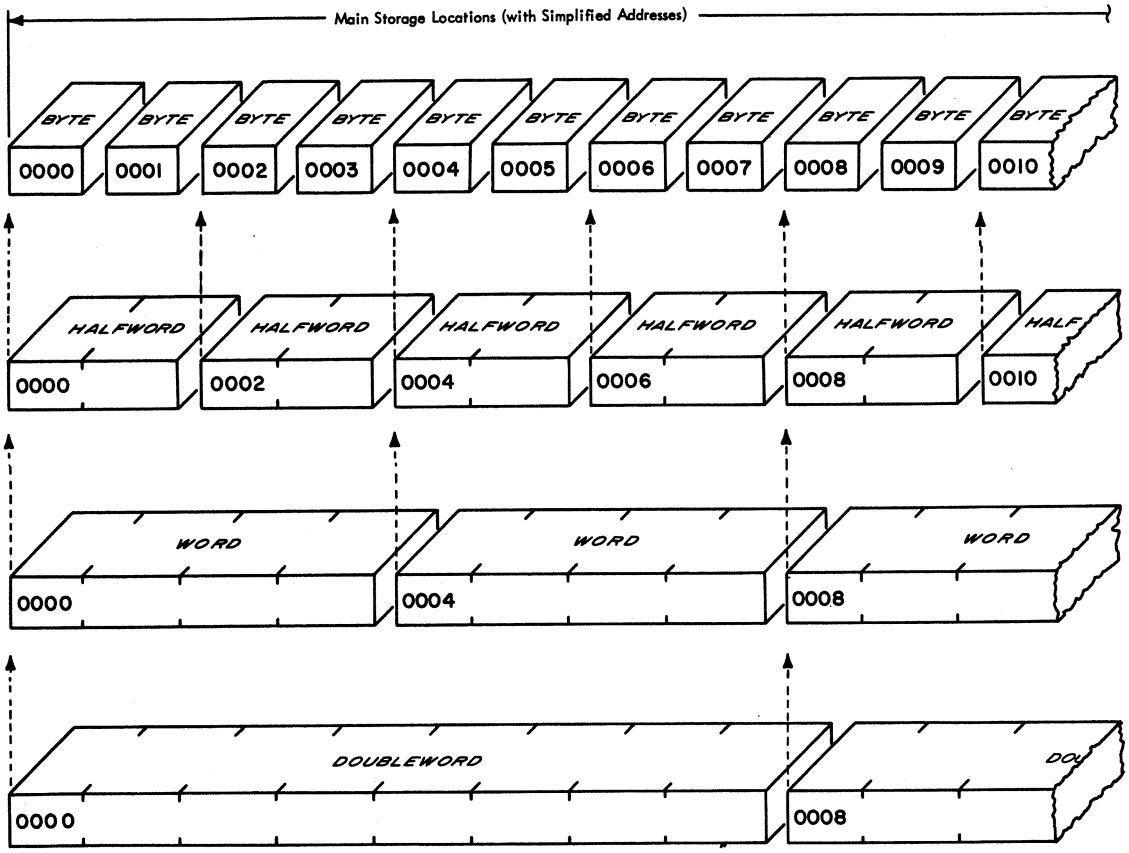


Figure 1-4. Representative Integral Boundaries for Halfwords, Words, and Doublewords in Main Storage

Storage Interleaving, a model-dependent capability, increases the number of main-storage accesses started in a storage cycle, thereby significantly increasing the amount of data accessed per unit of time.

High-Speed Buffer Storage

High-speed buffer storage, a model-dependent feature, dynamically stores currently used portions of processor storage for faster accessing of data. High-speed buffer storage satisfies many requests for storage, making the effective storage access time much less than the actual processor-storage cycle time.

Central Processing Unit

The central processing unit (CPU) (or central processor in some models) is the controlling center of System/370. It provides facilities for:

- Addressing main storage
- Fetching and storing data
- Arithmetic and logical processing of data
- Executing instructions in a desired sequence
- Initiating communication between main storage and input/output (I/O) devices.

Three types of programmable registers are provided by the processing unit: general, floating-point, and control. The 16 *general registers* and 4 *floating-point registers* are accessible to the problem programmer and are capable of receiving data, holding it, and permitting it to be operated on. The general registers are used primarily for fixed-point, logical, and addressing operations. The floating-point registers are used only for floating-point arithmetic. The control registers provide for the handling of information used to control some system operations. These registers are accessible to the control program by way of specific instructions. The number of registers and register positions available with any system model depends on which installed functions require control registers.

Arithmetic and Logical Operations

The arithmetic and logical operations fall into the following four classes:

- Decimal arithmetic
- Binary integer arithmetic
- Floating-point arithmetic
- Logical operations

These classes differ in the data formats and field lengths used, the registers involved, and the operations provided.

Decimal Arithmetic

Decimal arithmetic, used principally for commercial applications, is performed on signed decimal data. Generally, decimal data entering and leaving the system by means of devices such as card reader-punches and printers is in *zoned* format (Figure 1-5). But for processing and for storage in direct-access and magnetic-tape devices, decimal data is in *packed* format (Figure 1-6). Packing fits two decimal digits (or one digit and sign) into one byte. Because only four binary digits are needed to express one decimal digit, packing permits more efficient handling of decimal data.

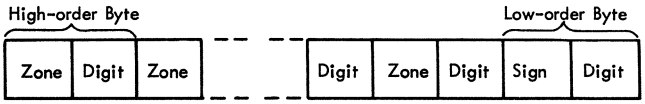


Figure 1-5. Zoned Decimal Number Format

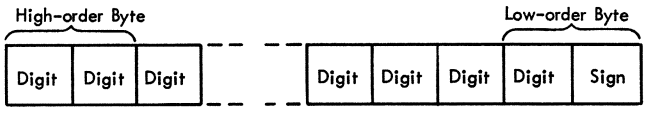


Figure 1-6. Packed Decimal Number Format

Packed data is taken from main storage, processed, and returned to storage without the data passing through any general registers; this is called *storage-to-storage* processing. The decimal field length, specified by the instruction, can be expanded to as many as 31 digits plus sign, packed in up to and including 16 bytes.

Fixed-Point Arithmetic

Fixed-point arithmetic is used to perform arithmetic operations on both data and storage addresses.

The fixed-point binary word (Figure 1-7), the basic arithmetic operand in System/370, is a 32-bit signed integer (a 31-bit integer with a high-order sign bit). Halfword operands can be specified in many operations where a fullword is not needed, thus improving both performance and use of storage.

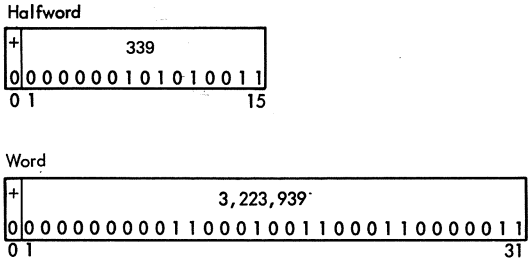


Figure 1-7. Fixed-Point Number Formats (with Signed Binary Data)

The 16 general registers, each four bytes (32 bits) wide, are used for fixed-point operations. For fixed-point product and dividend precision, two adjacent registers can be coupled, effectively doubling the register width.

Floating-Point Arithmetic

Floating-point arithmetic, used primarily in scientific applications, greatly increases the speed, precision, and efficiency of computations. In System/370, this form of numeric representation can express positive or negative decimal values from about 10^{-78} to about 10^{76}.

Floating-point numbers may be short (24-bit fractions, with about seven-decimal-place precision), long (56-bit fractions, with about 17-decimal-place precision), or extended (112-bit fractions, with about 34-decimal-place precision). Floating-point fractions are made up of hexadecimal (base 16) digits, each consisting of four binary digits and having equivalent decimal (base 10) values of 0-15. The short format (Figure 1-8) usually reduces execution times and increases the number of operands that can be stored, the long format (Figure 1-9) provides greater precision, and the extended format (Figure 1-10) provides about twice the precision of the long format. (See "Extended-Precision Floating-Point" in Chapter 3.)

Four floating-point registers, each eight bytes wide, are provided. The availability of these registers eliminates much fetching and storing of intermediate results. The 16 general registers are also used, primarily for indexing and address arithmetic.

The vector facility provides performance gains when working with floating-point values in engineering and scientific applications that use vectors.

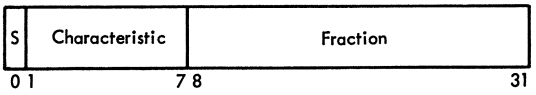


Figure 1-8. Short Floating-Point Number Format

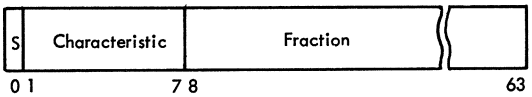


Figure 1-9. Long Floating-Point Number Format

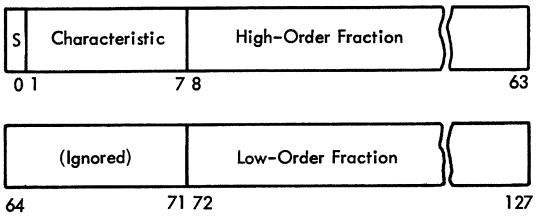


Figure 1-10. Extended Floating-Point Number Format

Logical Operations

The logical operations provide System/370 with the ability to manipulate logical quantities. The manipulations include: comparing, testing, translating (character for character), editing (sign and punctuation control), and moving logical data. The data may have either a fixed- or variable-length format (Figure 1-11 and 1-12). Fixed-length data, processed through the general registers, may be one, four, or eight bytes long; variable-length data, processed storage to storage, can extend to 256 bytes.

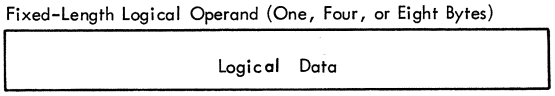


Figure 1-11. Fixed-Length Logical Format

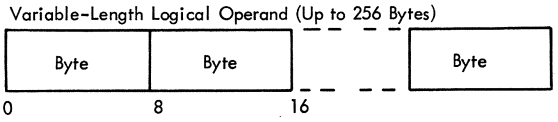


Figure 1-12. Variable-Length Logical Format

Instruction Formats

Main storage addressing and the execution of processing programs are directed by the CPU. The instructions that make up these programs may be of several different formats, identified by the format codes RR, RRE, RX, RS, S, SI, SS, and SSE (Figure 1-13) as follows:

- RR denotes a register-to-register operation. The operands are in general registers, and the result replaces the first operand.
- RRE denotes a register-and-register operation having an extended op-code field.
- RX denotes a register-and-indexed-storage operation. The first operand is in a general register, and the second operand is in a main storage location. This format includes a quantity for indexing the main storage address; the quantity is contained within a general register, which is used as an index register and specified by the instruction. The result of an RX operation may replace the first operand depending on the instruction.

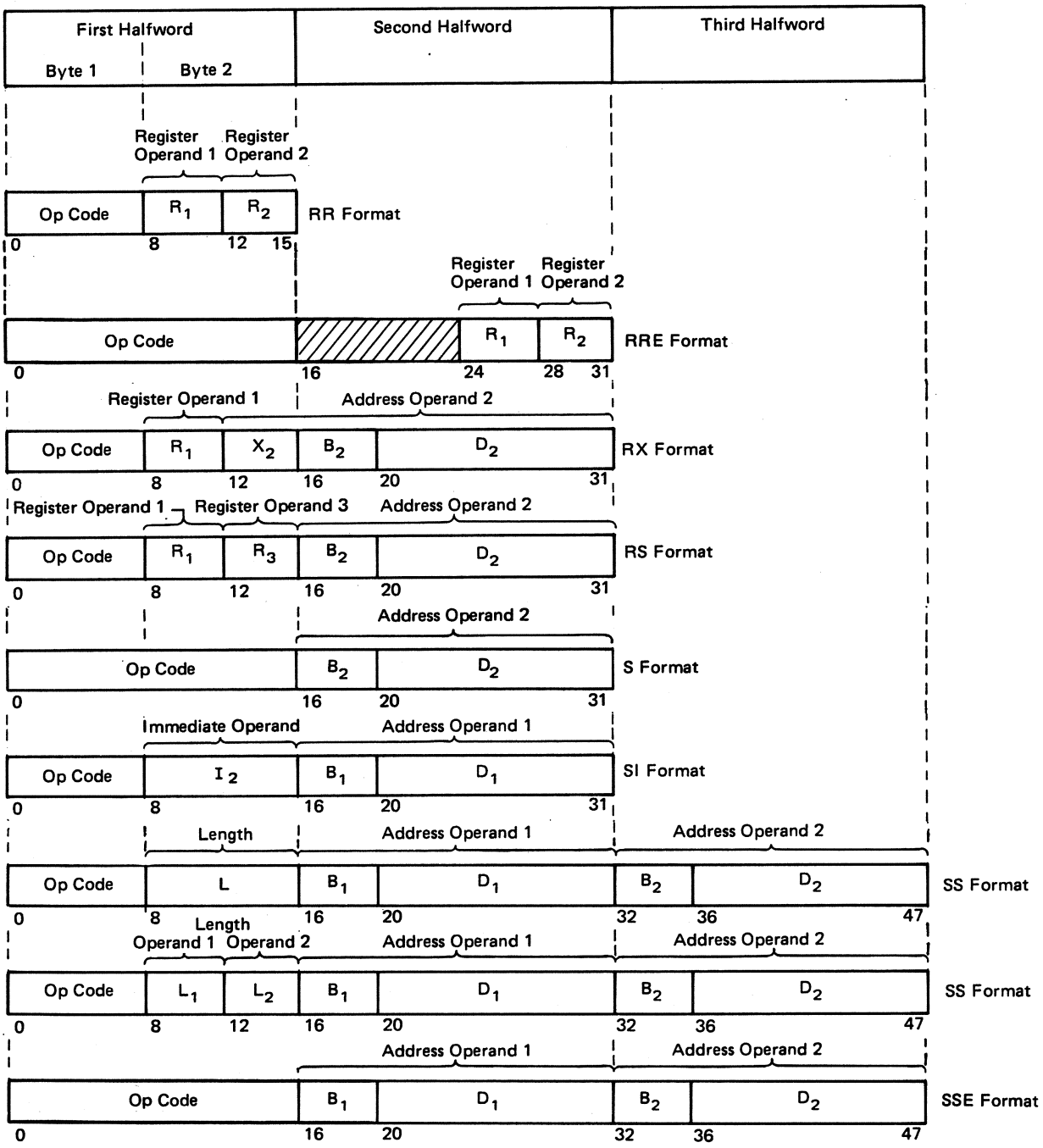


Figure 1-13. Basic Instruction Formats

- RS denotes a register-and-storage operation. The first operand is in a general register, the second operand is in main storage, and a third may be specified by another general register.
- S denotes an operation using an implied operand and storage.
- SI denotes an immediate-operand-and-storage operation. The first operand is one byte of data carried in the instruction itself (the immediate operand), and the second operand is in main storage.
- SS denotes a storage-to-storage operation. Both operands are in main storage.
- SSE denotes a storage-and-storage operation having an extended op-code field.

Generally, the first byte of each of these formats gives the operation code (the "op code"), which identifies the operation to be performed; for RRE, S, and SSE format instructions however, the first *two* bytes are used for the op code.

Operator Facilities

The operator facilities provide for manual operation and control of the system. They include operator-to-machine communication, indication of machine status, control over the setting of the time-of-day clock, initial program loading, resets, and other manual controls for operator intervention in normal machine operation.

The need for operator manipulation of manual controls is minimized by the system design and by the governing control program, which reduces the number and seriousness of operator errors.

Input/Output Operations

An input/output operation transfers data between main storage and an I/O device. An I/O operation is initiated by a program instruction that generates a command to a *channel.* A *control unit* receives the command by means of the I/O *interface,* decodes it, and starts the I/O device.

Channels

Channels are the direct controllers of I/O devices and control units. They allow System/370 to read, write, and compute, all at the same time, by relieving the CPU of the task of communicating directly with the I/O devices.

Depending on the System/370 model, channels may be separate units, complete with the necessary logical and storage capabilities, or they may be physically integrated in the processor. The channels used with the Model 168 and 168-3 are physically separate units (2860 Selector Channel, 2870 Multiplexer Channel, and 2880 Block Multiplexer Channel), whereas the channels of the other System/370 models described in this publication are part of the processor. In either case, the channel functions are identical, but may be implemented in such a way as to have different data transfer rates.

Functionally, the channel data path is divided into *subchannels.* Each subchannel provides facilities to control one I/O operation.

Some subchannels can control several I/O devices, and others can control only one. These are called *shared* and *nonshared* subchannels, respectively.

System/370 has three types of channels: byte multiplexer, selector, and block multiplexer.

Byte Multiplexer Channels

Byte multiplexer channels separate the operations of high-speed devices from those of lower-speed devices. Channel operations are in either of two modes: *byte* mode for lower data rates, and *burst* mode for higher data rates.

In byte mode, the single data path of the channel can be shared by a large number of lower-speed I/O devices (such as card readers, printers, and terminals) operating concurrently; the channel receives and sends data to the I/O devices on demand.

Burst mode is forced by devices such as magnetic tape units or disk units and is not under the control of the programmer. Such high-speed devices, having established a logical connection with a channel, usually stay connected to it for the duration of data transfer and thereby force the channel into burst-mode state.

Some System/370 models (Models 168 and 168-3) provide selector subchannels as well as byte multiplexer subchannels within the byte multiplexer channel.

Byte multiplexer subchannels may operate in either byte or burst mode, and may be of either the shared or nonshared type. In byte mode, each can operate one low- or medium-speed I/O device concurrently, if the total load on the channel does not exceed the channel capacity. In burst mode, one byte multiplexer subchannel monopolizes the byte multiplexer channel and operates one higher-speed I/O device.

Selector subchannels, which are of the shared type only, operate only in burst mode; each can operate one I/O device concurrently with the byte multiplexer subchannels but can control as many as 16 I/O devices.

Selector Channels

Selector channels transmit data to or from a single I/O device at a time. They can handle both high- and lower-speed I/O devices, but their burst-mode operation makes them especially suitable for high-speed devices. Each selector channel attaches up to eight I/O control units and can address as many as 256 I/O devices. One I/O device per selector channel can be transmitting data at any given time; no other I/O device on the channel can transmit data until all data is handled for the selected device.

In general, I/O operations on a selector channel are overlapped with processing, and all channels can operate simultaneously, provided that the processing unit's data rate capabilities are not exceeded. The maximum data rates for the selector channels vary with the System/370 models and the channel options available, and range from 1.3 to 1.85 million bytes per second.

Block Multiplexer Channels

Block multiplexer channels have advantages of both byte multiplexer and selector channels in that they can concurrently operate many high-speed I/O devices on a single data path.

Block multiplexer channels operate in either of two modes: selector or block multiplex. *Selector mode* is functionally equivalent to selector channel operation, permitting attachment of all the I/O devices which can attach to selector channels. In *block multiplex mode,* these channels permit interleaving (multiplexing) of channel programs for high-speed devices in such a way that channel programs can be initiated sooner and channels can be freed earlier than would be possible with selector channels. The byte and block multiplexer channels differ primarily in that the block multiplexer channels can operate with much faster I/O devices, and they transfer larger quantities of data per transmission. These quantities are referred to as *blocks,* and may include a number of records.

Block multiplexer channels provide a number of subchannels of the shared or nonshared type. The maximum data rates for block multiplexer channels vary with the System/370 models and processor complexes and options available. These rates vary from 1.2 to 3.0 million bytes per second.

I/O Devices

I/O devices fall into a number of categories, some of which overlap. They are used in and for:

- Auxiliary storage
- Machine and manual (keyed) input, both local and remote
- Data communications
- Reading (or output) of external documents and displays
- Process control
- Data acquisition

Many I/O devices function with an external document, such as a punched card or a reel of magnetic tape. Others handle only electrical signals, such as those in process-control and data acquisition systems.

Control Unit Function

The control unit function provides the logic circuitry and the storage areas (buffers) needed to operate the attached I/O devices. Yet, to the user, most control unit functions cannot be distinguished from I/O device functions.

The control unit function may be part of the I/O device or the processor (integrated adapter), or it can physically be a separate unit.

I/O Interface

The I/O interface provides a uniform method of attaching various I/O devices (through control units) to a channel. The information format and the control signal sequences provided by the interface are independent of the type of control unit and channel. Certain I/O devices that do not use the I/O interface do use the same programming information format and sequences.

Interruption System

The interruption system permits System/370 to dynamically respond to equipment and programming errors, and greatly aids the efficient use of I/O equipment. To make the interruption procedure as short and simple as possible, switching between the interrupted program and the control program (the program that services interruptions) must be efficient.

The interruption system uses *program status words* (PSWs) to hold status and control information. Additionally, System/370 uses control registers to regulate the interruption system.

As soon as an interruption occurs, current status information, together with an identification of the cause of the interruption, is put into a PSW. This "old" PSW is stored at a fixed location. The system then fetches a "new" PSW from a different fixed location. Each class of interruption uses two fixed locations in main storage: one to receive the old PSW when the interruption occurs, and the other to supply the new PSW that governs the servicing of that class of interruption.

After the interruption has been serviced, the CPU may be restored by the control program to the status it had before the interruption.

Classes of Interruptions

The interruption system separates interruptions into six classes:

Program interruptions are caused by various kinds of programming errors or events; the exact type of condition is identified in the program old PSW.

Supervisor Call interruptions are caused when the program executes an instruction to pass control to the part of the control program, called the *supervisor,* which performs the supervisory functions associated with a task.

External interruptions are caused by an external device that requires attention, by the interval timer (an internal clocking device) going past zero, by the operator pressing the interrupt key, and for other reasons.

I/O interruptions are caused by an I/O device ending an operation or otherwise needing attention. Identification of the device and channel causing the interruption is stored in the I/O old PSW; in addition, the status of the device and channel is stored in a fixed location.

Machine Check interruptions are caused by the machine-checking circuits detecting an error.

Restart interruptions are caused by the operator activating the restart key or by another processor specifying restart.

Disallowing of Interruptions

Most interruptions may be either allowed or temporarily disallowed. When an interruption is disallowed, it is either delayed or does not occur, the outcome depending mainly on the class of interruption. The following interruptions can be disallowed:

- All I/O interruptions
- All external interruptions
- Some program interruptions
- All machine-check interruptions

Priority of Interruptions

During the execution of an instruction, several interruption conditions may occur simultaneously. When this happens, the competing interruption requests are serviced in a fixed order of priority.

Virtual Storage Capability

System/370 virtual storage extends and enhances system capabilities by permitting users to program as though the system has multiple address spaces, each with as many as 16,384K (16,777,216) bytes of storage. This storage capability is provided by way of dynamic address translation, channel indirect data addressing, and associated programming support. The contents of virtual storage are usually maintained on an external storage medium called *external page storage.*

Virtual storage is divided into *segments* of either 64K (65,536) bytes or 1,024K (1,048,576) bytes. Each segment is divided into *pages* of 2K or 4K bytes. A segment is a block of sequential logical addresses spanning 64K or 1,024K bytes in virtual storage. A

page is a block of sequential logical addresses spanning 2K or 4K bytes in virtual storage. A page may contain instructions, data or both. A page is transferable between real storage and external page storage. When a program is executed, the addresses specified by the program are translated, via dynamic address translation, into real addresses in main storage.

As pages of virtual storage are addressed, if they are not already in main storage they are brought in from external page storage to replace pages in real main storage that are not needed. The swapping of pages of storage is performed by the operating system.

Expanded storage, if installed, provides performance improvement by dynamically retaining pages from main storage that are most likely to be referred to by the workload.

Architectural Modes of Operation

In certain processor complexes, System/370 provides two modes of operation: System/370 (S/370), which uses 24-bit addressing, and System/370 extended architecture (370-XA), which uses either 24- or 31-bit addressing.

The 370-XA mode has evolved from the System/370 architecture, with special attention given to the implementation of large systems. It incorporates a number of significant new facilities beyond S/370 mode. Some facilities available in the S/370 mode are changed or not provided in the 370-XA mode. The most significant change from S/370 mode is in the I/O facilities provided by the channel subsystem, which consists of an I/O processor and a number of associated channel paths.

The channel subsystem includes the following new capabilities:

- Path-independent addressing of I/O devices, which permits the initiation of I/O operations with any device without regard to which CPU is executing the I/O instruction or how the I/O device is attached to the channel subsystem.
- Path management, whereby the channel subsystem determines what paths are available for selection, chooses a path, and manages any busy conditions encountered while attempting to initiate I/O processing with associated devices.
- Programmable interruption subclasses, which permit the programmed assignment of I/O interruption requests from individual I/O devices to any one of eight interruption queues.
- A channel command word (CCW) format for the direct use of 31-bit addresses in channel programs, which is in addition to the System/370 CCW format. The format of the CCWs is specified when an I/O operation is initiated.
- Address-limit checking, which provides an additional storage-protection facility to prevent data access to storage locations above or below a specified absolute address.
- Monitoring facilities, which cause the measuring and accumulation, in main storage, of key I/O-resource usage parameters for individual subchannels of the channel subsystem.
- A set of 13 new I/O instructions, which are provided for the control of the channel subsystem.

Other extensions incorporated in the 370-XA mode are as follows:

- Bimodal addressing, which provides two modes of operation: a 24-bit addressing mode and a 31-bit addressing mode.
- The 31-bit logical addressing, which extends the virtual address space from the 16M (16,777,216) bytes addressable with 24-bit addresses to 2G (2,147,483,648) bytes.
- The 31-bit real and absolute addressing, which provides addressability for up to 2G bytes of main storage. This facility replaces the extended-real-addressing facility of System/370.
- The 370-XA protection facilities, which recognize the 4K-byte block of storage as the basic unit of storage allocation for 370-XA mode by providing only one storage key for each 4K-byte block.
- The tracing facility, which assists in the determination of system problems by providing an ongoing record in storage of significant events.
- The two orders: set prefix and store status at address, which provide additional capability for

communication between CPUs by the Signal Processor instruction.

- The Divide (DXR) instruction, which provides for an extended-precision dividend, divisor, and quotient in floating-point arithmetic.

Except for the following facilities and several other differences in function described in the *IBM System/370 Extended Architecture Principles of Operation*, the 370-XA mode provides all the facilities provided by the System/370 mode as defined in the *IBM System/370 Principles of Operation*:

- The System/370 I/O instructions and I/O interruptions.
- The System/370 formats containing 24-bit addresses.
- The basic-control mode and associated PSW format, as well as the controls and information formats of the interruption mechanism.
- The interval timer at storage location 80.
- The 2K-byte block associated with a storage key and the Insert Storage Key, Reset Reference Bit, and Set Storage Key instructions.
- Direct control, including the Read Direct and Write Direct instructions, and the external signals.
- Certain System/370 machine-check and I/O recovery facilities, whose functions are handled differently in 370-XA mode.

Control-Program Compatibility

Control programs written to run on systems operating in the S/370 mode cannot be directly transferred from those systems to systems operating in 370-XA mode. However, to provide full control-program compatibility for the S/370 mode, all processor complexes that provide the 370-XA mode also offer manual controls to place the machine in the System/370 mode.

Problem-State Program Compatibility

As described in the *IBM System/370 Extended Architecture Principles of Operation* manual, a program written to run in the problem state on systems operating in the S/370 mode will run on a system operating in the 370-XA mode, provided that the program:

- Observes the limitations described under "Compatibility Among Systems in 370-XA Mode" in the *IBM System/370 Extended Architecture Principles of Operation.*
- Is not dependent on control-program facilities that are unavailable to the system.
- Takes into account other changes made to the S/370 architectural definition that affect compatibility between the S/370 mode and the 370-XA mode as described in Appendix D of the *IBM System/370 Extended Architecture Principles of Operation.*

Multiprocessing

The term *multiprocessing* applies to a system with two or more CPUs. Multiprocessing offers:

- Improved workload balance between the processors by the sharing of processor storage and I/O devices.
- Increased availability through maintenance that is concurrent with job activity. Job processing can continue while a maintenance subsystem (processor, processor storage, and I/O devices) is used to complete a particular maintenance task.
- Increased system flexibility because each system can operate independently, with its own system control program, assigned processor storage, and I/O devices, if the complex can be partitioned.

Multiprocessing is possible in a system that uses appropriate models (see Chapter 2) of the following:

- IBM 3158 or 3158-3 Processing Unit
- IBM 3158 or 3158-3 Processing Unit with the IBM 3052 Attached Processing Unit

- IBM 3168 or 3168-3 Processing Unit
- IBM 3168-3 Processing Unit with the IBM 3062 Attached Processing Unit
- IBM 3031 Processor with the IBM 3041 Attached Processor
- IBM 3033 Processor
- IBM 3033 Processor with the IBM 3042 Attached Processor

The IBM 3081, 3084, and 3090 Processor Complexes also perform multiprocessing.

Uniprocessor models of the 3158, 3158-3, 3168, 3168-3, and 3033 can be converted to multiprocessor models. In addition, the 3083 uniprocessor can be converted to the 3081 dyadic processor.

Chapter 2. System/370 Models

System/370 Model 115

System/370 Model 115 (Figure 2-1), the smallest of the System/370 models, is a compact, versatile system with 64K (65,536) bytes to 384K (393,216) bytes of monolithic processor storage. The Model 115, with either the IBM 3115-0 Processing Unit or the IBM 3115-2 Processing Unit that has extended performance, offers integrated attachment of punched-card, tape, and disk devices; printers; and data communications terminals. The Model 115 also offers channel attachment of a variety of I/O devices, including the IBM 3540 Diskette Input/Output Unit for cardless system operation.

Other prominent features contributing to performance are:

- Virtual storage capability, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- An integrated display/keyboard console, which provides the system control function and uses the display for better system-to-operator communications.
- A console file, which provides the facility for loading control storage with microcode or a system checkout program.
- The alter/display function, which provides a means of displaying and altering main storage data at a printer-keyboard.

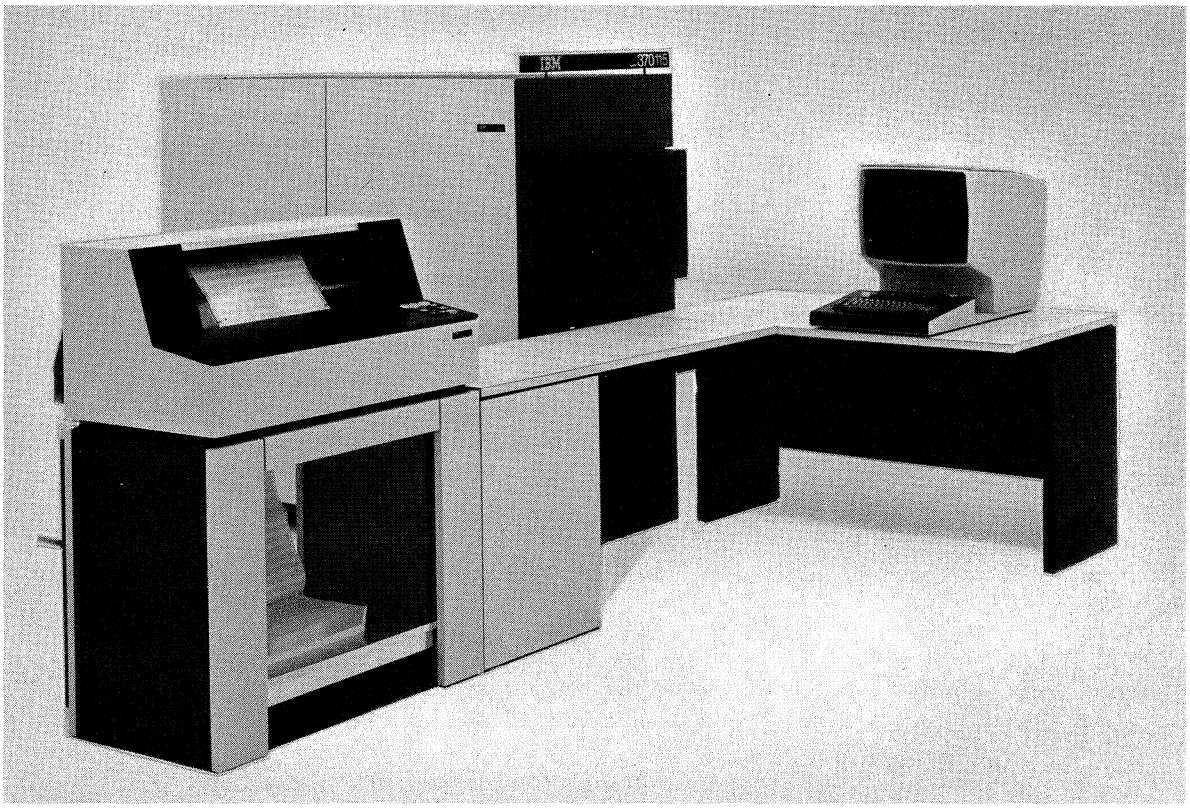


Figure 2-1. IBM System/370 Model 115 with Another Device

System Components

The Model 115 system includes:

- IBM 3115-0 Processing Unit Model F, FE, G, GE, or GF; or the IBM 3115-2 Processing Unit Model F2, FE2, G2, GE2, GF2, H2, or HG2.
- IBM 3340 Direct Access Storage Facility Model A2 with 3340 Model B1 and/or B2, and IBM 3344 Direct Access Storage Model B2 and/or B2F
- 3540 Diskette Unit or a card reader
- Line printer
- Appropriate additional input/output devices

The system controls are located at the operator console, which consists of a display with a keyboard. The console enables the operator to start and stop the system and to display and alter selected information in the storage areas. After initial microprogram load (IMPL), object programs can be loaded from I/O devices via the keyboard and display.

3115-0 and 3115-2 Processing Units

The 3115-0 and 3115-2, which have a basic machine cycle time of 480 nanoseconds for one byte on the machine instruction processor of the 3115-0, and 480 nanoseconds for two bytes on the instruction processing unit of the 3115-2, have the following logical components:

- Several subprocessors
- Processor storage
- Channel (optional)

Subprocessors

The subprocessors include:

- The *main storage controller,* which controls access to main storage, keeps and updates the address registers for the other subprocessors.
- The *service processor,* which loads microprograms from a console file, handles maintenance support and the manual control of the system, and logs and evaluates errors.
- The *machine instruction processor,* (MIP) of the 3115-0, which fetches and executes program instructions, executes arithmetic/logical instructions, analyzes I/O instructions, calculates addresses, sets condition codes, updates the PSW, and controls the direct disk attachment.
- The *instruction processing unit* (IPU) of the 3115-2, which performs the same functions as the MIP of the 3115-0 except for control of the direct disk attachment. This function is handled by a separate I/O processor. Because it does not have to control the direct disk attachment, the IPU has a higher instruction execution rate than the MIP.
- The *input/output processors,* which execute I/O commands, and supervise data transfer between the I/O devices and the main storage controller.

Processor Storage: Part of IBM 3115-0 and 3115-2 Processing Units

Processor Storage Capacities:

Capacity (Bytes)	115 Model Designation 3115-0	3115-2
65,536 (64K)	F	F2
98,304 (96K)	FE	FE2
131,072 (128K)	G	G2
163,840 (160K)	GE	GE2
196,608 (192K)	GF	GF2
262,144 (256K)	–	H2
393,216 (384K)	–	HG2

Storage Cycle Time: 480 nanoseconds.

Storage Access Width: Two bytes.

Channel: Part of IBM 3115-0 and 3115-2 Processing Units

The Model 115 can have one byte multiplexer channel with 32 subchannels, as many as eight of which can be shared.

The basic 3115-0 or 3115-2 channel data rate is 19 kilobytes per second in byte mode. The 3115-2 channel with the extended byte multiplexer feature has a data rate of 25 kilobytes per second in byte mode. The burst-mode data rate for either channel is 29 kilobytes per second.

IBM 3340 Direct Access Storage Facility

The IBM 3340 Direct Access Storage Facility provides high-speed, direct access storage for the Model 115. The 3340, which has movable heads, is available as Model A2 (control unit and two disk storage drives), Model B1 (one disk storage drive), and Model B2 (two disk storage drives). As many as four 3340 drives can be attached to the 3115-0 and as many as eight drives can be attached to the 3115-2.

IBM 3344 Direct Access Storage Models B2 and B2F

The IBM 3344 Direct Access Storage Models B2 and B2F attach to the 3340 Model A2 to provide additional high-speed, direct-access storage capacity. The 3344 Model B2 has two disk storage drives and movable heads. The 3344 Model B2F also has two disk storage drives but has fixed heads, which provide zero seek time for a certain portion of the storage.

3540 Diskette Input/Output Unit

The IBM 3540 Diskette Input/Output Unit allows the use of magnetic diskettes with the Model 115. The 3540 is available as Model B1, which the has control unit function and one diskette drive, and Model B2, which has the control unit function and two diskette drives.

Features of the 3115-0 and 3115-2

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Conditional swapping
CPU timer and clock comparator
Halt device
Limited channel logout
Translation

Optional

Floating point (on 3115-0, with or without extended-precision floating point; on 3115-2, requires extended-precision floating point)
Extended-precision floating point
External signals

Programming Assists

Optional

1401/1440/1460 compatibility
System/360 Model 20 compatibility

Channel Features

Optional

Byte multiplexer channel (3115-0, 19 kilobytes per second; 3115-2, 25 kilobytes per second) (8 shared subchannels and 24 unshared subchannels)

Integrated Adapters

Standard

3340 direct disk attachment (on 3115-0: one 3340 Direct Access Storage Facility Model A2, and one 3340-B1/B2; on 3115-2: one 3340-A2, and as many as three 3340-B1/B2s), or
3340/3344 direct disk attachment (on 3115-2 only: one 3340-A2, and as many as three 3340-B1/B2s and 3344 Direct Access Storage Model B2 and/or B2Fs; with string switch on 3340 and no 3344s, string may be shared with any System/370 processor except the 3115-0 and 3125-0)

Optional

2311 Disk Storage Drive Model 1 compatibility on 3340, or 2314 Direct Access Storage Facility compatibility on 3340
2560 Multi-Function Card Machine Model A1 or A2 attachment, or 5425 Multi-Function Card Unit Model A1 or A2 attachment
3203 Printer Model 1 or 2 attachment (with universal character set), or 5203 Printer Model 3 attachment (universal character set optional)
5213 Console Printer Model 1 attachment (with or without 1052 Printer Keyboard compatibility on 5213-1)
Magnetic tape adapter (for one 3411 Magnetic Tape Unit and Control Model 1 and as many as three 3410 Magnetic Tape Units Model 1; or one 3411-2 and as many as five 3410-2s; or one 3411-3 and as many as five 3410-3s; or one 3803 Tape Control Model 3 and as many as eight 3420 Magnetic Tape Units Model 3 or 3420-5s in any combination)
Integrated communications adapter (as many as 5 synchronous lines, or as many as 4 synchronous lines and as many as 8 asynchronous lines)

Miscellaneous Features

Standard

Audible alarm
Storage error checking and correction
Service processor

Programming Support for the Model 115

Programming support for the Model 115 includes:

- DOS (Disk Operating System)
- DOS/VS (Disk Operating System/Virtual Storage). With the CPU in basic control mode, operation with System/360 programs is possible if the 1052 and 2311 (or 2314) compatibility features are installed and both the IBM 5213 Printer and IBM 3340 Direct Access Storage Facility Model A2 are attached.

System/370 Model 125

The System/370 Model 125 (Figure 2-2), with either the IBM 3125-0 Processing Unit or the IBM 3125-2 Processing Unit, which has improved performance, has a storage capacity of from 96K (98,304) bytes to 512K (524,288) bytes. Monolithic circuitry, used in both main (processor) storage and control storage, contributes to the high performance level of the Model 125.

Other prominent features contributing to performance are:

- Virtual storage capability, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- An integrated display/keyboard console, which provides the system control functions, replaces the conventional indicators and switches, and uses the display for better operator/system communication.
- Integrated attachment of a variety of I/O devices, which eliminates the need for external control units; or channel attachment of other I/O devices such as the IBM 3540 Diskette Input/Output Unit for cardless system operation.
- A console file, which provides the facility for loading control storage with microcode or a system checkout program.
- The alter/display function, which provides a means of displaying and altering main storage data at the display/keyboard console.

System Components

The Model 125 system includes:

- IBM 3125-0 Processing Unit Model FE, G, GE, GF, or H; or IBM 3125-2 Processing Unit Model FE2, G2, GE2, GF2, H2, HG2, or I2
- IBM 3333 Disk Storage and Control and IBM 3330 Disk Storage, or
- IBM 3340 Direct Access Storage Facility and IBM 3344 Direct Access Storage
- IBM 3540 Diskette Input/Output Unit or a card reader
- Line printer
- Appropriate additional input/output devices

The system controls are located at the operator console, which consists of a display with a keyboard. The console enables the operator to start and stop the system and to display and alter selected information in storage. After initial microprogram loading (IML), object programs can be loaded from I/O devices by means of the keyboard and display.

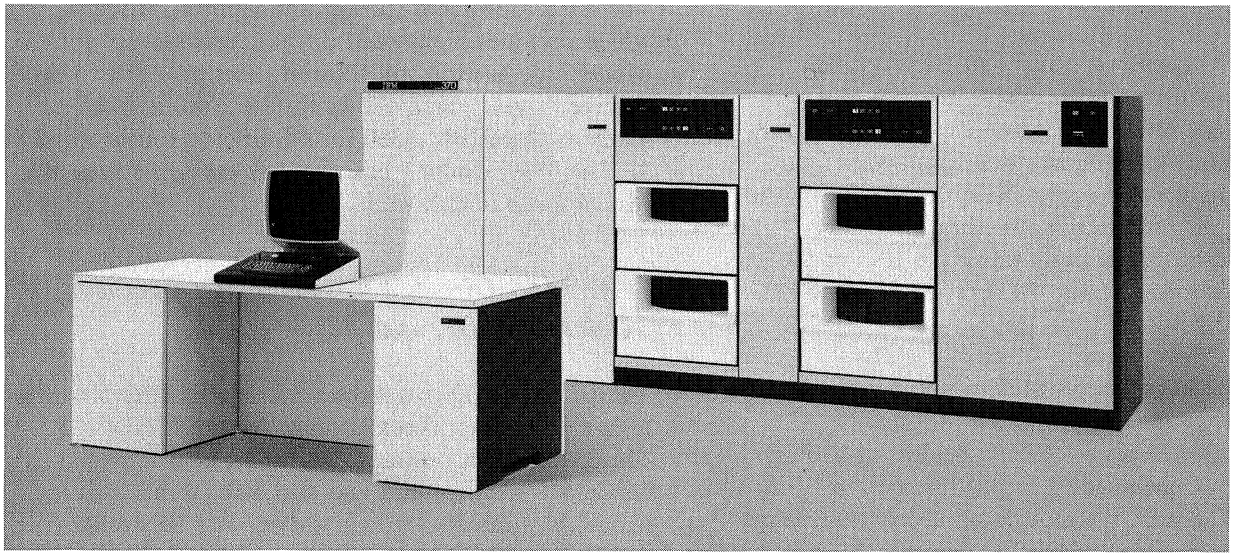


Figure 2-2. IBM System/370 Model 125 with Other Devices

IBM 3125-0 and 3125-2 Processing Units

The 3125-0 and 3125-2 Processing Units, which have a basic machine cycle time of 480 nanoseconds for two bytes in the 3125-0, and 320 nanoseconds for two bytes in the 3125-2, have the following logical components:

- Several subprocessors
- Processor storage
- Channels (optional)

Subprocessors

The subprocessors include:

- The *main storage controller* (MSC), which can directly access main storage and control accessing of main storage by the other processors on a fixed-priority basis. The MSC has a logical storage area containing address registers assigned to each processor. The registers are maintained and updated by the MSC as it handles each request for access to main storage.
- The *service processor*, which (SVP) loads microprograms from the console file into the processors, supervises the manual control of the system, and controls microinstruction retry by the IPU. When an error is detected, the SVP attempts recovery, and also logs and evaluates the error for maintenance support.
- The *instruction processing unit* (IPU), which processes instructions, selects input/output processors, and handles interruptions. It fetches instructions from main storage, analyzes them, fetches associated operands, processes them, and returns the results to main storage. Under identical operating conditions, the IPU of the 3125-2 is from 20% to 30% faster than the IPU of the 3125-0.
- The *input/output processors*, which handle data transfer, control information, and sense information between the I/O devices and main storage. Once selected by the instruction processing unit, the input/output processor takes over the servicing of the I/O devices.

  A system may have more than one input/output processor, and more than one I/O device can be attached to each processor.

Processor Storage: Part of IBM 3125-0 and 3125-2 Processing Units

Processor Storage Capacities:

Capacity (Bytes)	125 Model Designation 3125-0	3125-2
98,304 (96K)	FE	FE2
131,072 (128K)	G	G2
163,840 (160K)	GE	GE2
196,608 (192K)	GF	GF2
262,144 (256K)	H	H2
393,216 (384K)	–	HG2
524,288 (512K)	–	12

Storage Cycle Time: 480 nanoseconds.

Storage Access Width: Two bytes.

Channel: Part of IBM 3125-0 and 3125-2 Processing Units

The Model 125 can have one byte multiplexer channel with 32 subchannels, as many as eight of which can be shared. The sustained data rate in byte mode is 25 kilobytes per second. The maximum data rate in burst mode is 29 kilobytes per second.

IBM 3333 Disk Storage and Control Model 1 and IBM 3330 Disk Storage Models 1 and 2

The IBM 3333 Disk Storage and Control Model 1, which provides high-speed direct access storage for the Model 125, has the control unit function and two disk storage drives, which allows the attachment of as many as three IBM 3330 Disk Storage Models 1 and 2. The 3330 Model 1 has two disk storage drives; the Model 2 has one drive.

IBM 3340 Direct Access Storage Facility Models A2, B1, and B2

The IBM 3340 Direct Access Storage Facility provides high-speed, direct access storage for the Model 125. The 3340, which has movable heads, is available as Model A2 (control unit and two disk storage drives), Model B1 (one disk storage drive), and Model B2 (two disk storage drives). As many as eight 3340 drives can be attached to the 3125-0 and as many as 16 drives can be attached to the 3125-2.

IBM 3344 Direct Access Storage Models B2 and B2F

The IBM 3344 Direct Access Storage Models B2 and B2F attach to the 3340 Model A2 to provide additional high-speed, direct-access storage capacity. The 3344 Model B2 has two disk storage drives and movable heads. The 3344 Model B2F also has two disk storage drives but has fixed heads, which provide zero seek time for a certain portion of the storage.

IBM 3540 Diskette Input/Output Unit Models B1 and B2

The IBM 3540 Diskette Input/Output Unit allows the use of magnetic diskettes with the Model 125. The 3540 is available as Model B1, which has control unit function and one diskette drive, and Model B2, which has control unit function and two diskette drives.

Features of the 3125-0 and 3125-2

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Conditional swapping
CPU timer and clock comparator
Halt device
Limited channel logout
Translation

Optional

Floating point with extended-precision floating point
External signals

Programming Assists

Optional

1401/1440/1460 compatibility
System/360 Model 20 compatibility

Channel Features

Optional

Byte multiplexer channel (25 kilobytes per second; 29 kilobytes per second burst rate, 8 shared and 24 unshared subchannels)

Integrated Adapters

Standard

3330/3333 direct disk attachment (one 3333-1 and one 3330-1 or -2),
or 3340 direct disk attachment (on 3125-0: one 3340-A2 and as many as three 3340-B1s and -B2s; on 3125-2: one or two 3340-A2s, each with as many as three 3340-B1s and -B2s),
or 3340/3344 direct disk attachment (on 3125-2 only: one 3340-A2 and as many as three 3340-B1s, 3340-B2s, 3344-B2s, and 3344-B2Fs in first string; one 3340-A2 and as many as three 3340-B1s and 3340-B2s in second string; with string switch on 3340 and no 3344s in string, may be shared with any System/370 processor except 3115-0 or 3125-0)

Optional

2311 Disk Storage Drive Model 1 compatibility on 3330, or 2311-1 compatibility on 3340, or 2314 Direct Access Storage Facility compatibility on 3340
3504 Card Reader Model A1 or A2 attachment
2560 Multi-Function Card Machine Model A1 or A2 attachment,
or 5425 Multi-Function Card Unit Model A1 or A2 attachment,
or 3525 Card Punch attachment
1403 Printer Model 2 attachment (universal character set optional),
or 1403-7 attachment,
or 1403-N1 attachment (universal character set optional),
or 3202 Printer Model 1 or 2 attachment (universal character set and 1403 carriage control emulation optional)
5213 Console Printer Model 1 attachment (with or without 1052 Printer-Keyboard compatibility on 5213-1)
Magnetic tape adapter (one 3411 Magnetic Tape Unit and Control Model 1 and as many as three 3410 Magnetic Tape Units,
or one 3411-2 and as many as five 3410-2s,
or one 3411-3 and as many as five 3410-3s,
or one 3803 Tape Control Model 3 and as many as eight 3420 Magnetic Tape Units Model 3s or 5s in any combination)
Integrated communications adapter (as many as 6 synchronous and 16 asynchronous lines)

Miscellaneous Features

Standard

Audible alarm
Instruction retry
Storage error checking and correction
Service processor

Programming Support for the Model 125

Programming support for the Model 125 includes:

- DOS (Disk Operating System)
- DOS/VS (Disk Operating System/Virtual Storage)

With the CPU in basic control mode, operation with System/360 programs is possible if the 1052 and 2311 (or 2314) compatibility features are installed and both the IBM 5213 Printer and IBM 3340 Direct Access Storage Facility Model A2 are attached. If the IBM 3330 Disk Storage is attached, the 2311 (or 2314) compatibility feature is not required for operation with DOS Release 27.

System/370 Model 135

The System/370 Model 135 (Figure 2-3), with either the IBM 3135 Processing Unit or the IBM 3135-3 Processing Unit (with improved performance), offers as many as 512K (524,288 bytes) of processor storage with System/370 reliability and performance, at relatively low cost. Features such as error checking and correction (ECC) circuits and instruction retry increase Model 135 reliability, and monolithic storage circuits contribute significantly to performance.

Further enhancing the performance of the Model 135 are:

- Virtual storage capability, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- The console file, which provides the facility for loading control storage with the System/370 microprogram, diagnostic microprograms, or a system checkout program.
- The alter/display function, which provides a means of displaying and altering main storage data at a printer-keyboard.
- The CPU-integrated I/O adapters, which eliminate the need for external control units for some commonly used I/O devices.

System Components

The Model 135 system includes:

- IBM 3135 Processing Unit Model FE, GD, GF, H, HF, HG, or I; or IBM 3135 Processing Unit Model A1, A2, A3, or A4
- IBM 3210 Console Printer-Keyboard Model 1, or the IBM 3215 Console Printer-Keyboard Model 1
- IBM 3046 Power Unit Model 1
- Appropriate input/output devices

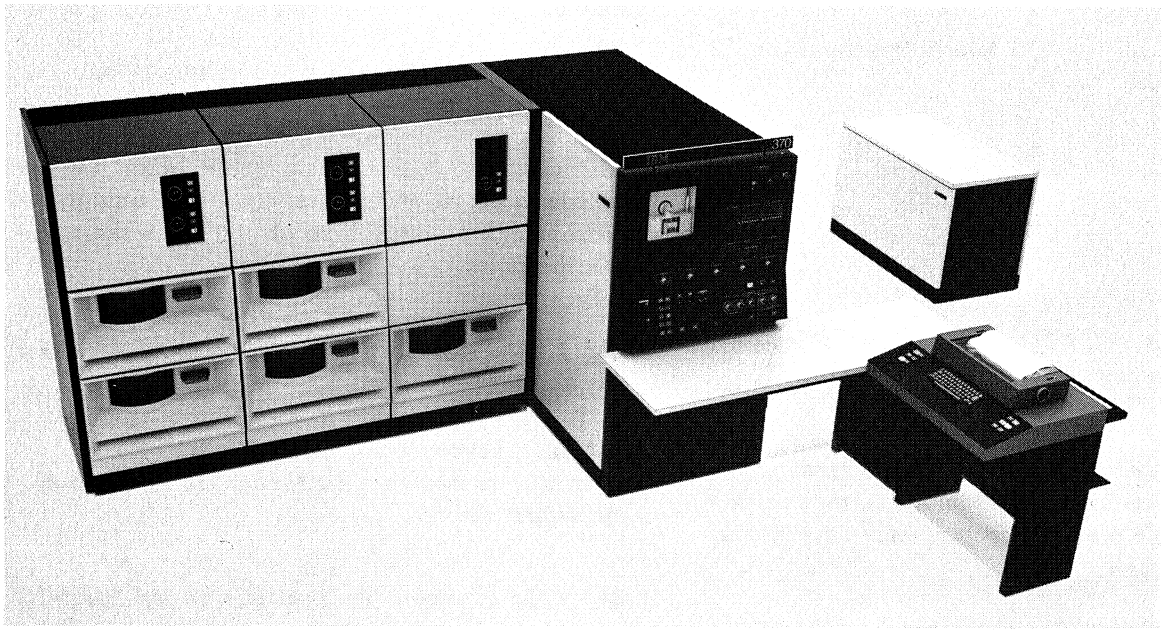


Figure 2-3. IBM System/370 Model 135 with Other Devices

The system is controlled and monitored by means of the system control panel on the CPU and the console printer-keyboard. The console file, which is located on the system control panel, is used to load into control storage the microcode required for system operation. As part of the loading operation, diagnostic microprograms check out the system.

IBM 3135 and 3135-3 Processing Units

The 3135 and 3135-3 Processing Units, which have a basic machine cycle time of 275 to 1,485 nanoseconds depending on the type of instruction performed, have the following logical components:

- Central processing unit
- Processor storage with control storage
- Channels

Processor Storage: Part of 3135 and 3135-3 Processing Units

Processor Storage Capacities:

Capacity (Bytes)	135 Model Designation 3135	3135-3
98,304 (96K)	FE	–
147,456 (144K)	GD	–
196,608 (192K)	GF	–
262,144 (256K)	H	A1
327,680 (320K)	HF	A2
393,216 (384K)	HG	A3
524,288 (512K)	I	A4

Note: Models A1, A2, A3, and A4 are available as a miscellaneous-equipment specification (MES) to 3135 Models H, HF, HG, and I, respectively.

Storage Cycle Time: 770 nanoseconds for main storage read, 935 nanoseconds for main storage write. These storage cycle times include the fetch time for the next microinstruction.

Storage Access Width: Two bytes, but four bytes in certain read operations.

Control Storage: Part of 3135 and 3135-3 Processing Units

Control Storage Capacity: The control storage capacity of the 3135 Processing Unit is 24K (24,576) bytes, expandable to 36K (36,864) bytes or 48K (49,152) bytes. The control storage capacity of the 3135-3 Processing Unit is 128K (131,072) bytes.

Channels: Part of 3135 and 3135-3 Processing Units

The Model 135 can have as many as four channels, including the integrated file adapter (IFA), which is addressed as channel 1. One byte multiplexer channel is standard on both the 3135 and the 3135-3. The byte multiplexer channel for the 3135 has 16 subchannels as standard, which can be optionally extended to 64, 128, or 256 subchannels. The byte multiplexer channel for the 3135-3 has 64 subchannels as standard, which can be optionally extended to 128 or 256 subchannels.

The 3135 can have one or two additional selector channels that can have the optional block multiplexer channel feature to operate as block multiplexer channels.

The 3135-3 can have one or two additional block multiplexer channels.

Each block multiplexer channel for the Model 135 can have one of the following subchannel combinations: 16 nonshared and 1 shared, 8 nonshared and 9 shared, or 8 nonshared and 5 shared subchannels.

IBM 3210 Console Printer-Keyboard Model 1

The IBM 3210 Console Printer-Keyboard Model 1, which has a keyboard and a SELECTRIC &supr. printer, can be used with the Model 135 as a console input/output device.

IBM 3215 Console Printer-Keyboard Model 1

The IBM 3210 Console Printer-Keyboard Model 1, which has a keyboard and a matrix printer with pin-feed platen, can be used with the Model 135 as a console input/output device.

IBM 3046 Power Unit Model 1

The IBM 3046 Power Unit Model 1 provides power for the 3135 and 3135-3 Processing Units.

Features of the 3135 and 3135-3

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Command retry
Conditional swapping (3135-3)
CPU timer and clock comparator (3135-3)
Floating Point (3135-3)
Extended-precision floating point (3135-3)
Halt device
Limited channel logout
PSW-key handling
Translation

Optional

Conditional swapping (3135)
CPU timer and clock comparator (3135)
Direct control with external signals
Floating point (3135)
Extended-precision floating point (3135)

Programming Assists

Standard

APL assist (3135-3)
ECPS:VS1 (3135-3)
ECPS:VM/370 (3135-3)
OS/DOS compatibility

Optional

APL assist (3135)
1401/1440/1460 compatibility
System/360 Model 20 compatibility
Virtual machine assist (3135)

Channel Features

Standard

Byte multiplexer channel (8 shared, 8 nonshared subchannels on 3135; 8 shared, 56 nonshared subchannels on 3135-3)

Optional

Byte multiplexer subchannels, additional (8 shared, and 56 nonshared, 8 shared and 120 nonshared, or 256 nonshared)
Block multiplexer channel (3135; converts 3330/3340 integrated file adapter, and also selector channel(s) to block multiplex operation with 1 shared selector subchannel, 16 address subchannels, and 16 nonshared subchannels each)
Block multiplexer channel, first (3135-3, 1.3 megabytes per second)
Block multiplexer channel, second (3135-3, 1.3 megabytes per second)
Block multiplexer shared subchannel (16 nonshared and one 16-address shared selector; or 8 nonshared, eight 16-address block shared, and one 16-address shared selector; or eight nonshared, four 32-address block shared, and one 16-address shared selector; options apply to each block multiplexer channel)
Selector channel, first (3135)
Selector channel, second (3135)

Integrated Adapters

Optional

2319 Disk Storage Model A1 integrated file adapter
3330/3340/3344 integrated file adapter (with or without 2314 compatibility on 3340)
1403-2 Printer attachment (universal character set optional),
or 1403-7 Printer attachment,
or 1403-N1 Printer attachment (universal character set optional)
3210-1 adapter,
3210 Console Printer-Keyboard Model 1 adapter,
or 3215-1 Console Printer-Keyboard Model 1 adapter (required)
Integrated communications adapter (as many as 8 synchronous or asynchronous lines in any combination)

Miscellaneous Features

Standard

Audible alarm
Instruction retry
Storage error checking and correction

Optional

Emergency power-off control for one or two, or as many as 12 systems

Programming Support for the Model 135

Programming support for the Model 135 includes:

- DOS (Disk Operating System)
- DOS/VS (Disk Operating System/Virtual Storage)
- OS/MFT (Operating System/Multiprogramming with a Fixed Number of Tasks)
- OS/VS1 (Operating System/Virtual Storage 1)
- VM/370 (Virtual Machine Facility/370)

System/370 Model 138

The IBM System/370 Model 138 (Figure 2-4) provides either 512K (524,288) bytes or 1,024K (1,048,576) bytes of processor storage and a level of performance between those of the Models 135 and 145.

Other characteristics that contribute significantly to the performance of the Model 138 include:

- Virtual storage capability, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- Control storage capacity that covers control storage requirements for the full line of Model 138 standard and optional features.
- A display console with a keyboard that provides a visual communication link with the system.
- Instruction retry facilities, and error checking and correction (ECC) circuits.
- The CPU-integrated I/O adapters, which eliminate the need for external control units for several commonly used I/O devices.
- Extended control-program support.

System Components

The Model 138 system includes:

- IBM IBM 3138 Processing Unit Model I or J with attached display console and keyboard
- IBM IBM 3046 Power Unit Model 1
- Appropriate input/output devices

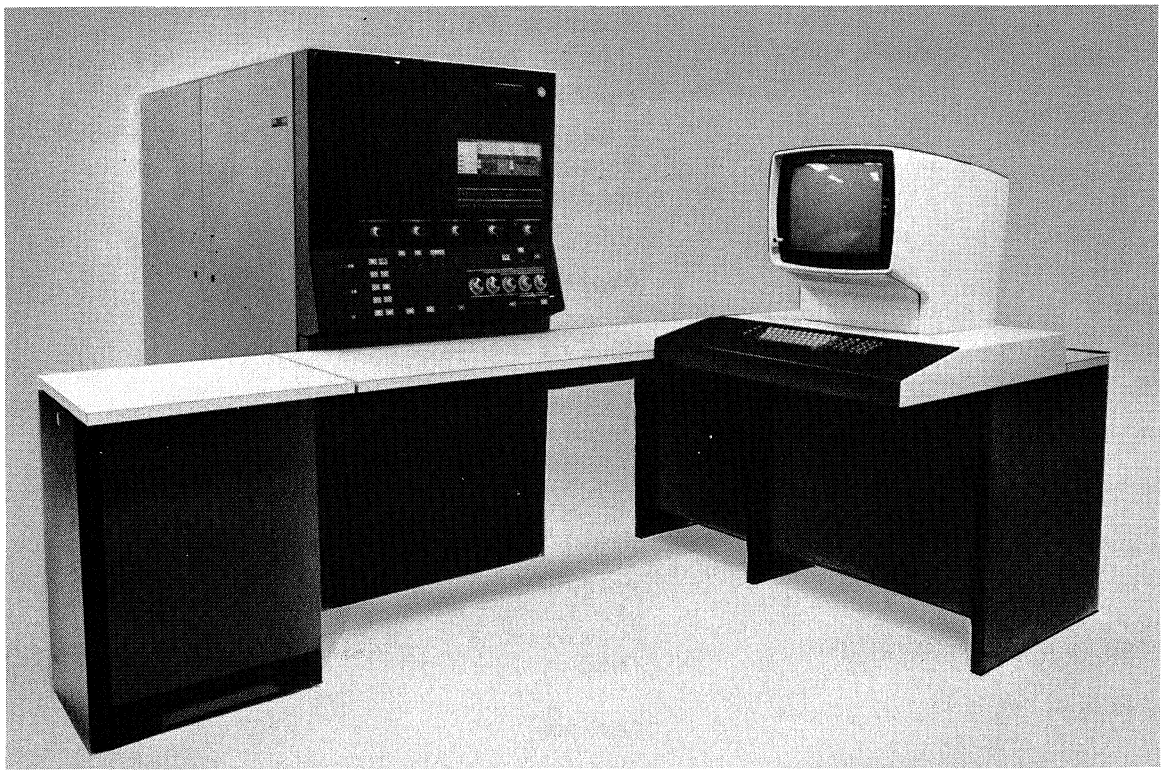


Figure 2-4. IBM System/370 Model 138

The system is controlled and monitored by means of the system control panel on the CPU, and the display console with keyboard. An IBM 3287 Printer Model 1 or 2 can be attached to the Model 138 as a console printer. The console file, which is located under the operator's console table, is used to load into control storage the microcode required for system operation. As part of the loading operation, diagnostic microprograms check out the system.

IBM 3138 Processing Unit

The 3138 Processing Unit, which has a basic machine cycle time of 275 to 1,485 nanoseconds (depending on the type of instruction performed), has the following logical components:

- Central processing unit
- Processor storage with control storage
- Channels

Processor Storage: Part of 3138 Processing Unit

Processor Storage Capacities:

Capacity (Bytes)	Model
524,288 (512K)	I
1,048,576 (1M)	J

Storage Cycle Time:

Operation	Time (Nanoseconds)
Read byte or halfword	715
Read fullword	880
Write	935

Storage Access Width: Two bytes or four bytes, depending on the operation.

Control Storage: Part of 3138 Processing Unit

Control Storage Capacity: 128K (131,072) bytes.

Channels: Part of 3138 Processing Unit

The Model 138 can have as many as four channels, including the integrated file adapter (IFA), which is addressed as channel 1. One byte multiplexer channel and two block multiplexer channels are standard.

The byte multiplexer channel has 64 subchannels as standard, and can optionally have totals of 128 or 256 subchannels.

Each block multiplexer channel can have one of the following subchannel combinations: 16 nonshared and 1 shared, 8 nonshared and 9 shared, or 8 nonshared and 5 shared subchannels.

IBM 3046 Power Unit Model 1

The IBM 3046 Power Unit Model 1 provides power for the 3138 Processing Unit.

Features of the 3138

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Command retry
Conditional swapping
CPU timer and clock comparator
Floating point
Extended-precision floating point
Halt device
Limited channel logout
PSW-key handling
Translation

Optional

Direct control with external signals

Programming Assists

Standard

APL assist
ECPS:VS1
ECPS:VM/370
OS/DOS compatibility
3135 CPU mode selection

Optional

1401/1440/1460 compatibility
System/360 Model 20 compatibility

Channel Features

Standard

Byte multiplexer channel (8 shared and 56 nonshared subchannels)
Block multiplexer channel, first (1.3 megabytes per second)
Block multiplexer channel, second (1.3 megabytes per second)

Optional

Byte multiplexer subchannels, additional (8 shared and 120 nonshared, or 256 nonshared)
Block multiplexer shared subchannel (16 nonshared and one 16-address shared selector;
or eight nonshared, eight 16-address block shared, and one 16-address shared selector;
or eight nonshared, four 32-address block shared and one 16-address shared selector; options apply to each block multiplexer channel)

Integrated Adapters

Standard

Display console
3286 Printer Model 2, 3287 Console Printer Model 1 or 2 adapter

Optional

3203 Printer Model 4 attachment, first
3203 Printer Model 4 attachment, second
3330/3340/3344 integrated file adapter (with or without 2314 Direct Access Storage Facility compatibility on 3340 Direct Access Storage Facility)
1403 Printer Model 2 attachment (universal character set optional),
or 1403-7 Printer attachment,
or 1403-N1 Printer attachment (universal character set optional)
Integrated communications adapter (as many as 8 synchronous or asynchronous lines in any combination)

Miscellaneous Features

Standard

Audible alarm
Instruction retry
Storage error checking and correction

Optional

Emergency power-off control for one or two, or as many as 12 systems

Programming Support for the Model 138

Programming support for the Model 138 includes:

- DOS/VS (Disk Operating System/Virtual Storage)
- OS/VS1 (Operating System/Virtual Storage 1)
- VM/370 (Virtual Machine Facility/370)

System/370 Model 145

The System/370 Model 145 (Figure 2-5), with either the IBM 3145 Processing Unit or the IBM 3145-3 Processing Unit (with improved performance), is a versatile data processing system for both commercial and scientific applications. The Model 145 provides efficient performance while preserving upward compatibility, and offers processor storage capacities as large as 2,048K (2,097,152) bytes.

The performance of the Model 145 is further enhanced by:

- Virtual storage capability, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- System/370's notable reliability and serviceability features, such as its retry capabilities, error-logging facilities, extensive internal checking circuits, and error checking and correction (ECC) circuits for main storage and control storage.
- A console file, which provides a facility for loading control storage with either the System/370 microprogram, extensive microdiagnostics, or system tests.
- An alter/display function, which provides a means of displaying and altering main storage without interfering with any concurrent I/O operations.
- A control storage capacity of 128K (131,072) bytes in the 3145-3 Processing Unit.

System Components

The Model 145 system includes:

- IBM 3145 Processing Unit Model GE, GFD, H, H2, HG, HG2, I, I2, IH2, J2, JI2, or K2; or the IBM 3145-3 Processing Unit Model A1, A2, A3, A4, A5, A6, or A7
- IBM 3210 Console Printer-Keyboard Model 1 or IBM 3215 Console Printer-Keyboard Model 1
- IBM 3345 Storage and Control Frame Models 1, 2, 3, 4, or 5 (3145 Models H, HG, and I)
- IBM 3046 Power Unit Model 1 (3145 Models HG and I)
- IBM 3047 Power Unit Model 1 (3145 Models H2, HG2, I2, IH2, J2, JI2, K2, and 3145-3 Models A1 through A7)
- Appropriate input/output devices

The Model 145 is controlled and monitored by means of the system control panel on the 3145 or 3145-3 Processing Unit, and by the 3210 or 3215 Console Printer-Keyboard Model 1. The console file, located under the operator's console table, is the initial microprogram loading (IMPL) device for the system. The file provides all microcode for the system on removable diskettes.

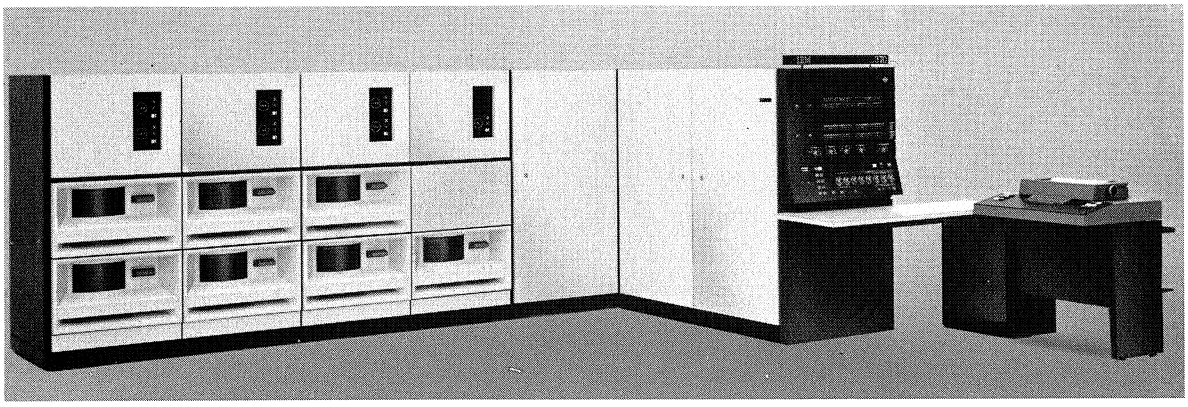


Figure 2-5. IBM System/370 Model 145 with Other Devices

IBM 3145 and 3145-3 Processing Units

The 3145 and 3145-3 Processing Units, which have a basic machine cycle time from 202.5 to 315.0 nanoseconds for the 3145, and from 180.0 to 270.0 nanoseconds for the 3145-3 (the exact time for each CPU depends on internal CPU operations), have the following logical components:

- Central processing unit
- Processor storage with control storage
- Channels

Processor Storage: Part of 3145 and 3145-3 Processing Units

Processor Storage Capacities:

Capacity (Bytes)	145 Model Designation 3145	3145-3
163,840 (160K)	GE	–
196,608 (192K) *	–	A1
212,992 (208K)	GFD	–
262,144 (256K)	H, H2	–
327,680 (320K)*	–	A2
393,216 (384K)	HG, HG2	–
458,752 (448K)*	–	A3
524,288 (512K)	I, I2	–
720,896 (704K)*	–	A4
786,432 (768K)	IH2	–
983,040 (960K)*	–	A5
1,048,576 (1M)	J2	–
1,507,328 (1472)*	–	A6
1,572,864 (1536K)	JI2	–
2,031,616 (1984K)*	–	A7
2,097,152 (2M)	K2	–

*Reflects the removal of 64K from 3145 model being converted.

Note: 3145 Models A1 through A7, which have improved performance, are available as a miscellaneous-equipment specification (MES) to 3145 Models H2, HG2, I2, IH2, J2, JI2, and K2, respectively.

Storage Cycle Time: 540.0 nanoseconds for a main storage read and 607.5 nanoseconds for a main storage write in the 3145; 405 nanoseconds for a main storage read and 540 nanoseconds for a main storage write in the 3145-3.

Storage Access Width: Eight bytes on instruction fetches.

Control Storage: Part of 3145 and 3145-3 Processing Units

Control Storage Access Time: 109 nanoseconds for the 3145 and 75 nanoseconds for the 3145-3.

Control Storage Capacity: The 3145 has a control storage capacity of 32K (32,768) bytes, which is expandable to 64K (65,536) bytes to cover control storage requirements for installed features. The additional control storage capacity is at the expense of main storage. The storage boundary is determined at the time that the microprogram is compiled by IBM.

The 3145-3 has a control storage capacity of 128K (131,072) bytes that covers control storage requirements for the full line of 3145-3 features. In converting from a 3145 to a 3145-3, all of the currently used control storage and up to 64K (65,536) bytes of main storage is removed and replaced with the new 128K control storage.

Channels: Part of 3145 and 3145-3 Processing Units

The 3145 Processing Unit can have as many as five channels. One byte multiplexer channel and one selector channel are standard. Three additional selector channels are available as optional features. If the IFA feature is installed, only one additional selector channel can be attached. The block multiplexer channel feature provides block multiplexer capabilities for all system selector channels.

The 3145-3 Processing Unit can have as many as five channels. One byte multiplexer channel and one block multiplexer channel are standard. Three additional block multiplexer channels are available as special features.

The byte multiplexer channel for the 3145 has 16 subchannels as standard. Subchannels can be added for a total of 32, 64, 128, or 256. The byte multiplexer channel for the 3145-3 has 64 subchannels as standard. Subchannels can be added for a total of 128 or 256.

The block multiplexer channels for the 3145 have 16 nonshared subchannels as standard. Subchannels can be added, in increments of 16, for a system total of 512. Block multiplexer channels for the 3145-3 have 64 nonshared subchannels as standard. Subchannels can be added for a system total of 128, 256, or 512.

IBM 3210 Console Printer-Keyboard Model 1

The IBM 3210 Console Printer-Keyboard Model 1, which has a keyboard and a SELECTRIC ® printer, can be used with the Model 145 as a console input/output device.

IBM 3215 Console Printer-Keyboard Model 1

The IBM 3210 Console Printer-Keyboard Model 1, which has a keyboard and a matrix printer with pin-feed platen, can be used with the Model 145 as a console input/output device.

IBM 3345 Storage and Control Frame

The IBM 3345 Storage and Control Frame is available in five models to provide for the 3145 additional processor storage and the capability for attachment of the 3333/3330, 3340, 3344, and 3350 direct access storage devices (DASD) as follows:

3145 Model	3345 Model	Additional Storage in Bytes	DASD Attachment
HG	1	393,216	No
I	2	524,288	No
H and below	3	-	Yes
HG	4	393,216	Yes
I	5	524,288	Yes

IBM 3046 Power Unit Model 1

The IBM 3046 Power Unit Model 1 provides electric power for the 3145 Processing Unit Models HG and I.

IBM 3047 Power Unit Model 1

The IBM 3047 Power Unit Model 1 provides power for the 3145 Processing Unit Models H2, HG2, I2, IH2, J2, J12, K2, and 3145-3 Models A1 through A7.

Features of the 3145 and 3145-3

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Clear I/O (3145-3)
Command retry
Conditional swapping (3145-3)
CPU timer and clock comparator (3145-3)
Floating point (3145-3)
Extended-precision floating point (3145-3)
Halt device
I/O extended logout
Limited channel logout
PSW-key handling (3145-3)
Translation

Optional

Clear I/O (3145)
Conditional Swapping (3145)
CPU timer and clock comparator (3145)
Direct control with external signals
Floating point with extended-precision floating point (3145)
PSW-key handling (3145)

Programming Assists

Standard

APL assist (3145-3)
ECPS:VS1 (3145-3)
ECPS:VM/370 (3145-3)
OS/DOS compatibility

Optional

APL assist (3145)
1401/1440/1460 compatibility, or 1401/1440/1460 and 1410/7010 compatibility
VM assist (3145)

Channel Features

Standard

Byte multiplexer channel (8 shared and 8 nonshared subchannels on 3145; 8 shared and 56 nonshared subchannels on 3145-3)
Selector channel, first (3145)
Block multiplexer channel, first, with 8 subchannels (3145-3)
Word buffer (3145-3; increases block multiplexer channel data rate from 820 kilobytes per second to 1.85 megabytes per second)

Optional

Byte multiplexer subchannels, additional (8 shared, or 56 nonshared), or 8 shared and 120 nonshared, or 256 nonshared)
Block multiplexer channel, second (3145-3)
Block multiplexer channel, third (3145-3)
Block multiplexer channel, fourth (3145-3)
Block multiplexer channel (3145) (converts selector channel(s) to block multiplex operation; subchannels are provided in groups of 16 up to a maximum of 512 per system)
Selector channel, second (3145)
Selector channel, third (3145)
Selector channel, fourth (3145)
Word buffer (3145; increases selector channel data rate from 820 kilobytes per second to 1.85 megabytes per second)

Integrated Adapters

Optional

Channel-to-channel adapter
2319 Disk Storage Model A1 integrated file adapter (3145-FED, -GE, -GFD, -H, -HG, and -I)
Integrated storage control (3145-H2, -HG2, -I2, -IH2, -J2, -JI2, -K2, and 3145-3) with or without two-channel switch)
3210 Console Printer Keyboard adapter, or 3215 Console Printer-Keyboard adapter (required)
3210-2 Remote Console Printer attachment

Miscellaneous Features

Standard

Audible alarm
Instruction retry
Storage error checking and correction

Optional

Emergency power-off control for one or two, or as many as 12 systems

Programming Support for the Model 145

Programming support for the Model 145 includes:

- DOS (Disk Operating System)
- DOS/VS (Disk Operating System/Virtual Storage)
- OS/MFT (Operating System/Multiprogramming with a Fixed Number of Tasks)
- OS/MVT (Operating System/Multiprogramming with a Variable Number of Tasks)
- OS/VS1 (Operating System/Virtual Storage 1)
- OS/VS2 (Operating System/Virtual Storage 2)
- VM/370 (Virtual Machine Facility/370)

System/370 Model 148

The IBM System/370 Model 148 (Figure 2-6) provides efficient performance while preserving upward compatibility in both commercial and scientific applications, and offers processor storage capacities of 1 megabyte (1,048,576 bytes) or 2 megabytes (2,097,152 bytes).

The performance of the Model 148 is further enhanced by:

- Virtual storage capability, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- System/370 reliability and serviceability features, such as retry capabilities, error-logging facilities, extensive internal checking circuits, and error checking and correction (ECC) circuits for main storage and control storage.
- A console file, which provides a facility for loading control storage with either the System/370 microprogram, extensive microdiagnostics, or system tests.
- An input/output display console and keyboard for operator communication with the system. The display console provides a fast means of displaying system status information and also provides the capability to select some aspects of the system environment at initial microprogram loading (IMPL) time.
- Extended control-program support.
- Control storage capacity that covers control storage requirements for the full line of Model 148 standard and optional features.

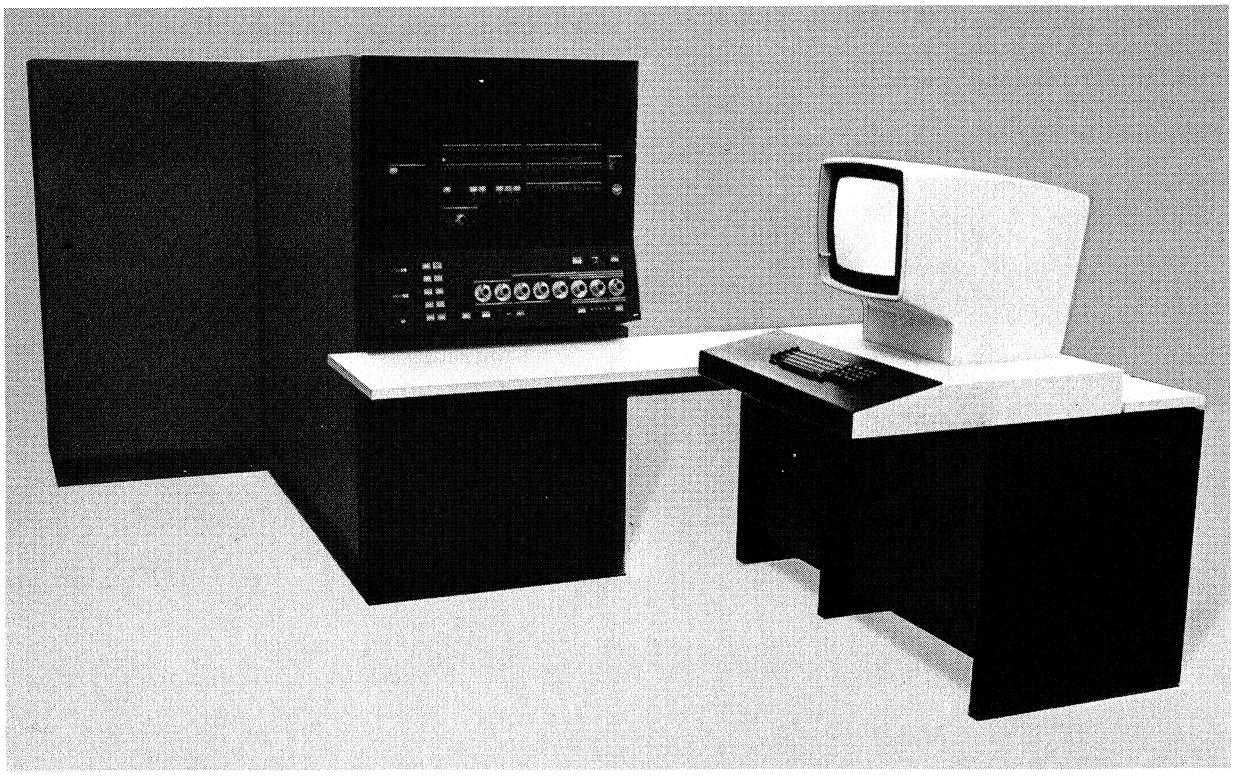


Figure 2-6. IBM System/370 Model 148

System Components

The Model 148 system includes:

- IBM 3148 Processing Unit Model J or K with attached display console and keyboard
- IBM 3047 Power Unit Model 1
- Appropriate input/output devices

The Model 148 is controlled and monitored by means of the system control panel on the CPU and the display console. An IBM 3287 Printer Model 1 or 2 can be attached to the Model 148 as a console printer. The console file, which is located under the operator's console table, is the initial microprogram loading (IMPL) device for the system. The file provides all microcode for the system on removable diskettes.

IBM 3148 Processing Unit

The 3148 Processing Unit, which has a basic machine cycle time of 180 to 270 nanoseconds (depending on internal CPU operations), has the following logical components:

- Central processing unit
- Processor storage with control storage
- Channels

Processor Storage: Part of 3148 Processing Unit

Processor Storage Capacities:

Capacity (Bytes)	Model
1,048,576 (1M)	J
2,097,152 (2M)	K

Storage Cycle Time: 405 nanoseconds for a main storage read, and 540 nanoseconds for a main storage write.

Storage Access Width: Eight bytes on instruction fetches.

Control Storage: Part of 3148 Processing Unit

Control Storage Capacity: 128K (131,072) bytes.

Control Storage Access Time: 75 nanoseconds.

Channels: Part of 3148 Processing Unit

One byte multiplexer channel and four block multiplexer channels are standard on the Model 148.

The byte multiplexer channel has 64 byte multiplexer subchannels, and additional subchannels can be added for a total of 128 or 256 subchannels.

The four block multiplexer channels have 64 nonshared subchannels as standard. Subchannels can be added for a system total of 128, 256, or 512. Each channel has the word buffer that increases channel data rate by allowing up to four bytes at a time to be transferred between the channel and processor storage.

IBM 3047 Power Unit Model 1

The IBM 3047 Power Unit Model 1 provides power for the 3148 Processing Unit.

Features of the 3148

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Floating point
Extended-precision floating point
Halt device
I/O extended logout
Limited channel logout
PSW-key handling
Translation

Optional

Direct control with external signals

Programming Assists

Standard

APL assist
ECPS:VS1
ECPS:VM/370
OS/DOS compatibility
1401/1440/1460 and 1410/7010 compatibility
3145 CPU mode selection

Channel Features

Standard

Byte multiplexer channel (8 shared and 120 nonshared subchannels,
or 256 nonshared subchannels
Block multiplexer channels (four channels, with a total of 512 subchannels, each channel has the word buffer for a data rate of 1.85 megabytes per second)
Word buffer (increases block multiplexer channel data rate from 820 kilobytes per second to 1.85 megabytes per second)

Integrated Adapters

Standard

Display console
3286 Printer Model 2, 3287 Console Printer Model 1 or 2 adapter

Optional

Channel-to-channel adapter
Integrated storage control (with or without two-channel switch)
3203 Printer Model 4 attachment, first
3203 Printer Model 4 attachment, second

Miscellaneous Features

Standard

Audible alarm
Instruction retry
Storage error checking and correction

Optional

Emergency power-off control for one or two, or as many as 12 systems

Programming Support for the Model 148

Programming support for the Model 148 includes:

- DOS/VS (Disk Operating System/Virtual Storage)
- OS/VS1 (Operating System/Virtual Storage 1)
- VM/370 (Virtual Machine Facility/370)

System/370 Model 158

The System/370 Model 158 (Figure 2-7), with either the IBM 3158 Processing Unit or the extended-performance IBM 3158-3 Processing Unit, features monolithic processor storage and virtual storage capability, and provides both high performance and expanded capabilities for a variety of applications.

The Model 158 offers:

- Processor storage, which uses compact, high-speed circuitry, and provides real storage capacities of 524,288 bytes to 6,291,456 bytes.
- Virtual storage capability, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- The System/370 extended feature, which is supported by the MVS/System Extensions program product, improves the execution of some of the functions of MVS, the operation of the translation lookaside buffer (TLB), and the protection of some of the storage locations used by the operating system.
- High-speed buffer storage, which stores currently used sections of processor storage for faster accessing of data.
- A display console, which provides a visual communication link with the system.
- An attached processing capability, which, by means of the IBM 3052 Attached Processing Unit Model 1, increases the instruction execution rate of the system.
- A multiprocessing capability, which increases flexibility and availability, permits the sharing of processor storage and I/O devices, and improves workload balance between the two processing units.
- Retry facilities, which reattempt the execution of most failing instructions and channel commands.

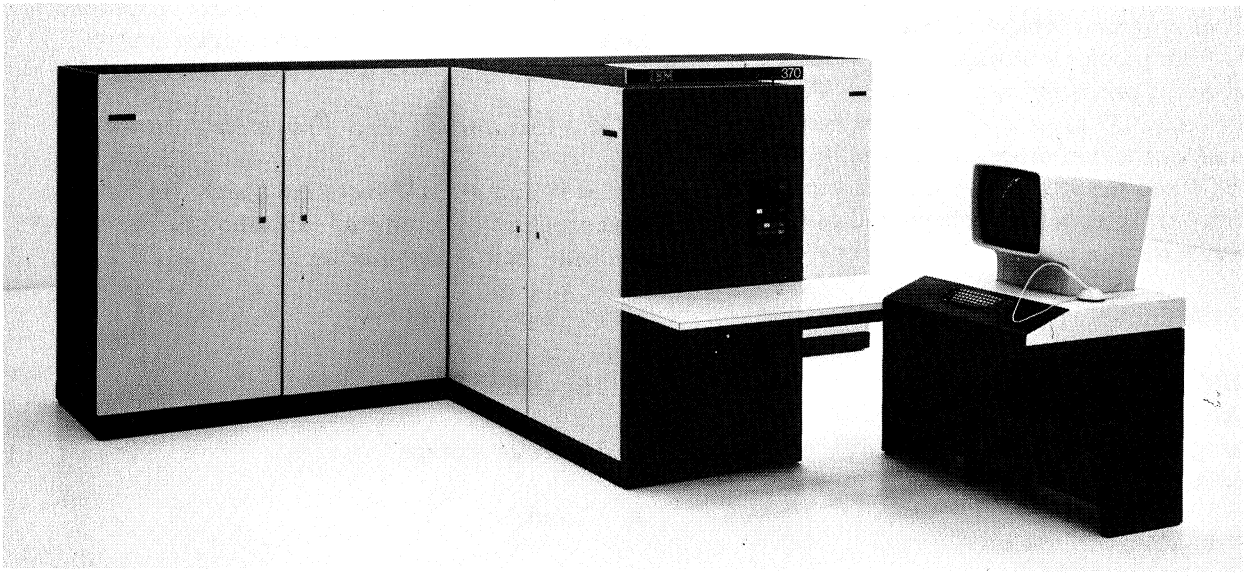


Figure 2-7. IBM System/370 Model 158

System Components

The Model 158 uniprocessing system includes:

- IBM 3158 Processing Unit Model I, J, JI, K, KJ, L, LJ, or LK; or IBM 3158-3 Processing Unit Model U31, U32, U33, U34, U35, U36, U37, or U38
- Appropriate input/output devices

The Model 158 attached processing system includes:

- IBM 3158 Processing Unit Model AP1, AP2, AP3, AP4, AP5, AP6, AP7, or AP8; or IBM 3158-3 Processing Unit Model A31, A32, A33, A34, A35, A36, A37, or A38
- IBM 3052 Attached Processing Unit Model 1 (with an IBM 3056 Remote System Console attached for diagnostic use)
- Appropriate input/output devices

The 3158 or 3158-3 Processing Unit and the 3052 Attached Processing Unit operate under a single system control program. The 3052 retains, in its buffer, data from processor storage of the 3158 or 3158-3, and works primarily with the buffer. A 3056 is attached to the 3052 as part of its service processor. The combined instruction processing capability of the 3158 or 3158-3 and the 3052 processors can increase system instruction execution rates beyond those of the uniprocessing system.

The Model 158 multiprocessing system includes:

- Two IBM3158 Processing Units Model MP1, MP2, MP3, MP4, MP5, or MP6; or IBM 3158-3 Processing Units Model M31, M32, M33, M34, M35, M36, M37, or M38
- IBM 3058 Multisystem Unit
- Appropriate input/output devices

The two multiprocessor processing units operate under a single system control program, sharing each other's processor storage and also input/output devices whose control units have two-channel switching capability. The IBM 3058 Multisystem Unit, which is located between the two processing units, enables intersystem communication and also permits selection of the mode of operation (MP or UP), assignment of storage addresses, and attachment of I/O control units having the remote switch attachment feature.

In a multiprocessing system with the 3158, both processing units must have the same real storage capacity. In a multiprocessing system with the 3158-3, the two processing units (except in Models M31 and M33) may have different real storage capacities. A multiprocessor model of a 3158 and one of a 3158-3 a can be connected if each has the same real storage capacity, in which case alternate power down is not operational.

The systems are controlled and monitored by means of the display console, and the system control panel on the 3158 or 3158-3 Processing Unit. The cathode-ray tube display, which provides a visual communication link with the system, can show 25 lines per display with 80 characters per line. Manual input to the system is provided by both a light pen and a keyboard. Printed copy of the display is available by means of an IBM 3213 Console Printer. Execution of console functions is under microprogram control.

IBM 3158 and 3158-3 Processing Units

The 3158 and 3158-3 Processing Units, which have a basic machine cycle time of 115 nanoseconds, have the following logical components:

- Central processing unit
- High-speed buffer storage
- Processor storage
- Channels

High-Speed Buffer Storage

The high-speed buffer storage capacities are 8K (8,192) bytes for the 3158, and 16K (16,384) bytes for the 3158-3.

Processor Storage: Part of 3158 and 3158-3 Processing Units

Processor Storage Capacities:

Capacity (Bytes)	158 Model Designation 3158	3158-3
524,288 (512K)	I, AP1, MP1	U31, A31, M31
1,048,576 (1M)	J, AP2, MP2	U32, A32, M32
1,572,864 (1536K)	JI, AP3, MP3	U33, A33, M33
2,097,152 (2M)	K, AP4, MP4	U34, A34, M34
3,145,728 (3M)	KJ, AP5, MP5	U35, A35, M35
4,194,304 (4M)	L, AP6, MP6	U36, A36, M36
5,242,880 (5M)	LJ, AP7	U37, A37, M37
6,291,456 (6M)	LK, AP8	U38, A38, M38

Storage Cycle Time: 1,035 nanoseconds for a read, and from 690 to 920 nanoseconds for a write.

Storage Access Width: Sixteen bytes.

Channels: Part of 3158 and 3158-3 Processing Units

The Model 158 can have one byte multiplexer channel and as many as five block multiplexer channels, or two byte multiplexer channels (the second as an optional feature) and as many as four block multiplexer channels.

Processing Unit Conversion

A 3158 can be field-converted to a 3158-3.

IBM 3052 Attached Processing Unit

The IBM 3052 Attached Processing Unit is an instruction processor that uses monolithic technology and works with the 3158 or 3158-3 Processing Unit to increase instruction execution rates beyond those of the 3158 or 3158-3 alone.

The 3052, which has a basic machine cycle time of 115 nanoseconds, has the following logical components:

- Central processing unit
- High-speed buffer storage

High-Speed Buffer Storage

The 3052 has a high-speed buffer storage capacity of 16K (16,384) bytes.

IBM 3056 Remote System Console Model 1

The IBM 3056 Remote System Console Model 1, an optional feature for the 3158 and 3158-3, is a standalone display and keyboard for the Model 158. The display and keyboard are identical to those on the 3158 and 3158-3. The 3056 permits remote operation of the system up to 150 feet from the 3158 or 3158-3, thus providing increased flexibility in system configuration and operation.

IBM 3058 Multisystem Unit Model 1

The IBM 3058 Multisystem Unit Model 1 contains hardware for communications between two multiprocessing models of the Model 158. The 3058 also contains control facilities for mode of operation (uniprocessing or multiprocessing), storage address assignment, and attachment of input/output units having the remote switch attachment feature.

Features of the 3158 and 3158-3

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Floating point
Halt device
Limited channel logout
Multiprocessing (A, AP, M, and MP models)
PSW-key handling
Translation

Optional

Direct control (with external signals)
Extended-precision floating point
System/370 extended

Programming Assists

Optional

1401/1440/1460 and 1410/7010 compatibility
7070/7074 compatibility
Assists for MVS/370
OS/DOS compatibility
ECPS OS/VS1 (includes virtual machine assist and extended-precision floating point)
Virtual machine assist

Channel Features

Standard

Byte multiplexer channel (3158: 8 shared and 120 nonshared subchannels, or 256 nonshared subchannels; 3158-3: 256 nonshared subchannels less 16 or 32 for each shared subchannel)
Block multiplexer channels, two (3158: 8 shared subchannels per channel and 480 nonshared subchannels per system; 3158-3: 32 or 40 shared subchannels per channel and as many as 736 nonshared subchannels per system)

Optional

Block multiplexer channel, third
Block multiplexer channel, fourth, or byte multiplexer channel, second
Block multiplexer channel, fifth

Integrated Adapters

Standard

Display console

Optional

3213 Console Printer attachment
3056 Remote Console attachment
Channel-to-channel adapter
Integrated storage controls (two) with or without two-channel switches and with or without staging adapters on M and MP models, and with or without adapters, and (on M and MP-series models) with or without remote switch attachment

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
Instruction retry
I/O power sequence control for control units 1 to 16

Optional

Emergency power-off control for one or two, or as many as 12 systems
Power warning
I/O power sequence control for control units 17 through 36 in groups of four

Features of the 3052

The following features are categorized as programming features, programming assists, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Conditional swapping
CPU timer and clock comparator
Floating point
Multiprocessing
PSW-key handling
Translation

Optional

Direct control (with external signals)
Extended-precision floating point
System/370 extended

Programming Assists

Optional

1401/1440/1460 and 1410/7010 compatibility
7070/7074 compatibility
Assists for MVS/370
OS/DOS compatibility
Virtual machine assist

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
Instruction retry

Programming Support for the Model 158

Programming support for the Model 158 includes:

- DOS/VS (Disk Operating System/Virtual Storage
- OS/MFT (Operating System/Multiprogramming with a Fixed Number of Tasks)
- OS/MVT (Operating System/Multiprogramming with a Variable Number of Tasks)
- OS/VS1 (Operating System/Virtual Storage 1)
- OS/VS2 (Operating System/Virtual Storage 2)
- MVS/System Extensions program product (for the System/370 extended feature)
- VM/370 (Virtual Machine Facility/370)

The Model 158 attached processing system is supported by the latest release level of OS/VS2 modified by a selectable unit (SU).

The Model 158 multiprocessing system, when operating in MP mode, is supported by OS/VS2 Releases 2 and 3.

System/370 Model 168

The System/370 Model 168 (Figure 2-8), with either the IBM 3168 Processing Unit or the IBM 3168-3 Processing Unit, is designed for large-scale, high-speed scientific and commercial applications.

The Model 168 offers:

- Integrated monolithic processor storage, which provides real storage capacities of 1M (1,048,576) bytes to 8M (8,388,608) bytes.
- Virtual storage capability, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- The System/370 extended feature (supported by the MVS/System Extensions program product), which improves the execution of some of the functions of MVS, the operation of the translation lookaside buffer (TLB), and the protection of some of the storage locations used by the operating system.
- High-speed buffer storage, which can sharply reduce the time required for fetching currently used sections of processor storage.
- Instruction retry and processor storage error checking and correction (ECC), which improve operations.
- An attached processing capability in the 3168-3, which, by means of the IBM 3062 Attached Processing Unit, increases the instruction execution rate of the system.
- A multiprocessing capability, which improves workload balance between the two processing units by permitting the sharing of processor storage and I/O devices.

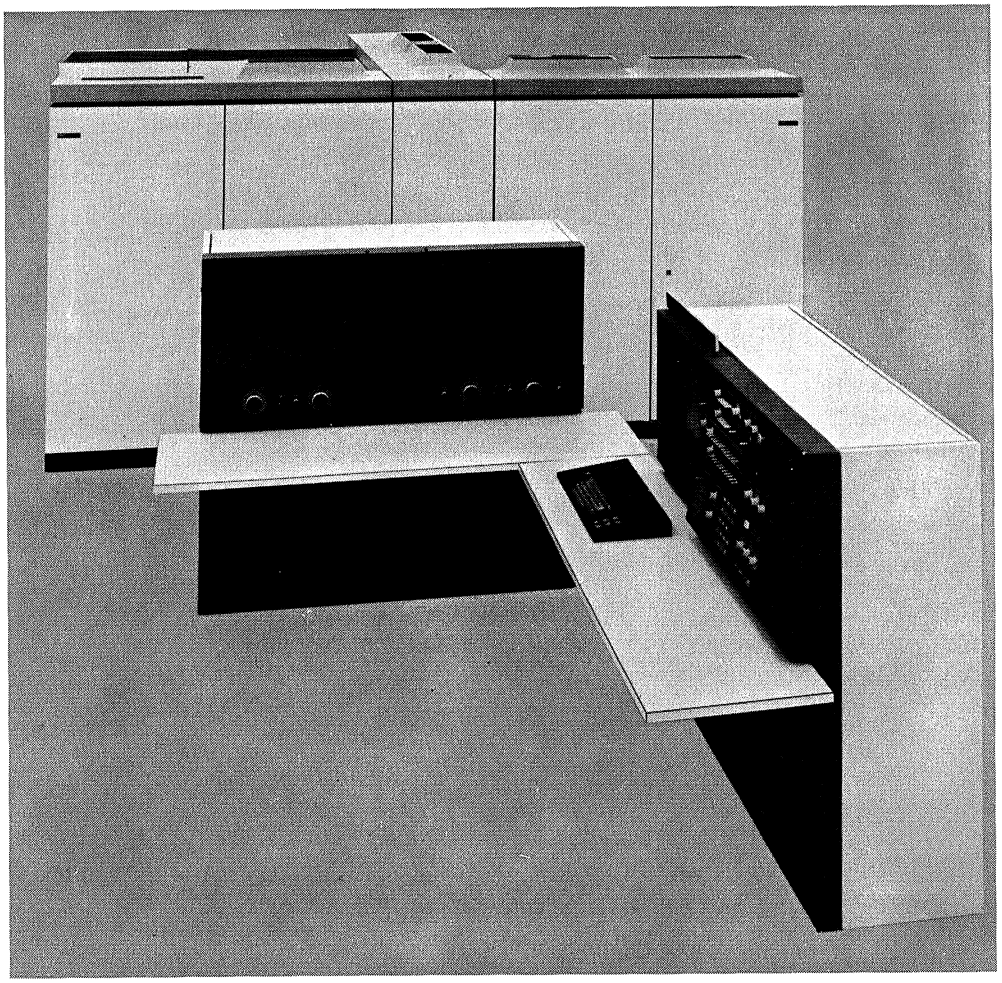


Figure 2-8. IBM System/370 Model 168 with IBM 3066 System Console

System Components

The Model 168 uniprocessing system includes:

- IBM 3168 Processing Unit Model J, K, KJ, L, LJ, LK, LKJ, or M: or IBM 3168-3 Processing Unit Model U31, U32, U33, U34, U35, U36, U37, or U38
- IBM 2860 Selector Channel and/or IBM 2870 Multiplexer Channel and/or IBM 2880 Block Multiplexer Channel
- IBM 3066 System Console Model 2
- IBM 3067 Power and Coolant Distribution Unit (Model 2 for the 3168 and Model 3 for the 3168-3)
- Appropriate input/output devices

The Model 168 attached processing system includes:

- IBM 3168-3 Processing Unit Model A31, A32, A33, A34, A35, A36, A37, or A38
- IBM 3062 Attached Processing Unit Model 1
- IBM 2860 Selector Channel and/or IBM 2870 Multiplexer Channel and/or IBM 2880 Block Multiplexer Channel
- IBM 3066 System Console Model 3 (allows diagnostic or system activity choices for either processing unit)
- IBM 3067 Power and Coolant Distribution Units (one Model 3 for the 3168-3 and one Model 5 for the 3062)
- Appropriate input/output devices

The 3168-3 Processing Unit and the 3062 Attached Processing Unit operate under a single system control program with the channels attached to the 3168-3. The 3062 achieves high performance by retaining processor storage data on which it is currently operating in its own 32K buffer storage and working primarily with the buffer. The combined instruction processing capability of the two processors can increase system instruction execution rates beyond those of the uniprocessing system.

The Model 168 multiprocessing system includes:

- Two IBM 3168 Processing Units Model MP1, MP2, MP3, MP4, MP5, MP6, MP7, or MP8; or two IBM 3168-3 Processing Units Model M31, M32, M33, M34, M35, M36, M37, or M38
- IBM 2860 Selector Channel and/or IBM 2870 Multiplexer Channel and/or IBM 2880 Block Multiplexer Channel (one or more channels for each processing unit)
- IBM 3068 Multisystem Communication Unit Model 1
- IBM 3066 System Console Model 2 (one for each processing unit)
- IBM 3067 Power and Coolant Distribution Unit Models 2 or 3 (one Model 2 for the 3168 and one Model 3 for the 3168-3)
- Appropriate input/output devices

The two processors, which need not have the same processor storage capacities, operate under a single system control program. These processors share each other's processor storage and can also share input/output devices whose control units have two-channel switching capability. The 3068 Multisystem Communication Unit, located between the processors, provides for intersystem communication, selection of the mode of operation (MP or UP), assignment of storage addresses, and attachment of I/O control units having the remote switch attachment feature.

The 3168 Processing Unit MP-series and the 3168-3 Processing Unit M-series are compatible and may be interconnected in the multiprocessing configuration.

The system is controlled and monitored by means of the IBM 3066 System Console. Here, the operator may enter data, obtain visual output, be alerted by an audible alarm, or interact with the system; for example, by presenting an attention signal.

IBM 3168 and 3168-3 Processing Units

The 3168 and 3168-3 Processing Units, which have a basic machine cycle time of 80 nanoseconds, have the following logical components:

- Central processing unit
- High-speed buffer storage
- Processor storage

The channels are separate units.

High-Speed Buffer Storage

The high-speed buffer storage capacity is 8K (8,192) bytes for the 3168, which is optionally expandable to 16K (16,384) bytes; and 32K (32,768) bytes for the 3168-3.

Processor Storage: Part of 3168 and 3168-3 Processing Units

Processor Storage Capacities:

Capacity (Bytes)	168 Model Designation 3168	3168-3
1,048,576 (1M)	J, MP1	U31, A31, M31
2,097,152 (2M)	K, MP2	U32, A32, M32
3,145,728 (3M)	KJ, MP3	U33, A33, M33
4,194,304 (4M)	L, MP4	U34, A34, M34
5,242,880 (5M)	LJ, MP5	U35, A35, M35
6,291,456,(6M)	LK, MP6	U36, A36, M36
7,340,032 (7M)	LKJ, MP7	U37, A37, M37
8,388,608 (8M)	M, MP8	U38, A38, M38

Storage Cycle Time: 320 nanoseconds.

Storage Access Width: Eight bytes.

Storage Interleaving: Four-way.

Channels: IBM 2860 Selector Channel, 2870 Multiplexer Channel, and 2880 Block Multiplexer Channel

The System/370 Model 168 uses the IBM 2860 Selector Channel Models 1-3, the IBM 2870 Multiplexer Channel Model 1, and the IBM 2880 Block Multiplexer Channel Models 1 and 2, which contain the following channels:

Unit	Model	Channels
2860	1	One selector channel
	2	Two selector channels
	3	Three selector channels
2870	1	One byte multiplexer channel
2880	1	One block multiplexer channel
	2	Two block multiplexer channels

Six selector or block multiplexer channels in any combination (with or without one byte multiplexer channel, or five selector or block multiplexer channels in any combination with two byte multiplexer channels can be attached to the Model 168).

Five additional block multiplexer channels are optionally available (system limit of seven channel frames).

Processing Unit Conversion: The 3168 Processing Unit Models J through M can be converted to a 3168 MP-series Processing Unit, or to a 3168-3 U-series, A-series, or M-series Processing Unit.

All conversions require appropriate changes to associated 3066 System Console and the 3067 Power and Coolant Distribution Unit.

IBM 3062 Attached Processing Unit

The 3062 is an instruction processor using monolithic system technology that attaches to and works only with an 3168-3 A-series Processing Unit. The 3062, which has a basic machine cycle time of 80 nanoseconds, has the following logical components:

- Central processing unit
- High-speed buffer storage

High-Speed Buffer Storage

The high-speed buffer storage capacity of the 3062 is 32K (32,768) bytes.

IBM 3066 System Console Models 2 and 3

The IBM 3066 System Console provides the switches, lights, display, and control functions for the Model 168. The 3066 Model 2 is used with each 3168 or 3168-3 Processing Unit. The 3066 Model 3 is used with each 3168-3 A-series model to support the 3062 Attached Processing Unit.

IBM 3067 Power and Coolant Distribution Unit Models 2 and 3

The IBM 3067 Power and Coolant Distribution Unit provides power and coolant distribution control for the Model 168. The 3067 Model 2 is used with the 3168 and the 3067 Model 3 is used with the 3168-3.

IBM 3068 Multisystem Communication Unit Model 1

The IBM 3068 Multisystem Communication Unit Model 1 contains hardware for communications between two multiprocessing models of the Model 168. The 3068 also contains control facilities for mode of operation (uniprocessing or multiprocessing), storage address assignment, and attachment of input/output units having the remote switch attachment feature.

Features of the 3168 and 3168-3

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Direct control
Extended-precision floating point
External signals
Fast release
Floating point
Halt device
I/O extended logout
Multiprocessing (A, M, and MP models)
PSW-key handling
Translation

Optional

System/370 extended

Programming Assists

Optional

7070/7074 compatibility
7080 compatibility
709/7090/7094/7094-II compatibility
Assists for MVS/370

Channel Features

Standard

192 nonshared subchannels (2870)
8 shared and 56 nonshared subchannels (individually on each block-multiplexer channel of 2880; data transfer rate of as high as 1.5 megabytes per second)

Optional

Channel-to-channel adapter (2860; individually on each selector channel)
High-speed transfer (2860; individually on each selector channel for support of the 3803 Magnetic Tape Control Model 3. Allows data transfer rates of as high as 1.3 megabytes per second)
Selector subchannel, first (for first or second 2870)
Selector subchannel, second (for first or second 2870)
Selector subchannel, third (for first 2870)
Selector subchannel, fourth (for second 2870)
Two-byte interface (2880; individually on each block multiplexer channel. Allows data transfer rates of as high as 3.0 megabytes per second)
Extended unit control words (2880; individually on each block multiplexer channel. Provides for 256 subchannels per channel)

Integrated Adapters

Standard

Display Console

Optional

3213 Console Printer integrated attachment (3168-3)
Integrated storage controls (two) with or without two-channel switches and with or without staging adapters, and (on M- and MP-series models) with or without remote switch attachment)

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
Instruction retry
Storage configuration control
Channel reconfiguration hardware (M and MP models)

Optional

High-speed buffer storage expansion to 16,384 bytes (3168)
High speed multiply
Emergency power-off control for one or two, or as many as 12 systems

Features of the 3062

The following features are categorized as programming features, programming assists, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Conditional swapping
CPU timer and clock comparator
Direct control
Extended-precision floating point
External signals
Floating point
Multiprocessing
PSW-key handling
Translation

Optional

System/370 extended

Programming Assists

Optional

Assists for MVS/370

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
High speed multiply
Instruction retry

Programming Support for the Model 168

Programming support for the Model 168 uniprocessing system includes:

- OS/MFT (Operating System/Multiprogramming with Fixed Number of Tasks)
- OS/MVT (Operating System/Multiprogramming with Variable Number of Tasks)
- OS/VS1 (Operating System/Virtual Storage 1)
- OS/VS2 (Operating System/Virtual Storage 2)
- MVS/System Extensions program product (for the System/370 extended feature)
- VM/370 (Virtual Machine Facility/370)

Programming support for the Model 168 multiprocessing system, when operating in MP mode, is by OS/VS2 (Operating system/Virtual Storage) Release 2.

Programming support for the Model 168 attached processing system is by OS/VS2 (Operating System/Virtual Storage 2) Release 3.

IBM 3031 Processor Complex and IBM 3031 Attached Processor Complex

The IBM 3031 Processor Complex (Figure 2-9) and the IBM 3031 Attached Processor Complex are designed for both commercial and scientific applications.

The 3031 Processor Complex and 3031 Attached Processor Complex offer:

- Virtual storage, which permits the user to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- A performance level, which is greater than that of the System/370 Model 148 when operating in the same configuration under identical programming. This increased performance results from the faster basic machine cycle time, the use of high-speed buffer storage, and the improved internal hardware design of the 3031 Processor.
- Integrated monolithic processor storage, which provides capacities of from 2M (2,097,152) bytes to 8M (8,388,608) bytes in 1M-byte (1,048,576-byte) increments.
- The System/370 extended facility, which, supported by the MVS/System Extensions program product, improves the execution of some of the functions of MVS, the operation of the translation lookaside buffer (TLB), and the protection of some of the storage locations that are used by the operating system.
- Channels within the processor, which keep power, space, and cooling requirements at a minimum.
- A console with an operator panel and two operating stations, which are individually addressable for system operation or service support.

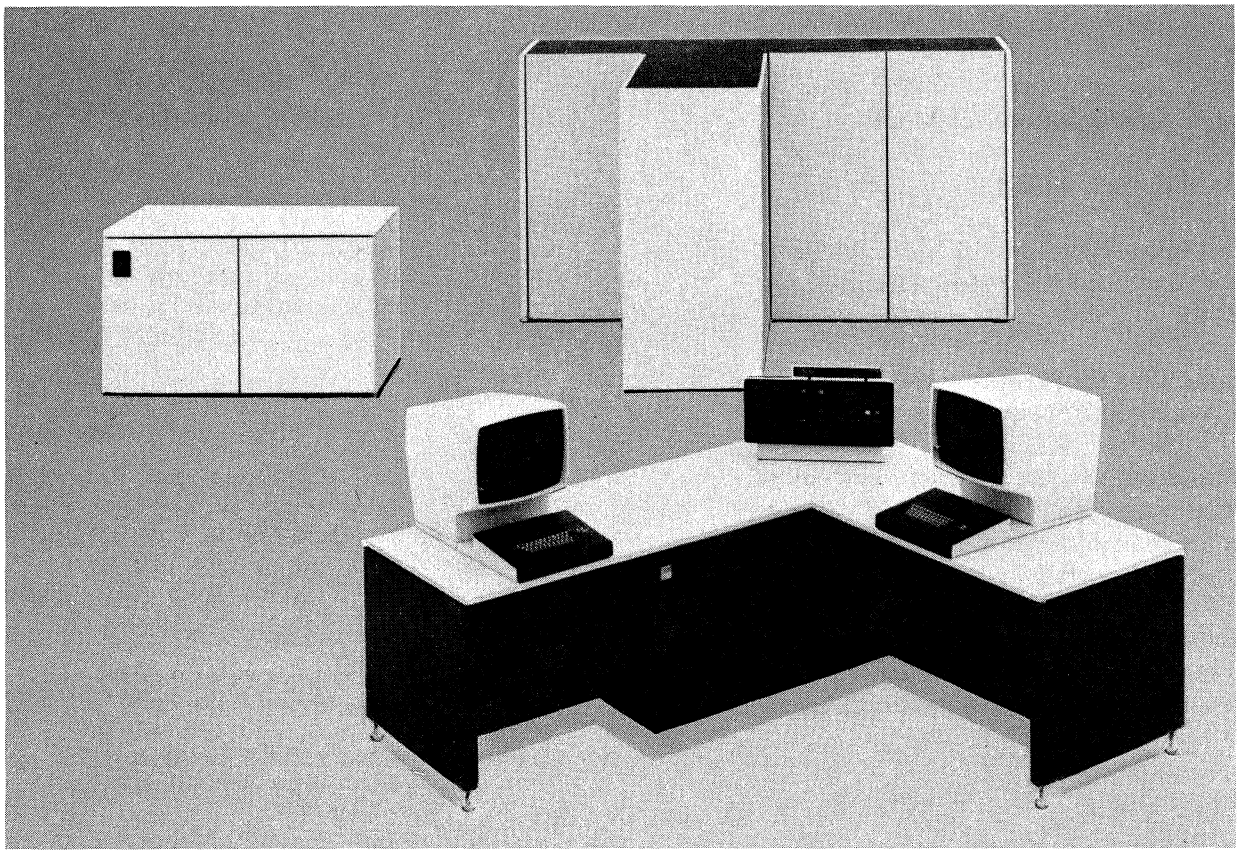


Figure 2-9. IBM 3031 Processor Complex (Design Model)

- Instruction retry and processor storage error checking and correction (ECC), which improve operations.
- An increase in the combined instruction rate by use of the IBM 3041 Attached Processor in conjunction with the 3031 Processor.

System Components

The IBM 3031 Processor Complex includes:

- IBM 3031 Processor Model 2, 3, 4, 5, 6, 7, or 8
- IBM 3036 Console Model 1
- IBM 3017 Power Unit Model 1

The system includes the 3031 Processor Complex and appropriate input/output devices.

The 3031 Attached Processor Complex includes:

- IBM 3031 Processor Model A2, A3, A4, A5, A6, A7, or A8
- IBM 3041 Attached Processor Model 1
- IBM 3036 Console Model 1
- IBM 3017 Power Unit Model 1 (one for the 3031 Processor and one for the 3041 Attached Processor)

The system includes the 3031 Attached Processor Complex and appropriate input/output devices.

The 3041 Processor provides arithmetic and control functions that work with those of the 3031 Processor to increase the combined rate of instruction execution. The 3031 and 3041 operate under a single control program. The 3041 operates with its own high-speed buffer and accesses processor storage in the 3031. Plan views of the 3031 Processor Complex and 3031 Attached Processor Complex are shown in Figure 2-10.

The systems are controlled, monitored, and serviced by means of the IBM 3036 Console Model 1.

IBM 3031 Processor

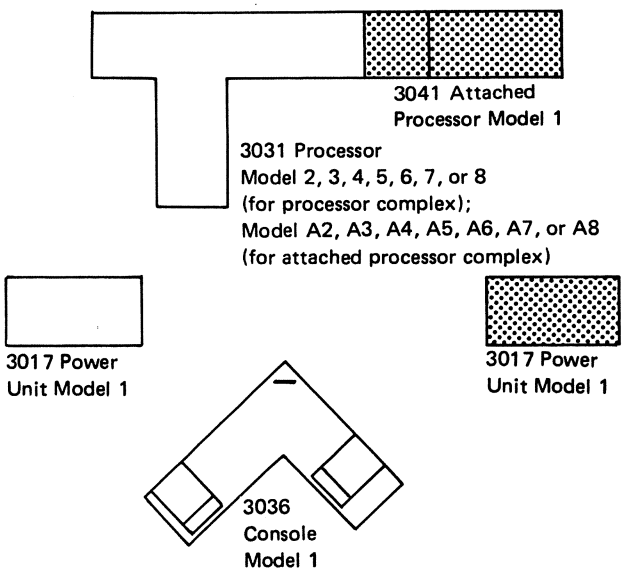
The 3031 Processor, which has a basic machine cycle time of 115 nanoseconds, has the following logical components:

- Central processing unit
- High-speed buffer storage
- Processor storage
- Channels

High-Speed Buffer Storage

The high-speed buffer storage of the 3031 has a capacity of 32K (32,768) bytes.

Processor Storage: Part of 3031 Processor



Note: The processor complex includes only nonshaded elements; the attached processor complex includes all elements.

Figure 2-10. Representative Plan Views of the 3031 Processor Complex and 3031 Attached Processor Complex

Processor Storage Capacities:

Capacity (Bytes)	3031 Model	Processor Designation
2,097,152 (2M)	2,	A2
3,145,728 (3M)	3,	A3
4,194,304 (4M)	4,	A4
5,242,880 (5M)	5,	A5
6,291,456 (6M)	6,	A6
7,340,032 (7M)	7,	A7
8,388,608 (8M)	8,	A8

Storage Cycle Time: 345 nanoseconds.

Storage Access Width: Eight bytes.

Storage Interleaving: Four-way.

Channels: Part of 3031 Processor

One byte multiplexer channel and five block multiplexer channels are standard on the 3031 Processor.

IBM 3041 Attached Processor

The 3041 Attached Processor is an instruction processor that attaches to and works with the 3031 Processor to achieve instruction execution rates beyond those of the 3031 Processor alone. Processor storage and the channels are part of the 3031 Processor only. The 3041 Attached Processor, which has a basic machine cycle time of 115 nanoseconds, has the following logical components.

- Central processing unit
- High-speed buffer storage

High-Speed Buffer Storage

The high-speed buffer storage of the 3041 has a capacity of 32K (32,768) bytes.

IBM 3036 Console Model 1

The IBM 3036 Console Model 1 has an operator panel and two operating stations. Each station consists of a display, which can show as many as 25 lines of 80 characters per line; a keyboard; a station processor; and a diskette drive. Each station is addressable so that it can be designated as either the operator station or the service support station.

A console security keylock is provided on the right side of each display:

1. With the key turned to the horizontal position, an initial microprogram load (IMPL) and normal display functions can be performed.

2. With the key turned to the vertical position, an IMPL cannot be performed. Any effort to change the frame that is presented on either display causes an alarm to sound.

IBM 3017 Power Unit Model 1

The IBM 3017 Power Unit Model 1 is a motor generator that produces 208 V ac, 415 Hz. One 3017 is required for the 3031 Processor in a 3031 Processor Complex; an additional 3017 is required for the 3041 Attached Processor in a 3031 Attached Processor Complex.

Features of the 3031

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Extended-precision floating point
Fast release
Floating point
Halt device
I/O extended logout
Limited channel logout
Multiprocessing (A-series models)
PSW-key handling
System/370 extended
Recovery extensions
Translation

Optional

Direct control (with external signals)
Dual address space (by miscellaneous equipment specification [MES] only)

Programming Assists

Standard

ECPS:VM/370
ECPS:VS1
Assists for MVS/370

Optional

Shadow-table bypass assist (by MES only)

Channel Features

Standard

One byte-multiplexer channel (256 subchannels, of which as many as 8 may be shared; data rate of 40 to 75 kilobytes per second)
Five block-multiplexer channels (each with 256 subchannels, of which as many as 8 may be shared; data rate of 1.5 megabytes per second)

Optional

Data streaming on two block multiplexer channels providing a data rate of 3.0 megabytes per second

Integrated Adapters

Optional

Channel-to-channel adapter

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
Instruction retry
Reloadable control storage
Storage configuration control

Features of the 3041

The following features are categorized as programming features, programming assists, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Conditional swapping
CPU timer and clock comparator
Extended-precision floating point
Floating point
Multiprocessing
PSW-key handling
System/370 extended
Translation

Optional

Direct control (with external signals)
Dual address space (by MES only)

Programming Assists

Standard

ECPS:VM/370
ECPS:VS1
Assists for MVS/370

Optional

Shadow-table bypass assist (by MES only)

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
Instruction retry
Reloadable control storage

Programming Support for the 3031 Processor Complex and 3031 Attached Processor Complex

Programming support for the 3031 Processor Complex or the 3031 Attached Processor Complex operating in uniprocessor mode includes:

- MVS (Multiple Virtual Storage)
- MVS/SP (Multiple Virtual Storage/System Product)
- MVS/System Extensions program product
- VM/370 (Virtual Machine Facility/370)
- VM/System Extensions program product
- VM/SP (Virtual Machine/System Product)
- OS/VS1 (Operating System/Virtual Storage 1)
- DOS/VS (Disk Operating System/Virtual Storage)
- ACP (Airline Control Program)

Programming support for the 3031 Attached Processor Complex operating in attached processor mode with the 3041 Attached Processor includes:

- OS/VS2 (Operating Systems/Virtual Storage 2)
- MVS/System Extensions program product
- MVS/SP (Multiple Virtual Storage/System Product)
- VM/370 (Virtual Machine Facility/370)
- VM/System Extensions program product
- VM/SP (Virtual Machine/System Product)

IBM 3032 Processor Complex

The IBM 3032 Processor Complex (Figure 2-11), which is designed for both commercial and scientific applications, offers:

- A performance level, which is greater than that of the System/370 Model 158 with the 3158-3 when operating in the same configuration under identical programming. This increased performance results from the faster basic machine cycle time and from the improved internal hardware design of the 3032 Processor.
- Virtual storage, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of processor storage.
- Integrated monolithic processor storage, which provides capacities of 2M (2,097,1520) bytes, 4M (4,194,304) bytes, 6M (6,291,456) bytes, and 8M (8,388,608) bytes.
- The System/370 extended facility, which, supported by the MVS/System Extensions program product, improves the execution of some of the functions of MVS, the operation of the translation lookaside buffer (TLB), and the protection of some of the storage locations that are used by the operating system.
- Channels within the processor, which keep power, space, and cooling requirements at a minimum.
- High-speed buffer storage, which stores currently used sections of processor storage for faster accessing of data.
- A console with an operator panel and two operating stations, which permits system operation concurrent with maintenance activity.
- Instruction retry and processor storage error checking and correction (ECC), which improve operations.

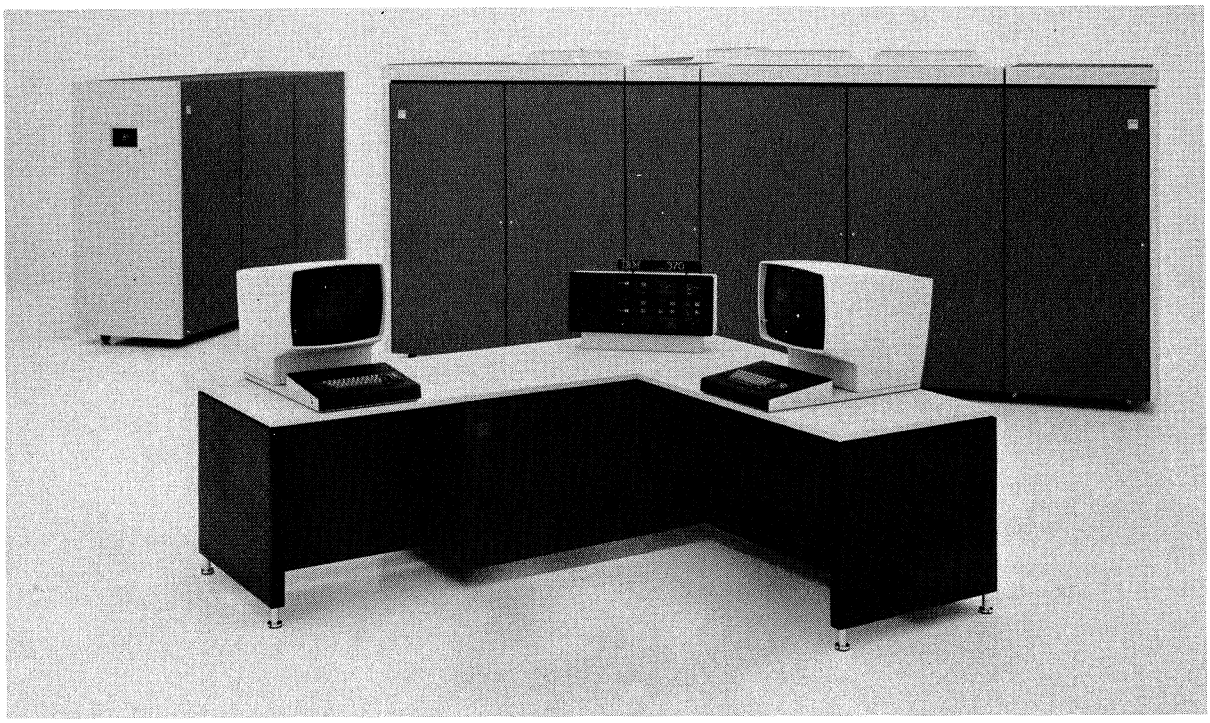


Figure 2-11. IBM 3032 Processor Complex (Design Model)

System Components

The 3032 Processor Complex includes:

- IBM 3032 Processor Models 2, 4, 6, or 8
- IBM 3036 Console Model 1
- IBM 3027 Power and Coolant Distribution Unit Model 1

The system includes the 3032 Processor Complex and appropriate input/output devices.

The system is controlled, monitored, and serviced by means of the IBM 3036 Console Model 1.

IBM 3032 Processor

The 3032 Processor, which has a basic machine cycle time of 80 nanoseconds, has the following logical components:

- Central processing unit
- High-speed buffer storage
- Processor storage
- Channels

High-Speed Buffer Storage

The high-speed buffer storage capacity of the 3032 is 32K (32,768) bytes.

Processor Storage: Part of 3032 Processor

Processor Storage Capacities:

Capacity (Bytes)	3032 Processor Model Designation
2,097,152 (2M)	2
4,194,304 (4M)	4
6,291,456 (6M)	6
8,388,608 (8M)	8

Storage Cycle Time: 320 nanoseconds.

Storage Access Width: Eight bytes.

Storage Interleaving: Four-way.

Channels: Part of 3032 Processor

One group of one byte multiplexer channel and five block multiplexer channels is standard on the 3032 Processor.

An additional group of one byte multiplexer channel and five block multiplexer channels is optional on the 3032 Processor.

IBM 3036 Console Model 1

The IBM 3036 Console Model 1 has an operator panel and two operating stations. Each station consists of a display, which can show as many as 25 lines of 80 characters per line; a keyboard; a console processor; and a diskette drive. Each station is addressable so that it can be designated as either the operator console or the service support console.

A console security keylock is provided on the right side of each display:

1. With the key turned to the horizontal position, an initial microprogram load (IMPL) and normal display functions can be performed.
2. With the key turned to the vertical position, an IMPL cannot be performed. Any effort to change the frame that is presented on either display causes an alarm to sound.

IBM 3027 Power and Coolant Distribution Unit Model 1

The IBM 3027 Power and Coolant Distribution Unit Model 1 provides control for the distribution of power and coolant to the 3032 Processor Complex.

Features of the 3032

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Direct control
Extended-precision floating point
External signals
Fast release
Floating point
Halt device
I/O extended logout
Limited channel logout
PSW-key handling
System/370 extended
Recovery extensions
Translation

Programming Features

Standard

Assists for MVS/370

Channel Features

Standard

One byte-multiplexer channel (256 subchannels, of which as many as 8 may be shared; data rate of from 40 to 75 kilobytes per second)
Five block-multiplexer channels (each has 256 subchannels, of which as many as 8 may be shared; data rate of 1.5 megabytes per second)

Optional

Extended channels (provides another byte multiplexer channel and five more block multiplexer channels)
Data streaming (on two block multiplexer channels of standard channel group with data rate of 3.0 megabytes per second;
or two byte interface on one block-multiplexer channel of standard channel group with data rate of 3.0 megabytes per second)
Data streaming (on two block multiplexer channels of optional channel group with data rate of 3.0 megabytes per second;
or two-byte interface on one block multiplexer channel of optional channel group with data rate of 3.0 megabytes per second)

Integrated Adapters

Optional

Channel-to-channel adapter

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
Instruction retry
Reloadable control storage
Storage configuration control

Programming Support for the 3032 Processor Complex

Programming support for the 3032 Processor Complex includes:

- MVS (Multiple Virtual Storage)
- MVS/System Extensions program product
- MVS/SP (Multiple Virtual Storage/System Product)
- VM/370 (Virtual Machine Facility/370)
- VM/System Extensions program product
- VM/SP (Virtual Machine/System Product)
- OS/VS1 (Operating System/Virtual Storage 1)
- ACP (Airline Control Program)

IBM 3033 Processor Complex, IBM 3033 Processor Complex Model Groups N and S, IBM 3033 Attached Processor Complex, and IBM 3033 Multiprocessor Complex

The IBM 3033 Processor Complex (Figure 2-12), IBM 3033 Processor Complex Model Groups N and S, IBM 3033 Attached Processor Complex, and IBM 3033 Multiprocessor Complex are designed for large-scale, high-speed scientific and commercial applications. With the same configuration under identical programming, the performance level of the 3033 U-series, A-series, M-series, and Model Group N Processors is greater than that of the 3168-3 Processing Unit. The performance level of the 3033 Processor Model Group S is greater than that of the 3031 Processor. Contributing to the performance of the 3033 Processor Complex and 3033 Processor Model Groups N and S Processor Complexes are:

- Virtual storage, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of storage.
- Integrated monolithic processor storage, which provides real storage capacities of up to 24M (25,165,824) bytes in the 3033 U-series and A-series Processors, up to 16M (16,777,216) bytes in the 3033 M-series Processor, 3033 Processor Model Group N, and 3033 Processor Model Group S. The 3033 Multiprocessor Complex can provide up to 32M (33,554,432) bytes of addressable real storage.
- The System/370 extended facility, which, supported by the MVS/System Extensions program product, improves the execution of some of the functions of MVS, the operation of the translation lookaside buffer (TLB), and the protection of some of the storage locations that are used by the operating system.
- Integrated channels, which reduce power, space, and cooling requirements over a similarly configured Model 168.
- A console with an operator panel and two operating stations, which permits system operation concurrent with maintenance activity.
- Instruction retry and processor storage error checking and correction (ECC), which improve operations.

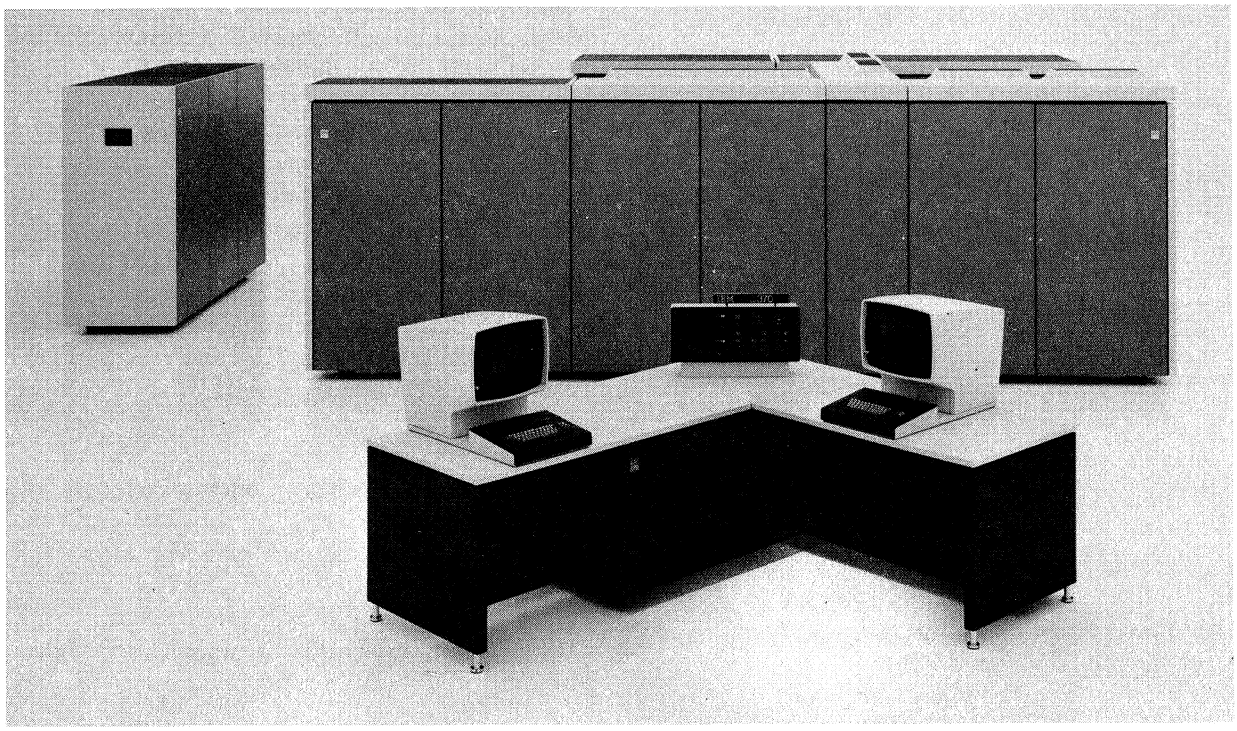


Figure 2-12. IBM 3033 Processor Complex (Design Model)

- Extended addressing (U-series, A-series, and M-series models only), which includes: extended real addressing, 31-bit indirect address word (IDAW), storage-key instruction extensions (with storage-key 4K-byte block on 3033-U24 and -A24 Models only).
- High-speed buffer storage, which stores currently used sections of processor storage for faster accessing of data.
- Power boundaries, which permit elements that have been logically configured out of the system (by the VARY command) to be physically varied offline, repaired, tested, and placed back online.
- Alternate CPU recovery (ACR) of MVS and channel-set switching, which enable both the attached processor complex and the multiprocessor complex to attempt to continue operation with a subset of total system resources.

System Components

The IBM 3033 Processor Complex includes:

- IBM 3033 Processor Model U4, U6, U8, U12, U16, or U24
- IBM 3036 Console Model 1
- IBM 3037 Power and Coolant Distribution Unit Model 1

The system includes the 3033 Processor Complex and appropriate input/output devices.

The IBM 3033 Processor Complex Model Group N includes:

- IBM 3033 Processor Model N4, N8, N12, or N16
- IBM 3036 Console Model 1
- IBM 3037 Power and Coolant Distribution Unit Model 1

The system includes the 3033 Processor Complex Model Group N and appropriate input/output devices.

The IBM 3033 Processor Complex Model Group S includes:

- IBM 3033 Processor Model S4, S8, S12, or S16
- IBM 3036 Console Model 1
- IBM 3037 Power and Coolant Distribution Unit Model 1

The system includes the 3033 Processor Complex Model Group S and appropriate input/output devices.

The IBM 3033 Attached Processor Complex includes:

- IBM 3033 Processor Model A4, A6, A8, A12, A16, or A24
- IBM 3042 Attached Processor Model 1 or 2
- IBM 3038 Multiprocessor Communication Unit Model 1
- IBM 3036 Console (one for the 3033 and one for the 3042)
- IBM 3037 Power and Coolant Distribution Unit Model 1 with the multiprocessing feature (one for the 3033 and one for the 3042)

The system includes the processor complex and appropriate input/output devices.

The 3033 attached processor complex normally operates in attached processor (AP) mode in which both processors share processor storage of the 3033. If the 3042 Model 1 is used, channels are part of the 3033 only. If the 3042 Model 2 is used, channels are part of both the 3033 and the 3042-2.

The IBM 3033 Multiprocessor Complex includes:

- Two IBM 3033 Processors Model M4, M6, M8, M12, or M16
- IBM 3038 Multiprocessor Communication Unit Model 1
- IBM 3036 Console Model 1 (one for each processor)

- IBM 3037 Power and Coolant Distribution Unit Model 1 with the multiprocessing feature (one for each processor)

The system includes the 3033 Multiprocessor Complex and appropriate input/output devices.

The 3033 Multiprocessor Complex can operate in either uniprocessor (UP) or multiprocessor (MP) mode. In UP mode, as many as 16 megabytes (as many as 32 megabytes if the extended addressing feature is installed) from the combined processor storage can be addressed by one processor. In MP mode, as many as 16 megabytes (as many as 32 megabytes if the extended addressing feature is installed) of the combined processor storage can be addressed by either processor.

Figure 2-13 shows plan views of the 3033 Processor Complex, 3033 Processor Complex Model Group N or S, 3033 Attached Processor Complex, and 3033 Multiprocessor Complex.

The systems are each controlled, monitored, and serviced by means of IBM 3036 Console.

IBM 3033 Processor and 3033 Processor Model Groups N and S

The 3033 Processor and the 3033 Processor Model Groups N and S, which have a basic machine cycle time of 57 nanoseconds, have the following logical components:

- Central processing unit
- High-speed buffer storage
- Processor storage
- Channels

High-Speed Buffer Storage

High-speed buffer storage capacities are 64K (65,536) bytes for the 3033 Processor, 16K (16,384) bytes for the 3033 Processor Model Group N, and 1K (1,024) bytes for the 3033 Processor Model Group S.

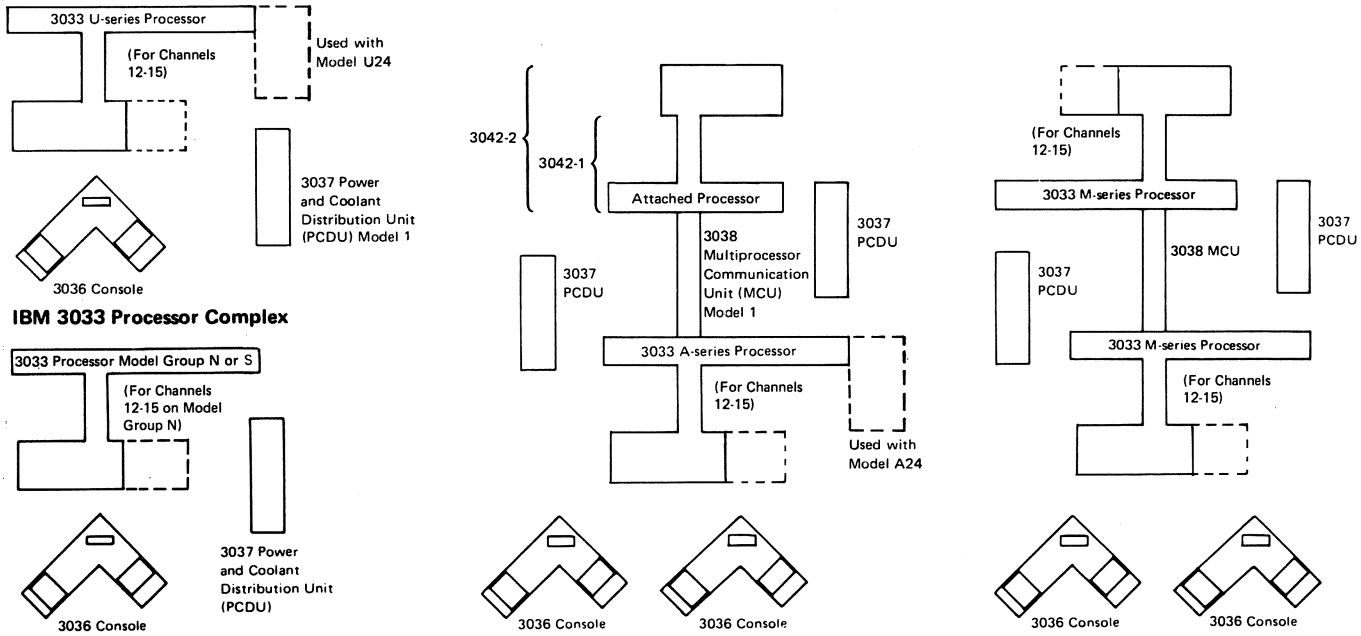


Figure 2-13. Plan Views of IBM 3033 Processor Complex, IBM 3033 Processor Complex Model Group N or S, IBM 3033 Attached Processor Complex, and IBM 3033 Multiprocessor Complex

Processor Storage: Part of 3033 Processor and 3033 Processor Model Groups N and S

Processor Storage Capacities:

Capacity (Bytes)	3033 Processor Model Designation
4,194,305 (4M)	S4, N4, U4, A4, M4
6,291,456 (6M)	U6, A6, M6
8,388,608 (8M)	S8, N8, U8, A8, M8
12,582,912 (12M)	S12, N12, U12, A12, M12
16,777,216 (16M)	S16, N16, U16, A16, M16
25,165,824 (24M)	U24, A24

Storage Cycle Time: 342 nanoseconds.

Storage Access Width: Eight bytes.

Storage Interleaving: Eight-way for the 3033 Processor, and four-way for the 3033 Processor Model Groups N and S.

Channels: Part of 3033 Processor and 3033 Processor Model Groups N and S

Twelve channels (two groups, each containing one byte multiplexer channel and five block multiplexer channels) are standard on the 3033 Processor U-series, A-series, and M-series models.

Six channels (one group containing one byte multiplexer channel and five block multiplexer channels) are standard on the 3033 Processor Model Group N and S.

Ten channels (one group containing one byte multiplexer channel and five block multiplexer channels, and a second group containing either four block multiplexer channels or one byte multiplexer channel and three block multiplexer channels) are optional on the 3033 Processor U-series, A-series, and M-series models and the 3033 Processor Model Group N.

Six channels (one group containing one byte multiplexer channel and five block multiplexer channels) are optional on the 3033 Processor Model Group S.

Each channel contains 256 subchannels, of which as many as eight in each channel can be shared subchannels.

Processor Conversion

The 3033 Processor Model Group S can be converted in the field to the 3033 Processor Model Group N or U, the 3033 Model Group N can be converted to the 3033 U-series Processor, and the 3033 U-series Processor can be converted to the 3033 A- or M-series Processor.

IBM 3042 Attached Processor Models 1 and 2

The IBM 3042 Attached Processor Models 1 and 2 provide arithmetic, logical, and control functions that work with those of the 3033 Processor to increase the rate of instruction execution. Model 2 has channels; Model 1 does not. The 3042 works with its own high-speed buffer storage and accesses processor storage, which is part of the 3033 Processor. The 3042 Attached Processor, which has a basic machine cycle time of 57 nanoseconds, has the following logical components:

- Central processing unit
- High-speed buffer storage
- Channels (Model 2 only)

Channels: Part of 3042 Attached Processor Model 2

One group of one byte multiplexer channel and five block multiplexer channels is standard on the 3042-2. An additional group of one byte-multiplexer channel and five block-multiplexer channels is available as an optional feature.

High-Speed Buffer Storage

The 3042 Models 1 and 2 each have a high-speed buffer storage capacity of 64K (65,536) bytes.

IBM 3038 Multiprocessor Communication Unit Model 1

The IBM 3038 Multiprocessor Communication Unit Model 1 contains hardware for communications between the two processors of a 3033 Attached Processor Complex or a 3033 Multiprocessor Complex. The 3038 is located between the two processors of either complex and contains two interdependent but logically isolated sides, each of

which is an extension of the associated processor. The optional extended addressing feature is required on the 3038 attached to a 3033 Processor Model A24 with the extended addressing feature in a 3033 Attached Processor Complex.

IBM 3036 Console Model 1

The IBM 3036 Console Model 1 has an operator panel and two operating stations. Each station consists of a display, which can show as many as 25 lines of 80 characters per line: a keyboard; a console processor; and a diskette drive. Each station is addressable so that it can be designated as either the operator console or the service support console.

A console security keylock is provided on the right side of each display:

- With the key turned to the horizontal position, an initial microprogram load (IMPL) can be performed. The display that is addressed as the operator console can present either the program (PR) frame or the power control (PC) frame, and the display that is addressed as the service support console can present any other frame.

- With the key turned to the vertical position, an IMPL cannot be performed. Any effort to change the frame that is presented on either display causes an alarm to sound.

In a 3033 Attached Processor Complex and in a 3033 Multiprocessor Complex, either of the two 3036 Consoles can be designated as the primary console. The primary console can be used to display and enter the mode of operation (UP, AP, or MP), and to assign addresses in processor storage.

IBM 3037 Power and Coolant Distribution Unit Model 1

The IBM 3037 Power and Coolant Distribution Unit Model 1 supplies power to the 3036 Console and, under control of the 3036, distributes power and coolant to the 3033 Processor, the 3033 Processor Model Groups N and S, or the 3042 Attached Processor Models 1 and 2. The optional multiprocessing feature is required on each of the two 3037s in a 3033 Attached Processor Complex and in a 3033 Multiprocessor Complex. The optional extended power feature is required on the 3037 attached to a 3033 Processor Model A24 or U24.

Features of the 3033

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing
Channel-set switching (A- and M-series models)
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Direct control
Extended-precision floating point
External signals
Fast release
Floating point
Halt device
I/O extended logout
Limited channel logout
Multiprocessing (A- and M-series models)
PSW-key handling
Recovery extensions
System/370 extended
Translation

Optional

Extended addressing (U-, A-, and M-series models only; provides extended real addressing, storage-key instruction extensions, 31-bit indirect-data-address word; required on Models U24 and A24 and on those models also provides storage-key 4K-byte block)
3033 Extension (provides dual address space, start-I/O fast queuing, and suspend-and-resume)

Programming Assists

Standard

Assists for MVS/370

Channel Features

Standard

First and second channel groups (U-, A, and M-series models; one byte multiplexer channel and five block multiplexer channels per group)
First channel group (Model Groups N and S; one byte multiplexer channel and five block multiplexer channels)

Optional

Second channel group (Model Groups N and S; one byte multiplexer channel and five block multiplexer channels)
Third channel group (Model Group N, and U-, A-, and M-series models; one byte multiplexer channel and four block multiplexer channels, or four block multiplexer channels)
Data streaming (on two block multiplexer channels of the first channel group providing a data rate of 3.0 megabytes per second;
or two-byte interface on one block multiplexer channel of first channel group providing a data rate of 3.0 megabytes per second)
Data streaming (on two block multiplexer channels of the second channel group providing a data rate of 3.0 megabytes per second;
or two-byte interface on one block multiplexer channel of second channel group providing a data rate of 3.0 megabytes per second)

Integrated Adapters

Optional

Channel-to-channel adapter for first channel group
Channel-to-channel adapter for second channel group

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
Instruction retry
Reloadable control storage
Storage configuration control

Features of the 3042

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Channel indirect data addressing (3042-2 only)
Channel-set switching
Clear I/O (3042-2 only)
Command retry (3042-2 only)
Conditional swapping
CPU timer and clock comparator
Direct control
Extended-precision floating point
External signals
Fast release (3042-2 only)
Floating point
Halt device (3042-2 only)
I/O extended logout
Limited channel logout (3042-2 only)
Multiprocessing
PSW-key handling
Recovery extensions
System/370 extended
Translation

Optional

Extended addressing (provides extended real addressing, storage-key instruction extensions, 31-bit indirect data-address word; required if attached to 3033-A24 and if so attached also provides storage-key 4K-byte block)
3033 extension (provides dual address space, start-I/O-fast queuing on 3042-2 only, and suspend-and-resume)

Programming Assists

Standard

Assists for MVS/370

Channel Features

Standard

First channel group (3042-2; one byte multiplexer channel and five block multiplexer channels, each channel with 256 subchannels, of which as many as eight may be shared)

Optional

Second channel group (3042-2; one byte multiplexer channel and five block multiplexer channels, each channel with 256 subchannels, of which as many eight may be shared)
Data streaming on two block multiplexer channels of first channel group providing a data rate of 3.0 megabytes per second, or two-byte interface on one block multiplexer channel of first channel group providing a data rate of 3.0 megabytes per second
Data streaming on two block multiplexer channels of second channel group providing a data rate of 3.0 megabytes per second, or two-byte interface on one block multiplexer channel of second channel group providing a data rate of 3.0 megabytes per second

Integrated Adapters

Optional

Channel-to-channel adapter for first channel group (3042-2 only)
Channel-to-channel adapter for second channel group (3042-2 only)

Miscellaneous Features

Standard

Error checking and correction
High-speed buffer storage
Instruction retry
Reloadable control storage

Programming Support for the 3033 Processor Complexes

Programming support for the 3033 Processor Complex, the 3033 Processor Complex Model Groups N and S, the 3033 A-series Processors of the 3033 Attached Processor Complex running in uniprocessor mode, or either processor of the 3033 Multiprocessor Complex running in uniprocessor mode includes:

- MVS (Multiple Virtual Storage)
- VM/370 (Virtual Machine Facility/370)
- OS/VS1 (Operating System/Virtual Storage 1)
- DOS/VSE (Disk Operating System/Virtual Storage Extended) Advance Functions program product
- ACP (Airline Control Program)

Notes:

1. Storage capacities of greater than 8M (8,388,608) bytes are not supported by OS/VS1.
2. DOS/VSE with its Advanced Functions program product supports the 3033 U-series Processors, the 3033 Processors Model Group N, and the 3033 Processors Model Group S, but is recommended only for the Model Group S. The maximum processor storage capacity for use with DOS/VSE is 8M (8,388,608) bytes.
3. The Airline Control Program requires the ACP/Transaction Processing Facility when used with the 3033 Processors Model Group S.

Programming support for the 3033 Multiprocessor Complex running in multiprocessor mode and for the 3033 Attached Processor Complex running in attached processor mode includes:

- MVS (Multiple Virtual Storage)
- VM/370 (Virtual Machine Facility/370)

Program products available for performance enhancement are:

- MVS/SE (Multiple Virtual Storage/System Extensions program product)
- VM/SE (Virtual Machine/System Extensions program product)
- MVS/SP (Multiple Virtual Storage/System Product)
- ACP/TPF (Airline Control Program/Transaction Processing Facility)

IBM 3081 Processor Complex

The IBM 3081 Processor Complex (Figure 2-14) is a powerful and versatile general-purpose computer designed for commercial, scientific, data acquisition, and data communication applications.

The 3081 Processor Complex offers:

- Virtual storage, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of central storage while operating in S/370 mode and as many as 2,147,483,648 bytes of central storage while operating in 370-XA mode.
- A higher instruction execution rate with reduced space, power, and cooling requirements when compared to the 3033 Processor Complex. The higher instruction execution rate is achieved by the fast cycle time inherent in the new technology and by the application of two central processors to the tasks to be performed. The reduced space, power, and cooling requirements are a result of the new technology package.
- Two modes of operation: System/370 (S/370) mode for programs with 24-bit addresses, and System/370 extended architecture (370-XA) mode for programs with 24-bit or 31-bit addresses. The 370-XA mode also uses a channel subsystem, which manages channel pathing and I/O busy condition handling.
- In S/370 mode, compatibility with the 3033 Processor Complex including the System/370 extended facility, the 3033 extension feature, and the extended addressing feature as standard.
- Either 16 (standard) or 24 (includes optional group) integrated channels, which are shared by both central processors. Channel-set switching (S/370 mode) and data streaming (S/370 and 370-XA modes) are standard.
- Control program microcode assistance as standard including the virtual machine assist feature, the preferred machine assist feature, the System/370 extended facility, and the 3033 extension feature.
- Integrated central storage of 16M (16,777,216) bytes, 24M (25,165,824) bytes, 32M (33,554,432) bytes, 48M (50,331,648) bytes, or 64M (67,108,864) bytes.

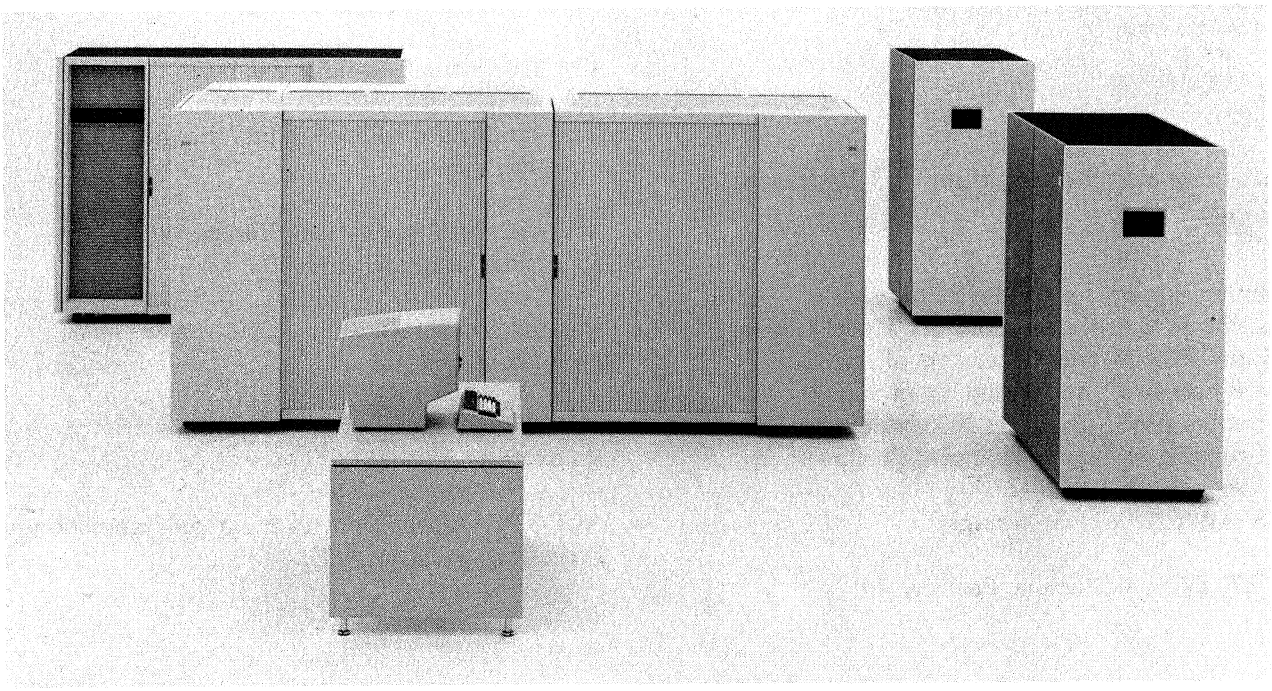


Figure 2-14. IBM 3081 Processor Complex (Design Model)

- High-speed buffer storage (cache) for each central processor, which is transparent to programming and significantly reduces effective storage access time.
- Processor checkpoint retry, which provides a comprehensive, high-level automatic recovery mechanism.
- A high degree of reliability, which is achieved principally by the use of new technology.

System Components

The 3081 Processor Complex includes:

- IBM 3081 Processor Unit Model D16, D24, D32, G16, G24, G32, G48, G64, GX2, GX2, GX3, GX4, GX6, K16, K24, K32, K48, K64, KX1, KX2, KX3, KX4, or KX6
- IBM 3082 Processor Controller Models 16, 24, X16, or X24
- IBM 3278 Display Console Model 2A
- IBM 3087 Coolant Distribution Unit Model 1
- IBM 3089 Power Unit Model 1

An operator console is also required for communication with the control program.

The system includes the 3081 Processor Complex and appropriate input/output devices.

The system is controlled by means of the IBM 3278 Display Console Model 2A (system console), which is used to interact with the system hardware, and an operator console, which is used to interact with the system control program.

IBM 3081 Processor Unit

The 3081 Processor Unit Models D, G, and K have a basic machine cycle time of 26 nanoseconds. This time can be reduced to 24.5 nanoseconds in the Models G and K by installing the performance feature (optional), which includes changes to the 3081 and the 3082 Processor Controller. The basic machine cycle time of the 3081 Processor Unit Models GX and KX is 24 nanoseconds. Models G and GX are faster than Model D, and Models K and KX are faster than Models G and GX, respectively. All of the models have the following logical components:

- Two central processors
- High-speed buffer storage for each central processor
- Central storage
- External data controller
- System controller

Central Processors

The two integrated central processors use large scale integration (LSI) technology in their implementation. Their major logical structure is the thermal conduction module (TCM), which provides as many as 133 high-density chips mounted on a multilayered substrate within a helium-filled envelope.

High-Speed Buffer Storage

The high-speed storage capacity of the 3081 Models D, G, and GX is 32K (32,768) bytes. The high-speed storage capacity of the 3081 Models K and KX is 64K (65,536) bytes.

Central Storage

Central storage, which is shared by both central processors, consists of two basic storage elements (BSEs). In addition to the program addressable portion (main storage), central storage also contains a hardware system area where microcode, UCWs, and other critical system data are kept.

Central Storage Capacities:

Capacity (Bytes)	3081 Processor Unit Model Designation
16,777,216 (16M)	D16, G16, GX1, K16, KX1
25,165,824 (24M)	D24, G24, GX2, K24, KX2
33,554,432 (32M)	D32, G32, GX3, K32, KX3
50,331,648 (48M)	G48, GX4, K48, KX4
67,108,864 (64M)	G64, GX6, K64, KX6

Storage Cycle Time: 312 nanoseconds.

Storage Access Width: Eight bytes.

Storage Interleaving: Two-way or four-way, depending on storage size.

External Data Controller

As many as 24 channels (16 are standard) are provided by the external data controller (EXDC), which is an integrated input/output processing element. In S/370 mode, the channels can operate as two logical sets (one for each central processor) and channel-set switching is possible. As many as four of the total number of channels can be designated to operate as byte multiplexer channels; the remainder are designated to operate as block multiplexer channels. Channel designation can be changed at the site of installation. In 370-XA mode, the EXDC operates as a channel subsystem that allows either central processor to operate with any I/O device attached to the subsystem. The subsystem can have as many as 24 channels, as many as four of which can be designated to operate as byte multiplexer channels, and the remainder are designated to operate as block multiplexer channels. Data streaming, during block multiplexer operations, is possible in either S/370 mode or 370-XA mode.

System Controller

The system controller controls data transfer, storage access, and storage error checking and correction. The time-of-day clock is in the system controller.

Processor Unit Conversion

The 3081 models can be converted in the field to other models of the 3081 and to models of the IBM 3084 Processor Unit as follows:

From	To
3081 Model D or G	3081 Model K
3081 Model K	3084 Model Q
3081 Model GX	3084 Model KX
3081 Model KX	3084 Model QX

IBM 3082 Processor Controller Models 16, X16, 24, and X24

The IBM 3082 Processor Controller Models 16, X16, 24, and X24 supervise the operation of the 3081 Processor Complex. The 3082 Models 16 and 24 are used with the 3081 Processor Unit Models D, G, and K. The 3082 Models X16 and X24 are used with the 3081 Processor Unit Models GX and KX.

The number of channels on a 3081 determines which model of the 3082 is used. For 16 channels, the 3082 Model 16 or X16 is used. For 24 channels, the 3082 Model 24 or X24 is used.

The 3082 performs the following functions for the 3081:

- Supervises the powering up of the 3081 Processor Complex and attached I/O devices under power sequence control.
- Resets and initializes the various components of the 3081 Processor Unit, and performs all functions that are initiated through the system console and that are part of the system architecture (for example, alter, display, and address compare).
- Controls configurable components within the 3081 Processor Unit, such as the central storage arrays, central processors, and channels.
- Assists the 3081 Processor Unit in error recovery and provides a logout of errors for use by service personnel.
- Monitors the voltage levels and coolant flow within the processor complex.
- Provides a data communication link to a remote support facility.
- Provides, on request, data on the operation of the processor complex and the level of system activity.
- Provides the means for problem analysis and isolation of failing field replaceable units (FRUs) or groups of FRUs by service personnel.
- Provides the control-unit function for the IBM 3278 Display Console Model 2A, the service support console (located within the 3082 for use by service personnel), the optional IBM 3278

Display Station Model 2 (programming support console), IBM 3287 Printer Model 1 or 2, IBM 3268 Printer Model 2, and IBM 3230 Printer Model 2.

IBM 3278 Display Console Model 2A

The IBM 3278 Display Console Model 2A (system console) is used by the operator to interact with the 3081 Processor Complex in performing address compare, alter/display, start, stop, reset, restart, and initial program loading, and in displaying activity levels of the channels and central processors. The functions are performed through use of display frames, service language commands, and function keys.

IBM 3087 Coolant Distribution Unit Models 1 and 2

The IBM 3087 Coolant Distribution Unit Models 1 and 2 control the chilling and distribution of water to portions of the processor complex that are water cooled.

The 3087 Model 1 evacuates heat to the building's chilled water through a water-to-water heat exchanger. The 3087 Model 2 evacuates heat directly to the air of the computer room through a water-to-air heat exchanger.

IBM 3089 Power Unit Model 1

The IBM 3089 Power Unit Model 1 provides 400-Hz ac power to the 3081 Processor Complex.

Features of the 3081

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Branch and save
Channel indirect data addressing
Channel-set switching
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Dual address space
Extended-precision floating point
Extended real addressing
Fast release
Floating point
Halt device
I/O extended logout
Limited channel logout
Multiprocessing
PSW-key handling
Recovery extensions
Segment protection
Service signal
Start-I/O-fast queuing
Storage-key-instruction extensions
Storage-key 4K-block (except 3081 D-16)
Suspend and resume
System/370 extended
Test block
Translation
31-bit indirect data address word

Programming Assists

Standard

Assists for MVS/370
Preferred-machine assist with control switch assist
Start interpretive execution assist
VM assist
VM assists for CPU timer

Channel Features

Standard

First and second channel groups (eight channels each; as many as four can be designated byte multiplexer channels with the remainder designated block multiplexer channels)
Data Streaming on all block multiplexer channels, providing a data rate of 3.0 megabytes per second

Optional

Third channel group (eight block multiplexer channels)

Integrated Adapters

Optional

Channel-to-channel adapters (one or two)

Miscellaneous Features

Standard

Audible alarm
Error checking and correction
High-speed buffer storage
I/O power sequence control for control units 1 to 32
Processor checkpoint retry
Reloadable control storage
Storage configuration control

Optional

I/O power sequence control for control units 33 to 64
Performance improvement (Models G and K only)

Programming Support for the 3081 Processor Complex

Programming support for the 3081 Processor Complex includes:

- MVS/SP (Multiple Virtual Storage/System Product):
  - Version 1 (for operation in S/370 mode)
  - Version 2 (for operation in 370-XA mode)
- VM/SP (Virtual Machine/System Product), Model D16 only
- VM/SP HPO (Virtual Machine/System Product with the VM/SP High Performance Option), all models
- VM/XA Migration Aid (Virtual Machine/Extended Architecture Migration Aid)
- VM/XA Systems Facility (Virtual Machine/Extended Architecture Systems Facility)

IBM 3083 Processor Complex

The IBM 3083 Processor Complex (Figure 2-15) is a powerful and versatile general-purpose computer designed for commercial, scientific, data acquisition, and data communication applications.

The 3083 Processor Complex offers:

- Virtual storage, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes while operating in S/370 mode and each with as many as 2,147,483,648 bytes while operating in 370-XA mode.
- A higher instruction execution rate with reduced space, power, and cooling requirements when compared to the 3033 Processor Complex. The higher instruction execution rate is achieved principally by the fast cycle time inherent in the new technology. The reduced space, power, and cooling requirements are a result of the new technology package.
- Two modes of operation: System/370 (S/370) mode for programs with 24-bit addresses, and System/370 extended architecture (370-XA) mode for programs with 24-bit or 31-bit addresses. The 370-XA mode also uses a channel subsystem, which provides channel path management and I/O busy condition handling.
- In S/370 mode, compatibility with the 3033 Processor Complex including the System/370 extended facility, the 3033 extension feature, and the extended addressing feature as standard.
- Eight (standard), 16, or 24 integrated channels in which data streaming is standard.
- Control program microcode assistance as standard including the virtual machine assist feature, the preferred machine assist feature, the System/370 extended facility, and the 3033 extension feature.

Figure 2-15. IBM 3083 Processor Complex with Other Devices (Design Models)

- Integrated central storage of 8M (8,388,608) bytes, 16M (16,777,216) bytes, 24M (25,165,824) bytes, or 32M (33,554,432) bytes.
- High-speed buffer storage (cache), which is transparent to programming and significantly reduces effective storage access time.
- Processor checkpoint retry, which provides a comprehensive, high-level automatic recovery mechanism.
- A high degree of reliability, which is achieved principally by the use of new technology.

System Components

The 3083 Processor Complex consists of:

- IBM 3083 Processor Unit Model B8, B16, B24, B32, BX0, BX1, BX2, BX3, CX0, CX1, CX2, CX3, E8, E16, E24, E32, EX0, EX1, EX2, EX3, J8, J16, J24, J32, JX0, JX1, JX2, or JX3
- IBM 3082 Processor Controller Model 8, X08, 16, X16, 24, or X24
- IBM 3278 Display Console Model 2A (system console)
- IBM 3087 Coolant Distribution Unit Model 1 or 2
- IBM 3089 Power Unit Model 1

An operator console is also required for communication with the control program.

The system includes the 3083 Processor Complex and appropriate input/output devices.

The system is controlled by means of the IBM 3278 Display Console Model 2A, which is used to interact with the system hardware, and an operator console, which is used to interact with the system control program.

IBM 3083 Processor Unit

The 3083 Processor Unit Models E, B, and J have a basic machine cycle time of 26 nanoseconds. This time can be reduced to 24.5 nanoseconds by installing the performance feature (optional), which includes changes to the 3083 and the 3082 Processor Controller. The basic machine cycle time of the 3083 Processor Unit Models CX, EX, BX, and JX is 24 nanoseconds.

The 3083 Models B and BX are faster than Models E and EX, respectively, the Models J and JX are faster than Models B and BX, respectively, and the Model EX is faster than Model CX.

The 3083 Processor has the following logical components:

- Central processor
- High-speed buffer storage
- Central storage
- External data controller
- System controller

Central Processor

The central processor uses large scale integration (LSI) technology in its implementation. The major logical structure is the thermal conduction module (TCM), which provides as many as 133 high-density chips mounted on a multilayered substrate within a helium-filled envelope.

High-Speed Buffer Storage

The high-speed buffer storage capacity of the 3083 is 16K (16,384) bytes for Models E, EX, and CX, 32K (32,768) bytes for Models B and BX, and 64K (65,536) bytes for Models J and JX.

Central Storage

Central storage consists of two basic storage elements (BSEs) providing for 8M-byte, 16M-byte, 24M-byte, or 32M-byte storage capacities. The access time is 312 nanoseconds. Central storage uses two-way interleaving of contiguous 2K-byte blocks of storage. In addition to the program addressable portion (main storage), central storage also contains a hardware

system area where microcode, UCWs, and other critical system data are kept.

Central Storage Capacities:

Capacity (Bytes)	3083 Processor Unit Model Designation
8,388,608 (8M)	CX0, E8, EX0, B8, BX0, J8, JX0
16,777,216 (16M)	CX1, E16, EX1, B16, BX1, J16, JX1
25,165,824 (24M)	CX2, E24, EX2, B24, BX2, J24, JX2
33,554,432 (32M)	CX3, E32, EX3, B32, BX3, J32, JX3

Storage Cycle Time: 312 nanoseconds.

Storage Access Width: Eight bytes.

Storage Interleaving: Two-way.

External Data Controller

Depending on the model, as many as 24 channels (eight are standard) are provided by the external data controller (EXDC), which is an integrated input/output processing element. As many as four of the total number of channels can be designated to operate as byte multiplexer channels; the remainder are designated to operate as block multiplexer channels. Channel designation can be changed at the site of installation. Data streaming, during block multiplexer operations, is possible in either S/370 mode or 370-XA mode. The channel capabilities vary by model as follows:

Number of Channels	3083 Model
8, 16	- CX
8, 16	E, EX
8, 16, 24	B, BX
8, 16, 24	J, JX

System Controller

The system controller controls data transfer, storage access, and storage error checking and correction. The time-of-day clock is in the system controller.

Processor Unit Conversion

The 3083 models can be converted in the field to other models of the 3083 and the 3081 as follows:

From	To
3083 Model E	3083 Model B or J
3083 Model B	3083 Model J or 3081 Model G or K
3083 Model J	3081 Model K
3083 Model CX	3083 Model EX
3083 Model EX	3083 Model BX
3083 Model BX	3083 Model JX or 3081 Model GX
3083 Model JX	3081 Model KX

IBM 3082 Processor Controller Models 8, X08, 16, X16, 24, and X24

The IBM 3082 Processor Controller Models 8, X08, 16, X16, 24, and X24 supervise the operation of the 3083 Processor Complex. The 3082 Models 8, 16, and 24 are used with the 3083 Processor Unit Models E, B, and J. The 3082 Models X08, X16, and X24 are used with the 3083 Processor Unit Models CX, EX, BX, and JX.

The number of channels on a 3083 Processor Unit determines which model of the 3082 is used. For eight channels, the 3082 Model 8 or X08 is used; for 16 channels, the 3082 Model 16 or X16 is used; and for 24 channels, the 3082 Model 24 or X24 is used.

The 3082 performs the following functions:

- Supervises the powering up of the 3083 Processor Complex and attached I/O devices under power sequence control.
- Resets and initializes the various components of the 3083 Processor Unit, and performs all functions that are initiated through the system console and that are part of the system architecture (for example, alter, display, and address compare).
- Controls configurable components within the 3083 Processor Unit such as the central storage arrays and channels.
- Assists the 3083 Processor Unit in error recovery and provides a logout of errors for use by service personnel.
- Monitors the voltage levels and coolant flow within the processor complex.
- Provides a data communication link to a remote support facility.

- Upon request provides data on the operation of the processor complex and the level of system activity.
- Provides the means for problem analysis and isolation of failing field replaceable units (FRUs) or groups of FRUs by service personnel.
- Provides the control-unit function for the IBM 3278 Display Console Model 2A, the service support console (located within the 3082 for use by service personnel), the optional IBM 3278 Display Station Model 2 (programming support console), the IBM 3287 Printer Model 1 or 2, the IBM 3268 Printer Model 2, and the 3230 Printer Model 2.

IBM 3278 Display Console Model 2A

The 3278 Display Console Model 2A (system console) is used by the operator to interact with the 3083 Processor Complex in performing address compare, alter/display, start, stop, reset, restart, and initial program loading, and in displaying activity levels of the channels and central processor. The functions are performed through use of display frames, service language commands, and function keys.

IBM 3087 Coolant Distribution Unit Models 1 and 2

The IBM 3087 Coolant Distribution Unit Models 1 and 2 control the chilling and distribution of water to portions of the processor complex that are water cooled.

The 3087 Model 1 evacuates heat to the building's chilled water through a water-to-water heat exchanger. The 3087 Model 2 evacuates heat directly to the air of the computer room through a water-to-air heat exchanger.

IBM 3089 Power Unit Model 1

The IBM 3089 Power Unit Model 1 provides 400-Hz ac power to the 3083 Processor Complex.

Features of the 3083

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Branch and save
Channel indirect data addressing
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Dual address space
Extended-precision floating point
Extended real addressing
Fast release
Floating point
Halt device
I/O extended logout
Limited channel logout
Multiprocessing
PSW-key handling
Recovery extensions
Segment protection
Service signal
Start-I/O-fast queuing
Storage-key-instruction extensions
Storage-key 4K-byte block
Suspend and resume
System/370 extended
Test block
Translation
31-bit indirect data address word

Programming Assists

Standard

Assists for MVS/370
Preferred-machine assist with control-switch assist
Start interpretive execution assist
VM assist
VM assists for CPU timer

Channel Features

Standard

First channel group (eight channels; as many as four channels in the first two channel groups may be designated byte multiplexer channels, with the remainder designated block multiplexer channels)
Data streaming on all block multiplexer channels providing a data rate of 3.0 megabytes per second

Optional

Second channel group (eight channels)
Third channel group (eight block multiplexer channels; available on model groups B, BX, J and JX only)

Integrated Adapters

Optional

Channel-to-channel adapters (one or two)

Miscellaneous Features

Standard

Audible alarm
Error checking and correction
High-speed buffer storage
I/O power sequence control for control units 1 to 32
Processor checkpoint retry
Reloadable control storage
Storage configuration control

Optional

I/O power sequence control for control units 33 to 64
Performance improvement (Models E, B, and J)

Programming Support for the 3083 Processor Complex

Programming support for the 3083 Processor Complex includes:

- MVS/SP (Multiple Virtual Storage/System Product):
  - Version 1 (for operation in S/370 mode)
  - Version 2 (for operation in 370-XA mode)
- VM/SP HPO (Virtual Machine/System Product with the VM/SP High Performance Option)
- VM/XA Migration Aid (Virtual Machine/Extended Architecture Migration Aid)
- TPF (Transaction Processing Facility)
- VM/XA Systems Facility (Virtual Machine/Extended Architecture Systems Facility)

IBM 3084 Processor Complex

The IBM 3084 Processor Complex (Figure 2-16) is a powerful and versatile general-purpose computer designed for commercial, scientific, data acquisition, and data communication applications. The 3084 Processor Complex offers:

- Virtual storage, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes while operating in S/370 mode and as many as 2,147,483,648 bytes while operating in 370-XA mode.
- The power of four central processors, 48 channels, as many as 128M bytes of storage, and as many as four channel-to-channel adapters under the control of a single control program and a single operational interface. Should a failure occur, the failing elements generally may be removed, repaired, and returned to the configuration permitting continued operation at about half performance. Concurrent repair is the normal mode of maintenance for the 3084.
- The possibility of operating in partitioned mode as two separate processor complexes running under separate control programs.
- The ability to vary offline certain portions of the processor complex for maintenance with minimum disruption of the workload.
- Two modes of operation: System/370 (S/370) mode for programs with 24-bit addresses (this mode is possible only when the 3084 operates as two processor complexes), and System/370 extended architecture (370-XA) mode for programs with 24-bit or 31-bit addresses. The 370-XA mode also uses a channel subsystem, which provides channel path management and I/O busy condition handling.
- In S/370 mode, compatibility with the 3033 Processor Complex including the System/370 extended facility, the 3033 extension feature, and the extended addressing feature as standard.
- Forty-eight integrated channels, which are shared by the central processors. Channel-set switching (S/370 mode) and data streaming (S/370 and 370-XA modes) are standard.

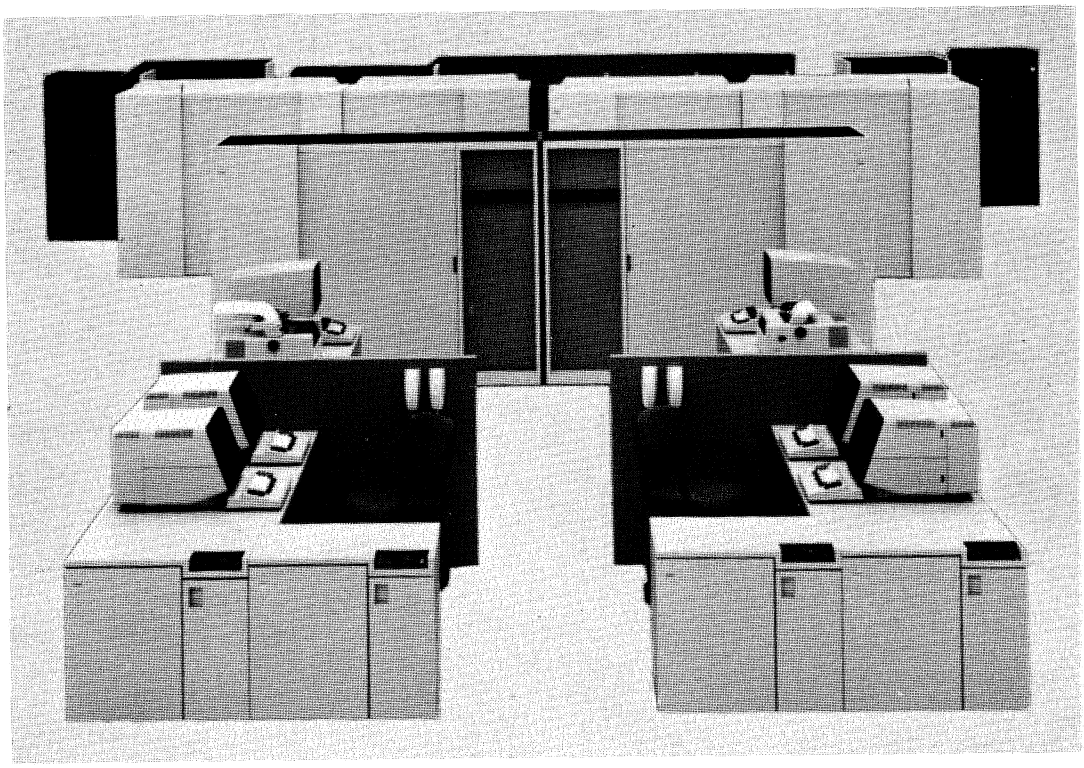


Figure 2-16. IBM 3084 Processor Complex with Other Devices (Design Models)

- Control program microcode assistance as standard including the virtual machine assist feature, the preferred machine assist feature, the System/370 extended facility, and the 3033 extension feature.
- Integrated central storage of 32M (33,554,432) bytes, 48M (50,331,648) bytes, 64M (67,108,864) bytes, 96M (100,663,296) bytes, or 128M (134,217,728) bytes.
- High-speed buffer storage (cache) for each central processor, which is transparent to programming and significantly reduces effective storage access time.
- Processor checkpoint retry, which provides a comprehensive, high-level automatic recovery mechanism.
- A high degree of reliability, which is achieved principally by the use of new technology.

System Components

The 3084 Processor Complex consists of:

- IBM 3084 Processor Unit Model Q32, Q48, Q64, Q96, QC8, QX3, QX4, QX6, QX9, or QXC
- IBM 3082 Processor Controller Model Q48 or X48
- Two IBM 3278 Display Consoles Model 2A (system consoles)
- Two IBM 3087 Coolant Distribution Units Model 1 or 2
- Two IBM 3089 Power Units

Depending on the application, one or more operator consoles are also required for communication with the control program.

The system includes the 3084 Processor Complex and appropriate input/output devices.

The system is controlled by means of the 3278 Display Consoles Model 2A, which are used to interact with the system hardware, and the operator consoles, which are used to interact with the system control program.

IBM 3084 Processor Unit

The 3084 Processor Unit Model Q has a basic machine cycle time of 26 nanoseconds. This time can be reduced to 24.5 nanoseconds by installing the performance feature (optional), which includes changes to each side of the 3084 and each side of the 3082 Processor Controller. The basic machine cycle time of the 3084 Processor Unit Model QX is 24 nanoseconds.

The 3084 Processor Unit may be operated as a four-way tightly coupled multiprocessor or may be partitioned into two independent processor complexes, each with a dyadic processor. When configured as a four-way multiprocessor, the 3084 operates in 370-XA mode using a single control program. When partitioned into its two sides (A and B), each side operates independently with its own control program, which may be operated in either S/370 or 370-XA mode. The IBM 3084 Processor Unit includes the following logical components:

- Four central processors
- High-speed buffer storage for each central processor
- Shared central storage
- Two external data controllers
- Two system controllers

High-Speed Buffer Storage

Each central processor of the 3084 has a 64K (65,536) byte high-speed buffer storage.

Central Processors

The 3084 contains four central processors that use large scale integration (LSI) technology in their implementation. Their major logical structure is the thermal conduction module (TCM), which provides as many as 133 high-density chips mounted on a multilayered substrate within a helium-filled envelope.

Central Storage

All of central storage is shared by all four central processors in the 3084. When partitioned into two processor complexes, or when a maintenance configuration is created for concurrent repair of a side, storage is divided into two parts on the basis of physical residency (either side-A or side-B). Each side contains two basic storage elements.

In addition to the program addressable portion (main storage), central storage also contains a hardware system area where microcode, UCWs, and other critical system data are kept.

Central Storage Capacities:

Capacity (Bytes)	3084 Processor Unit Model Designation
33,554,432 (32M)	Q32, QX3
50,331,648 (48M)	Q48, QX4
67,108,864 (64M)	Q64, QX6
100,663,296 (96M)	Q96, QX9
134,217,728 (128M)	QC8, QXC

Storage Cycle Time: 312 nanoseconds.

Storage Access Width: Eight bytes.

Storage Interleaving: Two-way.

External Data Controller

The 3084 contains two external data controllers (EXDCs) that together have 48 channels. Each side contains an EXDC with 24 channels. In S/370 mode, the channels operate as logical sets (one for each central processor per side) and channel-set switching is possible. As many as four channels on each side of the 3084 can be designated to operate as byte multiplexer channels; the remainder are designated to operate as block multiplexer channels. Channel type can be changed at the site of installation. In 370-XA mode, the EXDC operates as a channel subsystem that allows any central processor to operate with any I/O device attached to the subsystem. During block multiplexer operations, data streaming is possible in either S/370 mode or 370-XA mode.

System Controller

The 3084 has two system controllers (one for each side), which control data transfer, storage access, and storage error checking and correction. The two system controllers are interconnected. Each system controller contains a time-of-day clock.

IBM 3082 Processor Controller Models Q48 and X48

The IBM 3082 Processor Controller Models Q48 and X48, which contain completely duplexed hardware, supervise the operation of the 3084 Processor Complex. Model Q48 is used with 3084 Processor Unit Models Q32, Q48, Q64, Q96, and QC8. Model X48 is used with 3084 Processor Unit Models QX3, QX4, QX6, QX9, and QXC. During partitioned processing, each side of the 3082 operates with its half of the processor complex. During single-image operation, one side of the 3082 controls the complex while the other side acts as a standby controller should the main processor controller fail.

The 3082 performs the following functions for the 3084:

- Supervises the powering up of the 3084 Processor Complex and attached I/O devices under power sequence control.
- Resets and initializes the various components of the 3084 Processor Unit, and performs all functions that are initiated through the system console and that are part of the system architecture (for example, alter, display, and address compare).
- Controls components that can be configured within the 3084 Processor Unit such as the central storage arrays, central processors, and channel paths.
- Assists the 3084 Processor Unit in error recovery and provides a logout of errors for use by service personnel.
- Monitors the voltage levels and coolant flow within the processor complex.
- Provides a data communication link to a remote support facility.

- Upon request provides data on the operation of the processor complex and the level of system activity.
- Provides the means for problem analysis and isolation of failing field replaceable units (FRUs) or groups of FRUs by service personnel.
- Provides the control-unit function for the IBM 3278 Display Console Model 2A, the service support console (located within the 3082 for use by service personnel), the optional IBM 3278 Display Station Model 2 (programming support console), the IBM 3287 Printer Model 1 or 2, the IBM 3268 Printer Model 2, and the IBM 3230 Printer Model 2.

IBM 3278 Display Console Model 2A (System Console)

The IBM 3278 Console Model 2A (system console) is used by the operator to interact with the 3084 Processor Complex in performing address compare, alter/display, start, stop, reset, restart, and initial program loading, and in displaying activity levels of the channels and central processors. The functions are performed through the use of display frames (menu selection), service language commands, and function keys.

IBM 3087 Coolant Distribution Unit Models 1 and 2

The IBM 3087 Coolant Distribution Unit Models 1 and 2 control the chilling and distribution of water to portions of the processor complex that are water cooled.

The 3087 Model 1 evacuates heat to the building's chilled water through a water-to-water heat exchanger. The 3087 Model 2 evacuates heat directly to the air of the computer room through a water-to-air heat exchanger. Each 3084 Processor Complex requires either two 3087 Model 1's or two 3087 Model 2's.

IBM 3089 Power Unit Model 1

Each IBM 3089 Power Unit Model 1 provides 400-Hz ac power to its side of the processor complex.

Features of the 3084

The following features are categorized as programming features, programming assists, channel features, integrated adapters, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Branch and save
Channel indirect data addressing
Channel-set switching
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Dual address space
Extended-precision floating point
Extended real addressing
Fast release
Floating point
Halt device
I/O extended logout
Limited channel logout
Multiprocessing
PSW-key handling
Recovery extensions
Segment protection
Service signal
Start-I/O -fast queuing
Storage-key-instruction extensions
Storage-key 4K-byte block
Suspend and resume
System/370 extended
Test block
Translation
31-bit indirect data address word

Programming Assists

Standard

Assists for MVS/370
Preferred-machine assist with control-switch assist
Start interpretive execution assist
VM assist
VM assists for CPU timer

Channel Features

Standard

Three A-side and three B-side channel groups (eight channels each; as many as four channels in the first two channel groups on each side may be designated byte-multiplexer channels, with the remainder designated block-multiplexer channels)
Data streaming on all block multiplexer channels providing a data rate of 3.0 megabytes per second

Integrated Adapters

Optional

Channel-to-channel adapters (one or two on A-side)
Channel-to-channel adapters (one or two on B-side)

Miscellaneous Features

Standard

Audible alarm
Error checking and correction
High-speed buffer storage
I/O power sequence control for control units 1 to 32 on A-side)
I/O power sequence control for control units 1 to 32 on B-side)
Can be partitioned into two independent dyadic processors
Processor checkpoint retry
Reloadable control storage
Storage configuration control

Optional

I/O power sequence control for control units 33 to 64 on A-side)
I/O power sequence control for control units 33 to 64 on B-side)
Performance improvement (Model Q only)

Programming Support for the 3084 Processor Complex

Programming support for the 3084 Processor Complex includes:

- MVS/SP (Multiple Virtual Storage/System Product):
  - Version 1 (for operation in S/370 mode)
  - Version 2 (for operation in 370-XA mode)
- VM/XA Migration Aid (Virtual Machine/Extended Architecture Migration Aid)
- VM/SP HPO (Virtual Machine/System Product with the VM/SP High Performance Option)
- VM/XA Systems Facility (Virtual Machine/Extended Architecture Systems Facility)

IBM 3090 Processor Complex

The IBM 3090 Processor Complexes Model 200 (Figure 2-17) and Model 400 are general-purpose System/370 computers that are compatible with and that offer improved performance over certain 308x computers in commercial, scientific, and data communication applications.

The 3090 Processor Complex Model 200 has a dyadic processor unit (IBM 3090 Processor Unit Model 200) and associated hardware to complete the complex. If one of the central processors in the Model 200 fails, the other central processor continues to operate. The 3090 Processor Complex Model 400 has a four-way processor unit (3090 Processor Unit Model 400) with associated hardware to complete the complex. If one of the central processors in the Model 400 fails, the remaining central processors continue to operate. In addition, the Model 400 can operate either in single-image mode or in partitioned mode. Both processor units have an integrated central storage and an integrated channel subsystem. With the same configuration under identical programming, the 3090 Processor Complex Models 200 and 400 provide greater performance levels than the IBM 3081 Processor Complex with the IBM 3081 Processor Unit Model KX and the IBM 3084 Processor Complex with the IBM 3084 Processor Unit Model QX, respectively.

Like the 308x Processor Complexes, the 3090 Processor Complexes offer:

- Two modes of operation: System/370 (S/370) mode for programs with 24-bit addresses, and System/370 extended architecture (370-XA) mode for programs with 24-bit or 31-bit addresses. S/370 mode is provided on the 3090 Processor Complex Model 400 only when the processor complex has been partitioned.

- Virtual storage, which permits users to program as though the system has multiple address spaces, each with as many as 16,777,216 bytes of central storage while operating in S/370 mode and as many as 2,147,483,648 bytes of central storage while operating in 370-XA mode.

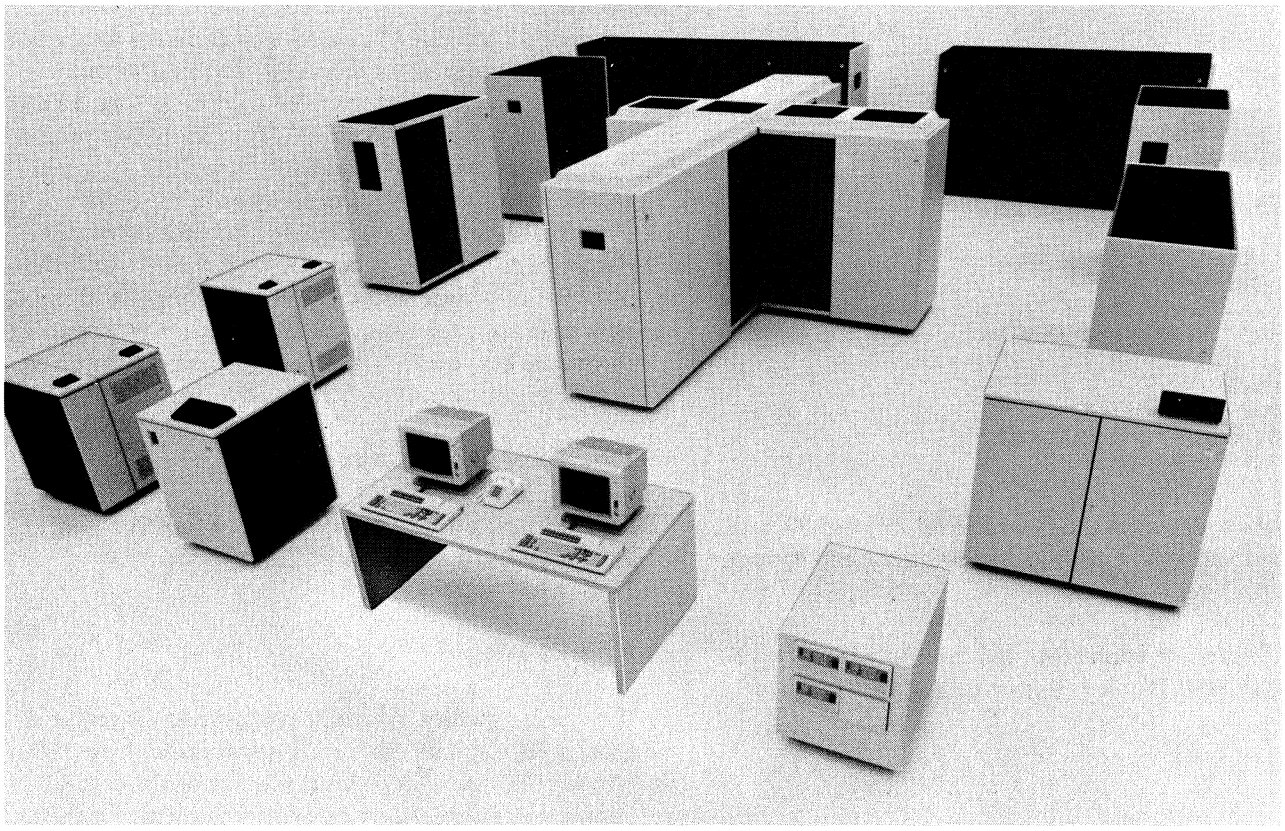


Figure 2-17. IBM 3090 Processor Complex Model 200 with Other Devices (Design Models)

In addition, the 3090 Processor Complexes offer:

- An optional high-speed, high-volume, expanded storage, which provides improved system performance by reducing the paging and swapping load on channel-attached paging devices in storage-constrained, heavy-paging operations.
- Optional capability on each of the central processors of the 3090 Processor Complex to execute vector instructions, which provide greater performance in engineering and scientific applications that use vectors.
- Auto-answer capability, which enhances remote support by allowing quick access to a problem by IBM service representatives who have the skills necessary to correct the problem.

System Components

The 3090 Processor Complex Models 200 and 400 include the following units in the quantities indicated:

Unit	3090 Processor Complex Model 200	400
IBM 3090 Processor Unit Model 200	1	–
IBM 3090 Processor Unit Model 400	–	1
IBM 3092 Processor Controller Model 1	1	–
IBM 3092 Processor Controller Model 2	–	1
IBM 3097 Power and Coolant Distribution Unit Model 1	1	2
IBM 3089 Power Unit Model 3 or other source of 400-Hz power	2	4

The system includes the 3090 Model 200 or 400 with required support devices and appropriate input/output devices.

The systems are controlled and monitored by use of the IBM 3180 Display Station.

IBM 3090 Processor Unit Models 200 and 400

The IBM 3090 Processor Unit Models 200 and 400, which have a basic machine cycle time of 18.5 nanoseconds, include the following logical components in the quantities and capacities indicated:

Component	3090 Processor Unit Model 200	400
Central processors with high-speed buffers	2	4
Central storage capacity in bytes	64M	128M
Expanded storage (optional) capacity in bytes	64M 128M	128M 256M
Channels	32-48	64-96
System control element	1	2

Central Processors

Each central processor (CP) of the 3090 Processor Unit Models 200 and 400 has a machine cycle time of 18.5 nanoseconds and a 64K-byte high-speed buffer storage. The major logical structure is the thermal conduction module (TCM), which provides as many as 100 high-density chips mounted on a multilayered substrate within a helium-filled envelope. The 3090 uses emitter-coupled logic (ECL) in its TCMs rather than the transistor-to-transistor logic (TTL) used in the TCMs of the central processors in the 308x Processor Unit. The technology and the overlapped design of the central processor in the 3090 allow the 3090 Processor Complex Models 200 and 400 to reach new levels of performance. Each central processor can directly access central storage, the channel subsystem, and expanded storage (if installed).

High-Speed Buffer Storage

Each central processor of the 3090 Processor Unit Model 200 and 400 has a 65K- (65,536-) byte high-speed buffer storage.

Vector Facility

The vector facility, which is available as an optional feature for each of the central processors of the 3090 Models 200 and 400, is an extension of the central processor's instruction and execution elements that increases the throughput in certain engineering and scientific data processing applications that use vectors. A central processor with the vector facility installed performs vector arithmetic and logical operations on

as many as 128 sets of operands with a single instruction.

When installed on a central processor, the vector facility provides the following:

- One hundred seventy-one vector instructions
- Sixteen vector registers, which have 128 thirty-two-bit elements each (even-odd registers are coupled to contain 64-bit elements)
- A vector mask register
- A vector count register
- A vector status register
- Contiguous, noncontiguous, and random addressing of storage
- Binary operation, 32-bit floating-point operation, and 64-bit floating-point operation
- Compound Multiply and Add, Multiply and Subtract, and Multiply and Accumulate instructions

The use of instruction formats with three addresses minimizes the movement of data in registers and improves the reuse of operands. The operations are performed on binary, 32-bit floating-point, and 64-bit floating-point data with operands from storage, from vector registers, or from a scalar register. An extensive set of load and store operations allows the processing of regularly spaced vectors, indirectly accessed vectors, and bit-mask-controlled vectors. Source- or target-vector elements in main storage are accessed in one of the following ways:

- Starting address modified by stride values (sequential addressing)
- Starting address modified by a vector of element numbers (indirect element selection)
- Vector register and main storage elements selected under bit-mask control

Instructions are provided for setting and managing the vector count; for saving, restoring, and clearing vector registers; and for updating vector status. A new set of operands can be initiated and a 32-bit or 64-bit result produced each machine cycle (except in a divide operation, when a result is produced every 16 cycles).

When the vector facility is installed on the 3090 Model 200 (on one or both central processors), one additional frame is attached to the 3090 Processor Unit. When the vector facility is installed on the A-side or B-side of the 3090 Model 400 (on one or both central processors on that side), one additional frame is attached to that side of the 3090 Processor Unit, for a maximum of two additional frames for each 3090 Model 400.

The improvement in performance resulting from the use of the vector facility with the 3090 Models 200 and 400 depends on the application and the method of solving the problem. The amount of vector processing, the length of the vectors and their storage characteristics, the addressing patterns, and the reuseing of operands all have a significant effect on the performance gain realized.

Central Storage

Central Storage Capacities:

Capacity (Bytes)	3090 Processor Unit Model
67,108,864 (64M)	200
134,217,728 (128M)	400

During initialization, at least 288K (294,912) bytes of central storage are assigned to the hardware system area where microcode, UCWs, and other critical system data are stored. Central storage has single-bit error detection and correction and double-bit error detection.

Expanded Storage

Expanded storage dynamically retains pages from central storage that are most likely to be referred to by the workload. The transfer of 4K-byte blocks of data is accomplished under program control. Relatively long input/output paging operations are replaced by extremely fast page movement, which improves system response time and throughput. In addition, because the load on the channel-attached paging devices is reduced, fewer paging devices are likely to be required. Expanded storage has single- and double-bit error detection and correction and triple-bit error detection.

Expanded Storage Capacities:

Capacity (Bytes)	3090 Processor Unit Model
67,108,864 (64M)	200
134,217,728 (128M)	200, 400
268,435,456 (256M)	400

Expanded storage is symmetrical on the Model 400.

Channel Subsystem

The channel subsystem is an integrated input/output processor, which has 32, 40, or 48 channels in the 3090 Processor Unit Model 200, and 64, 80, or 96 channels in the 3090 Processor Unit Model 400. Channels are distributed equally on each side of the Model 400. As many as four channels in the Model 200 and as many as eight channels in the Model 400 can be optionally designated as byte multiplexer channels. The remainder are designated as block multiplexer channels.

Both data streaming and non-data-streaming devices can be attached to any block multiplexer channel. When operating in data-streaming mode, each block multiplexer channel can operate at rates up to and including 3.0 megabytes per second.

Operation can be in either S/370 mode (channels) or 370-XA mode (channel paths). In 370-XA mode, all channel paths are accessible to any central processor. In S/370 mode, channels are organized into two channel sets, one for each central processor. As many as 32 channels can be assigned to a channel set, depending on the system control program used. When operating under the Multiple Virtual Storage/System Product, as many as 16 channels can be assigned to a channel set. When operating under the Virtual Machine/High Performance Option, the maximum is 32 channels for each channel set. If one central processor fails during operation in S/370 mode, channel-set switching permits the remaining central processor to continue all channel activity.

During processor complex operation, one or more failing channels can be configured offline for problem determination.

System Control Element

The system control element (SCE) controls communication between the central processors, the channel subsystem, and central storage.

IBM 3092 Processor Controller Models 1 and 2

The IBM 3092 Processor Controller Models 1 and 2, which have duplexed functions, supervise the operation of the 3090 Processor Complex Models 200 and 400, respectively. The 3092 Models 1 and 2 provide the following:

- Manual controls for IPL, start, stop, and address compare
- Powering on and off and initialization of the processor complex, and powering on and off of attached input/output units, all under power sequence control
- Capability for the processor complex to operate in either S/370 or 370-XA mode
- Configuration of the processor complex
- Monitoring and control of voltage levels, coolant temperature, and coolant flow for the processor complex
- Control and assistance in error recovery of various retryable and recoverable portions of the processor complex
- Error analysis for the isolation of failing field-replaceable units (FRUs)
- Diagnostic tests and assists for service representatives including remote diagnostic capability
- Automatic switchover to the backup processor controller hardware facilities if certain failures occur
- As many as 24 user-defined System Activity Display frames (for example, Central Processor Utilization and Channel Utilization)
- A local alarm and provision for remote alarms to indicate abnormal conditions
- Battery-operated time-of-day clock

The following are required for use with the 3092 Processor Controller in the quantities indicated:

Requirement	3090 Processor Complex Model 200	3090 Processor Complex Model 400
IBM 3180 Display Station Model 145	2	3*
IBM 3370 Direct Access Storage Model A2 with string switch feature	2	2
4800-bps, switched-network modem with auto-answer capability (IBM 3864 Modem Model 2 with 5801 auto-call feature, or equivalent)	1	2*
Access to a tape control and drive able to handle tape with a density of 6250 bytes per inch at a maximum data rate of 1.25 megabytes per second (IBM 3420 Magnetic Tape Unit Model 4, 6, or 8, or equivalent)	1	1

Legend:

* For operation in partitioned mode

Optional Devices

The 3092 Processor Controller also supports the following optional IBM input/output devices:

- One IBM 3287 Printer Model 1 or 2 for copying display images.
- Three additional 3180 Display Stations Model 140, which can be used as one each of certain console functions including: system console (includes system activity display), service console, limited programming support representative (PSR) console, system display console monitor, service support display console monitor, and program mode console.

An optional console table is available to provide an operator work station for one or two operators and their display consoles.

IBM 3180 Display Station Model 145

The IBM 3180 Display Station Model 145 is used as the primary system display (console) for the 3090, and also for interaction with the processor complex by service personnel and support personnel. One 3180 is used as a system display on the 3090 Processor Complex Model 200, on the 3090 Processor Complex Model 400 operating in single-image mode, and one for each side of the 3090 Processor Complex Model 400 operating in partitioned mode. A second 3180 Model 145 is used as a service support display on the 3090 Model 200 and on the 3090 Model 400 operating in single-image mode. A third 3180 Model 145 is used as an additional service support display on the 3090 Model 400 operating in partitioned mode. The system display can be as far as 1500 meters (4921 feet) from the 3092 Processor Controller. The service support display can be as far as 10 meters (33 feet) from the 3092.

IBM 3370 Direct Access Storage Model A2

The IBM 3370 Direct Access Storage Model A2 is a high-speed, large- capacity, fixed-media direct-access storage device that stores a duplicate copy of data essential to the operation of the 3090 Processor Complex. For the 3090 Model 200 and for each side of the Model 400, one of the two 3370s is the active unit, the other is the backup unit. If a failure occurs in a 3370 or in one of the dual processors in the 3092 Processor Controller, automatic switchover is normally accomplished without system interruption. Each 3370 must have the string-switch feature.

IBM 3864 Modem Model 2

The IBM 3864 Modem Model 2 is a microprocessor-based modem that provides a means for transmitting data over communication lines. Operation is point to point in half-duplex mode over four-wire nonswitched duplex facilities. The 5801 auto-call feature on the 3864 provides auto-answer capability in obtaining the remote support facility for the 3090 Processor Complex.

IBM 3420 Magnetic Tape Unit Model 4, 6, or 8

The IBM 3420 Magnetic Tape Unit Model 4, 6, or 8, which is controlled by the IBM 3803 Tape Control Model 3, is used for microcode installation and for certain maintenance functions. The data rates are 470,000 bytes per second for the 3420 Model 4; 780,000 bytes per second for the Model 6; and 1,250,000 bytes per second for the Model 8. Although access is required, this tape control and drive does not have to be dedicated to the 3092 Processor Controller.

IBM 3097 Power and Coolant Distribution Unit Model 1

The IBM 3097 Power and Coolant Distribution Unit Model 1 distributes the power and coolant required by the 3090 Processor Complex Models 200 and 400. The 3097 contains power distribution functions, and the heat exchanger, pumps, and controls necessary for cooling the liquid-cooled portion of the processor complexes. The 3097 also contains the controls for power sequencing. One 3097 is required for the Model 200 and two are required for the Model 400.

IBM 3089 Power Unit Model 3

The IBM 3089 Power Unit Model 3 provides 400-Hz power to the 3090 Processor Complex Models 200 and 400. The 3089, which is designed for use in the computer machine room, contains a motor generator (MG) mounted in a noise-suppressing frame and housing. Two 3089s are required for a 3090 Processor Complex Model 200 and four are required for a 3090 Model 400.

Features of the 3090

The following features are categorized as programming features, programming assists, channel features, and miscellaneous features.

Programming Features

Standard

System/370 commercial instruction set
Branch and save
Central storage
Channel indirect data addressing
Channel-set switching
Clear I/O
Command retry
Conditional swapping
CPU timer and clock comparator
Dual address space
Extended-precision floating point
Extended real addressing
Fast release
Floating point
Halt device
Limited channel logout
Multiprocessing
PSW-key handling
Recovery extensions
Segment protection
Service signal
Start-I/O-fast queuing
Storage-key instruction extensions
Storage-key 4K-byte block
Suspend and resume
System/370 extended
Test block
Translation
31-bit indirect data address word

Optional

Vector facility (individually on each central processor)

Programming Assists

Standard

Assists for MVS/370
Preferred-machine assist with control-switch assist
Start interpretive execution assist
VM assist
VM assists for CPU timer

Optional

Expanded storage

Channel Features

Standard

32 channels (Model 200 only; four channels may be designated byte-multiplexer channels, with the remainder designated block-multiplexer channels)
64 channels (Model 400 only; four channels on the A-side and four channels on the B-side may be designated byte-multiplexer channels, with the remainder designated block-multiplexer channels)
Data streaming on all block multiplexer channels providing a data rate of 3.0 megabytes per second

Optional

Channel group, first additional (Model 200 only; eight block multiplexer channels)
Channel group, first additional (Model 400 only; eight block multiplexer channels each on the A-side and B-side)
Channel group, second additional (Model 200 only; eight block multiplexer channels)
Channel group, second additional (Model 400 only; eight block multiplexer channels each on the A-side and B-side)

Miscellaneous Features

Standard

Audible alarm
Error checking and correction
High-speed buffer storage
I/O power sequence control for control units 1 to 64 (Model 200 only)
I/O power sequence control for control units 1 to 64 on the A-side, and control units 1 to 64 on the B-side (Model 400 only)
Can be partitioned into two independent dyadic central processors (Model 400 only)
Instruction retry
Reloadable control storage
Storage configuration control

Optional

I/O power sequence control for control units 65 to 128 (Model 200 only)
I/O power sequence control for control units 65 to 128 on the A-side (Model 400 only)
I/O power sequence control for control units 65 to 128 on the B-side (Model 400 only)

Programming Support for the 3090 Processor Complex

Programming support for the 3090 Processor Complex includes:

- MVS/SP (Multiple Virtual Storage/System Product) Version 1, which supports the 3090 Model 200 and also the 3090 Model 400 operating in partitioned mode only.
- MVS/SP (Multiple Virtual Storage/System Product) Version 2, which supports the 3090 Model 200 and also the 3090 Model 400 operating in partitioned mode or in single-image mode.
- VM/SP HPO (Virtual Machine/System Product with VM/SP High-Performance Option), which supports the 3090 Model 200 and also the 3090 Model 400 operating in partitioned mode only.
- VM/XA Systems Facility (Virtual Machine/Extended Architecture Systems Facility), which supports the 3090 Model 200 and also the 3090 Model 400 operating in partitioned mode only.

Programming support for the vector facility includes:

- MVS/XA (Multiple Virtual Storage/Extended Architecture)
- VM/SP HPO (Virtual Machine/System Product with High-Performance Option)

Chapter 3. System/370 Features

This chapter describes general System/370 in the following order:

- Programming features
- Programming assists
- Channel features
- Integrated adapters
- Miscellaneous features

Figures 3-1 and 3-2 at the end of this chapter compare the features and characteristics of the System/370 processors.

Programming Features

The following are descriptions of the System/370 programming features. The architectural mode in which each feature can operate (S/370, 370-XA, or both) is indicated in the first sentence of the description.

System/370 Commercial Instruction Set

System/370 commercial instruction set (S/370 or 370-XA mode), when operating in the S/370 architectural mode, includes instructions for use with the following basic computing functions:

- Basic control mode
- Branching
- Byte-oriented operand
- Control registers
- Data movement
- Decimal arithmetic
- Signed and unsigned binary integer arithmetic
- General registers
- Interval timer
- I/O operations
- Logical operations
- Monitoring
- Key-controlled storage protection
- Status switching
- Time-of-day clock

In the 370-XA architectural mode, some of the preceding functions are not provided, some are modified, and new functions are provided.

Functions not provided are:

- Basic control (BC) mode (execution in 370-XA mode is comparable to execution in the extended-control (EC) mode of System/370.
- Interval timer
- The Set Storage Key (SSK) and Insert Storage Key (ISK) instructions.

Modified functions are:

The channel subsystem has a different logical structure from that of the I/O facilities provided in System/370, with the result that I/O instructions, channels, channel sets, and I/O addressing are replaced in the 370-XA mode by a new set of I/O instructions, by logical device addressing, and by device-addressing mechanisms.

Compatibility with System/370 has been maintained in the CCWs (format 0), 31-bit IDAWs, and channel programs.

In the System/370 mode, subchannels are not shared among channels, and each subchannel is associated with only one channel path. In the 370-XA mode, each subchannel is uniquely associated with one I/O device, and that I/O device is uniquely associated with that one subchannel within the channel subsystem, regardless of the number of channel paths by which the I/O device is accessible to the channel subsystem.

Functions are provided in the channel subsystem in the 370-XA mode to detect malfunctions, to recover from these malfunctions if possible, and to report to the program by means of a channel report.

In the System/370 mode, I/O interruptions are accepted only by the CPU to which the channel set is currently connected. The I/O interruption causes the I/O address identifying the channel and device causing the interruption to be stored at locations 186-187, and the measurement byte to be stored at real location 185. In the 370-XA mode, I/O interruptions can be accepted by any CPU in the configuration. The subsystem ID and I/O-interruption parameter are stored at the doubleword at real location 184.

Associated with the new I/O instructions is a new program-interruption condition called operand exception.

New functions provided are:

- Bimodal addressing, which provides two modes of operation: a 24-bit addressing mode, for running old programs, and a 31-bit addressing mode. The mode is controlled by bit 32 in the PSW, and unprivileged instructions are provided that examine and set the mode. These instructions permit the combining of old programs, which must operate in the 24-bit addressing mode, with new programs, which can take advantage of the 31-bit addressing mode.

- 31-bit addressing, which provides the ability to perform either 24-bit or 31-bit address arithmetic for operand address generation. The 31-bit addressing also provides for 31-bit addresses in table entry formats, such as those that appear in page tables, segment tables, entry tables, and linkage tables.

- Page protection, which provides a page-protection bit in the page-table entry. Page protection can be used in a manner similar to the System/370 mode segment protection, which is not offered in the 370-XA mode.

- Tracing, which provides the Trace instruction and a new program interruption condition as an aid in problem determination. Tracing of successful branch instruction and address-space switching instructions can also be performed.

- Interpretive execution, which provides hardware support for several areas of virtual machine operation, such as interval timer operation, prefixing, address translation, and privileged instruction handling.

- Sorting instructions, which are designed to improve sort performance. These instructions are used by the IBM Program Product DFSORT (mixed case Data Facility Sort) Release 7 and later releases, running under MVS/XA when sorting fixed-length records using the blockset sort method.

Branch and Save

Branch and save (S/370 or 370-XA mode) provides two Branch and Save (BAS and BASR) instructions.

Channel Indirect Data Addressing

Channel indirect data addressing (S/370 or 370-XA mode) provides a means of translating data addresses in channel command words (CCWs) for I/O operations by allowing contiguous areas of virtual storage to be mapped into noncontiguous areas of real storage. The addresses contained in channel command words (CCWs) in virtual storage must be translated by the control program before execution.

Channel-Set Switching

Channel-set switching (S/370 mode) permits the program-controlled switching of channel sets between two tightly-coupled processors so that if one processor fails, either channel set may be assigned to the other connected channels, but only one channels requires the adapter.

Clear I/O

Clear I/O (S/370 mode) provides the clear I/O function in a channel when the privileged Clear I/O (CLRIO) instruction is executed. The clear-I/O function causes a channel to discontinue its current I/O operation with an addressed I/O device by storing the status of the operation in the channel status word (CSW) and by making the associated subchannel available.

Command Retry

Command retry (S/370 or 370-XA mode) is a channel and control unit procedure that causes a command in a channel program to be retried, without causing an I/O interruption. The retry is initiated by a control unit and the number of retries is device-dependent.

Conditional Swapping

Conditional swapping (S/370 or 370-XA mode) provides the instructions Compare and Swap (CS) and Compare Double and Swap (CDS), used, for example, in controlling the sharing of a common storage area.

CPU Timer and Clock Comparator

CPU timer and clock comparator (S/370 or 370-XA mode) provides two timing facilities. The CPU timer measures processor elapsed time and causes an interruption at the end of the period specified by the program. The timer is decremented when the processor is executing instructions and when the processor is in the wait state, but not in the stopped state. The program uses the Set CPU Timer (SPT) instruction to set the timer to a specific value and the Store CPU Timer (STPT) instruction to inspect the timer. The contents of the CPU timer are reset to 0 by an initial CPU reset.

The clock comparator causes an interruption when the time-of-day (TOD) clock reaches a value specified by the program. The format of the clock comparator is the same as that of the TOD clock. The program can initiate inspection of the clock comparator by using the Store Clock Comparator (STCKC) instruction and can set it by using the Set Clock Comparator (SCKC) instruction.

Direct Control

Direct control (S/370 mode) provides for exchanging control signals between two System/370 processors, between a System/370 processor and another processor, or between a System/370 processor and an external device, such as an analog-to-digital converter. Direct control bypasses the channel by using the two direct control instructions and six external interruption lines (external signals feature), each of which, when pulsed, sets up the conditions for an external interruption.

Dual Address Space

Dual address space (S/370 or 370-XA mode) facility consists of the following interrelated functions:

- Two address spaces for immediate use by the program
- Means for changing to other spaces
- Three instructions for moving information
- A table-based subroutine-linkage mechanism
- The use of multiple access keys for key-controlled protection by problem programs
- Aids for program-problem analysis (S/370 mode only)

Additionally, control and authority mechanisms are incorporated to control these functions. Twelve instructions are provided by the dual address space (DAS) facility.

Extended-Precision Floating Point

Extended-precision floating point (S/370 or 370-XA mode) permits floating-point operands to have 112-bit fractions (extended precision), twice the length of the 56-bit fractions available with long-precision floating-point arithmetic. Extended-precision floating point also includes seven floating-point instructions that use the extended-precision format (a signed seven-bit characteristic and a 28-digit fraction).

Extended Real Addressing

Extended real addressing (S/370 mode) allows the addressing of more than 16M-bytes (16,777,216) of main storage in a processor operating with the MVS/System Product (MVS/SP) or the VM/System Product with the VM/SP High Performance Option (VM/SP HPO).

External Signals

External signals (S/370 mode) provides six lines from external equipment to the CPU. When pulsed, the lines set up the conditions for an external interruption.

Fast Release

Fast release (S/370 mode) provides for early release of the CPU by a channel during execution of the Start I/O Fast Release instruction. Fast release occurs before device-selection is completed, thereby reducing the CPU delay associated with the operation.

Floating Point

Floating point (S/370 or 370-XA mode), which includes the floating-point instructions and four 64-bit floating-point registers, allows operands to be represented by either 24-bit fractions (short precision) or 56-bit fractions (long precision).

Halt Device

Halt device (S/370 mode), which provides the halt device function in a channel when the privileged Halt Device (HDV) instruction is executed, signals the addressed I/O device to terminate its current I/O operation.

I/O Extended Logout

I/O extended logout (S/370 mode) provides for the storing of detailed channel-error information for use by error-recovery routines.

Limited-Channel Logout

Limited channel logout (S/370 mode) provides four bytes of channel-status information for model-independent recovery from channel errors.

Multiprocessing

Multiprocessing (S/370 or 370-XA mode) includes the following facilities:

- CPU-address identification
- CPU signaling and response
- Prefixing
- Shared main storage
- TOD-clock synchronization

These facilities include four extensions to external interruption (external call, emergency signal, TOD clock sync check, and malfunction alert); control register positions for the TOD-clock-sync bit and for the masks for the four external-interruption conditions, and the Set Prefix, Signal Processor, Store CPU Address, and Store Prefix instructions.

PSW-Key Handling

PSW-key handling (S/370 or 370-XA mode) provides a means for handling the four-bit protection key (for store and fetch operations), which is part of the current PSW. PSW-key handling includes the Set PSW Key from Address (SPKA) and Insert PSW Key (IPK) instructions.

Recovery Extensions

Recovery extensions (S/370 mode) consist of the following:

- The clear channel function in a channel, which can be used to perform an I/O-system reset in a channel when the Clear Channel (CLRCH) instruction is executed.
- Machine-check extensions, which include a machine-check external damage-code validity bit and which provide a detailed indication of the cause of external damage.
- Limited channel logout extensions, which consists of two additional logout bits, to indicate whether the I/O interface is operative and whether the logout is valid.

Segment Protection

Segment protection (S/370 mode) provides a segment protection bit in the segment-table entry. When the bit is 1, any attempt to store in a segment causes a protection exception to be recognized.

Service Signal

Service signal (S/370 or 370-XA mode) provides an external interruption which is used by the service processor to signal model-dependent information to the control program.

Start-I/O-Fast Queuing

Start-I/O-fast queuing (S/370 mode) provides for fast release of the CPU by the channel during the execution of Start I/O Fast Release and the queuing of the operation at the subchannel when the control unit or device is busy, rather than termination of the operation by means of an I/O interruption.

Storage-Key Instruction Extensions

Storage-key instruction extensions (S/370 or 370-XA mode) provide the Set Storage Key Extended (SSKE), Insert Storage Key Extended (ISKE), and Reset Reference Bit Extended (RRBE) instructions, which provide 31-bit addresses and operate on the storage key associated with each 4K-byte block of storage.

Storage-Key 4K-Byte Block

Storage-key 4K-byte block (S/370 or 370-XA mode) provides for a single key associated with each 4K-byte block of storage and, in S/370 mode, provides a storage-key-exception control bit.

Suspend and Resume

Suspend and resume (S/370 mode) provides a suspend bit in the channel command word (CCW), which may indicate that the channel program is to be suspended, as well as a bit in the channel address word (CAW) that controls whether the suspend bit should be examined, and a new bit in the channel status word, which indicates that a channel program has been suspended. The Resume I/O instruction causes a suspended channel program to be resumed.

System/370 Extended

System/370 extended (S/370 mode), includes the following functions:

- Low-address protection, which improves system reliability, availability, and serviceability by increasing the protection of low-address main storage (addresses 0 through 511) vital to the system control program.
- The Invalidate Page Table Entry (IPTE) instruction and the common-segment bit, which increase the efficiency of dynamic address translation.
- The Test Protection (TPROT) instruction, which performs tests for potential protection violations without causing program interruptions for protection exceptions.

Test Block

Test block (S/370 or 370-XA mode) provides the Test Block (TB) instruction for testing the usability of a 4K-byte block of main storage.

Translation

Translation (S/370 or 370-XA mode) includes the following facilities:

- Dynamic address translation (DAT), which provides a means for translating virtual addresses to real addresses in main storage. Data and programs can be moved to an external storage device and later returned to main storage for completion of execution. A lookup procedure is used to compare storage references with address translations in a special buffer to determine if a current translation exists. If one does exist, it is used; if not, translation proceeds and the result is put into the buffer.
- Extended control (EC) mode, which is specified when PSW bit 12 is set to 1, provides for an expanded PSW format and CPU mode in which certain System/370 features (such as dynamic address translation) can operate.
- Program-event recording (PER), which permits the selective recording of events in the execution of a program. Examples of such events are: a successful branch, the alteration of a selected general register, the alteration of a selected main storage area, and instruction fetching from a selected main storage area.
- Set-system-mask suppression, which suppresses the execution of the Set System Mask (SSM) instruction so that a program interruption for a special-operation exception occurs.
- Store Status, which (1) changes the operation of the system-reset-normal key and (2) places the contents of the current PSW and the

program-addressable registers into permanently assigned locations within the first 512 bytes of central storage.

Vector Facility

Vector facility (S/370 or 370-XA mode) enhances performance in the processing of engineering and scientific data processing applications containing vectors. Vector facility provides 171 vector instructions, 16 vector registers, a vector mask register, and a vector status register. For more information see "Vector Facil ity" under "IBM 3090 Processor Complex" in Chapter 2.

31-Bit Indirect Data-Address Word

31-bit indirect data-address word (IDAW) (S/370 or 370-XA mode) extends the size of the address field in indirect-data-address words to 31 bits.

Programming Assists

The following are descriptions of the System/370 programming assists.

APL Assist

APL assist (S/370 mode) is an APL emulator that replaces functions performed by the APL software interpreter. This feature can provide a performance improvement for many applications when used with VS APL Program Product 5748-AP1.

Assists for MVS/370

Assists for MVS/370 (S/370 or 370-XA mode) provides the following:

- The SVC Assist instruction, which improves CPU performance by reducing the time needed to enter MVS supervisory services.
- The Fix Page instruction, Add FRR instruction (present if dual-address space is present), the six tracing instructions, and the four lock-handling instructions, which improve CPU performance.
- Page-fault assist (present if dual-address space is present, except on the 3031 Processor), which improves MVS performance by directly assigning and initializing a page frame when a page-translation exception is recognized on first reference to certain virtual pages.
- VM assists for MVS/370 assists, which perform functions for virtual machines are identical to functions of corresponding MVS assists for real machines.

ECPS: VS1

Extended control-program support for operating system/virtual storage 1 (ECPS:VS1) (S/370 or 370-XA mode) provides an assist to OS/VS1 by emulating certain supervisor functions.

ECPS: VM/370

Extended control-program support for virtual machine/370 (ECPS:VM/370) (S/370 or 370-XA mode) provides an assist to VM/370 by emulating certain supervisor functions. ECPS:VM/370 includes the following.

- Virtual machine assist (VMA)
- Control program assist (CPA)
- Expanded virtual machine assist (EVMA)
- Virtual interval timer assist (VITA)

Expanded Storage

Expanded storage (S/370 or 370-XA mode) dynamically retains pages from central storage that are most likely to be referred to by the workload. The transfer of 4K-byte blocks of data is accomplished under program control. Expanded storage has single-bit and double-bit error detection and correction and triple-bit error detection.

OS/DOS Compatibility

OS/DOS (operating system/disk operating system) compatibility (S/370 mode) provides the ability to execute DOS programs under operating system control.

Preferred-Machine Assist

Preferred-machine assist (S/370 mode) permits a single MVS/SP virtual-equals-real (V = R) virtual machine operating under VM/SP with the VM/SP High Performance Option to operate with a minimum of interpretive instruction execution, thereby allowing it to achieve near native performance. With preferred machine assist, any MVS/SP release that supports more than 16M bytes of real storage can use real storage above 16M bytes when operating as a V = R virtual machine. Control switch assist (CSA), an extension to preferred-machine assist, increases the speed with which interrupts on CP-owned channels are presented to a preferred virtual machine and adds several functions, including the use of the virtual machine communication facility (VMCF).

Shadow-Table Bypass Assist

Shadow-table bypass assist (S/370 mode) improves performance of certain virtual machines having the virtual equals real (V = R) option by executing certain virtual machine instructions and program interruptions directly without requiring any intervention or assistance by the VM/370 control program.

Start Interpretive Execution Assist

Start interpretive execution (SIE) assist (370-XA mode) improves the performance of virtual equals real (V = R) guests. Most I/O instructions and associated interruptions are handled without leaving interpretive execution mode.

System/360 Model 20 Compatibility

System/360 Model 20 compatibility (S/370 mode) supports an emulation program. The feature and emulation program together provide the means to execute programs originally written for the System/360 Model 20.

Virtual Machine Assist

Virtual machine assist (VMA) (S/370 mode) improves central processor performance by eliminating the requirement for certain program interruptions. For example, virtual storage operating systems (such as OS/VS1 and DOS/VS) that run in problem state under control of VM/370 use many privileged instructions and supervisor call instructions (SVCs) that cause interruptions VM/370 ordinarily must handle. The virtual machine assist feature causes many of these interruptions to be intercepted and handled by the CPU instead.

VM Assists for the CPU Timer

VM assists for the CPU timer (S/370 mode) permit a CPU to directly execute the Set CPU Timer (SPT) and Store CPU Timer (STPT) instructions for a virtual machine operating under the Virtual Machine/System Product with Virtual Machine High Performance Option (VM/SP-HPO).

1401/1440/1460 Compatibility

The 1401/1440/1460 compatibility feature (S/370 mode) supports an emulation program. The feature and emulation program together provide the means to execute programs originally written for the 1401, 1440, or 1460 data processing system.

1401/1440/1460 and 1410/7010 Compatibility

The 1401/1440/1460 compatibility feature (S/370 mode) supports an emulation program. The feature and emulation program together provide the means to execute programs originally written for the 1401, 1440, 1460, 1410, or 7010 data processing system.

3135 CPU Mode Selection

The 3135 CPU mode selection feature (S/370 mode) provides the capability to run on the System/370 Model 138 any system control program that supports the System/370 Model 135.

3145 CPU Mode Selection

The 3145 CPU mode selection feature (S/370 mode) provides the capability to run on the System/370 Model 148 any system control program that supports the System/370 Model 145.

7070/7074 Compatibility

The 7070/7074 compatibility feature (S/370 mode) supports an emulation program. The feature and emulation program together provide the means to execute programs originally written for the 7070 or 7074 data processing system.

7080 Compatibility

The 7080 compatibility feature (S/370 mode) supports an emulation program. The feature and emulation program together provide the means to execute programs originally written for the 7080 data processing system.

709/7090/7094/7094II Compatibility

The 709/7090/7094/7094 II compatibility feature (S/370 mode) supports an emulation program. The feature and emulation program together provide the means to execute programs originally written for the 709, 7090, 7094, or 7094 II data processing system.

Modem clocking (S/370 mode) allows a terminal adapter to operate at one or more specific data rates to match those of a particular modem.

Channel Features

The following are descriptions of the System/370 channel features.

Block Multiplexer Channel

Block multiplexer channels can operate as a selector channels, which in burst mode are especially suitable for high-speed operation, or as block multiplexer channels, which permit the interleaving (multiplexing) of channel programs for high-speed devices. Each block multiplexer channel provides eight control unit positions. For more information, see "Block Multiplexer Channels" in Chapter 1.

Byte Multiplexer Channel

Byte multiplexer channels operate in either byte mode, for lower data rates when operating with devices such as printers and terminals, or in burst mode, for higher data rates when operating with devices such as magnetic tape units and disk drives. Each byte multiplexer channel provides eight control unit positions. For more information, see "Byte Multiplexer Channels" in Chapter 1.

Data Streaming

Data streaming, a feature for block multiplexer channels, is initiated by the control unit, and permits data rates of up to 3 megabytes per second and cable lengths of up to 122 meters (400 feet).

Selector Channel

Selector channels transmit a complete record to or from an I/O device without interruption, which makes them especially suitable for operation with high-speed devices as well as being able to handle low and medium speed devices. Each selector channel provides eight control unit positions. For more information, see "Selector Channels" in Chapter 1.

Two-Byte Interface

Two-byte interface (also referred to as the bus-extension feature) permits a block multiplexer channel to transfer data at rates as high as 3 million bytes per second.

Integrated Adapters

The following are descriptions of the System/370 integrated adapters.

Integrated Adapters for I/O Devices

Integrated adapters for I/O devices allow direct attachment of the indicated I/O devices to the processor.

Channel-to-Channel Adapter

Channel-to-channel adapter provides a path for and synchronization of data transfers between two channels, which are usually on separate systems. In effect, the two systems are then interconnected (loosely coupled). The data transfer rate is at the speed of the slower of the two attached channels. The adapter uses one or two control unit positions on each of the two connected channels, but only one channel requires the adapter.

Integrated Communications Adapter

Integrated communications adapter (ICA) provides the basic control storage and circuits for direct attachment of communications lines to the processor.

Integrated Storage Controls

Integrated storage controls (ISC) provides for the attachment of the 3333 Models 1 or 11 and/or the 3340 Model A2 and/or the 3350 Model A2 or A2F. The ISC is organized functionally into two separate paths with as many as 16 drives per path and as many as 32 drives per path when ISC control store extension is installed. Each ISC path requires a control unit position on a block multiplexer channel. The staging adapter for the ISC enables each path of integrated storage control (ISC) to be attached to 3333 Model 1's and 11's and/or 3350 Model A2s or A2Fs and their associated drives for a maximum of 32 drives per path.

Remote Switch Attachment

Remote switch attachment allows the two-channel switch for the integrated storage control to be attached to the configuration control panel of the appropriate multisystem communication unit.

Two-Channel Switch

Two-channel switch permits a path for data transfers to be attached to a second channel, which may be on the same processor or on different processors.

Miscellaneous Features

The following are descriptions of the System/370 miscellaneous features.

Audible Alarm

Audible alarm alerts the operator to conditions that require operator intervention.

Channel Reconfiguration Hardware

Channel reconfiguration hardware allows either CPU in a multiprocessing system to receive interruptions from channels normally dedicated to the other CPU and to control the channels.

Emergency Power-Off Control

Emergency power-off control provides, in effect, a single emergency power-off (EPO) switch by connecting one or two, or as many as 12 systems, allowing power to all systems to be turned off in an emergency.

Error Checking and Correction

Error checking and correction automatically detects all single- and double-bit errors and most multiple-bit errors, then corrects the single-bit errors in data read from main storage. Error checking and correction (ECC) code bits are stored with the data. Expanded storage, when provided, has single-bit and double-bit error detection and correction and triple-bit error detection.

High-Speed Buffer Storage

High-speed buffer storage, which is also called cache, allows fast access to most-recently-used main storage data, therefore, satisfying many storage fetch requests without involving large-capacity main storage. This results in a shorter effective main storage access time than the actual main storage cycle time. On some System/370 models, the high-speed buffer storage can be expanded.

High-Speed Multiply

High-speed multiply enhances internal performance on both fixed- and floating-point multiply operations by reducing multiplication time.

Instruction Retry

Instruction retry automatically examines any instruction during whose execution an error is detected and, in most cases, reattempts its execution. Source data is saved before being altered during an operation. When an error is detected, a microprogram returns the CPU to the beginning of the operation or to a point in the operation that was correctly executed, and the operation is continued.

I/O Power Sequence Control

I/O power sequence control permits the power sequencing (powering on or off) by the processor of attached control units, the quantity of which depends on the processor. On some System/370 models, this quantity can be increased.

Performance Improvement

Performance improvement reduces the basic machine cycle time of 3081, 3083, and 3084 Processor Units to 24.5 nanoseconds. This feature includes changes to the processor unit and the processor controller.

Power Warning

Power warning provides a signal to the processor when the power is outside the specified limits.

Processor Checkpoint Retry

Processor checkpoint retry, which is also called CPU retry, corrects intermittent errors by reprocessing one or more instructions using pertinent data saved between checkpoints.

Reloadable Control Storage

Reloadable control storage (RCS) holds microprograms that control the processor, channels, and features. These microprograms are loaded into the RCS by an initial microcode load (IML) procedure.

Service Processor

Service processor is a functionally separate realtime monitor that improves serviceability and availability by continuously recording the most recent processor control information. When a hardware failure occurs, the service processor logs error data for diagnostic use. The service processor can be attached by communication line to a remote support facility.

Storage Configuration Control

Storage configuration control permits main storage to be reconfigured. Reconfiguration is normally accomplished by the operator interacting with the control program but may also be performed as part of the initial microcode load (IML). Storage configuration and control allows a malfunctioning basic storage module to be removed from the operational configuration after a processor unit is initialized.

Storage Error Checking and Correction

Storage error checking and correction provides single-bit error correction and double-bit error detection in central storage.

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 1 of 9)

Features and Characteristics	Application on Processors									
	3115-0 3115-2	3125-0 3125-2	3135	3135-3	3138	3145	3145-3	3148	3158 3158-3	3168 3168-3
Programming Features										
System/370 commercial instruction set	std	std	std	std	std	std	std	std	std	std
Branch and save	-	-	-	-	-	-	-	-	-	-
Channel indirect data addressing	std	std	std	std	std	std	std	std	std	std
Channel-set switching	-	-	-	-	-	-	-	-	-	-
Clear I/O	-	-	-	-	-	opt	std	std	std	std
Command retry	-	-	std	std	std	std	std	std	std	std
Conditional swapping	std	std	opt	std	std	opt	std	std	std	std
CPU timer and clock comparator	std	std	opt	std	std	opt	std	std	std	std
Direct control	-	-	opt	opt	opt	opt	opt	opt	opt	std
Dual address space	-	-	-	-	-	-	-	-	-	-
Extended-precision floating point	opt	opt	opt	std	std	opt	std	std	opt	std
Extended real addressing	-	-	-	-	-	-	-	-	-	-
External signals	opt	opt	opt	opt	opt	opt	opt	opt	opt	std
Fast release	-	-	-	-	-	-	-	-	-	std
Floating point	opt	opt	opt	std	std	opt	std	std	std	std
Halt device	std	std	std	std	std	std	std	std	std	std
I/O extended logout	-	-	-	-	-	std	std	std	-	std
Limited-channel logout	std	std	std	std	std	std	std	std	std	-
Multiprocessing	-	-	-	-	-	-	-	-	std	std
PSW-key handling	-	-	std	std	std	opt	std	std	std	std
Recovery extensions	-	-	-	-	-	-	-	-	-	-

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 2 of 9)

Features and Characteristics	Application on Processors									
	3115-0 3115-2	3125-0 3125-2	3135	3135-3	3138	3145	3145-3	3148	3158 3158-3	3168 3168-3
Programming Features (continued)										
Segment protection	-	-	-	-	-	-	-	-	-	-
Service signal	-	-	-	-	-	-	-	-	-	-
Start-I/O-fast queuing	-	-	-	-	-	-	-	-	-	-
Storage-key instruction extensions	-	-	-	-	-	-	-	-	-	-
Storage-key 4K-byte block	-	-	-	-	-	-	-	-	-	-
Suspend and resume	-	-	-	-	-	-	-	-	-	-
System/370 extended	-	-	-	-	-	-	-	-	opt	opt
Test block	-	-	-	-	-	-	-	-	-	-
Translation	std	std	std	std	std	std	std	std	std	std
Vector facility	-	-	-	-	-	-	-	-	-	-
31-bit indirect data-address word	-	-	-	-	-	-	-	-	-	-
Programming Assists										
APL assist	-	-	opt	std	std	opt	std	std	-	-
Assists for MVS/370	-	-	-	-	-	-	-	-	opt	opt
ECPS:VS1	-	-	-	std	-	-	std	std	opt	-
ECPS:VM/370	-	-	-	std	-	-	std	std	-	-
Expanded storage	-	-	-	-	-	-	-	-	-	-
OS/DOS compatibility	-	-	std	std	std	std	std	std	opt	-
Preferred-machine assist	-	-	-	-	-	-	-	-	-	-
Shadow-table-bypass assist	-	-	-	-	-	-	-	-	-	-
Start interpretive execution assist	-	-	-	-	-	-	-	-	-	-
System/360 Model 20 compatibility	opt	opt	opt	opt	opt	-	-	-	-	-

Features and Characteristics	Application on Processors									
	3115-0 3115-2	3125-0 3125-2	3135	3135-3	3138	3145	3145-3	3148	3158 3158-3	3168 3168-3
Programming Assists (continued)										
Virtual machine assist	-	-	opt	-	-	opt	-	-	opt	-
VM assists for the CPU timer	-	-	-	-	-	-	-	-	-	-
1401/1440/1460 compatibility	opt	opt	opt	opt	opt	opt	opt	-	-	-
1401/1440/1460 and 1410/7010 compatibility	-	-	-	-	-	opt	opt	std	-	-
3135 CPU mode selection	-	-	-	-	std	-	-	-	-	-
3145 CPU mode selection	-	-	-	-	-	-	-	std	-	-
7070/7074 compatibility	-	-	-	-	-	-	-	-	opt	opt
7080 compatibility	-	-	-	-	-	-	-	-	-	opt
709/7090/7094/7094II compatibility	-	-	-	-	-	-	-	-	-	opt
Channel Features										
Block multiplexer channel	-	-	opt	opt	std	std	std	std	std	opt
Byte multiplexer channel	opt	opt	std	std	std	std	std	std	std	opt
Data streaming	-	-	-	-	-	-	-	-	-	-
Selector channel	-	-	opt	-	-	opt	-	-	-	opt
Two-byte interface	-	-	-	-	-	-	-	-	-	opt
Integrated Adapters										
1403 attachment	-	opt	-	opt	opt	-	-	-	-	-
2311/2314 compatibility on 3340	opt	opt	-	-	-	-	-	-	-	-
2319 adapter	-	-	-	opt	-	opt	opt	-	-	-
2560/3525/5325 attachment	opt	opt	opt	-	-	-	-	-	-	-
3056 adapter	-	-	-	-	-	-	-	-	opt	-

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 3 of 9)

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 4 of 9)

Features and Characteristics	Application on Processors									
	3115-0 3115-2	3125-0 3125-2	3135	3135-3	3138	3145	3145-3	3148	3158 3158-3	3168 3168-3
Integrated Adapters (continued)										
3203/5203 attachment	opt	-	-	-	opt	-	-	opt	-	-
3210/3215 adapter	-	-	opt	opt	-	opt	opt	-	-	-
3213 adapter	-	-	-	-	-	-	-	-	opt	opt
3286/3287 adapter	-	-	-	-	opt	-	-	opt	-	-
3333/3330 attachment	-	std	-	-	-	-	-	-	-	-
3333/3340/3344 adapter	-	-	opt	opt	opt	-	-	-	-	-
3340 attachment	-	std	-	-	-	-	-	-	-	-
3340/3344 attachment	-	std	-	-	-	-	-	-	-	-
3411/3410 or 3803/3420 attachment	opt	opt	-	-	-	-	-	-	-	-
3504 attachment	-	opt	-	-	-	-	-	-	-	-
5213 attachment	-	opt	-	-	-	-	-	-	-	-
Channel-to-channel adapter	-	-	-	-	-	opt	opt	opt	opt	opt
Display console adapter	-	-	-	-	-	-	-	-	std	std
Integrated communications adapter	opt	opt	opt	opt	opt	-	-	-	-	-
Integrated storage controls	-	-	-	-	-	opt	opt	-	opt	opt
Remote switch attachment	-	-	-	-	-	-	-	-	opt	opt
Two-channel switch	-	-	-	-	-	opt	opt	-	opt	opt
Miscellaneous Features										
Audible alarm	std	std	std	std	std	std	std	std	-	-
Channel reconfiguration hardware	-	-	-	-	-	-	-	-	-	std
Emergency power-off control	-	-	opt	opt	opt	opt	opt	opt	opt	opt
Error checking and correction	-	-	-	-	-	-	-	-	std	std
High-speed buffer storage	-	-	-	-	-	-	-	-	std	std

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 5 of 9)

Features and Characteristics	Application on Processors									
	3115-0 3115-2	3125-0 3125-2	3135	3135-3	3138	3145	3145-3	3148	3158 3158-3	3168 3168-3
Miscellaneous Features (continued)										
High-speed multiply	-	-	-	-	-	-	-	-	-	opt
Instruction retry	-	-	std	std	std	std	std	std	std	std
I/O power sequence control	-	-	-	-	-	-	-	-	std	-
Performance improvement	-	-	-	-	-	-	-	-	-	-
Power warning	-	-	-	-	-	-	-	-	opt	-
Processor checkpoint retry	-	-	-	-	-	-	-	-	-	-
Reloadable control storage	-	-	-	-	-	-	-	-	opt	-
Service processor	std	std	-	-	-	-	-	-	std	-
Storage configuration control	-	-	-	-	-	-	-	-	-	std
Storage error checking and correction	std	std	std	std	std	std	std	std	-	-
Processor basic machine cycle time (nanoseconds)	480	480	275-1485	275-1485	275-1485	202.5-315	180-270	180-270	115	80
Processor storage or central storage										
Storage access width (number of bytes fetched per access)	2	2	2 or 4	2 or 4	2 or 4	8	8	8	16	8
Storage cycle time, (nanoseconds)	480	480, 320	770-935 rd, 935 wr	770-935 rd, 935 wr	715-880 rd, 935 wr	540 rd, 607.5 wr	405 rd, 540 wr	405 rd, 540 wr	1035 rd, 690-920 wr	320 (a)
Storage interleaving	-	-	-	-	-	-	-	-	-	4-way

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 6 of 9)

Features and Characteristics	Application on Processors									
	3115-0 3115-2	3125-0 3125-2	3135	3135-3	3138	3145	3145-3	3148	3158 3158-3	3168 3168-3
Processor storage or central storage capacities (bytes) (Entries are processor designations)										
65,536 (64K)	F, F2	-	-	-	-	-	-	-	-	-
98,304 (96K)	FE, FE2	FE, FE2	FE	-	-	-	-	-	-	-
131,072 (128K)	G, G2	G, G2	-	-	-	-	-	-	-	-
147,456 (144K)	-	-	GD	-	-	-	-	-	-	-
163,840 (160K)	GE, GE2	GE, GE2	-	-	-	GE	-	-	-	-
196,608 (192K)	GF, GF2	GF, GF2	GF	-	-	-	-	-	-	-
212,992 (208K)	-	-	-	-	-	GFD	A1	-	-	-
262,144 (256K)	H2	H, H2	H	A1	-	H, H2	-	-	-	-
327,680 (320K)	-	-	HF	A2	-	-	A2	-	-	-
393,216 (384K)	HG2	HG2	HG	A3	-	HG, HG2	-	-	-	-
458,752 (448K)	-	-	-	-	-	-	A3	-	-	-
524,288 (512K)	-	I2	I	A4	I	I, I2	-	-	I,AP1, MP1,U31, A31,M31	-
720,896 (704K)	-	-	-	-	-	-	A4	-	-	-
786,432 (768K)	-	-	-	-	-	IH2	-	-	-	-
983,040 (960K)	-	-	-	-	-	-	A5	-	-	-
1,048,576 (1024K or 1M)	-	-	-	-	J	J2	-	J	J,AP2, MP2,U32, A32,M32	J,MP1, U31,A31, M31

Features and Characteristics	Application on Processors									
	3115-0 3115-2	3125-0 3125-2	3135	3135-3	3138	3145	3145-3	3148	3158 3158-3	3168 3168-3
Processor storage or central storage capacities (bytes) (continued)										
1,507,328 (1472K)	-	-	-	-	-	-	A6	-	-	-
1,572,864 (1536K or 1.5M)	-	-	-	-	-	JI2	-	-	JI,AP3, MP3,U33, A33,M33	-
2,031,616 (1984K)	-	-	-	-	-	-	A7	-	-	-
2,097,152 (2M)	-	-	-	-	-	K2	-	K	K,AP4, MP4,U34, A34,M34	K,MP2, U32,A32, M32
3,145,728 (3M)	-	-	-	-	-	-	-	-	KJ,AP5, MP5,U35, A35,M35	KJ,MP3, U33,A33, M33
4,194,304 (4M)	-	-	-	-	-	-	-	-	L,AP6, MP6,U36, A36,M36	L,MP4, U34,A34, M34
5,242,880 (5M)	-	-	-	-	-	-	-	-	LJ,AP7, U37,A37, M37	LJ,MP5, U35,A35, M35
6,291,456 (6M)	-	-	-	-	-	-	-	-	LK,AP8, U38,A38, M38	LK,MP6, U36,A36, M36
7,340,032 (7M)	-	-	-	-	-	-	-	-	-	LKJ,MP7, U37,A37, M37
8,388,608 (8M)	-	-	-	-	-	-	-	-	-	M,MP8, U38,A38, M38

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 7 of 9)

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 8 of 9)

Features and Characteristics	Application on Processors									
	3115-0 3115-2	3125-0 3125-2	3135	3135-3	3138	3145	3145-3	3148	3158 3158-3	3168 3168-3
Channels										
Maximum channels	1	1	4 (b)	4 (b)	4 (b)	5	5	5	6	12
Byte multiplexer (standard)	1	1	1	1	1	1	1	1	1	-
Byte multiplexer (optional)	-	-	-	-	-	-	-	-	1 (d)	2
Block multiplexer (standard)	-	-	-	-	2	-	1	4	2	-
Block multiplexer (optional)	-	-	(c)	2	-	(c)	3	-	3	11
Selector (standard)	-	-	-	-	-	1	-	-	-	-
Selector (optional)	-	-	2	-	-	3	-	-	-	6
Programming Support										
DOS	-	yes	yes	yes	-	yes	yes	-	yes	-
DOS/VS	yes	yes	yes	yes	yes	yes	yes	yes	yes	-
OS/MFT	-	-	yes	yes	-	yes	yes	-	yes	yes
OS/MVT	-	-	-	-	-	yes	yes	-	yes	yes
OS/VS1	-	-	yes	yes	yes	yes	yes	yes	yes	yes
OS/VS2	-	-	-	-	-	yes	yes	-	yes	yes
VM/370	-	-	yes	yes	yes	yes	yes	yes	yes	yes

Legend:

std standard
opt optional
- not applicable

Notes:

(a) The storage cycle times given for the 3168 do not reflect the time reductions that result from storage interleaving or, additionally, for 3168 and 3168-3 tie reductions resulting from the use of the high-speed buffer.

(b) Includes the integrated file adapter, addressed as a selector or block multiplexer channel.

(c) The block multiplexer channel feature provides block multiplexer capabilities for all attached selector channels.

(d) Takes the place of a fourth block multiplexer channel.

Figure 3-1. Comparison of System/370 Processors, 3115-0 through 3168-3 (Part 9 of 9)

Figure 3-2. Comparison of System/370 Processors, 3031 through 3090 (Part 1 of 8)

Features and Characteristics	Application on Processors								
	3031	3032	3033	3033 Model Group N	3033 Model Group S	3081	3083	3084	3090
Programming Features									
System/370 commercial instruction set	std	std	std	std	std	std	std	std	std
Branch and save	-	-	-	-	-	std	std	std	std
Channel indirect data addressing	std	std	std	std	std	std	std	std	std
Channel-set switching	-	-	std	-	-	std	-	std	std
Clear I/O	std	std	std	std	std	std	std	std	std
Command retry	std	std	std	std	std	std	std	std	std
Conditional swapping	std	std	std	std	std	std	std	std	std
CPU timer and clock comparator	std	std	std	std	std	std	std	std	std
Direct control	opt	std	std	std	std	-	-	-	-
Dual address space	opt	-	-	-	-	std	std	std	std
Extended-precision floating point	std	std	std	std	std	std	std	std	std
Extended real addressing	-	-	opt	-	-	std	std	std	std
External signals	-	std	std	std	std	-	-	-	-
Fast release	std	std	std	std	std	std	std	std	std
Floating point	std	std	std	std	std	std	std	std	std
Halt device	std	std	std	std	std	std	std	std	std
I/O extended logout	std	std	std	std	std	std	std	std	std
Limited-channel logout	std	std	std	std	std	std	std	std	std
Multiprocessing	std	-	std	-	-	std	std	std	std
PSW-key handling	std	std	std	std	std	std	std	std	std
Recovery extensions	std	std	std	std	std	std	std	std	std
Segment protection	-	-	-	-	-	std	std	std	std

Features and Characteristics	Application on Processors								
	3031	3032	3033	3033 Model Group N	3033 Model Group S	3081	3083	3084	3090
Programming Features (continued)									
Service signal	-	-	-	-	-	std	std	std	std
Start-I/O-fast queueing	-	-	-	-	-	std	std	std	std
Storage-key instruction extensions	-	-	-	-	-	std	std	std	std
Storage-key 4K-byte block	-	-	-	-	-	std	std	std	std
Suspend and resume	-	-	-	-	-	std	std	std	std
System/370 extended	std	std	std	std	std	std	std	std	std
Test block	-	-	-	-	-	std	std	std	std
Translation	std	std	std	std	std	std	std	std	std
Vector facility	-	-	-	-	-	-	-	-	opt
31-bit indirect data-addressing word	-	-	-	-	-	std	std	std	std
Programming Assists									
APL assist	-	-	-	-	-	-	-	-	-
Assists for MVS/370	std	std	std	std	std	std	std	std	std
ECPS:VS1	std	-	-	-	-	-	-	-	-
ECPS:VM/370	std	-	-	-	-	-	-	-	-
Expanded storage	-	-	-	-	-	-	-	-	opt
OS/DOS compatibility	-	-	-	-	-	-	-	-	-
Preferred-machine assist	-	-	-	-	-	std	std	std	std
Shadow-table bypass assist	opt	-	-	-	-	-	-	-	-
Start interpretive execution assist	-	-	-	-	-	std	std	std	std
System/360 Model 20 compatibility	-	-	-	-	-	-	-	-	-
Virtual machine assist	-	-	-	-	-	std	std	std	std

Figure 3-2. Comparison of System/370 Processors, 3031 through 3090 (Part 2 of 8)

Figure 3-2. Comparison of System/370 Processors, 3031 through 3090 (Part 3 of 8)

Features and Characteristics	Application on Processors								
	3031	3032	3033	3033 Model Group N	3033 Model Group S	3081	3083	3084	3090
Programming Assists (continued)									
VM assists for the CPU timer	-	-	-	-	-	std	std	std	std
1401/1440/1460 compatibility	-	-	-	-	-	-	-	-	-
1401/1440/1460 and 1410/7010 compatibility	-	-	-	-	-	-	-	-	-
3135 CPU mode selection	-	-	-	-	-	-	-	-	-
3145 CPU mode selection	-	-	-	-	-	-	-	-	-
7070/7074 compatibility	-	-	-	-	-	-	-	-	-
7080 compatibility	-	-	-	-	-	-	-	-	-
709/7090/7094/7094II compatibility	-	-	-	-	-	-	-	-	-
Channel Features									
Block multiplexer channel	std	std	std	std	std	std	std	std	std
Byte multiplexer channel	std	std	std	std	std	std	std	std	std
Data streaming	opt	opt	opt	opt	opt	std	std	std	std
Selector channel	-	-	-	-	-	-	-	-	-
Two-byte interface	-	opt	opt	opt	opt	-	-	-	-
Integrated Adapters									
1403 attachment	-	-	-	-	-	-	-	-	-
2311/2314 compatibility on 3340	-	-	-	-	-	-	-	-	-
2319 adapter	-	-	-	-	-	-	-	-	-
2560/3525/5425 attachment	-	-	-	-	-	-	-	-	-
3056 adapter	-	-	-	-	-	-	-	-	-
3203/5203 attachment	-	-	-	-	-	-	-	-	-
3210/3215 adapter	-	-	-	-	-	-	-	-	-

Figure 3-2. Comparison of System/370 Processors, 3031 through 3090 (Part 4 of 8)

Features and Characteristics	Application on Processors								
	3031	3032	3033	3033 Model Group N	3033 Model Group S	3081	3083	3084	3090
Integrated Adapters (continued)									
3213 adapter	-	-	-	-	-	-	-	-	-
3286/3287 adapter	-	-	-	-	-	-	-	-	-
3333/3330 attachment	-	-	-	-	-	-	-	-	-
3330/3340/3344 adapter	-	-	-	-	-	-	-	-	-
3340 attachment	-	-	-	-	-	-	-	-	-
3340/3340 attachment	-	-	-	-	-	-	-	-	-
3411/3410 or 3803/3420 attachment	-	-	-	-	-	-	-	-	-
3504 attachment	-	-	-	-	-	-	-	-	-
5213 attachment	-	-	-	-	-	-	-	-	-
Channel-to-channel adapter	opt	opt	opt	opt	opt	opt	opt	opt	opt
Display console adapter	-	-	-	-	-	-	-	-	-
Integrated communications adapter	-	-	-	-	-	-	-	-	-
Integrated storage controls	-	-	-	-	-	-	-	-	-
Remote switch attachment	-	-	-	-	-	-	-	-	-
Two-channel switch	-	-	-	-	-	-	-	-	-
Miscellaneous Features									
Audible alarm	std	std	std	std	std	std	std	std	std
Channel reconfiguration hardware	-	-	-	-	-	-	-	-	-
Emergency power-off control	-	-	-	-	-	-	-	-	-
Error checking and correction	std	std	std	std	std	std	std	std	std
High-speed buffer storage	std	std	std	std	std	std	std	std	std
High-speed multiply	-	-	-	-	-	-	-	-	-
Instruction retry	std	std	std	std	std	-	-	-	-

Figure 3-2. Comparison of System/370 Processors, 3031 through 3090 (Part 5 of 8)

Features and Characteristics	Application on Processors								
	3031	3032	3033	3033 Model Group N	3033 Model Group S	3081	3083	3084	3090
Miscellaneous Features (continued)									
I/O power sequence control	-	-	-	-	-	std	std	std	std
Performance improvement	-	-	-	-	-	opt	opt	opt	-
Power warning	-	-	-	-	-	-	-	-	-
Processor checkpoint retry	-	-	-	-	-	std	std	std	-
Reloadable control storage	std	std	std	std	std	std	std	std	std
Service processor	-	-	-	-	-	-	-	-	-
Storage configuration control	std	std	std	std	std	std	std	std	std
Storage error checking and correction	-	-	-	-	-	-	-	-	-
Processor basic machine cycle time (nanoseconds)	115	80	57	57	57	24,24.5, 26	24,24.5, 26	24,24.5, 26	18.5
Processor storage or central storage									
Storage access width (number of bytes fetched per access)	8	8	8	8	8	8	8	8	-
Storage cycle time (nanoseconds)	345	320	342	342	342	312	312	312	-
Storage interleaving	4-way	4-way	4-way	4-way	4-way	2-way	2-way	2-way	-
Processor storage or central storage capacities (bytes) (Entries are processor designations)									
2,097,152 (2M)	2,A2	2	-	-	-	-	-	-	-
3,145,728 (3M)	3,A3	-	-	-	-	-	-	-	-
4,194,304 (4M)	4,A4	4	U4,A4,M4	N4	S4	-	-	-	-
5,242,880 (5M)	5,A5	-	-	-	-	-	-	-	-
6,291,456 (6M)	6,A6	6	U6,A6,M6	-	-	-	-	-	-
7,340,032 (7M)	7,A7	-	-	-	-	-	-	-	-

Features and Characteristics	Application on Processors								
	3031	3032	3033	3033 Model Group N	3033 Model Group S	3081	3083	3084	3090
Processor storage or central storage capacities (bytes) (continued)									
8,388,608 (8M)	8,A8	8	U8,A8,M8	N8	S8	-	- CX0 E8 EX0 B8 BX0 J8 JX0	-	-
12,582,912 (12M)	-	-	U12,A12, M12	N12	S12	-	-	-	-
16,777,216 (16M)	-	-	U16,A16, M16	N16	S16	D16 - G16 GX1 K16 KX1	- CX1 E16 EX1 B16 BX1 J16 JX1	-	-
25,165,824 (24M)	-	-	U24,A24	-	-	D24 - G24 GX2 K24 KX2	- CX2 E24 EX2 B24 BX2 J24 JX2	-	-
33,554,432 (32M)	-	-	-	-	-	D32 - G32 GX3 K32 KX3	- CX3 E32 EX3 B32 BX3 J32 JX3	Q32 QX3	-
50,331,648 (48M)	-	-	-	-	-	G48 GX4 K48 KX4	-	Q48 QX4	-
67,108,864 (64M)	-	-	-	-	-	G64 GX6 K64 KX6	-	Q64 QX6	200
100,663,296 (96M)	-	-	-	-	-	-	-	Q96 QX9	-
134,217,728 (128M)	-	-	-	-	-	-	-	QCB QXC	400
Expanded storage capacities									
67,108,864 (64M)	-	-	-	-	-	-	-	-	200
134,217,728 (128M)	-	-	-	-	-	-	-	-	200,400
268,435,456 (256M)	-	-	-	-	-	-	-	-	400

Figure 3-2. Comparison of System/370 Processors, 3031 through 3090 (Part 6 of 8)

Figure 3-2. Comparison of System/370 Processors, 3031 through 3090 (Part 7 of 8)

Features and Characteristics	Application on Processors								
	3031	3032	3033	3033 Model Group N	3033 Model Group S	3081	3083	3084	3090
Channels									
Maximum channels	6	12	16	16	12	24	24	48	(f)
Byte multiplexer (standard)	1	1 (a)	2 (a)	1 (a)	1 (a)	(b) (e)	(c) (e)	(d) (e)	(f)
Byte multiplexer (optional)	-	1 (a)	1 (a)	2 (a)	1 (a)	(b) (e)	(c) (e)	(d) (e)	(f)
Block multiplexer (standard)	5	5 (a)	10 (a)	5 (a)	5 (a)	(b) (e)	(c) (e)	(d) (e)	(f)
Block multiplexer (optional)	-	5 (a)	4 (a)	9 (a)	5 (a)	(b)	(c)	(d)	(f)
Selector (standard)	-	-	-	-	-	-	-	-	-
Selector (optional)	-	-	-	-	-	-	-	-	-
Programming Support									
DOS	-	-	-	-	-	-	-	-	-
DOS/VS	yes	-	yes (g) (h)	yes (g) (h)	yes (g)	-	-	-	-
OS/MFT	-	-	-	-	-	-	-	-	-
OS/MVT	-	-	-	-	-	-	-	-	-
OS/VS1	yes	yes	yes	yes	yes	-	-	-	-
OS/VS2	yes	yes	yes	yes	yes	yes	yes	yes	yes
VM/370	yes	yes	yes	yes	yes	yes	yes	yes	yes

Figure 3-2. Comparison of System/370 Processors, 3031 through 3090 (Part 8 of 8)

Legend:

std standard
opt optional
- not applicable

Notes:

(a) The 3032 Processor has one group of one byte multiplexer channel and five block multiplexer channels as standard. One group of one multiplexer channel and five block multiplexer channels is optional.

The 3033 Processor has two groups of one byte multiplexer channel and five block multiplexer channels as standard. One group of either four block multiplexer channels or one byte multiplexer channel and three block multiplexer channels is optional.

The 3033 Processor Model Group N has one group of one byte multiplexer channel and five block multiplexer channels as standard. Two extended channel features are available: the first provides one byte multiplexer channel and five block multiplexer channels (12-channel configuration), and the second provides either four block multiplexer channels or one byte multiplexer channel and three block multiplexer channels (16-channel configuration).

The 3033 Processor Model Group S has one group of one byte multiplexer channel and five block multiplexer channels as standard. An extended channels feature provides an additional group of one byte multiplexer channel and five block multiplexer channels.

(b) The 3081 has 16 channels as standard. Four of these channels can be designated as a byte multiplexer channels; the remainder are designated as block multiplexer channels. One group of eight channels is optional.

(c) Four channels on each 3083 can be designated as byte multiplexer channels. The remainder are designated as block multiplexer channels. Channels available for the 3083 model are as follows:

3083 Model	Standard Channels	Optional Channels	Total Channels
E,EX	8	8	16
B,BX	8	16	24
J,JX	8	16	24

(d) The 3084 has 48 channels (24 on each side). Eight of these (four on each side) can be designagted as byte multiplexer channels; the remainder are designated as block multiplexer channels.

(e) As many as 4,080 unit control words (UCWs) are available for the 3081, 3083, and for each side of the 3084. Generally, one UCW is required for each control unit, I/O device, and channel path.

(f) The 3090 Processor Unit Model 200 can have 32, 40, or 48 channels of which four can be designated as byte multiplexer channels; the remainder are designated as block multiplexer channels. The 3090 Processor Unit Model 400 can have 64, 80, or 96 channels of which eight can be designated as byte multiplexer channels; the remainder are designaged as block multiplexer channels. As many as 4,096 unit control words (UCWs) are available for the 3090 Model 200 and for each side of the 3090 Model 400. Generally, one UCW is required for each control unit, I/O device, and channel path.

(g) DOS/VSE Advanced Functions Program Product only.

(h) Supported but not recommended.

Glossary and Abbreviations

(Refer to the *IBM Vocabulary for Data Processing Telecommunications, and Office Systems*, GC20-1699, for definition of those terms not included in this listing.)

alter/display. A feature whereby main storage data may be displayed and altered at the display/keyboard console.

block multiplex mode. The transmission of data to multiple I/O devices by the realtime interleaving of records in block form. differences in the rate or time of data transmission.

byte multiplex mode. The transmission of data to multiple I/O devices by the realtime interleaving of bytes.

character generator. A feature that translates the byte necessary to trace an alphameric character on the face of a display tube.

code-dependent device. A device whose operation depends on the code used in representing data.

communications-start-stop. One of three classifications of adapter used for connecting remote and local devices to the 2701 Data Adapter Unit.

compatibility feature. A feature, also called an emulator, that allows an IBM system to execute programs written for another system.

CP. control program.

data acquisition and control. The process of identifying, isolating, and gathering source data and providing the correct facility for its transmission.

data transfer rate. The number of bytes (or packed decimal digits and signs) per second transferred to or from the processor by a storage unit.

decimal arithmetic. Arithmetic operations performed on decimal numbers.

DSO. Direct system output.

EC mode. Extended control mode.

editing. The process of modifying data such as inserting or deleting special characters. errors, plus the detection of double-bit and some multiple-bit errors.

EXDC. External data controller.

extended floating-point number. A floating-point number with a 112-bit fraction. This is approximately 34-decimal-place precision.

external data controller (EXDC). An input/output processor located within the central processor.

field length. The length of a specified area in a record used for a particular category of data.

fixed length data format. A format in which data is present in units or equal and unvarying length.

GMT. Greenwich Mean Time.

ICA. Integrated communications adapter.

IDR. Identification record.

in-flight. During the process of moving.

instruction set. A set of instructions grouped for convenience in marketing.

internal performance. A factor in the total productivity of a system determined by a combination of throughput, response time, and availability.

interruption, classes of. The six classes of program interruption are: program, supervisor call, external, restart, machine check, and I/O.

interruptions, disallowing of. The delaying of or prevention of an interruption.

I/O interface. The physical and the logical connection between the channel and the I/O control unit.

ISC. Integrated storage controls.

IVP. Installation verification procedure.

logical operations. The comparing, testing, translating, editing, and relocating of logical data.

long floating-point number. A floating-point number with a 56-bit fraction. This is approximately 17-decimal-place precision.

LSI. Large scale integration.

M. 1,048,576 bytes of storage.

machine-dependent. Relates to a program or procedure that requires the use of specific hardware.

MVS. Multiple virtual storage.

native attachment. An attachment that is an integral part of the basic hardware.

unprivileged instruction. An instruction that is valid in both the problem and the supervisor states, as contrasted to a privileged instruction, which is valid only in the supervisor state.

nonshared subchannel. A division of a channel data path that can control only one I/O device.

op code. Operation code. Execute DOS programs under OS control.

OS/MVT. Operating System/Multiprogramming Varied Task.

OS/VS1. Operating System/Virtual Storage 1.

OS/VS2. Operating System/Virtual Storage 2.

packed format. A data format in which a byte may contain either two decimal digits or one decimal digit and a sign.

program switching. The switching from one program to another in the performance of a transaction.

RAS. Reliability, availability, and serviceability.

realtime application. An application that processes input as it is generated, as opposed to batch-type processing.

realtime process. A process in which response to input is fast enough to affect subsequent input.

reloadable control storage (RCS). Storage used to execute microprograms used to control the processor, plus channel functions and features. These microprograms are loaded into the RCS from the console as an initial microcode load procedure.

RR. Register to register (instruction format).

RS. Register and storage (instruction format).

RX. Register and indexed storage (instruction format).

S. Implied operand and storage (instruction format).

selectable unit (SU). A collection of macro instructions and modules that provides new function and device support. Selectable units are shipped independently of OS/VS2 releases.

selector mode. One or two modes in which a block multiplexer channel can operate, the other being block multiplex mode.

selector subchannel. A subchannel of the shared type that operates in burst mode and can operate one I/O device concurrently with byte multiplexer subchannels.

shared path. The single data path of a byte multiplexer channel shared concurrently, in byte mode, by more than one low-speed I/O device.

shared subchannel. A division of a channel data path; one that can control several I/O devices through one unit.

short floating-point number. A floating-point number with a 24-bit fraction. This is approximately seven-decimal-place precision.

SI. Immediate operand and storage (instruction format).

SS. Storage to storage (instruction format).

SSI. System status index (instruction format).

standard instruction set. A facility that includes all System/370 instructions that are not part of any separately defined grouping.

storage access width. The number of bytes fetched in each storage access.

storage cycle time. The time required by storage to process a reference to it.

storage interleaving. A performance factor that allows 2, 4, 8, or 16 storage accesses to be started during a storage cycle.

subchannel. A division of a channel data path.

supervisor-call interruption. An interruption caused by the supervisor-call instruction in passing control to the supervisor.

switch, two-channel. A feature that allows each of the two data paths of the integrated storage controls (ISC) feature to be connected to two channels on the same or separate systems.

TCM. Thermal conduction module.

thermal conduction module (TCM). An electronic component that consists of 118 high-density chips mounted on a multilayered substrate within a helium-filled envelope.

translation lookaside buffer (TLB). A buffer that, in dynamic address translation, holds information that would otherwise have to be maintained in and accessed from main storage.

two-byte interface. A feature that permits a block multiplexer channel to transfer data at rates as high as 3 megabytes per second.

universal instruction set. A facility of the commercial instruction set and the floating-point feature.

utility. Pertaining to a problem program designed to perform a common task.

wait time. Time the processor spends in the wait state.

writable control storage (WCS). A part of control storage that allows data in its storage locations to be overlaid with new data. Therefore, certain microprogram routines may be used that would otherwise require additional storage capacity.

zoned decimal format. A data format in which a zone character accompanies each decimal digit, except in the low-order byte position, which is occupied by a sign and decimal digit.

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Numerics

IBM System/370 System Summary: Processors

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