



PC Server 310

User's Reference

Note

Before using this information and the product it supports, be sure to read the general information under Appendix, "Product Warranties and Notices" on page 89.

First Edition (July, 1996)

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About This Book

This *PC Server 310 User's Reference* provides an overview of the technologies and features that make up your server. It is intended for anyone who has an interest in learning more about the IBM PC Server 310.

This reference does not provide specific instructions for performing procedures. That information is on your *PC Server 310 Setup and Installation sheet* and in your *PC Server 310 User's Handbook*.

How This Book is Organized

Chapter 1, "Introducing Your PC Server 310," contains an overview of the features and expansion capabilities of your server. This chapter also includes the PC Server 310 specifications.

Chapter 2, "Server Performance," contains information about server performance, the advantages of using a LAN, and tuning your server for optimal performance in your environment.

Chapter 3, "Microprocessors and Memory," contains general information about the microprocessors and types of memory in the PC Server 310 models.

Chapter 4, "Bus Architecture," describes the PC Server 310 bus architecture. Each PC Server 310 model has two expansion slots that are industry standard architecture (ISA) and three expansion slots that are shared peripheral component interconnect (PCI) and ISA. This advanced multiple-bus architecture provides high performance and a large selection of expansion options.

Chapter 5, "Data Storage Devices," explains PC Server 310 data storage capabilities and includes general information about the types of storage devices that you can install, such as diskette drives, hard disk drives, CD-ROM drives, and tape drives.

Chapter 6, “The SCSI Subsystem,” describes the SCSI (small computer system interface) subsystem. Your server uses the SCSI interface to communicate with SCSI devices such as hard disk drives, read-and-write optical drives, CD-ROM drives, tape drives, scanners, and printers.

Chapter 7, “Configuration,” contains information about the configuration process. It also contains a description of the configuration programs provided with your PC Server 310.

Chapter 8, “Input/Output Ports and Connectors,” contains information about ports and connectors on the PC Server 310 models, including the infrared port, keyboard, mouse, serial port, universal serial bus (USB), parallel port, video, Ethernet adapter, and SCSI adapter. Pin assignments for the I/O connectors are provided to help you determine if a device is compatible with your server.

Chapter 9, “Video Subsystem,” contains information about the super video graphics array (SVGA) controller and video device drivers. This chapter also includes detailed information about some of the monitors that you can attach to your server.

Chapter 10, “Security Features,” describes how to secure the server hardware and network data stored on the server, and describes the selectable-drive startup feature.

Appendix, “Product Warranties and Notices,” contains your product warranty and special notices, such as a list of trademarks used in this book.

If you find a term you're not familiar with, refer to the glossary located in the back of this book.

An index follows the glossary.

Related Publications

In addition to this *PC Server 310 User's Reference*, the following publications come with your PC Server 310:

- The *PC Server 310 Setup and Installation sheet* contains the instructions for installing your server.
- The *PC Server 310 User's Handbook* contains instructions for installing optional hardware, installing operating systems, and configuring your server. This book also describes how to troubleshoot the server and how to obtain service and technical assistance.
- The *PC Server Service and Support* pamphlet contains important information and phone numbers to call for different types of support for your PC Server.

The *IBM PC Server Hardware Maintenance Manual Supplement* is available for purchase. It contains error codes, advanced diagnostic procedures, and a parts catalog for PC Servers. This manual is intended for trained service technicians. (Diagnostic Diskettes are not included.)

To obtain a complete listing of publications that are available in the U.S. and Puerto Rico, call 1-800-426-7282. In Canada, call Customer Assistance at 1-800-465-1234. In all other countries, contact the IBM support organization that services your area, your IBM marketing representative, or your IBM reseller.

Chapter 1. Introducing Your PC Server 310

The PC Server 310 is designed to meet your needs today and provide expansion capabilities for the future. Your system is a high-performance server; microprocessor performance, memory, system expansion, flexibility, and large amounts of data storage are high priorities. Your PC Server 310 is designed for ease of use and reliability.

Your server is built around a powerful Intel Pentium microprocessor. You can upgrade the microprocessor as faster models become available. Your server also supports advanced 32-bit operating systems, such as the IBM OS/2 operating system and Microsoft Windows NT.

As always, your PC Server 310 meets stringent worldwide certifications for power, EMC (electromagnetic compatibility), and safety.



Features at a Glance

<p>Microprocessor</p> <ul style="list-style-type: none"> • Intel Pentium <p>Cache Memory</p> <ul style="list-style-type: none"> • Level-1, 16 KB • Level-2, 256 KB expandable to 512 KB <p>Memory</p> <ul style="list-style-type: none"> • 16 MB minimum, expandable to 160 MB • 60 ns, ECC-parity • Four SIMM sockets in two banks • One DIMM socket in one bank <p>Diskette Drives</p> <ul style="list-style-type: none"> • Standard: 3.5-inch, 1.44 MB • Optional (internal): 3.5-inch, 1.44 MB <p>Hard Disk Drives</p> <ul style="list-style-type: none"> • Number and capacities of drives vary by model • Supports up to three internal drives <p>CD-ROM Drive</p> <ul style="list-style-type: none"> • Standard: SCSI <p>Keyboard and Mouse (Auxiliary-Device)</p> <ul style="list-style-type: none"> • IBM keyboard • Mouse 	<p>Expansion Bays</p> <ul style="list-style-type: none"> • Two 5.25-inch drive bays • Three 3.5-inch drive bays • The number of bays available for expansion varies by model <p>Expansion Slots</p> <ul style="list-style-type: none"> • Two 16-bit ISA slots • Three 32-bit PCI/ISA shared slots • The number of slots available for expansion varies by model <p>Video</p> <ul style="list-style-type: none"> • Super video graphics array (SVGA) • Compatibility: <ul style="list-style-type: none"> – Color graphics adapter (CGA) – Video graphics array (VGA) <p>Security Features</p> <ul style="list-style-type: none"> • Bolt-down capability • Door lock • Selectable drive-startup • Power-on and administrator passwords <p>Upgradable POST and BIOS</p> <ul style="list-style-type: none"> • Upgradable EEPROM on the system board • POST/BIOS upgrades (when available) 	<p>Input/Output Connectors</p> <ul style="list-style-type: none"> • One infrared port • One keyboard port • One mouse (auxiliary-device) port • One serial port • Two universal serial bus (USB) ports • One parallel port • One video (monitor) port • One UltraSCSI adapter <ul style="list-style-type: none"> – One 8-bit internal port – One 16-bit internal port – One 16-bit external port • One Ethernet adapter (installed on some models) <ul style="list-style-type: none"> – 10Base-T – 10Base2 – 10Base5 <p>Power Supply</p> <ul style="list-style-type: none"> • 200 Watt with voltage switch (115–230 V ac) • Built-in overload and surge protection
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What Your PC Server 310 Offers

The PC Server 310 offers impressive performance using the Pentium microprocessor. Your server also provides large data-storage capabilities, enhanced system expandability, and SVGA video graphics. Ethernet networking is installed on some models. This system design provides a powerful, cost-effective server.

The PC Server 310 takes advantage of advancements in microprocessor speed, memory capacity, application programs, communication devices, and operating environments. It offers innovative multiple-bus architecture. This bus architecture defines the size, physical arrangement, and logical relationships of the expansion slots.

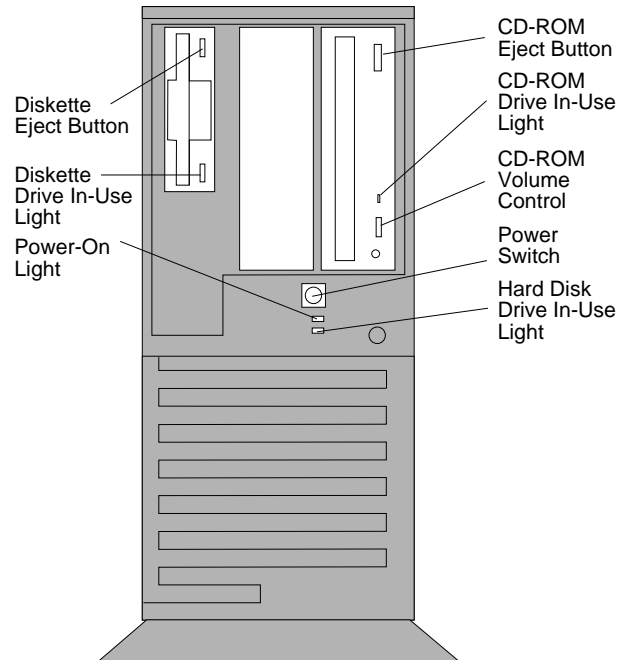
A riser card on the system board in your server provides five industry standard architecture (ISA) expansion slots and three peripheral component interconnect (PCI) expansion slots. A SCSI adapter is installed in one of the PCI expansion slots, and on some models, an Ethernet adapter is installed in one of the ISA slots.

The three PCI slots and their adjacent ISA slots are *shared expansion slots*. You can install an adapter in either the PCI expansion slot or the adjacent ISA expansion slot, but not in both.

The PCI bus architecture provides a high-performance local bus that supports high-throughput requirements, such as video adapters and mass storage adapters. The ISA bus remains the most popular PC bus architecture, supported by thousands of adapters and applications.

Controls and Status Indicators

The following illustration shows the location of the most commonly used controls and status indicators.



CD-ROM Eject Button: Push this button to release a CD-ROM from the drive.

CD-ROM Drive In-Use Light: This light is on whenever the CD-ROM drive is accessed.

CD-ROM Volume Control: Turn this to adjust the CD-ROM playback volume.

Power Switch: Press this to turn on or turn off your server. Do not turn off your server if any of the drive in-use lights are on. This might damage the information stored on a hard disk or diskette.

Hard Disk Drive In-Use Light: This lights when your server is accessing a SCSI device.

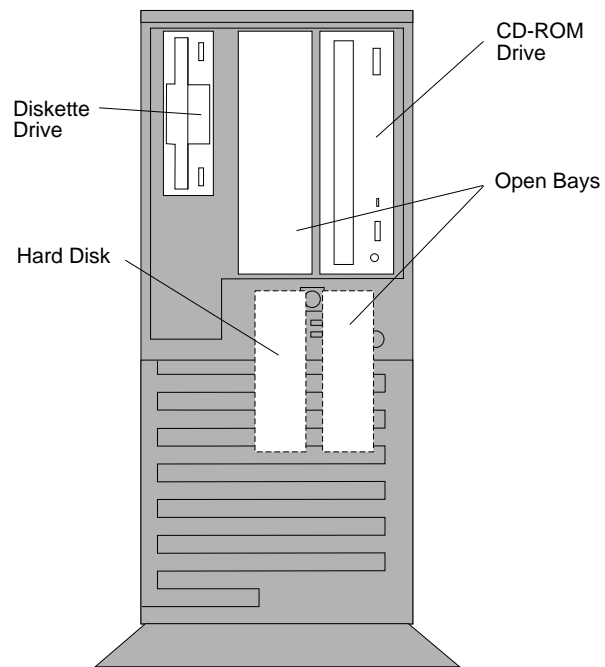
Power-On Light: This lights when you turn on your server.

Diskette-Drive In-Use Light: This lights when the drive is accessing a diskette.

Diskette Eject Button: Push this button to release a diskette from the drive.

Expansion Bays

The following illustration shows the location of the expansion bays. Your server comes with a 3.5-inch, 1.44 MB diskette drive and a CD-ROM drive. The number of hard disk drives that come with your server varies by model.



CD-ROM Drive: All models come with a CD-ROM drive.

Open Bays: The open bays provide the flexibility to use combinations of 3.5-inch or 5.25-inch hard disk, CD-ROM, tape, and rewritable optical drives in your server. For installation instructions and information about the types of drives that you can install in each bay, see your *PC Server 310 User's Handbook*.

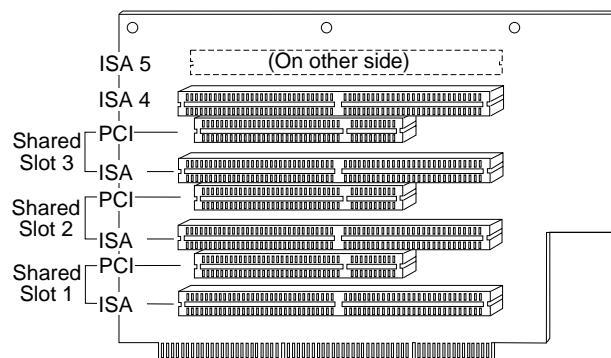
Hard Disk Drive: The number of preinstalled drives and their capacities vary by model.

Diskette Drive: All models come with a 3.5-inch, 1.44 MB diskette drive that uses 1 MB (unformatted) and 2 MB (unformatted) diskettes. For optimum use, format 1 MB diskettes to store 720 KB of data and 2 MB diskettes to store 1.44 MB of data.

Note: See Chapter 5, "Data Storage Devices" on page 37, for more information about data storage devices you can install in your server. For the latest information about available options, contact your IBM marketing representative or your IBM reseller.

Expansion Slots

The following illustration shows the riser card that comes in the PC Server 310.



The riser card contains five industry standard architecture (ISA) expansion slots and three peripheral component interconnect (PCI) expansion slots. The three PCI slots and their adjacent ISA slots are *shared expansion slots*. You can install an adapter in either the PCI expansion slot or the adjacent ISA expansion slot, but not in both.

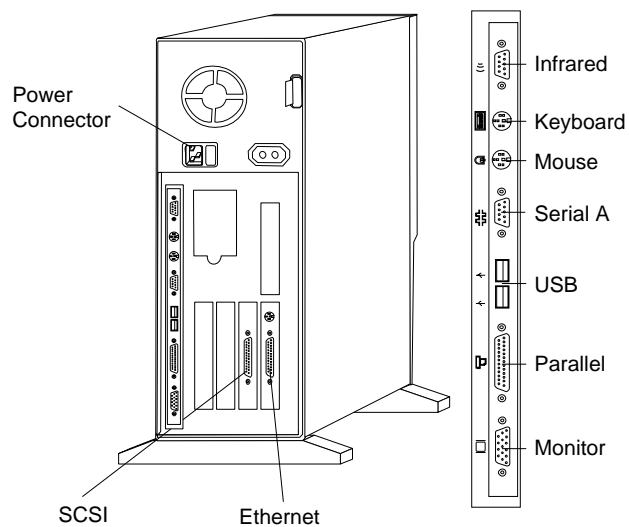
One of the PCI expansion slots contains a SCSI adapter, and on some models, one of the ISA slots contains an Ethernet adapter.

This leaves two shared PCI/ISA slots available for future expansion and, depending on your model, one or two ISA slots available. For example, you can add adapters to provide communications, specialized graphics, and sound.

Input/Output Ports

The following illustration shows the location and type of input/output ports (connectors) on your PC Server 310.

For pin assignments and other information about these connectors, see Chapter 8, “Input/Output Ports and Connectors” on page 57.



Power Connector: The server power cable attaches here.

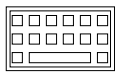
Ethernet Connector: The connector for the Ethernet network attaches here.



SCSI Connector: External SCSI devices attach here.



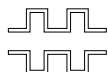
Infrared Connector: The infrared (IR) transceiver module attaches here. The IBM Infrared (IR) Transceiver option includes TranXit software. During installation, when the TranXit Setup Connection dialog box appears, click on *National 306/334 Evaluation Board* to select the driver that supports your system.



Keyboard Connector: The keyboard cable attaches here.



Mouse (Auxiliary-Device) Connector: The mouse (auxiliary-device) cable attaches here.



Serial Connectors: Serial signal cables for modems or other serial devices attach here. To attach 25-pin signal cables, you must use a 9-pin-to-25-pin adapter cable.



Universal Serial Bus (USB) Connector: You can attach I/O devices to these two USB connectors. A 4-pin cable is needed to connect devices to USB 1 or 2.



Parallel Connector: The signal cable for a parallel device, such as a printer, attaches here.



Monitor Connector: The monitor signal cable attaches here. Some specialized monitors, however, have signal cables that connect to an optional video adapter. Refer to the instructions that come with your monitor.

Plug and Play

Plug and Play is a technology designed to make PCI/ISA servers more convenient to expand and operate. Your server automatically recognizes ISA Plug and Play adapters and configures the server accordingly.

PCI adapters provide similar convenience. Your server automatically assigns system resources, such as memory and interrupt levels, to PCI adapters. This ensures that the server is configured correctly.

International Capabilities

The PC Server 310 is suitable for use worldwide. Electric power can vary from country to country; however, a switch enables you to set the PC Server 310 voltage to the standard power available in your country. See your *PC Server 310 Setup and Installation sheet* for information about switching voltages.

Language is another factor to consider. You can use your system with editions of operating systems that enable the system and keyboard to operate in other languages. With the appropriate adapter, those same operating systems also enable the display of some ideographic characters on your monitor. Now you can use one system to communicate in many languages.



Reliability, Availability, and Serviceability

Three of the most important factors in server design are *reliability*, *availability*, and *serviceability* (RAS). These factors help to ensure:

- The integrity of the data stored on your server
- That your server is available when you want to use it
- That, should a failure occur, you can easily diagnose and repair the failure with minimal inconvenience

The following is a list of some of the RAS features of your PC Server 310. Many of these features are described in later chapters of this book, or in your *PC Server 310 User's Handbook*.

- Menu-driven configuration programs
- Power-on self-test (POST) and Fast POST
- 24-hour customer support center¹
- Menu-driven diagnostic programs
- Error codes and messages
- Upgradable POST and basic input/output system (BIOS) code
- Parity-protected memory (can also be used in error correction code (ECC) mode)
- Parity checking on the:
 - SCSI bus
 - Keyboard interface
 - Serial ports

Operating System Support

You can use the PC Server 310 in a variety of environments to do many different tasks. To meet the requirements of these environments, your server supports several operating systems. Some operating systems, such as OS/2 2.1 or later, support more than 16 MB of memory. For more information, refer to your operating-system documentation or contact your IBM marketing representative or IBM reseller.

¹ Response time may vary, depending on the number and nature of the calls received.

Specifications

<p>Size</p> <ul style="list-style-type: none"> • With pedestal: <ul style="list-style-type: none"> - Depth: 455 mm (17.9 in.) - Height: 450 mm (17.7 in.) - Width: 260 mm (10.2 in.) • Without pedestal: <ul style="list-style-type: none"> - Depth: 455 mm (17.9 in.) - Height: 420 mm (16.5 in.) - Width: 155 mm (6.1 in.) <p>Weight</p> <ul style="list-style-type: none"> • Typical configuration as shipped: 14.2 kg (31.2 lb) <p>Heat Output</p> <ul style="list-style-type: none"> • Approximate heat output in British thermal units (Btu) per hour: <ul style="list-style-type: none"> - Minimum configuration: 150 Btu (44 watts) - Maximum configuration: 1434 Btu (420 watts) 	<p>Environment</p> <ul style="list-style-type: none"> • Air temperature: <ul style="list-style-type: none"> - System on: 10° to 35° C (50° to 95° F) Altitude: 0 to 914 m (3000 ft.) - System on: 10° to 32° C (50° to 90° F) Altitude: 914 m to 2133 m (3000 ft. to 7000 ft.) - System off: 10° to 43° C (50° to 110° F) Maximum Altitude: 2133 m (7000 ft.) • Humidity: <ul style="list-style-type: none"> - System on: 8% to 80% - System off: 8% to 80% • Maximum altitude: 2133 m (7000 ft) 	<p>Electrical Input</p> <ul style="list-style-type: none"> • Sine-wave input (50 to 60 Hz) is required • Input voltage: <ul style="list-style-type: none"> - Low range: <ul style="list-style-type: none"> - Minimum: 90 V ac - Maximum: 137 V ac - High range: <ul style="list-style-type: none"> - Minimum: 180 V ac - Maximum: 265 V ac • Input kilovolt-amperes (kVA) approximately: <ul style="list-style-type: none"> - Minimum configuration as shipped: 0.08 kVA - Maximum configuration: 0.52 kVA <p>Total Power Available for Drives</p> <ul style="list-style-type: none"> • Nominal Operating Current allowed: <ul style="list-style-type: none"> - +5 V dc line: 9.3 A - +12 V dc line: 6.0 A
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Chapter 2. Server Performance

Your productivity and satisfaction, as well as that of everyone on your network, depend upon server performance. Several factors influence the performance of your server, such as the configuration of the server hardware, application workloads, server operating-system configuration parameters, and the server operating environment.

This chapter provides information to help you avoid potential performance bottlenecks and includes suggestions for improving server performance.

One of the main capabilities of a local area network (LAN) is sharing of resources, such as data and expensive peripheral devices. The ability to share resources can mean a decrease in the cost of an individual workstation, because every workstation might not need its own software, printer, or hard disk. Also, sharing resources can improve work flow, work quality, and productivity.

Some reasons for this are:

- Centralized databases are easily shared.
- Security of information is more easily ensured.
- Using electronic mail, you can send meeting notices, notes, messages, letters, and text files to multiple users simultaneously.

Integrated Systems Management

The ServerGuide package that comes with your server gives you the option of installing IBM TME 10 NetFinity. NetFinity is a systems-management program that enhances the capabilities of your LAN. View the demonstration program and read the information in the ServerGuide package to learn more about NetFinity and how NetFinity can help you.

Performance Tuning

A performance tuning feature available on the ServerGuide CD (provided with your server) enables you to easily customize the programmable registers of your system so that your applications run faster than before. Use the ServerGuide performance tuning feature and follow instructions on the screen to improve the performance of your server.

Understanding Server Performance

You can optimize the performance of your server by balancing the performance of its main components. These components include the:

- Network operating system
- Application programs
- Network adapter
- System memory
- System microprocessor
- Hard disk subsystem (SCSI adapter and drives)

Network Operating System

Always check the documentation that comes with the network operating system to determine which parameters affect performance and which, if any, parameters you can change to increase performance. If you have a large network or increase the size of a network, you will probably need to adjust some settings to achieve optimum performance.

It is good practice to record the original settings before making any changes. If performance decreases, you can return the settings to their original values. It is also good practice to document a change by adding remarks, such as the date and the reason for the change, above or below the values that you change. If you need to make additional changes, such information can save you valuable time.

Application Programs

To allow you to improve performance in a network environment, many complex programs let you change specific parameters. To determine which parameters you can change, and when to change them, use the instructions that come with your program.

For the reasons mentioned in “Network Operating System” on page 16, it is good practice to record the original settings before you make any changes. If possible, document your changes by adding remarks near the values that you change.

Network Adapter

Some models of the PC Server 310 come with an Ethernet adapter (Ethernet 10 Mbps ISA). If you decide you need network throughput that is greater than this adapter provides, you can install a network adapter with higher performance or connect your server to a faster network. For example, you can install a bus-master Ethernet adapter. Bus-master network adapters provide higher throughput rates because they handle most of the network processing and leave the system microprocessor free for other tasks.

Adding a faster network adapter provides additional throughput. Therefore, the total number of transactions that the server processes per second increases and the application response time decreases. However, as you add more users, the effects of the faster network adapter are offset by the increase in data space access and write-data processing.

IBM and other companies offer baseband, broadband, token-ring, and Ethernet adapters for peripheral component interconnect (PCI) and industry standard architecture (ISA) systems.

For a current list of the network adapters that are available for your model, contact your IBM marketing representative or IBM reseller.

System Memory

When you have a large network or you have increased the size of a small network, you might need to install additional memory to maintain adequate performance. Additional memory might be needed to support additional application programs, buffers, or control blocks.

System Microprocessor

One way to improve system microprocessor performance is to lighten its load by using bus-master adapters. A bus-master adapter handles tasks, such as network processing or data transfers, with minimal system microprocessor involvement.

Another way to improve performance is to upgrade your microprocessor. To do this, follow instructions in your *PC Server 310 User's Handbook* to replace your existing microprocessor with a new, more powerful one.

The Hard Disk Subsystem

Your server has an UltraSCSI adapter that significantly increases performance by handling the processing of SCSI commands and data transfers, leaving the system microprocessor free to handle other tasks. Depending on your particular configuration, you might need to install an additional SCSI adapter when attaching external SCSI devices.

Estimating Server Performance and Capacity

There are no simple methods for evaluating your server performance in all environments. The hardware, software, applications, workloads, and number of users all affect server performance.

When you are ready to do a performance evaluation, you must always use a systematic approach. A good example of this approach follows:

1. Define the functional requirements of your server for your working environment.
2. Define what you consider to be adequate performance, such as response times and transaction rates.
3. Understand what factors affect server performance.
4. Decide what an approximate configuration of applications for your work environment would be.
5. Measure the current performance of your server by using a variety of application configurations.
6. Use the performance results to determine:
 - The location of performance bottlenecks
 - Which configuration provides sufficient performance today
 - Which configuration allows room for growth
7. Ensure that the performance of the server will still be acceptable if a component fails.

Improving Server Performance

Before you begin to experiment with applying upgrades or enhancements to improve performance, remember that the subsystem that causes a bottleneck depends largely on your applications.

Try to determine which applications most closely resemble your environment; concentrate on obtaining improvements for that application. It is possible that some changes might improve the performance of your application, but degrade the performance for other applications. If this occurs, you will need to assess the trade-offs.

When you understand the factors that affect server performance, you can then use a methodical approach to improving it. A good example of this type of approach is:

1. Measure the current server performance.
2. Identify the performance bottlenecks.
3. Upgrade components that cause the bottlenecks.
4. Measure the new performance of the server.

For example, if the bottleneck is memory, you could install additional memory; if the bottleneck is the hard disk subsystem, you could install an additional drive or create a disk array. You can replace slow network adapters with faster ones, or you can install additional adapters.

Chapter 3. Microprocessors and Memory

The processing center of your server contains devices that run programs and store data used by programs. These devices include the microprocessor and the components of the memory subsystem.

Microprocessor

The microprocessor is an integrated circuit that performs most of the control and computing functions of your server. A Pentium microprocessor is installed in your server.

Clock

The rate at which the microprocessor performs its basic operations is called the *clock speed*. Examples of basic operations include fetching an instruction from memory, decoding it, executing it, writing the result to memory, and so on. The process of executing an instruction always consists of several basic operations. The design of the microprocessor determines the maximum clock speed at which it can operate reliably, and the design of the server determines the optimal clock speed for the server. Clock speed is measured in megahertz (MHz).

A *clock cycle* is the time unit that measures how long the microprocessor takes to perform a basic operation at a given clock speed. Clock cycles are measured in nanoseconds (ns) and are inversely related to the clock speed. For example, at a clock speed of 25 MHz, one clock cycle takes 40 ns; at a clock speed of 100 MHz, one clock cycle takes 10 ns. The microprocessor in your server operates at two different clock speeds: one speed for transferring data into and out of the microprocessor, and a faster speed for internal microprocessor operations.

Performance

The Pentium microprocessor gains its high performance through its *superscalar* design. The microprocessor contains three *execution units*. Each execution unit can issue an instruction in one clock cycle and each contains a *pipeline*. A pipeline holds multiple instructions in various stages of execution. For example, while one instruction is being fetched two instructions are decoded, another is executed, and the results of another are written to memory. Compared to a microprocessor running at the same speed, but not using pipelining and multiple execution units, this design can speed up instruction execution by a factor of 15.

In practice, the speedup is much less. In many clock cycles, the microprocessor does not issue an instruction. Memory accesses, even to very fast cache memory, take multiple cycles to finish. Some instructions spend many clock cycles in the execution stage of a pipeline. Still, performance is substantially improved.

Registers and Interfaces

The microprocessor needs data, instructions, or both for each basic operation. Instructions and data are copied from memory into data-storage locations, known as *registers*, in the microprocessor. The microprocessor can read from and write to its registers very quickly. The registers also store the results of processing operations, until the results are needed for other operations or are written to memory.

The microprocessor *data interface* is the connection between the microprocessor and the data bus. The data interface of the microprocessor is 64 bits wide. For local operations, such as memory accesses, data is transferred 64 bits at a time.

The industry standard architecture (ISA) bus is 16 bits wide, and it supports 16-bit and 8-bit ISA adapters. The peripheral component interconnect (PCI) expansion bus is 32 bits wide, and it supports 32-bit PCI adapters. PCI adapters transfer 32 bits at a time; the 16-bit ISA adapters transfer 16 bits at a time and the 8-bit ISA adapters transfer eight bits at a time.

The set of instructions that the microprocessor can perform determines whether a particular program will run in the server. Programs, written for a 32-bit interface, require only that the microprocessor be capable of decoding and performing 32-bit instructions. The width of the data bus does not affect software compatibility.

The size of the microprocessor *address interface*, which connects the microprocessor and the address bus, determines the width of the address bus and the amount of physical memory the microprocessor can address. The Pentium microprocessor in your server has a 32-bit address interface and can address up to 4 GB of physical memory.

Real Mode and Protected Mode

The microprocessor has a *real mode* with a 1 MB address space. When the microprocessor is in the real mode, your server can run programs written for earlier models of the IBM Personal Computer. The real mode is the default condition for the microprocessor; the microprocessor is always in the real mode after the server is turned on and before any operating system is started. The real mode does not support virtual memory (see “Physical Memory and Virtual Memory” on page 26).

The microprocessor also has a *protected mode*, which supports virtual memory and allows the microprocessor to address more than 1 MB of memory. In protected mode in a multitasking environment, the microprocessor manages the memory so that each program is protected from interference from other programs running at the same time.

The operating system you install determines whether the microprocessor stays in the real mode or is switched to the protected mode. For example, when the server runs DOS, the microprocessor stays in the real mode. DOS makes only limited use of the capabilities provided by the protected mode. When the IBM OS/2 operating system starts, it switches the microprocessor to the protected mode. The OS/2 operating system uses the virtual memory and multitasking capabilities provided by the protected mode of the microprocessor.

Note: The OS/2 operating system has a real mode and a protect mode. These operating-system modes are not related to the real mode and protected mode of the microprocessor.

Numeric Computing

The microprocessor in your server has an execution unit that executes only floating-point arithmetic and mathematical instructions. This execution unit, called the *floating-point unit* (FPU), executes the types of instructions previously executed by the separate math coprocessors used in earlier personal computers. These instructions, generally called *numeric instructions*, perform basic floating-point arithmetic and a variety of mathematical functions.

The microprocessor control circuits pass data and instructions to the FPU, which then performs the mathematical operations. The two other execution units, called *integer units*, can execute instructions concurrently with the FPU. The FPU is pipelined, so several floating point instructions can be in various stages of execution simultaneously.

Programs that require extensive mathematical calculations run much faster when the FPU performs the calculations, because the FPU is designed specifically for that purpose. A program that is intended to use the FPU must contain specific instructions that are recognized by the FPU. Otherwise, the program will not activate the FPU, and the integer units will perform the calculations.

Memory Subsystem

The memory subsystem consists of a memory controller, random access memory and read-only memory, physical memory and virtual memory, and cache memory.

Memory Controller

The memory controller is a device that controls access to system memory by the microprocessor and I/O devices. Registers in the memory controller contain information about the amount and type of memory that is installed in the server. During a system reset, the POST routine writes this information into the registers.

Random Access Memory and Read-Only Memory

Random access memory (RAM) is used for temporary storage of data and instructions during processing. RAM is *volatile* memory, and it is contained in memory components known as single-inline memory modules (SIMMs) and dual-inline memory modules (DIMMs). To retain its contents, it must have a constant supply of electrical current. When the server is turned off, no current is supplied to RAM, so RAM data is lost.

The system board has a small area of *nonvolatile* RAM. A small current from the system battery allows this RAM to retain its contents while the server is turned off. The power-on password, time and date, and system configuration information are stored here.

Read-only memory (ROM) stores the programs that the server uses for startup procedures and other internal operations. These programs are permanently encoded in the ROM module. ROM is *nonvolatile* memory and retains its contents when the server is turned off. Generally, the contents of ROM modules cannot be modified. However, your server contains electrically erasable programmable ROM (EEPROM) modules (or flash memory) that can be modified. For example, the power-on self-test (POST) and basic input/output system (BIOS) code in your server are stored in *flash memory*, so they can be updated (modified) whenever enhancements are made.

Physical Memory and Virtual Memory

Physical memory consists of all the writable memory locations in the server, most of which are in single-inline memory modules (SIMMs). Portions of the physical memory are reserved for the operating system, for the power-on self-test, and for the video data that is being displayed. The part of physical memory available for instructions and data that the server uses to run programs is *system memory*.

Your server supports up to 160 MB of 60 ns/70 ns parity RAM. You can add memory to your server by installing 4 MB, 8 MB, 16 MB, or 32 MB SIMMs, or a 16 MB or 32 MB DIMM. See your *PC Server 310 User's Handbook* for more information about installing additional RAM.

Virtual memory is memory that appears to be allocated to application programs. The operating system uses a portion of the hard disk as virtual memory, swapping data and instructions between the hard disk and physical memory. The portion of the hard disk used for virtual memory is often called *swap space*. The amount of swap space on the disk determines the amount of available virtual memory, which is typically much larger than the actual amount of installed physical memory.

Virtual memory supports very large programs and *multitasking*. In multitasking, multiple programs run simultaneously. The memory requirements of these programs can exceed the amount of available physical memory. The operating system allocates the memory required by each program as virtual memory and manages the available physical memory, swapping portions of each program's address space to the hard disk as required.

The maximum amount of virtual memory that an operating system can allocate is determined by the microprocessor and limited by the amount of available swap space. The microprocessor in your server can address up to 64 TB of virtual memory in the protected mode.

Cache Memory

Cache memory temporarily stores frequently used data in a *cache*, a fast, relatively small buffer between the microprocessor and system memory. Cache memory can respond to requests to read from or write to memory without imposing *wait states* on the microprocessor. A wait state is a clock cycle during which the microprocessor suspends processing and waits for a response to a request to read to or write from system memory (a *memory I/O operation*). Wait states cause the server to operate less efficiently than it would if the microprocessor did not suspend processing.

The system board in your server contains level-1 and level-2 caches. Cache performance depends on the size of the cache and the application programs you are running on your server.

Level-1 Cache

The level-1 cache is implemented as an area of very fast RAM in the microprocessor. This type of cache memory is also referred to as an internal cache. A Pentium microprocessor provides 16 KB of level-1 cache memory: 8 KB for data and 8 KB for instructions.

The level-1 cache stores the data and instructions most frequently used by the microprocessor in the current execution context. (The execution context is the executable code and associated data used by the program running on the microprocessor.) When the execution context changes, the level-1 cache controller copies new data and instructions into the cache, replacing data and instructions that are no longer needed. The microprocessor executes programs much faster, because it sends fewer read and write requests to system memory.

Server performance improves each time the microprocessor finds what it needs in the cache (a *cache hit*). The microprocessor is designed so that the cache hit rate is very high, and the penalty for a *cache miss* is minimized. A cache miss occurs when the information needed by the microprocessor is not available in the cache. In the case of a cache miss, the level-1 cache controller must request the needed data from the level-2 cache or system memory. One or more wait states are imposed on the microprocessor while the data is located. The cache controller on the microprocessor manages the use of the cache so that the number of cache hits far exceeds the number of cache misses.

Level-2 Cache

The system board in your server has a 256 KB level-2 cache (expandable to 512 KB). The level-2 cache consists of high-speed static random access memory (SRAM). The level-2 cache provides an intermediate level of storage between the level-1 cache and system memory. Although level-2 cache accesses are slower than level-1 cache accesses, level-2 cache accesses are still much faster than system memory accesses.

In the case of a level-1 cache miss, the microprocessor can access the level-2 cache relatively quickly. When the microprocessor cannot find what it needs in the level-2 cache, this is known as a *second-level cache miss*. When a *second-level cache miss* occurs, the cache controller locates the data or instruction in system memory and copies it into one of the caches.

Write-Back Mode

For maximum performance, both caches are set to the write-back mode. In the write-back mode, the microprocessor updates the cache in just over one clock cycle. After the microprocessor updates the cache, the cache controller updates system memory. The microprocessor is free to perform other operations while the cache controller updates system memory. Because the cache controller updates system memory, which is a relatively lengthy process, the microprocessor is free to execute instructions.

Chapter 4. Bus Architecture

This section contains an overview of input/output (I/O) buses and explains how advanced I/O buses can improve performance.

A computer *bus* is a pathway of wires and signals that carries (or transfers) information inside the server; information includes data, addresses, instructions, and controls. The microprocessor has an external bus, called the *processor bus* or *local bus*, that carries information between the microprocessor and main memory. The local bus has the same bus width (64 bits) as the microprocessor and operates at the same external speed.

Another computer bus (*I/O bus* or *expansion bus*) carries information between the microprocessor or memory, and the I/O peripheral devices. The performance of the microprocessor-bus has improved rapidly, but improvements in the performance of I/O-buses have not equalled those of microprocessors and some peripheral devices, such as video and disk controllers. Regardless of how fast the microprocessor and other components are, data transfers between them must pass through the I/O bus.

Your server has two I/O buses: the *industry standard architecture* (ISA) bus and the *peripheral component interconnect* (PCI) bus. PCI is an advanced I/O bus standard developed by the computer industry to keep up with performance improvements of microprocessor buses and advanced peripheral devices. Although advanced designs can only match microprocessor bus performance up to a point, they do achieve higher throughput by speeding up the I/O bus and widening its data path. PCI is intended to add to, but not replace, the capability provided by the ISA bus.

ISA Bus Overview

One of the most widely used and successful I/O buses is the *industry standard architecture* (ISA) bus. The ISA bus is a 16-bit bus that operates at a speed of 8 MHz. It can transfer up to 8 MB of data per second between the microprocessor and an I/O device. Practical performance ranges between 4 MB and 8 MB per second.

The ISA bus continues to be popular because so many adapters, devices, and applications are designed and marketed for it. Peripheral devices that do not require faster throughput, such as fax modems, can use ISA. Also, ISA is adequate for users of DOS applications in a stand-alone environment, or for DOS network requestors with moderate performance requirements.

ISA buses are suitable for many applications but they cannot transfer data fast enough, for today's high-speed microprocessors and I/O devices. For example, the ISA bus might not provide the performance requirements of an application with high resolution and high-color content, or the requirements of a video device. Also, ISA might not be capable of handling the throughput required by some fast hard disk drives, network controllers, or full-motion video adapters.

PCI Bus Overview

The *peripheral component interconnect* (PCI) bus is an answer to the need for a higher-performance I/O bus. PCI architecture offers many features that improve I/O-bus performance such as:

- Industry-standard compatibility
- Wider data path
- Faster data-transfer rates
- More efficient data-transfer methods
- Enhanced peripheral-device performance
- Automatic configuration

Interface

The PCI bus connects to the microprocessor local bus through a buffered bridge controller. A *bridge* translates signals from one bus architecture to another. PCI and ISA devices get all their data and control information through the PCI controller. The PCI controller looks at all signals from the microprocessor local bus and then passes them to the ISA controller, or to peripheral devices connected to the PCI bus. However, the PCI bus is not governed by the speed of the microprocessor bus. The PCI bus can operate at speeds as fast as 33 MHz, slow down, or even stop if there is no activity on the bus, all independent of the microprocessor's operations. This independence is a distinguishing feature of the PCI bus that allows the microprocessor to do other work while the I/O bus is busy. Microprocessor independence also makes the PCI bus adaptable to various microprocessor speeds and allows consistency in the design and use of PCI peripheral devices.

Performance

One of the most significant features of the PCI bus is its 32-bit data path, which is twice the width of the ISA 16-bit data path. With the 32-bit data path and a higher speed of up to 33 MHz, the PCI bus can transfer information much faster than the ISA bus. Based on the mode of operation and the components used, the PCI bus can transfer data at speeds of up to 132 MB per second.

Peripheral Devices

The wider data path and higher throughput make the PCI bus a more suitable bus for today's high-speed microprocessors and I/O devices. Higher throughput translates into higher performance of peripheral devices, such as higher video resolutions, more colors, and quicker screen refreshes. The use of PCI architecture in your server enhances the performance of the monitor and the storage devices. The video controller is connected to the PCI bus on the system board. Thus, the peripheral devices that have the greatest demand for higher performance are supported by the benefits of PCI architecture.

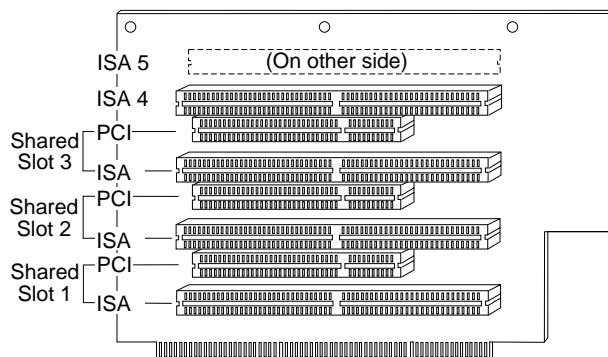
Expansion Bus Features

If you want to add new capabilities, such as communication, specialized graphics, or audio to your server, you can do so by installing optional *adapters*. Your server provides ISA expansion features so you can take advantage of the wide availability of ISA peripheral devices and applications. PCI expansion features allow you to add high-performance devices to your server, such as video or SCSI adapters.

You can install adapters into expansion slots in your server. These slots are grouped together on a *riser card* that connects to the ISA and PCI buses on the system board. The riser card has three shared PCI/ISA slots and two dedicated ISA slots.

The width of the I/O bus determines the types of adapters the server supports. The shared slots support 16-bit ISA adapters and 32-bit PCI adapters. The dedicated ISA slots only support 16-bit ISA adapters. The width of the I/O bus does not affect software compatibility.

You can install up to five adapters on the riser card. Each PCI connector and the ISA connector directly below it share an expansion slot opening at the back of the server. You can install a PCI adapter or an ISA adapter in a shared slot, but not both. The following illustration shows the PCI/ISA riser card.



The PCI bus operates at up to 33 MHz with a 32-bit data path. PCI connectors support both 3.3-volt and 5-volt adapters. A separate power cable connects to the back of the riser card to supply 3.3-volt power.

Also, there are expansion connectors on the system board for connecting additional storage devices to your server. For information about installing adapters and other optional features, refer to your *PC Server 310 User's Handbook*.

Adapter Configuration

When you install ISA adapters, you must configure them.

Plug and Play is a configuration method that makes expanding your PC Server 310 easier. Plug and Play adapters are easier to install and set up because they configure automatically.

ISA adapters that are not Plug and Play devices are referred to as *legacy* devices. The Configuration/Setup Utility program can help you manually configure legacy adapters.

For more information, see “Adapter Configuration” on page 54.

Chapter 5. Data Storage Devices

The IBM storage devices described in this chapter, along with a wide variety of industry standard storage devices, are used to expand the data storage capacity of your server.

Direct Access Storage Devices

In a direct access storage device (DASD), the time required to access data does not depend on the location of the data on the storage medium. These devices include diskette drives, hard disk drives, CD-ROM drives, and rewritable optical drives.

Diskette Drives

A 3.5-inch, 1.44 MB diskette drive comes as standard equipment on the PC Server 310. The drive uses diskettes with a formatted capacity of 720 KB or 1.44 MB of data. You can purchase an additional drive as an option.

To prevent loss of data, always format 1 MB diskettes to store 720 KB of data and 2 MB diskettes to store 1.44 MB of data.

SCSI Hard Disk Drives

IBM offers a variety of hard disk drives of various capacities and performance capabilities. The number of hard disk drives that your server can support is determined by your operating system. Refer to your operating-system documentation to determine the number of hard disk drives that your operating system supports.

Your server has an Adaptec UltraSCSI adapter that supports SCSI devices, such as hard disk drives, optical drives, and tape drives. For more information about the SCSI subsystem and the devices it supports, see Chapter 6, "The SCSI Subsystem." All models come with a SCSI CD-ROM drive.

The PC Server 310 supports drives that comply with ANSI SCSI Standards: X3.131-1986 (SCSI), X3.131-1994 (SCSI-2), and X3T10/1071D (proposed SCSI-3 standard).

SCSI CD-ROM Drive

Compact disc-read only memory (CD-ROM) drives use a disc that contains information that can only be viewed. The information cannot be changed or updated. While diskette drives, hard disk drives, and tape drives use a magnetic recording technique, CD-ROM drives use an optical technique that reads data at a much higher density than magnetic recording can achieve. All IBM CD-ROM drives use industry-standard, 5.25-inch CDs with formatted capacities of approximately 680 MB of data.

IBM CD-ROM drives comply with ANSI SCSI Standards: X3.131-1986 (SCSI) or X3.131-1994 (SCSI-2). They support CD-ROM, Extended Architecture (XA), a standard for interleaving different types of data, such as video, audio, and text. This provides you with the option of expanding your system to work with advanced multimedia applications.

Tape Drives

Tape drives are sequential-access devices that provide an excellent, cost-effective way to back up the important data on your server. In a sequential-access (or serial-access) device, data is stored in the same sequence as it was entered. For more information about the tape drives available for the PC Server 310, contact your IBM marketing representative or your IBM reseller.

IBM External SCSI Storage Enclosures

You can use a SCSI storage enclosure to increase the data-storage capacity of any server that has a SCSI controller. The IBM PC Server Enterprise Expansion Enclosure shown in the following illustration is one of several enclosures that you can attach to the external SCSI connector on your server.



The publication that is provided with the external enclosure includes information about setting it up, installing drives, removing drives, and attaching the enclosure to the server.

Chapter 6. The SCSI Subsystem

The PC Server 310 comes with a small computer system interface (SCSI) bus. Your server uses the SCSI interface to communicate with SCSI devices such as hard disk drives, read-and-write optical drives, CD-ROM drives, tape drives, scanners, and printers.

The SCSI subsystem in your server consists of the UltraSCSI adapter (referred to as the SCSI adapter), cabling, and connectors that allow the attachment of SCSI devices to your server. The adapter serves as the controller, sending commands to installed SCSI devices. The cabling provides a bus to carry the commands and data to and from the SCSI devices.

Advantages of the SCSI Subsystem

Before the SCSI standards were developed, many physical devices required controllers (usually adapters) that could support only one device or multiple devices of the same type. Because each device required support from the system microprocessor, every device added to the system increased the workload on the microprocessor. Also, because almost every device required its own adapter in a separate expansion slot, flexibility and growth were limited by the number of expansion slots in the system.

The SCSI standards define the interface through which the system communicates with different types of devices. Each SCSI device has a built-in *device controller* that interprets SCSI commands. The SCSI standards define the commands and messages that are used in the interface.

Several SCSI devices can operate concurrently and share the interface, achieving significantly higher overall data-transfer rates. You can realize faster, more efficient I/O management for network file servers by using the SCSI subsystem. The SCSI subsystem produces significant improvements in system performance and flexibility over other I/O interfaces.

In the PC Server 310, the maximum number of internal SCSI devices is four. One of the devices is a CD-ROM drive and the other three devices are hard disk drives or other SCSI devices. The number and capacity of hard disk drives varies by model. Depending on your particular configuration, you might need to install an additional SCSI adapter when attaching external SCSI devices.

The SCSI adapter supports:

- SCSI devices that conform to ANSI SCSI Standards:
 - X3.131-1986 (SCSI)
 - X3.131-1994 (SCSI-2)
 - X3T10/1071D (proposed SCSI-3 standard)
- Devices compatible with the SCSI Common Command Set
- Functions that are unique to a particular SCSI device, when they are supported by a specific device driver provided by the device manufacturer

Types of Interfaces

The two most common types of interfaces for attaching devices to a server are *device-level* interfaces and *bus-level* interfaces. The SCSI is a bus-level interface.

Device-Level Interfaces

Each device connected to a device-level interface has a controller that is mounted on a separate adapter, away from the physical device. Functions such as formatting, head selection, and error detection are directed by the controller and not by the device itself. The device is limited to performing the mechanical operations of reading and writing data, and it can do only what the controller allows it to do. There are limitations on the types of devices you can attach to the same controller.

Bus-Level Interfaces

Each device connected to a bus-level interface has a *device controller* that provides the details of how to accomplish the tasks performed by the device. A set of commands, the Common Command Set, specifies the tasks that devices are to perform. Each *device controller* determines how the tasks will be performed. The SCSI adapter imposes few restrictions on the number and types of devices that you can attach to it.

The SCSI standard allows great flexibility in the design of devices. Hardware manufacturers can develop SCSI devices to perform functions without requiring that the SCSI adapter supports those functions. Functions unique to a particular SCSI device are supported by the device driver provided by the device manufacturer. As new SCSI devices become available, there is no need to install new SCSI adapters. You can attach many different devices, such as hard disk drives, CD-ROM drives, scanners, and printers, to the same SCSI controller.

Physical Configuration

The following list describes a possible configuration of the SCSI subsystem in a PC Server 310:

- The UltraSCSI adapter is connected to the PCI bus.
- SCSI devices are attached by cable to one of the SCSI connectors on the UltraSCSI adapter. A cable attached to one of the adapter connectors inside the server provides connectors for internal SCSI devices. A cable (or series of cables) attached to the adapter connector on the back of the server provides connectors for external SCSI devices.
- The first external device is connected to an external SCSI cable, which connects to the external SCSI port. The external SCSI port is a 68-pin connector on the SCSI adapter. The connector is accessible on the rear panel of the PC Server 310. Additional external devices are connected to each other with SCSI option-to-option cables. The last external device must have a terminator; if there is only one external device, it must have a terminator. See “Termination” on page 47 for more information.

Note: Each device attached to the interface must conform to ANSI SCSI Standards: X3.131-1986 (SCSI), X3.131-1994 (SCSI-2), and X3T10/1071D (proposed SCSI-3 standard). These standards specify the mechanical, electrical, and functional requirements and the command sets that must be used by devices in the SCSI subsystem.

Device IDs

The SCSI ID is also known as the *SCSI address* or *physical unit number* (PUN).

You must assign a unique SCSI ID to each SCSI device that you attach to the server. The unique ID prevents two devices from sending data to the same SCSI controller at the same time. SCSI devices use a variety of mechanisms to set the SCSI ID; such as jumpers, thumb wheels, or switches.

- ID 7 is reserved for the SCSI adapter (always preset to ID 7).
- The CD-ROM drive is preset to ID 3.
- Narrow (8-bit) SCSI devices use IDs 0 through 6.
- Wide (16-bit) SCSI devices use IDs 0 through 15.

When more than one physical device is connected to the same SCSI adapter, the devices compete for support from the SCSI adapter. Because the SCSI adapter communicates with only one device at a time, the priority of a device is based on its SCSI ID.

In summary, SCSI IDs perform two functions:

- They allow the SCSI controller to distinguish one device from another.
- They allow the SCSI controller to determine the priority of each device.

Logical Unit IDs

Each physical device has a *physical unit number* (PUN) and a *logical unit number* (LUN). If a physical device supports no logical devices, its LUN is 0. Most SCSI devices support only LUN 0. Certain types of physical SCSI devices (bridge controllers) can support more than one logical unit (device).

For example, a printer controller might support up to eight printers. The printer controller is a physical device, and each printer is a logical device. If the printer controller is assigned to ID 2, the ID of the first printer appears in the SCSI device configuration as PUN 2, LUN 0. The IDs of the other printers are PUN 2, LUN 1; PUN 2, LUN 2; and on up to PUN 2, LUN 7.

Cabling

The adapter and cabling in your server support:

- SCSI narrow devices that use a set of eight data lines, one data-parity line, and various control lines. The adapter has one 50-pin connector for narrow devices (internal only).
- SCSI wide devices that use a set of 16 data lines, two data-parity lines, and various control lines. The adapter has two 68-pin connectors for wide devices (one internal and one external).

In all SCSI configurations, the interface must be terminated at both ends of the cable. When both an internal cable and an external cable are present, the entire configuration is seen as one long bus. In this case, there are only two termination points, at the far ends of the internal and external cables.

The interface uses daisy-chain cabling, where each device except the last one (internal or external) has one cable going into it and another coming out of it in a single connector. The last device has an incoming cable and a terminator.

Termination

SCSI devices are cabled to each other and to the SCSI adapter. The device at each end of the interface must be terminated.

If you have only internal SCSI devices connected to the internal connector on the SCSI adapter, the controller becomes the termination at one end of the cable.

If you use the internal connector *and* the external connector on the SCSI adapter, you must disable the termination of the adapter by using the SCSISelect utility program included with the server. See your *PC Server 310 User's Handbook* for more information.

The following rules apply to SCSI-device termination:

Note: For specific information about termination, refer to the instructions supplied with the device.

- If you have more than one internal SCSI device, the device at the end of the SCSI adapter cable must be terminated. Other internal devices connected to the same SCSI adapter must not be terminated.
- If you have both internal SCSI devices and external SCSI devices, the devices at the ends of the internal and external cables must be terminated. The adapter must not be terminated.
- If you have only one external device, that device must be terminated.

Chapter 7. Configuration

You play a key role in how your server allocates resources to hardware devices and software programs. This resource-allocation process is referred to as *configuration*. The steps that are required to configure your server depend on the number of devices, the variety of devices, and the software programs you install.

Your server has the flexibility and power to support several types of adapters and devices. This flexibility lets you choose from among thousands of adapters and devices that comply with the following standards:

- Industry standard architecture (ISA)
- Peripheral component interconnect (PCI)
- Small computer system interface (SCSI)

In general, the greater the number and variety of hardware devices and software programs that you install, the more you will have to interact with your server and your devices to correctly configure your system.

Your PC Server 310 comes with the following:

- Configuration/Setup Utility program
- SCSISelect Utility program
- Ethernet configuration diskettes

Power-On Self-Test

Each time you turn on your server, it performs a series of tests that check the operation of the server and some options. This series of tests is called the power-on self-test (POST). The POST is stored in an electrically erasable programmable ROM (EEPROM) module, along with the basic input/output system (BIOS) code and the Configuration/Setup Utility. The functions of the POST are:

- Check the server hardware and subsystems
- Update the server configuration
- Load the BIOS into system memory
- Load the operating system into system memory
- Report problems

While the POST is running, the server displays an IBM screen with several messages and prompts. If you have set a password in the Configuration/Setup Utility, a password prompt asks you for a password. Numbers cycle in the upper-left corner of the screen indicating memory checking is in progress. Other prompts allow you to access the Configuration/Setup Utility or escape from the POST.

When the POST is successfully completed, the server proceeds to the first screen of your operating system or application program. If problems are found, the POST displays error codes and messages. Refer to the problem-solving section of your *PC Server 310 User's Handbook* for explanations of error messages and actions you can take to correct problems.

Configuration Programs

Most server devices (storage devices, ports, adapters, and other optional features) have programmable settings. Your PC Server 310 has a special type of nonvolatile memory (called CMOS) where it saves these settings. A battery is used to keep this memory active, so the settings are not lost when you turn off the server. Each time you turn on the server, the POST routine copies the configuration settings from memory to the various devices to get them ready for operation. If the battery fails, the settings in memory are lost, and the Configuration/Setup Utility program automatically restores the default (factory) settings.

When you add or change built-in devices or optional features in your PC Server 310, the configuration settings are updated. Your PC Server 310 either automatically reconfigures the settings it has saved, or you might have to help with reconfiguration. The Configuration/Setup Utility program is used for this process.

Configuration/Setup Utility Program

The Configuration/Setup Utility program automatically updates and saves configuration settings when you make changes to your server hardware. However, some changes require input from you. You can view the current settings, change the settings of various features, set passwords, change the date and time, and do other tasks using the Configuration/Setup Utility program.

The main menu of the Configuration/Setup Utility program lists the following categories of configuration screens:

- System summary
- Vital product data (VPD)
- Device and I/O ports
- Date and time
- System security
- Start options
- Advanced setup
- ISA legacy resources

Some items are in brackets on the Configuration/Setup Utility program screens. These brackets indicate an item that you can change. The items without brackets are filled in by the program. An arrow, pointing to an item on a screen, indicates a setting that has changed since the last time you ran the Configuration/Setup Utility program.

If the server finds a setup error during startup, it displays a message on the screen and gives you the option to access the Configuration/Setup Utility program. Also, you can access the Configuration/Setup Utility program any time you want to view or change settings. Refer to your *PC Server 310 User's Handbook* for information about using the Configuration/Setup Utility program.

SCSISelect Utility Program

The PC Server 310 provides a built-in, menu-driven configuration program that enables you to view or change SCSI settings. You can use this program to change default settings, locate configuration conflicts, correct configuration conflicts, and format a new SCSI hard disk.

The settings that you can view or change include:

- Host Adapter SCSI ID
You can change the SCSI ID of the SCSI adapter from its default value of 7.
- SCSI Parity Checking
You can enable or disable parity checking on the SCSI adapter. The default setting is *enabled*.
- Host Adapter SCSI Termination
You can change the SCSI adapter termination. The default setting is *enabled*.
- SCSI Device Configuration
This enables you to configure SCSI device parameters. Before you can make updates, you must know the ID of the device whose parameters you want to configure.
- Advanced Configuration Options
These options include support for large hard disk drives and support for multiple disk drives with DOS version 5.0 or later.

For additional information about SCSISelect, refer to the documentation provided in the UltraSCSI adapter package that comes with your PC Server 310.

Ethernet Configuration Diskettes

When your PC Server 310 comes with an Ethernet adapter, you will receive configuration diskettes. For information about how to use these diskettes, refer to the Ethernet documentation that comes with your PC Server 310.

Configuration Process Overview

When you install a new device or change the position of an existing device, you might need to reconfigure your server. The steps required to configure your server depend on the option you install.

Some options, such as memory and PCI adapters, are recognized and configured automatically by the system. However, other options, such as ISA adapters and SCSI devices, must be manually configured.

Configuring SCSI Devices

Preinstalled SCSI devices are already configured. To configure new SCSI devices, check the documentation that comes with the device for instructions to set the SCSI ID and termination for the device. (See also “Termination” on page 47 for more information about termination.)

Adapter Configuration

When you install ISA adapters, you must configure them.

Configuration is accomplished by manually setting a variety of switches on the adapters. These switches control the assignment of server resources such as interrupt request (IRQ) lines, direct memory access (DMA) channels, and memory address ranges. New methods of configuring adapters and devices are now used on your server to make expansion an easier task.

Plug and Play Adapters

Plug and Play is a configuration method that makes expanding your PC Server 310 easier. Plug and Play adapters are easier to install and set up because they configure automatically. There are no jumpers or switches to set as on standard adapters. A Plug and Play adapter comes with built-in identification and configuration specifications set in memory on the adapter to provide installation information to the server during startup. This information is interpreted by the server's basic input/output system (BIOS). The BIOS routines automatically configure the adapter around the resources already in use by other devices.

PCI adapters are generally Plug and Play devices. Many ISA adapters are not Plug and Play devices. If the adapter you are installing is not Plug and Play, you must configure it manually.

Legacy Adapters

ISA adapters that are not Plug and Play devices are referred to as *legacy* devices. The Configuration/Setup Utility program can help you manually configure legacy adapters. Refer to your *PC Server 310 User's Handbook* for information about using the Configuration/Setup Utility program.

The screens of the Configuration/Setup Utility program show the legacy resources typically required by adapters:

- I/O port address
- Memory address
- Interrupt request (IRQ) line
- Direct memory access (DMA) channel

Available resources not currently being used by adapters already installed in your PC Server 310 are highlighted. From these screens, you can select available resources for the adapter you are installing. Set the resources that are used by installed legacy adapters to *not available*. This enables the Plug and Play program to configure around legacy adapters, and then you can set the appropriate jumper or switch settings on the adapter. Using this procedure helps prevent conflicts with other adapters. Refer to the adapter documentation for information about required resources. Also, if your PC Server 310 comes with preinstalled software, you can select these resources using the Plug and Play icon.

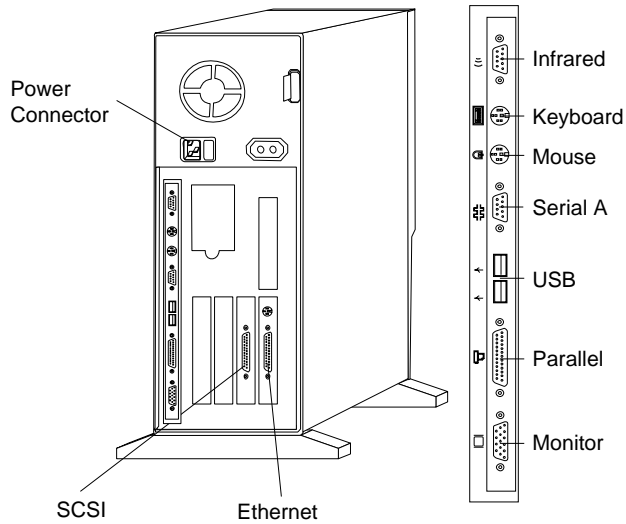
Note: The Plug and Play feature uses memory addresses ED00 to EFFF. If you install a legacy ISA adapter or use a memory manager program, do not use the addresses within this range.

Chapter 8. Input/Output Ports and Connectors

The input/output (I/O) connectors on the back of your server are for attaching devices to the following ports:

- Infrared
- Keyboard
- Mouse (auxiliary-device)
- Serial (16550-UART)
- Universal serial bus (USB)
- Parallel
- Monitor (video)
- Ethernet adapter
- SCSI adapter

The location of each connector is shown in the following illustration.



Infrared Port

The infrared port is where you can attach an optional infrared transceiver module. The transceiver allows wireless communication between your PC Server 310 and other infrared-capable servers and printers.

The IBM Infrared (IR) Transceiver option includes TranXit software. During installation, when the TranXit Setup Connection dialog box appears, click on **National 306/334 Evaluation Board** to select the driver that supports your system.

The infrared connector on the back of your PC Server 310 is a 9-pin, female, D-shell connector. The infrared transceiver module plugs into this connector and provides a link of up to one meter (39 in.) at a rate of 115 kilobits-per-second (Kbps). The infrared connector uses the same four port assignments as the serial port. Table 1 shows the pin-number assignments for the infrared connector.

Pin	Signal
1	Transmitted data (output)
2	Ground
3	Reserved
4	Ground
5	Ground
6	Received data (input)
7	Voltage (5 V)
8	Ground
9	Reserved

Table 1. Infrared Port Connector Pin-Number Assignments

Keyboard and Mouse (Auxiliary-Device) Ports

Your server provides one keyboard and one mouse (auxiliary-device) port. Table 2 shows the pin-number assignments for the keyboard connector and the mouse (auxiliary-device) connector.

Pin	Signal
1	Data
2	Reserved
3	Ground
4	+5 V dc
5	Clock
6	Reserved

Table 2. Keyboard Port Connector and Mouse (Auxiliary-Device) Port Connector Pin-Number Assignments

Serial Port

Serial A port is used to communicate with devices such as printers, plotters, and modems. Some modems are installed inside the server; others are attached externally using a serial-port connector. For example, you can attach an external modem to a serial port to communicate with another server over telephone lines. Serial A is 16550-UART (universal asynchronous receiver/transmitter) compatible, so it can support high-speed modems.

Serial ports transfer data *asynchronously*; they can transmit any number of bits with no restriction on the duration of the pauses between characters.

Serial ports transmit and receive data and commands at a rate of 300 bits-per-second (bps) up to 345,600 bps. The bits-per-second measurement is commonly referred to as the baud rate. To use a serial port at 345,600 bps, you need a shielded cable. For information about this cable, contact your IBM marketing representative or your IBM reseller.

You can increase the number of serial ports by installing a serial adapter in one of the expansion slots. For more information about installing adapters, refer to your *PC Server 310 User's Handbook*.

The Serial A connector on the back of the server is a 9-pin, male, D-shell connector that conforms to the RS-232D industry standard. Table 3 shows the pin-number assignments for the serial port connector.

Pin	Signal	Pin	Signal
1	Data carrier detect	6	Data set ready
2	Receive data	7	Request to send
3	Transmit data	8	Clear to send
4	Data terminal ready	9	Ring indicator
5	Signal ground		

Table 3. Serial Port Connector Pin-Number Assignments

Operating systems and application programs often designate serial ports with the name COM (communication). Many programs use COM1, COM2, COM3, and COM4 in their setup commands or menus to identify serial ports. When setting up your applications, you might have to identify the COM port to which a particular device is attached. Also, if you are adding a serial adapter or modem, you might have to configure the adapter or modem for a specific COM port. This might involve setting switches on the adapter or modem as well as changing settings in the Configuration/Setup Utility program.

Each serial connector or adapter in your PC Server 310 can use any of four available port settings, provided that a different setting is used for each. The settings include the port address (in hexadecimal) and the IRQ (interrupt request line), which determines how the microprocessor responds to an interrupt from the serial port. There is no direct relationship among the port connectors, the four available port settings, and the four COM numbers. The four available port settings, in sequential order, are: 3F8-IRQ 4, 2F8-IRQ 3, 3E8-IRQ 4, and 2E8-IRQ 3. When you start the server, the power-on self-test (POST) program assigns COM numbers to the port addresses that are actually in use at the time. POST goes down the list of addresses sequentially to assign COM numbers to each address in use by a serial device. If an address is not in use, a COM number is not assigned to it. POST assigns the next available COM number to the next address in use, if any.

POST assigns COM1 to Serial A during startup. The port address and IRQ for Serial A are factory preset at 3F8-IRQ 4. You can view the port address and IRQ settings for Serial A using the Configuration/Setup Utility program.

Generally, you do not have to change serial-port settings. However, if you add a serial adapter or use special hardware or software that causes a configuration conflict, you might have to change port settings. You can change the settings for Serial A using the Configuration/Setup Utility program. For more information about using the Configuration/Setup Utility program, refer to your *PC Server 310 User's Handbook*.

Universal Serial Bus Ports

The universal serial bus (USB) is an emerging serial interface standard for telephony and multimedia devices. Each USB port is a single connector for devices that previously used serial, parallel, keyboard, mouse, and game ports. USB technology uses Plug and Play to determine what device has been attached to the connector. Each USB device is accessed by a unique USB address. A device called a hub is used to convert a single USB connector into multiple attachment points. A hub has multiple ports where peripherals can be attached. USB provides 12 megabits-per-second (Mbps) bandwidth with a maximum of 63 peripherals and a maximum signal distance of five meters per segment.

Note: If more than one USB device is to be attached, then the device must be connected to a hub. Your PC Server 310 does not support a keyboard attached to the system USB port.

Your PC Server 310 comes with two USB ports. Table 4 shows the pin-number assignments for the USB port connectors.

Pin	Signal
1	VCC
2	-Data
3	+Data
4	Ground

Table 4. USB Port Connector Pin-Number Assignments

Parallel Port

The parallel port is most often used to communicate with a parallel printer, but you can use it to communicate with a variety of other parallel devices. The parallel port on the PC Server 310 supports extended, high-speed modes, which means that it can transfer data up to 10 times as fast as a standard parallel port.

You can increase the number of parallel connectors by installing a parallel adapter in one of the expansion slots. For more information about installing adapters, refer to your *PC Server 310 User's Handbook*.

The parallel connector on the back panel of the server is a 25-pin, female, D-shell connector. Table 5 shows the pin-number assignments for the parallel port connector. The standard mode signal names are shown; some signals have different names for other modes.

Pin	Signal	Pin	Signal
1	-Strobe	14	-Auto Fd XT
2	Data 0	15	-Error
3	Data 1	16	-Init
4	Data 2	17	-Select (SLCT) In
5	Data 3	18	Ground
6	Data 4	19	Ground
7	Data 5	20	Ground
8	Data 6	21	Ground
9	Data 7	22	Ground
10	-Ack	23	Ground
11	Busy	24	Ground
12	PError	25	Ground
13	Select (SLCT)		

Table 5. Parallel Port Connector Pin-Number Assignments

Parallel Port Assignments

Operating systems and application programs often designate parallel ports with the name LPT (line printer). Many programs use LPT1, LPT2, and LPT3 in their setup commands or menus to identify parallel ports. When setting up your applications, you might have to identify the LPT port to which a particular device is attached. To provide automatic configuration, some operating systems use Plug and Play BIOS calls to query the LPT port. Also, if you are adding a parallel adapter, you might have to configure the adapter for a specific LPT port. This might involve setting switches on the adapter as well as changing settings in the Configuration/Setup Utility program.

Each parallel connector or adapter on your PC Server 310 can use any of three available port settings, provided that a different setting is used for each. The settings include the port address (in hexadecimal) and the IRQ (interrupt request line), which determines how the microprocessor responds to an interrupt from the parallel port. There is no direct relationship among the three available port settings and the three LPT numbers. The three available port settings, in sequential order, are: 3BC-IRQ 7, 378-IRQ 5, and 278-IRQ 5. When you start the server, the POST program assigns LPT numbers to the port addresses that are actually in use at the time. POST goes down the list of addresses sequentially to assign LPT numbers to each address in use by a parallel device. If an address is not in use, an LPT number is not assigned to it. POST assigns the next available LPT number to the next address in use, if any.

The port address and IRQ setting for the built-in parallel port is preset at the factory to 3BC-IRQ 7, and the POST assigns LPT1 to it during startup.

If you add another parallel adapter that uses the next sequential address (378-IRQ 5), POST assigns LPT2 to it. You can view the port address and IRQ setting for the built-in parallel port using the Configuration/Setup Utility program.

Generally, you do not have to change the parallel-port setting. However, if you add a parallel adapter or use special hardware or software that causes a configuration conflict, you might have to change the port setting. Also, you have to change the parallel-port setting if you use ECP, EPP, or ECP/EPP modes because 3BC-IRQ 7 cannot be used for these modes. You can change the setting using the Configuration/Setup Utility program. For more information about using the Configuration/Setup Utility program, refer to your *PC Server 310 User's Handbook*.

Parallel Port Modes

The parallel port can operate in five different modes. One is a *standard*, unidirectional mode; the other four are *extended*, bidirectional modes that provide additional function and higher performance. Refer to the documentation that comes with printers and other parallel devices to determine the appropriate parallel mode to use and required device drivers.

Standard: This is the default mode. In this mode, the parallel port is limited to writing information to the device attached to it. You can use this mode with most *IBM-compatible* parallel printers.

Bidirectional: In this mode, the parallel port can transfer data to other PC server systems and supported devices.

ECP: The extended capabilities port (ECP) mode is a high-performance, bidirectional mode, that uses direct memory access (DMA) for data transfer to a high-speed printer or other device.

EPP: The enhanced parallel port (EPP) mode is a high-performance, bidirectional mode that has capabilities similar to ECP mode. The main difference is that EPP data transfers are processor-initiated instead of direct memory access (DMA). EPP supports the attachment of up to eight external devices such as hard disk drives, CD-ROM drives, tape drives, diskette drives, and a printer to the parallel port. You can connect these devices to each other in a daisy-chain arrangement, or you can connect them through an external multiplexor. The attachment of multiple devices requires device drivers supplied by the device manufacturers.

ECP/EPP: This mode combines the capabilities of the ECP and EPP modes. Select this mode if you have both ECP and EPP devices attached to the parallel port.

You can set these modes of operation for the parallel port using the Configuration/Setup Utility program. For more information about using the Configuration/Setup Utility program, refer to your *PC Server 310 User's Handbook*.

Monitor (Video) Port

You can attach a variety of video graphics array (VGA) or super video graphics array (SVGA) monitors to the monitor (video) port of your PC Server 310.

Your PC Server 310 comes with one 15-pin, female, D-shell connector on the back panel for attaching a monitor. Table 6 shows the pin-number assignments for the monitor (video) port connector.

Pin	Signal
1	Red
2	Green
3	Blue
4	Not used
5	Ground
6	Red ground
7	Green ground
8	Blue ground
9	+5V, used by DDC2B
10	Ground
11	Not used
12	DDC2B serial data
13	Horizontal synchronization (Hsync)
14	Vertical synchronization (Vsync)
15	DDC2B clock

Table 6. Monitor (Video) Port Connector Pin-Number Assignments

SCSI Adapter Ports

Your server comes with an UltraSCSI adapter that allows you to attach SCSI devices to your server. It has the following shielded, high-density connectors:

- One internal 50-pin (2 × 25-pin) for SCSI narrow devices
- One internal 68-pin (2 × 34-pin) for SCSI wide devices
- One external 68-pin (2 × 34-pin) for SCSI wide devices

Table 7 shows the pin-number assignments for the 50-pin (2 × 25-pin) SCSI narrow port connector.

Pin	Signal	Pin	Signal
1	Ground	26	Terminator power
2	Data 0	27	Reserved
3	Ground	28	Reserved
4	Data 1	29	Ground
5	Ground	30	Ground
6	Data 2	31	Ground
7	Ground	32	-Attention
8	Data 3	33	Ground
9	Ground	34	Ground
10	Data 4	35	Ground
11	Ground	36	-Busy
12	Data 5	37	Ground
13	Ground	38	-Acknowledge
14	Data 6	39	Ground
15	Ground	40	-Reset
16	Data 7	41	Ground
17	Ground	42	-Message
18	Data P	43	Ground
19	Ground	44	-Select
20	Ground	45	Ground
21	Ground	46	-Control/data
22	Ground	47	Ground
23	Reserved	48	-Request
24	Reserved	49	Ground
25	Not connected	50	-Input/output

Table 7. Pin-Number Assignments for the SCSI 50-pin (2 × 25-pin) Connector

Table 8 shows the pin-number assignments for the 68-pin (2 × 34-pin) SCSI wide port connectors.

Pin	Signal	Pin	Signal
1	Ground	35	Data 12
2	Ground	36	Data 13
3	Ground	37	Data 14
4	Ground	38	Data 15
5	Ground	39	Data P1
6	Ground	40	Data 0
7	Ground	41	Data 1
8	Ground	42	Data 2
9	Ground	43	Data 3
10	Ground	44	Data 4
11	Ground	45	Data 5
12	Ground	46	Data 6
13	Ground	47	Data 7
14	Ground	48	Data P0
15	Ground	49	Ground
16	Ground	50	Ground
17	+Term power	51	+Term power
18	+Term power	52	+Term power
19	Reserved	53	Reserved
20	Ground	54	Ground
21	Ground	55	-Attention
22	Ground	56	Ground
23	Ground	57	-Busy
24	Ground	58	-Acknowledge
25	Ground	59	-Reset
26	Ground	60	-Message
27	Ground	61	-Select
28	Ground	62	-Control/Data
29	Ground	63	-Request
30	Ground	64	-Input/Output
31	Ground	65	Data 8
32	Ground	66	Data 9
33	Ground	67	Data 10
34	Ground	68	Data 11

Table 8. Pin-Number Assignments for the SCSI 68-pin (2 × 34-pin) Connector

Ethernet Adapter Port

The Ethernet adapter in some server models provides three types of standard Ethernet connectors (you can use only one type of connector at a time):

10BASE-T This connector is used with a Category 3, 4, or 5 cable that has RJ-45 connectors. The cable is used in Ethernet networks that use a telephone twisted-pair cable. One end of the cable is attached to the 10BASE-T connector and the other end is attached to an Ethernet concentrator.

10BASE2 This connector is used with an RG-58 standard coaxial cable (IEEE Standard 802.3 10BASE2) that has bayonet connectors (BNCs). The cable is used in Ethernet networks that use thin coaxial cable. One end of the cable is attached to the 10BASE2 connector and the other end is attached to the Ethernet network.

10BASE5 This connector is also called an attachment unit interface (AUI), and it is used in Ethernet networks that use external transceivers. One end of a mini AUI-to-AUI adapter cable (IBM P/N 59G9004) is attached to the 10Base5 connector and the other end of the mini cable is attached to an Ethernet transceiver cable. You must purchase the adapter cable (IBM P/N 59G9004) separately.

Refer to the Ethernet adapter documentation that comes with your server for more information about Ethernet networks, cables, and connectors.

Chapter 9. Video Subsystem

Your PC Server 310 provides super video graphics array (SVGA) capability. The video controller on the system board is connected to an external 15-pin analog video connector on the rear panel of your server. This connector enables you to attach a video monitor to your server. For information about this connector, see “Monitor (Video) Port” on page 67.

The video controller supports high-resolution graphics and fast refresh rates that exceed International Organization for Standardization (ISO) 9241 Part 3, Visual Display Requirements. It also provides reduced-flicker operation when used with noninterlaced monitors that meet ISO standards. For more information about noninterlaced monitors, see “Vertical-Refresh Rate” on page 73.

The SVGA mode can provide a screen resolution of up to 1024 × 768 pels with up to 256 colors.

The video subsystem includes a video display buffer that contains 1 MB of video dynamic random access memory (VDRAM). (MB equals approximately 1 000 000 bytes.) The capabilities of the video driver and the amount of VDRAM in your server determine the resolution and number of colors that are supported. Your server supports the following screen resolutions and numbers of colors:

- 640 × 480 pels with up to 16.8 million colors (noninterlaced)
- 800 × 600 pels with up to 65,536 colors (noninterlaced)
- 1024 × 768 pels with up to 256 colors (noninterlaced)

Note: Monitors supporting 1280 × 1024 pels and up to 16 colors require operating system support. See your operating-system documentation for more information.

Additional features of the video subsystem include:

- Integrated VGA emulation
- Support for the 132-column text mode
- Reduced-flicker operation for noninterlaced monitors that meet ISO standards

You can install a video adapter in one of the PCI expansion slots. The system BIOS detects the installed adapter automatically at system startup.

Monitors come in many sizes and types. The video controller supports a wide range of monochrome and color monitors having various capabilities.

How Monitors Operate

The most common distinguishing characteristics are resolution, dot pitch, vertical-refresh rate, screen size, and color.

Resolution and Dot Pitch

If you look closely at the screen, you can see that the entire image is made up of many tiny dots. These dots are called *pels*. Resolution is measured by the number of pels needed to fill the screen (horizontal-by-vertical).

Dot pitch is more difficult to visualize. The inside of the monitor screen is coated with light-emitting materials called *phosphors*. Color monitors use three phosphors: red, green, and blue. The phosphor coating is made up of dots arranged in a red-green-blue (RGB) pattern. The distance from the center of one phosphor dot to the center of the next phosphor dot of the same color is called the dot pitch. Dot pitch is measured in millimeters, such as 0.28, 0.31, and 0.41.

In general, the monitor with the highest resolution and finest dot pitch produces the sharpest image. A monitor with a fine dot pitch, such as 0.28, produces sharper, better defined characters than a similar monitor that uses a coarser dot pitch, such as 0.41.

A system, used extensively for detailed graphics, might need a monitor that shows more colors, at a higher resolution and finer dot pitch, than one used exclusively for word processing. A black-and-white (monochrome) monitor can work as well as a color monitor for some applications.

Vertical-Refresh Rate

The phosphors on the inside of the monitor screen hold their brightness and color for a very short time. The image must be redrawn many times each second to refresh the phosphors. The vertical-refresh rate is the speed at which the image on the screen is redrawn.

The image is redrawn from top to bottom. By the time the bottom rows are drawn, the top rows are starting to fade. There are two ways of redrawing the image *interlaced* and *noninterlaced*. The interlaced method draws every other row from top to bottom, then starts at the top to fill in the rows that were skipped on the first pass. The noninterlaced method draws the complete image on each pass.

The vertical-refresh rate affects the stability of the image on the screen. Monitors, such as the IBM G50 and P50 that have a fast noninterlaced refresh rate, provide a very stable image with little or no visible flicker. Monitors with slower refresh rates tend to have more noticeable flicker. This is particularly evident with white and other light-colored backgrounds. You can often minimize flicker by changing the colors. Many programs allow you to select colors.

Sensitivity to flicker varies from person to person; young people are the most sensitive. Noninterlaced flicker occurs when the screen is redrawn at a rate that is slow enough to be detected by the human eye. Interlaced flicker occurs when an object on the screen is made up of alternating bright and dim lines, or when adjoining lines have very different pel (picture element) patterns.

Some application programs cannot reproduce all colors, so they use a technique called *dithering* to combine two colors. For example, light red might be produced by alternating lines of white and red. As the image is continually refreshed using the interlaced method, the red lines are drawn on one pass and the white lines on the next pass. As a result, the light-red object might appear to flicker while the rest of the image on the screen remains stable.

Selecting a Monitor

A monitor having a fast noninterlaced refresh rate fully uses the video capabilities of your server. The IBM G50 and the IBM P50 are examples of monitors that use your server's video capabilities fully.

However, as mentioned earlier, some applications demand less video support than others. IBM provides many monitors that you can use with your system. The following is a partial list of monitors and their characteristics.

Type	Dot Pitch	Resolution	Maximum Vertical Refresh Rate
G40	0.28	1024 × 768	43 Hz interlaced
G40	0.28	800 × 600	60 Hz noninterlaced
G40	0.28	640 × 480	75 Hz noninterlaced
G50	0.28	1024 × 768	72 Hz noninterlaced
G50	0.28	800 × 600	85 Hz interlaced
G50	0.28	640 × 480	85 Hz noninterlaced
P50	0.26	1024 × 768	85 Hz noninterlaced
P50	0.26	800 × 600	85 Hz noninterlaced
P50	0.26	640 × 480	85 Hz noninterlaced

Table 9. Monitor Types and Characteristics

For more details, refer to the information supplied with your monitor. For the current list of IBM monitors, see your IBM marketing representative or your IBM reseller.

Using Your Monitor

The following information will help you use your monitor comfortably and correctly.

Brightness and Contrast Controls

The Brightness and Contrast controls are used to adjust the image on the screen for maximum viewing comfort. On a new monitor, set the controls near their center position. Setting these controls to their maximum position can decrease the useful life of a monitor.

As the monitor gets older, the image tends to become dimmer. Adjust the Brightness and Contrast controls to compensate for this condition.

Screen-Saver Programs

Leaving the monitor turned on for prolonged periods of time without changing the information on the screen can adversely affect its ability to display information. Depending on what is on the screen, the image might burn into the phosphor coating (leaving a permanent image) or cause some areas of the screen to darken.

You can avoid this problem by using a *screen-saver program*. A screen-saver program turns off the video signal when the keyboard or mouse has not been used for a defined period of time. To restore the previous image and resume working with the monitor, you usually press any key or move the mouse. Several companies produce screen-saver programs. For details, contact your IBM marketing representative or your IBM reseller.

Avoiding Fatigue

The American Academy of Ophthalmology considers monitors safe for normal use. They state that monitors are not a hazard to vision and they do not damage the eye.

However, performing any visually demanding task for a long time, such as knitting, reading, or viewing a monitor screen, can cause eye fatigue. To avoid eye fatigue, you should reduce annoying glare and ensure that your vision is corrected for the task. If eye discomfort persists, consult your eye-care professional or physician.

Similarly, sore muscles and joints can result from any job or activity where you stay in a fixed position, or you repeat the same movement over a long period.

Modifying work practices can reduce muscle, joint, and eye fatigue. Taking breaks, rotating tasks, adjusting the monitor, adjusting lighting, and adjusting chair height all result in less fatigue.

Additional information is available by ordering the following publications from the nearest IBM branch office:

- *Comfort and You* (G360-2050)
- *The VDT Workstation and Vision* (SV04-0309)
- *Working with Displays* (G325-0620)

Chapter 10. Security Features

Security features deter unauthorized use of your system and data. If you use your server in a public environment, such as an office, you can implement the security features of your server to protect it and the data stored on it.

Before implementing any security features, evaluate your security requirements. Where will the system be located? Should it be secured to permanent furniture or fixtures? Should use of the system be limited? After you have identified your security needs, you can activate or implement the appropriate security features.

Hardware Security Features

One of the best methods for protecting your hardware from theft is to keep it under lock and key. For more protection, you can fasten your server to a stationary object (table, desk, or wall). Also, you can put critical resources, such as your server, behind locked doors in a limited-access area. This approach is particularly important. Anyone with the correct equipment and knowledge can gain access to the data on your hard disk and other storage devices through the connectors on the rear of your server. The hardware security features of your server include:

- The door lock and keys
- The optional U-bolt facility, which allows you to secure the system to a stationary object using a cable or chain

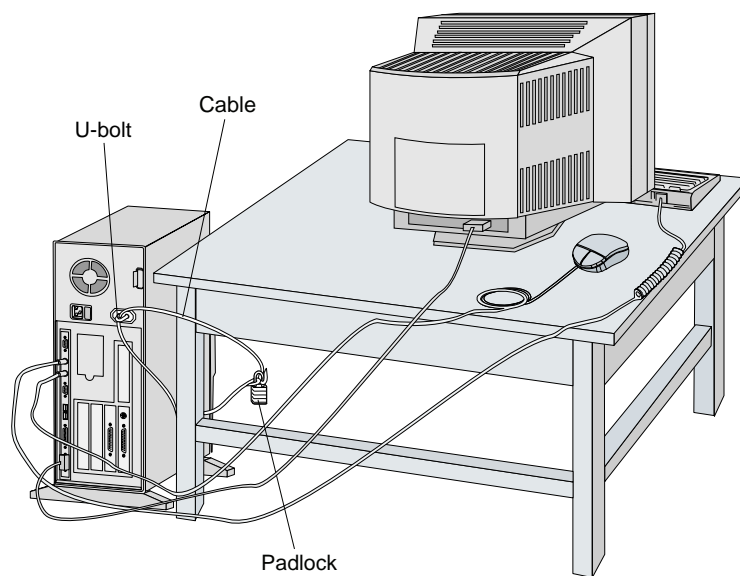
Door Lock and Keys

A door lock mechanically deters access to the drives. Two keys are provided with your server. Always store the keys in a safe place. If you lose them, you must order a replacement lock mechanism and keys from IBM.

Note: Anyone who has the key serial number and manufacturer's address can order duplicate keys, so store the tag in a safe place.

U-Bolt Facility

If your server is in an accessible area, you might need a method of securing it to a desk, table, or other stationary object. Two holes in the rear panel of the server can accommodate a U-bolt. After a U-bolt is installed, you can use a cable or a chain to lock the server in place. This capability is referred to as a *cable-down* or a *bolt-down* feature. Your *PC Server 310 User's Handbook* contains step-by-step instructions about how to install the U-bolt. The following illustration shows an example of how you can use the U-bolt to secure a server.



Software Security Features

This section contains information about the software security features provided with your PC Server 310.

- Power-on password
- Administrator password
- Keyboard password

Power-On Password

You do not need to set a power-on password to use your server, but a password helps to protect the information you store in it. The password can contain any combination of up to seven characters (A–Z, a–z, and 0–9). When a password is used, the keyboard and mouse (if attached to the mouse port) are locked to prevent unauthorized use of your server. The mouse remains active if it is connected to a serial port.

Keep a record of your power-on password in a secure place. If you forget it, but you remember the administrator password, you can enter the administrator password at the power-on password prompt to unlock the keyboard and mouse. You can then use the Configuration/Setup Utility program to set a new power-on password.

Administrator Password

Before setting an administrator password (also known as privileged-access or supervisor-level), it is a good idea to read this section completely. Using this security feature requires some planning and ongoing administration.

When the administrator password is set, you must use it to gain full access to the system Configuration/Setup Utility. Also, you can use it to override the power-on password.

After an administrator password is set, only those who know the password can perform tasks such as:

- Altering settings or features controlled by the system programs
- Running diagnostic tests

How the Administrator Password Works

Use the administrator password to prevent unauthorized access to system settings and configuration.

You can use any combination of up to seven characters (A-Z, a-z, and 0-9) for your administrator password, just as you can with your power-on password. For additional security, the two passwords should not be the same.

The most important reason for setting an administrator password is that when one is set, only those who know the password can access the system programs, modify the hardware, or change any of the settings.

If the password you enter is incorrect, Incorrect password appears and then the password prompt appears again. After three incorrect attempts, The system is locked appears, and you must turn off the server and start again.

If the administrator password is forgotten, refer to the “Configuration” chapter in your *PC Server 310 User's Handbook* for the procedure to enter a new password.

Keyboard Password

A keyboard password allows you to lock the keyboard while the system is turned on. This is useful if you leave your system on and unattended.

The way you set the keyboard password depends on the operating system you are using. The OS/2 operating system provides keyboard-password protection as a standard feature.

If you forget your keyboard password, turn off the server for at least 5 seconds; then turn it on. The keyboard password is erased from memory when you turn off the server.

Selectable Drive Startup

Selectable drive startup (sometimes referred to as *selectable boot*) allows you to control the startup sequence of the drives in your server. Each time you turn on the server, it checks the drives as it looks for the operating system. The order in which the system checks the drives is the *drive-startup sequence*.

In most cases, you do not need to change the *default* drive-startup sequence. However, you may want to change your default drive-startup sequence if you set an administrator password, or you are working with multiple hard disk drives, multiple operating systems, or different-sized diskette drives.

The default drive-startup sequence checks the primary diskette drive for a self-starting (bootable) diskette. If one is present, the operating system or program is loaded from the diskette. If not, the system checks the primary hard disk for an operating system. If one is present, it is loaded from that hard disk. If no operating system is present on a start-up device, a screen prompting for a diskette appears.

If you start the system from a diskette, the drive containing the diskette becomes drive A, regardless of the defined sequence. The first hard disk selected in the startup sequence becomes drive C. You can choose a startup sequence of up to four drives.

You can customize the startup sequence by changing the order in which the system checks the drives. You decide which drive is the first to be checked and the order in which the system checks the remaining drives.

Note: When you change the startup sequence, the drive letters might change. The operating system assigns the drive letters when the system starts. The letters A and B are *always* assigned to diskette drives. You can assign subsequent drive letters to any type of drive based on your operating system or the device drivers you use.

Attention: If you change your startup sequence, you must be extremely careful when doing *write* operations (for example, copying, saving, or formatting). You can accidentally overwrite data or programs if you select the wrong drive.

Securing Data

It is very difficult to secure shared information from theft, but an effective method is to limit user access. Only users who need the software or data should be able to access it. This level of access control is provided as a standard feature of most network operating systems. Password protection is another common feature of network operating systems that helps secure data from theft. Passwords, which are easy to use and very effective, help prevent unauthorized users from accessing sensitive files.

System usage can be audited by some advanced network-management programs, based on names, adapter addresses, date, time, and unsuccessful attempts to access a file. Such information can help identify users who attempt to access restricted data.

To secure extremely sensitive data, you might want to consider using a commercially available data-encryption tool. These tools (software or hardware) encode the files so that they are unintelligible unless a special key is used. Software is usually less expensive than a hardware device, but software is slower.

Protecting Data from Loss

There are several methods you can use to prevent the loss of data. You should consider these methods carefully, because some of them affect the performance, reliability, and hardware requirements of the server. There are primarily three ways that you can protect your data from loss:

- You can wait until the data accumulates on the server and then make backup copies of all the hard disks.
- You can configure a disk array to duplicate the data (create a redundant copy) as it is entered and then store the duplicate copy on a separate hard disk.
- You can configure a disk array to store the parity information about the data on the array as the data is being entered.

Backup Copies

A good method for preventing the loss of data is to make copies of the data. When a hardware failure occurs, you can always recover using the copies.

Backing up the entire contents of a hard disk to diskettes can be very time-consuming, and might require hundreds of diskettes when a network server has multiple hard disks. A faster and more efficient way to back up the data is to use a tape-backup drive. Using a tape-backup drive, you can copy large volumes of data from the hard disks to a single tape.

There are two problems with making backup copies. The first problem is someone has to remember to do it. The second problem is that you usually need to disconnect the server from the network to make the backup copies.

Redundant Copies

A convenient way to copy the contents of a hard disk is to duplicate all data as it is being entered. This duplicate copy is then stored on another hard disk. If one hard disk fails, you still have access to the data on the other. This method is more expensive than backing up to diskettes or tapes, because it doubles the amount of disk-storage space needed.

Parity Information

Storing parity information about the data as the data is being entered is an efficient, cost effective, and reliable method commonly used to guard against the loss of data. When a hard disk failure occurs, the parity information, and the data on the remaining functional disks, are used to reconstruct the data that was stored on the drive that failed.

Erased Files

Erasing a file from a diskette or hard disk does not destroy the file. With the right type of software, you can reclaim all or part of an erased file. This can cause a security risk if you sell a system or give someone a diskette that once contained classified or confidential information.

One way to help ensure that no readable information is left on a hard disk is to do a low-level format. An operating-system format operation does not remove all information from a hard disk.

The operating-system format operation works a little differently with diskettes. This format operation writes a repeated pattern over the entire surface. Any information that was on the diskette becomes unreadable.

Depending on the type of information stored, your company might require additional safeguards.

Viruses

A computer virus is a program (or set of instructions hidden within a program) that *infects* other programs by modifying them without your knowledge. Like any other program, the virus can do anything it is programmed to do. Some viruses are practical jokes and only cause unusual or erratic screen behavior. Others are destructive and erase or damage files, or overload memory and communication networks.

Viruses are generally spread unknowingly from computer to computer when programs are exchanged or shared. If you do not know where a program came from, be careful. Most reputable program distributors and bulletin-board owners scan their files to guard against viruses and maintain records to identify program owners.

Viruses are difficult to detect. Many stay inactive until triggered by a specified event such as a date, command, or some other operation. Others are activated when an infected program is started a specified number of times. When the symptoms of a virus appear, they might appear to be hardware failure or a software problem.

Virus-detection programs examine files and look for patterns associated with these viruses, or look for changes in the size of files. These programs detect a virus before it becomes widespread or causes damage. Many computer users check for viruses on a regular basis.

Your server comes with a virus-detection program that examines files at system startup. You can use the system Configuration/Setup Utility to enable or disable the virus-detection programs. Several other programs are available that can detect the presence of many known viruses.

When a virus is found, it must be removed. This might be as simple as replacing a file, or it might require the assistance of a trained technician. Some virus-detection programs can remove viruses and repair the damage caused by relatively benign viruses.

Here are a few tips to help you guard against computer viruses:

- Write-protect original program diskettes before using them. This ensures the diskettes will not be infected if a virus is already present in your system.
- Avoid using programs and diskettes from unknown sources.
- If you use programs that are provided from public-domain software distributors or bulletin-board services, find out what precautions they take to guard against viruses.
- Back up all critical data and programs regularly.
- Watch out for changes in file sizes (when they shouldn't change).
- Use password protection to limit access to your system or network.

Remember not every problem is caused by a virus. If your system starts acting erratically, refer to your *PC Server 310 User's Handbook* for information about testing the system.

Backup Power Supply

To prevent the loss of data caused by a power fluctuation, you might consider installing a backup power supply. There are two basic types of commercially available backup power supplies: *uninterruptible* and *standby*.

Uninterruptible Power Supplies

An uninterruptible power supply provides power when the main power source is lost. An uninterruptible power supply connects directly to the main power source (electrical outlet), and then the server connects to the power supply. The power supply transfers the power from the main power source to its internal battery and its internal battery then provides power to the server. The advantages of uninterruptible power supplies are that they require no switching time (because they are always on), and they protect the server from power surges. A disadvantage is that they usually cost more than standby power supplies.

Standby Power Supplies

A standby power supply waits until it detects a drop in voltage; it then turns on and provides power to the server until its battery power is depleted. An advantage of a standby power supply is low cost. It is usually less expensive than an uninterruptible power supply. A disadvantage of a standby power supply is the amount of time that it needs to turn itself on; the more time it takes, the greater the chance of losing data.

Appendix. Product Warranties and Notices

Warranties

The following is the statement of limited warranty for the United States, Canada, and Puerto Rico.

International Business Machines Corporation

Armonk, New York, 10504

Statement of Limited Warranty

The warranties provided by IBM in this Statement of Limited Warranty apply only to Machines you originally purchase for your use, and not for resale, from IBM or your reseller. The term "Machine" means an IBM machine, its features, conversions, upgrades, elements, or accessories, or any combination of them. Unless IBM specifies otherwise, the following warranties apply only in the country where you acquire the Machine. If you have any questions, contact IBM or your reseller.

Machine: IBM PC Server 310

Warranty Period*: Three Years

**Contact your place of purchase for warranty service information.*

Production Status

Each Machine is manufactured from new parts, or new and used parts. In some cases, the Machine may not be new and may have been previously installed. Regardless of the Machine's production status, IBM's warranty terms apply.

The IBM Warranty for Machines

IBM warrants that each Machine 1) is free from defects in materials and workmanship and 2) conforms to IBM's Official Published Specifications. The warranty period for a Machine is a specified, fixed period commencing on its Date of Installation. The date on your receipt is the Date of Installation, unless IBM or your reseller informs you otherwise.

During the warranty period IBM or your reseller, if authorized by IBM, will provide warranty service under the type of service designated for the Machine and will manage and install engineering changes that apply to the Machine.

For IBM or your reseller to provide warranty service for a feature, conversion, or upgrade, IBM or your reseller may require that the Machine on which it is installed be 1) for certain Machines, the designated, serial-numbered Machine and 2) at an engineering-change level compatible with the feature, conversion, or upgrade. Many of these transactions involve the removal of parts and their return to IBM. You represent that all removed parts are genuine and unaltered. A part that replaces a removed part will assume the warranty service status of the replaced part.

If a Machine does not function as warranted during the warranty period, IBM or your reseller will repair it or replace it with one that is at least functionally

equivalent, without charge. The replacement may not be new, but will be in good working order. If IBM or your reseller is unable to repair or replace the Machine, you may return it to your place of purchase and your money will be refunded.

If you transfer a Machine to another user, warranty service is available to that user for the remainder of the warranty period. You should give your proof of purchase and this Statement to that user. However, for Machines which have a life-time warranty, this warranty is not transferable.

Warranty Service

To obtain warranty service for the Machine, you should contact your reseller or call IBM. In the United States, call IBM at **1-800-772-2227**. In Canada, call IBM at **1-800-565-3344**. You may be required to present proof of purchase.

IBM or your reseller will provide certain types of repair and exchange service, either at your location or at IBM's or your reseller's service center, to restore a Machine to good working order.

When a type of service involves the exchange of a Machine or part, the item IBM or your reseller replaces becomes its property and the replacement becomes yours. You represent that all removed items are genuine and unaltered. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced. The replacement assumes the warranty service status of the replaced item. Before IBM or your reseller exchanges a Machine or part, you agree to remove all features, parts, options, alterations, and attachments not under warranty service. You also agree to ensure that the Machine is free of any legal obligations or restrictions that prevent its exchange.

You agree to:

1. obtain authorization from the owner to have IBM or your reseller service a Machine that you do not own; and
2. where applicable, before service is provided —
 - a. follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provide,
 - b. secure all programs, data, and funds contained in a Machine, and
 - c. inform IBM or your reseller of changes in a Machine's location.

IBM is responsible for loss of, or damage to, your Machine while it is 1) in IBM's possession or 2) in transit in those cases where IBM is responsible for the transportation charges.

Extent of Warranty

IBM does not warrant uninterrupted or error-free operation of a Machine.

The warranties may be voided by misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, removal or alteration of Machine or parts identification labels, or failure caused by a product for which IBM is not responsible.

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Electronic Emission Notices

Industry Canada Class B Emission Compliance Statement

This Class B digital apparatus meets the requirements of the Canadian Interference-Causing Equipment Regulations.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Federal Communications Commission (FCC) Statement

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult an IBM authorized dealer or service representative for help.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Proper cables and connectors are available from IBM authorized dealers. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized

changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Power Cords

For your safety, IBM provides a power cord with a grounded attachment plug to use with this IBM product. To avoid electrical shock, always use the power cord and plug with a properly grounded outlet.

IBM power cords used in the United States and Canada are listed by Underwriter's Laboratories (UL) and certified by the Canadian Standards Association (CSA).

For units intended to be operated at 115 volts: Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a parallel blade, grounding-type attachment plug rated 15 amperes, 125 volts.

For units intended to be operated at 230 volts (U.S. use): Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a tandem blade, grounding-type attachment plug rated 15 amperes, 250 volts.

For units intended to be operated at 230 volts (outside the U.S.): Use a cord set with a grounding-type attachment plug. The cord set should have the appropriate safety approvals for the country in which the equipment will be installed.

IBM power cords for a specific country are usually available only in that country:

IBM Power Cord Part Number	Used in These Countries
13F9940	Argentina, Australia, China (PRC), New Zealand, Papua New Guinea, Paraguay, Uruguay, Western Samoa
13F9979	Afghanistan, Algeria, Andorra, Angola, Austria, Belgium, Benin, Bulgaria, Burkina Faso, Burundi, Cameroon, Central African Rep., Chad, Czech Republic, Egypt, Finland, France, French Guiana, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Ivory Coast, Jordan, Lebanon, Luxembourg, Macau, Malagasy, Mali, Martinique, Mauritania, Mauritius, Monaco, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Romania, Senegal, Slovakia, Spain, Sudan, Sweden, Syria, Togo, Tunisia, Turkey, former USSR, Vietnam, former Yugoslavia, Zaire, Zimbabwe
13F9997	Denmark
14F0015	Bangladesh, Burma, Pakistan, South Africa, Sri Lanka
14F0033	Antigua, Bahrain, Brunei, Channel Islands, Cyprus, Dubai, Fiji, Ghana, Hong Kong, India, Iraq, Ireland, Kenya, Kuwait, Malawi, Malaysia, Malta, Nepal, Nigeria, Polynesia, Qatar, Sierra Leone, Singapore, Tanzania, Uganda, United Kingdom, Yemen, Zambia
14F0051	Liechtenstein, Switzerland
14F0069	Chile, Ethiopia, Italy, Libya, Somalia
14F0087	Israel
1838574	Thailand

**IBM Power
Cord
Part Number**

Used in These Countries

62X1045	Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Korea (South), Liberia, Mexico, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Suriname, Taiwan, Trinidad (West Indies), United States of America, Venezuela
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Glossary

This glossary includes terms and definitions from:

- The *American National Dictionary for Information Systems*, ANSI X3.172-1990, copyright 1990 by the American National Standards Institute (ANSI). Copies may be purchased from the American National Standards Institute, 11 West 42 Street, New York, New York 10036. Definitions are identified by the symbol (A) after the definition.
- The ANSI/EIA Standard—440-A: *Fiber Optic Terminology*. Copies may be purchased from the Electronic Industries Association, 2001 Pennsylvania Avenue, N.W., Washington DC 20006. Definitions are identified by the symbol (E) after the definition.
- The *Information Technology Vocabulary*, developed by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions of published parts of this vocabulary are identified by the symbol (I) after the definition; definitions from draft international standards, committee drafts, and working papers being developed by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet

been reached among the participating National Bodies of SC1.

A

access time. The time interval between the instant at which a call for data is initiated and the instant at which the delivery of data is completed.

adapter. A printed circuit board that modifies the system unit to allow it to operate in a particular way.

address. (1) A value that identifies a register or a particular part of storage. The value is represented by one or more characters. (2) The location in the storage of a computer where data is stored. (3) To refer to a specific storage location by specifying the value that identifies the location.

address bus. The path used for the transmission of address information in a computer.

analog. (1) Pertaining to data consisting of continuously variable physical quantities. (T) (2) Contrast with digital, discrete.

ANSI. American National Standards Institute. An organization consisting of producers, consumers, and general interest groups, that establishes the procedures by which accredited organizations create and maintain

voluntary industry standards in the United States.

application. The use to which an information processing system is put; for example, a payroll application, an airline reservation application, a network application.

application program. (1) A program that is specific to the solution of an application problem. Synonymous with application software. (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 on a network, enabling users to perform application-oriented activities.

arbitration. A process that determines which device or subsystem gains control of a bus when two or more devices or subsystems simultaneously compete for control.

architecture. See computer architecture.

B

bank. An aggregation of similar devices, such as single inline memory modules, connected to each other and used cooperatively.

bit. Either of the digits 0 or 1 when used in the binary numeration system. Synonymous with binary digit. (T)

bridge. A functional unit that interconnects two local area networks that use the same logical link control protocol but may use different medium access control protocols.

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) A portion of storage used to hold input or output data temporarily.

bus. One or more conductors used for transmitting signals, data, or power. See also address bus and data bus.

bus master. A device or subsystem that controls data transfers between itself and a subordinate.

byte. A string that consists of a number of bits, usually 8, that are treated as a unit and represent a character.

C

cable. The physical medium for transmitting signals; it includes copper conductors and optical fibers.

cache. A buffer storage that contains frequently accessed instructions and data; it is used to reduce access time.

client. A functional unit that receives shared services from a server. (T)

clock. A device that generates periodic, accurately spaced signals used for purposes such as timing, regulation of the operations of a processor, or generation of interrupts. (T)

clock cycle. In microprocessors, a unit of time expressed in nanoseconds (ns) that measures the period between clock signals.

code. A collection of instructions that is in a form that can be read and processed by a computer.

compatibility. The capability of a hardware or software component to conform to the interface requirements of a given computer without adversely affecting its functions.

computer architecture. (1) The logical structure and functional characteristics of a computer, including the interrelationships among its hardware and software components. (2) The organizational structure of a computer system, including hardware and software.

configuration. The manner in which the hardware and software of an information processing system are organized and interconnected. (T)

configure. To set up a computer for operation by describing to the

system the devices, optional features, and programs installed in the computer.

control. The determination of the time and order in which the parts of a computer and the devices that contain those parts perform the input, processing, storage, and output functions.

controller. A device that coordinates and controls the operation of one or more input/output devices, such as workstations, and synchronizes the operation of such devices with the operation of the system as a whole.

cycle. (1) An interval of space or time in which one set of events or phenomena is completed. (A) (2) A complete vibration, electric oscillation, or alternation of current.

D

DASD. Direct access storage device.

data. (1) A re-interpretable representation of information in a formalized manner suitable for communication, interpretation, or processing. Operations can be performed upon data by humans or by automatic means. (T) (2) Any representations such as characters or analog quantities to which meaning is or might be assigned. (A)

data bus. A bus used to communicate data internally and externally to and from a processing

unit, storage, and peripheral devices. (A)

device. A mechanical, electrical, or electronic piece of equipment designed to serve a special purpose or perform a special function.

digital. (1) Pertaining to data in the form of digits. (A) (2) Contrast with analog.

DIMM. Dual-inline memory module.

direct access storage device (DASD). A nonvolatile-storage device, such as a diskette drive, hard disk drive, or CD-ROM drive, in which access time is effectively independent of the location of the data on the storage medium.

direct memory access (DMA). The transfer of data between memory and input/output devices without microprocessor intervention.

disk array. Two or more hard disks interconnected to increase security, performance, or reliability.

disk duplexing. A method of storing data whereby the data from one hard disk is duplicated on another, with each hard disk drive using its own hard-disk controller. Contrast with disk mirroring.

diskette. A small magnetic disk enclosed in a jacket. (T)

disk mirroring. A method of storing data whereby the data from one hard disk is duplicated on another, with both hard disk drives sharing a single hard-disk controller. Contrast with disk duplexing.

DMA. Direct memory access.

dot pitch. In color video monitors, the distance on a scan line (expressed in millimeters) from the center of one phosphor dot to the center of the next phosphor dot of the same color.

E

EEPROM. Electrically erasable programmable read-only memory.

electrically erasable programmable read-only memory (EEPROM). EPROM that can be reprogrammed while it is in the computer.

EPROM. Erasable programmable read-only memory.

erasable programmable read-only memory (EPROM). A PROM that can be erased by a special process and reused. (T)

execution unit. A logical unit of a microprocessor that performs the arithmetic and logical operations specified by the microprocessor instruction set.

F

file. A named set of records stored or processed as a unit. (T)

file server. A high-capacity disk storage device or a computer that each computer on a network can use to access and retrieve files that can be shared among the attached computers.

floating-point unit (FPU). In microprocessors, an execution unit that executes floating-point arithmetic instructions.

frame. (1) A data structure that consists of fields, predetermined by a protocol, for the transmission of user data and control data. The composition of a frame, especially the number and types of fields, may vary according to the type of protocol. (T)

frequency. The rate of signal oscillation, expressed in hertz.

frequency-division multiplexing (FDM). Division of a transmission facility into two or more channels by splitting the frequency band transmitted by the channel into narrower bands, each of which constitutes a distinct channel. See also time-division multiplexing.

G

gateway. A functional unit that interconnects two computer networks with different network architectures. A gateway connects networks or systems of different architectures. A bridge interconnects networks or systems with the same or similar architectures.

GB. Gigabyte.

gigabyte. Approximately 1 000 000 000 bytes.

H

hard disk. A rigid magnetic disk such as the internal disks used in the system units of personal-computer systems and in external hard disk drives.

hard disk drive. A disk drive that reads and writes data on rigid disks, and can be installed in or connected to a computer.

hardware. (1) All or part of the physical components of an information processing system, such as computers or peripheral devices. (T) (2) The equipment, as opposed to the programming, of a computer. (3) Contrast with software.

hertz (Hz). A unit of frequency equal to one cycle per second.

I

icon. A graphic symbol, displayed on a screen, that a user can point to with a device such as a mouse in order to select a particular function or software application.

Synonymous with pictogram. (T)

initialization. Preparation of a system, device, or program for operation.

input/output. Pertaining to a device, process, or channel involved in data input, data output, or both.

input/output device. 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)

instruction. A statement that specifies an operation to be performed by a microprocessor, and that identifies data involved in the operation.

integer unit. In microprocessors, an execution unit that executes logical and integer arithmetic instructions.

I/O. Input/output.

ISA. Industry-standard architecture.

ISO. International Organization for Standardization. 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.

K

KB. Kilobyte.

kilobyte. Approximately 1000 bytes.

L

LAN. See local area network.

load. To bring all or part of a computer program into memory from auxiliary storage so that the computer can run the program.

local area network (LAN). (1) 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 may be subject to some form of regulation. (T) (2) A network in which a set of devices are connected to one another for communication and that can be connected to a larger network.

logical. (1) Pertaining to content or meaning as opposed to location or actual implementation. (A)

(2) Pertaining to a view or description of data that does not depend on the characteristics of the computer system or the physical

storage. (A) (3) Contrast with physical. (A)

M

math coprocessor. In personal-computer systems, a microprocessor that supplements the operations of the system microprocessor, enabling the computer to perform complex mathematical operations in parallel with other operations.

MB. Megabyte (one million bytes).

Mbps. Mega (one million) bits per second.

medium. A physical material in or on which data may be represented.

megabyte. Approximately 1 000 000 bytes.

megahertz (MHz). A unit of measure of frequency equal to 1 000 000 cycles per second.

memory. Addressable storage space in the computer that is used for temporary storage of instructions and data while a program is running, or for permanent storage of microcode. Contrast with auxiliary storage.

menu. A list of options displayed to the user by a data processing

system, from which the user can select an action to be initiated. (T)

microprocessor. A processor whose elements have been miniaturized into one or a few integrated circuits. (T)

millimeter (mm). One thousandth of a meter.

millisecond (ms). One thousandth of a second.

milliwatt (mw). One thousandth of a watt.

modem (modulator/demodulator). (1) A functional unit that modulates and demodulates signals. One of the functions of a modem is to enable digital data to be transmitted over analog transmission facilities. (T) (A) (2) 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.

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)

multitasking. A mode of operation that provides for concurrent performance, or interleaved execution, of two or more tasks. (I) (A)

N

nanosecond (ns). One thousand millionth (10⁻⁹) of a second.

network. (1) An arrangement of nodes and connecting branches. (T)
(2) A configuration of data processing devices and software connected for information interchange.

network server. See server.

nonvolatile. (1) Pertaining to a storage device whose contents are not lost when power is turned off. (T) (2) Contrast with volatile.

normalization. The process of restructuring a relation for the purpose of reducing it to its simplest form, so that each of its attributes is based on a simple domain that consists of single, noncomposite values. (A)

ns. nanosecond.

O

operating system. 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)

P

parity bit. A check bit appended to an array of binary digits to make the sum of all the binary digits, including the check bit, always odd or always even. (A)

PCI. Peripheral component interconnect.

performance. One of the two major factors, together with facility, on which the total productivity of a system depends. Performance is largely determined by a combination of throughput, response time, and availability.

physical. (1) Pertaining to actual implementation or location as opposed to conceptual content or meaning. (A) (2) Contrast with logical. (A)

pipeline. In microprocessors, a technique used to shorten the critical path of instruction execution by performing multiple execution stages simultaneously.

port. An access point for data entry or exit.

processing. The performance of logical operations and calculations on data, including temporary retention of data in microprocessor storage while the data is being operated on.

processor. A functional unit that interprets and executes instructions. A processor consists of at least an

instruction control unit and an arithmetic and logic unit. (T) See microprocessor and central processing unit.

program. (1) A sequence of instructions that a computer can interpret and execute. (2) To design, write, modify, and test computer programs. (I) (A)

programmable read-only memory (PROM). A storage device that, after being written to once, becomes read-only memory. (T) (A)

PROM. Programmable read-only memory.

prompt. A visual or audible message sent by a program to request the user's response. (T)

PUN. Physical unit number.

R

RAID. Redundant array of independent disks.

RAS. Reliability, availability, and serviceability.

random access memory (RAM). (1) A storage device in which data can be written and read. (2) A storage device into which data is written and from which data is read in a nonsequential manner.

read. To acquire or interpret data from a storage device, from a data medium, or from another source.

read-only memory (ROM). Memory in which stored data cannot be modified by the user except under special conditions. See also EEPROM, EPROM, and PROM.

record. (1) A set of data treated as a unit. (2) A set of one or more related data items grouped for processing.

refresh. (1) To recharge a memory location in volatile memory with an electric current so that it retains a state or binary value. (2) In computer graphics, the process of repeatedly producing a display image on a display surface so that the image remains visible.

register. (1) An integrated circuit that contains 8, 16, or 32 storage locations, each of which can store 1 bit of binary data. See also binary. (2) An area that stores binary data while it is being processed by the computer.

resolution. In video monitors, a measure of the sharpness of an image, expressed as the number of lines and columns on the monitor screen or the number of pels per unit of area.

S

SCSI. Small computer system interface.

seek time. The time required for the access arm of a direct access storage device to be positioned on the appropriate track.

sequential. Pertaining to a process in which all events occur one after the other, without any time lapse between them.

sequential access. The capability to enter data into a storage device or a data medium in the same sequence as the data is ordered, or to obtain data in the same order as it has been entered.

server. (1) A functional unit that provides shared services to workstations over a network. (2) In a network, a data station that provides facilities to other stations.

SIMM. Single-inline memory module.

small computer system interface (SCSI). A standard input/output interface used by personal computers.

socket. A receptacle for a microchip.

software. (1) All or part of the programs, procedures, rules, and associated documentation of a computer. Software is an intellectual creation that is independent of the medium on which it is recorded. (2) Contrast with hardware.

SQL. Structured query language.

startup sequence. In personal-computer systems, the order that the computer uses to search the direct access storage devices for an operating system.

storage. A functional unit into which data can be placed, in which it can be retained, and from which it can be retrieved.

subsystem. In computers, a secondary or subordinate system, usually capable of operating independently of a controlling system, and usually having a single purpose, such as displaying video or reading from and writing to hard disks. A subsystem can be integrated into the system board or on an adapter.

superscalar. In a microprocessor, a technique in which multiple independent instructions are issued per clock cycle.

swap space. In virtual memory systems, external storage allocated to program and memory images.

symmetric multiprocessing. In personal-computer systems, a multiprocessing design that enables two or more microprocessors to run concurrently and work independently, with each microprocessor capable of performing any application task.

system board. In a system unit, the main circuit board that supports a variety of basic system devices, such as a keyboard or a mouse, and provides other basic system functions.

system unit. In personal-computer systems, the part of the computer that contains the processor circuitry,

read-only memory (ROM), random access memory (RAM), and the I/O channel.

T

TB. Terabyte.

terabyte. Approximately 1 000 000 000 000 bytes.

throughput. A measure of the amount of work performed over a period of time, for example, number of jobs per day.

time-division multiplexing. Division of a transmission facility into two or more channels by allotting the common channel to several different information channels, one at a time. See also frequency-division multiplexing.

token. In a local area network, the symbol of authority passed successively from one data station to another to indicate the station temporarily in control of the transmission medium. Each data station has an opportunity to acquire and use the token to control the medium. A token is a particular message or bit pattern that signifies permission to transmit.

transaction. An exchange between a workstation and another device that accomplishes a particular action or result.

U

utility program. (1) A computer program in general support of computer processes; for example, a diagnostic program, a trace program, a sort program. (2) A program designed to perform an everyday task such as copying data from one storage device to another.

V

VDRAM. Video dynamic random access memory.

vertical-refresh rate. The rate, measured in hertz, at which a display image is redrawn from top to bottom.

virtual. Pertaining to a functional unit that appears to be real, but whose functions are accomplished by other means.

volatile. (1) Pertaining to a storage device whose contents are lost when power is turned off. (2) Contrast with nonvolatile.

W

wait state. A period during which a microprocessor suspends processing while waiting for a response to a request for an unavailable resource.

workstation. (1) A functional unit at which a user works. A workstation often has some

processing capability. (2) A terminal or microcomputer, usually one that is connected to a mainframe or to a network, at

which a user can perform applications.

write. To make a permanent or transient recording of data in a storage device or on a data medium.

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