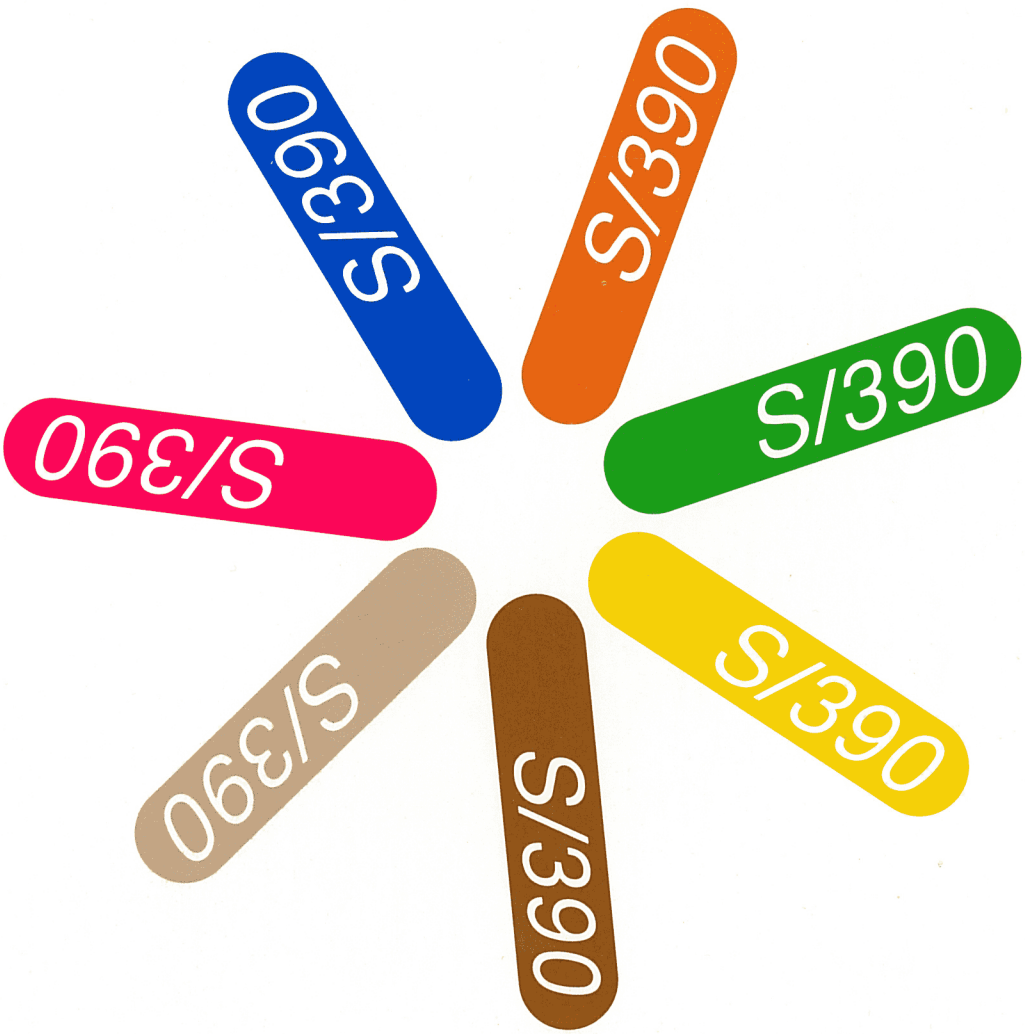
GA22-7138-01

Enterprise System/9000
Models 330, 340, 500, 580, 620, and 720

Functional Characteristics and Configuration Guide



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Second Edition (September 1991)

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MVS/SP
PR/SM
Processor Resource/Systems Manager
S/390
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3090

Preface

This publication describes the IBM* Enterprise System/9000* Models 330, 340, 500, 580, 620, and 720, their components, and functions. It also provides basic guidelines and recommendations for configuring channel loads.

This publication is intended for customer executives, data processing managers, and data processing technical staff.

Before reading this publication you should be familiar with IBM System/390* and IBM Enterprise Systems Architecture/390* (ESA/390*) as described in *IBM Enterprise Systems Architecture/390 Principles of Operation*, SA22-7201.

You should also be familiar with the IBM Enterprise Systems Connection Architecture* (ESCON* Architecture) as described in *Introducing Enterprise Systems Connection*, GA23-0383.

What is Included in This Publication

This publication contains the following chapters and appendixes:

- **Chapter 1, "Introduction,"** summarizes the model configurations, design highlights, and programming support of the ES/9000 Models 330, 340, 500, 580, 620, and 720.
- **Chapter 2, "ES/9000 Models 330, 340, 500, 580, 620, and 720,"** describes the characteristics of the ES/9000 Models 330, 340, 500, 580, 620, and 720.
- **Chapter 3, "ES/9000 Processor Unit Models 330, 340, 500, 580, 620, and 720,"** describes the logical components of the processor unit.
- **Chapter 4, "Consoles and Displays,"** describes the interactive consoles and displays in the ES/9000 Models 330, 340, 500, 580, 620, and 720 and, in particular, the facilities provided by the system console.
- **Chapter 5, "9022 Processor Controller,"** describes the processor controller.
- **Chapter 6, "Error Handling,"** describes error recovery procedures that are performed automatically by the processor controller, the customer problem analysis procedures, and the remote support facility procedures.
- **Chapter 7, "ES/9000 Models 330, 340, 500, 580, 620, and 720 Features,"** describes the standard and optional features provided by the ES/9000 Models 330, 340, 500, 580, 620, and 720.
- **Chapter 8, "Channel Operation Characteristics,"** describes the characteristics, function, and structure of the channels.
- **Chapter 9, "Channel Subsystem Performance Characteristics,"** describes ESCON and parallel channel performance concepts and characteristics, and the criteria for determining the sequence of attachment of the input/output (I/O) devices for parallel channels.
- **Chapter 10, "Channel Subsystem Configuration Guidelines,"** provides recommendations for ESCON channel configurations and describes how to configure I/O devices for operation on block multiplexer or byte multiplexer channels.

- **Chapter 11, "ES/9000 Models 330, 340, 500, 580, 620, and 720 Architectural Deviations,"** contains exceptions to the *IBM Enterprise Systems Architecture/390 Principles of Operation*.
- **Chapter 12, "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations,"** is a table that shows the ES/9000 Models 330, 340, 500, 580, 620, and 720 configurations.
- **"Glossary of Terms and Abbreviations,"** defines the technical terms and abbreviations used in this publication.

Related Publications

Other IBM publications that you will find helpful:

GA22-6974	*IBM System/360 and System/370 I/O Interface Channel to Control Unit Original Equipment Manufacturers' Information*
GA22-7000	*IBM System/370 Principles of Operation*
GA22-7002	*IBM System/370 Input/Output Configurator*
SA22-7095	*IBM System/370 Extended Architecture Interpretive Execution*
SA22-7125	*IBM Enterprise Systems Architecture/370 and System/370 Vector Operations*
GA22-7139	*IBM ES/9000 Processor Complex Models 820 and 900: Functional Characteristics and Configuration Guide*
SA22-7200	*IBM Enterprise Systems Architecture/370 Principles of Operation*
SA22-7201	*IBM Enterprise Systems Architecture/390 Principles of Operation*
SA22-7202	*IBM Enterprise Systems Architecture/390: ESCON I/O Interface*
SA22-7204	*IBM Enterprise Systems Architecture/390: Common I/O Device Commands*
GA32-0039	*IBM Input/Output Device Summary*
GC22-7064	*IBM Input/Output Equipment Installation Manual—Physical Planning for System/360, System/370, and 4300 Processors*
GA22-7123	*IBM ES/9000, ES/3090*: Processor Resource/Systems Manager Planning Guide*
GC22-7083	*IBM ES/9000 Processor Complex: Installation Manual—Physical Planning*
SC38-0085	*IBM ES/9000 Processor Complex: Operator Guide*
SC38-0089	*IBM ES/9000 Processor Complex: Recovery Guide*
SC38-0093	*IBM ES/9000 Processor Complex: Operator Messages for the System Console*
SC38-0097	*IBM ES/9000, IBM ES/3090: Input/Output Configuration Program User's Guide and Reference*
SK2T-6685	*IBM ES/9000 Processor Complex: Customer Library* (CD-ROM for ES/9000 Models 330, 340, 500, 580, 620 and 720 Customer Library).
GA23-0383	*Introducing Enterprise Systems Connection*
GC26-4519	*Introduction to Nonsynchronous Direct Access Storage Subsystems*
GC66-3181	*Enterprise Systems Connection: Planning for Migration*

Summary of Changes

The following product updates are included:

- Enhanced system reliability, availability, and serviceability
  - Extended sorting
  - Concurrent power maintenance
  - Concurrent CP TCM maintenance
- New ESCON and channel functions
  - ESCON extended distance feature (ESCON XDF*)
- New Processor Resource/Systems Manager* (PR/SM*) functions:
  - LPAR mode support for HIPPI
  - LPAR preferred path
  - LPAR management time report
  - LPAR IOCDS default
  - LPAR auto-reconfiguration
- New Integrated Cryptographic Feature (ICRF) function:
  - VM guest support for ICRF.
- New IBM Sysplex* Timer function:
  - External time source
  - Automatic propagation delay adjustment
- New ESCON and Channel Functions
  - ESCON Extended Distance Feature (ESCON XDF*)
  - ESCON data rate increase of 10 million bytes per second.

Chapter 1. Introduction

Overview

The IBM ES/9000 Models 330, 340, 500, 580, 620, and 720 are general-purpose data processing systems that operate in ESA/390 mode. These systems provide reliability, performance, and ease of use for commercial, engineering, and scientific applications. Models 330, 340, 500, 580, 620, and 720 offer new levels of function and performance. Figure 1-1 shows a view of an ES/9000 Model 720.

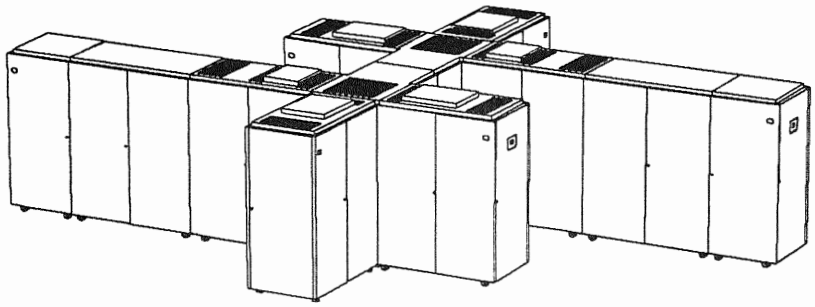


Figure 1-1. IBM ES/9000 Processor Complex Model 720 with Other Devices

The IBM ES/9000 family provides compatible growth for the IBM 3081, 3083, 3084, 3090*, Enterprise System/3090* (ES/3090*) Processor Complexes and upgrade progression to the ES/9000 Processor Complex. Refer to Table 1-1 for each model's upgrade progression.

Table 1-1. Upgrade Progression Chart

Model	Upgrade Progression
180J	500
200J	580 or 620
280J	620
300J	720
400J	720
500J	720
600J	720
15T	330
17T	330
18T	500
28T	620
330	500, 520
340	500 or 520
500	580, 620 or 640
580	620, 720 or 740
620	720 or 820[1]
720	820, 860, or 900[1]

[1]Upgrades from 330, 340 to 520, or from 500 to 640, or from 580 to 740, or from 620 to 820 or from 720 to 820, 860, and 900 involve substantial changes to the existing processor.

Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations

- The **ES/9000 Model 330** is a uniprocessor; it contains one central processor (CP). The CP has access to central storage, expanded storage, and channels. The ES/9000 Model 330 provides:
  - One CP
  - One vector facility feature (optional) for the CP
  - 32MB, 64MB, 96MB, or 128MB of central storage
  - Expanded storage (optional): 64MB, 128MB, 192MB, 256MB, or 512MB
  - 16, 32, 48, or 64 total channels; 16 or 32 can be parallel channels (16 are standard) and 0, 8, 16, or 32 can be ESCON* channels
  - Logically partitioned operation with as many as seven logical partitions
  - One Integrated Cryptographic Feature (optional), mutually exclusive with the vector facility on a CP.
- The **ES/9000 Model 340** is a uniprocessor; it contains one CP. The CP has access to central storage, expanded storage, and channels. The ES/9000 Model 340 provides:
  - One CP
  - One vector facility feature (optional) for the CP
  - 32MB, 64MB, 96MB, or 128MB of central storage
  - Expanded storage (optional): 64MB, 128MB, 192MB, 256MB, 512MB, or 1024MB
  - 16, 32, 48, or 64 total channels; 16 or 32 can be parallel channels (16 are standard) and 0, 8, 16, or 32 can be ESCON channels
  - Logically partitioned operation with as many as seven logical partitions
  - One Integrated Cryptographic Feature (optional), mutually exclusive with the vector facility on a CP.
- The **ES/9000 Model 500** is a two-way (dyadic) processor; it contains two integrated CPs. The CPs have access to central storage, expanded storage, and channels. The ES/9000 Model 500 provides:
  - Two integrated CPs
  - A vector facility feature (optional) for each CP
  - 64MB, 128MB, 192MB, or 256MB of shared central storage
  - Shared expanded storage (optional): 64MB, 128MB, 192MB, 256MB, 512MB, 1024MB, 1536MB, or 2048MB
  - 32, 48 or 64 total channels; 32, 48, or 64 can be parallel channels (32 are standard) and 0, 8, 16, or 32 can be ESCON channels
  - Logically partitioned operation with as many as seven logical partitions
  - One Integrated Cryptographic Feature (optional), mutually exclusive with the vector facility on a CP.

- The **ES/9000 Model 580** is a three-way (triadic) processor; it contains three integrated CPs, each having access to a common central storage, expanded storage, and channels. The ES/9000 Model 580 provides:
  - Three integrated CPs
  - One vector facility feature (optional) for each CP
  - 64MB, 128MB, or 256MB of shared central storage
  - Shared expanded storage (optional): 64MB, 128MB, 192MB, 256MB, 512MB, 1024MB, 1536MB, or 2048MB
  - 32, 48, or 64 total channels; 32, 48, or 64 can be parallel channels (32 are standard) and 0, 8, 16, or 32 can be ESCON channels
  - Logically partitioned operation with as many as seven logical partitions
  - One Integrated Cryptographic Feature (optional), mutually exclusive with the vector facility on a CP.
- The **ES/9000 Model 620** is a four-way (multi) processor; it contains four integrated CPs, each having access to a common central storage, expanded storage, and channels for single-image configuration or for physically partitioned configuration. The ES/9000 Model 620 provides:
  - Four integrated CPs
  - One vector facility feature (optional) for each CP
  - 64MB, 128MB, 256MB, or 512MB of shared central storage for each side,
  - Shared expanded storage (optional): 64MB, 128MB, 192MB, 256MB, 512MB, 1024MB, 1536MB, or 2048MB, for each side, installed asymmetrically with at least 64MB on each side
  - 64, 80, 96, 112, or 128 total channels; 64, 80, 96, 112, or 128 can be parallel channels (32 are standard) and 0, 8, 16, 32, 48, or 64 can be ESCON channels
  - Capability to be operated in a physically partitioned configuration as two dyadic processors
  - Logically partitioned operation with as many as seven logical partitions (as many as 14 when in a physically partitioned configuration)
  - One Integrated Cryptographic Feature for each side (optional), mutually exclusive with the vector facility on a CP.
- The **ES/9000 Model 720** is a six-way (multi) processor; it contains six integrated CPs, each having access to a common central storage, expanded storage, and channels for single-image configuration or for physically partitioned configuration. The ES/9000 Model 720 provides:
  - Six integrated CPs
  - One vector facility feature (optional) for each CP
  - 64MB, 128MB, 256MB, or 512MB of shared central storage, on each side, installed asymmetrically in increments of 64MB and 128MB
  - Shared expanded storage (optional): 64MB, 128MB, 192MB, 256MB, 512MB, 1024MB, or 2048MB, on each side, installed asymmetrically with at least 64MB on each side
  - 64, 80, 96, 112, or 128 total channels; 64, 80, 96, 112, or 128 can be parallel channels (64 are standard) and 0, 8, 16, 32, 48, or 64 can be ESCON channels
  - Capability to be operated in a physically partitioned configuration as two triadic processors
  - Logically partitioned operation (optional) with as many as seven logical partitions (as many as 14 when in a physically partitioned configuration)
  - One Integrated Cryptographic Feature for each side (optional), mutually exclusive with the vector facility on a CP.

Design Highlights

The ES/9000 Models 330, 340, 500, 580, 620, and 720 provide high performance and flexibility of use with improved design and technology. The design of the ES/9000 Models 330, 340, 500, 580, 620, and 720 incorporates:

- Optional expanded storage
- IBM Enterprise Systems Connection Architecture (ESCON Architecture) and technology for the optional ESCON Channels
- High levels of reliability, availability, and serviceability (including concurrent processor maintenance)
- ESA/390 architectural mode of operation
- Logically partitioned (LPAR) operating mode (standard)
- Optional Sysplex* Timer Attachment
- Optional Integrated Cryptographic Feature (ICRF)
- Dynamic reconfiguration
- Console integration
- VM data spaces
- Softcopy Publications.

Optional Expanded Storage

Optional high-speed, high-capacity expanded storage is available as an integrated part of the ES/9000 Processor Complex. Expanded storage improves system response and system performance balancing. ES/9000 Models 620 and 720 offer as many as 4GB (4 294 967 296 bytes) of optional expanded storage. Optional expanded storage for the ES/9000 Models 330, 340, 500, 580, 620, and 720 is shown in Chapter 12, "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations" on page 12-1.

ESCON Architecture and Technology

ESCON combines technology, architecture, and a set of interrelated hardware and software products and services that provide:

- ESCON Architecture
- ESCON channels, including the ESCON Extended Distance Feature (ESCON XDF)
- Fiber optic cabling, transmission, and reception
- Dynamic connectivity through switched point-to-point topology and data flow
- Interconnectivity with other networks.

For detailed information about the basic concepts of ESCON technology and architecture, see *Introducing Enterprise Systems Connection,* and *ESA/390 Principles of Operation.*

ESCON Architecture

ESCON Architecture, a channel architecture, is designed to support the fiber optic environment and dynamic connectivity.

ESCON Architecture uses link-level and device-level protocols for the transfer of information. Link-level protocols establish and maintain the physical and logical

path for the transmission and reception of information. Device-level protocols establish and maintain the transfer of information between a channel and control units that use device-level protocols.

For detailed information about the ESCON interface protocol, see *IBM Enterprise Systems Architecture/390: ESCON I/O Interface*.

ESCON Channels

ESCON Channels transfer information on a link in a serially transmitted synchronous bit stream (serial transmission) through fiber optic channel cables and:

- Operate using link-level protocols and device-level protocols, or
- Attach to an IBM 9034 ESCON Converter to attach to control units with parallel interfaces, using bus and tag cable.

For detailed information about the I/O commands used to operate the new ESCON interface protocols in the fiber optic environment, see *IBM Enterprise Systems Architecture/390: Common I/O Device Commands*.

Fiber Optic Cabling, Transmission, and Reception

ESCON LED multimode fiber optic technology providing a direct channel attachment range of up to 3 kilometers (1.9 miles); and control units can be attached to a range of up to 9 kilometers (5.6 miles) from a channel through two optional ESCON Directors.

ESCON XDF uses single-mode fiber optic technology providing a direct channel attachment range of up to 60 kilometers (37.3 miles); and control unit attachment range of up 43 kilometers (26.7 miles) from a channel through two optional ESCON directors. The following table shows the maximum cable distances that ESCON I/O devices can be located from the processor using ESCON Directors with ESCON XDF.

Table 1-2. Connectivity Distances Using ESCON XDF

Device	Maximum Link Distance	Minimum Number of ESCON Directors Required
ESCON Converter Models 1 and 2	3 km (1.9 miles)	1
9343 Model D04	9 km (5.6 miles)	1
3490 Models A01, A02, A10, A20,D31, D32, D41, and D42 (see note)	23 km (14.3 miles)	1
3174 Models 12L and 22L	43 km (26.7 miles)	2
3172 Model 1	43 km (26.7 miles)	2
ES/9000 Channel-to-Channel (CTC)	60 km (37.3 miles)	2

Note: Special features must be installed on the IBM 3490 Magnetic Tape Subsystem when they are attached at a distance greater than 9 km from the host processor with ESCON XDF.

Combining fiber optic cable with ESCON Architecture, moves data faster than with copper wire cable (bus and tag cable for parallel channels). Using ESCON

channels, data can move at a rate of up to 10 million bytes per second (MB/s) compared to a maximum of 4.5 MB/s when using parallel channels.

Dynamic Connectivity (Switched Point-to-Point Topology)

Using switched point-to-point topology and ESCON Directors, you can handle many channel and control unit connections simultaneously. The path between each point-to-point interconnection is called a link. With dynamic connectivity:

- Many control units can share a single link to a channel through an ESCON Director.
- Many channels can share a single link to a control unit through an ESCON Director.
- I/O configuration management is simplified through the use of dynamic reconfiguration management.
- Alternate paths can be used if a failure occurs.

Interconnectivity with Other Networks

Using the IBM 3172 Interconnect Controller and ESCON interface you can send large amounts of data at wideband speeds to remote processors, or a parallel (bus and tag) interface to an IBM 9034 ESCON Converter to use existing hardware and I/O interfaces that access commonly used local area networks.

High Levels of Reliability, Availability, and Serviceability

The ES/9000 offers high levels of reliability, availability, and serviceability (RAS) by providing capabilities that include:

- Online error detection and fault isolation techniques
- Concurrent processor maintenance
- Dynamic modification of the I/O configuration
- Deferred maintenance capability
- A remote support strategy
- Enhanced Power Subsystem.

RAS functions are implemented by the processor controller, which contains two integrated processor elements. The dual processor elements, when used with ES/9000 Models 330, 340, 500, and 580, enable the backup processor to monitor the active processor to help maintain availability for critical processor controller functions.

Note: For more information, see "Reliability, Availability, and Serviceability Considerations" on page 2-9.

ESA/390 Architectural Mode of Operation

Models 330, 340, 500, 580, 620, and 720 provide the Enterprise Systems Architecture/390 (ESA/390) mode in three ways:

- Basic mode
- Mode of a logical partition in the LPAR mode
- Mode of a guest virtual machine.

In ESA/390 mode (which includes the functions of ESA/370* mode), these models have problem-program compatibility with System/360*, System/370*, and 4300

processors. They can access virtual storage in multiple address spaces and data spaces. This extends addressability for system, subsystem, and application functions that use ESA/390.

ESA/390 mode provides:

- 31-bit addressing that provides the capability of a virtual address range of 2GB (2 147 483 648 bytes).
- ESCON and parallel channels.
- Channel path selection and I/O-busy-condition management as hardware functions (rather than control program functions) that provide:
  - As many as four channel paths available to each I/O device.
  - Increased I/O device accessibility by allowing each central processor to initiate operations with any of the I/O devices and to handle any I/O interruption conditions.
- A significantly extended addressability through access to multiple address spaces and data spaces while maintaining compatibility with existing 24-bit and 31-bit subsystems and user applications. Each address space can contain as many as 2GB of programs and data. Each data space can contain as many as 2GB of data.
- Support for the Start Interpretive Execution (SIE) instruction, allowing support of guest ESA/390 and System/370 virtual machines.

Logically Partitioned (LPAR) Operating Mode

Processor Resource/Systems Manager (PR/SM) offers the capability to enable the event-driven, logical partitioning function of the ES/9000 Processor Complex. PR/SM is standard on ES/9000 Models 330, 340, 500, 580, 620, and 720.

You select the operating mode during system initialization (power-on reset). This occurs for a single-image configuration or for each side of a physically partitioned configuration. The operating mode can be basic mode (ESA/390) or LPAR mode. When you select LPAR mode, you must specify the:

- Architectual mode (ESA/390 or System/370) of each partition
- Resources of each partition.

Most resources can be reconfigured without requiring a power-on reset. Before activating the partitions, central storage and optional expanded storage must be defined to the logical partitions. When a logical partition is activated, the storage resources are allocated in 1MB contiguous blocks. These allocations can be dynamically reallocated. After a logical partition is defined and activated, a supporting operating system can be loaded into that logical partition.

Note: You cannot share allocated central storage or expanded storage among multiple logical partitions.

Individual channel paths can be allocated to each logical partition. A channel path can be allocated only to one logical partition at a time. A device can be shared between logical partitions by using a separate channel path from each logical partition. Channel paths can be dynamically reconfigured between logical partitions.

CPs can be dedicated to a single logical partition or shared among multiple logical partitions. The allocation of CPs to a logical partition is made when the

partition is activated. The use of CP resources shared between logical partitions can be limited and modified by operator commands while the logical partitions are active.

PR/SM LPAR processor utilization reporting has been enhanced by improving the Resource Measurement Facility partition data report. The improved report provides LPAR management time information which shows LPARs overhead associated with the management of resources. The enhanced report contains more precise information on processor resource utilization to help you make better capacity planning decisions.

Included in PR/SM is an automatic reconfiguration facility that improves the operation of "hot standby" or backup partitions. When used in conjunction with MVS/ESA, a partition can invoke this facility to automatically:

- Reset the primary partition
- Reconfigure storage to the secondary partition
- Deactivate the primary partition without operator intervention.

PR/SM supports the dynamic reconfiguration capability provided with MVS/ESA Release 4.2 and subsequent releases. With this capability, an MVS/ESA image running in one partition can modify the I/O configuration of all partitions without performing:

- Power-on reset (POR) of the processor
- Initial program load (IPL) of the system control program (SCP).

Note: If you have a system prior to MVS/ESA Release 4.2, it may require an I/O generation and IPL. Devices that are pregenerated can be Vary offline without having to perform an IPL or an I/O generation.

Using dynamic reconfiguration you can:

- Add, delete, or modify I/O configuration definitions for channel paths, control units, and I/O devices in the processor.
- Save the changes made to the I/O configuration definitions and apply them to the active I/O configuration data set (IOCDS)
- Initiate these changes from MVS (MVS/ESA SP Version 4 Release 2).

Dynamic reconfiguration operates in both basic and LPAR mode.

If the optional vector facility feature or the optional ICRF feature is installed on a CP, it is available for use by all the partitions that share that CP. CPs that are dedicated to a logical partition (including associated vector or ICRF facilities) are available only to that logical partition.

Optional Vector Facility Feature

The vector facility feature is optional for each of the central processors of the ES/9000 Processor Complex; it is available on all ES/9000 Models 330, 340, 500, 580, 620, and 720. Central processors with the optional vector facility feature provide significantly increased levels of performance for many numeric-intensive engineering and scientific applications.

Optional IBM Sysplex Timer Attachment

The optional IBM Sysplex Timer, supported by MVS/ESA* SP Release 4.1, provides the capability of synchronizing the processor time-of-day clocks of the systems in a complex to establish a foundation for managing multiple systems.

Integrated Cryptographic Feature

The optional Integrated Cryptographic Feature (ICRF) improves the security of customer data. The ICRF adheres to international encryption standards and is tamper resistant. One ICRF for each side is available on the ES/9000 Models 330, 340, 500, 580, 620, and 720 and is mutually exclusive with the vector facility on a CP.

Dynamic Reconfiguration

With dynamic reconfiguration an MVS/ESA (Release 4.2 or subsequent releases) can modify the I/O configuration without performing:

- Power-on reset (POR) of the processor
- Initial program load (IPL) of the system control program (SCP).

Using dynamic reconfiguration you can:

- Add, delete, or modify I/O configuration definitions for channel paths, control units, and I/O devices in the processor.
- Make the updated IOCDS the current IOCDS.
- Initiate these changes from MVS (MVS/ESA SP Version 4 Release 2).

Dynamic reconfiguration operates in both basic and LPAR mode.

Console Integration

Console intergration is supported by MVS/ESA SP Version 4 Release 2 and allows the hardware system console to support both hardware functions and the operating system functions of initial start-up, recovery, and problem analysis.

VM Data Space

The VM data space facility makes the ESA/390 access-register architecture more useful in virtual machine applications. This facility improves access-register addressing capabilities previously available only under the Multiple Virtual Storage/Enterprise Systems Architecture (MVS/ESA) operating system. These addressing extensions can be used to make additional storage available to large, storage-constrained applications and can also be used by servers as an efficient way of sharing data between service virtual machines and the users that access those servers.

For information on how VM/ESA uses the VM data space facility, see *VM/ESA CP Programming Services*, SC24-5520.

Softcopy Publications

Softcopy customer publications, on CD-ROM, are provided with all ES/9000 Models 330, 340, 500, 580, 620, and 720 and can be viewed using the BookManager Read licensed programs. In addition to hardcopy publications, the CD-ROM disc is shipped with the ES/9000 Models 330, 340, 500, 580, 620, and 720 at no charge. Additional copies of the CD-ROM disc can be ordered from IBM via order number SK2T-6685.

Programming Compatibility

The information in this topic applies to all ES/9000 Models 330, 340, 500, 580, 620, and 720 in the single-image configuration, independently to each side of an ES/9000 in the physically partitioned configuration, and to operation in a logical partition.

Any program (including its programming support) written for ESA/390 mode operates on ES/9000 Models 330, 340, 500, 580, 620, and 720 operating in that mode, provided that the program:

- Is not time dependent.
- Does not depend on the presence of system facilities (such as storage capacity, I/O equipment, or optional features) when the facilities are not included in the configuration.
- Does not depend on the absence of system facilities when the facilities are included in the configuration.
- Does not depend on results or functions that are defined to be unpredictable in the *IBM Enterprise Systems Architecture/390 Principles of Operation.*
- Does not depend on results or functions that are defined in this publication (or, for logically partitioned operation, in the *ES/9000, ES/3090 Processor Complex: Processor Resource/Systems Manager Planning Guide*) as being differences or deviations from the appropriate *Principles of Operation* publication.
- Does not depend on the contents of instruction parameter fields B and C on interception of the SIE instruction. See *IBM System/370 Extended Architecture Interpretive Execution* for additional information.

Any problem state program written for System/370 operates in ESA/390 mode and any problem state or control program written for 370-XA or ESA/370 operates in ESA/390 mode, provided that in each case the program:

- Observes the limitations in the preceding statements.
- Does not depend on any programming support facilities that are not provided or that have been modified.
- Takes into account other changes made that affect compatibility between modes. These changes are described in the *IBM Enterprise Systems Architecture/390 Principles of Operation*.

In general, any program, including its programming support, that complies with the programming compatibility statements described above for the ES/9000 Models 330, 340, 500, 580, 620, and 720 will operate in a logical partition with the following exceptions:

- VM/XA* Migration Aid, VM/XA Systems Facility, and VM/XA System Product Release 1 are not supported in a logical partition. When operating in a logical partition, the CPU ID presented to that logical partition is not the same as when operating in ESA/370 mode. This may impact operation of software products that use the CPU ID field.

For more information, see the *IBM Processor Resource/Systems Manager Planning Guide.*

Programming Support

The control program you use depends on the mode in which the processor complex is operating. For example, an ES/9000 operating in ESA/390 mode requires a control program for ESA/390 mode.

The term *basic mode* refers to the mode the processor complex is operating in when it is not operating in LPAR mode. ESA/390 is an example of a basic mode and guest.

Control Programs for Basic Modes

The following control programs operate in basic mode:

- MVS/SP Version 3
- VM/ESA System Product Releases 1.0 and 1.1
- MVS/ESA System Product Release 4.1
- MVS/ESA System Product Release 4.2.

Guest Control Programs

VM/XA SP Release 2.1 and VM/ESA System Product Releases 1.0 and 1.1 provide Start Interpretive Execution (SIE) support for the following quest environments when operating in basic mode:

- MVS/SP Version 1 Release 3.5
- MVS/SP Version 2 Release 1.3
- MVS/SP Version 3 (requires VM/XA System Product Release 2); Release 2.1 supports the use of the Move Page facility by an MVS/SP Version 3 Release 3.1 guest
- VM/SP Release 4; Release 2.1 supports the use of the Move Page facility by an MVS/SP Version 3 Release 3.1 guest
- VM/SP High Performance Option Release 4.2
- OS/VS1 Release 7 with Basic Programming Extensions Release 4
- VSE/Advanced Function Version 2 and Version 4
- VSE/SP Version 2, Version 3, and Version 4
- VM/XA Systems Facility (V=V only)
- VM/XA System Product (V=V only, except that a V=R or V=F VM/XA SP 2.1 guest is supported with a VM/XA SP 2.1 host of ES/9000 Models 330, 340, 500, 580, 620, and 720)
- Advanced Interactive Executive/370 (AIX*/370) (V=V and V=R only).

Control Programs for Logically Partitioned Operation

The following System/370 control programs operate in LPAR mode:

- MVS/SP Version 2 Release 1.3
- MVS/SP Version 1 Release 3.5
- VM/SP Release 5 and subsequent releases
- VM/SP High Performance Option Release 4.2 and subsequent releases
- VSE/Advanced Function Version 2 and Version 4
- VSE/SP Version, Version 3, and Version 4

- Transaction Processing Facility (TPF) Version 2 Release 3 (if TPF-specific processor and DASD control unit Request for Price Quotations (RPQs) are not required).

The following ESA/390 control programs operate in LPAR mode:

- MVS/SP Version 3 Release 1.0 and subsequent releases
- VM/ESA System Product Release 1.0 and 1.1
- MVS/ESA System Product Release 4.1 and subsequent releases.

For information about the characteristics of those control programs operating in LPAR mode, see the *IBM ES/9000, ES/3090 Processor/Systems Manager Planning Guide*.

Chapter 2. ES/9000 Models 330, 340, 500, 580, 620, and 720

Overview

The following ES/9000 characteristics are described in this chapter:

- Processor complex machine requirements
- Optional machines and features
- Console and display configuration
- Power and cooling
- Input/Output operations
- Storage operations
- Data representation
- System security
- Technology
- Processor controller
- RAS considerations.

Processor Complex Machine Requirements

The ES/9000 Models 330, 340, 500, 580, 620, and 720 machine requirements fall into two categories:

- Standard machine requirements of the ES/9000 Processor Complex
- Corequisite machine requirements for the operation and maintenance of the processor complex that are ordered separately.

See Figure 2-1 on page 2-3 for a plan view of the ES/9000.

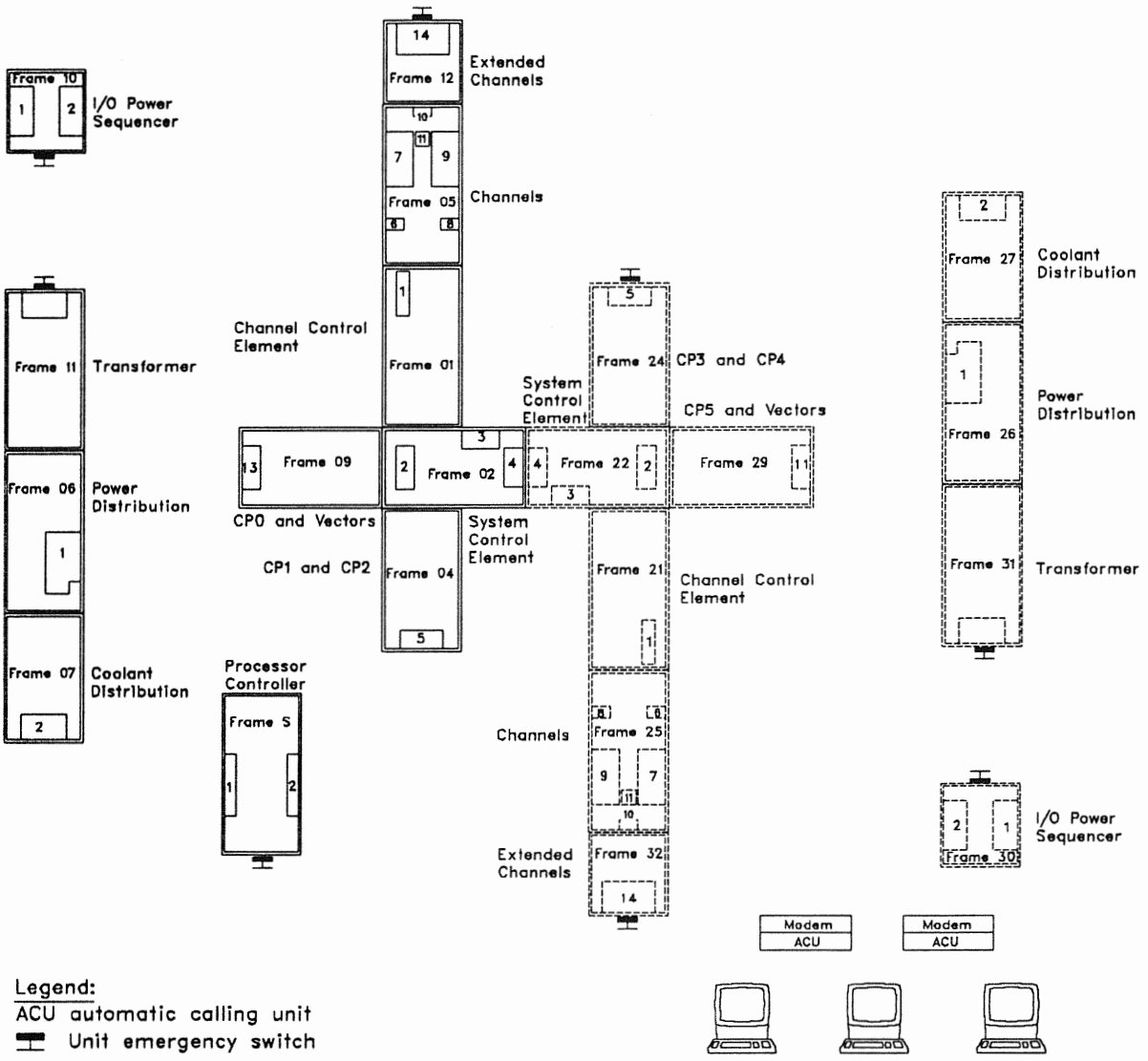


Figure 2-1. ES/9000 Unit Identification. ES/9000 Unit Identification for Models 330, 340, 500, 580, 620, and 720 maximum configuration (not to scale.) Upgrade to Models 620 and 720 frames are shown by dashed lines. (Model 330 does not have a frame 09, the vectors are in frame 04.)

Standard Machine Requirements

The standard machine requirements for the ES/9000 Processor Complex are:

- One IBM ES/9000 Processor Unit Models 330, 340, 500, 580, 620, and 720.
- One IBM 9022 Processor Controller Model 1A. ES/9000 Models 620 and 720 require one IBM 9022 Model 1A with specify code 5050.
- Two or three IBM 3206 Display Stations Model 100 (or equivalent). Three display stations are required for the ES/9000 Models 620 and 720; two display stations are required for the ES/9000 Models 330, 340, 500, and 580. See Chapter 4, "Consoles and Displays" for more information.

Corequisite Machine Requirements

The corequisite machine requirements for the ES/9000 Models 330, 340, 500, 580, 620, and 720 are:

- One or two IBM 5853 Modems Model 1 (or equivalent). ES/9000 Models 620 and 720 require two modems of the same type; ES/9000 Models 330, 340, 500, and 580 require one modem.
- One or two channel-attached operator display stations for communication with the control program. Two display stations are required for ES/9000 Models 620 and 720 in physically partitioned configuration and one for ES/9000 Models 330, 340, 500, and 580. See Chapter 4, "Consoles and Displays" for more information.

Note: IBM 3180 Display Station Model 140 and the 3864 Modem Model 2 can be used with ES/9000 Models 330, 340, 500, 580, 620, and 720.

Optional Machines and Features

Optional features for expanding the size, function, or performance of the system are ordered separately and are added to the processor complex at the customer's request.

Optional machines and features that may be included are shown in Chapter 12, "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations" on page 12-1. The following optional features are available for ES/9000 Models 330, 340, 500, 580, 620, and 720:

- Vector facility
- Central storage increments
- Expanded storage
- Parallel channel increments
- ESCON channels
- Integrated Cryptographic Feature (ICRF)
- IBM Sysplex Timer Attachment.

To augment the standard machine requirement of two or three display stations, as many as three additional 3206 Display Stations Model 100 (or equivalent) can be attached to ES/9000 Models 330, 340, 500, 580, 620, and 720.

Console and Display Configuration

A console is a logical device that performs logical functions. A display is a hardware device and is attached to particular ports of the processor controller. See "Standard Machine Requirements" on page 2-3 and "Optional Machines and Features" for standard and optional consoles available. See Chapter 4, "Consoles and Displays" on page 4-1 for more information.

The system and service support displays are controlled by the processor controller and the operator display is channel attached to the ES/9000 Models 330, 340, 500, 580, 620, and 720.

Optional displays are used for one or more of the following console functions:

- System console
- Service console
- Program mode console
- System monitor console
- Service monitor console.

Power and Cooling

Power and cooling functions are combined in one unit, the 9027 Power and Coolant Distribution Unit Model 1.

Power

The 9027 Model 1 distributes the 50/60 Hz power to the ES/9000 Processor Complex.

The 9027 does not contain an I/O power sequence control. An optional 9023 I/O power sequence (IOPS) Unit may be attached to a 9027 to power on and off as many as 128 control units.

Cooling

Water cooling is provided by a two-loop configuration: a system loop integral to the processor complex and a customer loop. In the system loop integral to the processor complex, chilled-distilled water is pumped from the coolant distribution unit (CDU) to the water-cooled components in the processor complex where the water picks up rejected heat. The warm water returns to the CDU where it passes through a heat exchanger and rejects the heat to the chilled water flowing in the customer loop.

The 9027 maintains a controlled temperature for the densely packed circuits in the ES/9000 Models 330, 340, 500, 580, 620, and 720. The 9027 contains the necessary controls to maintain the correct temperature within the processor complex.

A thermal warning message is sent to the system console when the processor water temperature exceeds a specified threshold.

If a cooling problem occurs because of a malfunction in the operating pump, an alternate pump is switched automatically into the coolant circuit for continued operation.

Input/Output Operations

The following information describes ES/9000 Model 500 I/O operations. Other ES/9000 models operate similarly, but the number of central processors and channels differs. For a summary of these differences, see "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations" on page 1-3.

I/O operations are handled by the channel subsystem in the processor complex. ESCON and parallel channels can be configured for block multiplexer mode of operation.

Only parallel channels can be configured for byte multiplexer mode of operation. For byte multiplexer mode of operation, as many as 8 parallel channels can be configured on the ES/9000 Models 330, 340, 500, and 580; and 16 parallel channels (8 per side) can be configured on the ES/9000 Models 620 and 720.

Failing channels can be removed from the operating configuration. As many as eight control units can be physically attached to a channel, and each channel can address as many as 256 I/O devices.

As many as four channel paths are available to any attached I/O device. During any I/O operation, one of the available channel paths to any specific I/O device is selected. Channel path selection is a hardware function rather than a function of the system control program.

At the start of an I/O operation, a central processor signals the channel subsystem that an I/O operation to a given I/O device is needed. An I/O request is posted to a queue; meanwhile, instruction execution in the central processor continues.

Channel-to-Channel Connection

Note: For detailed information about the ESCON channel-to-channel adapter, see *IBM Enterprise Systems Architecture/390: ESCON Channel-to-Channel Adapter*.

ESCON Channels (Attached to a 9034) and Parallel Channels: Parallel Channel-to-channel connection between multiple systems is accomplished by using the IBM 3088 Multisystem Channel Communication Unit Model A1, 1, or 2. For channel-to-channel communication between an ESCON channel and parallel channels, the ESCON channel can be extended by fiber optic cable to a 9034 ESCON Converter Model 1 that is connected to a 3088.

Parallel channel-to-channel connection between ES/9000 Models 330, 340, 500, 580, 620, and 720 and other IBM processors can be accomplished by using the channel-to-channel adapter (CTCA) feature on those processors that offer it, or by using the 3088.

Both data-streaming and interlock modes are standard on the 3088. Data-streaming mode provides for data transfers of as many as 4.5MB per second, independent of cable length. Cable distances of 122 meters (400 feet) between the processor and the 3088 are supported in both data-streaming and interlock modes.

The 3088 Model A1 provides two-processor connectivity and as many as 63 logical CTCA links. The 3088 Model A1 can be field upgraded to a 3088 Model 1 or Model 2. The 3088 Model 1 can interconnect as many as four processor channels and can provide the equivalent function of as many as 126 CTCAs. The 3088 Model 2 can interconnect as many as eight processor channels.

ESCON Channels (Using Link-Level and Device-Level Protocols): ESCON channel-to-channel connections between ES/9000 Models 330, 340, 500, 580, 620, and 720 and other IBM processors can be accomplished if one of the ESCON channels is set up in channel-to-channel mode.

Storage Operations

A hierarchical storage structure increases performance and contributes to system reliability. Each central processor contains a high-speed buffer (cache) that handes instruction, operand, and data fetches (128KB for ES/9000 Model 330 or 256KB for ES/9000 Models 340, 500, 580, 620, and 720.).

Central storage provides storage capacity for the ES/9000 Models 330, 340, 500, 580, 620, and 720 as shown in "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations" on page 1-3. Central storage is shared by all central processors. Expanded storage (an optional feature) is available for ES/9000 models as shown in the table in Chapter 12, "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations."

Expanded storage is controlled by the control program and transfers 4KB pages to and from central storage. The control program can use expanded storage to reduce the paging and swapping load to channel-attached paging devices in a storage constrained environment and a heavy paging environment.

In ESA/390 mode, storage addressing is extended from 24 bits to 31 bits, which represents an address range of 2GB (2 147 483 648 bytes). In addition, this mode permits the use of either 24-bit or 31-bit addressing, under program control, and permits existing application programs to run with existing control programs.

In ESA/390 mode, an additional channel command word (CCW) format is provided to permit direct addressing of storage of more than 16MB for I/O operations. With this format, channel programs can also reside in storage of more than 16MB.

Data Representation

The basic addressable data unit is an 8-bit byte that can be used as one character, two decimal digits, or 8 binary bits. The ES/9000 Models 330, 340, 500, 580, 620, and 720 provide the following data representation features:

- Efficient use of storage and effective I/O rates for decimal data
- Variable-length fields
- Broad and flexible code conversion
- Decimal arithmetic
- Fixed-point and floating-point arithmetic
- 32-bit words, 64-bit doublewords, and 128-bit extended words (for floating-point arithmetic)
- Instructions for functions such as translate, edit, convert, move, and compare.

System Security

Data integrity features, a two-level system access control, and the Integrated Cryptographic Feature (ICRF) contribute to a high level of system security. Customer planning and management are responsible for the implementation and adequacy of the following controls and for the use of the privileged operator controls such as display and alter storage.

Data Integrity

Data integrity is maintained through:

- Key-controlled storage protection (store and fetch)
- Low-address storage protection
- Storage error checking and correction
- Parity and other internal error checking
- Page protection
- Block multiplexer channel command retry
- Remote support authorization
- Clear reset of registers and main storage.

System Access Control

System access control protects against inadvertent system damage by restricting commands and the use of display frames only to persons at specified authorization levels. System access control is implemented through a hierarchical structure such that a user will have access to functions at a specified level as well as all levels below the specified level. Access levels can be defined for the system console and the service console.

Also, the 3206 Display Station provides the following:

- A security keylock on the display that allows authorized access and that prevents unauthorized access.
- User authorization for remote access (remote support facility) necessitates the matching of a user-assigned access code, as well as enablement of automatic dialing.
- The Integrated Cryptographic Feature (ICRF) is an optional integrated encryption feature, coupled with the central processor, that is capable of high performance in protecting both high-speed transactions and voluminous data being stored or transmitted. The ICRF adheres to international encryption standards and is tamper resistant. See "Integrated Cryptographic Feature" on page 3-7 for more information.

Processor Controller

The 9022 Processor Controller Model 1A is a stand-alone support unit that includes dual processors. One processor is active and the other is backup in the ES/9000 Models 330, 340, 500, and 580; or in the ES/9000 Models 620 and 720 in the single-image configuration. Both processors are active in ES/9000 Models 620 and 720 in the physically partitioned configuration. The backup processor monitors the active processor to provide a high level of availability.

The 9022 continuously monitors the ES/9000 Models 330, 340, 500, 580, 620, and 720 operation through direct communication with each component in the processor complex.

The 9022 initializes the system, distributes Licensed Internal Code (LIC) to writable control storage at initialization, monitors voltage levels and coolant temperature, and provides the control unit function for the attached display stations.

The 9022 also provides extensive error recording, recovery, and diagnostic support for the processor complex.

Licensed Internal Code (LIC): The ES/9000 Licensed Internal Code (LIC) is a fundamental component of the ES/9000 Processor Complex, copyrighted and licensed by IBM. Each ES/9000 model is delivered with a set of LIC licensed for use on and customized to the machine ordered. The LIC enables the ES/9000 Models 330, 340, 500, 580, 620, and 720 to operate in accordance with its Official Published Specifications.

Model upgrades, feature additions, and system engineering changes needed by the customer may require updated LIC. The updated LIC replaces the existing LIC that must be returned to IBM or erased. LIC is provided on optical disks.

Reliability, Availability, and Serviceability Considerations

The ES/3090 Processor Complex provides high levels of reliability, availability, and serviceability (RAS) by reducing downtime and by using standard features.

Reliability:

- Use of emitter-coupled logic in the thermal conduction modules (ECL/TCM technology) that provides a low intrinsic failure rate
- A dual processor controller that incorporates switchover and initialization of the functional side in the single-image configuration
- Internal DASD that support switchover in the single-image configuration
- Multiple consoles for monitoring functional console activity and for backup.

Availability:

- Enhanced Power Subsystem.
- Two or more central processors available on certain models.
- Concurrent power subsystem improves the ability of the system to continue running while replacing power supplies and central processor thermal conductor modules.
- Processor availability facility which enhances system availability and offers additional protection from problems that could impact end users or critical programs. This facility transparently moves programs in process from a failing CP to another operational CP and is available in basic mode and LPAR mode.
- Concurrent processor maintenance allows one of the central processors in a dyadic or larger machine to be varied offline and central processor TCMs replaced concurrent with the operation of the remaining processors.
- Automatic error detection and correction in both central storage and expanded storage
  - Single-bit error correction and double-bit error detection in central storage
  - Single-bit and double-bit error correction and triple-bit error detection in expanded storage.
- Storage deallocation
  - In 4MB increments under system program control.

- ESCON Architecture enhances system availability by supporting the dynamic addition, removal, or modification of channel paths, control units, I/O devices, and I/O configuration definitions to both hardware and software without requiring a planned outage with MVS/ESA SP Version 4.2.0.
- The ability to vary offline parallel channels in single channel increments.
- Customer problem analysis to effect recovery without a service call.

Serviceability:

- The location of many functional elements on power boundaries
- Automatic fault isolation (analysis routines) concurrent with operation
- Automatic remote support capability
- On-site problem isolation
  - Field replaceable unit (FRU) isolation
  - Trace tables
  - Error logout recording.

Chapter 3. ES/9000 Processor Unit Models 330, 340, 500, 580, 620, and 720

Overview

Each ES/9000 Processor Unit Model Model 820 and Model 900 consists of logical components (see Figure 3-1) that execute instructions and commands and that perform storage and channel operations. The logical components of the processor unit are as follows:

- One or more central processors
- Central storage
- Optional expanded storage
- One or two channel subsystems
- One or two system control elements.

The vector facility feature is an optional feature that is available for each central processor. The Integrated Cryptographic Feature (ICRF) is an optional feature that is available for one central processor on each side of the processor unit. ICRF is mutually exclusive with the vector facility on a central processor.

The ES/9000 Models 330, 340, 500, and 580 have one processor unit. The central processors, central storage, and the channel subsystem are contained in the processor unit.

The ES/9000 Models 620 and 720 have one processor unit with two sides (side 0 and side 1). The central processors, processor storage, and the channel subsystems are each associated with either side 0 or side 1. In a single-image configuration, the two sides function as one. In a physically partitioned configuration, the two sides are logically and physically distinct, but are located within the same processor unit.

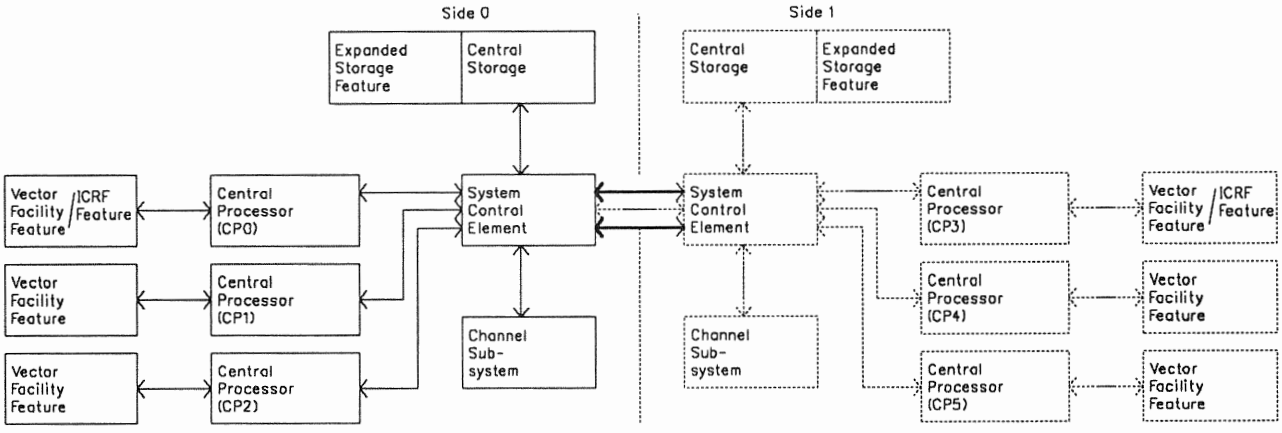


Figure 3-1. Logical Components in ES/9000 Processor Unit Model 720.

Notes:

1. One ICRF feature on each side can attach to any central processor on that side.
2. ICRF is mutually exclusive with the vector facility on a central processor.

CPU ID

A doubleword designated by the second operand address of the Store CPU ID (STIDP) instruction provides information about the ES/9000 Processor Complex. More information can be found in *IBM Enterprise Systems Architecture/390 Principles of Operation*. A summary of the contents of the doubleword follows:

System/370 or ESA/390 Mode:

VV	A	SSSSS	9021	0000

LPAR Mode:

VV	L	PSSSS	9021	0000

- VV is the version code (two hexadecimal digits):
  - 39 (Model 330)
  - 49 (Model 340)
  - 28 (Model 500)
  - 38 (Model 580)
  - 45 (Model 620)
  - 65 (Model 720).
- ASSSSS or LPSSSS constitutes the central processor (CPU) identification number (six hexadecimal digits):
  - The first digit (A in the basic modes, L in LPAR mode) is the CPU address, as stored by the Store CPU Address (STAP) instruction (see "CPU Address Identification" on page 7-15):

Digit	Model	
1	330	
1	340	
1 or 2	500	
0 or 1 or 2	580	
1 or 2	620	(side 0)
3 or 4	620	(side 1)
0 or 1 or 2	720	(side 0)
3 or 4 or 5	720	(side 1)

  - The next five digits (SSSSS) are, for the basic modes, selected from the serial number of the ES/9000 Processor Unit. In LPAR mode, the logical partition identifier replaces the first of the five digits (PSSSS).
- The next four digits are 9021 (for the processor unit machine type).
- The last four hexadecimal digits are 0000.

Central Processors

Each central processor (Figure 3-2) is Licensed Internal Code (LIC) controlled and contains an instruction element (IE), execution element (EE), control storage element (CSE), and buffer control element (BCE). The CSE fetches microinstructions that control instruction execution in the IE and EE. The BCE controls the transfer of data between central storage and the central processor containing that BCE. Dynamic address translation is an automatic function of the BCE.

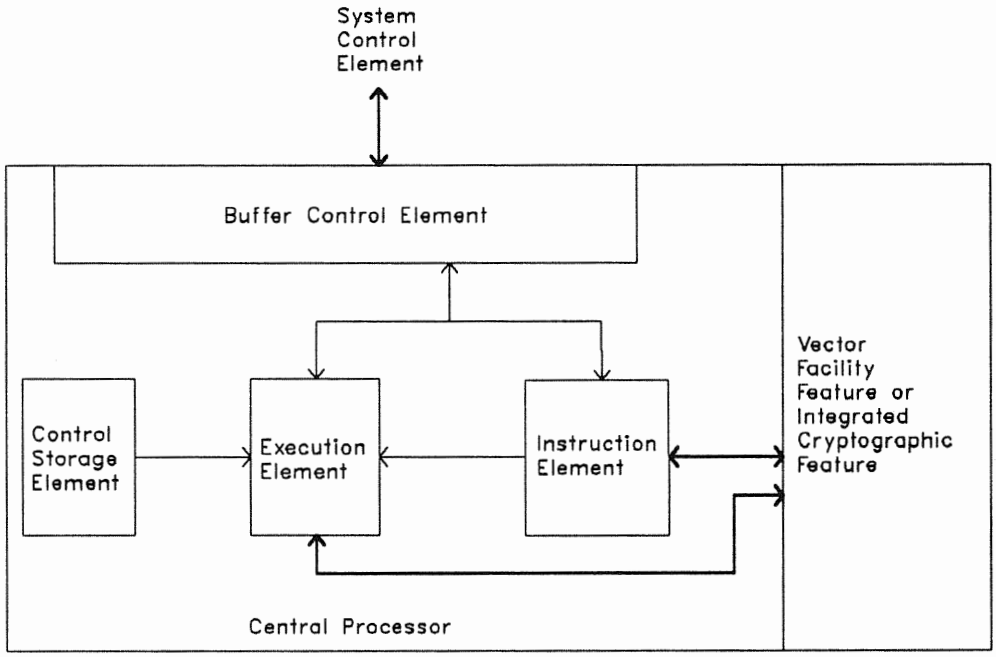


Figure 3-2. Elements of a Central Processor

Instruction Element

The instruction element (IE) controls the sequencing of all instructions. The IE performs the following operations:

- Decodes instructions
- Calculates addresses
- Sends fetch requests to the BCE (for instructions and data) in central storage
- Determines fetch priority

- Controls storage requests
- Provides the EE with:
  - Operation codes
  - Operands
  - Operand addresses.

The IE can process multiple instructions at the same time by handling the instructions in steps. As one instruction is fetched, decoded, and sent to a queue, the IE begins processing another instruction.

Execution Element

The execution element (EE) executes instructions set up by the IE and operates in parallel with the IE. The EE performs the following operations:

- Processes instructions
- Processes interruptions
- Overlaps operations with the IE
- Initiates control functions.

The EE performs the logical decisions, arithmetic functions, and many control functions of System/370 and ESA/390 architecture instructions. Arithmetic results provided by the EE include the following:

- Fixed point
- Fixed-point multiply
- Convert to binary
- Convert to decimal
- Floating point
- Extended-precision floating point.

Control Storage Element

The control storage element (CSE) is the logical element that controls LIC execution in the central processor and contains the supporting control storages and registers that are used by the central processors. The EE is primarily LIC controlled, and the CSE contains the LIC that is used for controlling the EE operation.

Buffer Control Element

The buffer control element (BCE) handles all central processor references to and from central storage, performs dynamic address translation, and controls the high-speed buffer.

The BCE includes:

- A 128KB high-speed buffer (ES/9000 Model 330)
- A 256KB high-speed buffer (ES/9000 Models 340, 500, 580, 620, and 720)
- A buffer directory
- A translation lookaside buffer (TLB)
- Dynamic address translation (DAT) hardware.

The **high-speed buffer** provides much faster access to data than if the data were stored in central storage. The high-speed buffer is transparent to programs that are being run. When data is referred to during instruction execution, the high-speed buffer, the buffer directory, and the TLB are accessed for address comparison.

The **buffer directory** contains the absolute addresses of central storage for data in the high-speed buffer.

The **translation lookaside buffer** stores the real address of the referenced page for a translated virtual address in central storage. Therefore, subsequent translations for the same virtual address are not required because the real address is immediately available in the TLB.

Dynamic address translation performs high-speed translation from virtual to real addresses for loading the TLB.

Vector Facility Feature

The vector facility feature is optional for each central processor of the ES/9000 Models 330, 340, 500, 580, 620, and 720.

Central processors with the optional vector facility feature provide significantly increased levels of performance for many numerically-intensive engineering and scientific applications. The vector facility feature is an extension of the instruction and execution elements of a central processor. Some of the vector facility feature characteristics follow:

- The vector facility feature performs vector arithmetic and logical operations on as many as 256 sets (on ES/9000 Models 330, 340, 500, 580, 620, and 720) of operands with a single instruction.
- Arithmetic and logical units can produce a 32-bit or 64-bit sum, difference, or product during each cycle.
- Compound operations can produce both a product and a sum during each cycle.

The vector architecture provides:

- Sixty-three instructions with 171 new operation codes (104 operation codes are for floating point)
- Storage vector addressing
- Contiguous, noncontiguous, and indirect element selection
- Compound multiply-and-add instructions
- Vector results placed in vector registers
- Scalar results placed in scalar registers
- Logical, binary, short floating-point, and long floating-point operands.

The vector facility feature is supported by:

- MVS/SP Versions 2, 3, and 4, VM/ESA SP, VM/XA SF, VM/XA SP, and VM/SP HPO including automatic support for asymmetric configurations
- Multitasking facility (MTF) under MVS/SP Versions 2 and 3 for assignment of multiple processors to a job

- Advanced Interactive Executive/370 (AIX/370) as a guest of VM/SP, VM/SP HPO, or VM/XA SP
- VS FORTRAN Version 2 with auto-vectoring capabilities
- APL2 Release 3; no modifications of existing APL2 application programs are required
- Engineering and Scientific Subroutine Library (ESSL): a set of high-performance mathematical routines compatible with the vector facility feature of the ES/9000 Processor Complex.

Additional information on the vector facility feature is available in *IBM Enterprise Systems Architecture/370 and System/370 Vector Operations*.

Integrated Cryptographic Feature

The Integrated Cryptographic Feature (ICRF) is an optional feature for a central processor on ES/9000 Models 330, 340, 500, and 580 and for one central processor on each side on ES/9000 Models 620 and 720. The ICRF feature is mutually exclusive with the vector facility feature on a central processor.

Central processors with the optional ICRF feature provide significantly increased levels of system security. The ICRF feature is an extension of the instruction and execution elements of a central processor. Some of the ICRF feature characteristics follow:

- The ICRF feature provides total system security using RACF, PR/SM, and the Integrated Cryptographic Service Facility/MVS (ICSF/MVS).
- The ICRF feature provides hardware instructions that, when running ICSF/MVS, provide cryptographic functions for data privacy, data integrity, cryptographic key installation and generation, electronic cryptographic key distribution, and Personal Identification Number (PIN) processing.
- The ICRF feature requires physical metal keys to operate key locks that select the secure modes on the Key Storage Unit.
- The ICRF feature includes hardware implementation of the Data Encryption Standard (DEA implementation) cryptographic algorithm.

The ICRF feature is supported by:

- ICSF/MVS
  - MVS/SP Version 3 Release 1.3 or higher
  - TSO/E Version 2 Release 1.0 or higher
  - ISPF Version 2 Release 3 or higher
  - RACF Release 8 or higher, or an equivalent access control product.

Storage

Storage is implemented in monolithic and large-scale-integration technologies. The ES/9000 Models 330, 340, 500, 580, 620, and 720 have three levels of storage: a high-speed buffer storage in each central processor, central storage, and optional expanded storage. The high-speed buffer is described under "Buffer

Control Element" on page 3-5. Also, see "Central Storage" on page 3-8 or "Expanded Storage" on page 3-9, for additional information.

Central Storage

The central storage available for each model is shown in Chapter 12, "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations." A hardware system area (HSA) is reserved within central storage for specific system information and cannot be addressed by user programs. The addressable portion of central storage is synonymous with main storage, as described in the *IBM Enterprise Systems Architecture/390 Principles of Operation*.

A central storage controller contains the logic for the following:

- Data storage and retrieval for the processor complex
- Central storage communication with the processor complex (by means of the system control element)
- Communication with and control of the optional expanded storage
- Error checking and correction (ECC).

Hardware System Area

For ES/9000 Models 330, 340, 500, 580, 620, and 720 during the initialization of the configuration, the hardware system area (HSA), which is unavailable for program use, selects at least 1.3MB of central storage.

The size of the HSA is affected by several factors. For example:

1. The I/O configuration as defined in the IOCDS (for example, the number of subchannels and ESCON channel paths)
2. The type of IOCDS used (IOP or IXP format)
3. The power-on reset mode (ESA/390 or LPAR)
4. The number of I/O trace units specified on the CONFIG frame (defaults to **4**).

Error Checking and Correction for Central Storage

Error checking and correction (ECC) code bits are stored with data in central storage. Single-bit errors detected during data transfer are corrected. Certain multiple-bit errors are flagged for follow-on action.

Data paths from the central processors and the channels are checked for parity. Parity bits are included in each command or data word.

Frame Deallocation

A dynamic page deallocation technique, under system program control, temporarily recovers some double-bit failures and allows the operating system to deallocate the failing page frame if the page is not fixed to that page frame. In these instances, the job is not ended (abended) and processing continues normally. Central storage can be deallocated in 4KB increments under system program control. At the option of the customer, maintenance service can be deferred until a predetermined amount of central storage has been deallocated.

Key-Controlled Storage Protection

Key-controlled storage protection provides both store and fetch protection. It prevents the unauthorized access or modification of information in central storage.

Each 4KB block of storage is protected by a 7-bit storage key. For processor-initiated store operations, access key bits 0-3 from the currently active program status word (PSW) are compared with bits 0-3 from the storage key associated with the pertinent 4KB of storage to be accessed. If the keys do not match, the central processor is notified of a protection violation, the data is not stored, and a program interruption occurs. The same protection is active for fetch operations if bit 4 of the storage key (the fetch protection bit) is on.

Expanded Storage

Expanded storage is an optional high-speed storage. The expanded storage available for the ES/9000 Models 330, 340, 500, 580, 620, and 720 is shown in Chapter 12, "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations."

Transfers to and from central storage are in 4KB pages. Data movement between central storage and expanded storage is initiated by the control program. No data can be transferred to expanded storage without passing through central storage. Expanded storage reduces the paging and swapping load to channels.

Error Checking and Correction for Expanded Storage

Error checking and correction (ECC) code bits within expanded storage are used to permit the following:

- Single-bit and double-bit error detection and correction
- Triple-bit error detection
- Some multiple-bit error detection.

Unrecoverable errors are flagged.

Channel Subsystem

ES/9000 Models 330, 340, 500, and 580 contain one channel subsystem (CSS). ES/9000 Models 620 and 720 contain two channel subsystems (one on each side). In a single-image configuration, the two channel subsystems of these models appear as a single dynamic channel subsystem to the control program.

A CSS consists of one channel control element (CCE) and as many as 64 channels. Each channel interface is controlled by a channel (CHN), and each group of four CHNs is controlled by a channel element (CHE).

Figure 3-3 on page 3-11 shows the channel subsystem of an ES/9000.

The following information applies to a channel subsystem for a processor that is not operating in a physically partitioned configuation, to either the side 0 or side 1 channel subsystem of ES/9000 Models 620 and 720 in a physically partitioned configuration, and to each logical partition of a logically partitioned processor.

The channel subsystem handles all I/O operations for the central processor. The CSS controls the communication between a configured channel and the control unit and device. The I/O configuration data set (IOCDS) that is selected at system initialization defines the channel paths on the processor complex; the mode of operation of the channel paths; the control units attached to the channel paths, switches, and links; and the I/O devices assigned to the control units. The IOCDS is created by the I/O configuration program (IOCP) and is stored on DASD internal to the processor controller. At system initialization, the IOCDS information is used to build the necessary control blocks in the hardware system area of central storage (which is not available for use).

Block Multiplexer Mode of Operation

All ESCON and parallel channels can be configured for block multiplexer mode of operation.

In block multiplexer mode of operation, ESCON channels attached to a 9034 and parallel channels can operate either in interlocked (high-speed transfer) mode or in data-streaming mode, and may be attached to control units that can operate in high-speed transfer mode or in data-streaming mode. ESCON channels using serial transmission of information can be attached to control units that operate using link-level and device-level protocols. Data rates can be as high as 4.5 million bytes per second for data-streaming mode and as high as 10 million bytes per second for serial transmission over fiber optic cables.

Byte Multiplexer Mode of Operation

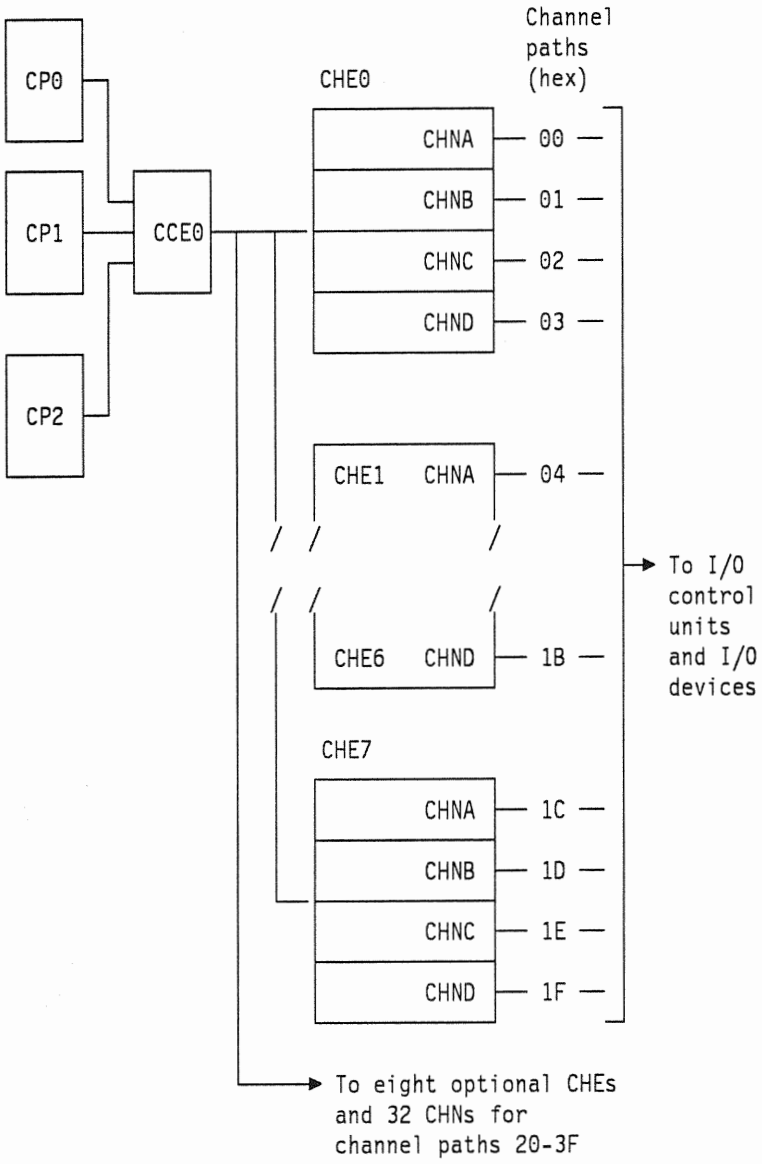
Only parallel channels at channel path ID (CHPID) location 00-07 (side 0) and 40-47 (side 1) can be configured for operation in byte multiplexer mode of operation.

Note: Any parallel channel not needed for byte multiplexer mode of operation can be configured for block multiplexer mode of operation.

As many as 8 parallel channels on ES/9000 Models 330, 340, 500, and 580; and 16 (8 on each side) parallel channels on ES/9000 Models 620 and 720 can be configured for byte multiplexer mode of operation.

In byte multiplexer mode of operation, parallel channels can be used either in byte multiplexer mode or in burst mode. Byte multiplexer mode permits the concurrent operation of several relatively slow-speed devices.

When logical partitioning is in effect, individual channel paths can be allocated to each logical partition. A channel path can be allocated only to one logical partition at a time. A device can be shared between logical partitions by using a separate channel path from each logical partition. Channel paths can be dynamically reconfigured between logical partitions without requiring a power-on reset of the processor complex.



Legend:

CCE is channel control element
CHE is channel element
CHN is channel
CP is central processor

Figure 3-3. Channel Subsystem for a Representative Processor Complex

Channel Control Element

The channel control element (CCE) interacts with central storage, the central processors, and the channels to provide the following services:

- Initializing and ending all channel operations
- Centralizing storage access control
- Prioritizing I/O operations
- Detecting and decoding central processor (CP) requests for I/O activity

- Fetching, updating, and restoring I/O control blocks

  Note: The ESA/390 control blocks represent logical channel queues and subchannels (devices).
- Detecting and decoding channel requests for service
- Presenting I/O interruptions to the CPs.

Channels

The channels control all data flow between the channel control element and the attached control units. Each channel operates independently to handle all interface sequences, CCW fetches, and data transfers.

Each channel is initialized at system initialization (or when assigned to a logical partition) for one of the following modes of operation:

- All ESCON and parallel channels can be initialized for ESA/390 block multiplexer mode of operation.
- Only parallel channels can be initialized for:
  - ESA/390 byte multiplexer mode of operation.

System Control Element

The system control element (SCE) accepts and processes storage requests from the central processors and the channel subsystem. The SCE analyzes each request and performs the following actions:

- Establishes request priority
- Performs cross-interrogation (to ensure that the requester receives the most recent copy of data that is shared)
- Processes requests
- Performs error checking
- Performs error reporting
- Handles request responses.

Chapter 4. Consoles and Displays

Overview

This chapter describes the required and optional consoles that support the ES/9000 Models 330, 340, 500, 580, 620, and 720 and also describes the system console interactive facilities.

A console is a logical device that performs logical functions by means of a display station. A display station is an input/output device. The ES/9000 Models 330, 340, 500, and 580 require two 3206 Display Stations Model 100 (or equivalent): one as a system display that can be designated as a system console, and one as a service support display that can be designated as a service console. The operating system requires an additional channel-attached display for an operator console.

Note: The IBM 3180 Display Station Model 140 and the IBM 3864 Modem Model 2 with automatic calling unit feature can be used, if available.

The ES/9000 Models 620 and 720 require three 3206 Display Stations Model 100 (or equivalent): two as system displays that can be designated as system consoles and one as a service support display that can be designated as a service console. The operating system requires two additional channel-attached displays for operator consoles for operation in a physically partitioned configuration.

The 9022 Processor Controller Model 1A supports as many as three additional (optional) 3206 Display Stations Model 100 (or equivalent) for the ES/9000 Models 330, 340, 500, and 580 and as many as two additional (optional) 3206 Display Stations Model 100 (or equivalent) for the ES/9000 Models 620 and 720. Each of these displays can be used as a:

- System console
- Service console
- Program mode console
- System monitor console
- Service monitor console.

A Console Assignment frame is provided for assigning selected logical consoles to specified displays. The Swap Cons function key on the display keyboard is used to reassign the logical consoles to a different display. The 3206 Model 100 (Figure 4-1 on page 4-3) and Model 110 are interchangeable.

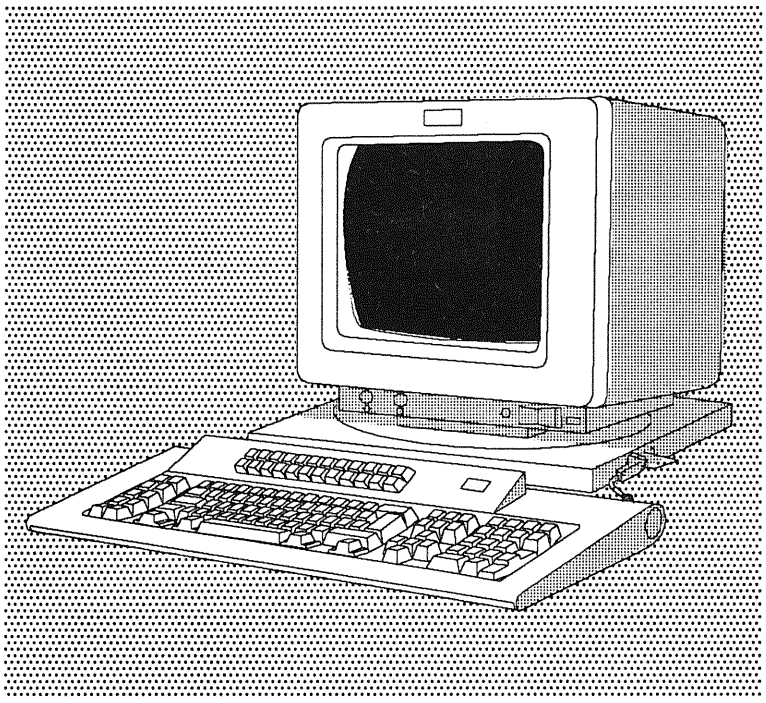


Figure 4-1. IBM 3206 Display Station Model 100

System Console Interactive Facilities

The following functions provide additional user control and flexibility in system operation:

- System definition
- System activity display (SAD)
- I/O configuration data set (IOCDS) content
- I/O problem determination (IOPD) information.

System Definition

The System Definition frame provides selections to:

- Supply a unique system name that is displayed on line 24 (system status line) of the screen
- Identify the frame that is to be displayed automatically after a power-on reset
- Enter initial program load (IPL) information (device identification and target central processor) for ESA/390 mode of operation for automatic IPL following a power-on reset.

LPAR Mode Definition

The LPAR mode definition frames provide selections to define:

- The number of CPs
- Central and expanded storage allocation
- Resource allocation parameter.

System Activity Display

A maximum of 24 (48 in a physically partitioned configuration) System Activity Display (SAD) frames can be defined to provide extensive flexibility in the different types of system activity that can be displayed. Frames can be defined to display central processor and channel activity pertinent to certain work shifts or types of jobs. SAD frame definition allows the customer to request that as many as 17 high-usage or low-usage channels or channel paths be dynamically identified and displayed.

A SAD index lists by number all defined SAD frames with their unique names (if specified when defined).

I/O Configuration Data Set Content

I/O configuration data sets (IOCDSs) are available to provide flexibility to change I/O configurations. ES/9000 Models 330, 340, 500, and 580 have six IOCDSs. ES/9000 Models 620 and 720 have six IOCDSs on each side in a physically partitioned configuration and a total of 12 in a single-image configuration.

Two IOCDS frames can be invoked that provide information about specified control units and devices in the I/O configuration that is defined for the IOCDS currently in effect. The two frames provide the following:

- Information about all control units (CUs) that are associated with a specified channel. The displayed information includes CU machine type, attached channel paths, protocol (data-streaming or interlock), and port addresses.
- Information about all devices that are accessible from a specified channel path.

I/O Problem Determination Information

Frames for ESA/390 mode include status information about all installed channel paths, specified subchannel content, shared control units, and device configuration.

IOPD frames provide the user with extensive I/O information and can be useful in identifying I/O problems.

Chapter 5. 9022 Processor Controller

Overview

The 9022 Processor Controller Model 1A (see Figure 5-1) monitors and controls the status of all physical units within the ES/9000 Models 330, 340, 500, 580, 620, and 720.

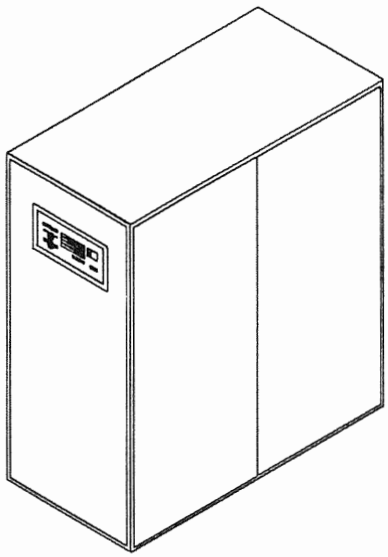


Figure 5-1. IBM 9022 Processor Controller Model 1A

The 9022 Model 1A supports:

- Power on and power off (including I/O units)
- Customer selection of ESA/390, or LPAR mode of operation
- System initialization
- Control of the configuration of hardware elements
- Control unit function for required and optional consoles and optional printers
- Monitoring of power supplies, temperature, and the presence of water flow
- Control and assistance for error recovery
- Collection and storage of error data (logout data) for later analysis
- Full processor complex remote support capability
- Problem analysis procedures for the customer
- Collection of information for System Activity Display (SAD) frames
- Collection of information for I/O Problem Determination (IOPD) frames
- Collection of status information for customer Problem Analysis (PA) frames.
- Automatic analysis of data (analysis routines) for field-replaceable unit (FRU) isolation

Corequisites

The 9022 requires the following corequisites for full processor complex support:

- Internal DASD is provided.
- Internal optical disk storage is provided.
- A 5853 Modem Model 1 (or equivalent).

The 5853 Modem Model E is interchangeable with the 5853 Modem Model 1.

System Power Panel

The 9022 contains the System Power control panel that includes switches for power on, power off, and emergency power off, switches for system configuration (if applicable), and indicators for power status and service mode. Figure 5-2 shows a typical System Power panel. For more information, see *ES/9000 Processor Complex: Operator Guide*.

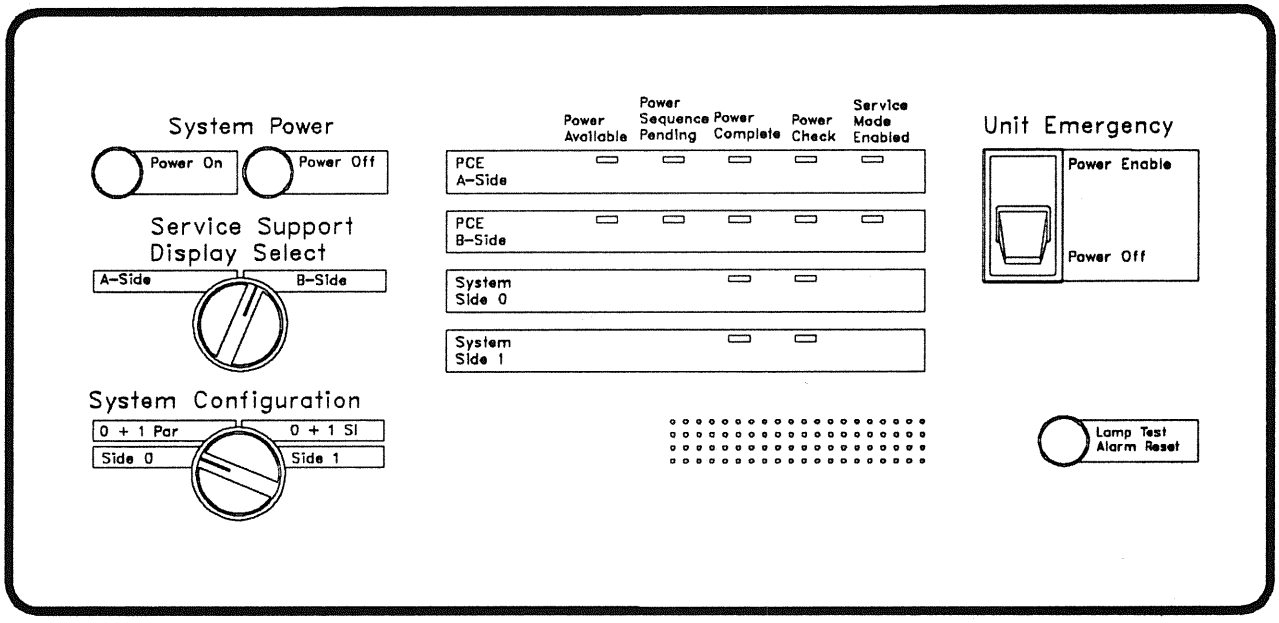


Figure 5-2. 9022 Model 1A System Power Panel

Dual Support Processors

The 9022 Model 1A contains dual processors (A-side and B-side). When used with ES/9000 Models 330, 340, 500, and 580, the backup processor monitors the active processor to help maintain availability. In most situations, if the active processor fails, a switchover to the backup processor occurs.

When the Power On pushbutton is pressed, both A-side and B-side of the 9022 automatically power on and an initial machine load (IML) and IPL occur. The battery-operated clock (BOC) is read and the processor controller time-of-day (TOD) clock is set. Each side communicates its state to the other side to set the active and backup sides. If both sides are functional, the A-side is made active and the B-side is the backup. If both sides are functional but the states of the DASD differ, the side with the most current DASD is made active. If one side is not functional, the functioning side is made active.

The 9022 Model 1A with specify code 5050 operates as described above for ES/9000 Models 620 and 720 in a single-image configuration. For a physically partitioned configuration, both sides are active. The A-side of the 9022 controls side 0 of an ES/9000 Processor Complex in a physically partitioned configuration, and the B-side of the 9022 controls side 1 of an ES/9000 Processor Complex in a physically partitioned configuration.

Operation Monitoring and Control

The 9022 monitors and controls the operations of the ES/9000 Processor Complex. The 9022 initializes and distributes power to all ES/9000 Processor Complex components and to all interconnected I/O control units that are under power-sequence control. During initialization of the ES/9000 Processor Complex, the 9022 validates areas of central storage as error-free data locations, records failing storage locations, and assigns the hardware system area in central storage based on contiguous error-free storage locations. After power sequencing is complete, the processor controller performs an IML.

During processing, the 9022 monitors voltage levels and coolant flow. If the coolant flow rate significantly decreases or stops, the second pump in the 9027 is switched into the coolant circuit to avoid thermal shutdown.

Error Recovery

The 9022 logs errors as they occur and then analyzes them for service personnel. Failure symptoms that are saved at the time of a malfunction are analyzed on a time-sharing basis with other processor controller functions; this operation is concurrent with operation of the processor complex.

The 9022 saves the symptoms of these errors, correlates multiple symptoms, performs error analysis, and isolates the failure to the failing FRU or group of FRUs. When automatic error-recovery attempts fail or the error occurs frequently, failure information is displayed on the system console, and an audible alarm is sounded to alert the operator of a problem requiring action. During IML, similar notification to the operator occurs when loss of storage exceeds a threshold that may degrade system performance.

Configuration

The 9022 can be used to initiate configuration changes in:

- Central storage
- Central processors
- Online channels.

However, operator-initiated action through the system control program is the preferred method of reconfiguration because it makes both hardware and software changes as a single, integrated action.

Remote Support Facility

The remote support facility (RSF) consists of three parts:

- RSF configuration
- RSF authorization
- RSF call details.

RSF Configuration

At installation, the RSF is tailored to the customer's requirements by the service representative. Two RSF configuration frames are available for the customer and the service organization to specify remote support facility information. These specifications include:

- As many as four telephone numbers for access to remote support
- Mode of operation for equipment used (for example, manual dialing, automatic dialing, modem type)
- Agreed-on service update schedule
- Allowance or disallowance of incoming and outgoing calls
- Unique RSF customer access code
- Customer and IBM information
  - Responsible customer personnel
  - Location of the system at the customer's installation
  - Customer's business, system console, and modem telephone numbers
  - Modem type
  - IBM branch office number and telephone number
  - Prime shift and off-hour shift dispatcher's telephone numbers.

The specified information can be changed at any time by invoking the frames and by entering the revised data.

RSF Authorization

No incoming or outgoing calls are allowed without customer authorization.

Customer authorization includes the following:

- Reason for call
- Type of call: outgoing, incoming, automatic calling, manual dialing
- Name of the person at the customer location to be contacted
- Whether a service representative is on-site
- Whether the system is immediately available
- Whether RSF can be enabled, can be deferred, or is not authorized.

RSF Call Details

Details of all RSF calls (both incoming and outgoing) are recorded and each call is listed on an RSF log index. The RSF log index can be displayed and any call that is listed can be selected from the index. The RSF log index shows the date, time, status, and reason for the call. When a call is selected, the first of a set of frames is displayed. The frames contain detailed information about the selected call.

See Chapter 6, "Error Handling," for information about customer problem analysis and RSF procedures.

Chapter 6. Error Handling

Overview

The 9022 Processor Controller automatically performs certain error recovery procedures. If automatic error recovery is not successful, a set of Problem Analysis frames and procedures is available to facilitate recovery by the user for certain types of failures, and remote support facility (RSF) procedures are available for all failures.

Automatic Error Recovery

Error handling by the processor controller provides both automatic recovery from many hardware malfunctions and reporting by machine-check or channel-check interruption.

Error recovery functions are provided for errors in central storage and for channel errors. When an error is detected, the 9022 automatically performs error analysis procedures to isolate the malfunctioning area directly and to identify (if applicable) the field replaceable unit (FRU) or group of FRUs. These procedures include problem recognition, recording, and diagnosis.

Error Checking and Correction

Error checking and correction in central storage provides automatic single-bit error detection and correction of all data read from central storage. Error checking also detects all double-bit errors and some multiple-bit errors of the data read from central storage, but does not correct the errors.

Some double-bit errors are temporarily recovered to allow the system control program an opportunity to deallocate the failing page frame.

Error checking and correction in expanded storage provides automatic single-bit and double-bit error detection and correction of all data read from expanded storage. Error checking also detects all triple-bit errors and some multiple-bit errors of the data read from expanded storage, but does not correct the errors.

Parity checking is used to verify other data in the processor complex that is not contained in central or expanded storage.

Machine-Check Handling

When a machine check occurs, the 9022 collects the error information and enters it in a log. The central processor then presents a machine-check interruption to the system control program.

All machine-check interruptions store a doubleword that contains a machine-check interruption code. Bits that are not assigned or are not implemented are stored as 0's. Certain bits in control register 14 are associated with machine-check handling. The ES/9000 Models 330, 340, 500, 580, 620, and 720 use bits 3 through 7 in ESA/390 mode.

When a malfunction makes it undesirable or impossible to continue processing, the central processor enters the check-stop state. The central processor always enters the check-stop state when any of the following occurs:

- PSW bit 13 is 0 and an exigent machine-check condition is generated.

- Another exigent machine-check condition is detected during the execution of an interruption that was caused by an exigent machine-check condition.
- The machine-check interruption code cannot be stored or the new PSW cannot be fetched during the execution of an interruption.
- Invalid ECC is detected in the prefix register.

The central processor is removed from the check-stop state by a CPU reset.

Note: When multiple central processors are part of the configuration, the processor controller generates a malfunction external interruption to all the configured central processors. If the processor controller cannot identify which central processor should be put into the check-stop state, all central processors are put into the check-stop state.

Figure 6-1 shows the machine-check interruption code (MCIC).

MCIC

Bit	Meaning
0	System damage
1	Instruction processing damage
2	System recovery
4	Timing facility damage
6	Vector facility failure
9	Channel report pending
10	Service-processor damage
11	Channel subsystem damage
13	Vector facility source
14	Backed up
16	Storage error uncorrected
17	Storage error corrected
18	Storage key error uncorrected
19	Storage degradation
20	PSW-EMWP validity
21	PSW mask and key validity
22	PSW program mask, condition code validity
23	PSW instruction address validity
24	Failing storage address validity
27	Floating-point register validity
28	General register validity
29	Control register validity
31	Storage logical validity
32	Indirect storage error
33	Access register validity
34	Delayed access exception
46	CPU timer validity
47	Clock comparator validity

Figure 6-1. Machine-Check Interruption Code (MCIC)

I/O Operations

Errors detected by the channel subsystem are reported to the central processors as I/O interruptions or machine-check interruptions. I/O interruptions report the following hardware-related conditions:

- Interface control check (IFCC)
- Channel control check (CCC)
- Channel data check (CDC).

Machine-check interruptions include the following:

- Unrecoverable errors (retry attempts are unsuccessful)
- Persistent errors (retry attempts can be made, but the error threshold is exceeded)
- Serious channel errors that require immediate reporting or that cannot be reported as an IFCC or CCC with an I/O interruption.

Problem Analysis

To attempt recovery before initiating the remote support facility, the user can invoke problem analysis from the System Console Index frame. If the problem was caused by a power malfunction, the first of a set of Power Status Problem Analysis frames is displayed. If the problem was caused for some other reason, the first of a second set of Problem Analysis frames is displayed.

Power Malfunction

To assist recovery from a power malfunction, the first set of Problem Analysis frames displays this information:

- Power boundary errors with reason codes
- A list of suggested recovery actions
- Defined service action.

For more information, see the *ES/9000 Processor Complex: Recovery Guide.*

Other Malfunctions

Status information is displayed for the central processors, hardware, interface control checks, and channels or channel paths. Based on the status information, the customer can select any of a variety of problem analysis categories that include:

- Non-I/O hardware errors
- Unsuccessful IPL
- Enabled or disabled wait state
- Interface control checks (IFCCs)
- I/O device errors
- Operator console lockout.

Each procedure provided by the Problem Analysis frames gives current status information for that type of malfunction, and then lists possible recovery actions.

The IOPD frames can also be used for troubleshooting IFCC and I/O device problems. If the attempt at recovery fails and if remote support is required, a selection from the frame invokes the RSF Authorization frame.

Remote Support Facility

A priority message is displayed when:

- The processor controller detects a failure that requires service.
- The remote support facility requires remote console control (from the remote support center).
- An automatic service update must be done.

A customer can also initiate remote support from the problem analysis procedures or can invoke the RSF Authorization frame and establish the remote connection.

After the service request is authorized, a telephone number is automatically dialed over the public switched network to establish a connection with a remote modem. The remote modem acknowledges the connection and the remote support facility is enabled.

When the remote support facility is connected by the data link, the remote support facility has access to the ES/9000 Processor Complex. In this way, control of the ES/9000 Processor Complex can be passed to the remote support facility.

Chapter 7. ES/9000 Models 330, 340, 500, 580, 620, and 720 Features

Overview

The ES/9000 Model 330, 340, 500, 580, 620, and 720 features are listed under the following topics:

- "Features Dependent on Architectural Mode"
- "Programming Assists Dependent on Architectural Mode"
- "Features Not Dependent on Architectural Mode."

Additional information about the mode-dependent features can be found in the following manuals:

- *IBM System/370 Extended Architecture Interpretive Execution*
- *IBM ES/9000 Processor Complex: Processor Resource/Systems Manager Planning Guide*
- *IBM Enterprise Systems Architecture/370 and System/370 Vector Operations*
- *IBM Enterprise Systems Architecture/390 Principles of Operation.*

The brief descriptions of features in this chapter show whether the function is a standard or host-program feature of that mode on the ES/9000 Processor Complex.

The column headings in the tables under "Features Dependent on Architectural Mode" and "Programming Assists Dependent on Architectural Mode" identify the architectural modes of the ES/9000 Processor Complex.

In both tables, the columns under ESA/390 Mode apply when the ES/9000 Processor Complex (or a side of a physically partitioned ES/9000 Processor Complex, or a logical partition) has been initialized to operate in the ESA/390 architectural mode. These columns apply to ES/9000 Models 330, 340, 500, 580, 620, and 720.

- The first column, ESA/390, describes the features that are apparent to the control program (host). MVS/SP Version 2, MVS/SP Version 3, and VM/XA SP are three typical control programs that may be used.
- The second column, ESA/390 Guest, describes the features that are apparent to an ESA/390-mode virtual machine, whose operation is initiated by means of a Start Interpretive Execution (SIE) instruction executed by the host.

Features Dependent on Architectural Mode

	ESA/390 Mode	
Feature	ESA/390	ESA/390 Guest
Advanced address space	Std	Std
Bimodal addressing	Std	Std
Branch and save	Std	Std
Byte-oriented operand	Std	Std
Channel indirect data addressing	Std	Std
Channel subsystem	Std	Std
Command retry	Std	Std
Conditional swapping	Std	Std
CPU timer and clock comparator	Std	Std
DB2 sort facility	Std	Std
ESCON Channels	Opt	Opt
Expanded storage	Opt	Opt
Extended-precision divide	Std	Std
Extended-precision floating point	Std	Std
Extended sorting	Std	Std
Floating point	Std	Std
Integrated Cryptographic Feature	Opt	Opt
Incorrect-length-indication suppression	Std	Std
Interpretive execution (SIE)	Std	Host
Key-controlled storage protection	Std (1)	Std (1)
Logging volume reduction	Std	Std
Monitoring	Std	Std
Move page	Std	Host
Multiprocessing:		
- CPU address identification	Std	Std
- CPU signaling and response	Std	Std
- Prefixing	Std	Std
- Shared main storage	Std	Std
- TOD clock synchronization	Std	Host
Page protection	Std	Std
Private space	Std	Std
Processor availability facility	Std	Std
PSW-key handling	Std	Std
Service signal	Std	Host
Sorting instructions	Std	Std
Storage key instruction extensions	Std	Std
Storage-key 4KB block:		
- Single-key 4KB blocks	Std	Std
System/370 extended facility:		
Non-MVS-dependent portion	Std	Std
Sysplex Timer	Opt	Opt
- Automatic propagation relay	Opt	Opt
- Extended time source	Opt	Opt
Test block	Std	Std
Time-of-day (TOD) clock	Std	Std

Feature	ESA/390 Mode: ESA/390	ESA/390 Mode: ESA/390 Guest
Tracing (ASN, branch, and explicit)	Std	Std
Translation:		
- Dynamic address translation:		
- 4KB page size	Std	Std
- 1MB segment size	Std	Std
- Program-event recording (PER)	Std	Std
- Set-system-mask suppression	Std	Std
- Store status	Std	Std
Vector facility	Opt	Opt
3033 extension:		
- Dual-address space (DAS)	Std (2)	Std (2)
31-bit IDAWs	Std	Std
31-bit real addressing	Std	Std

Notes:

Host — The design of the host software determines whether or not this function is simulated for the guest; direct interpretive execution may or may not occur.

Optional (Opt) — Implemented as an optional feature of the ES/9000 Models 330, 340, 500, 580, 620, and 720 when operating in this architectural mode.

Standard (Std) — Implemented as a standard feature of the ES/9000 Models 330, 340, 500, 580, 620, and 720 when operating in this architectural mode.

1 The storage key instruction extensions provide the required function to manage the storage keys in ESA/390 mode

2 Does not include dual-address space (DAS) tracing; address space number (ASN) tracing provides a comparable function.

Programming Assists Dependent on Architectural Mode

	ESA/390 Mode	
Programming Assists	ESA/390	ESA/390 Guest
SIE assist	Std (1)	--
System/370 extended facility		
- MVS-dependent portion:		
- Four lock-handling instructions	Std	Std
- SVC Assist instruction	Std	Std
- Add FRR instruction	Std	Std

Notes:

Standard (Std) Implemented as a standard feature of the ES/9000 Models 330, 340, 500, 580, 620, and 720 when operating in this architectural mode.

1 Not provided in a logical partition.

Features Not Dependent on Architectural Mode

Parallel Channel Feature	Optional or Standard	Model
Parallel Channel group, 1st Additional (16)	Optional	330, 340
Parallel Channel group, 1st Additional (16, side 0)	Optional	500, 580, 620, 720
Parallel Channel group, 1st Additional (16, side 1)	Optional	620, 720
Parallel Channel group, 2nd Additional (16, side 0)	Optional	500, 580, 620, 720
Parallel Channel group, 2nd Additional (16, side 1)	Optional	620, 720
Parallel Channels (16)	Standard	330, 340
Parallel Channels (32)	Standard	500, 580
Parallel Channels (64; 32 each side)	Standard	620, 720

ESCON Channel Feature		
ESCON Channel group, 1st Additional (16, side 0)	Optional	Models 330, 340, 500, 580, 620, and 720
ESCON Channel group, 1st Additional (16, side 1)	Optional	Models 620 and 720
ESCON Channel group, 2nd Additional (16, side 0)	Optional	Models 330, 340, 500, 580, 620, and 720
ESCON Channel group, 2nd Additional (16, side 1)	Optional	Models 620 and 720

Other Features	Optional or Standard	Model
CPU retry	Standard	Models 330, 340, 500, 580, 620, and 720
Data streaming	Standard	Models 330, 340, 500, 580, 620, and 720
Error checking and correction	Standard	Models 330, 340, 500, 580, 620, and 720
Expanded storage	Optional	Models 330, 340, 500, 580, 620, and 720
High-speed buffer storage	Standard	Models 330, 340, 500, 580, 620, and 720
I/O error alert	Standard	Models 330, 340, 500, 580, 620, and 720
9023 I/O power sequence control (for 1st to 64th control unit)	Optional	Models 330, 340, 500, 580, 620, and 720
9023 I/O power sequence control (for 65th to 128th control unit)	Optional	Models 330, 340, 500, 580, 620, and 720
Processor Resource/Systems Manager	Standard	Models 330, 340, 500, 580, 620, and 720

Feature Descriptions

This section describes the features and programming assists of the ES/9000 Models 330, 340, 500, 580, 620, and 720. These feature descriptions should be used with the preceding tables.

Advanced Address Space

Advanced address-space functions of the ES/9000 Models 330, 340, 500, 580, 620, and 720 provide capabilities not available in the 370-XA architecture; these ESA/390 functions allow programs and their data to reside in different address spaces. Data can be accessed in multiple address spaces concurrently, and address spaces can be selected for processing without control-program intervention, if authority previously has been granted by the control program. The five components of the advanced address-space facilities are an access-register mode (with a set of 16 access registers), a linkage-stack mechanism, a home-space mode, efficient means to access data in real storage, and efficient movement of fetch-protected data.

Access-Register Mode

Sixteen access registers permit the program to have immediate access to as many as sixteen 2GB address spaces including the address space in which the program resides. In the access-register translation mode, the B-fields and/or R-fields of many instructions may designate both a general register and an access register; the contents of the access register, along with the contents of protected tables in storage, specify the operand address space to be accessed. By changing the contents of the access registers, the program (under the control of an authorization mechanism) can have fast access to hundreds of different operand address spaces. Instructions are provided to load and store the contents of the access registers and to change between access-register mode and other translation modes.

Linkage Stack

A linkage stack can be used to pass control between programs residing in the same or different address spaces. The called and calling programs can have degrees of privilege and authority that are arbitrarily different. The state of the calling program is saved on the linkage stack and is restored during the return linkage.

Home-Space Mode

The home-space mode provides an efficient means for the control program to obtain control in the home address space where principal control blocks for a dispatchable unit (a task or a process) are kept.

Real-Storage Access

The Load Using Real Address and Store Using Real Address instructions allow the control program to access data in real storage more efficiently.

Data Movement

The Move with Destination Key instruction and the Move with Source Key instruction can improve performance when data is to be moved alternately (in both directions) between two storage areas that are fetch-protected by means of unequal keys.

Basic Control Mode

Basic control (BC) mode provides a PSW format that is compatible with the PSW format of System/360.

Bimodal Addressing

Bimodal addressing permits 31-bit logical addressing, yet allows users to continue running System/370 problem programs which use 24-bit logical addresses.

Branch and Save

Branch and save provides the Branch and Save instruction (BAS and BASR).

Byte-Oriented Operand

Byte-oriented operand allows storage operands of most unprivileged instructions to appear on any byte boundary without causing a specification exception and a program interruption. This feature applies to fixed-point, floating-point, and logical operands. It does not apply to instruction addresses, privileged instructions, or channel command words (CCWs).

Channel Indirect Data Addressing

The addresses contained in channel command words (CCWs) in virtual storage must be translated by the system control program before execution. Channel indirect data addressing allows immediately adjacent areas of virtual storage to be mapped into nonadjacent areas of absolute storage.

Channel-Set Switching

Channel-set switching permits program-controlled switching of channel sets between two central processors so that if one central processor fails, either channel set may be assigned to the other central processor.

Channel Subsystem

The ESA/370 dynamic channel subsystems queue I/O requests, select from as many as four channel paths to any I/O device, and handle I/O busy conditions. Thirteen ESA/390 I/O instructions are associated with the channel subsystem.

ES/9000 Models 620 and 720 have a channel subsystem on each side. However, when these models are in a single-image configuration, the two channel subsystems operate as one dynamic channel subsystem.

ESCON Channels

ESCON Channels transfer information on a link in a serially transmitted synchronous bit stream (serial transmission) through fiber optic channel cables and:

- Operate using link-level protocols and device-level protocols, or
- Attach to an IBM 9034 ESCON Converter for using bus and tag cables attachment to control units with parallel interfaces.

ESCON Extended Distance Feature (ESCON XDF)

ESCON XDF significantly lengthens the connectivity distances possible using the ESCON Architecture.

By using ESCON XDF single-mode fiber optic technology, connectivity distances can significantly exceed those offered by the LED multimode fiber technology.

For more information, see "Fiber Optic Cabling, Transmission, and Reception" on page 1-6.

Clear I/O

Clear I/O 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 allows a subchannel to retry a command without causing an I/O interruption. The retry is initiated by a control unit.

Conditional Swapping

Conditional swapping makes available the Compare and Swap (CS) and Compare Double and Swap (CDS) instructions.

Control-Switch Assist

The control-switch assist enhances the functions of the preferred-machine assist by increasing the speed with which interruptions on central processor (CP) owned channels are presented to a preferred virtual machine, and by allowing a preferred virtual machine to access certain control program DIAGNOSE codes. VM/SP HPO Release 3.2 and subsequent releases support control-switch assist.

CPU Retry

CPU retry automatically examines any instruction when an error occurs during the execution of the instruction. CPU retry usually attempts to execute the instruction again.

CPU Timer and Clock Comparator

The CPU timer of each central processor is a high-resolution timer that causes an interruption whenever its value is negative. The interruption request is allowed by setting bit 21 in control register 0 and the external mask bit in the PSW.

The CPU timer measures central processor elapsed time and causes an interruption at the end of the period that is specified by the program. The timer is decremented when the central processor is executing instructions and during the wait state, but is not decremented when the central processor is in the stopped state. The program can initiate inspection of the CPU timer by using the Store CPU Timer (STPT) instruction and can set the timer to a specific value by using the Set CPU Timer (SPT) instruction. The contents of the CPU timer are reset to 0 by initial CPU reset.

Note: When the time-of-day (TOD) clock is in the stopped state or in the error state, the CPU timer is not decremented.

The clock comparator of each central processor provides for an interruption when the TOD clock reaches a value specified by the program. The interruption is allowed when the central processor sets bit 20 in control register 0 and the external mask bit in the PSW.

The format of the clock comparator is the same as that of the TOD clock. A clock-comparator interruption is an external interruption. 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. The contents of the clock comparator are reset to 0 by an initial CPU reset.

Note: When the TOD clock is in the stopped state or in the error state, the clock comparator is not operating.

Data Streaming

Data streaming is available on all block multiplexer channels. It permits higher data rates (as many as 4.5MB per second, depending on the control units attached) and longer cable lengths. Data streaming is initiated by the control unit. The channel subsystem permits the intermixed attachment of data-streaming and non-data-streaming devices on the same channel.

DB2 Sort Facility

See "Extended Sorting" on page 7-12.

Error Checking and Correction

Data paths between expanded storage (if installed) and central storage, and between central storage and the channels and central processors, are checked using either parity or error checking and correction.

Error checking and correction (ECC) code bits are stored with the data in the central storage and in the expanded storage data arrays. ECC codes apply to data stored in and fetched from central storage and expanded storage; single-bit and multiple-bit error detection are performed in both central storage and expanded storage. Single-bit error correction takes place in both central storage and expanded storage. Double-bit error correction takes place in expanded storage.

Expanded Storage

Expanded storage is an optional high-speed, high-capacity storage that transfers 4KB pages to and from central storage. See "Optional Machines and Features" on page 2-4 for the expanded storage available for the ES/9000 Models 330, 340, 500, 580, 620, and 720.

Extended-Precision Divide

Extended-precision divide provides the Divide (DXR) instruction for extended-precision floating-point operands.

Extended-Precision Floating Point

Extended-precision floating point provides seven floating-point instructions that use the extended-precision format (a signed 7-bit characteristic and a 28-digit fraction).

Extended Real Addressing

Extended real addressing permits the addressing of real storage in excess of 16MB. The system control program uses extended real addressing for locating user programs and portions of the system control program in central storage at real addresses to 64MB. Extended real addressing does not affect virtual addressability, which may not exceed 16MB in each address space.

Extended Sorting

Extended sorting provides instructions that improve the performance of the DB2 sorting function. These improvements significantly reduce the amount of elapsed time and CPU time required for DB2 queries using sort when used with DB2 Version 2 Release 3.

Fast Release

Fast release provides the start-I/O-fast-release function on a channel when the Start I/O Fast Release (SIOF) instruction is executed. This function provides for early release of the central processor that executes the instruction. Fast release occurs before the device-selection procedure is completed, thereby reducing the central processor delay associated with the operation.

Floating Point

Floating point provides the floating-point instructions and the floating-point registers. In System/370, floating point combined with the commercial instruction set is sometimes referred to as the System/370 universal instruction set.

Halt Device

Using the privileged Halt Device (HDV) instruction, the halt-device function signals the addressed I/O device to terminate its current I/O operation.

High-Speed Buffer Storage

High-speed buffer storage in each central processor satisfies many storage fetch requests, making the effective storage access time much shorter than the actual central storage cycle time. For more information, see "Buffer Control Element" on page 3-5.

Integrated Cryptographic Feature

The IBM Integrated Cryptographic Feature (ICRF) together with IBM Integrated Cryptographic Service Facility/MVS (ICSF/MVS), Program Number 5685-051, provides a system for secure, tamper-detecting, high-speed cryptographic services. It enables you to encrypt, decrypt, and authenticate data, and to generate and manage cryptographic keys.

This version of the ICRF includes:

- A thermal conduction module (TCM)
- A key-storage unit (KSU)
- A key-entry unit (KEU)

ICRF uses the American National Standards Institute (ANSI) Data Encryption Algorithm (DEA), also known as the U.S. National Institute of Science and Technology Data Encryption Standard (DES) algorithm, to encrypt and decrypt data.

This version of ICRF can be installed on certain IBM ES/3090 J-Models and ES/3090-9000T Models by ordering the appropriate request for price quotation (RPQ). Order RPQ 8P1375 for the A-side and RPQ 8P1376 for the B-side.

ICRF can also be installed on ES/9000 Models 330, 340, 500, 580, 620, and 720. On a dual-sided processor complex, one ICRF can be installed on each side of the processor complex. On a single-sided processor complex, only one ICRF can be installed.

ICRF and the vector facility feature are mutually exclusive on a central processor. ICRF should be installed on the highest-numbered central processor for processors that can install the vector facility feature. No changes in installation planning are required for ICRF.

Incorrect-Length-Indication-Suppression Facility

For format-1 channel programs, the incorrect-length-indication-suppression facility provides the incorrect-length-indication mode. The incorrect-length-indication-suppression facility includes the incorrect-length-suppression-mode control, bit 24 of word 1 of the operation request block (ORB).

Interpretive Execution

The interpretive execution facility is used by VM/XA SF and VM/XA SP and provides hardware support for several areas of virtual machine operation such as interval timer operation, prefixing, address translation, and privileged instruction handling. This facility provides the Start Interpretive Execution (SIE) instruction (with interception format 2 installed), which is used to dispatch all virtual machines.

Interval Timer

The interval timer of each central processor provides external interruptions on a program-controlled basis. The value stored at a specified storage location is automatically decremented by 1 in bit position 23 every 3.33 milliseconds. The program receives an external interruption request when the interval timer decrements from 0 to a negative value. (Bit 7 of the PSW and bit 24 of control register 0 must be on.) The range of the interval timer is approximately 15.5 hours.

Note: When the TOD clock of a central processor is in the stopped or error state, the interval timer is not operating.

I/O Error Alert

I/O error alert permits a channel to be alerted when a malfunction affects the ability of a control unit to continue operating.

I/O Power Sequence Control

The 9023 provides I/O power sequence control for any ES/9000 Models 330, 340, 500, 580, 620, and 720. One I/O power sequence control on the 9023 directs the sequence of power on or off for 64 control units. An option is available to extend the power sequence to 64 additional (128 total) control units.

The ES/9000 Models 620 and 720 require two 9023s for the first 64 control units on each side. Two additional 9023s are optional to extend the power sequence to 128 control units on each side.

Key-Controlled Storage Protection

Key-controlled storage protection prevents unauthorized access to information in central storage. Key-controlled storage protection includes both store protection and fetch protection. If store protection is violated, data is not stored into the protected area; if fetch protection is violated, data is not retrieved from the protected area. When a violation is recognized, a program interruption occurs. See "Central Storage" on page 3-8 for more information.

Limited Channel Logout

Limited channel logout provides 4 bytes of channel status information for model-independent recovery from channel errors.

Logging Volume Reduction

Logging volume reduction together with IMS/ESA* Version 3 should result in reduced logging volume for DL/I databases accessed from IMS/DC or CICS*.

Monitoring

Monitoring provides a means of selectively recording designated events in the execution of a program. This facility is implemented by the Monitor Call (MC) instruction.

Move Page

Move page provides the Move Page instruction, which allows an application program to efficiently move a page (4KB) of data between main and expanded storage, provided that the source and destination pages are both valid. This instruction is used with the MVS/ESA HSPSERV routine, which handles the situation when one or both of the pages are invalid. The Move Page instruction is also used by MVS/DFP* VSAM Hiperspaces*.

Multiprocessing

The multiprocessing feature permits a multiprocessing configuration. Multiprocessing provides CPU address identification, CPU signaling and response, prefixing, shared main storage, and TOD clock synchronization. See Chapter 12, "Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations" for the number of CPs for each model.

CPU Address Identification

CPU address identification provides an address by which each of the central processors can be identified by the Signal Processor (SIGP) instruction. It also provides new external interruption conditions and the Store CPU Address (STAP) instruction by which the system control program can determine the address of a central processor. See "CPU ID" on page 3-3.

CPU Signaling and Response

CPU signaling and response provides for communication among the central processors. This feature provides the Signal Processor (SIGP) instruction and the mechanism to interpret and to act on several order codes, such as sense, stop, and restart.

Prefixing

For each central processor, prefixing provides a means of assigning real addresses 0 through 4095 to different 4KB blocks of central storage. One area of central storage (represented by a single contiguous range of absolute addresses) is assigned to each central processor.

Shared Main Storage

Shared main storage permits all central processors to have access to common main storage locations.

TOD Clock Synchronization

TOD clock synchronization provides a uniform appearance to a clock synchronization program in all ES/9000 Processor Complexes, allowing the program to be independent of the actual number of TOD clocks and central processors in a configuration. It includes a TOD clock synchronization control bit in control register 0.

Page Protection

Page protection provides protection against improper storing by controlling access to virtual storage by using the page protection bit in each page table entry.

Preferred Machine Assist

Preferred machine assist permits a single MVS/SP virtual-equals-real (V=R) virtual machine operating under VM/SP HPO to operate with a minimum of simulated instruction execution. This allows the MVS/SP virtual machine to achieve near basic performance. With preferred machine assist, any MVS/SP release that supports more than 16MB of real storage can use real storage above 16MB when MVS/SP is operating as a V=R virtual machine.

Private Space

Private space provides a bit in the segment-table designation to prevent the use of TLB entries for common segments, and to prevent the application of low-address protection and fetch-protection override to the specified address space.

Processor Availability Facility

The processor availability facility enhances system availability and offers additional protection from problems that could impact end users or critical programs. Currently, if a central processor (CP) encounters a failure, the program in process at the time of the failure abends and data is lost. The processor availability facility reduces the impact of many formerly unrecoverable CP failures. Systems with two or more CPs move the programs in process from the failing CP to another operational CP.

The processor availability facility is an extension of the hardware logic that supports CPU retry. CPU retry requires that status information about the program in process be available to the CP. When an error occurs in the execution of an instruction, CPU retry uses the status information to rerun the instruction, resuming the instruction flow at the precise point where the error occurred.

The processor availability facility makes the status information required by CPU retry available to the operating system responsible for recovering the program in process. Using the hardware status, the operating system or LPAR determines whether or not processor availability facility recovery can be performed. If so, processor availability facility moves the program in process to another operational CP. This is performed transparently to the application as if a normal interrupt occurred and the program rescheduled on a different CP.

In a PR/SM LPAR mode, processor availability facility offers additional benefits. A system running in basic mode with a single physical CP cannot use Processor Availability Facility. However, in a PR/SM LPAR partition where a single logical CP shares a pool of multiple physical CPs, a CP failure results in the rescheduling of the partition on another CP from the pool. This provides greater resilience in basic mode.

In addition, systems that do not support multiple CPs but still require high availability can benefit from Processor Availability Facility. For example, a VSE system running in a partition with shared access to multiple physical CPs can have improved protection and system availability by using Processor Availability Facility.

Processor Resource/Systems Manager

Processor Resource/Systems Manager (PR/SM) provides additional byte multiplexer channel capability, enables logical partitioning of the processor complex, and supports the VM/XA System Product Enhancement for Multiple Preferred Guests.

Logical Partitioning

PR/SM enables the ES/9000 Processor Complex (or side of a physically partitioned ES/9000 Processor Complex) to be initialized for logically partitioned operation. ES/9000 Models 330, 340, 500, 580, 620, and 720 support as many as seven logical partitions. ES/9000 Models 620 and 720 support as many as seven logical partitions (14 when operating in a physically partitioned configuration). See

"Logically Partitioned (LPAR) Operating Mode" on page 1-8 for more information.

Multiple High Performance Guests

PR/SM supports the VM/XA System Product Enhancement for Multiple Preferred Guests. It allows the support of multiple high-performance guests running concurrent with other virtual machines. Six V = F preferred guests are supported. When running a V = R preferred guest virtual machine, as many as five V = F preferred guests are supported. PR/SM supports devices dedicated to V = R and V = F guests. VMA, under SIE, supports V = R and V = F VM/SP and VM/SP HPO guests.

PR/SM LPAR Auto-Reconfiguration

This function in PR/SM is an automatic reconfiguration facility that improves the operation of "hot standby" or backup logical partitions. When it is used with MVS/ESA, a logical partition can invoke the automatic reconfiguration facility which:

- Resets the primary logical partition
- Automatically reconfigures storage to the secondary logical partition
- Automatically deactivates the primary logical partition

All this occurs without operator intervention.

PR/SM LPAR Management Time Reporting

PR/SM LPAR processor utilization reporting has improved the Resource Measurement Facility (RMF) partition data report. The improved report provides LPAR management time information and should help you understand PR/SM's low utilization effects in LPAR environments. It also make it easier for you to make better capacity planning decisions due to more precise information in the processor resource utilization report.

Retention of Logical Partition Processing Weight Definitions

PR/SM LPAR supports the retention of logical partition processing weight definitions across power-on reset.

This improves system operation by providing a new method for retaining the logical partition processing weights defined on the Logical Partition Control (LPCTL) frame.

Previously, the system associated the processing weight values (displayed in the Weight Value and Weight Capped fields) with a particular I/O configuration data set (IOCDS) slot (for example, A0, A1, A2). If you rewrote an IOCDS slot, the system retained the values only if:

- The number of logical partitions defined in the new IOCDS was equal to the number of logical partitions in the old version of the IOCDS.
- The names of the logical partitions defined in the new IOCDS were the same as the names of the logical partitions in the old version of the IOCDS.

If you did not meet these two conditions when you rewrote an IOCDS slot, the weights reverted to the default values after the system was power-on reset with the new IOCDS.

The system now associates the LPCTL frame processing weight values with the individual logical partition names and retains them as long as the logical partition name exists in any IOCDS.

PR/SM LPAR Preferred Path

You can specify preferred channel paths for devices in LPAR mode as well as basic mode. Use IOCP to define a preferred path for a device by coding the PATH parameter in the IODEVICE macroinstruction. For more information, see the *ES/9000, ES/3090 Input/Output Configuration Program User Guide*, GC38-0097.

PR/SM LPAR High-Performance Parallel Interface (HIPPI)

PR/SM LPAR supports the assignment of a HIPPI interface to a logical partition providing the same HIPPI capabilities available in basic mode. Support of HIPPI in LPAR mode includes:

- Enhanced large system resource utilization
- Ability to mix traditional computing and numerically intensive computing (NIC) on the same processor
- Ability of one logical partition to access two HIPPIs for Models 660, 820, 860, and 900.

PR/SM LPAR Support of ICRF

PR/SM LPAR mode now supports the use of ICRF by an MVS/ESA guest running under VM/ESA that is operating in a logical partition.

PSW-Key Handling

PSW-key handling provides the Set PSW Key from Address (SPKA) and Insert PSW Key (IPK) instructions.

Recovery Extensions

Recovery extensions consist of:

- 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 provide a detailed indication of the cause of external damage
- Limited channel logout extensions, which consist of two additional logout bits, to indicate whether the I/O interface is operative and whether the logout is valid.

Service Signal

Service signal provides an external interruption that is used by the 9022 Processor Controller to signal information to the control program.

SIE Assist

The Start Interpretive Execution (SIE) assist improves the performance of a V=R preferred guest that is running under VM/XA SF or VM/XA SP. Certain I/O instructions and associated I/O interruptions can be handled in the interpretive execution mode for System/370 and ESA/370 guest virtual machines if they are associated with devices dedicated to the guest.

Note: PR/SM provides a similar performance improvement for both V=R and V=F guests when used with the VM/XA SP Enhancement for Multiple Preferred Guests.

Sorting Instructions

Sorting instructions are used by the IBM Program Product DFSORT (Data Facility Sort), Release 7 and subsequent releases, running under MVS/SP Versions 2 and 3. The sorting instructions are used when sorting fixed-length records using the block-set sorting technique by the program DFSORT (Release 7 and subsequent releases).

Storage Key Instruction Extensions

The storage key instruction extensions 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 4KB block of storage.

Storage Key Instructions

The storage key instructions Set Storage Key (SSK) and Insert Storage Key (ISK) allow initialization and inspection of the storage key associated with each block of storage that is available in the configuration.

Storage-Key 4KB Block

Storage-key 4KB block allows a single key to be associated with each 4KB block of storage and, in System/370 mode, provides the storage-key exception control bit in control register 0.

IBM Sysplex Timer

The optional IBM Sysplex Timer, supported by MVS/ESA SP Release 4.1 and subsequent releases, provides the capability of synchronizing the processor time-of-day clocks of the systems in a complex. The IBM Sysplex Timer provides an external time source for attached processors when sharing data or workloads.

System/370 Extended Facility

The non-MVS-dependent portion of the System/370 extended facility consists of:

- Low-address protection, which improves system integrity by providing special protection for storage (at fixed storage addresses 0 through 511) that is vital to the system control program
- Invalidate Page Table Entry (IPTE) instruction and the common-segment bit, which increase the efficiency of dynamic address translation
- Test Protection (TPROT) instruction, which performs tests for potential protection violations without causing program interruptions for protection exceptions.

The MVS-dependent portion of the System/370 extended facility consists of:

- Supervisor Call (SVC) Assist instruction, which improves central processor performance by reducing the time needed to enter MVS supervisory services

- Fix Page instruction, Add FRR (Add Functional Recovery Routine) instruction, six tracing instructions, and four lock-handling instructions, which improve central processor performance.

Test Block

Test block provides the Test Block (TB) instruction for testing the usability of a 4KB block of central storage.

Time-of-Day Clock

The time-of-day (TOD) clock for each central processor provides a consistent measurement of elapsed time that can be used for indicating the time of day. The TOD clock for each central processor is initialized by the Set Clock (SCK) instruction by a central processor.

- Bit 51 increments at 1-microsecond intervals.
- Bits 52-55 are monotonic to ensure 1-microsecond counting in bit 51.
- Bits 61-63 contain the central processor address.

Tracing

Tracing provides three aids for problem-program analysis:

- Address-space-number (ASN) tracing
- Branch tracing
- Explicit tracing.

Translation

Translation includes the following features:

- Dynamic address translation
- Extended control (EC) mode
- Program-event recording (PER)
- Set-system-mask suppression
- Store status.

As part of these features, translation also provides the following instructions:

- Load Read Address (LRA)
- Purge Translation Lookaside Buffer (PTLB)
- Reset Reference Bit (RRB)
- Store Then AND System Mask (STNSM)
- Store Then OR System Mask (STOSM).

Dynamic Address Translation

Dynamic address translation (DAT) provides hardware translation of virtual addresses to real addresses during program execution. DAT supports real storage sizes according to the amount of storage available for each ES/3090 model.

The ES/9000 Models 330, 340, 500, 580, 620, and 720 use 4KB pages and either 64KB segments or 1MB segments. ESA/370 mode uses only the 1MB segment

size. An System/370 guest virtual machine under control of interpretive execution can use both segment sizes.

Extended Control Mode

When an ES/9000 Processor Complex operates in extended control (EC) mode, virtual storage and high-speed DAT are available.

Program-Event Recording

Program-event recording (PER) aids in debugging programs. During program execution, PER can monitor the following actions:

- Successful branches
- Alteration of general registers
- Instruction fetches from a specified storage area
- Alteration of a specified storage area.

Set-System-Mask Suppression

Set-system-mask suppression permits suppression of execution of the Set System Mask (SSM) instruction and provides the special-operation program interruption code.

Store Status

Store status is an operator-initiated function that places the contents of the current PSW and the program-addressable registers in permanently assigned locations within the first 512 bytes of absolute storage. Store status also includes a noninitializing manual reset function.

Vector Facility Feature

The vector facility feature is optional for each central processor in the ES/9000 Processor Complex. Central processors with the optional vector facility feature provide significantly increased levels of performance for many computer-intensive engineering and scientific applications. For ES/9000 Models 330, 340, 500, 580, 620, and 720, the section size is 256 and the partial-sum number is 4. For more information, see "Vector Facility Feature" on page 3-6 and *IBM Enterprise Systems Architecture/370 and System/370 Vector Operations*.

Virtual-Machine Assist

Virtual-machine assist (VMA), which is an assist for VM/SP, directly executes certain privileged virtual-machine instructions and validates page-table entries in the shadow tables. VMA improves performance on virtual-storage system operation under VM/SP by reducing the amount of time VM/SP spends in the real supervisor state. The reduction is achieved by emulation (instead of software simulation) of certain privileged operation codes used by the virtual-storage (guest) control program. An interpretively-executed System/370-mode guest virtual machine also can benefit from the advantages offered by VMA.

VM Assists for the CPU Timer

VM assists for the CPU timer permit a central processor to execute directly the Set CPU Timer (SPT) and Store CPU Timer (STPT) instructions for a virtual machine operating under VM/SP.

3033 Extension

The 3033 extension provides the following facilities:

- Dual-address space
- Start-I/O-fast queuing
- Suspend and resume.

All three facilities are supported in System/370 mode by MVS/SP Version 1 Release 3; dual-address space is supported in ESA/370 mode by MVS/SP Version 2 and by MVS/SP Version 3.

Dual-Address Space

Dual-address space aids communication between virtual address spaces. It provides:

- Twelve additional instructions
- Two address spaces for immediate use by a program
- A means of changing to other virtual address spaces
- A table-based subroutine linkage
- The use of multiple access keys for key-controlled protection by problem programs.

In ESA/370 mode the tracing facility provides an alternative set of aids.

Start-I/O-Fast Queuing

Start-I/O-fast queuing allows a Start I/O Fast Release (SIOF) instruction to complete execution independent of device selection or a channel-busy condition. Control unit or device busy conditions encountered before execution of a SIOF instruction cause the I/O operation to remain pending until facilities are available for initiation of the operation at the device.

Suspend and Resume

Suspend and resume provides:

- The suspend flag in the channel command word (CCW), which indicates that execution of a channel program is to be suspended
- A channel address word (CAW) bit that controls whether the suspend flag of the CCW should cause suspension of execution of a channel program
- A channel status word (CSW) bit that indicates that execution of a channel program has been suspended
- The Resume I/O (RIO) instruction, which causes the execution of a suspended channel program to be resumed.

31-Bit Indirect Data Address Word

The 31-bit indirect data address word (IDAW) extends the size of the address field in IDAWs to 31 bits.

31-Bit Real Addressing

31-bit real addressing ensures that certain fields contain 31-bit real addresses regardless of the setting of the addressing-mode control bit in the PSW.

Chapter 8. Channel Operation Characteristics

Overview

The channels in the channel subsystem permit transfer of data between central storage and I/O devices under control of a channel program. The channels act independent of other operations being performed by a central processor. A central processor is therefore free to resume other operations after initiating an I/O operation.

The channel facility required to perform an I/O operation is called a subchannel. The control and implementation of I/O operations depend on the following:

- Architectural mode of operation
  - ESA/370.
- Data mode of operation
  - Byte multiplexer (all ESCON and parallel channels)
  - Block multiplexer (parallel channels only).
- I/O interface protocol
  - ESCON channels using serial transmission
    - Link-level and device level
  - ESCON channels attached to a 9034 and parallel channels
    - Interlocked
    - Data streaming.

Subchannels

One unit control word (UCW) is assigned to each subchannel. UCWs are stored in the hardware system area of central storage and are moved to a channel subsystem during execution of an I/O operation.

Each UCW contains the following control information:

- Protection key
- Data address
- Identity of the operation specified by the command code
- CCW flags
- Byte count
- Channel status
- Address of the next CCW
- Channel path identifiers for as many as four channel paths, which may be configured to an I/O device.

In ESA/390 mode, one UCW is assigned for each subchannel (device).

The ES/9000 Models 330, 340, 500, 580, 620, and 720 provide one set of I/O display frames that display the contents of a specified subchannel or UCW.

The **data mode of operation** is determined by the multiplexer mode (byte or block) selected for specific channels during initialization of a logical partition or

of the processor complex (or for ES/9000 Models 620 and 720 the initialization of a side of a processor complex operating in a physically partitioned configuration).

The **I/O interface protocol** is determined by the interface sequencing operations selected for specific control units and their associated devices that are attached to the channel.

Channel Control

I/O operations over the interface are controlled by channel commands and mode-dependent I/O instructions, chaining operations, and I/O interruptions.

Channel Commands

Six basic channel commands can be specified by a CCW:

- *Write*, which initiates the transfer of data from central storage to an I/O device.
- *Read*, which initiates the transfer of data from an I/O device to central storage.
- *Read Backward*, which initiates the transfer of data from an I/O device to central storage, with the data bytes being stored in reverse order.
- *Control*, which specifies such operations as set tape density, rewind tape, advance paper in a printer, or sound an audible alarm.
- *Sense*, which requests information from a control unit. The information contains unusual conditions detected during the last I/O operation and detailed device status.
- *Transfer in Channel (TIC)*, which is executed by the channel subsystem and which specifies the location in central storage from which the next CCW in the channel program is to be fetched. The Transfer in Channel command provides branching between CCWs in noncontiguous storage areas. A Transfer in Channel command is not permitted to specify a CCW containing another Transfer in Channel command.

ESA/390 Mode

In ESA/390 mode, any CP can initiate I/O operations with any I/O device. Any CP can handle I/O interruptions from any I/O device. Each I/O device is assigned a unique device number, and each device is associated with one subchannel. The CPs communicate with devices by specifying the appropriate subchannel; the subchannel uses the assigned device address to communicate with the device over one or more channel paths. The device number provides a path-independent means to refer to a device for use in operator messages or at the time of IPL.

The I/O instructions for operation in ESA/390 mode are:

- *Start Subchannel (SSCH)*, which initiates execution of a channel program with the I/O device associated with the specified subchannel.
- *Test Subchannel (TSCH)*, which checks subchannel status and can clear the subchannel control bits.

- *Clear Subchannel (CSCH)*, which clears the subchannel and signals the channel subsystem to perform the clear function at the associated I/O device.
- *Halt Subchannel (HSCH)*, which terminates the current operation at the specified subchannel, and signals the channel subsystem to perform the halt function at the I/O device.
- *Resume Subchannel (RSCH)*, which signals the channel subsystem to resume execution of a suspended channel program with the I/O device associated with the specified subchannel.
- *Store Subchannel (STSCH)*, which stores control and status information about the specified subchannel.
- *Modify Subchannel (MSCH)*, which allows the control program to influence the execution of path management functions and some basic I/O functions.
- *Test Pending Interruption (TPI)*, which stores the interruption code for a pending I/O interruption and clears the interruption request.
- *Set Address Limit (SAL)*, which sets the address limit used in a comparison with the absolute storage address each time central storage is accessed for I/O data.
- *Reset Channel Path (RCHP)*, which initiates a reset of the specified channel path.
- *Set Channel Monitor (SCHM)*, which activates and deactivates the channel monitoring modes (measurement-block update and device-connect-time measurement).
- *Store Channel Path Status (STCPS)*, which identifies what channel paths are being used when STCPS is executed.
- *Store Channel Report Word (STCRW)*, which stores error-related information about a malfunction affecting the channel subsystem.

In ESA/390 mode, all I/O instructions except the SAL, SCHM, and STCPS instructions set the PSW condition code. This mode uses interruption response blocks rather than channel status words for returning interruption status to the program.

The SSCH instruction specifies an operation request block, which designates the channel program.

Chaining

Following the transfer of information over a channel designated by a CCW, an operation initiated by the SSCH instruction can be continued by fetching a new CCW. Fetching a new CCW immediately following the completion of the previous CCW is called *chaining.* (Chaining is described in more detail in the *IBM Enterprise Systems Architecture/390 Principles of Operation*.) CCWs located in contiguous areas of central storage (successive doubleword locations) can be chained. Chains of CCWs located in noncontiguous storage areas can be coupled for chaining purposes by using a Transfer in Channel command. All CCWs in a chain refer to the I/O device specified in the original instruction. The type of chaining (data or command) is specified by chain-data and chain-command flag bits in the CCW.

Data Chaining

When the data transfer specified by the current CCW is finished, data chaining causes the operation to continue by fetching a new CCW and using the storage area defined by the new CCW. Execution of the operation at the I/O device is not affected.

Command Chaining

Each time a new CCW is fetched during command chaining, a new I/O operation is specified. The new operation is initiated when the device end signal for the current operation is received, unless suspension is specified in the new CCW. When command chaining takes place, the completion of the current operation does not cause an I/O interruption.

I/O Interruptions

I/O interruptions report the completion of I/O operations to the CPs and also report error and time-out conditions.

Ending status information about the operation is available to the control program at the end of the I/O operation. When an I/O operation is completed, an I/O interruption request is sent to a central processor. When the request is honored, an I/O interruption occurs and places the central processor under control of the I/O new program status word (PSW). Until an I/O interruption condition is honored, it is called a pending I/O interruption.

Errors detected by the channel subsystem are reported to the CPs as I/O interruptions or machine-check interruptions. I/O interruptions report the following hardware-related conditions:

- Interface control check (IFCC); for example, interface tag errors and time-outs
- Channel control check (CCC); for example, parity, decode, or control errors
- Channel data check (CDC); for example, a parity error detected in central storage.

Machine-check interruptions include the following:

- Unrecoverable errors (retry is unsuccessful)
- Persistent errors (retry can be attempted, but the error threshold is exceeded)
- Serious channel element errors that require immediate reporting or cannot be reported as an IFCC or CCC with an I/O interruption.

For a listing of the machine-check interruption codes, see "Machine-Check Handling" on page 6-2.

Resets

An I/O system reset is issued to all channels, and the channels signal a system reset to all attached I/O devices. An I/O system reset:

- Stops all subchannel operations
- Resets interruptions and status in all subchannels.

An I/O system reset occurs as part of:

- Channel subsystem power-on reset

- Initial program load
- System reset.

A channel issues a selective reset to a specific I/O device in response to an IFCC, CCC, or as part of execution of the clear subchannel instruction. The status of the specific device is reset.

Channel Implementation

Each I/O interface may attach as many as eight control units and can address as many as 256 I/O devices. As many as 16 control units can be attached to an I/O interface using a switching unit (such as an IBM 3814 Switching Management System).

Multiplexing refers to the capability a channel and device have to disconnect and reconnect during an operation. Block multiplexing takes place between blocks of data, and byte multiplexing takes place between either bytes of data or groups of bytes of data.

Channel time-out functions and **device priority** described in the following sections apply only to ESCON channels attached to a 9034 ES Connection Converter and parallel channels.

Channel Time-Out Functions

Note: The optional time-out function described below applies only to ESCON channels that attach to a 9034 ES Connection Converter and parallel channels.

Each channel path has I/O interface time-out functions that time the control unit delays in completing the following I/O interface sequences:

- A 6-second time-out for all selection and status presentation sequences. A time-out occurs if the sequence is not complete within 6 seconds.
- A 30-second time-out for data transfer. A time-out occurs if a byte of data is not transferred within 30 seconds.

If a time-out occurs, the channel terminates the I/O request to the control unit and generates an IFCC interruption.

The time-out function detects malfunctions in control units and I/O devices that can cause the channel path to be unusable to other control units and I/O devices. The time-out function is specified as active or inactive for a device by IOCP when the IOCDS is created.

Device Priority on ESCON Channels Attached to a 9034 ES Connection Converter and Parallel Channels

Note: Device priority on an I/O interface applies only to ESCON channels attached to a 9034 ES Connection Converter and parallel channels.

Device priority on the I/O interface of a channel is in the order of attachment. If the devices are connected to the 'select out' line, the first device has the highest priority. If the devices are attached to the 'select in' line, the priority sequence is reversed. Devices attached to the 'select out' line have priority over devices attached to the 'select in' line. (See Figure 8-1.)

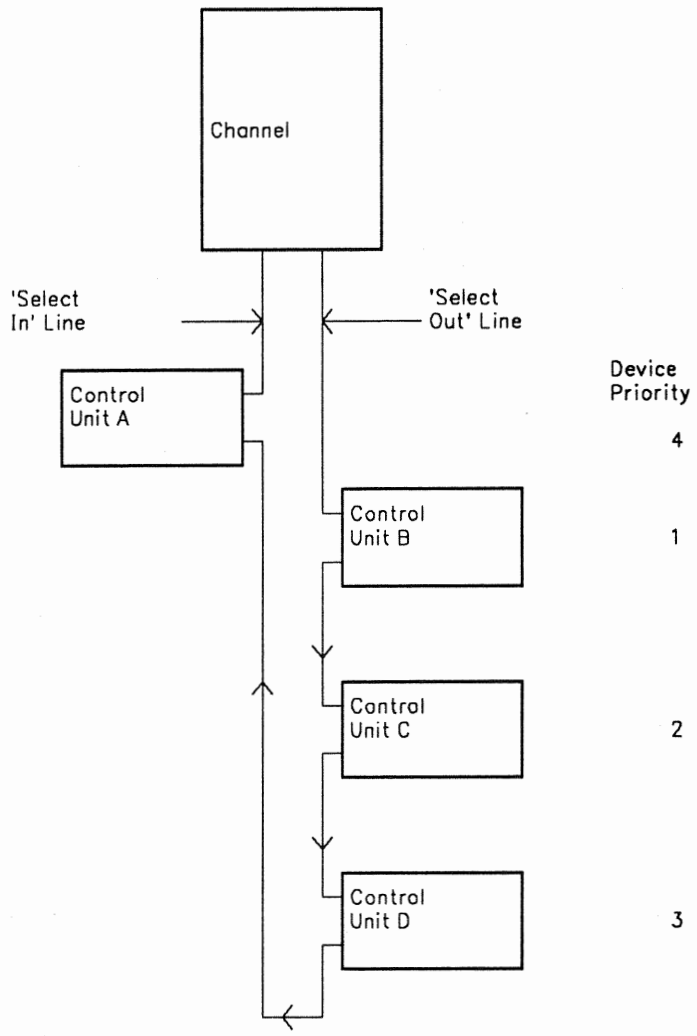


Figure 8-1. Device Priority on Parallel Channels

Dynamic Reconnection

In ESA/390 mode, the channel subsystem permits dynamic reconnection of I/O devices that have the dynamic-reconnection feature installed and that are set up to operate in a multipath mode, such as the IBM 3390 Direct Access Storage Model A14 or A22. Dynamic reconnection allows the device to reconnect and continue a chain of I/O operations using the first available channel path (one of as many as four possible channel paths defined in an IOCP parameter). The selected path is not necessarily the one used initially in the I/O operation.

Chapter 9. Channel Subsystem Performance Characteristics

Overview

This chapter describes the characteristics of ESCON channels and parallel channels that affect the performance of the channel subsystem.

Note: For readers who need to understand basic ESCON channel concepts, see *Introducing Enterprise Systems Connection*. For detailed information about synchronous and nonsynchronous I/O operation, see *Introduction to Nonsynchronous Direct Access Storage Subsystems*.

Maximizing channel subsystem performance is an important consideration in configuring I/O devices to an ES/9000 Processor Complex. Channel subsystem performance depends on the factors described in this chapter.

Summary of Channel Subsystem Performance Characteristics

Channel subsystem performance can be examined by observing two measurements:

- Response time (the amount of time taken to complete an I/O operation)
- Throughput (the number of I/O operations an I/O subsystem can complete in a given amount of time).

Channel subsystem response time and throughput can be broken up into four major components:

- Queuing and setup time
- Control unit and device time
- Data transfer time
- Completion time.

These major components of channel performance are affected by the following:

- Type of operation (nonsynchronous vs synchronous)
- Data transfer rates
- Distance
- Device characteristics
- Workload characteristics.

Description of Channel Performance Concepts and Characteristics

This section provides the description of the components of channel performance and the factors that affect channel performance characteristics:

- All ESCON and parallel channels
- ESCON channels (using link-level and device-level protocols)
- ESCON channels (attached to a 9034) and parallel channels
- Parallel channels only.

All ESCON and Parallel Channels

1. Queueing and Setup Time
   - The time taken for a channel path, control unit, and device to become available.
   - The time taken for a channel to send the I/O operation commands to the control unit.
2. Control Unit and Device Time
   - The time required by the control unit and device to prepare for the transfer of data for the I/O operation. For example, a non-cached DASD control unit may have to wait for the DASD's seek and latency times before being ready to accept or send data.
3. Data Transfer Time
   - The time it takes to transfer the data for the I/O operation.
4. Completion Time
   - The time it takes for the channel and control unit to post the status of and end the I/O operation.

Factors that affect the various components of performance include:

- Synchronous or nonsynchronous type of operation
- Data transfer rate
- Distance
- Attached device characteristics
- Channel subsystem workload characteristics.

Synchronous and Nonsynchronous I/O Operation

Note: For detailed information about concepts described in this section, see *Introduction to Nonsynchronous Direct Access Storage Subsystems*.

Synchronous Operation: Most DASD devices in a parallel environment transfer data synchronously. Synchronous operation requires that the channel, control unit, and device be active at the same time.

Note: All work involved in ending an operation and advancing to the next operation must be completed before the DASD head reaches the next record (commonly referred to as the inter-record gap). If this does not occur, a rotational positional sensing/sensor (RPS) miss or an overrun is generated and the operation must wait for one DASD revolution before continuing.

Nonsynchronous Operation: Nonsynchronous operation, which is used by the ESCON architecture, removes the requirements of synchronous operation. During nonsynchronous operation, the channel, control unit, and device do not have to be active at the same time to perform an I/O operation. This increases DASD storage potential (by reducing inter-record gap), allows the channel and control units to be separated by larger distances, permits the channel to perform other operations during the time it would have normally waited for the device (increasing the throughput of the system), eliminates command overruns, and may reduce response time (by reducing RPS misses.)

Note: Extended count key data (ECKD*) channel programs are required to realize the benefits of nonsynchronous I/O operations (count key data [CKD]

channel programs are supported, but without the benefit of nonsynchronous operation). CKD channel-program performance could be degraded relative to ECKD channel programs in a nonsynchronous environment.

Data Transfer Rate

One of the factors that affects channel performance is the data transfer rate. The I/O subsystem data rate is the data transfer rate between processor storage and the device during an I/O operation.

The I/O subsystem data rate is made up of three components:

- Channel data rate
- Control unit data rate
- Device data rate.

The channel data rate is the rate that the channel transfers data between the transmission link and processor storage during an I/O operation.

For ESCON channels, the channel data rate is 10 MB/s for block sizes less than or equal to 2048 bytes. However, it is a function of distance for block sizes larger than 2048 bytes. Table 9-1 on page 9-5 shows channel data rate as a function of distance for block sizes larger than 2048 bytes.

For parallel channels and ESCON channels attached to a 9034, the channel data rate is 4.5 MB/s

The control unit data rate is the rate that the control unit transfers data between the control unit and the transmission link during an I/O operation.

The device data rate is the rate of data transfer between the control unit and the device. This rate depends on the control unit and device you use.

The I/O subsystem data rate is the lowest of the channel data rate, the control unit data rate, and the device data rate. In cases where the data comes from the control unit or is stored on the control unit and not directly to the device (for example, a cache read), the I/O subsystem data rate is the lower of the two: channel data rate or the control unit data rate.

The I/O subsystem data rate affects only the data transfer portion of the response time for an I/O operation. Response time and throughput both improve (response time decreases and throughput increases).

Table 9-1. Channel Data Rate as a Function of Distance for Models 520 – 900		
Distance (km)	**Distance (miles)**	**Channel Data Rate (MB/s)**
0.122 (122 meters)	0.075 (133 yards)	17
3	1.86	17
6	3.72	17
9	5.59	17
12	7.46	14.2
15	9.32	11.9
20	12.43	9.4
30	18.64	6.3
43	26.72	4.7
60	37.28	3.4

I/O Device Characteristics

The characteristics of devices attached to a channel subsytem can have a substantial effect on performance. Device characteristics such as caches, buffers, and data transfer rates all affect response time and throughput.

Channel Subsystem Workload Characteristics

The performance of a specific I/O configuration varies based on the workload characteristics of that configuration. Two significant factors that determine workload characteristics and affect response time and throughput are channel program characteristics and cache-hit rates.

Channel Program Characteristics

Channel program characteristics affect channel subsystem performance. ESCON channel subsystems using link-level and device-level protocols perform nonsynchronous data transfers, and should use extended count key data (ECKD) channel programs.

Note: Count key data (CKD) channel programs run in an ESCON environment, but may increase response times and reduce throughput due to lost DASD rotations.

Channel programs containing indirect data address words (IDAWs), Transfer in Channel commands (TICs), and chained data commands, or that have poorly-aligned data boundaries cause longer storage-response and increase channel subsystem response times.

Note: Chained data commands increase response time due to an additional interlocked exchange between the channel and control unit. See "Distance" on page 9-6 for more information.

The amount of data to be transferred per an I/O operation affects throughput. As the amount of data transferred per I/O operation increases (the ratio of data transferred to overhead improves), throughput improves.

Cache-Hit Rates

For control units which implement caches, cache-hit rates affect the channel subsystem performance. As the cache-hit rate increases, response time and throughput improve. The cache-hit rate is the percentage of time data needed for a read operation is in the control unit's cache. For example, a cache-hit rate of 70% means that the required data is in the cache for 7 out of 10 read operations.

The cache-hit rate is significant because data is transferred out of the cache at the control unit's maximum data transfer rate, while data from the device is transferred at lower device speeds. This means that the higher the cache-hit rate, the better the response time and the better the throughput.

ESCON Channels

This section describes the performance characteristics of ESCON channels.

Distance

The distance between the channel and control unit affects the setup and completion times of an I/O operation; as the distance between the channel and the control unit increases, the response time increases and the throughput decreases. Channel and control unit utilization also increase as distance between the channel and control unit increases.

The speed of data transfer through fiber optic cable is subject to a propagation delay time. **Propagation delay time** is determined by two factors: the speed of light through the optical fiber (which is fixed), and the length of the fiber optic link. Propagation delay time increases as the distance between elements in a fiber optic environment increase.

Interlocked exchange affects response time. Interlocked exchange requires that the channel (or control unit) wait for a response from the control unit (or channel) before proceeding with the next step of an I/O operation. As distance increases, the interlocked-exchange response time increases because of longer propagation delay times.

Configuring ESCON Channels (Attached to a 9034) and Parallel Channels

This section describes channel performance concepts for ESCON channels (attached to a 9034) and parallel channels.

Performance-related factors that should be considered in configuring parallel and ESCON channels include:

- Elapsed time
- Critical time
- Deferred access.

Elapsed Time

The elapsed time to complete service for an I/O device connected to a channel includes the device tag time, the cable propagation time, the channel busy time to service the requested control sequence, and the wait time for channel resources.

Critical Time

The time that an I/O device can wait for channel service without a negative impact on the performance of the device is called *critical time*. Each I/O device has limits on the elapsed times of various sequences between the device and the channel. When these time limits are not satisfied, device performance may be reduced.

For devices operating on block multiplexer channels, the control sequences that have the most significant critical-time constraints are those related to chaining operations. For devices operating on byte multiplexer channels, the time for connecting and disconnecting of the device to the channel for each byte or burst of data sent is the most critical sequence.

In some cases, the time limit is related to synchronized motion (for example, the time between columns on a card moving through an IBM 2501 Card Reader, or the time between the end of a Search ID Equal and the beginning of a Read or Write at an IBM 3380 Direct Access Storage). In each case, a control sequence must be completed within a time limit that relates directly to the physical motion of the device to sustain maximum I/O performance.

The critical time of a device can be exceeded because of other traffic on the channel or other traffic in the channel subsystem. Central storage loading can also contribute to the elapsed time, but not significantly. If the elapsed time is greater than the critical time, some performance degradation occurs. The result of exceeding critical time is described under "Deferred Access" and "Device Class" on page 9-8.

Deferred Access

A **data deferred access** is caused by the inability of the channel to transmit or accept data at the rate requested or transmitted by an I/O device.

A data deferred access is much less likely to occur on buffered devices than on unbuffered devices because buffered devices can wait for channel service. Unbuffered devices (such as start-stop terminals) may have data deferred accesses when the time required for an error-recovery system logout exceeds the critical time.

Data-chaining operations involving the transfer of one or more blocks of data increase the probability of data deferred accesses with devices that do not respond to 'suppress out'. The probability of deferred accesses occurring during data chaining can be reduced by following the programming recommendations stated in "Data Chaining" on page 10-4.

A **chaining check** is an error detected in a channel when a channel accepts more data (in an input operation) than was specified by the count in the CCW. The check occurs when an I/O data rate is too high to be handled by the channel and storage.

A **command deferred access** is the inability of the channel to present the next command within the critical command-chaining time of a control unit.

Degradation (a loss in performance) can result from a deferred access. A deferred access that requires operator intervention can create significant degradation. In most cases, a deferred access that is handled automatically by retry does not significantly affect throughput.

Depending on the device and the type of deferred access, the operation may be halted when the need for a deferred access occurs, or it may continue transferring data until the end of the block is reached. A deferred access may cause a unit check to be presented to the channel. Any chaining is suppressed and an I/O interruption request is generated at the end of the operation. Certain control units, however, may initiate a command retry sequence without generating an I/O interruption request. See "I/O Interruptions" on page 8-5 for additional information.

Parallel Channels Only

This section describes the characteristics of devices that operate in byte multiplexer mode.

Device Class

Devices that can operate in byte multiplexer mode of operation are classified by what happens when a device is not serviced within the critical time for the requested control sequence for that device. Depending on how overall channel performance is impacted by the device critical time being exceeded, a device falls into one of three classes: 1, 2, or 3.

Device Class 1

When the critical time is exceeded, a deferred access occurs and the data is not transferred successfully. The consequent error indication causes an I/O interruption request, and program recovery action is required.

Device Class 2

When the critical time is exceeded, the device must be resynchronized. The additional delay results in performance degradation. The device performance is degraded by the combined delay of waiting for the channel and resynchronization.

Device Class 3

When the critical time is exceeded, the device waits for channel service and causes performance degradation (the delay of waiting for the channel service).

Block Multiplexer Mode of Operation

In block multiplexer mode of operation, a device stays connected to a channel continuously during the transfer of a full block of data.

Block multiplexer mode of operation allows a control unit to present channel end and to disconnect from a channel at the completion of a specified operation. Device end may be presented at a later point. During the interval between channel end and device end, another device attached to the same channel can be started or can complete an operation that is ready. However, if a second device does connect to the same channel during this interval, the first device may find the channel busy (because of the second device) when it tries to reconnect, and then the first device must wait for service.

ESCON Channels (Using Link-Level and Device-Level Protocols)

The ESCON Architecture provides two protocols for block multiplexer mode of operation on the I/O interface for the serial transmission of data: link-level and device-level protocols. Block multiplexer mode of operation using link-level and device-level protocols can sustain a maximum data rate of 10MB per second.

I/O operations for the serial transmission and reception of data require that link-level and device-level protocols be present in both the channel and the control unit.

ESCON Channels (Attached to a 9034) and Parallel Channels

The channel subsystem provides two modes for block multiplexer mode of operation on the I/O interface in a parallel environment: interlocked and data streaming.

Interlocked: Operation performance using the interlocked mode depends on overall tag timings (including channel subsystem service), cable length, and control unit service. Block multiplexer mode of operation using the interlocked protocol can sustain a maximum data of 1.5MB per second.

Data Streaming: The data-streaming protocol does not require interlocking of data transfer signals between the channel and the control unit; once data transfer is established over the interface, it continues at a rate governed by the control unit. Block multiplexer mode of operation using the data-streaming protocol can sustain a maximum data rate of 4.5MB per second.

Byte Multiplexer Mode of Operation (Parallel Channels Only)

Note: Only parallel channels can operate in byte multiplexer mode of operation.

Byte multiplexer mode of operation allows the execution of multiple I/O operations concurrently. Each addressed device is selected, one at a time, for transfer of a byte or a group of bytes to or from central storage. Bytes from multiple devices are interleaved on the channel and routed to or from the desired locations in central storage.

The load that a byte multiplexer channel can sustain is variable. It is governed by I/O device performance factors such as the data transfer rate, device buffers, number of bytes per data burst on the channel, channel program requirements, synchronized mechanical motion, and priority sequence position on the I/O interface. Byte multiplexer channel operations are concurrent with block multiplexer channel operations.

Byte Multiplexer Mode and Burst Mode

A byte multiplexer channel can be monopolized by one I/O device (burst mode) or shared by many I/O devices (byte multiplexer mode). The number of bytes transferred at a time in byte multiplexer mode can be one (single byte transfers) or more than one (multibyte transfers). Most control units that operate in byte multiplexer mode can also operate in burst mode. A manually set switch at the control unit determines whether the control unit operates in burst mode or byte multiplexer mode.

Some devices offer a choice of specifying how many bytes are transferred during a single data transfer sequence in byte multiplexer mode. For example, an IBM 3211 Printer can specify either burst mode or byte multiplexer mode with 1-byte or 6-byte transfers. Because most of the time spent in a data-transfer control sequence is for control, increasing the burst size (the number of bytes transferred per sequence) results in a relatively small increase in the total channel busy time for the sequence. Also, increasing the burst size reduces the number of data transfer sequences required (for example, by a factor of six for a 3211 Printer operating in byte multiplexer mode with 6-byte transfers). The net effect is a significant improvement in channel efficiency and a higher allowable data rate.

Burst mode, although most effective in the use of channel resources, can cause another device on the byte multiplexer channel to exceed its critical time. From the perspective of the control unit, burst mode occurs when the time contributed by the control unit in a transfer sequence is more than 32 microseconds. (See the *IBM System/360 and System/370 I/O Interface Channel to Control Unit OEMI*.) If the device configuration guidelines (see Chapter 10, "Channel Subsystem Configuration Guidelines" on page 10-1) are followed for byte multiplexer channels of an ES/3090 Processor Complex, deferred accesses are minimized and data transfer sequences exceeding 32 microseconds are acceptable when large burst sizes are specified.

Note: Most class-2 and class-3 devices that can operate in burst mode should be attached to block multiplexer channels for better performance.

Rules governing the placement of devices that can operate in byte multiplexer or burst mode on one or more byte multiplexer channels are discussed in Chapter 10, "Channel Subsystem Configuration Guidelines" on page 10-1.

Chapter 10. Channel Subsystem Configuration Guidelines

Overview

This chapter provides recommendations for readers who need to understand and plan for the installation and operation of an ESCON channel subsystem for an ES/9000 Processor Complex.

Information in this chapter that applies to a parallel environment is intended to assist in the physical placement of the control units connected to the I/O interface of a channel subsystem. The Input/Output Configuration Program establishes the physical and logical addressing relationships of the I/O devices in the ES/9000 Processor Complex configuration.

This chapter provides basic guidelines for I/O devices using caches and buffers to maximize data transfer rates in a channel subsystem.

ESCON Channel Subsystem Configurations

Note: Guidelines for planning and operating an ESCON channel subsystem are not provided in this section, but are available as described below. This section provides recommendations and publication references for readers who need to understand basic ESCON concepts or need to plan for the installation and operation of an ESCON channel subsystem.

The ESCON environment supports ES/9000 Models 330, 340, 500, 580, 620, and 720. In a channnel subsystem, all channels have equal priority.

ESCON combines ESCON Architecture, fiber optic technology, dynamic connectivity, and interconnectivity with other networks to provide new function and capabilities including enhanced connectivity, improved systems availability, better security, and better data center management.

ESCON LED multimode fiber optic technology provides a direct channel attachment range of up to 3 kilometers (1.864 miles); and control unit attachment range of up to 9 km (5.592 miles) from a channel through two optional ESCON Directors.

ESCON XDF single-mode fiber optic technology provides a direct channel attachment range of up to 60 kilometers (37.3 miles); and control unit attachment range of up 43 kilometers (26.7 miles) from a channel through two optional ESCON directors. These distances are significantly greater than the currently supported 400 feet. See "Fiber Optic Cabling, Transmission, and Reception" on page 1-6 for more information.

The ESCON environment is also designed to provide a platform for growth into a new generation of powerful and flexible products.

Recommendations and Guidelines for ESCON Channel Subsystem Configurations: The following recommendations are provided for readers who require additional information about ESCON channels that use link-level and device-level protocols or that attach to a 9034:

- To gain an understanding of basic ESCON concepts, see *Introducing Enterprise Systems Connection*.

This publication provides detailed information about the benefits and components of an ESCON environment, and includes a comprehensive list of the publications required for planning an ESCON channel subsystem.

- Detailed guidelines for interconnecting ESCON channels with existing control units and parallel interfaces are provided in *Enterprise Systems Connection: Planning for Migration*.

  Note: IBM 3490 and 3990 control units support both parallel and ESCON interfaces (the same control unit can be accessed from both environments) to provide the capability of having coexisting parallel and ESCON environments while migrating in stages toward a full ESCON environment.

- For guidelines that apply to the planning and operation of a specific channel subsystem, contact your IBM representative.

Guidelines for Parallel Channel Subsystem Configurations

This section applies to configurations for a parallel environment. It applies to both ESCON channels that attach to a 9034 and to parallel channels. In a channel subsystem, all channels have equal priority.

- Device sequence on block multiplexer channels
  - Device intermix
  - Data chaining.
- Byte Multiplexer channel analysis
  - Balancing device load across channels
  - Sequencing devices within a channel.

For positional placement of control units on a particular I/O interface, consider the service priority that is obtained from 'select out' or 'select in' tag propagation. (See "Device Priority on ESCON Channels Attached to a 9034 ES Connection Converter and Parallel Channels" on page 8-6 for more information.)

Device Sequence on Block Multiplexer Channels

To establish the sequence of devices on any channel, consider the following factors:

Device Class. Class-2 devices should have higher priority for service than class-3 devices.

Note: For information about device classes, see the appropriate publications for the devices under consideration for a parallel channel subsystem configuration.

Total System Priorities. Attach the devices (control units) that are most important to system performance first (in the highest priority position).

Channel Service Time. Within a system priority, attach the devices with the shortest channel service time first.

Device Intermix

Although different devices (such as an IBM 3380 Direct Access Storage and an IBM 3800 Printing Subsystem) can share channels, the decision to intermix devices depends on the load imposed on the channel by each device.

Usually, different types of devices should be attached to different channels because of their design and use.

Reasons for separate channel requirements include:

- Type of channel
- Paging and response time
- Random versus sequential records (such as disk versus tape)
- Chained records (such as tape or disk)
- Logging
- Different critical times
- Number of devices
- Channel utilization.

For example, to improve system performance, the following types of devices should be on separate block multiplexer channels:

- Direct-access storage devices (such as the IBM 3380 Direct Access Storage and 3390 Direct Access Storage)
- Tape devices (such as the IBM 3480 Magnetic Tape Subsystem and 3490 Magnetic Tape Subsystem).

Data Chaining

Data chaining can put a very heavy load on the channel. Factors affecting channel loading include:

- Data address alignment
- Low CCW byte counts
- High device-data rates
- Other channel activity within the channel subsystem
- Additional central storage accesses for CCWs during device data transfer.

Because of these factors, data deferred accesses and chaining checks can occur when data is chained during data transfer sequences. Two programming recommendations help minimize the probability of these two problems:

- If the device or control unit responds to the suppress-out tag and suppresses data transfers, make the minimum CCW byte count greater than the number of bytes or byte requests in transit on the I/O interface cable. This number varies; it depends on the cable length, the data transfer rate, and the protocol. With the interlocked protocol, no minimum byte count exists. With the data-streaming protocol, specifying a minimum byte count of 16 covers all combinations of local cable lengths and data transfer rates.

  Note: If a channel extender (using the IBM 3044 Fiber-Optic Channel Extender Link) is used, the minimum byte count is four times the cable

length (measured in thousands of feet) times the data rate (measured in MB per second).

- If the device or control unit does not suppress data transfer, specify byte counts to be no less than 54 times the device instantaneous data rate (a maximum data rate of 4.5MB per second) and put data addresses on doubleword or (preferably) quadword boundaries.

No minimum byte count restrictions exist for data chaining within gaps of a direct-access storage device record (that is, gaps between count, key, and data fields).

CCW Prefetching for ESCON Channels (Attached to a 9034)

Because ESCON channels allow control units to be placed further away from the channel than is allowed for parallel channels, the number of command overruns tend to increase with the longer response times caused by propagation delay. To eliminate this increase in command overruns, command chain prefetching has been implemented for ESCON channels using 9034s. This prefetching is done for all devices which have a device type of 33xx specified in the IOCP input deck.

Command-chain prefetching allows the next CCW in a channel program to be fetched before the data for the current CCW is moved (this only applies if the current CCW has the command chain flag set to one and the data chain flag set to zero). If the current CCW is a read, and the next CCW in the channel program is contained in the data read by the current CCW, prefetching cannot be completed (such self-modifying channel programs cannot take advantage of command chain prefetching).

Note: Any channel programs that are dynamically modified by the program during execution may behave differently on ESCON channels attached to a 9034 than native parallel channels due to a command chain prefetching.

Byte Multiplexer Channel Analysis

Many class-2 and class-3 devices can operate efficiently in burst mode on *block multiplexer* channels. Before attempting to configure any such devices on byte multiplexer channels, place as many of these devices as possible on block multiplexer channels. This reduces the contention of the devices remaining on byte multiplexer channels. Next, ensure that devices with a variable burst size capability are set for large burst size. Finally, balance the device load across the available byte multiplexer channels and sequence the devices within these channels (as described in "Balancing Device Load across Channels").

Balancing Device Load across Channels

To balance the device load across the channels, consider the following factors, in decreasing order of priority:

Burst Size. Try to configure I/O devices that are small burst devices (1, 2, 3, or 6 bytes per transfer) to one or more byte multiplexer channels, and all large burst devices (16 or 32 bytes per transfer) to other byte multiplexer channels. Class-1 devices should be distributed among the channels that attach small burst devices.

Critical Time. When possible, configure each byte multiplexer channel with both short and long critical time devices.

For example, if two I/O devices have short critical times, put each device on a separate byte multiplexer channel. If multiple devices (such as terminals) with different critical times attach to the same control unit, configure the control units according to the device with the shortest critical time.

Data Rate. Data rate balancing across multiple byte multiplexer channels should be done where no conflict exists with class-1 and critical-time considerations.

Availability. Standard guidelines for availability, which provide for alternate paths, should be followed.

Sequencing Devices Within a Channel

To sequence the devices (control units that have the most critical I/O devices) within a channel, consider the following factors.

Device Class. Attach class-1 devices first, class-2 devices next, and class-3 devices last. For information on class specifications, see "Device Class" on page 9-8.

Increasing Critical Time. Within a class, the device with the shortest critical time has the highest priority. For devices having the same critical time, attach the device with the smallest burst size first. A communications controller with several lines having short critical times should be ahead of a communications controller with one line having a short critical time. Devices operating in burst mode and connected to a byte multiplexer channel should be given lowest attachment priority.

General Device Considerations

In general, ensure that the feature information for each device attached (or to be attached) to the channel subsystem is carefully considered to determine the impact that the device can have on the configuration when attached.

For All ESCON and Parallel Channels

This section provides basic guidelines for using I/O devices with caches and buffers to maximize data transfer rates in a channel subsystem.

I/O Devices Using Caches: When the control unit reads or writes to a device, it matches the data transfer rate of the device. Therefore, the control unit will not use a faster transfer rate for the I/O operation.

Having a cache in the control unit, improves the rate that data transfers and the response time. A cache stores the most recently used data that was read or written to the attached device. This eliminates the need for the control unit to transfer information to or from the device during an I/O operation.

For example, if the data to be read is stored in the cache, the control unit can send the data at the higher transfer rate of the control unit instead of the device. In general, the larger the cache, the more likely the needed information is stored in the cache and therefore data transfer will take place at the control unit's maximum transfer rate.

I/O Devices Using Buffers: A buffer is similar to a cache, but does not reduce response time directly. A cache normally has a certain amount of information stored in it at any given time (even when there are no I/O operations taking place). This information, if needed, will not be read from the device during an I/O operation. A buffer only stores data during the data transfer portion of an I/O operation (data needed has to be read from the device).

A buffer allows information to be read from the device without the need for the control unit to be connected to a channel requesting that data. The control unit can disconnect from the requesting channel while the data is being read from the device (at device speed), then reconnect to the channel and send that data at the maximum data transfer rate of the control unit. Though this does not reduce the response time of the I/O operation, it allows the channel to be free for the other I/O operations while the data is being transferred from the device to the control unit, increasing throughput.

For ESCON Channels (Attached to a 9034) and Parallel Channels

For positional placement of control units on a particular I/O interface, consider the service priority that is obtained from 'select out' or 'select in' tag propagation. (See Figure 8-1 on page 8-7.)

Chapter 11. ES/9000 Models 330, 340, 500, 580, 620, and 720 Architectural Deviations

The following information describes architectural deviations from the *IBM Enterprise Systems Architecture/390 Principles of Operation*.

Concurrent Indication of PER Events with Operand-Access Exception

Storage alteration PER events may be indicated by the ES/9000 Models 330, 340, 500, 580, 620, and 720 for execution of the instructions Edit, Edit and Mark, and Translate, even though an operand-access exception is encountered that nullifies or suppresses instruction execution.

Protection Violation Instead of Delayed Access Exception

The ESA/390 Principles of Operation permit considerable extent of unpredictability when a valid and attached dynamic address translation (DAT) table entry is changed and the entry is used for translation before the translation lookaside buffer (TLB) is cleared of copies of that entry. The definition permits changes to all of those result fields that are not protected. Changes can occur, for example, to the condition code, to operands due to be changed in registers, and to those portions of the operands due to be changed in storage for which no access exception exists.

The ES/9000 Models 330, 340, 500, 580, 620, and 720 deviate from the architecture in that:

- Protection exceptions due to key-controlled protection, page protection, and segment protection that occur after the initial pretest are ignored.
- Storing for a store-type reference takes place.
- No interruption occurs.

Chapter 12. Summary of ES/9000 Models 330, 340, 500, 580, 620, and 720 Configurations

Item	Model 330	340	500	580	620	720
Central Processor:						
CP0	-	-	-	Std	-	Std
CP1	Std	Std	Std	Std	Std	Std
CP2	-	-	Std	Std	Std	Std
CP3	-	-	-	-	Std	Std
CP4	-	-	-	-	Std	Std
CP5	-	-	-	-	-	Std
System Control Element:						
SCE0	Std	Std	Std	Std	Std	Std
SCE1	-	-	-	-	Std	Std
Channel Subsystem:						
CSS0	Std	Std	Std	Std	Std	Std
CSS1	-	-	-	-	Std	Std
Vector Facility:						
VE0	-	-	-	Opt	-	Opt
VE1	Opt	Opt	Opt	Opt	Opt	Opt
VE2	-	-	Opt	Opt	Opt	Opt
VE3	-	-	-	-	Opt	Opt
VE4	-	-	-	-	Opt	Opt
VE5	-	-	-	-	-	Opt
ICRF:@						
First	Opt	Opt	Opt	Opt	Opt	Opt
Second	-	-	-	-	Opt	Opt
IBM Sysplex Timer Attachment: +						
First Timer	Opt	Opt	Opt	Opt	Opt	Opt
Second Timer	-	-	-	-	Opt	Opt
Central Storage:						
32MB	Std	Std	-	-	-	-
64MB	Opt	Opt	Std	Std	-	-
96MB	Opt	Opt	-	-	-	-
128MB	Opt	Opt	Opt	Opt	Std#	Std#
256MB	-	-	Opt	Opt	Opt#	Opt#
512MB	-	-	-	-	Opt#	Opt#

@ = ICRF is mutually exclusive with the vector facility on a central processor.
\+ = must be symmetrical for models 620 and 720.
\# = independent choice of 64MB, 128MB, or 256MB on each side, can be installed asymmetrically in increments of 64MB and 128MB.

Item	Model 330	340	500	580	620	720
Expanded Storage:						
64MB	Opt	Opt	Opt	Opt	-	-
128MB	Opt	Opt	Opt	Opt	Opt+	Opt+
192MB	Opt	Opt	Opt	Opt	Opt+	Opt+
256MB	Opt	Opt	Opt	Opt	Opt+	Opt+
512MB	Opt	Opt	Opt	Opt	Opt+	Opt+
1024MB	-	Opt	Opt	Opt	Opt+	Opt+
1536MB	-	-	Opt	Opt	Opt+	Opt+
2048MB	-	-	Opt	Opt	Opt+	Opt+
PR/SM:	Std	Std	Std	Std	Std	Std
Maximum Number of Channels (ESCON and Parallel):						
Parallel	32	32	64	64	128	128
ESCON and ESCON XDF	32	32	32	32	64	64
Total	64	64	64	64	128	128
Parallel Channels:						
16	Std	Std	-	-	-	-
32	Opt	Opt	Std	Std	-	-
48	-	-	Opt	Opt	-	-
64	-	-	Opt	Opt	Std@	Std@
ESCON XDF Channels:						
0	Std	Std	Std	Std	Std#	Std#
8	Opt	Opt	Opt	Opt	Opt#	Opt#
16	Opt	Opt	Opt	Opt	Opt#	Opt#
32	Opt	Opt	Opt	Opt	Opt#	Opt#
ESCON Channels:						
0	Std	Std	Std	Std	Std#	Std#
8	Opt	Opt	Opt	Opt	Opt#	Opt#
16	Opt	Opt	Opt	Opt	Opt#	Opt#
32	Opt	Opt	Opt	Opt	Opt#	Opt#
Processor Controller:						
9022 Model 1A	Req	Req	Req	Req	-	-
9022 Model 1A with specify code 5050	-	-	-	-	Req	Req

= independent choice of 0, 8, 16, or 32 on each side.
@ = 32, 48, or 64 on each side, independently.
+ = independent choice of 64MB, 128MB, 192MB, 256MB, 512MB, 1024MB, 1536MB, or 2048MB on each side, can be installed asymmetrically with a minimum of 64MB on each side.

Item	Model 330	340	500	580	620	720
Displays:						
(IBM 3206 Display Station 100, or equivalent)						
First Display	Req	Req	Req	Req	Req	Req
Second Display	Req	Req	Req	Req	Req	Req
Third Display	Opt	Opt	Opt	Opt	Req	Req
Fourth Display	Opt	Opt	Opt	Opt	Opt	Opt
Fifth Display	Opt	Opt	Opt	Opt	Opt	Opt
Sixth Display	-	-	-	-	Opt	Opt
Printers:						
(IBM 3287 Printer Model 1 or 2, or IBM 4224 Printer Model 201 or 202, or equivalent)						
First Printer	Opt	Opt	Opt	Opt	Opt	Opt
Second Printer	-	-	-	-	Opt	Opt
Modems:						
(5853 Model 1, or equivalent)						
First Modem	Req	Req	Req	Req	Req	Req
Second Modem	-	-	-	-	Req	Req
Power and Coolant Distribution Units:						
(IBM 9027 PCDU Model 1)						
First 9027	Req	Req	Req	Req	Req	Req
Second 9027	-	-	-	-	Req	Req
I/O Power Sequence Unit						
(IBM 9023 Model 1)						
First 9023	Opt	Opt	Opt	Opt	Opt	Opt
Second 9023	-	-	-	-	Opt	Opt

Legend:

CP Central processor
CSS Channel subsystem
Opt Optional
PCDU Power and coolant distribution unit
Req Required
SCE System control element
Std Standard
VE Vector
\- Not available

Glossary of Terms and Abbreviations

This glossary includes terms and definitions from:

- The *Dictionary of Computing*, SC20-1699.
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The following cross-references are used in this glossary:

Contrast with. This refers to a term that has an opposed or substantively different meaning.

See. This refers the reader to multiple-word terms in which this term appears.

See also. This refers the reader to terms that have a related, but not synonymous, meaning.

Synonym for. This indicates that the term has the same meaning as a preferred term, which is defined in the glossary.

A

abend. Abnormal end of task.

abnormal end of task (abend). Ending a task before its completion because of an error condition that cannot be resolved by recovery facilities while the task is being executed.

absolute address. (1) A direct address that identifies a location without reference to a base address. An absolute address may itself be a base address. (T) (2) In System/370 and ESA/390 modes, an address that exists after translation and prefixing, but before configuration occurs. See also *logical address*, *physical address*, *real address*, and *virtual address*.

ac. Alternating current.

AC. Action code.

ACC. Adapter common card.

access method. (1) A technique to obtain the use of data, storage, or the use of an input/output channel to transfer data; for example, random access method, sequential access method. (T) (2) A technique for moving data between main storage and input/output devices.

ACE. Auto-call equipment.

ACK. Positive acknowledgment.

acknowledgment. (1) The transmission, by a receiver, of acknowledge characters as an affirmative response to a sender. (T) (2) An indication that an item sent was received.

ACL. Array control logic.

action queue. A collection of pending maintenance actions.

activate logical partition. An operator-initiated procedure that performs a system reset to a logical partition and assigns the previously defined hardware to that partition. It causes an automatic IPL of the system control program to occur in the partition unless the operator performs the IPL manually. Contrast with *deactivate logical partition*.

active configuration. In an ESCON environment, the ESCON Director configuration determined by the status of the current set of connectivity attributes. Contrast with *saved configuration*.

active state indicator. An indicator, viewed from the fixed-format frames, that is used with error indicators (triggers) for isolating failures to a field-replaceable unit (FRU).

active subchannel. A subchannel that is locked and either busy or has a pending interrupt, and is indicated by subchannel status word (SCSW) bit 24 equals 1. The control information resides in the channel subsystem because it is necessary for the current operation. Contrast with *inactive subchannel*. See also *busy subchannel*.

Note: An active subchannel can also reside in the local working storage of an IOP or channel.

ACVP. Alternating current voltage present.

A/D. Alter/display.

adapter. (1) Hardware that provides some transitional functions between two or more devices. (2) A mechanism for attaching parts, for example, parts having different diameters. (3) In an ESCON environment, link hardware used to join different optical fiber connector types.

address. (1) A value that identifies a register, a particular part of storage, a data source, or a data sink. The value is represented by one or more characters. (T) (2) To refer to a device or an item of data by its address. (I) (A) (3) The location in the storage of a computer where data is stored. (4) In data communication, the unique code assigned to each device or workstation connected to a network. (5) The identifier of a location, source, or destination.

address generation. The method whereby the I-element address adder provides the address of the next instruction.

address translation. (1) The process of changing the address of an item of data or the address of an instruction to the address in main storage at which it is to be loaded or relocated. (2) In virtual storage systems, the process of changing the address of an item of data or an instruction from its virtual storage address to its real storage address. See also *dynamic address translation*.

AFIM. Automatic fault isolation manager.

AIX. Advanced Interactive Executive.

ALD. Automated logic diagram.

alert. An error message sent to the system services control point (SSCP) at the host system.

ALET. Address list entry table.

ALET/ALD. Address list entry table/access list designation.

allocate. To assign a resource, such as a disk or a diskette file, to perform a task. Contrast with *deallocate*.

alphanumeric field. A field that can contain any alphabetic, numeric, or special character.

alternate cursor. (1) In computer graphics, a cursor other than the one displayed on the display screen at power-on time. (2) An image reversal of each dot in the character cell at the cursor position.

ALU. Arithmetic and logic unit.

American National Standard Code for Information Interchange (ASCII). The standard code, using a coded character set consisting of 7-bit coded characters (8 bits including parity), used for information interchange among data processing systems, data communication systems, and associated equipment. The ASCII set consists of control characters and graphics characters. (A)

Note: IBM has defined an extension to ASCII code (characters 128 – 255).

analog event. A condition that exists when abnormal voltage or current is detected.

analog event register. A register that contains information relating to an analog event, including the type of event and where it was detected.

analysis routine. A routine that analyzes error records, provided by an error handler, to isolate failures to one or more field-replaceable units (FRUs).

ANSI. American National Standards Institute.

antireflection coating. A thin, dielectric or metallic film (or several such films) applied to an optical surface to reduce the reflectance and thereby increase the transmittance. (E)

APAR. Authorized program analysis report.

API. Application program interface.

application. (1) The use to which an information processing system is put, for example, a payroll application, an airline reservation application, a network application. (2) A collection of software components used to perform specific types of work on a computer.

application program. (1) A program that is specific to the solution of an application problem. (T) (2) A program written for or by a user that applies to the user's work, such as a program that does inventory control or payroll. (3) A program used to connect and communicate with stations in a network, enabling users to perform application-oriented activities.

application program interface (API). The formally defined programming language interface that is between an IBM system control program or licensed program and the user of the program.

APR. Alternate path retry.

AQ. Action queue.

AQE. Action queue entry.

AQEID. Action queue entry identifier.

AR. (1) Analysis routine. (2) Access register.

arithmetic and logic unit (ALU). A part of a computer that performs arithmetic operations, logic operations, and related operations. (I) (A)

ART. Analysis routine table.

ASCII. American National Standard Code for Information Interchange.

ASI. Active state indicator.

ASID. Address space identifier.

ASN. Address space number.

ASTE. ASN-second-table entry.

asynchronous. (1) Pertaining to two or more processes that do not depend upon the occurrence of specific events such as common timing signals. (T) (2) Without regular time relationship; unexpected or unpredictable with respect to the execution of program instructions. Contrast with *synchronous*.

attention identifier (AID). A character in a data stream indicating that the user has pressed a key, such as the Enter key, that requests an action by the system.

attenuation. (1) A decrease in magnitude of current, voltage, or power of a signal in transmission between points. (2) In fiber optics, a decrease in magnitude of average optical power.

Note: In an optical fiber, attenuation results from absorption, scattering, and other radiation. Attenuation is usually expressed in decibels (dB). However, attenuation is often used as a synonym for *attenuation coefficient*.

attenuation coefficient. In fiber optics, the rate of decrease in magnitude of average optical power with respect to distance along the fiber, usually expressed in decibels per kilometer (dB/km).

authorized program analysis report (APAR). A request for correction of a problem caused by a defect in a current, unaltered release of a program.

automated logic diagram (ALD). A computer-generated diagram that represents functioning circuitry in terms of logic blocks, interconnecting conductor networks, and input/output terminals.

automatic fault isolation manager. Licensed Internal Code that controls the selection and running of analysis routines used to isolate failing field-replaceable units (FRUs).

auto-vectoring. In VS FORTRAN Version 2, an automatic operation that compiles the source code to contain object code having vector instructions.

auxiliary storage. All addressable storage, other than main storage, that can be accessed by means of an input/output channel; for example, storage on magnetic tape or direct access devices. Contrast with *main storage*.

AWG. American wire gauge.

axial ray. In fiber optics, a light ray that travels along the optical axis. (E)

B

backup copy. A copy, usually of information or data, that is kept if the original is changed or destroyed.

backup diskette. A diskette that contains information copied from another diskette. It is used if the original information is unintentionally changed or destroyed.

balun. A transformer used to connect balanced cables, such as twisted-pair cables, to unbalanced cables, such as coaxial cables, by matching the electrical characteristics of the cables.

bandwidth. The difference, expressed in hertz, between the highest and the lowest frequencies of a range of frequencies.

basic mode. A central processor mode that does not use logical partitioning. Contrast with *logically partitioned (LPAR) mode*.

basic telecommunications access method (BTAM). An access method that permits read/write communication with remote devices.

basic transmission unit (BTU). In SNA, the unit of data and control information passed between path control components. A BTU can consist of one or more path information units (PIUs).

batch. (1) An accumulation of data to be processed. (2) A group of records or data processing jobs brought together for processing or transmission. (3) Pertaining to activity involving little or no user action. Contrast with *interactive*.

BCD. Binary coded decimal.

BCE. Buffer control element.

bend loss. See *macrobend loss* and *microbend loss*.

benzotriazole. A white crystalline compound used as a rust inhibitor.

BER. Bit error rate.

BIC. Buffer interface control.

BIDI. Bidirectional bus.

bidirectional bus (BIDI). A bus on which data can be sent in either direction.

BIF. Bidirectional interface.

bifurcation. In a duplex fiber optic cable, the process that separates the two fiber cores, allowing the attachment of an optical fiber connector to each core.

bill of material. A list of parts.

bin. One of 256 address locations in a buffer control element cache, a buffer control element directory, or a system control element directory.

binary-coded decimal notation (BCD). A binary-coded notation in which each of the decimal digits is represented by a binary numeral, for example, in binary-coded decimal notation that uses the weights 8, 4, 2, 1, the number "twenty-three" is represented by 0010 0011 (compare its representation 10111 in the pure binary numeration system). (I) (A)

binary synchronous communication (BSC). A form of telecommunication line control that uses a standard set of transmission control characters and control character sequences, for binary synchronous transmission of binary-coded data between stations. Contrast with *Synchronous Data Link Control (SDLC).*

bips. Billion (thousand million) instructions per second.

bit. Either of the digits 0 or 1 when used in the binary numeration system. (T) See also *byte.*

bit error rate (BER). In fiber optics, a comparison of the number of bits received incorrectly to the total number of bits transmitted. The BER relates directly to receiver sensitivity, transmitter power output, pulse dispersion, and total link attenuation.

bit rate. The speed at which bits are transmitted, usually expressed in bits per second.

bits per second (bps). In serial transmission, a unit of measure that indicates the speed at which a device or channel transmits a character.

block. A string of data elements recorded or transmitted as a unit. The element may be characters, words, or physical records. (T)

block multiplexer channel. A multiplexer channel that interleaves blocks of data. Contrast with *selector channel.* See also *byte multiplexer channel.*

block transfer. The process of transferring one or more blocks of data. (T)

B/M. Bill of material.

BOC. Battery-operated clock.

bpi. Bits per inch.

Bpi. Bytes per inch.

bps. Bits per second.

Bps. Bytes per second.

bridge. (1) An attaching device that connects two LAN segments to allow the transfer of information from one LAN segment to the other. A bridge can connect the LAN segments directly by network adapters and software in a single device, or can connect network adapters in two separate devices through software and use of a telecommunication link between the two adapters. (2) A functional unit that connects two local area networks that use the same logical link control protocol but may use different medium access control protocols. (T) Contrast with *gateway* and *router.*

Note: A bridge connects networks or systems of the same or similar architectures, whereas a gateway connects networks or systems of different architectures.

broadband LAN. A local area network in which data are encoded, multiplexed, and transmitted with modulation of carriers.

Note: A broadband LAN consists of more than one channel. (T)

broadcast. (1) Transmission of the same data to all destinations. (T) (2) Simultaneous transmission of data to more than one destination.

broadcast topology. A network topology in which all attached devices can receive a signal transmitted by any other device attached to the network.

BSC. Binary synchronous communication.

BTA. Benzotriazole.

BTAM. Basic telecommunications access method.

Btu. British thermal unit.

BTU. Basic transmission unit.

buffer. (1) A routine or storage used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transferring data from one device to another. (A) (2) To allocate and schedule the use of buffers. (A) (3) A portion of storage used to hold input or output data temporarily. See *fiber buffer.*

burst. In data communication, a sequence of signals counted as one unit in accordance with some specific criterion or measure. (A)

bus. (1) A facility for transferring data between several devices located between two end points, only one device being able to transmit at a given moment. (T) (2) A network configuration in which nodes are interconnected through a bidirectional transmission medium. (3) One or more conductors used for transmitting signals or power. (A)

bus-in data. Two digits of information transmitted from a control unit to a parallel channel. The information is data, an address, or status.

bus-out data. Two digits of information transmitted from a parallel channel to a control unit. The information is data, an address, or status.

busy subchannel. A subchannel that is either active and locked, inactive with an I/O operation pending or in process, or between commands in a multiplex operation. See also *active subchannel* and *inactive subchannel*.

byte. (1) A string that consists of a number of bits, treated as a unit, and representing a character. (T) (2) A binary character operated upon as a unit and usually shorter than a computer word. (A) (3) A string that consists of a particular number of bits, usually eight, that is treated as a unit, and that represents a character. (4) A group of eight adjacent binary digits that represent one extended binary-coded decimal interchange code (EBCDIC) character.

byte multiplexer channel. A multiplexer channel that interleaves bytes of data. Contrast with *selector channel*. See also *block multiplexer channel*.

C

C. Celsius.

CAC. Common adapter code.

cache. (1) A special purpose buffer storage, smaller and faster than main storage, used to hold a copy of the instructions and data obtained from main storage and likely to be needed next by the processor. (T) (2) A buffer storage that contains frequently accessed instructions and data; it is used to reduce access time.

CAI. Channel available interruption.

calculated link loss. In an ESCON environment, the total optical attenuation (loss) calculated for a specific link, the value of which cannot be more than the maximum loss allowed for that link. See also *maximum allowable link loss*.

card-on-board (COB) logic. The type of technology that uses pluggable, air-cooled cards.

carrier. An electric or electromagnetic wave or pulse train that may be varied by a signal bearing information to be transmitted over a communication system. (T)

CAW. Channel address word.

CB. Circuit breaker.

CC. Condition code.

CCA. (1) Channel communication area. (2) Common communication adapter.

CCC. Channel control check.

CCH. Channel-check handler.

CCITT. Comité Consultatif International Télégraphique et Téléphonique. The International Telegraph and Telephone Consultative Committee.

CCPF. Customer common profile facility.

CCS. Clock control section.

CCW. Channel command word.

CDA. Chain data address.

CDC. Channel data check.

CDF. Coolant distribution frame.

CE. (1) Correctable error. (2) Channel end.

central analog-to-digital converter. See *power/thermal analog-to-digital converter*.

central processor. A processor that contains the sequencing and processing facilities for instruction execution, interruption action, timing functions, initial program loading, and other machine-related functions.

central storage. Storage that is an integral part of the processor and includes both main storage and the hardware system area.

CERF. Customer engineering reporting facility.

cfm. Cubic feet per minute.

chained ESCD configuration. An ESCON Director (ESCD) configuration that requires a dedicated connection in one ESCD to complete the information path.

channel. The system element that controls one channel path, whose mode of operation depends on the type of hardware to which it is attached.

channel address. In System/370 mode, the 8 leftmost bits of an input/output address that identify the channel. See also *device address* and *input/output address*.

channel address word (CAW). An area in storage that specifies the location in main storage at which a channel program begins.

channel-attached. (1) Pertaining to attachment of devices directly by data channels (I/O channels) to a computer. (2) Pertaining to devices attached to a controlling unit by cables rather than by telecommunication lines. Contrast with *link-attached*.

channel command word (CCW). A doubleword at the location in main storage specified by the channel address word. One or more CCWs make up the channel program that directs data channel operations.

channel communication area (CCA). An area used to transmit control information between the channels and the IOP.

channel control check. A category of I/O errors affecting channel controls and sensed by the channel to which a device is attached. See also *channel data check*.

channel data check. A category of I/O errors, indicating a machine error in transferring data to or from storage and sensed by the channel to which a device is attached. See also *channel control check*.

channel Licensed Internal Code. That part of the channel subsystem Licensed Internal Code used to start, maintain, and end all operations on the I/O interface. See also *IOP Licensed Internal Code*.

channel path (CHP). A single interface between a central processor and one or more control units along which signals and data can be sent to perform I/O requests.

channel path configuration. In an ESCON environment, the connection between a channel and a control unit or between a channel, an ESCON Director, and one or more control units. See also *link, point-to-point channel path configuration,* and *switched point-to-point channel path configuration*.

channel path identifier (CHPID). In a channel subsystem, a value assigned to each installed channel path of the system that uniquely identifies that path to the system.

channel set. In System/370 mode, a collection of channels that can be addressed concurrently by a central processor. See also *channel subsystem*.

channel status word (CSW). An area in storage that provides information about the termination of input/output operations.

channel subsystem (CSS). A collection of subchannels that directs the flow of information between I/O devices and main storage, relieves the processor of communication tasks, and performs path management functions.

channel subsystem (CSS) Licensed Internal Code. Code that consists of the IOP Licensed Internal Code and the channel Licensed Internal Code.

check stop. The status when an error makes it undesirable or not possible to continue the operation in progress.

CHIM. Channel interface monitor.

CHN. Channel.

CHP. Channel path.

CHPID. Channel path identifier.

CICS. Customer Information Control System.

circuit breaker (CB). An electrical-overload and short-circuit protector that can be reset manually.

CKD. Count-key data.

cladding. In an optical cable, the region of low refractive index surrounding the core. See also *core* and *optical fiber*.

cm. Centimeter.

CM. Channel monitor.

CMC. Communications management configuration.

CME. Channel monitor expanded.

CMF. Central message facility.

CMS. Conversational monitor system.

CNC. Mnemonic for an ESCON channel attached to an ESCON-capable device.

CNM. Communication network management.

coaxial cable. A cable consisting of one conductor, usually a small copper tube or wire, within and insulated from another conductor of larger diameter, usually copper tubing or copper braid.

COB. Card on board.

collision. (1) An unwanted condition that results from concurrent transmissions on a channel. (T) For example, when a frame from a transmitting adapter encounters any other signal in its path (frame, noise, or another type of signal), the adapter stops transmitting and a collision occurs.

column. A vertical arrangement of data. Contrast with *row*.

command. (1) A character string from a source external to a system that represents a request for system action. (2) A request from a terminal for performance of an operation or execution of a program. (3) A value sent on an I/O interface from a channel to a control unit that specifies the operation to be performed.

command area. The area on a screen that contains the command entry field.

command chaining. The fetching of a new channel command word (CCW) immediately following the completion of the previous CCW.

command entry field. An entry field in which a user types commands.

command prompt. A displayed symbol that indicates where a user enters commands.

command retry. A channel and control unit procedure that causes a command to be retried without requiring an I/O interrupt.

communication adapter. A circuit card with associated software that enables a processor, controller, or other device to be connected to a network.

communication controller. (1) A device that directs the transmission of data over the data links of a network; its operation can be controlled by a program executed in a processor to which the controller is connected or it may be controlled by a program executed within the device. (T) (2) A type of communication control unit whose operations are controlled by one or more programs stored and executed in the unit. It manages the details of line control and the routing of data through a network.

communication controller node. A subarea node that does not contain a system services control point (SSCP).

communication control unit. A communication device that controls transmission of data over lines in a network.

communication network management (CNM). The process of designing, installing, operating, and managing distribution of information and control among users of communication systems.

comparator. (1) A device that compares two items of data and indicates the result of the comparison. (T) (2) A device for determining the dissimilarity of two items, such as two pulse patterns or words. (A)

completion code. The return code indicating that an operation has ended.

component. (1) Hardware or software that is part of a functional unit. (2) A functional part of an operating system; for example, the scheduler or supervisor.

compute-intensive. Pertaining to system operation characterized by high central processor utilization.

computer word. A word suitable for processing by a given computer, usually treated as a unit. (T)

computing system RPQ. A customer request for a price quotation on changes or additions to the functional capabilities of a computing system, hardware product, or device. The RPQ can be used with programming RPQs to solve unique data processing problems. See also *programming RPQ (PRPQ)*.

concentrator. (1) In data transmission, a functional unit that permits a common transmission medium to serve more data sources than there are channels currently available within the transmission medium. (T) (2) Any device that combines incoming messages into a single message (concentration) or extracts individual messages from the data sent in a single transmission sequence (deconcentration).

concurrent maintenance. Hardware maintenance actions performed by a service representative while normal operations continue without interruption. See also *nondisruptive installation* and *nondisruptive removal*.

configuration. (1) The arrangement of a computer system or network as defined by the nature, number, and the chief characteristics of its functional units. More specifically, the term configuration may refer to a hardware configuration or a software configuration. (I) (A) (2) In an ESCON Director, the physical connection capability determined by a set of attributes. The attribute values specify the connectivity control status and identifiers associated with the ESCD and its ports. See also *active configuration, configuration matrix, connectivity attribute*, and *saved configuration*.

configuration matrix. In an ESCON environment, an array of connectivity attributes that appear as rows and columns on a display device and can be used to determine or change active and saved configurations.

connectivity attribute. In an ESCON Director, the characteristic that determines a particular element of a port's status.

connectivity capability. (1) The capability that allows attachment of a device to a system without requiring physical reconfiguration of the device or its interconnections. (2) In an ESCON Director, the capability that allows logical manipulation of link connections to provide physical device attachment. See also *configuration matrix, connectivity control*, and *dynamic connection*.

connectivity control. In an ESCON Director, the method used to change a port's connectivity attributes, thereby determining the communication capability of the link attached to that port.

connector. (1) A means of establishing electrical flow. (A) See *optical fiber connector*.

connector-induced optical fiber loss. In an optical cable, part of the insertion loss, expressed in decibels (dB), caused by termination or handling within the connector, which results in impurities or structural changes to the optical fiber.

connector insertion loss. See *insertion loss*.

consensus processing. In ESCON Manager, the function that informs other hosts of connectivity changes, thereby allowing general agreement for changes to affected resources.

console. A logical device used for communication between the user and the system. (A) See *display station, monitor console, operator console, program mode console, programming support console, service console,* and *system console*.

control block. A storage area used by a computer program to hold control information. (I)

control character. A character whose occurrence in a particular context specifies a control function. (T)

control function. Synonym for *control operation*.

controller. A unit that controls input/output operations for one or more devices.

control operation. An action that affects the recording, processing, transmission, or interpretation of data; for example, starting or stopping a process, carriage return, font change, rewind, and end of transmission. (I) (A)

control panel assembly. The field-replaceable unit (FRU) that includes both the System Power panel and the Service panel.

control program. A computer program designed to schedule and to supervise the execution of programs of a computer system. (I) (A)

control register (CR). A register used for operating system control of relocation, priority interrupts, program event recording, error recovery, and masking operations.

control unit. A hardware unit that controls the reading, writing, or displaying of data at one or more input/output units.

control-unit end. In I/O operations, a signal from a control unit to the channel indicating that the control unit is no longer needed for the operation.

control unit header (CUH). See *logical control unit (LCU)*.

conversational monitor system (CMS). A virtual machine operating system that provides general interactive time sharing, problem solving, and program development capabilities, and operates only under the VM control program.

conversion. (1) In programming languages, the transformation between values that represent the same data item but belong to different data types. Information can be lost through conversion because accuracy of data representation varies among different data types. (I) (2) The process of changing from one method of data processing to another or from one data processing system to another. (3) The process of changing from one form of representation to another; for example, to change from decimal representation to binary representation.

core. (1) In an optical cable, the central region of an optical fiber through which light is transmitted. (E) (2) In an optical cable, the central region of an optical fiber that has an index of refraction greater than the surrounding cladding material. (E) See also *cladding* and *optical fiber*.

correctable error. An error that can be corrected by the error checking and correction hardware.

corrective maintenance. Maintenance performed specifically to overcome existing faults. (T) Contrast with *preventive maintenance*.

COS. Customized Operational Services.

COTC. Clip-on thermal conduction module cover.

count-key data (CKD). A DASD data recording format that uses self-defining record formats in which each record is represented by specific areas: a count area identifies the record and specifies its format, a data area contains the user data for the record, and an optional key area can be used to identify the data area contents. CKD is also used to refer to a set of channel commands that are accepted by a device that uses the CKD recording format. See also *extended count-key data*.

coupling loss. In fiber optics, the power loss suffered when coupling light from one optical device to another. (E) See also *gap loss*.

CP. Central processor.

CPI. Controller power initializer.

CPLSS. Central processor logic support station.

CPU. Central processing unit.

CR. Control register.

CRC. Cyclic redundancy check.

CRH. Channel request handler.

critical resource. A resource required for system operation. See also *system resource*.

CRW. Channel report word.

CS. (1) Central storage. (2) Channel set. (3) Control storage.

CSE. Control storage element.

CSS. Channel subsystem.

CSW. Channel status word.

CSX. Channel subsystem exerciser.

CTC. (1) Channel-to-channel. (2) Mnemonic for an ESCON channel attached to another ESCON channel.

CU. Control unit.

CUA. Control unit address.

CUADD. Control unit logical address.

CUCW. Control unit control word.

CUH. Control unit header.

cursor. (1) A movable, visible mark used to indicate the position at which the next operation will occur on a display screen. (A) (2) A visual cue that shows the user where keyboard input will appear on the screen.

curvature loss. Synonym for *macrobend loss*.

Customer Information Control System (CICS). An IBM licensed program that enables transactions entered at remote terminals to be processed concurrently by user-written application programs. It includes facilities for building, using, and maintaining data bases.

Customized Operational Services (COS). Part of the IBM Site Management Services Portfolio that provides contractual installation planning services.

cutoff wavelength. In fiber optics, the wavelength at which a particular waveguide mode ceases to be a bound mode. (E)

Note: In a single-mode fiber, concern is with the cutoff wavelength of the second order mode.

CUU. Channel and unit address.

CVC. Mnemonic for an ESCON channel attached to a 9034.

CW. Cable wrap.

CWSTG. Common-area working storage.

D

DAA. Data access arrangement.

DACB. Device address control block.

dark current. In fiber optics, the external current that, under specified biasing conditions, flows in a photosensor detector when there is no incident radiation. (E)

DASD. Direct access storage device.

DASD subsystem. A storage control and its attached direct access storage devices.

DAT. Dynamic address translation.

data access arrangement (DAA). (1) Equipment that permits attachment of privately owned data terminal equipment and telecommunication equipment to a network. (2) Circuitry that allows communication equipment to be connected to the public switched telephone network.

data bus. (1) A bus used to communicate data internally and externally to and from a processing unit, storage, and peripheral devices. (A) See *bus*.

data circuit-terminating equipment (DCE). In a data station, the equipment that provides the signal conversion and coding between the data terminal equipment (DTE) and the line. (I)

Notes:

1. The DCE may be separate equipment or an integral part of the DTE or of the intermediate equipment.
2. A DCE may perform other functions that are usually performed at the network end of the line.

data control block (DCB). A control block used by access method routines in storing and retrieving data.

data flow. Data movement, staging, and control through a system, a functional element, or a component measured in standard units of time, clock cycles, or internal operations.

data flow diagram. A diagram showing the movement, the staging, and the control of data through a system, a functional element, or a component.

data link. (1) Any physical link, such as a wire or a telephone circuit, that connects one or more remote terminals to a communication control unit, or connects one communication control unit with another. (2) The assembly of parts of two data terminal equipment that are controlled by a link protocol, and the interconnecting data circuit, that enable data to be transferred from a data source to a data sink. (I) (3) In SNA, synonym for *link*.

Note: A telecommunication line is only the physical medium of transmission; for example, a telephone wire, a microwave beam. A data link includes the physical medium of transmission, the protocol, and associated devices and programs — it is both physical and logical.

data processing (DP). The systematic performance of operations upon data; for example, arithmetic or logic operations upon data, merging or sorting of data, assembling or compiling of programs. (T)

data station. See *station*.

data stream. (1) All data transmitted through a data channel in a single read or write operation. (2) A continuous stream of data elements being transmitted, or intended for transmission, in character or binary-digit form, using a defined format.

data streaming. In an I/O interface, a mode of operation that provides a method of data transfer at up to 4.5 megabytes per second. Data streaming is not interlocked between the sender and the receiver. Once data transfer begins, the sender does not wait for acknowledgment from the receiver before sending the next byte. The control unit determines the data transfer rate. Contrast with *direct-coupled interlock (DCI)*.

data terminal equipment (DTE). (1) That part of a data station that serves as a data source, data receiver, or both. (I) (A) (2) Equipment that sends or receives data, or both.

data transfer. (1) The result of the transmission of data signals from any data source to a data receiver. (2) The movement, or copying, of data from one location and the storage of the data at another location.

data transfer mode. The method of information exchange used on an I/O interface. See *direct-coupled interlock (DCI)* and *data streaming*.

data transfer phase. The phase of a data call during which data signals can be transferred between data terminal equipment (DTE) connected by the network.

dB. Decibel.

DBCS. Double-byte character set.

dBm. A power level, expressed in decibels, relative to 1 milliwatt of radiant power.

dc. Direct current.

DCB. Data control block.

DCE. Data circuit-terminating equipment.

DCI. Direct-coupled interlock.

DCP. Diagnostic control program.

DCVP. Direct current voltage present.

DE. Device end.

deactivate logical partition. An operator-initiated procedure that releases the hardware assigned to a logical partition, making it available to other partitions. Contrast with *activate logical partition*.

Note: The operator should first deactivate the system control program, if possible or necessary, and then reactivate the partition, which could provide a reset to that partition, if required.

deallocate. To release a resource assigned to a task. Contrast with *allocate*.

DEC. Double-bit error correction.

decibel (dB). (1) One tenth of a bel. (2) A unit that expresses the ratio of two power levels on a logarithmic scale. (3) A unit for measuring relative power. The number of decibels is 10 times the logarithm (base 10) of the ratio of the measured power levels; if the measured levels are voltages (across the same or equal resistances), the number of decibels is 20 times the log of the ratio.

deconfigure. To remove a system resource from the currently active configuration, usually through the system control program (SCP) or through the Configuration (CONFIG) frame on the system console.

dedicated connection. In an ESCON Director, a connection between two ports that is not affected by information contained in the transmission frames. This connection, which restricts those ports from communicating with any other port, can be established or removed only as a result of actions performed by a host control program or at the ESCD console. Contrast with *dynamic connection*.

Note: The two links having a dedicated connection appear as one continuous link.

dedication. Pertaining to the assignment of a system resource; for example, an I/O device, a program, or a whole system, to one application or purpose.

default. Pertaining to an attribute, value, or option that is assumed when none is explicitly specified. (I)

degraded. Pertaining to a mode of operation in which the system operates with some resources not available.

delimiter. A character used to indicate the beginning or end of a character string. (T)

deselect. To remove a selection from a system console or service console frame that was previously marked or chosen.

destination. Any point or location, such as a node, station, or a particular terminal, to which information is to be sent.

destination address. A code that identifies the location to which information is to be sent. Contrast with *origin address*.

device. A mechanical, electrical, or electronic contrivance with a specific purpose.

device address. In System/370 mode, the 8 rightmost bits of an I/O address that identify a particular I/O device and a control unit on the designated channel. See *channel address, device-level addressing,* and *input/output address.*

device address control block (DACB). In System/370 mode, the control block used for subchannel operation.

device driver. A program that provides a software interface for a device, such as a printer, keyboard, or adapter.

device identifier. In a channel subsystem, an address, not apparent to the program, that is used to communicate with I/O devices. See also *channel path identifier, device number, input/output address,* and *subchannel number.*

Note: In System/370 mode, the device identifier is called a device address and consists of an 8-bit value.

device-level addressing. In an ESCON I/O interface, one of two levels of addressing, this level pertaining to an I/O device and identifying that device to the channel or control unit once the control unit has been determined through link-level addressing. Contrast with *link-level addressing.*

device number. In a channel subsystem, four hexadecimal digits that uniquely identify an I/O device.

device release. A command that ends the reservation of the device for the channel issuing the command, or for all channels in the same interface path group.

device reserve. A command that reserves the device for the channel issuing the command, or for all channels in the same interface path group.

Device Support Facilities. IBM-supplied System Control Programming (SCP) used for performing operations on disk volumes so that they can be accessed by IBM and user programs. Examples of these operations are initializing a disk volume and assigning an alternate track.

diagnostics. (1) The process of investigating the cause or the nature of a condition or a problem in a product or system. (2) Modules or tests used by computer users and service personnel to diagnose hardware problems.

DID. Domain identifier.

DIDLIST. Domain identifier list.

dielectric. Nonconductor of direct electric current.

DIFILE. Diagnostic history file.

DIO. Digital input/output.

direct access storage. A storage device that provides direct access to data. (I) (A) See also *random access memory.*

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data.

direct call facility. A facility that permits calling without requiring the user to provide address selection signals; the network interprets the call request signal as an instruction to establish a connection to one or more predetermined data stations. (I)

direct-coupled interlock (DCI). In an I/O interface, a mode of operation that provides a method of data transfer at up to 1.5 megabytes per second. DCI protocol requires the sender to raise a signal on the interface along with the byte of data being transferred. This signal and the accompanying data must be maintained until the receiver of the data sends a signal acknowledging that the data has been received. Contrast with *data streaming.*

directory lookaside table (DLAT). A table in the buffer control element used during dynamic address translation.

discontinuity. In fiber optics, an interruption or drop-out of the optical signal. (E)

disk. A round, flat, data medium that is rotated in order to read and write data. (T) See also *diskette.*

diskette. A thin, flexible magnetic disk enclosed in a protective jacket. See also *disk.*

diskette drive. The mechanism used to seek, read, and write data on diskettes.

disk image. An electronic representation of a disk or diskette containing files and programs. In some applications, the image can be loaded into computer storage and is used by the computer as though it were a physical disk or diskette.

disk operating system (DOS). An operating system for computer systems that use disks and diskettes for auxiliary storage of programs and data.

display device. (1) An output unit that gives a visual representation of data. Usually the data are displayed temporarily; however, arrangements may be made for making a permanent record. (I) (A) (2) In computer graphics, a device capable of presenting display elements on a display surface; for example, a cathode ray tube, plotter, microfilm viewer, or printer.

(3) A device that presents information on a screen. See also *display image* and *display screen.*

display element. (1) A basic graphic element that can be used to construct a display image; for example a dot, a line segment, a character string. (I) (A) (2) One of the smallest parts of a display image, such as an entry field or selection field.

display field. (1) In computer graphics, an area in a display buffer or on a display screen that contains a set of characters that can be manipulated or operated on as a unit. (2) A group of consecutive characters (in the buffer) that starts with an attribute character (defining the characteristics of the field) and contains one or more alphanumeric characters. The field continues to, but does not include, the next attribute character.

display frame. In computer graphics, an area in storage in which a display image can be recorded.

display ID. A display element located in a corner of displayed information that identifies the information within the application.

display image. (1) A collection of display elements or segments that are represented together at any one time on a display surface. (I) (A) (2) Information, pictures, or illustrations that appear on a display screen. See also *display device* and *display screen.*

display/printer adapter (DPA). An integrated control unit contained on each side of the processor controller that provides attachment capability for displays and printers.

display screen. (1) A display surface on which display images are presented. (2) The part of a display station or workstation on which information is displayed. See also *display device* and *display image.*

display station. (1) A physical device that can be used as multiple logical consoles. See also *console.* (2) An input/output device containing a display screen and an attached keyboard that allows a user to send information to or receive information from the system. See also *terminal* and *workstation.*

distribution panel. (1) In an ESCON environment, a panel that provides a central location for the attachment of trunk and jumper cables and can be mounted in a rack or wiring closet, or on a wall. (2) In the IBM Token-Ring Network, a wiring board that has a patch panel function and mounts in a rack.

DLAT. Directory lookaside table.

dm³. Cubic decimeter.

domain. (1) That part of a computer network in which the data processing resources are under common control. (T) (2) In SNA, a system services control point (SSCP) and the physical units (PUs), logical units (LUs), links, link stations, and all associated resources that the SSCP has the ability to control by means of activation requests and deactivation requests.

DOS. Disk operating system.

double-byte character set (DBCS). A set of characters in which each character occupies 2 bytes. Languages such as Japanese, Chinese, and Korean, that can contain more symbols than can be represented by 256 code points, require double-byte character sets. Entering, displaying, and printing DBCS characters requires special hardware and software support.

doubleword. A contiguous sequence of bits or characters that comprises two computer words and is capable of being addressed as a unit. (A)

downstream. (1) In the direction of data flow or toward the destination of transmission. (2) From the processor toward an attached unit or end user. Contrast with *upstream.*

downstream load (DSL). The capability of a distributed function terminal to receive its control program from the controller to which it is attached. A disk containing the terminal's control program is loaded into the control unit.

DP. Data processing.

DPA. Display/printer adapter.

DSFCB. Distant service facility control block.

DSL. Downstream load.

DST reg. Device status destination register.

DTE. Data terminal equipment.

duplex. Pertaining to communication in which data can be sent and received at the same time. Contrast with *half duplex.*

duplex connector. In an ESCON environment, an optical fiber component that terminates both jumper cable fibers in one housing and provides physical keying for attachment to a duplex receptacle.

duplex receptacle. In an ESCON environment, a fixed or stationary optical fiber component that provides a keyed attachment method for a duplex connector.

DW. Doubleword.

dynamic address translation (DAT). In virtual storage systems, the change of a virtual storage address to a real storage address during execution of an instruction. See also *address translation.*

dynamic connection. In an ESCON Director, a connection between two ports, established or removed by the ESCD and that, when active, appears as one continuous link. The duration of the connection depends on the protocol defined for the frames transmitted through the ports and on the state of the ports. Contrast with *dedicated connection*.

dynamic connectivity. In an ESCON Director, the capability that allows connections to be established and removed at any time.

dynamic reconfiguration. Pertaining to a processor reconfiguration between a single-image (SI) configuration and a physically partitioned (PP) configuration when the system control program is active. Contrast with *static reconfiguration*.

dynamic reconfiguration management. In MVS, the ability to modify the I/O configuration definition without needing to perform a power-on reset (POR) of the hardware or an initial program load (IPL).

E

EAR. Executable analysis routine.

EBCDIC. Extended binary-coded decimal interchange code.

EC. (1) Edge connector. (2) Engineering change.

ECC. Error checking and correction.

ECSW. Extended channel status word.

EE. Execution element.

EEPROM. Electrically-erasable programmable read-only memory.

EH. Error handler.

EIA. Electronics Industries Association.

EIA communication adapter. A communication adapter conforming to EIA standards that can combine and send information on two lines at speeds up to 19.2 kbps.

EIA 232D. An electrical interface defined by the Electronics Industries Association for establishing connections and controlling data flow between data terminal equipment and data communication equipment. The interface has been adapted to allow communication between DTEs.

electromagnetic interference (EMI). A disturbance in the transmission of data on a network resulting from the magnetism created by an electric current.

electro-optical. Synonym for *optoelectronic*.

electrostatic discharge (ESD). An undesirable discharge of static electricity that can damage equipment and degrade electrical circuitry.

element. A major part of a component (for example, the buffer control element) or a major part of a system (for example, the system control element).

EMC. Electromagnetic compatibility.

EMI. Electromagnetic interference.

emitter. In fiber optics, the source of optical power. (E)

emulate. To imitate one system with another, primarily by hardware, so that the imitating system accepts the same data, executes the same programs, and achieves the same results as the imitated system. (A) Contrast with *simulate*.

emulation. (1) The use of programming techniques and special machine features to permit a computing system to execute programs written for another system. (2) Imitation; for example, imitation of a computer or device. Contrast with *simulation*.

end of operation (EOP). A signal controlled by the Licensed Internal Code indicating that an instruction sequence has ended (the end of instruction execution).

entry field. An area where a user types information. Its boundaries are usually indicated.

environmental error record editing and printing program (EREP). The program that makes the data contained in the system recorder file available for further analysis.

E/O. Even/odd.

EOC. End of chain.

EOF. End of file.

EON. End of number.

EOP. End of operation.

EPO. Emergency power off.

erase. To remove information, leaving the space unoccupied.

EREP. Environmental error record editing and printing program.

ERP. Error recovery procedure.

error. A discrepancy between a computed, observed, or measured value or condition and the true, specified, or theoretically correct value or condition. (I) (A) Contrast with *failure* and *fault*.

error burst. In data communication, a sequence of signals containing one or more errors but counted as one unit in accordance with a specific criterion or measure. An example of a criterion is that if three consecutive correct bits follow an erroneous bit, then an error burst is terminated. (A)

error checking and correction (ECC). In a processor, the detection and correction of all single-bit errors, plus the detection of double-bit and some multiple-bit errors.

error correcting code. An error-detecting code designed to allow for automatic correction of certain types of errors. (T)

error handler. A component that responds to unsolicited interruptions; it analyzes error conditions and takes recovery steps.

error log. A data set or file in a product or system where error information is stored for later access.

error message. An indication that an error has been detected. (A) See also *information message* and *warning message*.

error recovery procedure (ERP). A procedure designed to help isolate and, where possible, to recover from errors in equipment. The procedure is often used with programs that record information on machine malfunctions.

ESA. Expanded storage array.

ESA/390. Enterprise Systems Architecture/390.

ESC. Expanded storage controller.

ESCD. Enterprise Systems Connection (ESCON) Director.

ESCD console. The ESCON Director input/output device used to perform operator and service tasks at the ESCD.

ESCD console adapter. Hardware in the ESCON Director console that provides the attachment capability between the ESCD and the ESCD console.

ESCM. Enterprise Systems Connection Manager.

ESCON. Enterprise Systems Connection.

ESCON channel. A channel having an Enterprise Systems Connection channel-to-control-unit I/O interface that uses optical cables as a transmission medium. Contrast with *parallel channel*.

ESCON Director (ESCD). A device that provides connectivity capability and control for attaching any two links to each other.

ESCON environment. The data processing environment having an Enterprise Systems Connection channel-to-control-unit I/O interface that uses optical cables as a transmission medium.

ESCON Manager (ESCM). A licensed program that provides host control and intersystem communication capability for ESCON Director connectivity operations.

ESD. Electrostatic discharge.

ESE. Expanded storage element.

ESSL. Engineering and Scientific Subroutine Library.

ESW. Extended status word.

ETR. External throughput rate.

event. (1) An occurrence or happening. (2) An occurrence of significance to a task; for example, the completion of an asynchronous operation, such as an input/output operation.

exchange. To remove an item and put another in its place; for example, to remove a field-replaceable unit (FRU) and install another of the same type.

execution element. An element in a central processor that performs all floating-point, fixed-point multiply, fixed-point divide, and convert operations.

exigent machine check. A machine-check interrupt to a central processor that cannot be delayed or ignored because the error that resulted in the machine check could cause a loss of data integrity. Contrast with *repressible machine check*.

exit routine. A routine that receives control when a specified event occurs, such as an error.

expanded storage. Optional high-speed storage that transfers 4KB pages to and from central storage.

extended binary-coded decimal interchange code (EBCDIC). A coded character set of 256 eight-bit characters.

extended channel status word (ECSW). Synonym for *limited channel logout (LCL)*.

extended count-key data. A set of channel commands that use the CKD track format. Extended count-key-data uses the Define Extent and Locate Record commands to describe the nature and scope of a data transfer operation to the storage control to tune the data transfer operation. The 3990 Storage Control supports the extended count-key-data commands. See also *count key data (CKD)*.

extent. (1) Continuous space on a disk or diskette that is occupied by or reserved for a particular data set, data space, or file. (2) A set of consecutively addressed tracks that a channel program can access.

The limits of an extent are defined by specifying the addresses of the first and last tracks in the extent.

F

F. Fahrenheit.

faceplate. A wall-mounted or floor-mounted plate for connecting data and voice connectors to a cabling system.

facility. (1) An operational capability, or the means for providing such a capability. (T) (2) A service provided by an operating system for a particular purpose; for example, the checkpoint/restart facility.

failure. An uncorrected hardware error. Contrast with *error* and *fault*.

Note: Failures are either recoverable or not recoverable by the software or the operator. The operator is always notified when failures occur. Usually, system recovery occurs through a hardware reconfiguration. If this is not possible, recovery requires a repair of the failed hardware.

FAR. Fullword address register.

FASC. Functional activity/status control.

fast path. A method of doing something more directly and quickly than the usual way. For example, pressing a function key is a faster path than typing a command.

fault. An accidental condition that causes a functional unit to fail to perform its required function. (I) (A) Contrast with *error* and *failure*.

fault isolation analysis routines (FIARs). Structured sets of routines and tests that dynamically control their own execution, based on available error data and the status of related portions of the system.

fault threshold. A prescribed limit to the number of faults in a specified category which, if exceeded, requires a remedial action. (T)

Note: The remedial action may include notifying the operators, running diagnostic programs, or reconfiguring to exclude a faulty unit.

FC. Feature code.

FCC. Federal Communications Commission.

FCS. Frame check sequence.

FDDI. Fiber Distributed Data Interface.

FDS. Flexible distribution system.

FE. Functional element.

feature. A part of an IBM product that may be ordered separately by the customer. A feature is designated as either special or specify and may be designated also as diskette-only.

feature code. A code used by IBM to process hardware and software orders.

Federal Communications Commission (FCC). A board of commissioners appointed by the President under the Communications Act of 1934, having the power to regulate all interstate and foreign communications by wire and radio originating in the United States.

FEID. Functional element identifier.

fence. A separation of one or more components or elements from the remainder of a system. This separation, which is by logical boundaries rather than power boundaries, allows simultaneous user operations and maintenance procedures.

ferrule. In fiber optics, a mechanical fixture, generally a rigid tube, used to confine the stripped end of a fiber bundle or a fiber. (E)

Notes:

1. Typically, individual fibers of a bundle are cemented together within a ferrule of a diameter designed to yield a maximum packing fraction.
2. Nonrigid materials, such as shrink tubing, can also be used for ferrules for special applications.

FIAR. Fault isolation analysis routines.

fiber. See *optical fiber*.

fiber buffer. Material used to protect an optical fiber from physical damage, thereby providing mechanical isolation or protection, or both.

Note: Cable fabrication techniques vary. Some result in tight contact between fiber and protective buffering (tight buffer), while others result in a loose fit (loose buffer), permitting the fiber to slide in the buffer tube. Multiple buffer layers can be used for added fiber protection.

Fiber Distributed Data Interface (FDDI). A high-performance, general-purpose, multistation network designed for effective operation with a peak data transfer rate of 100Mbps. It uses token-ring architecture with optical fiber as the transmission medium over distances of several kilometers.

fiber optic cable. See *optical cable*.

fiber optics. The branch of optical technology concerned with the transmission of radiant power through fibers made of transparent materials such as glass, fused silica, and plastic. (E)

Note: Telecommunication applications of fiber optics use optical fibers. Either a single discrete fiber or a nonspatially aligned fiber bundle can be used for each information channel. Such fibers are often called *optical fibers* to differentiate them from fibers used in noncommunication applications.

fiber optic subassembly. An optical component that contains a serializer, deserializer, transmitter, and receiver. See also *transmitter-receiver subassembly (TRS)*.

field macro diagram (FMD). Documentation used by service representatives to analyze card-on-board logic.

field prompt. Information in a screen or window that identifies an entry field.

field-replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. Sometimes, a field-replaceable unit may contain other field-replaceable units; for example, a brush and a brush block that can be exchanged individually or as a single unit.

filter. A device or program that separates data, signals, or material in accordance with specified criteria. (A)

FIPP. Fault isolation postprocessor.

flag. (1) A variable that indicates a certain condition holds. (T) (2) Any of various types of indicators used for identification; for example, a wordmark. (A) (3) A character that signals the occurrence of some condition, such as the end of a word. (A)

floating-point. (1) Pertaining to the representation of a quantity as a decimal number and using a symbol (exponent) to show the position for the decimal point, for example, 199.9 represented by $1.999-2$. (2) Pertaining to a machine feature for such arithmetic.

FM. Frequency modulation.

FMD. Field macro diagram.

formatted diskette. A diskette on which track and sector control information has been written and which may or may not contain data.

Note: A diskette must be formatted before it can receive data.

formatted display. A display in which the attributes of one or more display fields have been defined by the user. Contrast with *unformatted display*.

FP. Floating point.

frame. (1) A housing for machine elements. (2) The hardware support structure, covers, and all electrical parts mounted therein that are packaged as one entity for shipping. (3) A formatted display. See *display frame* and *transmission frame*.

frame check sequence (FCS). (1) A system of error checking performed at both the sending and receiving station after a block check character has been accumulated. (2) A numeric value derived from the bits in a message that is used to check for any bit errors in transmission. (3) A redundancy check in which the check key is generated by a cyclic algorithm.

FRU. Field-replaceable unit.

ft. Foot.

full duplex. Synonym for *duplex*.

fullword. Synonym for *computer word*.

functional element identifier (FEID). An alphanumeric character or characters identifying a component or element in service language or other diagnostic application programs.

function key. (1) In computer graphics, a button or switch that may be operated to send a signal to the computer program controlling the display. (T) (2) A key that, when pressed, performs a specified set of operations.

function key area. The area at the bottom of a screen or window that contains the function key assignments.

fusion splice. In fiber optics, a splice accomplished by the application of localized heat sufficient to fuse or melt the ends of two lengths of optical fiber, forming a continuous, single fiber. (E) Contrast with *mechanical splice*.

G

G. Giga.

gal. Gallon.

gap loss. In fiber optics, that optical power loss caused by a space between axially-aligned fibers. (E) See also *coupling loss*.

gate. (1) A combinational circuit that performs an elementary logic operation and usually involves one output. (T) (2) A combinational logic element having at least one input channel. (A)

gateway. A functional unit that connects two computer networks with different network architectures. (T) Contrast with *bridge* and *router*.

Note: A gateway connects networks or systems of different architectures. A bridge interconnects

networks or systems with the same or similar architectures.

gateway node. A node that is an interface between networks.

GB. Gigabyte.

general register. A register used for operations such as binary addition, subtraction, multiplication, and division. General registers are used primarily to compute and modify addresses in a program.

GHFR. Group history file record.

giga (G). Ten to the ninth power; 1 000 000 000 in decimal notation. When referring to storage size, 2 to the thirtieth power, 1 073 741 824 in decimal notation.

GMT. Greenwich mean time.

gnd. Ground.

gpm. Gallons per minute.

GR. General register.

graded-index fiber. An optical fiber with a refractive index that varies with the radial distance from the fiber axis. (E) Contrast with *step-index fiber*.

GTF. Generalized trace facility.

guest. In interpretive execution mode, the interpreted or virtual machine as opposed to the real machine (the host).

H

half duplex. In data communication, pertaining to transmission in only one direction at a time. Contrast with *duplex*.

halfword. A contiguous sequence of bits or characters that constitutes half a computer word and can be addressed as a unit. (A)

hard disk. A rigid disk used in a hard disk drive.

hard disk drive. A stand-alone disk drive that reads and writes data on rigid disks and can be attached to a port on the system unit.

hard error. An error condition on a network that requires that the network be reconfigured or that the source of the error be removed before the network can resume reliable operation. Contrast with *soft error*.

hardware-assist control (HAC). A function used to control and simplify hardware information transfer between the central processors and the channel subsystem, and includes the hardware system area directory in central storage, the channel subsystem Licensed Internal Code, and all the control blocks used for I/O operations.

hardware system area (HSA). A logical area of central storage, not addressable by application programs, used to store Licensed Internal Code and control information.

help for help. A help action that provides information about how the help facility works.

help index. A help action that provides an index of the help information available for an application.

help panel. See *help window*.

help window. A window that contains information to assist a user.

hertz (Hz). A unit of frequency equal to one cycle per second.

HES. Hall-effect sensor.

hex. Hexadecimal.

hexadecimal. (1) Pertaining to a selection, choice, or condition that has 16 possible values or states. (I) (2) Pertaining to a fixed-radix numeration system, with radix of 16. (I) (3) Pertaining to a numbering system with base of 16; valid numbers use the digits 0 – 9 and characters A – F, where A represents 10 and F represents 15.

hexadecimal number. The 1-byte hexadecimal equivalent of an EBCDIC character.

high-speed buffer. A cache or a set of logically partitioned blocks that provides significantly faster access to instructions and data than provided by central storage.

host. In interpretive execution mode, the real machine as opposed to the virtual or interpreted machine (the guest).

host access method. The access method that controls communication with a domain.

host application program. An application program executed in the host computer.

host computer. (1) In a computer network, a computer that usually performs network control functions and provides end users with services such as computation and database access. (T) (2) The primary or controlling computer in a multiple-computer installation.

host processor. (1) A processor that controls all or part of a user application network. (T) (2) In a

network, the processing unit in which resides the access method for the network.

hot I/O. A serious error condition caused by an I/O interrupt that disrupts system operation.

hp. Horsepower.

HPO. High performance option.

HSA. Hardware system area.

Hz. Hertz.

I

IAR. Instruction address register.

IBM Cabling System. A permanently installed wiring system that does not need to be rewired when terminals are moved from one location to another within an office complex. It allows transmission of data at very high speeds and is the foundation for installing a local area network.

IBM program support representative (PSR). An IBM service representative who performs maintenance services for IBM software at a centralized IBM location. Contrast with *IBM systems engineering operations specialist.*

IBM systems engineering operations specialist. An IBM service representative who performs maintenance services for IBM software in the field. Contrast with *IBM program support representative.*

ICE. Interconnect communication element.

ID. Identifier.

IDAW. Indirect data address word.

identifier (ID). (1) One or more characters used to identify or name a data element and possibly to indicate certain properties of that data element. (T) (2) A sequence of bits or characters that identifies a program, device, or system to another program, device, or system. (3) In an ESCON Director, a user-defined symbolic name of 24 characters or fewer that identifies a particular ESCD. See also *password identifier* and *port address name.*

IE. Instruction element.

IEEE 802.2 interface. An interface adhering to the 802.2 Logical Link Control (LLC) Standard of the Institute of Electrical and Electronics Engineers. This standard is one of several standards for local area networks approved by the IEEE.

IF. Instruction fetch.

IFCC. Interface control check.

IML. Initial machine load.

IMLP. Initial machine load pending.

immediate access storage. A storage device whose access time is negligible in comparison with other operating times. (A)

IMS. Information Management System.

inactive subchannel. A subchannel that is busy (even if unlocked), not busy, or has a pending interrupt, and is indicated by subchannel status word (SCSW) bit 24 equals 0. The control information resides outside the channel subsystem because it is not necessary for the current operation. Contrast with *active subchannel.* See also *busy subchannel.*

index-matching material. In fiber optics, a material, often a liquid or cement, whose refractive index is nearly equal to the core index, used to reduce Fresnel reflections from a fiber end face. (E) See also *mechanical splice.*

indirect data address word. A word containing an absolute address that designates data in a storage frame.

information message. A message telling a user that a function is performing normally or has completed normally. User acknowledgment may not be required, depending on the message. See also *error message* and *warning message.*

infrared. Invisible radiation having a wavelength longer than 700 nm. (T)

initialization. (1) The operations required for setting a device to a starting state, before the use of a data medium, or before implementation of a process. (T) (2) Preparation of a system, device, or program for operation. (3) To set counters, switches, addresses, latches, or storage contents to zero or to other starting values at the beginning of, or at the prescribed points in, a computer program or process.

initial machine load (IML). A procedure that prepares a device for use.

initial program load (IPL). (1) The initialization procedure that causes an operating system to commence operation. (2) The process by which a configuration image is loaded into storage at the beginning of a work day or after a system malfunction. (3) The process of loading system programs and preparing a system to run jobs.

input/output (I/O). (1) Pertaining to a device whose parts can perform an input process and an output process at the same time. (I) (2) Pertaining to a functional unit or channel involved in an input process, output process, or both, concurrently or not, and to

the data involved in such a process. (3) Pertaining to input, output, or both.

input/output address. (1) In System/370 mode, a 16-bit address that consists of two parts: the 8 bits of the leftmost part constitute the channel address, and the 8 bits of the rightmost part constitute the device address. (2) In ESA/390 mode, an address provided by the channel subsystem that consists of four parts: channel path identifiers, subchannel numbers, device numbers, and addresses (called device identifiers). Device identifiers are dependent on the channel path type and not visible to programs. See *channel path identifier, device identifier, device number*, and *subchannel number*.

input/output configuration. The collection of channel paths, control units, and I/O devices that attaches to the processor.

input/output configuration data set (IOCDS). The data set that contains an I/O configuration definition built by the I/O configuration program (IOCP).

input/output configuration program (IOCP). A program that defines to a system all the available I/O devices and the channel paths.

input/output interface. The interface that connects channels and control units for the exchange of signals and data.

input/output unit. A device in a data processing system by means of which data can be entered into the system, received from the system, or both. (I) (A)

input unit. A device in a data processing system by means of which data can be entered into the system. (I) (A) Contrast with *output unit*.

insertion loss. In fiber optics, the total optical power loss caused by insertion of an optical component such as a connector, splice, or coupler. (E)

instruction address. (1) The address of an instruction word. (I) (A) (2) The address that must be used to fetch an instruction. (A)

instruction address register (IAR). (1) A special purpose register used to hold the address of the next instruction to be executed. (T) (2) A register in a processor that contains the address of the next instruction to be performed.

instruction counter. A counter that indicates the location of the next computer instruction to be interpreted. (A)

instruction element (IE). A part of a processor that executes some instructions and generates operand addresses and instruction requests. It also controls the sequencing of instructions through the machine and is usually controlled by Licensed Internal Code.

integrated offload processor (IOP). The processor in the interconnect communication element that detects, initializes, and ends all channel subsystem operations.

intensified field. On a display screen, data in a field displayed at a brighter level than other data.

intensity. In fiber optics, the square of the electric field amplitude of a light wave. The intensity is proportional to irradiance and can be used in place of the term "irradiance" when only relative values are important. (E)

interactive. Pertaining to a program or system that alternately accepts input and then responds. An interactive system is conversational; that is, a continuous dialog exists between the user and the system. Contrast with *batch*.

interactive operator facility (IOF). The part of NetView Distribution Manager (DM) that allows the NetView DM control operator to monitor the progress of transmissions and to intervene as necessary.

interactive problem control system (IPCS). A component of VM that permits online problem management, interactive problem diagnosis, online debugging for disk-resident control program abend dumps, problem tracking, and problem reporting.

Interactive System Productivity Facility (ISPF). An IBM licensed program that serves as a full-screen editor and dialog manager. Used for writing application programs, it provides a means of generating common display screens and interactive dialogs between the application programmer and the terminal user.

interconnect panel. Synonym for *distribution panel*.

interface. (1) A shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate. The concept includes the specification of the connection of two devices having different functions. (T) (2) Hardware, software, or both, that links systems, programs, or devices.

International Organization for Standardization (ISO). An organization of national standards bodies from various countries established to promote development of standards to facilitate international exchange of goods and services, and develop cooperation in intellectual, scientific, technological, and economic activity.

interoperability. (1) The capability to communicate, execute programs, or transfer data among various functional units in a way that requires the user to have little or no knowledge of the unique characteristics of those units. (T) (2) The ability to link SAA and non-SAA environments and use the combination for distributed processing.

interrupt. (1) A suspension of a process, such as execution of a computer program caused by an external event, and performed in such a way that the process can be resumed. (A) (2) To stop a process in such a way that it can be resumed. (3) In data communication, to take an action at a receiving station that causes the sending station to end a transmission. (4) To temporarily stop a process.

interruption. Synonym for *interrupt*.

interrupt level. The means of identifying the source of an interrupt, the function requested by an interrupt, or the code or feature that provides a function or service.

intersystem communication. (1) Transfer of data between systems by means of data exchange or data interchange. (2) In a system environment containing multiple ESCON Managers, communication that occurs between ESCM hosts connected to the same ESCON Director.

INTF. Interface.

invalidation. The process of removing records from cache because of a change in status of a subsystem facility or function, or because of an error while processing the cache image of the set of records. When such a cache image is invalidated, the corresponding records cannot be accessed in cache and the assigned cache space is available for allocation.

I/O. Input/output.

IOCDS. I/O configuration data set.

IOCDSM. I/O configuration data set management.

IOCP. I/O configuration program.

IOEL. I/O extended logout.

IOF. Interactive operator facility.

IOP. Integrated offload processor.

IOPD. I/O problem determination.

IOP Licensed Internal Code. The part of the channel subsystem Licensed Internal Code used to start, maintain, and end (normally or abnormally) all operations with the central processor. See also *channel Licensed Internal Code*.

IOPQ. IOP queue.

IOPS. I/O power sequencer.

IOPTRC. IOP trace.

IOS. (1) I/O sequencer. (2) I/O supervisor.

IOTA. I/O transaction area.

IPCS. Interactive problem control system.

IPD. Instruction processing damage.

IPF. Instruction processing function.

IPL. Initial program load.

IPNOM. Internal path not-operational mask.

IPS. Integrated power system.

IRB. Interruption response block.

irpt. (1) Interrupt. (2) Interruption.

ISO. International Organization for Standardization.

ISPF. Interactive System Productivity Facility.

ISR. Incident summary record.

ITR. Internal throughput rate.

J

jacket. In an optical cable, the outermost layers of protective covering.

JCL. Job control language.

JES. Job entry subsystem.

job control language (JCL). A control language used to identify a job to an operating system and to define the job's requirements.

job entry subsystem (JES). A system facility for spooling, job queuing, and managing I/O.

jumper cable. In an ESCON environment, an optical cable having two conductors that provides physical attachment between two devices or between a device and a distribution panel. Contrast with *trunk cable*.

K

k. Kilo.

kb. Kilobit.

KB. Kilobyte.

KB/s. Kilobytes per second.

keyboard mapping table. Information presented in tabular form that compares the function of each key from one keyboard to another.

kgf. Kilogram force.

kilo (k). Thousand.

kilobit (kb). One thousand binary digits.

kilobyte (KB). 1024 bytes for storage size; otherwise, 1000 bytes.

kilometer. One thousand meters; 0.62 mile.

kPa. Kilopascal.

kVA. Kilovolt ampere.

kW. Kilowatt.

L

LA. Logout analysis.

LAM. Logout analysis machine.

LAN. Local area network.

LAN segment. (1) Any portion of a local area network (for example, a single bus or ring) that can operate independently, but is connected to other parts of the establishment network by using bridges. (2) A whole ring or bus network without bridges.

LAN segment number. The identifier that uniquely distinguishes a LAN segment in a multisegment LAN.

laser. A device that produces optical radiation using a population inversion to provide light amplification by stimulated emission of radiation and (generally) an optical resonant cavity to provide positive feedback. Laser radiation can be highly coherent temporally, or spatially, or both. (E)

latency. The time interval between the instant at which an instruction control unit initiates a call for data and the instant at which the actual transfer of data starts. (T)

lb. Pound.

LCL. Limited channel logout.

LCU. Logical control unit.

leased line. Synonym for *nonswitched line.*

LED. Light-emitting diode.

LIC. Licensed Internal Code.

Licensed Internal Code (LIC). Software provided for use on specific IBM machines and licensed to customers under the terms of IBM's Customer Agreement. Microcode can be Licensed Internal Code and licensed as such.

light-emitting diode (LED). A semiconductor chip that gives off visible or infrared light when activated.

lightguide. See *optical fiber* and *optical waveguide.*

light pen. A light-sensitive pick device that is used by pointing it at the display surface. (I) (A)

light ray. The path of a point on a waveform. The direction of the light ray is generally normal to the wavefront. (E)

limited broadcast. In the IBM Token-Ring Network, the forwarding of specially designated broadcast frames only by bridges that are enabled to forward them.

limited channel logout (LCL). A detailed I/O error record, contained in the hardware system area of central storage, that can be used with the fixed logout when a failure occurs.

Note: This logout is not necessarily available for all channels.

line control character. See *transmission control character.*

link. (1) In an ESCON environment, the physical connection and transmission medium used between an optical transmitter and an optical receiver. A link consists of two conductors, one used for sending and the other for receiving, providing a duplex communication path. (2) In an ESCON I/O interface, the physical connection and transmission medium used between a channel and a control unit, a channel and an ESCD, a control unit and an ESCD, or, at times, between two ESCDs.

link address. In an ESCON environment, an address assigned at initialization that identifies a channel or control unit and allows it to send and receive transmission frames and perform I/O operations. See also *port address.*

link-attached. Pertaining to devices that are connected to a controlling unit by a data link. Contrast with *channel-attached.*

link-level addressing. In an ESCON I/O interface, one of two levels of addressing, this level pertaining to link-level functions and identifying the channel path between the channel and a control unit. Contrast with *device-level addressing.*

link loss budget. See *maximum allowable link loss.*

link segment. In an ESCON environment, any portion of an optical cable between connectors, including passive components.

LIR. Link incident record.

local. Synonym for *channel-attached.*

local area network (LAN). A computer network located on a user's premises within a limited

geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary can be subject to some form of regulation.

Note: A LAN does not use store and forward techniques.

local storage. Synonym for *local working storage*.

local working storage. A storage area immediately available to a central processor or the channel subsystem and used to temporarily hold data or control information necessary for the operation being performed.

Note: General registers and floating-point registers are not included.

log. (1) To record, for example, to log all messages on the system printer. (2) A record of events that have occurred.

logical address. The address found in the instruction address portion of the program status word (PSW). If translation is off, the logical address is the real address. If translation is on, the logical address is the virtual address. See also *absolute address*, *physical address*, *real address*, and *virtual address*.

logical control unit. A group of contiguous words in the hardware system area that provides all of the information necessary to control I/O operations through a group of paths that are defined in the IOCDS. Logical control units represent to the channel subsystem a set of control units that attach common I/O devices.

logically partitioned (LPAR) mode. A central processor mode, available on the Configuration frame when using the PR/SM feature, that allows an operator to allocate processor unit hardware resources among logical partitions. Contrast with *basic mode*.

logical partition (LP). A subset of the processor hardware that is defined to support the operation of a system control program (SCP). See also *logically partitioned (LPAR) mode*.

logical processor. In LPAR mode, a central processor in a logical partition.

logical switch number. A two-digit number used by the I/O configuration program (IOCP) to identify a specific ESCON Director.

logical-to-physical coordination. In ESCON Manager, the coordination of a physical connectivity change in an ESCON Director with an equal logical change in any associated host.

logical vector. In LPAR mode, a vector associated with a logical processor.

logic support station (LSS). Hardware used to attach processor complex elements that respond to commands from the processor controller and includes scan control logic.

logo. A letter, combination of letters, or symbol that identifies a product or company.

logout. Log data that has been collected, formatted, and recorded.

longitudinal offset loss. In waveguide-to-waveguide coupling, synonym for *gap loss*. (E)

loop. (1) A sequence of instructions that is to be executed iteratively (T) (2) A closed unidirectional signal path connecting input/output devices to a system.

loss budget. See *maximum allowable link loss*.

LP. Logical partition.

LPAR. Logically partitioned.

lpm. Liters per minute.

LPSW. Load program status word.

LPUM. Last-path-used mask.

LSB. Least significant byte.

LSE. Logic support element.

LSS. Logic support station.

LU. Logical unit.

LWS. Local working storage.

M

m. (1) Milli; one thousandth part. (2) Meter.

mA. Milliampere.

machine check. An error condition that is caused by an equipment malfunction.

machine-readable information (MRI). Synonym for *soft copy*.

macrobending. In an optical fiber, optical attenuation caused by macroscopic deviations of the axis from a straight line. (E) Contrast with *microbending*.

macrobend loss. In an optical fiber, that loss attributable to macrobending. (E) Contrast with *microbend loss*.

main storage. (1) Program-addressable storage from which instructions and other data can be loaded

directly into registers for subsequent processing. (I) (A) (2) That part of internal storage into which instructions and other data must be loaded for subsequent execution or processing. (3) The part of a processor unit where programs are run. See *central storage*.

Notes:

1. Main storage refers to the whole program-addressable execution space and can include one or more storage devices.
2. The term *main storage* is generally used in large and intermediate computers. The term *memory* is primarily used in microcomputers, calculators, and some minicomputers.

maintenance analysis procedure (MAP). A step-by-step procedure for tracing a symptom to the cause of a failure.

MAP. Maintenance analysis procedure.

mark. A symbol or symbols that indicate the beginning or the end of a field, a word, an item of data or a set of data such as a file, record, or block. (I) (A)

master console. In a system with multiple consoles, the console used for communication between the operator and the system.

MAT. Master analog threshold.

material dispersion. In fiber optics, that dispersion attributable to the wavelength dependence of the refractive index of a material used to form the fiber. (E)

maximum allowable link loss. In an ESCON environment, the maximum amount of link attenuation (loss), expressed in decibels, that can exist without causing a possible failure condition. Contrast with *calculated link loss*.

Mb. Megabit.

MB. Megabyte.

MBO. Measurement block origin.

Mbps. Megabits per second.

MC. Machine check.

MCB. Multichannel buffer.

MCH. Machine-check handler.

MCI. Machine-check interruption.

MCIC. Machine-check interruption code.

MCLIST. Master control list.

MCT. (1) Maintenance configuration table. (2) Machine configuration table.

MD. IBM Maintenance Device.

MEC. Machine engineering change.

mechanical splice. In fiber optics, a splice accomplished by fixtures or materials rather than thermal fusion. Index matching material can be applied between two fiber ends. (E) Contrast with *fusion splice*.

medium. A physical carrier of electrical or optical energy.

mega (M). 10 to the sixth power; 1 000 000 in decimal notation. When referring to storage size, two to the twentieth power; 1 048 576 in decimal notation.

megabit (Mb). A unit of measure for throughput. One megabit equals 1 000 000 bits.

megabyte (MB). (1) A unit of measure for storage size. One megabyte equals 1 048 576 bytes. (2) Loosely, one million bytes.

megahertz (MHz). A unit of measure for frequency. One megahertz equals 1 000 000 hertz.

merge. To combine the items of two or more sets that are each in the same given order into one set in that order.

MES. Miscellaneous equipment specification.

MHz. Megahertz.

MI. Manual intervention.

microbending. In an optical fiber, sharp curvatures involving local axial displacements of a few micrometers and spatial wavelengths of a few millimeters. Such bends can result from fiber coating, cabling, packaging, installation, etc. (E) Contrast with *macrobending*.

Note: Microbending can cause significant radiative losses and mode coupling.

microbend loss. In an optical fiber, that loss attributable to microbending. (E) Contrast with *macrobend loss*.

micrometer. One millionth part of a meter.

micron. Synonym for *micrometer*.

microsecond. One-millionth of a second.

MIH. Missing interruption handler.

min. Minute.

minimum acceptable receive level. In an ESCON environment, the calculated level, expressed in decibels, received at a specific point in the link. This value is used as a rejection criterion when measuring the actual level received at the same point.

mm. Millimeter.

modal (or mode) dispersion. Synonym for *multimode distortion*.

modal (or mode) distortion. Synonym for *multimode distortion*.

modem (modulator/demodulator). A device that converts digital data from a computer to an analog signal that can be transmitted on a telecommunication line, and converts the analog signal received to data for the computer.

modulation. The process by which a characteristic of a carrier is varied in accordance with the characteristic of an information-bearing signal. (T)

monitor. A device that observes and records selected activities within a data processing system for analysis.

monitor console. An optional logical display used to monitor the service or system console. Each monitor console can be assigned to any of the physical displays attached to the processor controller.

monochromatic. Consisting of a single wavelength or color. In practice, radiation is never perfectly monochromatic but, at best, displays a narrow band of wavelengths. (E)

monomode optical fiber. Synonym for *single-mode optical fiber*.

MP. (1) Multiprocessor. (2) Maintenance procedure.

MRI. Machine-readable information.

ms. Millisecond.

MSA. Main storage array.

MSB. Most significant byte.

MSC. Main storage controller.

MSE. Main storage element.

multidrop. A network configuration in which there are one or more intermediate nodes on the path between a central node and an endpoint node. (T)

multidrop topology. A network topology that allows multiple control units to share a common channel path, reducing the number of paths between channels and control units. Contrast with *switched point-to-point topology*. See also *point-to-point topology*.

multifiber cable. An optical cable that contains two or more fibers. (E) See also *jumper cable*, *optical cable assembly*, and *trunk cable*.

multimode distortion. In an optical fiber, that distortion resulting from differential mode delay. (E)

Note: The term *multimode dispersion* is often used as a synonym; such usage, however, is erroneous because the mechanism is not dispersive in nature.

multimode optical fiber. A graded-index or step-index optical fiber that allows more than one bound mode to propagate. (E) Contrast with *single-mode optical fiber*.

multiple preferred guests. A VM facility that, when used with the Processor Resource/Systems Manager (PR/SM) feature, supports multiple preferred virtual machines. See also *preferred virtual machine*.

multiplexer channel. A channel designed to operate with a number of I/O devices simultaneously. Several I/O devices can transfer records at the same time by interleaving items of data. See *block multiplexer channel* and *byte multiplexer channel*.

multiplexing. In data transmission, a function that permits two or more data sources to share a common transmission medium so that each data source has its own channel. (I) (A)

multipoint. Pertaining to communication among more than two stations over a single telecommunication line.

multipoint connection. A connection established among more than two data stations. (I) (A) Contrast with *point-to-point connection*.

multipoint line. A telecommunication line or circuit connecting two or more stations. Contrast with *point-to-point line*.

multiprocessing. (1) A mode of operation for parallel processing by two or more processors of a multiprocessor. (I) (A) (2) Pertaining to the simultaneous execution of two or more computer programs or sequences of instructions by a computer. (A) (3) Loosely, parallel processing. (A) (4) Simultaneous execution of two or more sequences of instructions by a multiprocessor.

multiprocessor (MP). A processor complex that can be physically partitioned to form two operating processor complexes.

mV. Millivolt.

MVS/ESA. Multiple Virtual Storage/Enterprise Systems Architecture.

MVS/SP. Multiple Virtual Storage/System Product.

MVS/XA. Multiple Virtual Storage/Extended Architecture.

N

N/A. (1) Not applicable. (2) Not available.

nanosecond (ns). (1) One thousand millionth of a second. (2) One thousandth of a microsecond.

NC. Normally closed.

NEMA. National Electrical Manufacturer's Association.

NetView. An IBM licensed program used to monitor a network, manage it, and diagnose its problems.

network. (1) An arrangement of nodes and connecting branches. (T) (2) A configuration of data processing devices and software connected for information exchange.

NFPA. National Fire Protection Association.

NIOSH. National Institute for Occupational Safety and Health (U.S.A.).

nm. Nanometer.

NO. Normally open.

node. (1) In a network, the point at which one or more functional units connect channels or data circuits. (I) (2) In a network topology, the point at the end of a branch. (T) (3) In SNA, an endpoint of a link, or a junction common to two or more links in a network.

nondisruptive installation. The physical installation of additional units while normal operations continue without interruption. Contrast with *nondisruptive removal*. See also *concurrent maintenance*.

nondisruptive removal. The physical removal of existing units while normal operations continue without interruption. Contrast with *nondisruptive installation*. See also *concurrent maintenance*.

non-physical-contact connector. In an ESCON environment, an optical fiber connector type having an air gap between itself and its receptacle, thereby providing a junction point having (usually) more loss compared to a physical-contact connector.

nonswitched line. (1) A connection between systems or devices that does not have to be made by dialing. Contrast with *switched line*. (2) A telecommunication line on which connections do not have to be established by dialing.

nonvolatile storage. A storage device whose contents are not lost when power is cut off. (T)

no-op. No-operation.

no-operation (no-op) instruction. An instruction whose execution causes a computer to proceed to the next instruction to be executed without performing an operation. (T)

NOR. Normal output request.

ns. Nanosecond.

NSI. Next sequential instruction.

NSS. National Service Support.

NTF. No trouble found.

numeric. (1) Pertaining to data that consists of numerals. (T) (2) Pertaining to data or to physical quantities that consist of numerals. (A) (3) Pertaining to any of the digits 0 through 9.

numerical aperture. Colloquially, the sine of the radiation or acceptance angle of an optical fiber, multiplied by the refractive index of the material in contact with the exit or entrance face. This usage is approximate and imprecise, but is often used. (E)

O

OEM. Original equipment manufacturer.

OEMI. Original equipment manufacturers' information.

offline. (1) Pertaining to the operation of a functional unit that takes place either independently of, or in parallel with, the main operation of a computer. (T) (2) Neither controlled by, nor communicating with, a computer. Contrast with *online*.

OLTEP. Online test executive program.

OLTS. Online test system.

OMC. Optical mode conditioner.

online. (1) Pertaining to the operation of a functional unit when under the direct control of a computer. (T) (2) Pertaining to a user's ability to interact with a computer. (A) (3) Pertaining to a user's access to a computer via a terminal. (A) (4) Controlled by, or communicating with, a computer. Contrast with *offline*.

online test executive program (OLTEP). An IBM program for managing the online tests that are available for device preventive maintenance and service. Normally, only IBM service personnel use this program.

online testing. Testing that is performed concurrent with running the user's programs; that is, while the device under test is still connected and being used, with minimum effect on normal operation.

online test system (OLTS). The device tests running under OLTEP that allow a user to test I/O devices concurrently with execution of programs. Tests may be run to diagnose I/O errors, to verify repairs and engineering changes, or to periodically check devices.

operating system (OS). Software that controls the execution of programs and that may provide services such as resource allocation, scheduling, input/output control, and data management. Although operating systems are predominantly software, partial hardware implementations are possible. (T)

operator console. (1) A functional unit containing devices that are used for communications between a computer operator and a computer. (T) (2) A display used for communication between the operator and the system, used primarily to specify information concerning application programs and I/O operations and to monitor system operation.

optical cable. A fiber, multiple fibers, or a fiber bundle in a structure built to meet optical, mechanical, and environmental specifications. (E) See also *jumper cable, optical cable assembly,* and *trunk cable.*

optical cable assembly. An optical cable that is connector-terminated. Generally, an optical cable that has been terminated by a manufacturer and is ready for installation. (E) See also *jumper cable* and *optical cable.*

optical connector. See *optical fiber connector.*

optical detector. A transducer that generates an output signal when irradiated with optical power. (E) See also *optoelectronic.*

optical fiber. Any filament made of dielectric materials that guides light, regardless of its ability to send signals. (E) See also *fiber optics* and *optical waveguide.*

optical fiber cable. Synonym for *optical cable.*

optical fiber connector. A hardware component that transfers optical power between two optical fibers or bundles and is designed to be repeatedly connected and disconnected.

optical fiber splice. A permanent joint that couples optical power between two fibers. See also *fusion splice* and *mechanical splice.*

optical fiber waveguide. Synonym for *optical fiber.*

optical link. See *link.*

optical link loss. See *maximum allowable link loss.*

optical link segment. See *link segment.*

optical mode conditioner (OMC). A tool that, when inserted between an optical LED source and the ESCON link under test, provides a consistent method for measuring optical attenuation.

optical power. Synonym for *radiant power.*

optical receiver. Hardware that converts an optical signal to an electrical logic signal. Contrast with *optical transmitter.*

optical repeater. In an optical fiber communication system, an optoelectronic device or module that receives a signal, amplifies it (or, for a digital signal, reshapes, retimes, or otherwise reconstructs it) and retransmits it. (E)

optical spectrum. Generally, the electromagnetic spectrum within the wavelength region extending from the vacuum ultraviolet at 40 nm to the far infrared, 1 mm. (E)

optical time domain reflectometer (OTDR). A measurement device used to characterize a fiber wherein an optical pulse is transmitted through the fiber, and the resulting light scattered and reflected back to the input and is measured as a function of time. Useful in estimating attenuation coefficient as a function of distance, and identifying defects and other localized losses. (E)

optical transmitter. Hardware that converts an electrical logic signal to an optical signal. Contrast with *optical receiver.*

optical waveguide. (1) A structure capable of guiding optical power. (E) (2) In optical communications, generally a fiber designed to transmit optical signals. See *optical fiber.* See also *cladding, core, fiber optics, multimode optical fiber, optical fiber,* and *single-mode optical fiber.*

optical wrap. Signal transmission, used mainly for testing, that routes the signal from the optical output of a device directly to the optical input.

option. (1) A specification in a statement that may be used to influence the execution of the statement. (2) A hardware or software function that can be selected or enabled as part of a configuration process. (3) Hardware (such as a network adapter) that can be installed in a device to change or enhance device functions.

optoelectronic. (1) Pertaining to a device that responds to optical power, emits or modifies optical radiation, or uses optical radiation for its internal operation. (E) (2) Any device that functions as an electrical-to-optical or optical-to-electrical transducer. (E)

origin address. A code that identifies the location from which information is sent. Contrast with *destination address.*

original equipment manufacturer (OEM). A manufacturer of equipment that may be marketed by another manufacturer.

OS. Operating system.

OT. Overtemperature.

OTDR. Optical time domain reflectometer.

output device. Synonym for *output unit.*

output unit. A device in a data processing system by which data can be received from the system. (I) (A) Contrast with *input unit.*

OV. Overvoltage.

P

PA. (1) Problem analysis. (2) Program access. (3) Program area.

PAC. Prioritization and control.

packet. (1) In data communication, a sequence of binary digits, including data and control signals, that is transmitted and switched as a composite whole. (I) Contrast with *transmission frame.*

Note: The data control signals and, possibly, error control information are arranged in a specific format.

page. In a virtual storage system, a fixed-length block that has a virtual address and is transferred as a unit between real storage and auxiliary storage. (I) (A)

paging. The transfer of pages between real storage and auxiliary storage. (I) (A)

PAM. Path available mask.

parallel. (1) Pertaining to a process in which all events occur within the same interval of time, each handled by a separate but similar functional unit; for example, the parallel transmission of the bits of a computer word along the lines of an internal bus. (T) (2) Pertaining to concurrent or simultaneous operation of two or more devices or to concurrent performance of two or more activities in a single device. (A) (3) Pertaining to concurrent or simultaneous occurrence of two or more related activities in multiple devices or channels. (A) (4) Pertaining to the simultaneity of two or more processes. (A) (5) Pertaining to the simultaneous processing of the individual parts of a whole, such as the bits of a character and the characters of a word, using separate facilities for the various parts. (A)

parallel channel. A channel having a System/360 and System/370 channel-to-control-unit I/O interface that uses bus-and-tag cables as a transmission medium. Contrast with *ESCON channel.*

parameter. (1) A variable that is given a constant value for a specified application and that may denote the application. (I) (A) (2) An item in a menu for which the user specifies a value or for which the system provides a value when the menu is interpreted. (3) Data passed between programs or procedures.

partition. See *logical partition* and *target logical partition.*

PASN. Primary address space number.

passive component. In an ESCON environment, any link component that does not contain electronic logic; for example, a splice, connector, adapter, coupler, distribution panel, or optical cable.

password. (1) A value used in authentication or a value used to establish membership in a set of people having specific privileges. (2) A unique string of characters known to the computer system, and to a user who must specify it to gain full or limited access to a system and to the information stored within it.

password identifier. In an ESCON Director, a user-defined symbolic name of 24 characters or fewer that identifies the password user.

patch panel. Synonym for *distribution panel.*

path. In a network, any route between any two nodes. (T)

PB. Pushbutton.

PBC. Page boundary crossing.

PBX. Private branch exchange.

PC. Parity check.

PCC. Processor controller code.

PCCC. Protocol converter check.

PCDU. Power and coolant distribution unit.

PCE. Processor controller.

PCI. (1) Program-controlled interruption. (2) Power control interface.

PCL. Processor controller log.

PCU. Physical control unit.

PD. Problem determination.

PDF. Power distribution frame.

PER. Program event recording.

PF. Program function.

pH. (1) Percentage of hydrogen. (2) Hydrogen-ion concentration.

PH. (1) Polarity hold. (2) Phase.

photocurrent. A stream of electrons produced by photoelectric or photovoltaic effects.

photodiode. A diode designed to produce photocurrent by absorbing light. Photodiodes are used for the detection of optical power and for the conversion of optical power to electrical power. (E)

physical address. The absolute address after configuration (the final address). See also *absolute address, logical address, real address*, and *virtual address*.

physical-contact connector. In an ESCON environment, an optical fiber connector type having a polished end face that aligns precisely with its receptacle, providing an extremely low-loss junction point. Contrast with *non-physical-contact connector*.

physical ID. A unique name used to identify specific components in a data processing complex.

physically partitioned (PP) configuration. A system configuration that allows the processor controller to use both processor complex sides as individual processor complexes. The A-side of the processor controller controls side 0, and the B-side of the processor controller controls side 1. Contrast with *single-image (SI) configuration*.

physical partitioning. The process of reconfiguring the processor complex from the single-image configuration to the physically partitioned (PP) configuration.

PIB. Port information block.

pigtail. In fiber optics, a short length of optical fiber having one unterminated end that can be spliced to another optical fiber.

PIM. Path installed mask.

plenum cable. Cable that is UL-listed as having adequate fire resistance and low smoke-producing characteristics, and can be installed without conduit in ducts, plenums, and other spaces used for environmental air, as permitted by NEC Articles 725-2(b) and 800-3(d).

PMH. (1) Problem management hardware. (2) Power monitoring hybrid.

PMR. Problem management record.

PN. Part number.

PNOM. Path not operational mask.

point-to-point channel path configuration. In an I/O interface, a configuration that consists of a single link between a channel and one control unit. Contrast with *switched point-to-point channel path configuration*.

point-to-point connection. A connection established between two data stations for data transmission. Contrast with *multipoint connection*.

Note: The connection may include switching facilities.

point-to-point line. A switched or nonswitched telecommunication line that connects a single remote station to a computer. Contrast with *multipoint line*.

point-to-point topology. A network topology that provides one communication path between a channel and a control unit and does not include switching facilities. Contrast with *switched point-to-point topology*. See also *multidrop topology*.

polling. (1) On a multipoint connection or a point-to-point connection, the process whereby data stations are invited one at a time to transmit. (I) (2) Interrogation of devices for such purposes as to avoid contention, to determine operational status, or to determine readiness to send or receive data. (A)

POM. Path operational mask.

pop-up window. A movable window, fixed in size, in which a user provides information required by an application so that it can continue to process a user request.

POR. Power-on reset.

port. (1) An access point for data entry or exit. (2) A receptacle on a device to which a cable for another device is attached. See also *duplex receptacle*.

port address. In an ESCON Director, an address used to specify port connectivity parameters and to assign link addresses for attached channels and control units. See also *link address*.

port address name. In an ESCON Director, a user-defined symbolic name of 24 characters or fewer that identifies a particular port.

port card. In an ESCON environment, a field-replaceable hardware component that provides the optomechanical attachment method for jumper cables and performs specific device-dependent logic functions.

port information block (PIB). In an ESCON Director, a data area that contains information relating to the connectivity of each available port.

port number. In an ESCON Director, a hexadecimal number that identifies a physical link connection point. This number is the same as the port address unless the service representative has reassigned the port associated with that address.

POST. Power-on self-test.

power-on reset state. The condition after a machine power-on sequence and before an IPL of the control program.

power-on self-test (POST). A series of tests that are run each time power is switched on.

power/thermal adapter. Hardware that provides the attachment capability for power/thermal stations and allows them to respond to commands from the processor controller.

power/thermal analog-to-digital converter. Hardware that converts the power/thermal sensor signals from analog to digital values.

power/thermal station. Hardware that attaches to the power/thermal adapter and contains the scan control logic.

PP. Physically partitioned (as in configuration).

PPC. Primary power compartment.

ppm. Parts per million.

PRB. Problem record block.

preferred virtual machine. (1) In VM, a particular virtual machine to which one or more of the performance options have been assigned. (2) In the VM/XA System Product, a virtual machine that runs in the V = R (virtual = real) area. The control program gives this virtual machine preferred treatment in performance, processor assignment, and I/O interrupt handling. See also *multiple preferred guests.*

prefetch. To fetch data from central storage before it is needed and to store data in a buffer.

preventive maintenance. Maintenance performed specifically to prevent faults from occurring. (A) Contrast with *corrective maintenance.*

primary distribution panel. The connection point at a building's service entrance that feeds the distribution panels for one or more computer systems.

primary ESCON Manager. In a system environment containing multiple ESCON Managers, the source of ESCM commands.

prioritization and control. Hardware that determines data-flow timing and direction between elements of the channel subsystem.

private branch exchange (PBX). An automatic or manual private telephone exchange for transmission of calls to and from the public telephone network.

problem determination (PD). The process of determining the source of a problem; for example, a program component, machine failure, telecommunication facilities, user or contractor-installed programs or equipment, environmental failure such as a power loss, or user error.

problem determination procedure. A prescribed sequence of steps taken to identify the source of the problem.

problem state. A condition during which the processor cannot execute input/output and other privileged instructions. Contrast with *supervisor state.*

processor complex. A system configuration that consists of all the machines required for operation; for example, a processor unit, a processor controller, a system display, a service support display, and a power and coolant distribution unit.

processor controller. Hardware that initializes and provides support and diagnostic functions for the processor unit.

processor controller code (PCC). Licensed Internal Code that runs in the processor controller.

Processor Resource/Systems Manager (PR/SM) feature. The feature that allows the processor to use several system control programs (SCPs) simultaneously, provides logical partitioning capability for the real machine, and provides support for multiple preferred guests.

processor storage. The storage available to the central processors (central storage and, if installed, expanded storage).

processor unit. Hardware that consists of one or more central processors, central storage, optional expanded storage, channel subsystem, and system control element.

product data. In an ESCON Director, information contained in an electrically-erasable programmable read-only memory (EEPROM) module that defines specific hardware characteristics and can be displayed or modified.

profile. (1) A description of the characteristics of an entity to which access is controlled. (2) Data that describes the significant characteristics of a user, a group of users, or one or more computer resources.

program area (PA). Central storage used to store application programs and data for customer use.

program function (PF) key. On a keyboard, a key that passes a signal to a program to call for a particular operation.

programming RPQ (PRPQ). A customer request for a price quotation on changes or additions to the functional capabilities of system control programming or licensed programs. The RPQ can be used with computing system RPQs to solve unique data processing problems. See also *computing system RPQ.*

programming support console. A logical device used as a data bank access console that can be assigned to any of the physical displays attached to the processor controller.

program mode console. A logical device that can be assigned to any of the physical displays attached to the processor controller.

program status word (PSW). An area in storage used to indicate the sequence in which instructions are executed, and to hold and indicate the status of the computer system.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM as resulting from a defect in a current, unaltered release of the program.

program version. A separate IBM licensed program, based on an existing IBM licensed program, that usually has important new code or functions.

protected field. On a display device, a display field in which a user cannot enter, modify, or erase data. Contrast with *unprotected field.*

protective plug. In an ESCON environment, a type of duplex connector that provides environmental and physical protection. Contrast with *wrap plug.*

protocol. (1) A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. (I) (2) In SNA, the meanings of and the sequencing rules for requests and responses used for managing the network, transferring data, and synchronizing the states of network components. (3) A specification for the format and relative timing of information exchanged between communicating parties.

PRPQ. Programming RPQ.

PR/SM. Processor Resource/Systems Manager.

PS. Power supply.

PSB. Present status byte.

psi. Pound-force per square inch.

PSR. Program support representative.

PSW. Program status word.

PT. Power/thermal.

PTA. Power/thermal adapter.

PTAM. Power/thermal access method.

PTCM. Power/thermal cyclic monitor.

PTF. Program temporary fix.

PTS. Power/thermal station.

PTSA. Power/thermal system adapter.

PTT. Post Telephone and Telegraph.

PU. (1) Processing unit. (2) Physical unit.

Q

Q-array. The buffer array used to transfer information between the processor controller and the system control element.

Q-bus. The logic support station bus used to transfer information between the processor controller and the central processor.

QW. Quadword.

R

radiant power. In fiber optics, the time rate of flow of radiant energy, expressed in watts. The prefix is often dropped and the term power is used. (E)

RAM. Random access memory.

random access memory (RAM). (1) A storage device in which data can be written and read. (2) A storage device into which data is entered and from which data is retrieved in a nonsequential manner.

RAS. Reliability, availability, serviceability.

RC. Return code.

RCS. Remote control support.

REA. Request for engineering action.

read-only memory (ROM). (1) A storage device in which data, under normal conditions, can only be read. (T) (2) Memory in which stored data cannot be modified by the user except under special conditions.

real address. An address before prefixing, such as found in the instruction address portion of the channel

status word (CSW). If translation is off, the logical address is the real address. See also *absolute address*, *logical address*, *physical address*, and *virtual address*.

REC. Request for engineering change.

receiver. In fiber optics, see *optical receiver*.

reconfiguration. (1) A change made to a given configuration in a computer system; for example, isolating and bypassing a defective functional unit or connecting two functional units by an alternative path. Reconfiguration is effected automatically or manually and can be used to maintain system integrity. (T) (2) The process of placing a processor unit, main storage, and channels offline for maintenance, and adding or removing components. (3) Contrast with *nondisruptive installation* and *nondisruptive removal*.

recovery. To maintain or regain system operation after a failure occurs. Generally, to recover from a failure is to identify the failed hardware, to deconfigure the failed hardware, and to continue or restart processing.

REFCODE. Reference code.

reference code. See *system reference code*.

reflection. In fiber optics, the abrupt change in direction of a light beam at an interface between two dissimilar media so that the light beam returns to the medium from which it originated. Reflection from a smooth surface is termed specular, whereas reflection from a rough surface is termed diffuse. (E)

reg. Register.

register. A part of internal storage having a specified storage capacity and usually intended for a specific purpose. (T)

remote. Synonym for *link-attached*.

remote support facility (RSF). A system facility invoked by Licensed Internal Code that provides procedures for problem determination and error detection.

REN. Ringer equivalence number.

repeater. In fiber optics, see *optical repeater*.

repressible machine check. A machine-check interrupt to a central processor that can be masked and delayed because the error that resulted in the machine check did not cause a loss of data integrity. Contrast with *exigent machine check*.

request for engineering action (REA). A document that starts the release of an engineering change.

request for price quotation (RPQ). See *computing system RPQ* and *programming RPQ (PRPQ)*.

RER. Reformatted error record.

response field. On a display device, a specified area on the display space where the user can enter, change, or erase response data.

return code. (1) A code used to influence the execution of succeeding instructions. (A) (2) A value returned to a program to indicate the results of an operation requested by that program.

reverse video. A form of highlighting a character, field, or cursor by reversing the color of the character, field, or cursor with its background; for example, changing a red character on a black background to a black character on a red background.

RIF. Register interface.

ring network. A network configuration in which devices are connected by unidirectional transmission links to form a closed path.

Note: A ring of an IBM Token-Ring Network is referred to as a LAN segment or as a Token-Ring Network segment.

ring segment. Any section of a ring that can be isolated (by unplugging connectors) from the rest of the ring. A segment can consist of a single lobe, the cable between access units, or a combination of cables, lobes, or access units (or all).

ring sequence. The order in which devices are attached on a ring network.

ring station. A station that supports the functions necessary for connecting to a LAN and for operating with the token-ring protocols. These include token handling, transferring copied frames from the ring to the using node's storage, maintaining error counters, observing medium access control (MAC) sublayer protocols (for address acquisition, error reporting, or other duties), and (in the full-function stand-alone mode) directing frames to the correct data link control (DLC) link station.

ring topology. A logically circular, unidirectional transmission path without defined ends in which control can be distributed or centralized.

RMF. Resource Measurement Facility.

rms. Root-mean-square.

RO. Read only.

ROM. Read-only memory.

ROS. Read-only storage.

rotational position sensing (RPS). A function that permits a DASD to reconnect to a block multiplexer channel when a specified sector has been reached. This allows the channel to service other devices on the channel during positional delay.

router. An attaching device that connects two LAN segments, which use similar or different architectures, at the reference model network layer. Contrast with *bridge* and *gateway*.

row. A horizontal arrangement of data. Contrast with *column*.

RPQ. Request for price quotation.

RSC. Remote support center.

RSF. Remote support facility.

R/W. Read/write.

RWSTG. Reserve-area working storage.

S

s. Second.

SA. (1) System area. (2) Stand-alone.

SAA. Systems Application Architecture.

SAD. System activity display.

SADS. System activity display support.

SAT. Sequential address table.

saturation level. In fiber optics, the maximum input power that can be received without increasing the error rate.

saved configuration. In an ESCON environment, a stored set of connectivity attributes whose values determine a configuration that can be used to replace all or part of the ESCD's active configuration. Contrast with *active configuration*.

SC. Storage controller.

scalar. (1) A quantity characterized by a single value. (I) (A) (2) A type of program object that contains either string or numeric data. It provides representation and operational characteristics to the byte string to which it is mapped. (3) Pertaining to a single data item as opposed to an array of data items. (4) Contrast with *vector*.

scan. An operation that writes data to or reads data from functional elements through shift register latches arranged in scan rings.

scan bus. The bus used by the processor controller to monitor all system elements by sampling facility scan ring latches. The processor controller can also control and initialize system elements by using the scan bus to change system facilities and to control clocks.

scan commands. Service language commands that allow scan ring data to be displayed, changed, and compared.

scan data in (SDI). Synonym for *scanin*.

scan data out (SDO). Synonym for *scanout*.

scan in. To write data to a scan ring.

scanin. A serial data transfer from a logic support station to a thermal conduction module.

scan out. To read data from a scan ring.

scanout. A serial data transfer from a thermal conduction module to a logic support station.

scan ring. Shift register latches on the perimeters of functional elements that enable hardware to be initialized or monitored by the processor controller using the logic support station scan bus.

scattering. In fiber optics, the change in direction of light rays or photons after striking a small particle or particles. In can also be regarded as the diffusion of a light beam caused by the inhomogeneity of the transmitting medium. (E)

SCB. Sense command byte.

SCE. System control element.

SCH. Subchannel.

SCP. System control program.

screen. See *display screen*.

scroll. To move a display image vertically or horizontally to display data that cannot be observed within the boundaries of the display frame.

SCS. Single channel service.

SCSW. Subchannel status word.

S/D. Serializer/deserializer.

SDI. Scan data in.

SDLC. Synchronous Data Link Control.

SDO. Scan data out.

SEC. System engineering change.

secondary ESCON Manager. In a system environment containing multiple ESCON Managers, an ESCM that receives a command from the primary ESCM through intersystem communication.

selection field. An area on a display frame that cannot be scrolled and contains a fixed number of choices.

selector channel. An I/O channel designed to operate with only one I/O device at a time. After the I/O device is selected, a complete record is transferred 1 byte at a time. Contrast with *byte multiplexer channel*. See also *block multiplexer channel*.

selector pen. Synonym for *light pen*.

sensitivity. In optical system receivers, the minimum power required to achieve a specified quality of performance in terms of output signal-to-noise ratio or other measure. (E) For example, sensitivity could be expressed in decibels with reference to 1 milliwatt (dBm) at a specific bit error rate (BER).

service clearance. Minimum space required to allow working room for the person installing or servicing a unit.

service console. A logical device used by service representatives to maintain the processor complex and to isolate failing field-replaceable units (FRUs). The service console can be assigned to any of the physical displays attached to the processor controller.

service information message (SIM). A message appearing on the operator console and indicated in the EREP exception report that indicates the need for repair or customer action. The SIM identifies the affected area of the storage control or device and the effect of the service action.

Service panel. The part of the control panel assembly on the processor controller used only by service representatives to perform a maintenance or repair action.

service representative. A person who performs maintenance services for IBM hardware products or systems. See also *IBM program support representative*.

service support display. A display station attached to a port of the processor controller and required for service support. See also *system display*.

session. In SNA, a logical connection between two network addressable units (NAUs) that can be activated, tailored to provide various protocols, and deactivated as requested.

sheathing. Synonym for *jacket*.

shift register latch. Logic that operates either in parallel for normal (register-to-register) data flow or serially (from the high-order to low-order positions) during a scan operation.

SI. Single-image configuration.

SID. Save installation data.

signal interruption. A logic signal sent from the channel subsystem to the central processor at the completion of an I/O operation that indicates the subsystem needs to transfer information. The signal is sent as a coded series of bits contained in a command to the system control element.

signal work (SIGW). A logic signal sent from the central processor to the channel subsystem that indicates the processor is beginning or halting an I/O operation.

SIGW. Signal work.

SIM. Service information message.

simulate. (1) To represent certain features of the behavior of a physical or abstract system by the behavior of another system; for example, to represent a physical phenomenon by means of operations performed by a computer or to represent the operations of a computer by those of another computer. (I) (A) (2) To imitate one system with another, primarily by software, so that the imitating system accepts the same data, executes the same computer programs, and achieves the same results as the imitated system. (A) Contrast with *emulate*.

simulation. The use of a data processing system to represent selected behavioral characteristics of a physical or abstract system; for example, the representation of air streams around airfoils at various velocities, temperatures, and air pressures. Contrast with *emulation*.

single channel service (SCS). Testing a single channel while the other channels remain operational. See also *concurrent maintenance*.

single-image configuration. A system configuration that allows the processor controller to use one processor complex side while the other side is available as a backup. The A-side or B-side becomes the operational processor complex, the remaining side becomes the backup, and all the functional elements can be activated.

single-mode optical fiber. An optical fiber in which only the lowest-order bound mode (which can consist of a pair of orthogonally polarized fields) can propagate at the wavelength of interest. (E) Contrast with *multimode optical fiber*.

single point of failure. A failure, usually in one unit, that causes down time for multiple units and, possibly, the whole system.

SLC. Service language command.

SLDM. Storage and logic diagnostic monitor.

SMS. Storage management subsystem.

SNA. Systems Network Architecture.

soft copy. (1) A nonpermanent copy of the contents of storage in the form of a display image; for example, a cathode ray tube display. (T) (2) Information that a machine can read or obtain from a storage medium. (3) One or more files that can be electronically distributed, manipulated, and printed by a user.

soft error. (1) An error that occurs sporadically and that may not appear on successive attempts to read data. (T) (2) An intermittent error on a network that requires retransmission. (3) Contrast with *hard error*.

Note: A soft error by itself does not affect overall reliability of the network, but reliability may be affected if the number of soft errors reaches the ring error limit.

solid-state component. A component whose operation depends on control of electric or magnetic phenomena in solids; for example, a transistor, crystal diode, or ferrite core. (E)

source address. Synonym for *origin address*.

SP. Service processor.

SPD. Service processor damage.

spectral width. In fiber optics, a measure of the wavelength extent of a spectrum. (E)

SPEF. System prompting entry field.

splice. See *optical fiber splice*.

splice loss. Synonym for *insertion loss*.

S/R. Send/receive.

SS. (1) Side switch. (2) Start-stop.

SSCP. System services control point.

standard. Something established by authority, custom, or general consent as a model or example.

static reconfiguration. Pertaining to a processor complex reconfiguration between a single-image (SI) configuration and a physically partitioned (PP) configuration when the system control program is not active. Contrast with *dynamic reconfiguration*.

station. (1) An input or output point of a system that uses telecommunication facilities; for example, one or more systems, computers, terminals, devices, and associated programs at a particular location that can send or receive data over a telecommunication line. (2) A location in a device at which an operation is performed; for example, a read station. (3) In SNA, a link station.

step-index fiber. An optical fiber having a uniform refractive index in the core. (E) Contrast with *graded-index fiber*.

storage. (1) A functional unit into which data can be placed, in which they can be retained, and from which they can be retrieved. (T) (2) The action of placing data into a storage device. (I) (A)

storage control. In a DASD subsystem, the component that connects the DASD to the host channels, performs channel commands, and controls the DASD devices. For example, the 3990 Model 2 and Model 3 are storage controls.

storage director. In a 3990 Storage Control, a logical entity consisting of one or more physical storage paths in the same storage cluster. In a 3880 Storage Control, a storage director is equal to a storage path.

storage key. (1) An indicator associated with one or more storage blocks that requires that tasks have a matching protection key in order to use the blocks. (2) A control field associated with a defined block of storage that protects that block of storage from unauthorized access and change.

storage management subsystem (SMS). An operating environment that helps automate and centralize the management of storage. To manage storage, SMS provides the storage administrator with control over data class, storage class, management class, storage group, and automatic class selection routine definitions.

storage subsystem. A storage control and its attached storage devices.

strength member. In an optical cable, material that can be located either centrally or peripherally and that functions as a strain relief.

stride. The number of element positions in storage needed to advance from one vector element to the next. For example, contiguous vectors have a stride of one.

subarea. A portion of the SNA network consisting of a subarea node, attached peripheral nodes, and associated resources. Within a subarea node, all network addressable units (NAUs), links, and adjacent link stations in attached peripheral or subarea nodes that are addressable within the subarea share a common subarea address and have distinct element addresses.

subchannel. In 370-XA and ESA/390 modes, the facility that provides all of the information necessary to start, control, and complete an I/O operation.

subchannel number. A system-unique 16-bit value used to address a subchannel. See also *channel path identifier, device identifier*, and *device number*.

subsystem. A secondary or subordinate system, or programming support, usually capable of operating independently of or asynchronously with a controlling system. (T) See *DASD subsystem* and *storage subsystem*.

subsystem storage. Synonym for *cache*.

supervisor state. A condition during which a processor can execute input/output and other privileged instructions. Contrast with *problem state*.

SVCH. Service channel.

switched line. A telecommunication line in which the connection is established by dialing. Contrast with *nonswitched line*.

switched point-to-point channel path configuration. In an ESCON I/O interface, a configuration that consists of a link between a channel and an ESCON Director and one or more links from the ESCD, each of which attaches to a control unit. This configuration depends on the capabilities of the ESCD for establishing and removing connections between channels and control units. Contrast with *point-to-point channel path configuration*.

switched point-to-point topology. A network topology that uses switching facilities to provide multiple communication paths between channels and control units. See also *multidrop topology*. Contrast with *point-to-point topology*.

switchover. Pertaining to the operation that changes the backup side of the processor controller to the active side and places the active side offline.

synchronous. (1) Pertaining to two or more processes that depend on the occurrence of specific events, such as common timing signals. (T). (2) Occurring with a regular or predictable time relationship. Contrast with *asynchronous*.

Synchronous Data Link Control (SDLC). A discipline conforming to subsets of the Advanced Data Communication Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop. (I) Contrast with *binary synchronous communication (BSC)*.

SYSGEN. System generation.

SYSIML. System initial machine load.

SYSIN. System input.

SYSLOG. System log.

SYSOUT. System output.

Sysplex Timer. An IBM table-top unit that synchronizes the time-of-day (TOD) clocks in as many as 16 processors or processor sides.

SYSRESET. System reset.

system activity display support. A function that monitors the busy status of each central processor and channel.

system configuration. A process that specifies the devices and programs that form a particular data processing system.

system console. (1) A console, usually having a keyboard and a display screen, that is used by an operator to control and communicate with a system. (2) A logical device used for the operation and control of hardware functions (for example, IPL, alter/display, and reconfiguration). The system console can be assigned to any of the physical displays attached to the processor controller.

system control element (SCE). Hardware that handles the transfer of data and control information associated with storage requests between the elements of the processor.

system control programming (SCP). IBM-supplied programming that is fundamental to the operation and maintenance of the system. It serves as an interface with licensed programs and user programs and is available without additional charge.

system display. A display station that attaches to a port of the processor controller and is required for normal system operation. See also *service support display*.

system generation (SYSGEN). The process of selecting optional parts of an operating system and of creating a particular operating system tailored to the requirements of a data processing installation. (I) (A)

system log (SYSLOG). A data set or file in which job-related information, operational data, descriptions of unusual occurrences, commands, and messages to or from the operator are stored.

System Power panel. The part of the control panel assembly on the processor controller used by both customers and service representatives to determine and control the power status of both the processor controller and the processor complex. Contrast with *Service panel*.

system reference code. A code that contains information, such as a failing field-replaceable unit, for a service representative.

system reset (SYSRESET). To reinitialize the execution of a program by repeating the initial program load (IPL) operation.

system resource. Hardware, such as a central processor, I/O devices, channel paths, software programs, or other components that contribute to system operation. See also *critical resource*.

Systems Application Architecture (SAA). A set of IBM software interfaces, conventions, and protocols that provide a framework for designing and developing applications that are consistent across systems.

system services control point (SSCP). In SNA, the focal point within an SNA network for managing the configuration, coordinating network operator and problem determination requests, and providing directory support and other session services for end users of the network. Multiple SSCPs, cooperating as peers, can divide the network into domains of control, with each SSCP having a hierarchical control relationship to the physical units (PUs) and logical units (LUs) within its domain.

Systems Network Architecture (SNA). The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of, networks.

T

tap. A signal used to alert the receiver during communication between the IOP and a channel (CHN). For an IOP tap, the IOP is the receiver and the tap functions as a channel interrupt. For a CHN tap, the channel is the receiver and the tap functions as an unsolicited response.

target logical partition. In LPAR mode, the current or immediate logical partition being used or displayed. It is identified on the status line and determined by the SETLP service language command.

target processor. The processor that controls execution during a program restart, instruction trace, stand-alone dump, or IPL, and whose ID is identified by highlighting on the status line.

TCC. Top-card connector.

TCM. Thermal conduction module.

TDHFR. Temporary DID history file record.

tera. Ten to the twelfth power, 1 000 000 000 000 in decimal notation. When referring to storage size, 2 to the fortieth power, 1 009 511 627 776 in decimal notation.

terminal. (1) A functional unit in a system or communication network at which data may enter or leave. (T) (2) A point in a system or communication network at which data can either enter or leave. (A) (3) In data communication, a device, usually having a keyboard and display device, capable of sending and receiving information. See also *display station* and *workstation*.

TH. Thermal.

thermal conduction module (TCM). A field-replaceable unit (FRU) that has multiple logic modules containing level-sensitive scan design logic.

threshold. A level, point, or value above which something is true or will take place and below which it is not true or will not take place.

time-of-day (TOD) clock. A system hardware feature that is incremented once every microsecond, and provides a consistent measure of elapsed time suitable for indicating date and time. The TOD clock runs regardless of whether the processor is in a running, wait, or stopped state.

time-out. (1) An event that occurs at the end of a predetermined period of time that began at the occurrence of another specified event. (I) (2) A time interval allotted for specific operations to occur; for example, response to polling or addressing before system operation is interrupted and must be restarted. (3) A terminal feature that logs off a user if an entry is not made within a specified period of time.

TOD. Time of day.

token. A sequence of bits passed from one device to another on the token-ring network that signifies permission to transmit over the network. It consists of a starting delimiter, an access control field, and an end delimiter. The access control field contains a bit that indicates to a receiving device that the token is ready to accept information. If a device has data to send along the network, it appends the data to the token. When data is appended, the token then becomes a frame.

token-bus network. (1) A bus network in which a token-passing procedure is used. (T) (2) A network that uses a ring topology, in which tokens are passed in a sequence from node to node. A node that is ready to send can capture the token and insert data for transmission. (3) A group of interconnected token rings.

token-ring network. (1) A ring network that allows unidirectional data transmission between data stations, by a token passing procedure, such that the transmitted data return to the transmitting station. (T)

(2) A network that uses ring topology, in which tokens are passed in a circuit from node to node. A node that is ready to send can capture the token and insert data for transmission.

Note: The IBM Token-Ring Network is a baseband LAN with a star-wired ring topology that passes tokens from network adapter to network adapter.

topology. The physical or logical arrangement of nodes in a computer network.

TOS. (1) Time-out sequencer. (2) Time-out sequence.

TP. (1) Test point. (2) Teleprocessing.

TPA. Thermal process analog.

TPC. Thermal process controller.

TPF. Transaction processing facility.

TPO. Time-out power off.

trace. (1) A record of the execution of a computer program. It exhibits the sequences in which the instructions were executed. (A) (2) A record of the frames and bytes transmitted on a network.

transducer. A device for converting energy from one form to another. (E)

transistor-transistor logic (TTL). A circuit in which the multiple-diode cluster of the diode-transistor logic circuit has been replaced by a multiple-emitter transistor.

transmission character. In an I/O interface, a group of 10 bits, derived from the transmission code, that is sent and received serially by bit over the interface.

transmission code. (1) A code for sending information over telecommunication lines. (2) In an I/O interface, a 10-bit code that forms transmission characters. Data is encoded 8 bits at a time into 10-bit transmission characters. Information is received over the link 10 bits at a time, and those transmission characters used for data are decoded into the correct 8-bit codes. Other 10-bit special transmission characters are used for functions that must be distinguishable from the contents of the frame.

transmission control character. (1) A control character used to control or facilitate transmission of data between data terminal equipments. (I) (A) (2) Characters transmitted over a line that are not message data but cause specific control operation to be performed when encountered. Among such operations are addressing, polling, message delimiting and blocking, transmission error checking, and carriage return.

transmission frame. In data transmission, data transported from one node to another in a particular format that can be recognized by the receiving node. In addition to a data or information field, a frame has some kind of delimiter that marks its beginning and end and usually control fields, address information that identifies the source and destination, and one or more check bits that allow the receiver to detect any errors that may occur after the sender has transmitted the frame.

transmission medium. The physical medium that conveys signals between data stations; for example twisted pair, optical fiber, and coaxial cable. (T)

Note: Free space is a transmission medium for electromagnetic waves.

transmittance. In fiber optics, the ratio of transmitted power to incident power. (E)

transmitter. In fiber optics, see *optical transmitter*.

transmitter-receiver subassembly (TRS). In an ESCON environment, the electronic component that contains an optical transmitter and an optical receiver. See also *fiber optic subassembly*.

trap. (1) An unprogrammed conditional jump to a specified address that is automatically activated by hardware. A recording is made of the location from which the jump occurred. (I) (2) A forced Licensed Internal Code branch, usually to an error routine.

TRS. Transmitter-receiver subassembly.

trunk cable. In an ESCON environment, a cable consisting of multiple fiber pairs that do not directly attach to an active device. This cable usually exists between distribution panels and can be located within, or external to, a building. Contrast with *jumper cable*.

TSO. Time sharing option.

TSO/E. TSO Extensions.

TSO Extensions (TSO/E). In MVS, a time-sharing system accessed from a terminal that allows user access to MVS system services and interactive facilities.

TTA. Twin-tail adapter.

TTL. Transistor-transistor logic.

U

UCW. Unit control word.

UE. Uncorrectable error.

UEPO. Unit emergency power off.

UL. Underwriters Laboratory.

unformatted display. A display screen on which the user has not defined a display field. Contrast with *formatted display*. See also *protected field*.

unit address. The last two hexadecimal digits of a device address or a device number.

Note: Often used interchangeably with control unit address and device address in System/370 mode.

unit control word. An identifier that contains the control information necessary for a channel to perform input/output operations to an attached device.

unit emergency power off (UEPO). A readily accessible control device that removes all power from one or more units beyond the power control compartment.

unprotected field. A displayed field in which a user can enter, change, or delete data. Contrast with *protected field*.

upstream. (1) In the direction opposite to data flow or toward the source of transmission. (2) Toward the processor from an attached unit or end user. Contrast with *downstream*.

URSF. Universal remote support facility.

USEF. User-specified entry field.

user identification (user ID). A string of alphanumeric characters that identifies a user to a system.

USOC. Universal Service Order Code.

USP. United States Pharmacopoeia.

utility disk. A diskette or hard disk that contains the Licensed Internal Code necessary to run various utilities; for example, to copy portions of a diskette for a backup diskette.

UV. Undervoltage.

V

V. Volt.

V ac. Volts alternating current.

VAC. Vector activity count.

validation test (VT). (1) A test to determine whether an implemented system fulfills its specified requirements. (T) (2) A test to check hardware for error-free operation following repair, replacement, or engineering changes.

validation test case list. A list of validation tests scheduled by the automatic fault isolation manager or selected by the diagnostic display frame manager to verify a fault or to reduce the size of a field-replaceable unit group.

variable. (1) In programming languages, a language object that may take different values, one at a time. The values of a variable are usually restricted to a certain data type. (I) (2) A quantity that can assume any of a given set of values. (A) (3) A name used to represent a data item whose value can be changed while the program is running.

vary concentrator. A system control program interface that allows the execution of multiple Vary requests from a single control point.

V dc. Volts direct current.

VE. Vector element.

vector. (1) A quantity usually characterized by an ordered set of numbers. (I) (A) (2) A one-dimensional array. Contrast with *scalar*.

vector facility. An optional feature that enables a processor to run programs that issue vector instructions used for scientific calculations.

VF. Vector facility.

virtual address. The address of a location in virtual storage. A virtual address must be translated into a real address to process the data in processor storage. See also *absolute address*, *logical address*, *physical address*, and *real address*.

virtual machine (VM). (1) A virtual data processing system that appears to be at the exclusive disposal of a particular user, but whose functions are accomplished by sharing the resources of a real data processing system. (T) (2) A functional simulation of a computer system and its associated devices, multiples of which can be controlled concurrently by one operating system.

Virtual Machine/System Product (VM/SP). An IBM licensed program that manages the resources of a single computer so that multiple computing systems appear to exist. Each virtual machine is the functional equivalent of a "real" machine.

virtual storage (VS). (1) The storage space that may be regarded as addressable main storage by the user of a computer system in which virtual addresses are mapped into real addresses. The size of virtual storage is limited by the addressing scheme of the computer system and by the amount of auxiliary storage available, not by the actual number of main storage locations. (I) (A) (2) Addressable space that is apparent to the user as the processor storage space,

from which the instructions and the data are mapped into the processor storage locations.

visible light spectrum. The portion of the light spectrum (up to 750 nm) that can be seen. See also *wavelength*.

VM. Virtual machine.

VMCF. Virtual machine communication facility.

VM/ESA. Virtual Machine/Enterprise Systems Architecture.

VM/SP. Virtual Machine/System Product.

VM/SP HPO. Virtual Machine/System Product High Performance Option.

VM/XA. Virtual Machine/Extended Architecture.

VM/XA SF. Virtual Machine/Extended Architecture Systems Facility.

VM/XA SP. Virtual Machine/Extended Architecture System Product.

voice-grade channel. A data communication channel suitable for transmission of speech, digital data, or analog data, or for facsimile telegraphy, usually with a frequency range of about 300 to 3000 Hz.

voice-grade telephone line. A telephone line that is normally used for transmission of voice communication. The line requires a modem for data communication.

VP. Voltage present.

VS. Virtual storage.

VSE. Virtual storage extended.

VT. Validation test.

VTAM. Virtual telecommunications access method.

W

W. Watt.

WAN. Wide area network.

warning message. An indication that a possible error has been detected. See also *error message* and *information message*.

waveform. The mathematical representation of a wave, especially a graph of deviation at a fixed point versus time.

wavelength. The distance from one point in a periodic waveform to the same point in the next cycle.

Note: ESCON links operate using a wavelength of 1300 nm. However, other typical wavelengths can be 850 or 1550 nm.

WCS. Writable control storage.

wide area network (WAN). A network that provides communication services to a geographic area larger than that serviced by a local area network or a metropolitan area network, and that may use or provide public communication facilities. (T)

wideband. Synonym for *broadband*. (T)

window. (1) A choice in the action bar of some applications. Users select it to arrange the display of several windows or to change the active window. (2) A choice in the action bar of multiple-document interface applications. (3) A choice in an action bar that allows the user to arrange the display of all open windows and to change the active window. (4) A choice in the action bar of multiple-document interface applications that allows a user to arrange the display of all open windows and to change the active window.

wiring closet. A room that contains one or more equipment racks and distribution panels that are used to interconnect cables.

Note: Sometimes called a *network wiring closet* to distinguish it from a telephone wiring closet.

work area. An area reserved for temporary storage of data to be operated on.

workstation. (1) A functional unit at which a user works. A workstation often has some processing capability. (T) (2) A terminal or microcomputer, usually one that is connected to a mainframe or network, at which a user can perform applications. (3) See also *display station* and *terminal*.

WP. Write protect.

wraparound. The continuation of an operation from the maximum addressable location in storage to the first addressable location.

wrap plug. In an ESCON environment, a type of duplex connector used to wrap the optical output signal of a device directly to the optical input. Contrast with *protective plug*.

wrap test. A test that checks attachment or control unit circuitry without checking the mechanism itself by returning the output of the mechanism as input. For example, when unrecoverable communication adapter or machine errors occur, a wrap test can transmit a specific character pattern to or through the modem in a loop and then compare the character pattern received with the pattern transmitted. See also *optical wrap*.

X

X.21. In data communication, a recommendation of the International Telegraph and Telephone Consultative Committee (CCITT) that defines the interface between data terminal equipment and public data networks for digital leases and circuit switched synchronous services.

X.25. In data communication, a recommendation of the CCITT that defines the interface between data terminal equipment and packet switching networks.

Z

ZH. Zero high.

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Readers' Comments

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and Configuration Guide

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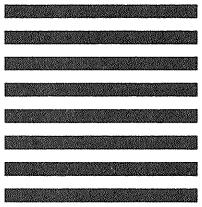

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