



PC Server 325

**User's Reference**

**Note**

Before using this information and the product it supports, be sure to read the general information under Appendix A, "Product Warranties and Notices" on page 85.

**First Edition (September 1996)**

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## About This Book

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This *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 325.

This reference does not provide specific instructions for performing procedures. That information is on your *PC Server 325 Setup and Installation* sheet and in your *PC Server 325 User's Handbook*.

### How This Book is Organized

Chapter 1, "Introducing the IBM PC Server 325," provides an overview of the features and expansion capabilities of your server. This chapter also includes the PC Server 325 specifications.

Chapter 2, "Understanding 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 325.

Chapter 4, "Bus Architecture," describes the PC Server 325 bus architecture. All server models contain peripheral component interconnect (PCI) and extended industry standard architecture (EISA) expansion slots. This advanced multiple-bus architecture provides high performance and a large selection of expansion options.

Chapter 5, "Data Storage Devices," explains PC Server 325 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 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,” provides information about the configuration process. It also contains a description of the configuration programs provided with your PC Server 325.

Chapter 8, “Input/Output Ports and Connectors,” provides information about the serial, parallel, keyboard, mouse, video, Ethernet, infrared, and SCSI input/output (I/O) connectors on the PC Server 325. 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.

An Appendix A, “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 are not familiar with, refer to the glossary located in the back of this book.

An index follows the glossary.

## Related Publications

The following publications come with your PC Server 325:

- The *PC Server 325 Setup and Installation* sheet contains information about setting up your server.
- The *PC Server 325 User's Handbook* contains detailed information about configuring, using, installing options in, and troubleshooting your server.
- The *PC Server Service and Support* pamphlet explains how you can get assistance from IBM, including:
  - Warranty service for your server
  - Technical support from IBM HelpWare
  - Extended service after the warranty period

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

Additional publications are available for purchase from IBM. For a list of publications available in your country:

- In the U.S. and Puerto Rico, call IBM PC Books at 1-800-426-7282.
- In Canada, call 1-800-465-1234.
- In other countries, contact your IBM reseller or marketing representative.





## Chapter 1. Introducing the IBM PC Server 325

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The IBM PC Server 325 is ideally suited for networking environments that require superior microprocessor performance, efficient memory management, flexibility, and large amounts of reliable data storage.

Performance, ease of use, reliability, and expansion capabilities were key considerations during the design of your server. These design features make it possible for you to customize the server hardware to meet your needs today, while providing flexible expansion capabilities for the future.

Your server is built around a powerful Intel Pentium Pro microprocessor. You can install a second microprocessor in your server to increase performance and to provide symmetric multiprocessing (SMP) capability.

Your IBM PC Server 325 comes with a three-year limited warranty, the IBM ServerGuide package, and IBM PC Server Startup Support. The PC Server Startup Support program provides comprehensive telephone assistance for the installation of your hardware *and* your software during your first 90 days.

As always, your IBM server meets stringent worldwide certifications for power, EMC (electromagnetic compatibility), and safety.

## Features at a Glance

The following table summarizes the features of the PC Server 325.

<p><b>Microprocessor</b></p> <ul style="list-style-type: none"> <li>• Pentium Pro microprocessor</li> <li>• 16 KB of level-1 cache</li> <li>• 256 KB (min.) of level-2 cache</li> <li>• Clock rate varies by model</li> </ul> <p><b>Memory</b></p> <ul style="list-style-type: none"> <li>• Standard: 32 MB (min.), expandable to 512 MB</li> <li>• 60 ns, buffered Extended Data Output (EDO), Error Correcting Code (ECC)</li> <li>• Four dual inline memory-module sockets</li> </ul> <p><b>Diskette Drive</b></p> <ul style="list-style-type: none"> <li>• Supports one drive</li> <li>• Standard: One 3.5-inch, 1.44 MB</li> <li>• Optional (internal): <ul style="list-style-type: none"> <li>– 3.5-inch, 1.44 MB</li> <li>– 3.5-inch, 2.88 MB</li> </ul> </li> </ul> <p><b>Hard Disk Drives</b></p> <ul style="list-style-type: none"> <li>• Number and capacities of hard disk drives vary by model</li> <li>• Supports up to five internal hard disk drives</li> </ul> <p><b>CD-ROM Drive</b></p> <ul style="list-style-type: none"> <li>• Standard: SCSI CD-ROM</li> </ul>	<p><b>Keyboard and Auxiliary Device</b></p> <ul style="list-style-type: none"> <li>• Keyboard (some models)</li> <li>• Mouse (some models)</li> </ul> <p><b>Expansion Slots</b></p> <ul style="list-style-type: none"> <li>• Supports up to six adapters</li> <li>• One dedicated PCI slot</li> <li>• Four shared PCI/EISA slots</li> <li>• One dedicated EISA slot</li> </ul> <p><b>Expansion Bays</b></p> <ul style="list-style-type: none"> <li>• Two 5.25-inch drive bays</li> <li>• Five 3.5-inch drive bays</li> <li>• The number of bays available for expansion varies by model</li> </ul> <p><b>Upgradable POST and BIOS</b></p> <ul style="list-style-type: none"> <li>• Flash ROM modules on the system board</li> <li>• POST/BIOS upgrades (when available)</li> </ul> <p><b>Security Features</b></p> <ul style="list-style-type: none"> <li>• Bolt-down capability</li> <li>• Door lock</li> <li>• LogicLock security enabled</li> <li>• Power-on password</li> <li>• Administrator password</li> <li>• Selectable drive startup</li> <li>• Security-error indicator</li> </ul>	<p><b>Integrated Functions</b></p> <ul style="list-style-type: none"> <li>• Two serial ports</li> <li>• One infrared port</li> <li>• One parallel port</li> <li>• Mouse port</li> <li>• Keyboard port</li> <li>• UltraSCSI controller <ul style="list-style-type: none"> <li>– One 16-bit external connector</li> <li>– One 16-bit internal connector</li> </ul> </li> <li>• Ethernet controller <ul style="list-style-type: none"> <li>– 10BASE-T port</li> <li>– AUI port</li> </ul> </li> <li>• Video port compatible with: <ul style="list-style-type: none"> <li>– Super video graphics array (SVGA)</li> <li>– Video graphics adapter (VGA)</li> <li>– Color graphics adapter (CGA)</li> </ul> </li> <li>• 1 MB of video RAM</li> </ul> <p><b>Power Supply</b></p> <ul style="list-style-type: none"> <li>• 250 W with voltage switch (115–230 V ac)</li> <li>• Built-in overload and surge protection</li> <li>• Automatic restart after a momentary loss of power</li> </ul>
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## **What Your IBM PC Server 325 Offers**

The IBM PC Server 325 is designed to be cost effective, powerful, and flexible. It offers impressive performance using the Pentium Pro microprocessor. You can install a second microprocessor in your server to increase performance and to provide SMP capability.

Your server also provides large data-storage capabilities, enhanced system expandability, and SVGA video graphics.

The PC Server 325 uses both peripheral component interconnect (PCI) and extended industry standard architecture (EISA) bus architectures, to provide compatibility with a wide range of existing hardware devices and software applications. You can install a combination of up to six PCI and EISA adapters in the expansion slots on the system board.

The PCI bus is a 32-bit local bus that provides a high-speed data path between the microprocessor and peripheral devices, such as the video and hard disk subsystems. The system board in your server contains a PCI UltraSCSI controller, a PCI Ethernet controller, and a PCI video controller.

The EISA bus is a popular PC bus architecture, supported by thousands of adapters and applications. One of the benefits of EISA is that it allows you to install and use both EISA and industry standard architecture (ISA) adapters and the devices that they support. Because EISA is fully backward compatible, you can install both old and new ISA adapters and software in your server.

## IBM ServerGuide

The IBM ServerGuide package contains several compact discs (CDs). These CDs contain menu-driven programs that make it easy for you to install your operating system, network program, and systems-management software. These CDs also contain online publications and a performance-tuning program. Refer to the documentation packaged with the ServerGuide CDs for more detailed information.

## Operating System Support

You can use the PC Server 325 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 support the multiple-microprocessor capability of your server.

You can access the latest information about the operating systems that your PC Server 325 supports on the World Wide Web. See “Getting Help on the World Wide Web” on page 5 for more information.

If you do not have access to the World Wide Web, call IBM for the latest information:

- In the U.S., call 1-800-772-2227.
- In Canada, call 1-800-565-3344.
- In all other countries, contact the IBM support organization that services your area, your IBM marketing representative, or your IBM reseller.

## Getting Help on the World Wide Web

You can access the latest information about product compatibility and configuration on the World Wide Web. This information is updated as new PC Server products are announced.

The following is a sample of the information available at <http://www.pc.ibm.com/servers/> on the World Wide Web.

- Current updates to device drivers, flash BIOS, and other software
- A listing of products that have been tested for compatibility with IBM PC Servers
- Certification and compatibility information about network operating systems and operating systems

## IBM PC Server Startup Support

The IBM PC Server Startup Support program provides comprehensive telephone assistance 24 hours a day, 7 days a week, during the first 90 days after the installation of your server.<sup>1</sup> IBM gives you direct access to trained specialists who can help you set up, install, and configure your server.

Help is available for IBM and non-IBM network operating systems, network interface adapters, and other optional peripherals. To receive a list of the network products supported by the IBM PC Server Startup Support program, call the IBM PC Company Automated Fax System at 1-800-426-3395 in the U.S., or call 1-800-465-3299 in Canada, and ask for document number 16125.

For more information about this program, or for help with the installation of your server:

- In the U.S., call IBM at 1-800-772-2227.
- In Canada, call IBM at 1-800-565-3344.
- In all other countries, contact the IBM support organization that services your area, your IBM marketing representative, or your IBM reseller.

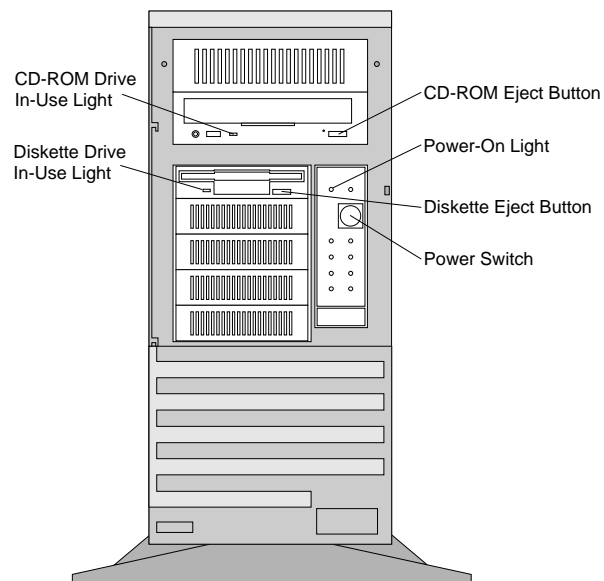
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<sup>1</sup> Response time will vary, depending on the number and nature of calls received.

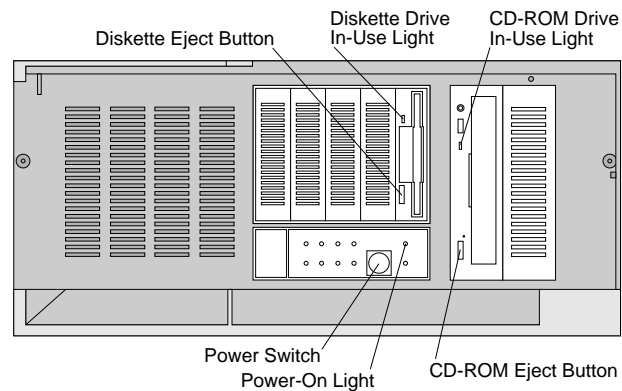
## Controls and Indicators

The most commonly used controls and indicators are on the front of your server.

### Tower Model<sup>2</sup>



### Drawer Model<sup>2</sup>



<sup>2</sup> Front view with the door removed.

**CD-ROM Eject Button:** Push this button to release the compact disk (CD) from the CD-ROM drive.

**Power-On Light:** This green LED lights when you turn on your server by pressing the power switch, or when the server powers on in the unattended-startup mode.

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

**Power Switch:** Use this switch to toggle between the *attended* and *standby* modes.

To toggle from the:

- Standby mode to the attended mode, press and release the power switch.
- Attended mode to the standby mode, press the power switch just until the power LEDs go out and then immediately release the switch.

The PC Server 325 comes with an automatic-restart feature that enables the server to restart following a momentary power loss. This means that the server is never completely turned off (unless, of course, its power cord is disconnected).

Your server also comes with an unattended-startup feature that enables you to configure the server to power on at a specified date and time, or when it receives a signal from either of its serial ports.

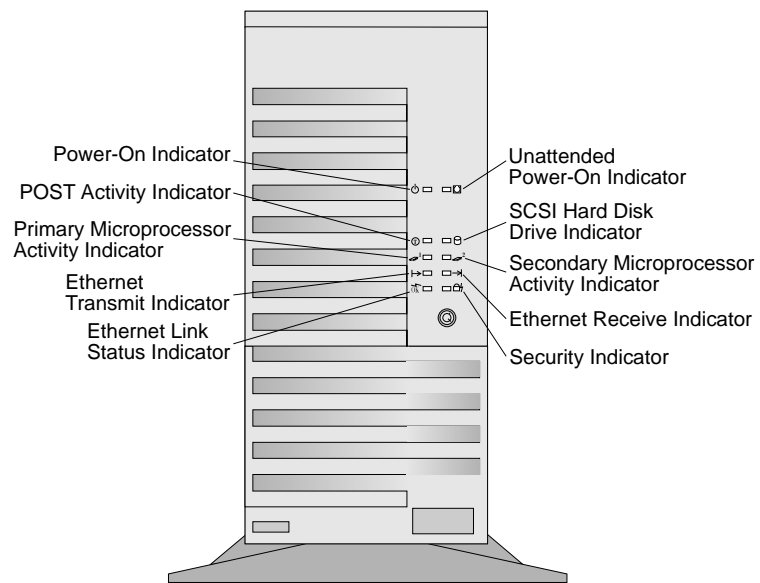
See your *User's Handbook* for more information about the standby mode, attended mode, and unattended-startup feature.

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

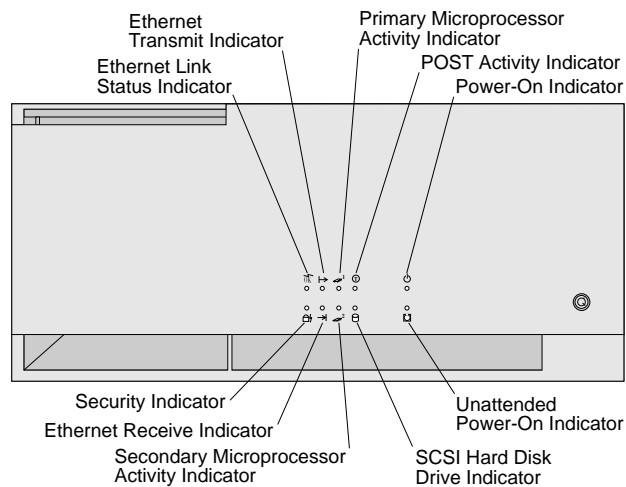
**CD-ROM Drive In-Use Light:** This lights when the CD-ROM drive is accessed.

## Operator Panel Status Indicators











### Tower Model



### Drawer Model



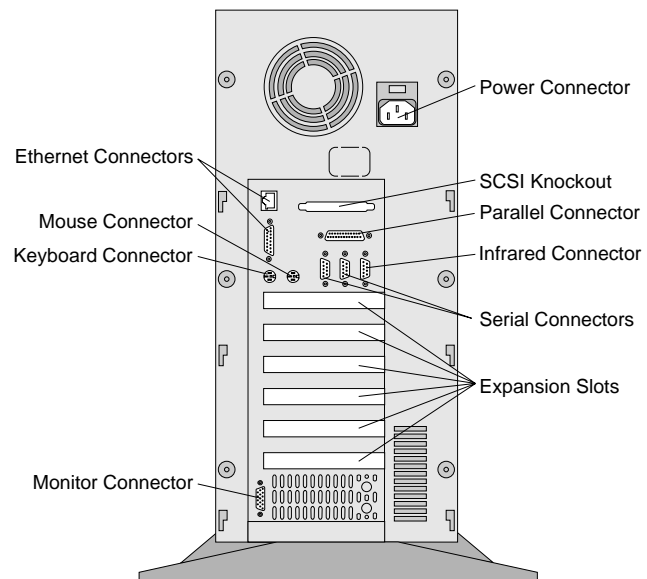


-  **Unattended Power-On Indicator:** This LED lights when the server powers on in the unattended-startup mode.
-  **SCSI Hard Disk Drive Indicator:** This amber LED lights when your server is accessing a SCSI device.
-  **2 Secondary Microprocessor Activity Indicator:** When a second microprocessor is installed, this amber LED indicates the activity of both installed microprocessors.
-  **Ethernet Receive Indicator:** This amber LED indicates reception activity on the network.
-  **Security Indicator:** When tamper-detection hardware and software are installed and enabled, this amber LED shows that a security hardware or software error occurred.
-  **Ethernet Link Status Indicator:** This green LED indicates an active link connection on the 10BASE-T interface.
-  **Ethernet Transmit Indicator:** This amber LED indicates transmission activity on the network.
-  **1 Primary Microprocessor Activity Indicator:** When only one microprocessor is installed, this amber LED indicates microprocessor activity. It also comes on during POST.
-  **POST Activity Indicator:** This amber LED lights while the power-on self-test (POST) is running. If this light remains illuminated, a POST error has occurred or the system microprocessor has stopped.
-  **Power-On Indicator:** This green LED lights when you turn on your server by pressing the power switch, or when the server powers on in the unattended-startup mode.

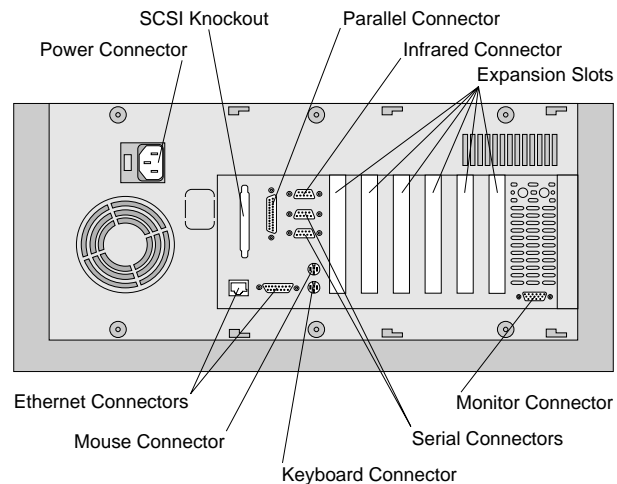
## Input/Output Connectors

The input/output ports (connectors) are shown in the following illustrations.

### Tower Model



### Drawer Model



**Power Connector:** The server power cable connects here.

**SCSI Connector Knockout:** When the external SCSI cable is installed, you can attach an external SCSI device here.



**Parallel Connector:** The server has one 25-pin parallel port. A signal cable for a parallel device, such as a printer, connects here.



**Infrared Connector:** The server has one connector for an infrared (IR) transceiver module option.



**Serial Connectors:** The server has two 9-pin serial connectors (A and B). Serial signal cables for modems or other serial devices connect here. Serial port B shares a port assignment with the infrared port. For port assignments, see “Serial Port Connectors” on page 58.

**Expansion Slots:** Additional connectors might be here if optional adapters are installed.



**Monitor Connector:** The monitor signal cable connects here.



**Keyboard Connector:** The keyboard cable connects here.



**Mouse Connector:** The mouse cable connects here. This connector is sometimes called the auxiliary-device port.



**Ethernet Connectors:** There are two Ethernet connectors: an RJ-45 and a DB-15. The RJ-45 connector is for attachment to the integrated 10BASE-T (twisted-pair) transceiver. If your server comes with an Ethernet interface cable, you must attach one end to the RJ-45 connector on the server, and the other end to the cable on the 10BASE-T device. The DB-15 attachment unit interface (AUI) connector is for attachment of an external 10BASE2, 10BASE5, 10BASE-F, or 10BASE-T medium attachment unit (MAU).

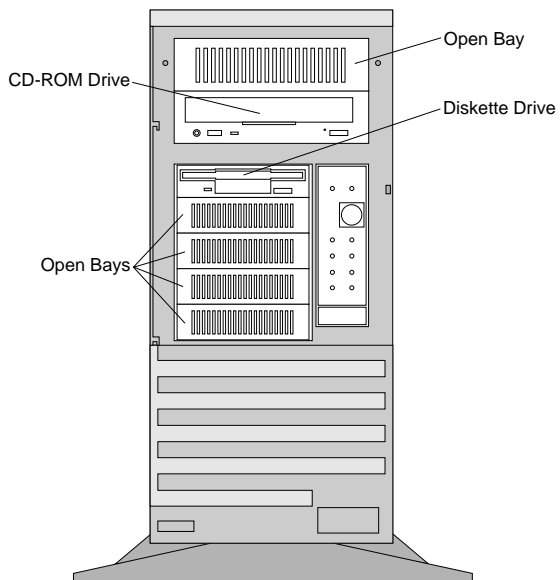
Refer to your *Setup and Installation* sheet and your *User's Handbook* for details about Ethernet cable requirements.

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

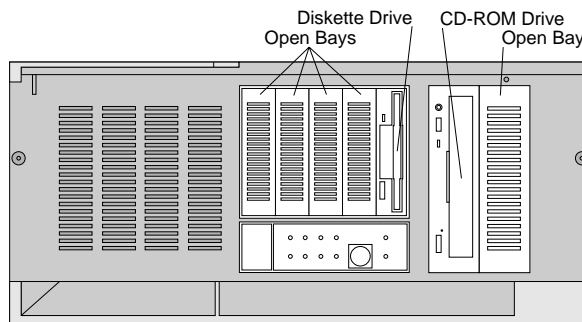
## Expansion Bays

Your server comes with one 3.5-inch, 1.44 MB diskette drive, and one 5.25-inch CD-ROM drive.

### Tower Model<sup>3</sup>



### Drawer Model<sup>3</sup>



<sup>3</sup> Front view with the door removed.

**Open Bays:** The open bays provide the flexibility to install combinations of 3.5-inch or 5.25-inch devices such as hard disk, CD-ROM, and tape drives in your server. For installation instructions and information on the types of drives that you can install in each bay, refer to your *User's Handbook*.

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

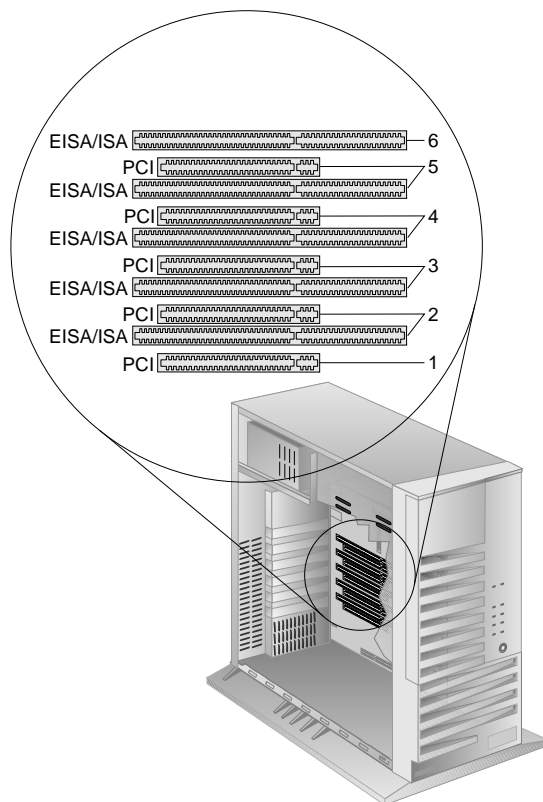
**CD-ROM Drive:** All models come with a SCSI CD-ROM drive.

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

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

## Expansion Slots

The following illustration shows the location and numbering of the PCI and EISA expansion slots. Note the location of the shared expansion slots (slots 2, 3, 4, and 5).



All PC Server 325 models have six expansion slots on the system board. Expansion slot 1 is PCI. Expansion slot 6 is EISA/ISA. The four remaining expansion slots (slots 2, 3, 4, and 5) are *shared expansion slots*. This means that you can install an adapter in either the PCI expansion slot or the adjacent EISA/ISA expansion slot, but not in both.

## International Capabilities

The IBM PC Server 325 is suitable for use worldwide. Electric power can vary from country to country; however, your PC Server 325 has a voltage-selection switch that you can set to the standard power available in your country. See your *Setup and Installation* sheet for information on setting voltages.

Language is another factor to consider. You can use special editions of operating systems that let the server and keyboard operate with other languages. With the appropriate adapter, those same operating systems also let you view Asian characters on your monitor.



## 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; and 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 325. Many of these features are described in later chapters of this book, or in your *User's Handbook*.

- Menu-driven configuration programs
- Power-on self-test (POST) and Fast POST
- 24-hour customer support center<sup>4</sup>
- Menu-driven diagnostic programs
- Error codes and messages
- Upgradable POST and basic input/output system (BIOS) software
- Error correction code (ECC) memory
- ECC-protected memory bus
- Parity checking on the SCSI bus, keyboard interface, and serial ports
- Automatic restart after power failure
- Vital product data (VPD), including serial number information and replacement part numbers, stored in nonvolatile memory, making remote maintenance of your server more efficient

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<sup>4</sup> Response time will vary, depending on the number and nature of calls received.



# Specifications

<p><b>Size</b></p> <ul style="list-style-type: none"> <li>• Tower model, with pedestal:             <ul style="list-style-type: none"> <li>- Depth: 473 mm (18.6 in.)</li> <li>- Height: 455 mm (17.9 in.)</li> <li>- Width: 315 mm (12.4 in.)</li> </ul> </li> <li>• Tower model, without pedestal:             <ul style="list-style-type: none"> <li>- Depth: 473 mm (18.6 in.)</li> <li>- Height: 425 mm (16.7 in.)</li> <li>- Width: 195 mm (7.7 in.)</li> </ul> </li> <li>• Drawer model:             <ul style="list-style-type: none"> <li>- Depth: 465 mm (18.3 in.)</li> <li>- Height: 216 mm (8.5 in.)</li> <li>- Width: 482 mm (19.0 in.)</li> </ul> </li> </ul> <p><b>Weight</b></p> <ul style="list-style-type: none"> <li>• Typical server as shipped: 17 kg (37.5 lb)</li> </ul> <p><b>Environment</b></p> <ul style="list-style-type: none"> <li>• Air temperature:             <ul style="list-style-type: none"> <li>- Server on: 10° to 35° C (50° to 95° F)</li> <li>Altitude: 0 to 914 m (3000 ft.)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Server on: 10° to 32° C (50° to 90° F)</li> <li>Altitude: 914 m (3000 ft.) to 2133 m (7000 ft.)</li> <li>- Server off: 10° to 43° C (50° to 110° F)</li> <li>Maximum Altitude: 2133 m (7000 ft.)</li> </ul> <ul style="list-style-type: none"> <li>• Humidity:             <ul style="list-style-type: none"> <li>- Server on: 8% to 80%</li> <li>- Server off: 8% to 80%</li> </ul> </li> <li>• Maximum altitude: 2133 m (7000 ft.)</li> </ul> <p><b>Electrical Input</b></p> <ul style="list-style-type: none"> <li>• Sine-wave input (50 to 60 Hz) is required</li> <li>• Input voltage:             <ul style="list-style-type: none"> <li>- Low range:                 <ul style="list-style-type: none"> <li>- Minimum: 90 V ac</li> <li>- Maximum: 137 V ac</li> </ul> </li> <li>- High range:                 <ul style="list-style-type: none"> <li>- Minimum: 180 V ac</li> <li>- Maximum: 265 V ac</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Input kilovolt-amperes (kVA) approximately:             <ul style="list-style-type: none"> <li>- Minimum configuration as shipped: 0.08 kVA</li> <li>- Maximum configuration: 0.52 kVA</li> </ul> </li> </ul> <p><b>Total Power Available for Drives</b></p> <ul style="list-style-type: none"> <li>• Nominal Operating Current allowed:             <ul style="list-style-type: none"> <li>- +5 V dc line: 5.3 A</li> <li>- +12 V dc line: 5.0 A</li> </ul> </li> </ul> <p><b>Heat Output</b></p> <ul style="list-style-type: none"> <li>• Approximate heat output in British Thermal Units (Btu) per hour:             <ul style="list-style-type: none"> <li>- Minimum configuration: 350 Btu (102 watts)</li> <li>- Maximum configuration: 860 Btu (251 watts)</li> </ul> </li> </ul>
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## Chapter 2. Understanding Server Performance

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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. Sharing resources also can improve work flow, work quality, and productivity.

Some reasons for this are:

- Centralized databases can be shared easily.
- Security of information is more easily ensured.
- Meeting notices, notes, messages, letters, and text files can be sent to multiple users simultaneously, using electronic mail.

### Performance Tuning

A performance-tuning feature available on the ServerGuide CD (provided with your server) enables you to customize the programmable registers in your server so that your applications can run faster than before. Refer to the documentation that comes with the ServerGuide package for information about using the performance-tuning feature.

## Server Performance

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

- Network operating system
- Application programs
- Network adapter or controller
- System memory
- System microprocessor
- Hard disk subsystem (SCSI controller 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. The original parameter settings provided by most network operating systems typically support a network with 12 to 18 concurrent users. If you have a larger network or increase the size of a network, you will probably need to adjust some of these settings to maintain adequate 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 changes by making remarks, such as the date and reason for the changes, above or below the values that you change. Such information can save you valuable time if you need to make additional adjustments.

## Application Programs

Most complex programs allow you to change specific parameters to improve performance in a network environment. Use the instructions that come with the application programs to determine which parameters to change to improve performance and when to change them.

It is good practice to record the original settings before you make any changes and, if possible, document the changes by making remarks above or below the values that you change.

## Network Adapters and Controllers

Your PC Server 325 comes with a full-duplex Ethernet network controller on the system board. This 32-bit, bus-master controller provides direct-memory-access buffer management for low microprocessor and bus use. Bus-master network controllers provide higher throughput rates because they handle most of the network processing and leave the system microprocessor free for other tasks.

If you decide that you need additional network throughput, you can install a higher-performance network adapter in your server. 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 network adapters for PCI and EISA servers.

You can access the latest information about the network adapters available for your PC Server 325 on the World Wide Web. (See “Getting Help on the World Wide Web” on page 5 for more information.) If you do not have access to the World Wide Web, contact your reseller or marketing representative for a current list of the network adapters that are available for your server.

## System Memory

When you have a large network or you increase 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.

The PC Server 325 supports up to 512 MB of buffered extended data output (EDO), error correcting code (ECC) system memory. Your server comes with a minimum of 32 MB of system memory. To increase system memory, you can install additional dual inline memory modules (DIMMs) with a speed of 60 ns.

## System Microprocessor

One way to optimize the performance of your server is to install an additional microprocessor. The processor board in your server supports up to two Pentium Pro microprocessors. Each microprocessor has global access to all I/O devices and has an integrated:

- Level-1 cache, 16 KB
- Level-2 cache, 256 KB (min.)
- Cache controller
- Advanced programmable interrupt controller (APIC)

Integrating the level-2 cache, cache controller, and APIC into the Pentium Pro microprocessor improves performance and alleviates some of the performance bottlenecks experienced with earlier microprocessor designs.

Another way to improve system microprocessor performance is to lighten the load on the microprocessor by using bus-master adapters. Bus-master adapters handle tasks, such as the network processing or data transfers, with minimal system-microprocessor involvement.

## The Hard Disk Subsystem

Your server comes with an UltraSCSI controller on the system board. This controller significantly increases performance by handling the processing of SCSI commands and data transfers, leaving the system microprocessor free to handle other tasks.

You can attach an external or multiple internal SCSI devices to the built-in UltraSCSI controller. If necessary, you can install SCSI adapters for further expansion. You also can use SCSI storage enclosures to house additional 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:

- Define the functional requirements of your server for your working environment.
- Define what you consider to be adequate performance, such as response times, transaction rates, and number of users.
- Understand what factors affect server performance.
- Decide what an approximate configuration of applications for your work environment would be.
- Measure the current performance of your server using a variety of application configurations; then, use the performance results to locate performance bottlenecks and to determine which configuration provides sufficient performance today, and allows room for growth.
- 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 the applications that you are using.

Try to determine which subsystem is the most likely bottleneck for your environment, then concentrate on obtaining improvements for components within that subsystem. Some changes might improve the performance of one 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 it's the microprocessor, you could install an additional microprocessor; if it's 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, and so on.



## Chapter 3. Microprocessors and Memory

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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. Your server comes with an Intel Pentium Pro microprocessor. You can install a second Pentium Pro microprocessor in your server to enhance performance and provide symmetric multiprocessing (SMP) capability.

### Microprocessor 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<sup>5</sup>, 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 operations within the microprocessor.

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<sup>5</sup> MHz denotes internal clock speed of the microprocessor only; other factors might also affect application performance.

## Microprocessor Performance

The Pentium Pro microprocessor gains its high performance through its innovative design. *Dynamic Execution* is the term given to the design of the Pentium Pro microprocessor. This dynamic design enables the Pentium Pro microprocessor to speculatively execute instructions in any order, but always complete the instructions in their original program order. Looking 20 to 30 instructions ahead of the instruction pointer, the Pentium Pro microprocessor predicts program flow, and then analyzes the program data flow to determine the best order in which to execute the program's instructions. This approach eliminates the constraint for linear instruction sequencing and enables the microprocessor to schedule up to five instructions per clock cycle, although a sustained rate of three instructions per clock cycle is more typical.

One of the design features that helps the Pentium Pro achieve its higher clock rate is its *pipeline* implementation. In a pipeline, multiple instructions are in various stages of execution. For example, while one instruction is fetched, two are decoded, another is executed, and the results of another are written to memory. This parallelism speeds up instruction execution significantly when compared to a microprocessor that runs at the same speed and does not use pipelining.

The Pentium Pro microprocessor has a 12-stage, *superpipelined* implementation. This superpipelined implementation trades some work per pipestage for more stages, which results in a pipe-stage time that is 33 percent less than the pipe-stage time of a standard Pentium microprocessor.

Another design feature that enables the Pentium Pro to achieve its higher clock rate is the integration of several system components. Each Pentium Pro microprocessor in your server contains a 256 KB (min.) level-2 cache, a cache controller, and an advanced programmable interrupt controller (APIC). In earlier personal computers, these system components were not contained within the microprocessor. Instead, they were separate components on the system board, processor board, or memory board.

This added level of integration improves performance by alleviating some of the performance bottlenecks experienced with earlier system designs. This integration also results in a microprocessor bus that more closely resembles a symmetric multiprocessing (SMP) system bus, rather than resembling a previous generation processor-to-cache bus.

## Microprocessor 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. Registers also store the results of processing operations until the results are needed for other operations or are written to memory.

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.

## Real Mode and Protected Mode Operation

The microprocessor has a *real mode* with a 1 MB address space. 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 microprocessor also has a *protected mode* that 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 does not use the capabilities provided by the protected mode. When a multitasking

operating system starts, it switches the microprocessor to the protected mode and uses the multitasking capabilities provided by the protected mode of the microprocessor.

## Numeric Computing

The microprocessor in your server has an execution unit that performs 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 control circuits within the microprocessor pass data and instructions to the FPU, which then performs the mathematical operations. Other units, such as the *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 microprocessor. Otherwise, the microprocessor will not assign the operation to the FPU, and the integer units will perform the calculations.

## Memory Subsystem

The *memory subsystem* consists of the memory controller, random access memory, read-only memory, physical memory, 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.

Your PC Server 325 has a 32-bit *direct-memory-access* (DMA) controller. This DMA controller is a *bus master* that manages all DMA data transfers between system memory and I/O devices.

DMA is a method used to transfer large amounts of data between system memory and I/O devices without the assistance of the microprocessor. This is more efficient than *programmed I/O*, in which the microprocessor reads the data from the sending device, and then writes it to the receiving device.

With DMA data transfers, data bypasses the system microprocessor as it moves between system memory and I/O devices. This improves server performance because the microprocessor does not need to interrupt its processing activities to manage data transfers.

Transferring data between system memory and an I/O device requires two steps. First, the microprocessor gives the DMA controller the location, destination, and amount of data that is to be transferred. Then, the DMA controller transfers the data, allowing the microprocessor to continue with other processing tasks.

When a device needs to use the bus to send or receive data, it competes with all the other devices that are trying to gain control of the bus, in a process known as *arbitration*. The DMA controller does not arbitrate for control of the bus; instead, the I/O device that is sending or receiving data (the *DMA subordinate*) participates in arbitration. The DMA controller takes control of the bus when the central-arbitration-control point grants the request of the DMA subordinate.

## Random Access Memory and Read-Only Memory

Random access memory (RAM) is used for temporary storage of data and instructions during processing. RAM is contained in memory components known as *dual inline memory modules* (DIMMs). It is *volatile* memory, which means that to retain its contents, it must be constantly refreshed by an electrical current. While the server is

turned off, no current is supplied to the dual inline memory modules so no data is retained in RAM.

Your server supports up to 512 MB of 60 ns buffered EDO, ECC memory. You can increase system memory by installing DIMMs in the four connectors on the processor board.

In addition to volatile RAM, the system board has a small area of *nonvolatile RAM* (NVRAM). Using a small current from the system battery, NVRAM retains its contents while the server is turned off. Your passwords, the time and date, and the system configuration information are stored in NVRAM.

Read-only memory (ROM) stores programs that the server uses for startup procedures and other internal operations. ROM is *nonvolatile* memory, and retains its contents when the server is turned off.

Generally, the contents of a ROM module are permanently encoded and cannot be modified. However, some of the ROM modules in your server can be reprogrammed (*flash memory*) while they are in the server. For example, the POST and BIOS software in your server is stored in flash memory so that it can be updated whenever enhancements are made.

## Physical Memory

*Physical memory* consists of all the writable memory locations in the server, most of which are in dual inline memory modules (DIMMs).

Portions of the physical memory are reserved for:

- Operating system
- Power-on self-test
- Video data being displayed
- Adapter ROM data, which is copied into memory

The part of physical memory available for instructions and data that the server uses to run programs is *system memory*.

Refer to the *User's Handbook* that comes with your server for more information about installing additional memory.

## Virtual Memory

*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.

## Cache Memory

*Cache memory* is high-speed memory, known as static random access memory (SRAM). To reduce the time that the microprocessor spends waiting for system memory to respond, your server uses cache memory. Cache memory improves server performance by temporarily storing frequently used data and instructions in a *cache*, a small buffer between the microprocessor and system memory.

Each Pentium Pro microprocessor in your server contains a cache controller for its 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, which is part of the microprocessor, consists of very fast RAM. This type of cache memory is also referred to as an internal cache. The Pentium Pro microprocessor provides 16 KB of internal level-1 cache. (1 KB equals approximately 1000 bytes.)

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.) This enables the microprocessor to execute programs much faster because the microprocessor does not have to access system memory for each read or write request. When the execution context changes, the cache controller writes out the current contents of the level-1 cache to the level-2 cache. Then, it copies the new data and instructions into the level-1 cache, replacing the data and instructions that are no longer needed.

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 integrated cache controller quickly locates the needed information from the level-2 cache or system memory, and then copies the information into the level-1 cache. The cache controller manages the use of the cache so that the number of cache hits far exceeds the number of cache misses.

### *Level-2 Cache*

Each Pentium Pro microprocessor in your server also contains a level-2 cache of at least 256 KB. 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. If the microprocessor does not find what it needs in the level-2 cache (a *second-level cache miss*), the cache controller locates the data or instruction in system memory and copies it into both of the caches.

### *Write Modes*

The microprocessor cache memory in your server has two write modes: *write-back* and *write-through*.



In the *write-back* mode, the microprocessor updates the level-1 cache, and the cache controller updates the level-2 cache and system memory as needed. This leaves the microprocessor free to perform other operations. For maximum performance, your PC Server 325 cache memory is set to the write-back mode.

In the *write-through* mode, the microprocessor updates the level-1 cache, the cache controller updates the level-2 cache, and then the cache controller updates system memory. This is done for each write with no consideration of need. While the cache controller is updating system memory, which is a relatively lengthy task, the microprocessor might be idle with an outstanding memory request. You can use the Configuration/Setup program to change the cache memory setting to the write-through mode, but performance is substantially reduced.



## Chapter 4. Bus Architecture

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A *bus* is an electrical pathway for transferring signals and power among microprocessors, memory, adapters, and I/O devices. The signals include addresses, data, and control information.

The PC Server 325 incorporates three bus architecture designs. These are:

- The multiprocessing bus, which provides the ability to install up to two Pentium Pro microprocessors in your server and enables symmetric multiprocessing (SMP).
- The peripheral component interface (PCI) bus, which provides a high-throughput local bus.
- The extended industry standard architecture (EISA) bus, which provides an expansion bus that supports PC compatibility and a wide range of adapters, including industry standard architecture (ISA) adapters.

### Multiprocessing Bus Overview

The multiprocessing bus is a 64-bit bus that provides symmetric multiprocessing capabilities. It supports up to two microprocessors and has a peak-data-transfer rate of 500 megabytes-per-second (MBps).

Either microprocessor connected to the multiprocessing bus can be assigned any application task, and each microprocessor connected to the bus can globally access the system memory and the input/output (I/O) devices in the server.

The microprocessor-to-PCI *bus bridge* connects the multiprocessing bus to the PCI bus. This bus bridge provides a path through which the microprocessors can access PCI devices mapped anywhere in memory or I/O address spaces.

### PCI Bus Overview

The PCI bus is a 32-bit local bus that provides a high-speed data path between the processor board and peripheral devices, such as the video and hard disk subsystems. This industry-standard bus

has 32 signal paths for data; 32 bits of address or data can be sent across the bus simultaneously.

The PCI bus in your server provides a 32-bit data path. However, only when the sending device and the receiving device are 32 bits wide is the full width of the 32-bit data bus used. For example, when a 32-bit device transfers data to an 8-bit device, the 32-bit device must send the data in four 8-bit transfers.

Your PC Server 325 has a primary and a secondary PCI bus. The primary PCI bus connects the microprocessor bus to the integrated video controller, two PCI expansion slots, and the PCI-to-PCI bridge. The secondary PCI bus connects to the primary PCI bus through the PCI-to-PCI bridge, and it provides the SCSI controller, the Ethernet controller, and three additional PCI expansion slots access to server resources.

The implementation of the PCI bus in your server supports bus speeds up to 33 MHz and allows PCI masters access to system memory. In addition, the PCI bus supports burst data transfers at 133 MBps; an address and multiple data words (each containing up to 32 bits) can be sent in each transfer.

You can install up to five PCI adapters in your PC Server 325. During startup, your server automatically detects the adapters and assigns them interrupt levels, I/O addresses, memory addresses, arbitration levels, and other system resources.

## Expansion Bus

The PCI expansion bus supports the addition of adapters to add new functions to your server. Adapters plug into connectors, called *expansion slots*, on the system board. These connectors provide paths for transferring data to and from the adapters. Many adapters provide bus-master capabilities, which enable the adapters to perform operations without interrupting the system microprocessors.

## Bus Master Implementation

The PCI bus supports *bus masters*. A bus master is an on-board device or controller, or an adapter, that can take control of (own) the bus. The system microprocessor is the first owner of the bus at server startup.

A bus master can have its own microprocessor, instruction cache, and memory. By taking over some of the work of the system microprocessor, bus masters create a multiprocessing environment and increase overall server performance.

Typical bus masters include:

- Memory and cache controllers
- Disk controllers
- Direct memory access (DMA) controllers
- Video controllers and adapters
- Network interface adapters

Once a bus master has control of the bus, it can issue bus commands to other devices on the bus. The target of a bus master, called a *subordinate*, executes bus commands issued by a bus master. Subordinates can initiate service requests, such as interrupts, but subordinates never own the bus.

A bus master can also be a subordinate, but, at a given time, it must be either a bus master or a subordinate. It cannot be both simultaneously.

## PCI Bus Arbitration

The PCI bus architecture supports *arbitration*, a process that determines which of two or more competing devices has control of the bus at any given time. When multiple devices need to own a bus at the same time, these devices participate in arbitration.

The PCI bus architecture implements a *central arbitration control point*. This is where contending devices send their arbitration signals.

## Bus Parity Checking

The PCI bus supports *bus parity checking*, a method of verifying that data has not been changed during a data-transfer operation. Bus parity checking uses an extra bit, known as a *parity bit*, that is sent with each byte of data as it is transferred across the bus. The PCI bus in your server uses even parity. The parity bit is set to 1 or 0 so that each byte has an even number of 1's. If the parity of the received byte does not match the parity of the byte as it was sent, an error occurred during transmission and the receiving device can request that the data be sent again.

## EISA Bus Overview

The EISA bus is 32-bits wide and supports 32-bit EISA adapters. One of the benefits of EISA is that it allows you to install and use both EISA and ISA adapters and the devices that they support. Because EISA is fully backward compatible, you also can install both 16-bit and 8-bit ISA adapters and software in your server.

The 32-bit EISA 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 EISA Configuration program, supplied with your server, automatically detects and configures EISA adapters. On most ISA adapters, you must set switches and jumpers. The program assists you in determining the necessary switch and jumper settings.

Data transfers on the EISA bus are synchronized to an 8.33 MHz bus clock signal. If the target device on the EISA bus supports *EISA burst-mode transfers*, the data transfer might require only one cycle of the bus clock for each subsequent transfer after the initial data transfer.

Because the data path on the EISA bus is 32-bits wide, four bytes of data (maximum) can be transferred during each data transaction.

## Chapter 5. Data Storage Devices

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IBM data storage devices and IBM external storage enclosures are available for the PC Server 325. You can use these storage devices, along with a wide variety of industry-standard storage devices, to expand the data storage capacity of your server.

### IBM 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, and CD-ROM drives.

### Diskette Drives

All PC Server 325 models come with one 3.5-inch, 1.44 MB diskette drive installed as a standard feature. However, two diskette drives are supported. You can install an additional diskette drive to expand the capabilities of your server.

Your server supports the following diskette drives: the 3.5-inch, 1.44 MB; the 3.5-inch, 2.88 MB; and the 5.25-inch, 1.2 MB.

#### *3.5-Inch, 1.44 MB Diskette Drive*

The 3.5-inch, 1.44 MB diskette drive comes as standard equipment. This drive uses 1 MB and 2 MB, 3.5-inch diskettes. To prevent the loss of data, format 1 MB diskettes to store 720 KB of data, and 2 MB diskettes to store 1.44 MB of data.

### *3.5-Inch, 2.88 MB Diskette Drive*

This drive uses 3.5-inch diskettes with a formatted capacity of 720 KB, 1.44 MB, or 2.88 MB. To prevent the loss of data, always format 1 MB diskettes to store 720 KB of data, 2 MB diskettes to store 1.44 MB of data, and 4 MB diskettes to store 2.88 MB of data.

### *5.25-Inch, 1.2 MB Diskette Drive*

This drive uses 5.25-inch diskettes with a formatted capacity of 360 KB or 1.2 MB. Diskettes formatted on this drive to store 360 KB of data might not be usable in 360 KB diskette drives.

An external model and an internal model are available. The internal model attaches to the diskette drive cable. The external model attaches to an adapter that you install in an expansion slot.

## **SCSI Hard Disk Drives**

The PC Server 325 supports drives that comply with ANSI SCSI Standards X3.131-1986 (SCSI), X3.131-1994 (SCSI-2), and X3T10/1071D (the proposed SCSI-3 standard).

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 UltraSCSI controller on the system board. This SCSI controller 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."

You can install SCSI drives inside the server or in an external storage enclosure. (For more information about SCSI storage enclosures, see "IBM External SCSI Storage Enclosures" on page 42.)



## SCSI CD-ROM Drive

All PC Server 325 models come with a SCSI *compact disc-read only memory* (CD-ROM) drive installed as a standard feature. CD-ROM drives use compact discs that the server can read from but not write to. Data can be viewed but not updated or changed. 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 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 server to work with advanced multimedia applications. Your CD-ROM drive also supports the Kodak Photo CD standard for pictures on CDs.

Handle a CD by the edges only. Periodically clean your CDs by wiping them with a soft, lint-free cloth, from the center of the CD to the outer edge. Do not clean CDs in a circular pattern, because this can cause loss of data.

## Tape Drives

Tape drives are sequential-access devices that provide a cost-effective way to back up the important data on your server. You can copy several billion bytes of data from the hard disks to a single tape. In a sequential-access (or serial-access) device, data is stored in the storage medium in the same sequence as it was entered. Contact your IBM reseller or marketing representative for more information about the tape drives available for your server.

## **IBM External SCSI Storage Enclosures**

The PC Server Enterprise Expansion Enclosure is one of several SCSI storage enclosures that you can attach to your server. The publication provided with each external enclosure includes information about setting it up, installing and removing drives, and attaching the enclosure to the server.

When attaching external storage enclosures to your server, you might need to install an additional SCSI controller (adapter) to maintain adequate signal quality on the SCSI bus.



Contact your IBM marketing representative or your IBM reseller for additional information.

## Chapter 6. The SCSI Subsystem

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The *small computer system interface* (SCSI) enables your server to communicate with devices such as hard disk drives, CD-ROM drives, tape drives, scanners, and printers.

All IBM PC Server 325 models come with a bus-master UltraSCSI controller on the system board. This SCSI controller supports two, 16-bit (Fast/Wide) connectors: one internal and one external. These connectors are on a *split bus*, and they enable you to attach both internal and external SCSI devices to the same SCSI bus.

The internal SCSI connector provides support for SCSI devices installed inside the server. The external SCSI connector provides support for an external SCSI device, such as a tape drive.

The UltraSCSI controller also supports:

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

For more information about the UltraSCSI controller, refer to the UltraSCSI publications provided with your server.

## Advantages of the SCSI Subsystem

The SCSI standards define the interface through which the system communicates with different types of devices. Before the SCSI standards were developed, most physical devices required controllers (usually adapters). These adapters 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 subsystem produces significant improvements in server performance and flexibility over other I/O interfaces. Each SCSI device has a built-in *device controller* that interprets the SCSI command set. The SCSI standards define the commands and messages used in the interface.

Several SCSI devices can operate concurrently and share the interface. This means significantly higher data-transfer rates and faster, more efficient, I/O management for network servers. The SCSI controller is the key component in the SCSI subsystem. You can connect internal and external physical devices to the same SCSI controller.

## 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 controller 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 controller support 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.

## SCSI Device ID

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

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

You must assign a unique SCSI ID to each SCSI device that you install in or attach to the server. The unique ID prevents two devices from sending or receiving data on the SCSI bus at the same time. SCSI devices use a variety of mechanisms to set the SCSI ID, such as jumpers, thumbwheels, or switches.

The 16-bit (Fast/Wide) SCSI devices can use IDs 0 through 6, or 8 through 15; 8-bit (Fast/Narrow) SCSI devices can use IDs 0 through 6. ID 7 is reserved for the SCSI controller, which comes preset to ID 7.

In summary, the SCSI controller uses SCSI IDs to distinguish one device from another and to determine the priority of each device.

## SCSI Logical Unit Number

Each physical device has a physical unit number 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 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 so on.

## Cabling

All PC Server 325 models come with a 16-bit SCSI cable preinstalled. This cable is connected to the internal SCSI connector on the system board, and it supports both 8-bit and 16-bit SCSI devices.

*Note:* You need an optional 16-bit to 8-bit converter to attach an 8-bit device to the 16-bit cable.

The internal SCSI cable provides seven SCSI device connectors, one of which is connected to your CD-ROM drive. Depending upon your model, another connector on this cable might be attached to a hard disk drive. You can use the remaining connectors to install additional SCSI devices in your server.

A 16-bit external SCSI cable also comes with your server. You can use this cable to attach an external device to the external SCSI connector on the system board.

When the internal and external cables are both installed, the entire configuration is seen as one long bus.

## Termination

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

If you have only internal SCSI devices installed *and* you have not installed the external SCSI cable, the SCSI controller provides the termination for one end of the bus, and the terminator attached to the end of the internal cable provides the termination for the other end of the bus.

*Note:* To maintain signal quality on the SCSI bus, do not attach more than one SCSI device to the external connector.

You can attach both 16-bit and 8-bit SCSI devices to the SCSI bus. A SCSI termination jumper (J29) is provided to ensure proper signal quality and termination. Refer to the *User's Handbook* for more information.

The following rules apply to SCSI-device termination:

- If you have both internal SCSI devices and an external SCSI device installed, the device at the end of the internal cable and the device at the end of the external cable must be terminated.
- If you have more than one internal SCSI device, only the device farthest from the UltraSCSI controller must be terminated. Other internal devices connected to the same cable must not be terminated.

*Note:* For specific information about device termination, see the instructions supplied with the device.



## Chapter 7. Configuration

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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 required to configure your server depend on the number and variety of devices you install 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:

- Peripheral component interconnect (PCI)
- Extended industry standard architecture (EISA)
- Industry standard architecture (ISA)
- 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 server.

## Configuration Programs

All PC Server 325 models come with menu-driven configuration programs. Step-by-step instructions for using these utility programs are provided in your *User's Handbook*.

You can use the configuration programs to view or change system-board settings and assignments, EISA and ISA device assignments, PCI device assignments, and SCSI device assignments.

Your PC Server 325 comes with the following configuration programs:

- **Configuration/Setup Program**

All PC Server 325 models come with this built-in configuration program, which you can access during system startup. It is stored in nonvolatile RAM on the system board.

You can use this program to set the date and time, set passwords, view or change system-board settings, or to view or change PCI device settings. You can also use this program to define system security and set the startup sequence for your drives.

Run this program when you first set up your server; when you get a configuration error during startup; or when you install, remove, or change the position of a device in the server.

Before you install a new device or program, or make changes to your existing configuration, be sure to record the current settings. In the unlikely event that a conflict occurs, you will be able to change the settings back to their original values.

- **EISA Configuration Diskette**

This diskette comes with all PC Server 325 models. It contains configuration and utility programs for EISA and ISA adapters. You can use the programs on this diskette to configure EISA and ISA adapters. (Instructions for using this diskette are in your *User's Handbook*.)

- **SCSISelect Program**

The built-in Adaptec SCSISelect configuration program comes with all PC Server 325 models. It enables you to view or change the assignments of SCSI devices attached to the UltraSCSI controller on the system board. You can use this utility program to change default settings, resolve configuration conflicts, or perform a low-level format on a SCSI hard disk drive connected to the integrated SCSI controller. For more information, see “The SCSISelect Utility Program” on page 53, your *User's Handbook*, and the UltraSCSI controller publications provided with your server.

## Configuration Process Overview

Your server uses jumpers, switches, and configuration programs to assign interrupt levels, input/output addresses, memory addresses, and other system resources.

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.

Your server automatically recognizes and configures some options, such as memory and PCI adapters. However, when you install other options, such as EISA or ISA adapters and SCSI devices, you must manually configure them.

## Configuring PCI Adapters

Programmable configuration hardware enables your server to recognize and configure PCI adapters automatically. This programmable hardware consists of:

- Nonvolatile RAM on the system board
- ROM used to store the device configuration information
- Registers on the system board and adapters

Instead of jumpers and switches that you set manually, PCI adapters have registers that act as electronic switches. These read-and-write registers are set by POST each time you turn on the server. The registers are volatile storage areas, and retain the configuration

information only while the server is turned on. When you turn off the server, the configuration information is cleared from these registers.

A current copy of the configuration information is stored in a battery-backed memory area known as nonvolatile RAM. The same battery that supports the nonvolatile RAM module supports the real-time clock module, which provides a time-of-day clock, a 100-year calendar, and 64 bytes of nonvolatile RAM that the server uses to store some setup information, such as passwords.

Each PCI adapter has a unique device ID. POST uses the device ID to identify the type and location of each PCI adapter in the server.

The programmable configuration hardware, together with the configuration programs and configuration files, simplifies the process of configuring PCI devices by:

- Eliminating the need for setting jumpers and switches on PCI adapters
- Enabling you to configure the server automatically or manually using menu-driven programs
- Identifying the type and location of each device in the server
- Resolving system resource conflicts

During startup, the PC Server 325 automatically detects PCI devices and uses the configuration information provided in the ROM on the device to assign system resources.

Your server uses this configuration information to assign interrupt levels, input/output addresses, memory addresses, and other system resources to PCI devices. In most cases, the server will operate using the default settings.

## Configuring EISA or ISA Adapters

Before you install an EISA or ISA adapter in your server, be sure to check the documentation that comes with the adapter. Some adapters have jumpers or switches that you must set to assign system resources, such as interrupt levels and memory addresses. Before you assign a system resource to the adapter, you must verify

that the resource is not already assigned to the system board or another device. To do this:

1. Check the adapter documentation to see which system resources, such as interrupt level or memory-address space, it needs to function properly.
2. Start the built-in Configuration/Setup program.
3. Record the settings of the existing devices.
4. Compare the settings of the existing devices to the settings required by the new adapter; then, choose settings for the new adapter that will not conflict with an existing device.

Some adapter documentation might list only one choice for a system resource. For example, the adapter might operate only at interrupt level 3. If this occurs, you might need to change the assignment of an existing device to avoid a configuration conflict.

5. Set the jumpers or switches on the new adapter.
6. Install the new adapter in an available expansion slot.
7. Use the EISA Configuration Diskette to assign or verify the adapter's configuration.

## Configuring SCSI Devices

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

### *The SCSISelect Utility Program*

You can use the built-in SCSISelect utility program to change default settings, locate and correct configuration conflicts, and format a new SCSI hard disk.

Your *User's Handbook* provides instructions for using the SCSISelect utility program.

The settings that you can view or change include:

- Host Adapter SCSI ID

You can change the SCSI ID of the SCSI controller from its default value of 7.

- SCSI Parity Checking

The PC Server 325 does not support the nonparity mode. For your server to function properly, you must leave this parameter set to *Enabled*.

- SCSI Device Configuration

You can 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 hard disk drives when using DOS version 5.0 or later versions.

## Configuring the Serial Ports

When you turn on your server, the power-on self-test (POST) assigns the serial ports to specific communication port addresses. You can install adapters to support additional serial ports.

Each serial connector or adapter in your server can use any of four available port settings, provided that a different setting is used for each.

*Note:* The infrared port and serial port B are a shared port.

The settings include the port address (in hexadecimal) and the interrupt request (IRQ), which determines how the microprocessor responds to an interrupt from the serial port.

The four available port settings are:

COM1, Serial Port A: **3F8h-IRQ 4**

COM2, Serial Port B: **2F8h-IRQ 3**

COM3, Serial Port A: **3E8h-IRQ 4**

COM4, Serial Port B: **2E8h-IRQ 3**

Some application programs use only COM1 and COM2, and some modems require a specific port address. If you need to change communication port address assignments to resolve conflicts, use the Configuration/Setup program.

## Configuring the Parallel Port

When you turn on your server, the power-on self-test (POST) assigns the parallel port to a specific I/O port address, if the parallel port is enabled.

To enable or disable the parallel port, use the Configuration/Setup program.

## Option Configuration Files

The configuration files for an optional device normally are provided on an Option Diskette that comes with the device. The server uses these configuration files to assign settings that define how the device will operate. Sometimes Option Diskettes also contain device drivers and diagnostic programs for the device.

When you install a device that comes with an Option Diskette, be sure to read the instructions that come with the device. Refer to the information provided with the option, the instructions provided in your *User's Handbook*, and your operating system documentation to install the device-specific files provided on the Option Diskette.





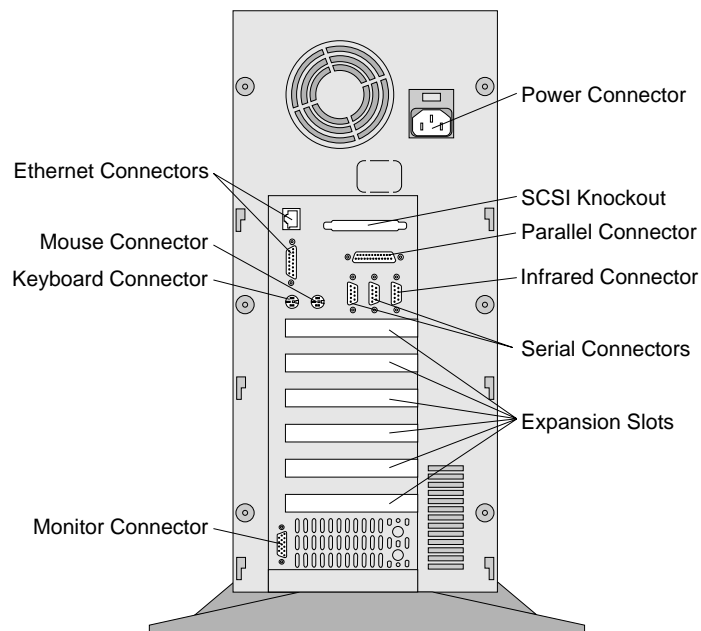
## Chapter 8. Input/Output Ports and Connectors

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The input/output (I/O) connectors (ports) on the back of your server are for attaching external devices, such as printers, keyboards, and monitors, to your server. These I/O connectors include:

- Two serial connectors
- One parallel connector
- One video (monitor) connector
- One keyboard connector
- One mouse (auxiliary-device) connector
- One external SCSI connector (knockout)
- Two Ethernet connectors
- One infrared connector

The following illustration shows the location of these connectors.



## Serial Port Connectors

Serial ports are used to communicate with printers, plotters, external modems, auxiliary terminals, and other computers. Your server provides two serial ports (A and B). You can add more serial ports by installing a serial adapter in one of the expansion slots.

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

The serial ports transmit and receive data and commands at a rate of 300 bits per second (bps) up to 115 200 bps. The bits-per-second measurement is commonly referred to as the *baud rate*.

Each of the two serial connectors provided on your PC Server 325 uses a 9-pin, D-shell connector.

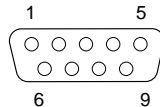


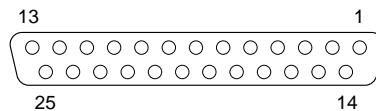
Table 1 shows the pin-number assignments for the serial port connectors. The pin-number assignments conform to the RS-232C industry standard.

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 1. Serial Port Connector Pin-Number Assignments

## Parallel Port Connector

Parallel ports are used to communicate with printers and other devices, such as some CD-ROM and tape drives. Your server provides one 25-pin, D-shell connector on the back of the server.



This parallel port connector conforms to the Institute of Electrical and Electronics Engineers (IEEE) Standard 1284. There are three standard modes of operation:

- Standard Parallel Port (SSP)
- Enhanced Parallel Port (EPP)
- Extended Parallel Port (ECP)

Table 2 shows the pin-number assignments for the parallel port connector. The signal names for all three modes are shown. SSP and ECP signal names are the same; EPP signal names that are different are shown in parentheses.

Pin	Signal	Pin	Signal
1	-STROBE (-WRITE)	14	-AUTO FD (-DSTRB)
2	Data 0	15	-ERROR
3	Data 1	16	-INIT
4	Data 2	17	-SLCT IN (-ASTRB)
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 (-WAIT)	24	Ground
12	PE	25	Ground
13	SLCT		

Table 2. Parallel Port Connector Pin-Number Assignments

## Video Port Connector

The video port is where you can attach a video monitor to your PC Server 325. Your server provides a 15-pin video port connector.

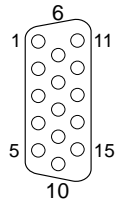


Table 3 shows the pin-number assignments for the video port connector.

Pin	Signal
1	Red
2	Green or monochrome
3	Blue
4	Not connected
5	Ground
6	Red ground
7	Green ground or monochrome ground
8	Blue ground
9	Reserved
10	Ground
11	Not connected
12	Display data channel (DDC data)
13	Horizontal synchronization (Hsync)
14	Vertical synchronization (Vsync)
15	Display data channel (DDC clock)

Table 3. Video Port Connector Pin-Number Assignments

## Keyboard and Mouse Connectors

Your server provides one keyboard port and one auxiliary-device port. An auxiliary device can be a mouse or other pointing device.

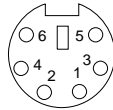


Table 4 shows the pin-number assignments for the keyboard and auxiliary-device port connectors.

Pin	Signal
1	Data
2	Not connected
3	Ground
4	+5 V dc
5	Clock
6	Not connected

*Table 4. Keyboard and Auxiliary-Device Port Connectors Pin-Number Assignments*

## SCSI Connectors

Your server comes with an UltraSCSI controller on the system board. This controller has two 68-pin, shielded, high-density connectors. You can use these connectors to install SCSI devices in your server or to attach an external SCSI device to your server.

See Chapter 6, “The SCSI Subsystem” on page 43 for additional information about the SCSI subsystem.

### Internal SCSI Connector

A 7-drop, 68-pin (16-bit) cable is installed in your server. This cable is connected to the internal connector for the UltraSCSI controller. You can use this cable to install additional SCSI devices in your server. A CD-ROM drive is installed as standard equipment. A hard disk drive might also be installed, depending on the model of your PC Server 325.

### External SCSI Connector

To attach an external SCSI device to your server, install the SCSI 16-bit, 68-pin external SCSI cable provided with your PC Server 325. The external SCSI cable provides a connector to which you can attach an external SCSI device.

For more details on installing the external SCSI cable, refer to your *User's Handbook*.

Table 5 shows the pin-number assignments for the 68-pin SCSI 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	Reserved
16	Ground	50	-PRSN
17	Terminal power	51	Terminal power
18	Terminal power	52	Terminal 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	Not connected	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 5. The 68-Pin SCSI Port Connector Pin-Number Assignments

## Ethernet Port Connectors

Your integrated Ethernet controller provides two network interfaces with automatic port selection. There are two types of standard Ethernet connectors provided at the rear of your server: an RJ-45 and a DB-15. Only one connector can be in use at one time.

See Appendix A, “Product Warranties and Notices” for the electronic emission and Federal Communications Commission (FCC) requirements for using these connectors. Refer to your *User's Handbook* for details about Ethernet cable requirements.

### RJ-45 Connector

This connector is for use with category 3, 4, or 5 twisted-pair cable. The RJ-45 connector enables an Ethernet network to attach to the internal 10BASE-T transceiver in your server.

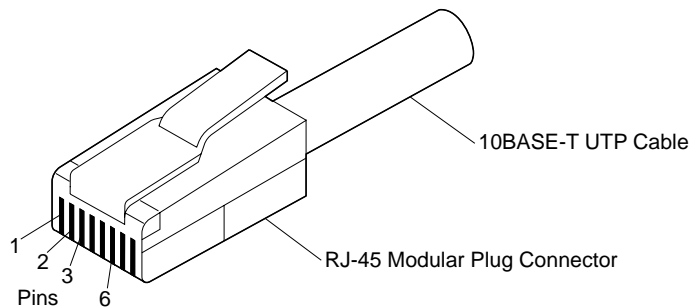


Table 6 shows the pin-number assignments for the RJ-45 Ethernet connector.

Pin	Signal
1	Transmit data+
2	Transmit data-
3	Receive data+
4	Reserved
5	Reserved
6	Receive data-
7	Reserved
8	Reserved

Table 6. RJ-45 Ethernet Connector Pin-Number Assignments



## DB-15 Connector

This connector, also called an attachment unit interface (AUI), is used in Ethernet networks using external transceivers. This standard, 15-pin AUI connector connects to any media type through a media attachment unit (MAU).

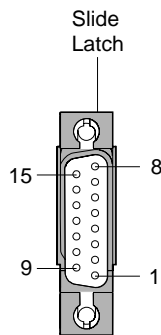


Table 7 shows the pin-number assignments for the DB-15 AUI connector.

Pin	Signal
1	Shield ground
2	AUI collision+
3	AUI data out+
4	Reserved
5	AUI data in+
6	Signal ground
7	Reserved
8	Reserved
9	AUI collision-
10	AUI data out-
11	Reserved
12	AUI data in-
13	+12 V dc
14	Reserved
15	Reserved

Table 7. DB-15 Ethernet AUI Connector Pin-Number Assignments

## Infrared Connector

Your server comes with an infrared (IR) connector where you can attach an optional infrared transceiver module. The transceiver allows wireless communication between your server and other infrared-capable computers and printers.

*Note:* The serial B connector and the infrared connector share the serial B port; you can use only one connector at a time.

The IR connector is a 9-pin, D-shell connector. The transceiver module plugs into this connector and provides a link of up to one meter at baud rates of 1.15 megabits-per-second (Mbps) and 4 Mbps. The IR connector uses the same port assignments as serial port B.

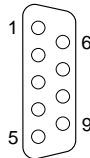


Table 8 shows the pin numbers and signal names assigned to this connector.

Pin	Signal
1	IR output
2	Ground
3	Reserved
4	IR input 2
5	IR control 1
6	IR input 1
7	+5 V dc
8	IR control 2
9	Reserved

*Table 8. Infrared Connector Pin-Number Assignments*

## Chapter 9. Video Subsystem

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Your PC Server 325 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 is for attaching a video monitor to your server. For information about this connector, see “Video Port Connector” on page 60.

The video controller supports high-resolution graphics and fast refresh rates that exceed the specifications of the 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 69.

The SVGA mode can provide a screen resolution of up to 1024 x 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)*. The amount of VDRAM in your server and the capabilities of the video device driver determine the resolution and the number of colors that are supported. Your server supports the following screen resolutions and numbers of colors:

- 640 x 480 pels with up to 16.8 x 10<sup>6</sup> colors (noninterlaced)
- 800 x 600 pels with up to 65 536 colors (noninterlaced)
- 1024 x 768 pels with up to 256 colors (noninterlaced)

*Note:* Monitors supporting 1280 x 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 PCI expansion slot 1 or PCI expansion slot 2.

*Note:* For your server to recognize an optional video adapter, you must move a jumper on the system board.

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

These characteristics can be very important. 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. For some applications, a black-and-white (monochrome) monitor might work as well as a color monitor.

## 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 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 you work with. 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 the pattern of pels in adjoining lines is very different, or when an object on the screen is made up of alternating bright and dim lines.

Some application programs cannot reproduce all colors, and 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

IBM provides many monitors that you can use with your server. To take full advantage of the video capabilities provided by your server, use a monitor with a fast noninterlaced refresh rate, such as the IBM G40, G50, or P50 monitor.

The following table provides a partial list of monitors and their characteristics.

Type	Dot Pitch	Resolution	Maximum Vertical Refresh Rate
G40	0.28	1024x768	43 Hz interlaced
G40	0.28	800x600	60 Hz noninterlaced
G40	0.28	640x480	75 Hz noninterlaced
G50	0.28	1024x768	72 Hz noninterlaced
G50	0.28	800x600	85 Hz interlaced
G50	0.28	640x480	85 Hz noninterlaced
P50	0.26	1024x768	85 Hz noninterlaced
P50	0.26	800x600	85 Hz noninterlaced
P50	0.26	640x480	85 Hz noninterlaced

Table 9. Monitor Types and Characteristics

For more details, refer to the information supplied with your monitor.

Contact your IBM reseller or marketing representative for the current list of IBM monitors.

## Screen-Saver Programs

Leaving the monitor turned on for prolonged periods without changing what appears on the screen can adversely affect the monitor. Depending on what is on the screen, the image might burn into the phosphor coating (leaving a permanent image) or cause darkening of some areas of the screen.

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. To resume working with the monitor, you press a predefined key to restore the previous image to the screen. Several companies produce screen-saver programs. Contact your IBM reseller or marketing representative for details.

## **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.

## **Avoiding Fatigue**

The American Academy of Ophthalmology considers monitors safe for normal use and has declared they present no hazard to vision and 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 properly 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 during which you stay in a fixed position or repeat the same movement over a long period.

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

Additional information is available by ordering the following publications through your 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

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Security features deter unauthorized use of your server 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 server be located? Should it be secured to permanent furniture or fixtures? Should use of the server be limited? After you have identified your security needs, you can activate or implement the appropriate security features.

### LogicLock

*LogicLock* security is available as an optional feature for your PC Server 325. This advanced security feature uses tamper-evident microswitches on the covers to detect if someone has tried to open the cover.

For more information about this optional feature, contact your IBM reseller or marketing representative.

### Securing Hardware

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, such as a table, a desk, or a wall. Another approach is to locate critical resources, including your server, in a limited-access area behind locked doors. This approach is particularly important, because anyone with the proper equipment and knowledge can gain access to the data stored 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 server to a stationary object using a cable or chain
- The security-cover option

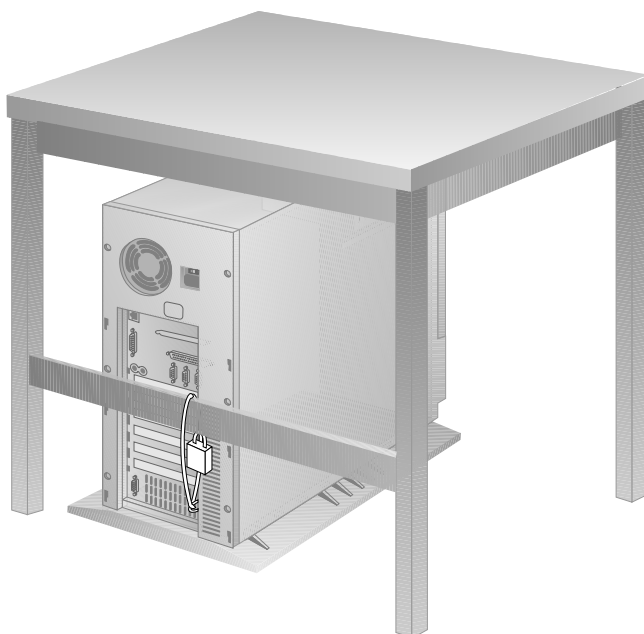
## Door Lock and Keys

A door lock mechanically deters access to the drives. It controls access to the small door that covers the removable media drives as well as the entire front cover.

Two keys with a serial number tag are provided with your server. Always store the keys in a safe place. Anyone who has the key serial number and manufacturer's address can order duplicate keys, so also store the tag in a safe place. If you lose the keys and tag, you must order a replacement lock mechanism and keys from IBM.

## 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 chain to lock the server in place. (This capability is referred to as a *cable-down* or a *bolt-down* feature.)



Step-by-step instructions for installing the U-bolt are in your *User's Handbook*.

### Security-Cover Option

At the rear of your server are several connectors that can be used to send and receive data. Anyone with the correct equipment and knowledge can use these connectors to gain access to the data stored on your hard disk and other storage devices. The rear cover of your server accommodates a security cover that prevents access to these connectors.



The security-cover option prevents the cables from being removed from the rear of the server, and prohibits other computers or devices from being attached to the unused connectors.

*Note:* The security-cover option is not a standard feature of your server; it is available from your IBM reseller or IBM marketing representative.

## 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.

Some advanced network-management programs can audit usage, 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 encode the files so that they are unintelligible unless a special key is provided. You can use a program or an encryption device to encrypt data. Software programs are usually less expensive than hardware devices, but programs are slower.

## Power-On Password

You do not need to use a power-on password to use your server, but a password helps protect the information you store in your server. A power-on password can contain any combination of up to seven characters (A–Z, a–z, and 0–9). Keep a record of your password in a secure place.

The power-on password locks the keyboard and mouse (if attached to the auxiliary-device port) to help prevent unauthorized use of your server. If the mouse is connected to a serial port, the mouse remains active.

Refer to your *User's Handbook* for specific instructions on setting and changing the power-on password.

## Administrator Password

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

By using an administrator password, you can control access to the Configuration/Setup program. You can also use the administrator password to override the power-on password. After an administrator password is set, only those who know the password can perform certain tasks.

**Attention:** If an administrator password is set, then forgotten, it cannot be overridden or removed. The system board must be replaced.

### *When to Use the Administrator Password*

Use the administrator password when highly classified information must be protected. Although it can be used with your power-on password, it provides a much higher level of security when used with an operating system that controls access through the use of passwords.

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, do not make the two passwords the same.

One important difference between the power-on password and the administrator password is that a forgotten administrator password cannot be overridden or disabled. The single most important reason for setting an administrator password is that when one is set, only those who know the password can access the built-in configuration programs and modify the hardware or change the settings.

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

### *Setting an Administrator Password*

When you set an administrator password, you might want to change your drive-startup sequence as described in “Selectable Drive Startup.” You can select the default drive-startup sequence, which includes a diskette drive. But to increase the security of the server, you can remove the diskette drive from the drive-startup sequence. Instructions for setting the administrator password are in your *User's Handbook*.

### **Keyboard Password**

You can set a keyboard password to lock the keyboard while the server is turned on. This is useful if you leave your server on and unattended. With the keyboard locked, no one can use or restart your server.

The way you set the keyboard password depends on the operating system you are using. Many operating systems provide keyboard-password protection as a standard feature.

### **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 server checks the drives is the *drive-startup sequence*.

#### *Default Startup Sequence*

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

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 server 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.

### *Customizing the Startup Sequence*

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

When you change the startup sequence, the drive letters might change. The operating system assigns the drive letters when the server starts. Letters A and B are *always* assigned to diskette drives. Subsequent drive letters can be assigned to any type of drive based on the operating system or the device drivers used.

**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 from Loss**

There are several methods you can use to prevent the loss of data. 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. Or, 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. That way, in the event of a hardware failure, you can always recover using the copies.

Backing up the entire contents of a hard disk to diskettes can be very time-consuming and, in the case of a network server that has multiple hard disks, might require hundreds of diskettes. 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. In the event of a hard disk failure, the parity information and the data on the remaining functional disks are used to reconstruct the data that was stored on the failed drive.



## Viruses

Computer viruses are a problem that exists within the personal computer community. A computer virus is a program (or 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, causing unusual or erratic screen behavior. Others are destructive, erasing or damaging files or overloading memory and communication networks.

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 the virus appear, it might be difficult to determine if the problem is a hardware failure, a problem in the software, or a virus in action.

Virus-detection programs examine files and look for patterns associated with these viruses, or look for changes in the size of files. These programs are best used as a preventive measure to 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 built-in program that verifies the first sector on your hard disk drive (the master boot record) during startup. This program checks for any changes to the sector that might be caused by a virus. You can use the Configuration/Setup program to enable or disable this program. 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.

Viruses are generally spread unknowingly from computer to computer when programs are exchanged or shared. If you don't 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.

Here are a few tips to help 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 server.
- Avoid using programs and diskettes from unknown sources.
- If you use programs 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 should not change).
- Use password protection to limit access to your server or network.

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

## Erased Files

Erasing a file from a diskette or hard disk does not destroy the file. With the right type of software, all or part of an erased file can be reclaimed. This can cause a security risk if you sell a server 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.

## **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 switches 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 switch itself on; the more time it takes, the greater the chance of losing data.



## Appendix A. Product Warranties and Notices

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### 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

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**Machine:** PC Server 325

**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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2. the amount of any other actual direct damages or loss, up to the greater of U.S. \$100,000 or the charges (if recurring, 12 months' charges apply) for the Machine that is the subject of the claim.

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NetWare	Novell, Inc.
Novell	Novell, Inc.
Pentium	Intel Corporation
SCSISelect	Adaptec, Inc.

Other company, product, and service names, which may be denoted by a double asterisk (\*\*), may be trademarks or service marks of others.

### Class A Devices

Your server complies with Industry Canada and FCC *Class A* requirements when it is attached to an Ethernet network through the Ethernet controller on the system board.

*Note:* If you are using an RJ-45 connector, you must use the Ethernet interface cable that comes with your server.

## Electronic Emission Notice for Class A Devices Industry Canada Class A Emission Compliance Statement

This Class A 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 A 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 A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. 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.

**Class B Devices**

Your server complies with Industry Canada and FCC *Class B* requirements if it is not attached to an Ethernet network through the Ethernet controller on the system board.

**Electronic Emission Notice for Class B Devices  
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:

<b>IBM Power Cord Part Number</b>	<b>Used in These Countries</b>
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
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

## Glossary

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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

**ac.** Alternating current.

**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.

**APAR.** Authorized program analysis report.

**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.

**attachment unit interface (AUI).** In a local area network, the interface between the medium attachment unit and the data terminal equipment within a data station. (I) (A)

**ASCII.** American National Standard Code for Information Interchange.

**asynchronous.** (1) Pertaining to two or more processes that do not depend upon the occurrence of a specific event such as a common timing signal. (T) (2) A class of data transmission service whereby all requests for service contend for a pool of dynamically allocated ring bandwidth and response time.

**attenuation.** A decrease in magnitude of current, voltage, or power of a signal in transmission between points.

**AUI cable.** The cable used to connect the AUI port on the Ethernet controller to a transceiver on a 10BASE5, 10BASE2, or 10BASE-F segment.

**AUI port.** A connector on the Ethernet controller that conforms to the AUI port specifications in IEEE Standard 802.3.

**AWG.** American Wire Gauge.

## B

**baud rate.** In remote communications, the transmission rate that is synonymous with signal events. The baud rate is usually expressed in bits per second.

**BBS.** Bulletin board system.

**BIOS.** Basic Input/Output System.



**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.

**cable segment.** A section of cable

between components or devices on a network. A segment may consist of a single patch cable, multiple patch cables connected together, or a combination of building cable and patch cables connected together. See *LAN segment*, *ring segment*.

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

**carrier sense multiple access with collision detection (CSMA/CD).** A network protocol in which the transmitting workstation detects data collisions and waits a random length of time before retrying the transmission.

**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.

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

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

**collision.** An unwanted condition that results from concurrent transmissions on a channel. (T)

**collision detection.** In carrier sense multiple access with collision detection (CSMA/CD), a signal indicating that two or more stations are transmitting simultaneously.

**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.

**crossover cable.** A type of 10BASE-T cable in which the transmit and receive data pairs are wired so that the transmit pair is terminated at the pin positions used by the receive pair at the opposite end of the cable. A crossover cable is used to connect the 10BASE-T port (on an Ethernet controller) to a 10BASE-T port (on a repeater) that does not perform the crossover function.

**CSMA/CD.** See *carrier sense multiple access with collision detection*.

**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)

**dB.** Decibel.

**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.

**DLC.** Data link control.

**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.

**duplex.** Pertaining to communication in which data can be sent and received at the same time. Synonymous with *full-duplex (FDX)*. Contrast with *half-duplex (HDX)*.

**Dynamic Execution.** The term given to the micro-architecture design of the Pentium Pro microprocessor. This design enables the Pentium Pro microprocessor to speculatively execute instructions in any order, but always complete the instructions in their original program order.

## E

**ECC.** Error correcting code.

**EDO.** Extended data output.

**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.

**extended industry standard architecture (EISA).** An expansion bus architecture used in a network server that provides compatibility among hardware components.

## F

**FDX.** Full-duplex. Synonymous with *duplex*. Contrast with *HDX*.

**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.

**FTP.** File transfer protocol. FTP is an application protocol used for transferring files to and from host computers.

## 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

**half-duplex.** In data communication, pertaining to transmission in only one direction at a time. Contrast with *duplex*.

**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.

**HDX.** Half-duplex.

**hexadecimal.** Pertaining to a system of numbers to the base 16; hexadecimal digits range from 0 through 9 and A through F, where A represents 10 and F represents 15.

**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)

**ID.** Identification, identifier.

**IEEE.** Institute of Electrical and Electronics Engineers.

**IEEE Standard 802.3.** A series of standards that define a type of LAN that uses an access method called *carrier sense multiple access with collision detection (CSMA/CD)* over cabling of various types. The cabling types defined by the standard are thick coaxial (10BASE5), thin coaxial (10BASE2), unshielded twisted pair (10BASE-T), and optical fiber (10BASE-F).

**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.

**Internet Packet Exchange (IPX).** The routing protocol used to connect Novell's servers or any workstation or router that implements IPX with other workstations. Although similar to TCP/IP, it uses different packet formats and terminology. See also *TCP/IP* and *Xerox Network Systems\*\* (XNS\*\*)*.

**Internet Protocol (IP).** A protocol used to route data from its source to its destination in an Internet environment.

**interrupt level.** The means of identifying the source of an interrupt, the function requested by an interrupt, or the code or feature that provides a function or service.

**I/O.** Input/output.

**IPX.** Internet Packet Exchange.

**IRQ.** Interrupt request.

**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.

## J

**jabber.** Transmission by a data station beyond the time interval allowed by the protocol. (T)

**jumper.** A connector between two pins on a network adapter that enables or disables an adapter option, feature, or parameter value.

## K

**KB.** Kilobyte.

**kilobyte.** Approximately 1000 bytes.

**km.** Kilometer.

## L

**LAA.** Locally administered address.

**LAPS.** LAN Adapter Protocol Support. Replaced by MPTS.

**LAN.** Local area network.

**LAN segment.** Any portion of a LAN (for example, a single bus or ring) that can operate independently but is connected to other parts of the establishment network via bridges.

**LED.** Light-emitting diode.

**link segment.** In simple terms, a single cable or interconnected cables that connect a device to a 10BASE-T repeater. The cables in a link segment are unshielded twisted-pair cables that conform to the cabling specifications in IEEE Standard 802.3 10BASE-T.

**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.

**locally administered address.** In a local area network, an adapter address that the user can assign to override the universally administered address. Contrast with *universally administered address*.

**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)

**LUN.** Logical unit number.

## M

**m.** (1) Milli; one thousandth part. (2) Meter.

**MAC.** Medium access control.

**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.

**MAU.** Medium attachment unit.

**MB.** Megabyte.

**Mbps.** One million bits per second.

**MDI.** Medium Dependent Interface.

**MDI port.** The port that acts as the electrical and mechanical interface between the twisted-pair link segment and the medium attachment unit.

**MDI-X.** A port on a 10BASE-T repeater that performs the crossover function.

**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.

**MPTS.** Multiple Protocol Transport Services. LAPS replacement.

**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.

**NDIS.** Network Driver Interface Specification.

**NetBEUI.** NetBIOS extended user interface.

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

**NetBIOS.** Network BIOS. An operating system interface for application programs used on IBM personal computers that are attached to the IBM Token-Ring Network. See also *BIOS*.

**NLM.** NetWare loadable module.



**node address.** The address of an adapter on a LAN.

**nonvolatile.** (1) Pertaining to a storage device whose contents are not lost when power is cut 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

**OBI.** Options by IBM.

**ODI.** Open-Data Link Interface.

**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

**packet.** In data communication, a sequence of binary digits, including data and control signals, that is transmitted and switched as a composite whole. The data, control signals, and possibly error control

information are arranged in a specific format. (I)

**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.

**pel.** Picture cell.

**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.

**POST.** Power-on self-test.

**power-on self-test (POST).** A series of diagnostic tests that are run automatically by a device when the power is switched on.

**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 monitor 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.

**repeater.** A device used to amplify or reshape signals.

**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.

**segment.** A section of cable between components or devices. A segment may consist of a single patch cable, several patch cables that are connected, or a combination of building cable and patch cables that are connected.

**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.

**small computer system interface (SCSI).** A standard input/output

interface used by personal computers.

**SMP.** See symmetric multiprocessing.

**SNAP.** Subnetwork Access Protocol.

**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.

**straight-through cable.** A type of 10BASE-T cable in which the transmit and receive data pairs are wired so that each signal wire is terminated at the same pin position at each end of the cable. A straight-through cable is used to connect the 10BASE-T port (on an Ethernet controller) to a 10BASE-T port (on a repeater) that performs the crossover function.

**Subnetwork Access Protocol (SNAP).** A 5-byte protocol discriminator that identifies the non-IEEE standard protocol family to which it belongs.

**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.

**TCP.** Transmission Control Protocol.

**TCP/IP.** Transmission Control Protocol/Internet Protocol.

**telephone twisted pair.** One or more twisted pairs of copper wire in the unshielded voice-grade cable commonly used to connect a telephone to its wall jack. Also referred to as *unshielded twisted pair* (UTP).

**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.

**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.

**transceiver.** A physical device that connects a host interface to a local area network, such as Ethernet. Ethernet transceivers contain electronics that apply signals to the cable and sense collisions.

**Transmission Control Protocol (TCP).** A communications protocol used in Internet and in any network that follows the U.S. Department of Defense standards for inter-network protocol. TCP provides a reliable host-to-host protocol between hosts in packet-switched communications networks and in interconnected systems of such networks. It assumes that the Internet protocol is the underlying protocol.

**Transmission Control Protocol/Internet Protocol (TCP/IP).** A set of protocols that allow cooperating computers to share resources across a heterogeneous network.

**transmit.** To send information from one place for reception elsewhere. (A)

**twisted pair.** A transmission medium that consists of two insulated electrical conductors twisted together to reduce noise. (T)

## U

**universally administered address.** In a local area network, the address permanently encoded in an adapter at the time of manufacture. All universally administered addresses are unique. Contrast with *locally administered address*.

**unshielded twisted pair (UTP).** See *telephone twisted pair*.

**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 monitor 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 cut 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.

## Numerics

**10BASE-F.** 10 Mbps baseband fiber optic. Dual fiber point-to-point cabling with no defined maximum node count. Maximum fiber optic cable distance is 0.5–2 km,

depending on system configuration. Covered by section 16, 17, and 18 drafts of the IEEE 802.3 Ethernet standards.

**10BASE-T.** 10 Mbps baseband twisted pair. Point-to-point twisted-pair cabling and repeaters to provide network services. There is no maximum node count. Maximum cable distance is 100 m. Covered by section 14 of the IEEE 802.3 Ethernet standards.

**10BASE2.** 10 Mbps baseband 200 m. A low-cost version of 10BASE5, commonly known as Cheapernet. The maximum number of nodes per cable segment is 30.

**10BASE5.** 10 Mbps baseband 500 m. Commonly known as Ethernet. The maximum number of nodes per cable segment is 100.

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