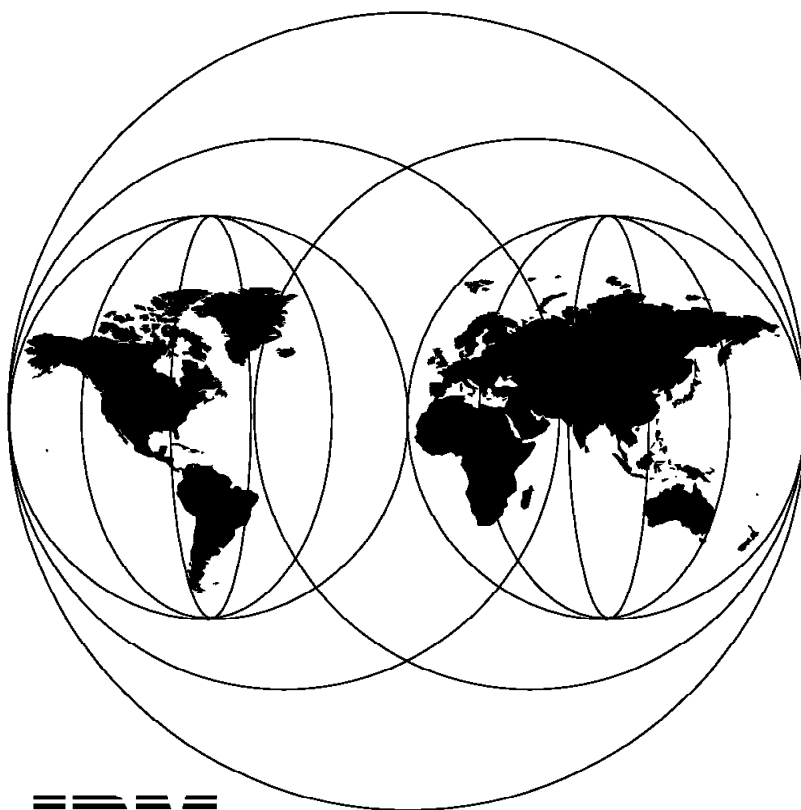


IBM PC Server and Windows NT Integration Guide

March 1997



IBM

**International Technical Support Organization
Raleigh Center**

Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix F, "Special Notices" on page 163.

First Edition (March 1997)

This edition applies to current models of IBM PC Servers for use with Windows NT Server 4.0

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Preface

This redbook will help you implement Windows NT Server 4.0 on an IBM PC Server and to understand how to configure for the best performance. It explores the tools necessary to configure the server hardware, presents topics that should be considered before installing Windows NT, and details the options and process of installing the code onto your IBM PC Server.

Performance monitoring is also covered in detail complete with example uses of Performance Monitor and TME 10 NetFinity to determine what performance bottlenecks may exist in your configuration.

Some knowledge of PC servers and Windows NT is assumed.

This redbook is a follow-on from *IBM PC Server and Windows NT Integration Guide*, SG24-4578-00.

The Team That Wrote This Redbook

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This redbook is a follow-on from *IBM PC Server and Windows NT Integration Guide*, SG24-4578-00. The authors of this publication were:

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Chapter 1. Introduction

Windows NT Server 4.0 is one of the major network operating systems available on the market today, and is continuing to gain market acceptance. At the time of publishing, previews are being shown of what may appear in version 5.0 of the product. This demonstrates the fact the product is being developed and refined to meet market demand.

Some features that set NT 4.0 apart from NT 3.51 include the following:

- Revamped Windows 95 look and feel.
- Integral DNS service.
- Internet Server 2.0.
- Front Page, a new Web publishing tool.
- Several refinements to the system, with some major sections of code rewritten to run faster.

In this redbook, we aim to demonstrate how easy and quickly NT 4.0 can be installed on the range of IBM PC servers from the IBM PC Server 310 right up to the IBM PC Server 704 and Server 720.

This book is not designed to teach you how to use Windows NT - it is assumed that you are already familiar with the operating system. Rather, this book is designed to aid you in installing and tuning NT 4.0 on your new IBM PC Server. We have tested the installations on a variety of current and recent servers and adapters so as to provide as much insight as possible into using the hardware that you, the readers, are likely to have.

1.1 Where Windows NT is Heading

Naturally, Microsoft is continuing to enhance the operating system and is already in beta test for the next version of the product, Version 5.0.

A press release dated November 4, 1996 announcing a preview of the Windows NT Server 5.0 was shown to developers at Microsoft's Professional Developer's Conference. It stated a number of enhancements to the product, including:

- Active Directory
- Active Server
- Management Console

The full text of the press release can be found at URL:

<http://www.microsoft.com/corpinfo/PRESS/1996/Nov96/MSNT5PR.htm>

1.2 IBM and Windows NT

IBM continues to consider Windows NT to be one of the major network operating systems of choice for its PC Server customers. To this end, IBM has committed a large amount of resources to ensure that Windows NT runs at its best on IBM hardware.

The Kirkland Programming Center is one of IBM's major interfaces to Microsoft. Located in Kirkland, Washington, the facility is five miles from Microsoft's Redmond campus, allowing quick access to the Microsoft team.

The mission at the Kirkland Center is to adapt Microsoft's products to IBM hardware to satisfy customer requirements. This requires early involvement in the design cycle, timely adaptation and porting, development of complimentary software and drivers, extensive testing, and performance monitoring. The close working relationship to Microsoft, both physical and personal, allows this to happen. Kirkland has direct, high-speed data links to Microsoft that allow for instant access to key databases residing on Microsoft Servers.

The center's development and test teams are responsible for the porting efforts, as well as developing and testing new software, drivers, and HALs (hardware abstraction layers). The Kirkland technical support people help IBM's marketing and sales teams, and our defect support team provides Level 3 support to IBM's Help Centers around the world.

IBM has been a certified Microsoft Solution Provider since 1994, and was actively involved in the early development of Windows NT Server 4.0. IBM is also formalizing technical management and hardware compatibility arrangements with Microsoft to speed the development of open solutions.

IBM became a certified Microsoft Compatibility Laboratory site for Windows NT in April, 1996. Because we can perform our own Windows-logo certifications, we can bring products to market sooner - and with far fewer system compatibility problems. IBM is also one of eight companies world-wide to participate in the Microsoft OEM Technical Management Program.

IBM PC Company is enhancing its use of Windows NT on its complete product line. As well as PC servers, IBM desktop PCs are also certified for Windows NT. The ThinkPad family provides simply the best mobile support for Windows NT in the industry. The Aptiva family is anticipating Windows NT by moving device drivers to the Windows Driver Model, to ensure portability between Windows 95 and Windows NT.

IBM software is also being written for or ported to Windows NT across the board. Some software, such as the ServeRAID SCSI RAID adapter online management tool runs on Windows NT and Windows 95. Most of IBM software development teams that write code for the PC platform have or have plans for running their applications and server code to run on Windows NT. This shows the commitment IBM has to the operating system.

1.3 IBM PC Server and Windows NT Integration Guide

This redbook should help you install NT 4.0 on your IBM PC Server and provide assistance with the monitoring of its performance in your production environment and tune it to maximize the potential of your IT investment.

The following chapter discusses the configuration of the hardware itself, though the use of SCSI and RAID utilities, CMOS setups and reference partitions.

Chapter 3 through Chapter 5 describe the process of installing Windows NT Server 4.0 both with ServerGuide 3.0 and without.

Finally, Windows NT's Performance Monitor and TME 10 NetFinity are then discussed. We describe how to use them to monitor and tune the performance of your server.

Chapter 2. Hardware Configuration

This chapter focuses on the setup and configuration of your IBM PC Server hardware. The most common tasks are presented here. For more information about these tasks, please see the user guides that came with your system.

The different technologies used to implement the PC Server family require different methods for configuration. Unfortunately, there is no one common configuration program that can be run on a machine to completely configure it. In most cases, multiple programs will need to run in order to complete this process.

This chapter gives instructions on using the various configuration programs and when to use each one. There are some model dependencies, however. If you see differences between what you see on your machine and what is documented here, consult the user guides that comes with the system.

The configuration programs and a brief explanation of each are listed below:

- BIOS setup

This program is used to configure system options on PCI/EISA/ISA machines. The system options include such things as diskette and hard disk options, video subsystem, and system memory.

- EISA configuration utility

This utility is used to configure I/O adapters on machines with an EISA bus.

- SCSISelect Utility

This utility allows you to configure the SCSI subsystem on PCI/EISA/ISA machines. RAID subsystems are usually handled separately.

- System Partition programs

These programs allow you to configure system options, I/O adapters, and the SCSI subsystem on Micro Channel machines. They are either on the reference partition of the server's hard disk, or on a reference diskette, or a combination of both.

- RAID utility

This utility allows you to configure the RAID subsystem on machines equipped with a RAID adapter.

These configuration programs are updated from time to time. The latest versions can be found on IBM PC Company's web site. Refer to Appendix A, "Sources of Drivers and Information" on page 147 for more information.

2.1 The BIOS Setup Program

The setup program is used to configure system options on ISA and EISA machines. The system options include such things as diskette and hard disk options, video subsystem, and system memory. These parameters are controlled by system BIOS and, hence, need to be modified before the operating system boots.

For this redbook, we have used the PC Server 330 for the screen shots and descriptions. The BIOS in this machine is indicative of the current range of PC Servers from IBM.

To access the setup program:

1. Turn on the server and watch the screen for the blue IBM logo to appear.
2. When prompted, press the F1 key
3. Follow the instructions on the panel to view or change the configuration as described below.
4. To exit the setup program, select **Exit Setup** from the main menu.

When you successfully enter the BIOS setup program, the main menu appears, shown in Figure 1 for the PC Server 330:

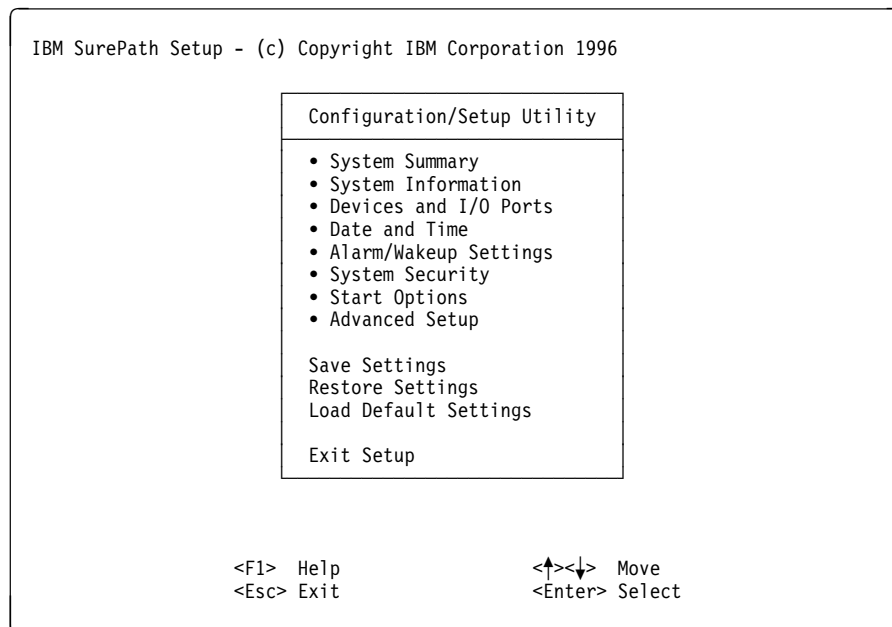


Figure 1. BIOS Setup Program - Main Menu (PC Server 330)

Each menu option is described below.

2.1.1.1 System Summary

Selecting this option shows you a read-only summary of your server. Some of these line items are changeable using other main menu options.

System Summary	
Processor	Pentium Pro (sA1)
Processor Speed	200 Mhz
Math Coprocessor	Internal
System Memory	640 KB
Extended Memory	31 MB
Cache Size	256 KB
Shadow RAM	384 KB
System ROM	E0000h - FFFFFh
PCI Data Parity NMI	[Enabled]
Diskette Drive A:	[1.44 MB 3.5"]
Diskette Drive B:	[Not installed]
Mouse	[Installed]

2.1.1.2 System Information

This choice also shows read-only summaries of your server, divided into two sections:

- Product Data
- PCI Routing

Selecting **Product Data** shows you the following information (as per our test Server 330):

Product Data	
Machine Type/Model	8640ESS
Flash EEPROM Revision Level	RAET27AUS
System Board Identifier	J113965H38X
System Serial Number	23LG592
BIOS Date	11/18/96

On our test server, we see it is a Server 330 (machine type/model 8640-ESS) with a serial number 23LG592, and a BIOS level RAET27AUS dated 11/18/96. This information is required by IBM Service if you need to place a service call on your machine. The machine type/model and serial number should match the numbers printed on the bottom of the front of your server.

Selecting **PCI Routing** shows you the following information.

PCI Routing	
Planar SCSI INT_A	is Routed to IRQ11
Planar Ethernet INT_A	is Routed to IRQ10
PCI Slot 1 INT_A	is not Routed
PCI Slot 1 INT_B	is not Routed
PCI Slot 1 INT_C	is not Routed
PCI Slot 1 INT_D	is not Routed
PCI Slot 2 INT_A	is not Routed
PCI Slot 2 INT_B	is not Routed
PCI Slot 2 INT_C	is not Routed
PCI Slot 2 INT_D	is not Routed
PCI Slot 3 INT_A	is not Routed
PCI Slot 3 INT_B	is not Routed
PCI Slot 3 INT_C	is not Routed
PCI Slot 3 INT_D	is not Routed
PCI Slot 4 INT_A	is not Routed
PCI Slot 4 INT_B	is not Routed
PCI Slot 4 INT_C	is not Routed

This window indicates the IRQs to which the PCI interrupts are routed to. It is a scrollable window.

2.1.1.3 Devices and I/O Ports

This option from the main menu gives you the ability to change the details of your ports and diskette drives.

Devices and I/O Ports	
Serial Port A Address	[3F8h-IRQ 4]
Serial Port B Address	[2F8h-IRQ 3]
Infrared	[Disabled]
Infrared DMA	[Disabled]
Parallel Port	[3BCh-IRQ 7]
Parallel Port Mode	[Standard]
Parallel Port Extended Mode	[]
Mouse	[Installed]
Diskette Drive A:	[1.44 MB 3.5"]
Diskette Drive B:	[Not installed]

You can specify the I/O address and IRQ for the two COM: ports on your server, the I/O address of the Infrared port (if your PC Server has one, like the Server 330) and the address and type of parallel port (standard, bidirectional, EPP/ECP).

2.1.1.4 Alarm/Wakeup Settings

With this option, you can configure your server to automatically start at a set time up to one month in advance.

Alarm/Wakeup Settings	
Warning:	
If you enable a choice on this menu and save the settings, the server will be halted and must be powered off. The Wakeup choices are disabled when the server is restarted.	
Wakeup Timer	[Disabled]
Wakeup Date	[10]
Wakeup Time	[00:00:00]
Wakeup on Ring	[Disabled]

Note: This setting is to start the server one time only. You cannot use it to start multiple times. Once you set this option, you must power off the server. If you manually power the server back on, the wakeup options will be disabled, and you will need to reset them.

2.1.1.5 System Security

From here, you can specify a power-on password (POP) and an administrator password.

Selecting **Power-on Password** lets you set change or delete the POP. You can also specify if a prompt for the POP (if it is set) will appear at boot time.

If the POP is set and you specify On for Password Prompt, the server will not boot until you enter the password. If you specify Off, the system will boot with the keyboard locked and user input will be ignored until the POP is entered.

Power-on Password	
Enter your new power-on password twice.	
Enter Power-on Password	[]
Enter Power-on Password Again	[]
Set or Change Power-on Password	
Delete Power-on Password	
Password Prompt	[On]

The administrator password, if set, restricts access to the BIOS setup program to authorized users only.

Administrator Password	
Enter your new administrator password twice.	
Enter Administrator Password	[]
Enter Administrator Password Again	[]
Set or Change Administrator Password	
Delete Administrator Password	
Power-on password changeable by user	[No]

2.1.1.6 Start Options

Selecting this option shows the following window:

Start Options	
Keyboard NumLock State	[Off]
Keyboard Speed	[Fast]
Keyboardless Operation Mode	[Disabled]
First Startup Device	[Diskette Drive 0]
Second Startup Device	[Hard Disk 0]
Third Startup Device	[Disabled]
Fourth Startup Device	[Disabled]
Power On Self Test	[Quick]
Virus Detection	[Disabled]

You can specify the state of NumLock at boot time, and the repeat rate of the keyboard. You can also specify whether the server can be started with or without a keyboard.

This window also lets you specify the order in which devices in your system are checked for bootable media. You can specify diskette drives, hard drives or network adapter (some systems also allow the CD-ROM to be bootable).

You can also specify if built-in virus detection is enabled at boot time, and if you want Quick or Enhanced POST.

2.1.1.7 Advanced Setup

Selecting this menu choice shows you this window:

Advanced Setup	
Warning:	
Items on the following menu control advanced hardware features. If they are configured incorrectly, the system might malfunction.	
<ul style="list-style-type: none"> • Cache Control • ROM Shadowing • PCI Bus Control 	

Figure 2. BIOS Advanced Setup

Selecting **Cache Control** gives you the following window:

Cache Control	
Cache State	[Enabled]
Cache Type	[Write-Back]
Cache Size	256KB
Video BIOS caching	[Enabled]
Video Buffer caching	[Disabled]
Option ROM caching	[Disabled]

Here, you can enable or disable the L2 cache, specify whether the cache is write-back or write-through, and view the amount of cache that is installed in your server.

You can also specify if Video BIOS (C0000h - C7000h), Video Buffer (B0000h - BFFFFh) is cached into main memory. You can also enable whether you can cache (shadow) ROM areas. If you enable this, you can specify which components of ROM you wish to shadow in ROM Shadowing on the Advanced Setup menu (Figure 2). Doing so enhances system performance.

The ROM Shadowing option gives you the following choices:

ROM Shadowing	
F0000h - FFFFFh (System BIOS)	Enabled
E0000h - EFFFFh (System BIOS)	Enabled
D8000h - DFFFFh	[Disabled]
D0000h - D7FFFh	[Disabled]
C8000h - CFFFFh	[Enabled]
C0000h - C7FFFh	Enabled

Here, you can specify which components of ROM you wish to cache in main memory.

Note: If the address range is used for an adapter card buffer, do not enable shadowing

Selecting **PCI Bus Control** shows you the following panel.

PCI Bus Control	
PCI Data Parity NMI	[Enabled]
CPU-PCI Write Buffers	[Disabled]
SCSI ROM Address	[C8000]
PCI Primary Bus MLT	[30h]
PCI Secondary Bus MLT	[90h]
<ul style="list-style-type: none"> • PCI Interrupt Requests 	

PCI Data Parity NMI enables the generation of a non-maskable interrupt when a PCI data parity error occurs. CPU-PCI Write Buffers enables the CPU to PCI write posting. SCSI ROM Address lets you specify the I/O address of the server's imbedded SCSI controller. The PCI Master Latency Timer values can be set for both the primary and secondary buses.

2.1.2 BIOS Updates

The BIOS of PCI/EISA servers are located in a flash ROM on the motherboard. If necessary, it can be updated with a new version that can be obtained from the Web.

For more information on how to obtain BIOS updates, please refer to Appendix A, "Sources of Drivers and Information" on page 147.

2.2 EISA Configuration Utility

This utility is used when you add or remove an ISA or EISA adapter. We use an example to illustrate the process. In our example, we add an Auto Token-Ring 16/4 ISA adapter in slot 3 of a PC Server 320. The steps to complete the process are as follows:

1. Boot with the EISA configuration utility diskette.
2. Answer **Y** to the following question:
Do you want to configure your system now [Y,N]?
3. The welcome panel will appear. Press Enter to continue. A panel similar to the one in Figure 3 will then appear.

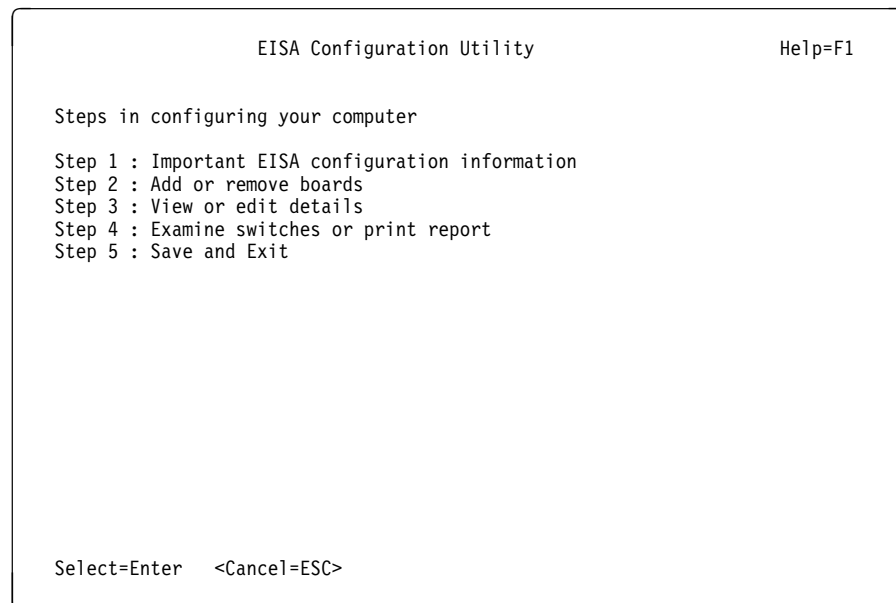


Figure 3. EISA Configuration Utility - Steps

If you are not familiar with the ISA and EISA cards, you can read the information in step 1; otherwise, you can skip to step 2.

A panel similar to the one in Figure 4 on page 12 will appear.

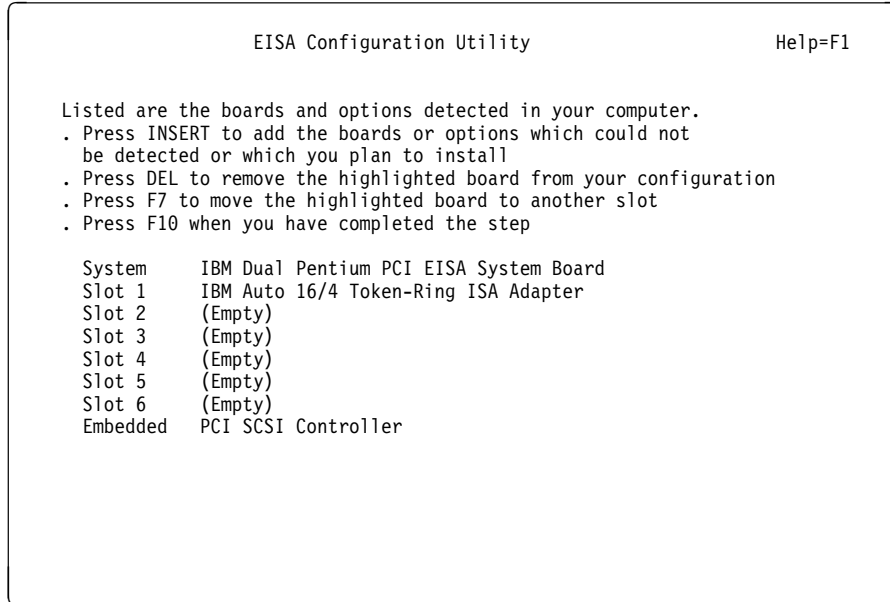


Figure 4. EISA Configuration Utility - Adding or Removing Boards

EISA Configuration Diskettes

EISA adapters are shipped with a diskette that contains a configuration file (a .CFG file) that the EISA configuration utility needs so that it knows what parameters are available for the adapter. This .CFG file should be copied to the EISA configuration diskette. If the file has been copied to the diskette, the EISA adapter is added automatically.

If you have not copied the .CFG file, you will be prompted to insert the adapter's configuration diskette into the diskette drive during this process and the .CFG file will be copied to your diskette.

Our token-ring adapter is recognized but not in the correct slot. This is because it is not possible for EISA systems to determine what slot ISA adapters are in. So we must tell the system what slot it is in by *moving* the adapter to the correct slot.

4. To move the ISA adapter to the correct slot:
 - a. With the arrow key, select the desired adapter.
 - b. Press F7. A Move Confirmation panel appears:

Move Confirmation	
Board Name:	IBM Auto 16/4 Token-Ring ISA Adapter
OK=ENTER <Cancel=ESC>	

- c. Select **OK**.
 - d. With the arrow key, select the destination slot and press Enter.
 - e. Press F10 to return to the EISA Configuration menu.

5. View or edit details

After adding EISA or ISA adapters, you will often need to view and/or edit the settings for the adapter. To view or edit an adapter's details:

- a. From the Main menu, select **Step 3: View or edit details** with the arrow key.
- b. Press Enter to view configuration details. You will see a panel similar to that shown in Figure 5.

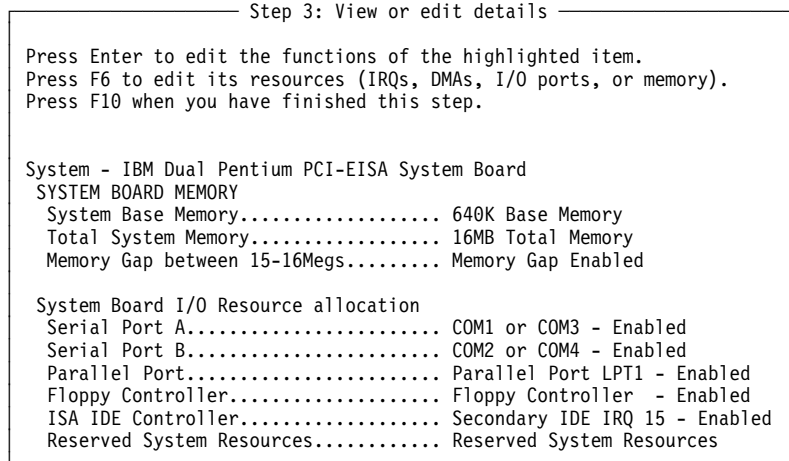


Figure 5. EISA Configuration Utility - View/Edit Details

Use the Edit Resources option to change interrupt request levels, I/O addresses and other parameters whose settings may need to be changed to avoid conflicts with other devices.

Note

Sometimes changing a setting during this step requires you to change a switch or jumper setting on the system board or on an adapter.

When finished, press F10 to exit and return to the EISA Configuration menu.

6. Examine switches or print report

You can use this option to display the correct switch and jumper settings for the installed devices that have switches and jumpers. You can also choose to print a system configuration report. To do this:

- a. Use the arrow key to select **Step 4** and press Enter.
- b. Select the board(s) marked with an arrow and press Enter.
- c. The necessary switch/jumpers settings are displayed in a panel similar to the one shown in Figure 6.

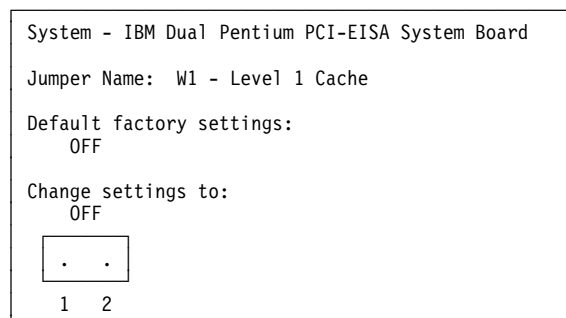


Figure 6. EISA Configuration Utility - Jumper Settings

- d. Press F7 if you want to print configuration settings. You can print:
 - Settings for selected board or option
 - Settings for selected board or option to a file
 - All configuration settings
 - All configuration settings to a file
 - e. When finished, press F10 to return to the Configuration menu.
7. Select **Step 5** and press Enter to save your configuration.

2.3 SCSISelect Utility Program

This utility is used on PCI/EISA models of the IBM PC Server line and lets you configure the non-RAID SCSI controller. For instruction on how to configure the RAID controller see 2.5, "RAID Adapter Utilities" on page 37.

Specifically, SCSISelect allows you to do the following:

- View and modify parameters for the SCSI controller
- View and modify parameters of SCSI devices
- Perform low-level formatting of attached SCSI hard disks

To access the SCSISelect Utility Program, do the following:

1. Turn on the server and watch the screen.
2. When the message Press <Ctrl><A> appears, press Ctrl and A simultaneously.

A panel similar to the one in Figure 7 will appear.

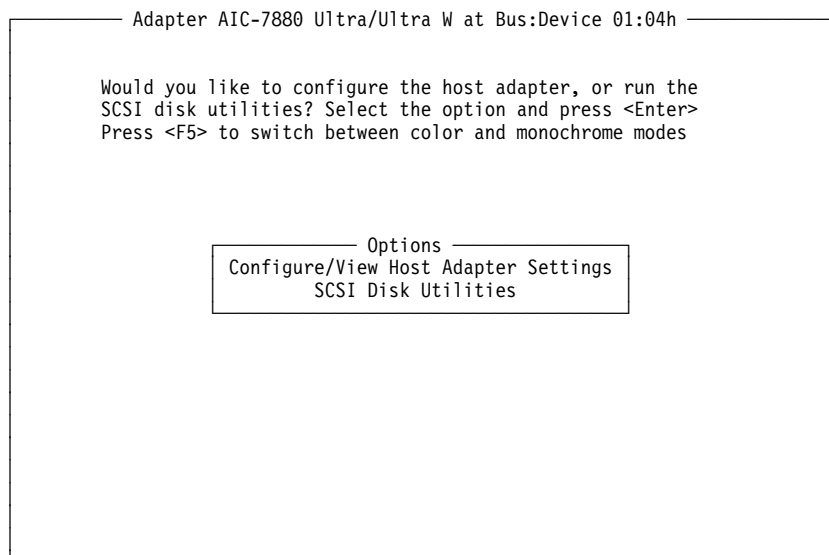


Figure 7. IBM PC Server SCSISelect Utility Program - Main Menu

- Press Enter to go to the Configure/View Host Adapter Settings option.

A panel similar to the one in Figure 8 on page 15 will appear.

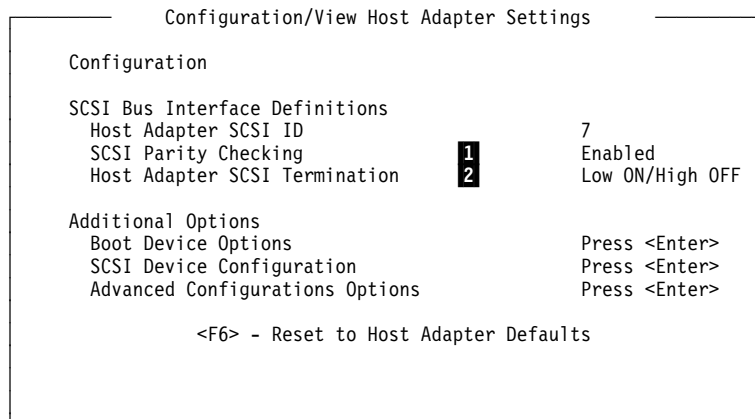


Figure 8. IBM PC Server SCSISelect Utility Program - Host Adapter Settings

The fields on this panel are described as follows:

1 SCSI Parity Checking

Select this option to enable or disable SCSI Parity Checking on the host adapter. If enabled, the host adapter will check parity when reading from the SCSI bus to verify the correct transmission of data from your SCSI devices. SCSI Parity Checking should be disabled if any attached SCSI device does not support SCSI parity. Most currently available SCSI devices do support SCSI parity.

2 Host Adapter SCSI Termination

All SCSI interfaces use daisy-chained cabling. The cable starts at the adapter and goes to the first device, and then out of that device to the next device and so on until it reaches the last device in the chain. The last device has an incoming cable and a *terminator*. The terminators are used to absorb potential signal reflections on the SCSI bus that would cause interference. The last device on the bus must always be terminated.

The SCSI-2 Fast/Wide PCI adapter that came with the PCI/EISA server has three connectors that can be the starting points for a daisy-chained cable: one 8-bit, 50-pin (SCSI-I) internal connector, one 16-bit, 68-pin (SCSI-II Wide) internal cable connector, plus another 16-bit, 68-pin external connector. The adapter has built-in terminators on these connectors.

The setting for the Host Adapter SCSI termination needs to be configured depending on which connectors are used. This option is comprised of two entries, a low and a high. You can think of them as software jumpers. Each entry, low and high, can take on either an on or off value, thereby giving four possible different combinations of the two entries. The chart below shows the proper values of these entries depending upon which connectors have been used.

Note

Only two of the three connectors can be used, either the two internal or one internal and one external.

16-bit (68-pin) internal connector	8-bit (50-pin) internal connector	16-bit (68-pin) external connector	Low value	High value
Yes			On	On
		Yes	On	On
	Yes		On	On
Yes		Yes	Off	Off
Yes	Yes		Off	On
	Yes	Yes	Off	On

After configuring the host adapter, you need to configure the SCSI devices. To do this, from the panel shown in Figure 8 on page 15:

- Use the arrow keys to select **SCSI Device Configuration**.
- Press Enter.

A panel similar to the one in Figure 9 will appear.

SCSI Device Configuration									
SCSI Device ID	#0	#1	#2	#3	#4	#5	#6	#7	
Initiate Sync Negotiation	1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Max Sync Transfer Rate	2	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Enable disconnection	3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Initiate Wide negotiation	4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Options listed below have NO EFFECT if the BIOS is disabled									
Send start unit command	5	No	No	No	No	No	No	No	No
Include in BIOS Scan	6	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SCSI Device ID	#8	#9	#10	#11	#12	#13	#14	#15	
Initiate Sync Negotiation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Max Sync Transfer Rate	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Enable disconnection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Initiate Wide negotiation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Options listed below have NO EFFECT if the BIOS is disabled									
Send start unit command	No	No	No	No	No	No	No	No	No
Include in BIOS Scan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 9. PC Server 320 SCSISelect Utility Program - SCSI Device Configuration

To modify settings on this panel:

- Use the arrow keys to select the parameter to modify.
- Press Enter to edit the value.
- Use the arrow keys to select the new value or press Esc to quit.
- Press Enter to validate the new value.

The fields in this panel are described below:

1 Initiate Sync Negotiation

The host adapter always responds to synchronous negotiation if the SCSI device initiates it. However, when this field is set to Yes, the host adapter will initiate synchronous negotiation with the SCSI device.

Some older SCSI-1 devices do not support synchronous negotiation. Set Initiate Sync Negotiation for these devices to avoid malfunction.

2 Maximum Sync Transfer Rate

The default value is 10.0 MBps for SCSI-II Fast devices. If you are using SCSI-II Fast/Wide devices, the effective maximum transfer rate is 20.0 MBps.

Older SCSI-1 devices do not support fast data transfer rates. If the transfer rate is set too high, this may cause your server to operate erratically or even hang. Select 5.0 Mbps for any SCSI-I devices.

3 Enable Disconnection

This option determines whether the host adapter allows a SCSI device to disconnect from the SCSI bus (also known as the Disconnect/Reconnect function).

You should leave the option set to Yes if two or more SCSI devices are connected to optimize bus performance. If only one SCSI device is connected, set Enable Disconnection to No to achieve better performance.

4 Send Start Unit Command

Enabling this option reduces the load on your server's power supply by allowing the SCSI devices to power-up one at a time when you boot the server. Otherwise, the devices all power-up at the same time.

The SCSI-2 Fast and Wide Adapters issue the start unit command to each drive one at a time. The SCSI-2 Fast/Wide Streaming RAID adapter issues the start unit command to two drives at a time.

Note

In order to take advantage of this option, verify that the autostart jumpers have been removed on hard drives. Otherwise, the drives will spin up twice: once at Power on Reset (POR) time and again when the adapter sends the start unit command.

5 Include in BIOS SCAN

This option determines whether the host adapter BIOS supports devices attached to the SCSI bus without the need for device driver software. When set to Yes, the host adapter BIOS controls the SCSI device. When set to No, the host adapter BIOS does not search the SCSI ID.

Notes:

1. The Send start unit and Include in BIOS Scan options have no effect if BIOS is disabled in the Advanced Configuration Options panel (see Figure 10 on page 18).
2. Disabling the host adapter BIOS frees up 8-10 KB memory address space and can shorten boot-up time, but you should only disable this option if the peripherals on the SCSI bus are all controlled by device drivers and do not need the BIOS (for example, a CD-ROM).

After completing the device configuration, there are a few more parameters that need to be configured. To do this:

- Press ESC to quit the SCSI Device Configuration menu.
- Use the arrow keys to select the **Advanced Configuration Options** menu.
- Press Enter.

A panel similar to the one in Figure 10 on page 18 will appear.

```
----- Advanced Configuration Options -----  
  
Reset SCSI Bus at IC Initialization                               Enabled  
  
----- Options listed below have NO EFFECT if the BIOS is disabled -----  
  
Host Adapter BIOS (configuration utility reserves BIOS space)  Enabled  
Support Removable disks under BIOS as Fixed Disks              Boot only  
Extended BIOS translation for DOS drives > 1 GByte            Enabled  
Display <Ctrl-A> message during BIOS initialization           Enabled  
Multiple LUN support                                           Disabled  
BIOS support for bootable CD-ROM                               Enabled  
BIOS support for Int13 Extensions                              Enabled  
Support for Ultra SCSI speed                                   Enabled
```

Figure 10. PC Server 320 SCSISelect Utility Program - Advanced Configuration

To modify the settings on this panel:

- Use the arrow keys to select the parameter to modify.
- Press Enter to edit the parameter.
- Use the arrow keys to select the new value or press Esc to quit.
- Press Enter to validate the new value.

When finished:

- Press Esc to quit the SCSI Advanced Configuration options menu.
- Press Esc to quit the Configuration menu.
- Use the arrow keys to select the **SCSI Disk Utilities**.
- Press Enter.

A panel similar to the one in Figure 11 will appear.

```
----- Select SCSI ID Disk and Press <Enter> -----  
  
SCSI ID #0 : IBM          DPES-31080  
SCSI ID #1 : No device  
SCSI ID #2 : No device  
SCSI ID #3 : IBM          CDRM 00203  
SCSI ID #4 : No device  
SCSI ID #5 : No device  
SCSI ID #6 : No device  
SCSI ID #7 : AHA-2940/AHA-2940W  
SCSI ID #8 : No device  
SCSI ID #9 : No device  
SCSI ID #10 : No device  
SCSI ID #11 : No device  
SCSI ID #12 : No device  
SCSI ID #13 : No device  
SCSI ID #14 : No device  
SCSI ID #15 : No device
```

Figure 11. PC Server 320 SCSISelect Utility Program - DASD Information

This panel shows the devices that are attached to the adapter and their SCSI IDs. It will also allow you to perform a low-level format of the disk or to scan it for media defects if desired. To do this:

- Use the arrow keys to select the DASD to format.
- Follow the directions on the panel.

When finished:

- Press Esc to quit the SCSI disk utility.
- Select **Yes** to confirm.

You have now completed the SCSI subsystem configuration.

Don't forget to save changes before you exit.

2.4 System Partition Programs

If you have a PCI/MCA machine, you will run the system programs. The system programs are a set of utility programs you can use to configure the SCSI subsystem, system options, and I/O adapters. Also, you can use them to set passwords, change the date and time, and test the server. In effect, they are the equivalent of Setup, EISA Configuration and SCSISelect for a PCI/EISA machine.

These programs are obtainable in several ways:

- Shipped with the server on two diskettes called the reference diskette and the diagnostic diskette.
- Created from images for these diskettes on the ServerGuide CD-ROM that is shipped with the system.
- On the system partition of the machine.

Non-array systems are shipped with the system programs already installed in a protected area of the hard disk called the system partition. The system partition is protected against operating-system read, write, and format operations to guard against accidental erasure or modification. Disk-array systems do not have a system partition.

You can start the system programs in one of two ways:

1. Boot using the system partition.
2. Boot using reference diskette.

The system partition should be used if available. The reference diskette is normally used to:

- Configure and test disk-array models (since there is no system partition).
- Test non-array models if you cannot start the system programs from the system partition.
- Reconstruct the programs on the system partition of a non-array model when you replace the hard disk drive or if the programs are damaged.
- To install the DOS keyboard-password program and other stand-alone utility programs.

2.4.1.1 Starting from the System Partition

To start the system programs from the system partition:

1. Turn off the server.
2. Remove all media (diskettes, CD-ROMs, or tapes) from all drives.
3. Turn on the server. The IBM logo appears on the panel.
4. When the F1 prompt appears, press F1. A second IBM logo panel appears, followed by the system programs Main Menu. The Main Menu is shown in Figure 12 on page 21.

To select an option:

1. Use the up arrow key or down arrow key to highlight a choice.
2. Press Enter.

2.4.1.2 Starting from the Reference Diskette

To start the system programs from the reference diskette:

1. Turn off the server.
2. Insert the reference diskette into your diskette drive.
3. Turn on the system.

After a few moments, the system programs Main Menu appears. It will look similar to the one in Figure 12 on page 21.

To select an option:

1. Use the up arrow key or down arrow key to highlight a choice.
2. Press Enter.

2.4.1.3 Main Menu Options

Regardless of whether you started the system programs by booting from the system partition or from the reference diskette, the main menu similar to Figure 12 on page 21 will be displayed.

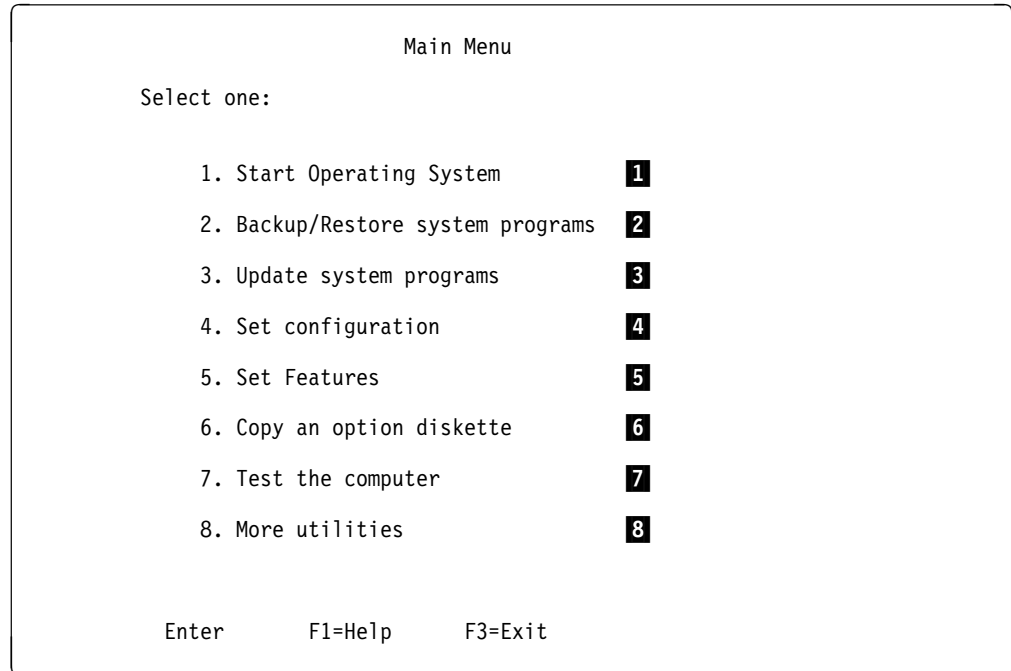


Figure 12. System Programs - Main Menu

The following are the options available on the Main Menu:

1 Start Operating System

Exits from the system programs and loads the operating system.

2 Backup/Restore system programs

Makes a backup copy of the system programs from the hard disk to diskette or restores the system programs from the diskette to hard disk.

3 Update system programs

Periodically, updated versions of the reference diskette and diagnostic diskette are made available. This option copies a new version of the system programs to the system partition. This option does not apply to disk-array models.

Note

This utility will only install system programs that are a later version than the ones already installed on the system partition.

4 Set configuration

This option contains programs used to view, change, back up, or restore the configuration information. It also contains the Automatic Configuration program.

The configuration information consists of:

- Installed system options
- Memory size
- Adapter locations and assignments
- SCSI subsystem parameters

5 Set Features

This option allows you to set system parameters such as date and time, type of console, startup sequence, fast startup mode, and passwords.

6 Copy an options diskette

Micro Channel machines use configuration files called adapter descriptor files (.ADF files) in order to know what parameters and values are available for the adapter. This option copies configuration and diagnostic files from an option diskette to the system partition or to the backup copy of the system programs diskettes. The server needs these files to make the new options operational.

Attention!

This utility will prompt you for both the reference diskette and the diagnostic diskette so that the proper programs can be copied from the adapter option diskette to these diskettes. Make sure that you have copies of both diskettes before you select this utility. These diskettes can be obtained from Diskette Factory on the ServerGuide CD.

7 Test the computer

Run diagnostics on the system hardware. These tests show if the hardware is working properly. If a hardware problem is detected, an error message appears explaining the cause of the problem and the action to take.

8 More utilities

This option is a set of utilities that displays information which is helpful when service is required. Revision levels and the system error log are some of the utilities available in this option.

2.4.1.4 Backup/Restore System Programs Menu

When you select this option from the Main Menu, a panel like the one in Figure 13 will appear.

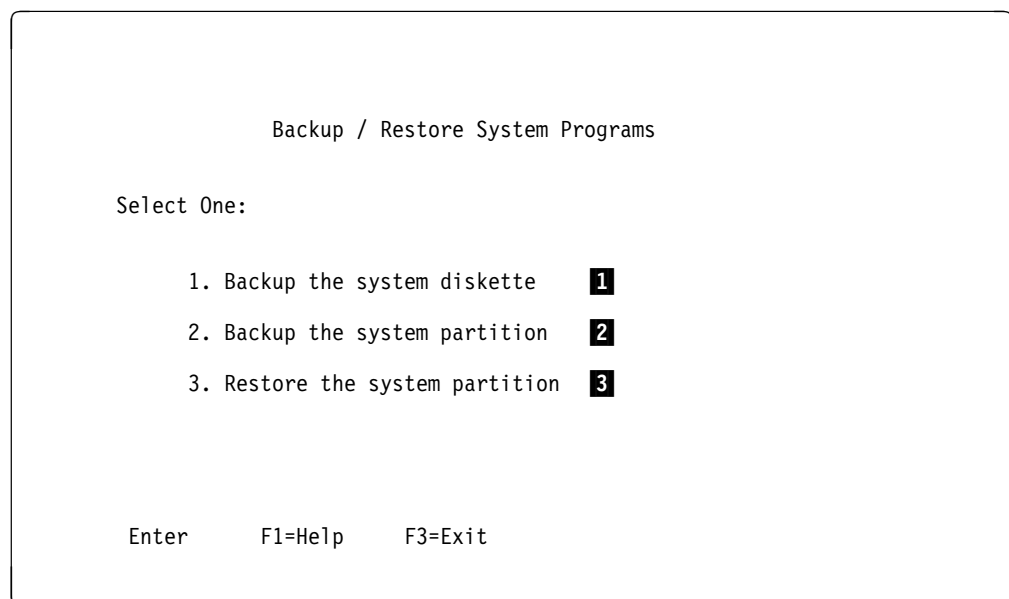


Figure 13. System Programs - Backup/Restore System Programs Menu

The following options are available:

- 1** Backup the system diskettes
Makes a backup copy of the Reference and Diagnostic diskettes.
- 2** Backup the system partition
Makes a backup of the system partition from the hard disk drive to diskettes. You need two diskettes to perform this procedure.
- 3** Restore the system partition
Restores the system partition from the backup diskettes. Use this utility program to rebuild the system partition in case of accidental loss or damage. (Note: you can only use this option when the system programs are running from a diskette.)

2.4.1.5 Set Configuration Menu

The Set Configuration menu allows you to work with the system configuration. Select this option to view, change, backup or restore the configuration. The Set Configuration menu is shown in Figure 14.

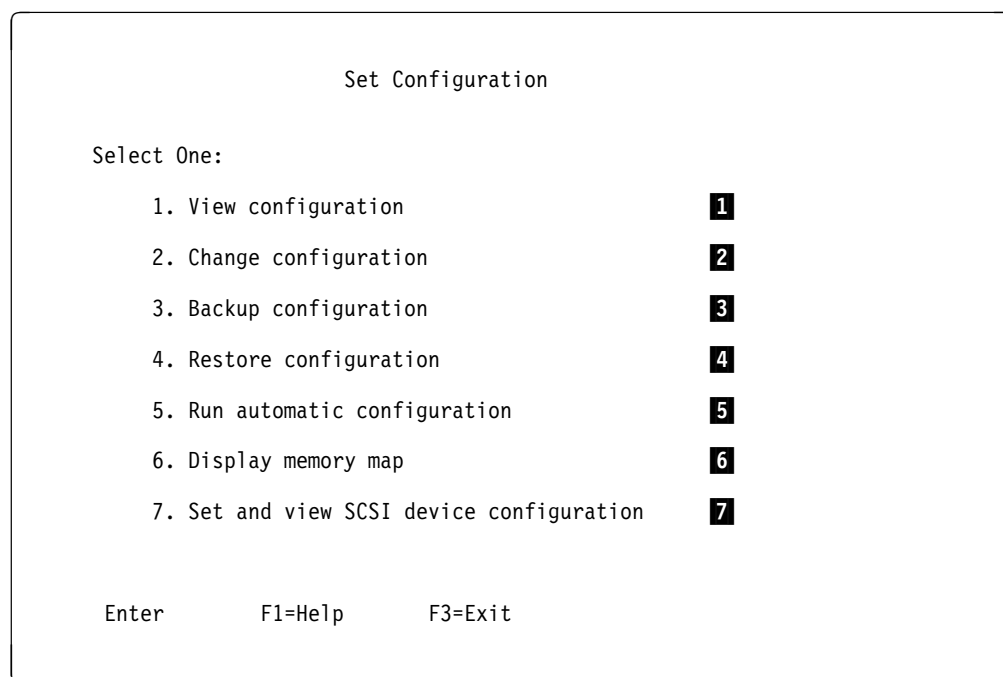


Figure 14. System Programs - Set Configuration Menu

The following options are available:

- 1** View configuration
This displays the present configuration information that includes the size of the memory installed in the server, the assignment of the built-in features, and the location of installed adapters and their parameter settings. Figure 15 on page 24 is an example of a configuration panel.
Note: You cannot make changes from this panel.

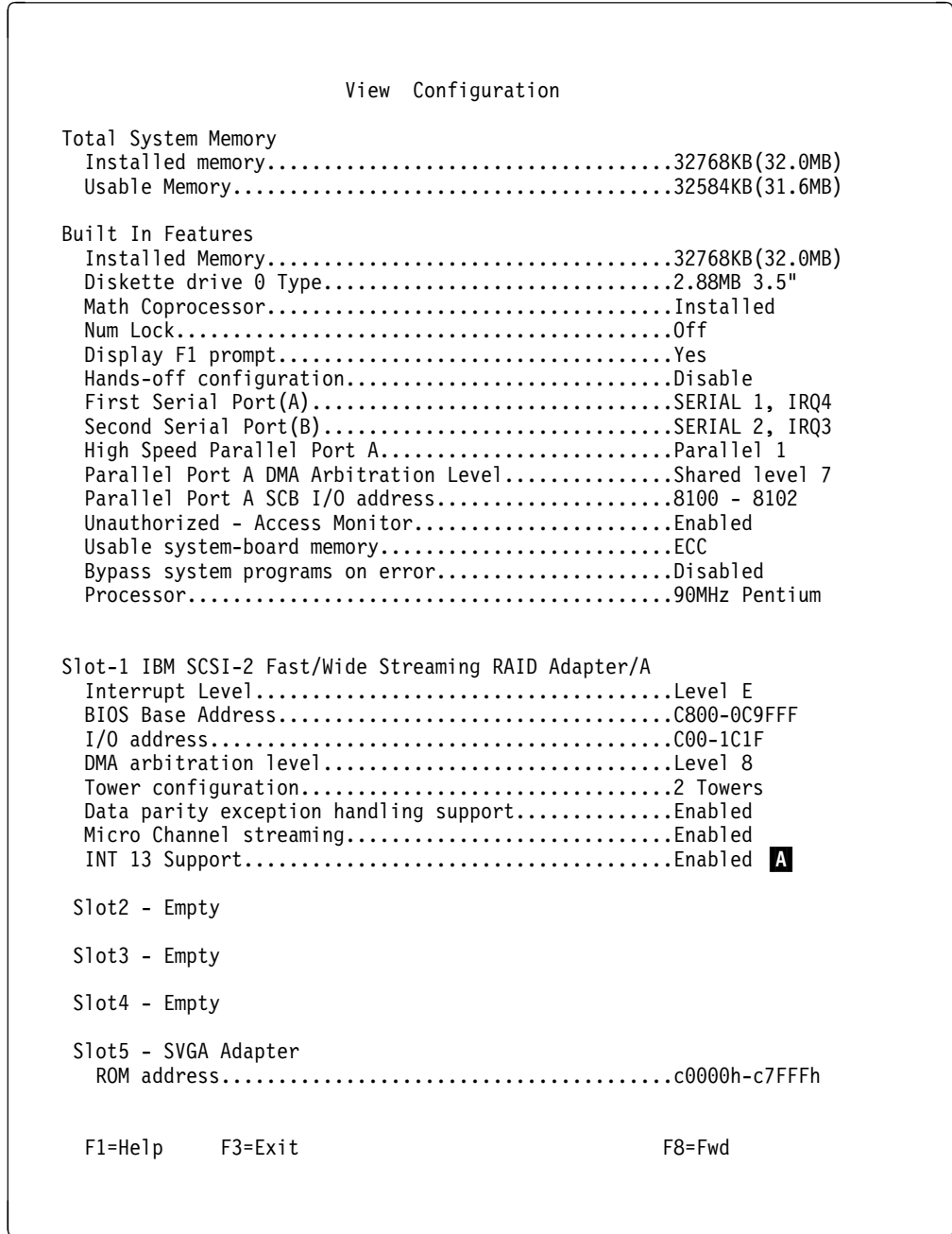


Figure 15. System Programs - View Configuration Panel

Booting from a RAID Drive

If you plan to install your operating system on a drive that is connected to a RAID controller, ensure you have INT 13 Support (shown at **A** in Figure 15) set to Enabled.

If you do not, you will not be able to boot any RAID adapter-attached drives.

2 Change configuration

Change configuration allows you to change configuration information used by the server. Use the Home, End, Page Up, Page Down, Up and Down arrow

keys to move from field to field, and F5 and F6 to scroll through the choices. Use F10 to save the changes to non-volatile CMOS RAM.

If a setting conflicts with another, an asterisk (*) appears next to the conflicts and the word conflicts appears at the right corner of the windows. You must remove all conflicts before the configuration can be saved.

Note: Some settings are set by the system and cannot be overridden. The user can change only those settings that have not been set by the system. These are the settings enclosed in brackets ([..]).

3 Backup configuration

This makes a copy of the configuration information stored in CMOS RAM to the hard disk system partition or to the reference diskette. Back up the configuration of your server every time an adapter is added, removed or a configuration assignment is changed.

4 Restore configuration

This retrieves the configuration information that the user saved previously with the backup configuration program and restores this information to the CMOS RAM.

5 Run automatic configuration

This verifies and updates the configuration information. Use this program after an adapter is added or removed or to configure the server. The automatic configuration program sets system-board features first, and then adapters one at a time, starting with the lowest numbered slot.

After you use this choice, select **Backup configuration** to make a copy of the new configuration information.

Notes:

1. Running automatic configuration resets parameters to their default values.
2. This option can be used whenever the default values for adapters will be adequate. If the default values need to be changed, then you must use the Change configuration option discussed previously. Often, the automatic configuration can be used as a starting point to ensure no settings conflict. Then, the change configuration can be used to fine tune any desired settings.
3. If you had a configuration where specific values were required and you experience problems after running automatic configuration, you need to change the parameters back to the required values.

6 Display memory map

This displays how memory in the address range 0C0000H through 0DFFFFH is being used by any adapters installed in the server. It identifies each device using this space by name and shows the addresses being used by that device.

This choice is helpful to determine what parts of the memory in the server are not being used (for example, to find space available for an expanded memory specification (EMS) page frame. Figure 16 on page 26 shows the Memory Map panel.

```

                                Memory Map
0C000H
  SVGA Adapter
  Micro Channel slot.....5
  Size(in KB).....32

0C8000H
  IBM SCSI-2 Fast/Wide Streaming RAID Adapter
  Micro Channel Slot.....1
  Size(in KB).....8

0CA000H
  Memory not being used
  Size(in KB).....88

F1=Help   F3=Exit
```

Figure 16. Set Configuration - Memory Map

7 Set and view SCSI device configuration

This displays the current SCSI device settings, and allows you to make changes for some devices. If a setting causes a conflict with another, an asterisk (*) appears next to the conflicts. Figure 17 on page 27 is an example of a SCSI configuration panel.

Note

For disk-array models, you can *view* settings for the RAID adapter. However, you must use the IBM RAID controller diskette to *change* the RAID adapter settings. The IBM RAID controller diskette can be obtained from Diskette Factory on the ServerGuide CD-ROM.

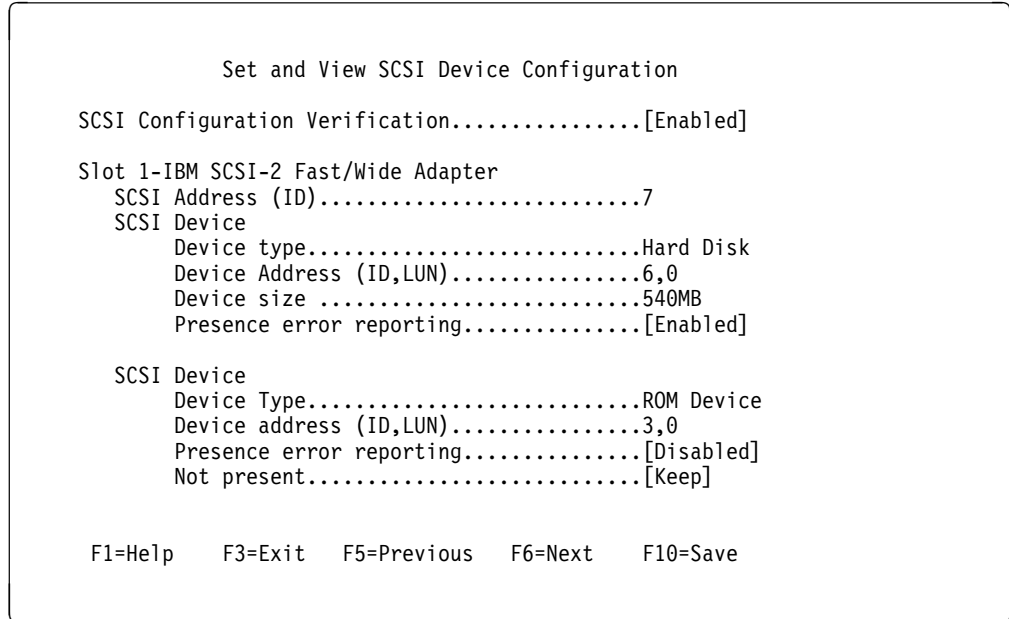


Figure 17. Set Configuration - SCSI Device Configuration

The Presence error reporting field on this panel works as follows:

- When presence error reporting is set to Enabled on a device, POST reports a configuration error if the device is disconnected or turned off.
- When presence error is set to Disabled on a device, POST does not check to see if the device is attached or turned on.

The Not present field instructs the system on what actions to take for an individual SCSI device that was previously configured but was not found during this discovery process. Using the Keep setting will cause the configuration program to leave the device in the configuration. Using the Remove setting will cause the device to be permanently removed from the configuration. To remove a SCSI device:

1. Locate the Not present field for the SCSI device you want to remove.
2. Highlight the Keep setting; then press F5 or F6 to change it to Remove.
3. Press F10 to save the changed setting.

2.4.1.6 Set Features Menu

When the user selects this option from the Main Menu, a panel similar to the one in Figure 18 on page 28 will appear.

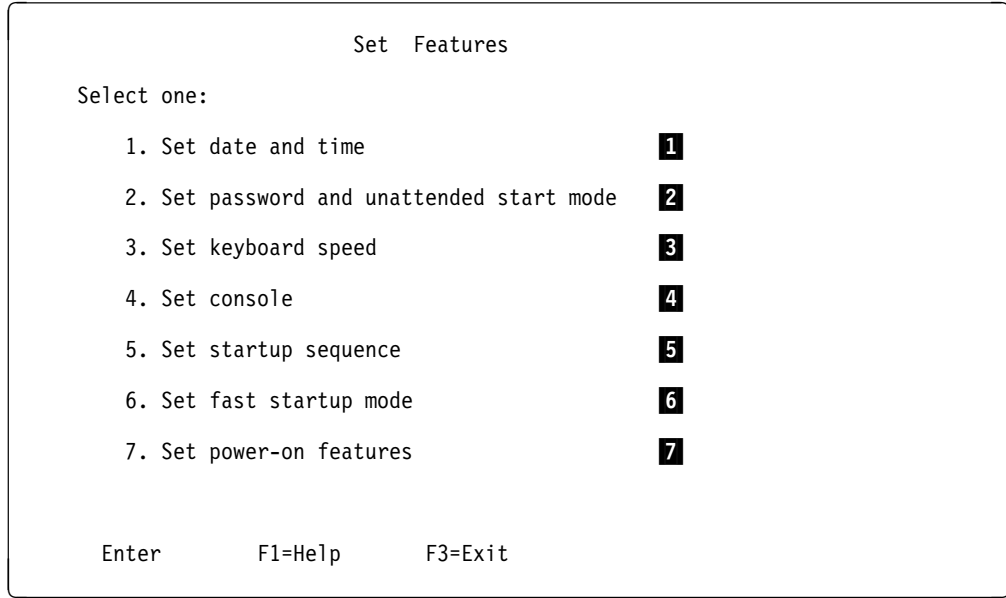


Figure 18. Set Features Menu

The features found on this menu are described below:

1 Set date and time

This allows you to set the current date and time. Once set, CMOS RAM keeps the date and time even when the system is powered off.

2 Set password and unattended start mode

This helps prevent the use of the server by unauthorized persons. Two types of passwords are available from this option:

- Power-on password
- Administrator password

Refer to 2.4.1.7, “Set Passwords and Security Features” on page 30 for details.

3 Set keyboard speed

This changes the speed at which characters respond when you type. There are two options:

- Normal keyboard

The normal keyboard speed displays the character on the screen at the rate of 10 characters per second.

- Fast keyboard

The fast keyboard speed displays the character on the screen at the rate of 30 characters per second.

4 Set console

This changes the server console. The server console is the hardware that you use to communicate with your server. There are three options for this setting:

1. Display and keyboard

Select this option if you want to use a display and keyboard as the server console. Errors will occur when the server is turned on if the display or the keyboard is not attached.

2. Display only

Select this option if you want to use a display without a keyboard as the server console.

3. No console

Select this option if you want to use the server without a system console. If you select this option, you can remove the monitor, the keyboard, and any attached ASCII terminal and the system will still come up without the errors normally associated with a missing keyboard or missing monitor.

5 Set startup sequence

This option lets you select the sequence of the drives on which the system searches for a valid boot record when you turn it on.

The default startup sequence is the first diskette drive followed by the first hard disk. You can alter this sequence with this utility. Figure 19 shows an example of the startup sequence when one hard disk is installed.

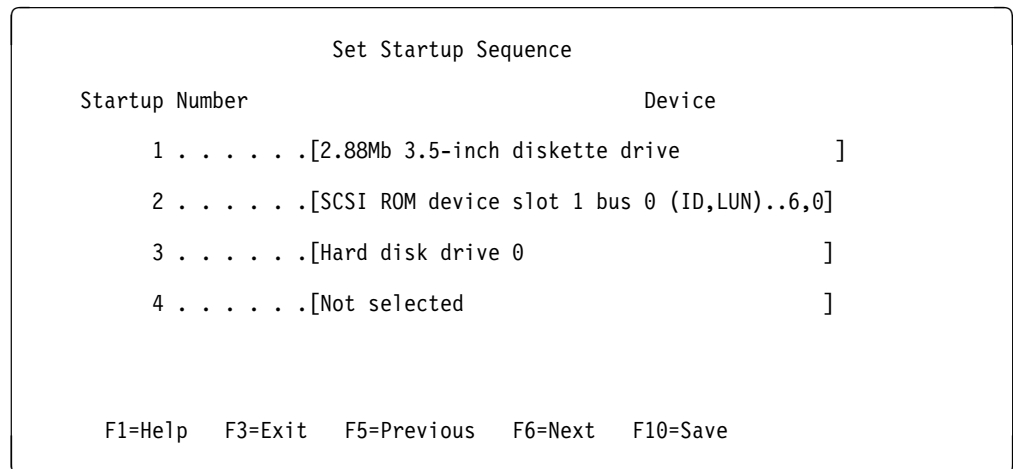


Figure 19. Set Startup Sequence Panel

To change the startup sequence, move the cursor to the device box and use the F5 and F6 keys to toggle the options. The devices that you can choose will be determined by the number of devices that you have installed. A maximum of four devices may be selected in the startup sequence.

6 Set fast startup mode

If enabled, the server runs a less extensive POST routine at cold boot time, thereby reducing the amount of startup time required by the system prior to loading the operating system.

Note

You will save some startup time in this mode. However, in the unlikely event of a memory failure, you might not be aware of it until you begin using your operating system.

7 Set power-on features

This panel lets you set the options for when and how the server can be started. It can be turned on automatically at a set time, or be turned on from a remote location through a modem.

When you select this option from the Set Features menu, a panel similar to the one in Figure 20 will appear.

```
Set Power-On Features

Serial-Port Power-On mode.....[Disabled]  A
Real-Time-Clock Power-On mode.....[Enabled] B
  Power-On day of the month.....01
  Power-On time.....12:00

System-error restart.....[Disabled]  C

F1=Help  F3=Exit  F9=Toggle
```

Figure 20. Set Power-On Features Panel

The features on this panel are described below:

A Serial-Port Power-On Mode

This option allows you to start the server using a modem. When this option is enabled, the server starts when the modem detects an incoming call on the attached phone line.

B Real-Time Clock Power-On Mode

When this option is enabled, the server will turn on when the present time matches the day and time values you have entered.

If you want the server to start only on a certain day of the month, type the date in the space provided. If you want the server to start every day, you must leave this field without a date. Figure 20 shows an example where the server will be powered on the fifth day of every month at 12:00 PM.

C System-Error Restart

When the system-error restart feature is enabled, the server can automatically restart in situations that would normally result in the server stopping or locking up.

2.4.1.7 Set Passwords and Security Features

When you select this option from the Set Features menu (Figure 18 on page 28), a panel similar to the one in Figure 21 on page 31 will appear.

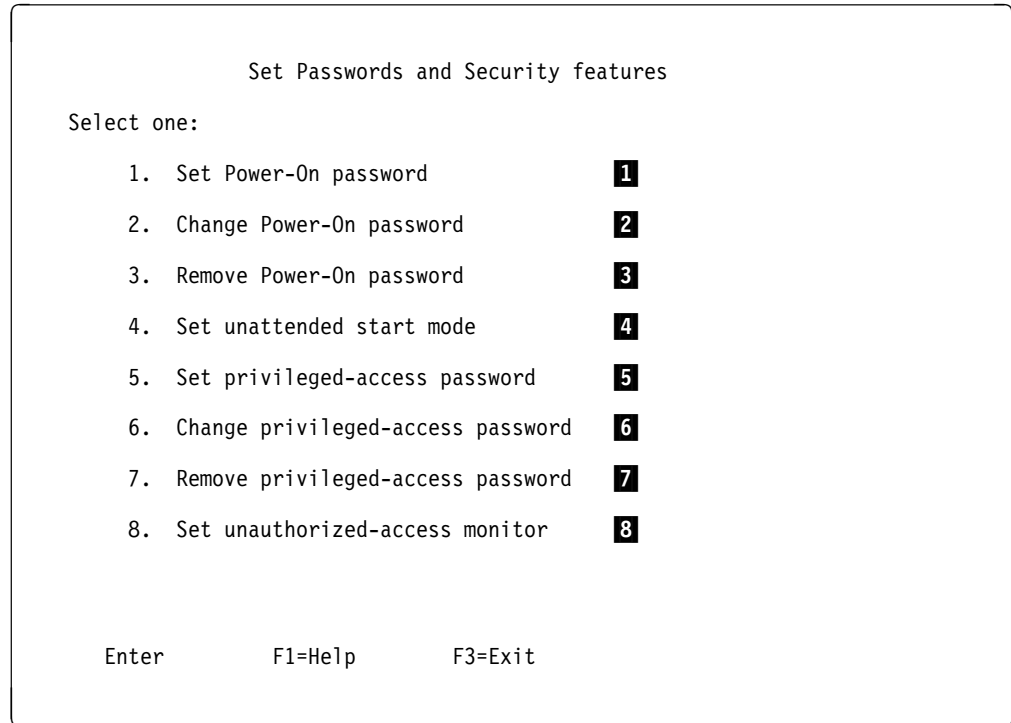


Figure 21. Set Passwords and Security Features

Some of the features found on this panel are described below:

1 Set power-on password

This prevents unauthorized use of the server. After you set the power-on password, a password prompt will appear each time the server is powered on.

To use the server, type the correct password at the password prompt and then press Enter. If the password was not entered correctly, you will see a message that says the password was incorrect and you will be prompted to try again. If you do not enter the correct password after three tries, you must turn the system off and then on again before further attempts are possible.

Note

If you forget the power-on password, you can remove it by moving jumper JMP1 on the system board. This jumper is located above the memory connectors.

2 Change power-on password

This option displays the instructions for changing the current power-on password, which are:

1. Turn off the server and wait a few seconds, then turn it on.
2. The following message will appear:

Enter password

Type the current password followed by a space, the new password followed by a space, and the new password again.

3. Press Enter.

3 Remove power-on password

This option shows the instructions for removing the current power-on password, which are:

1. Turn off the server and wait a few seconds, then turn it on.
2. The following message will appear:
Enter password
Type the current password followed by a space.
3. Press Enter.

Unattended Mode

If the unattended start mode is active, you must remove it before you can change or remove the power-on password because the password prompt does not appear when the unattended start mode is set.

4 Set unattended start mode

The unattended start mode locks the keyboard and mouse when the system is powered on, but it allows the operating system and startup files to be loaded. The keyboard and mouse remain locked until you enter the power-on password.

This mode is useful for unattended operations and for network servers because it allows authorized network users access to information on the server but prohibits unauthorized access via the system keyboard and mouse.

When the server is in the unattended mode, the password prompt will not appear unless an attempt to start the system from a diskette or other removable media is issued. If you start the server from a removable media, the password prompt will appear and you must enter the correct power-on password to continue.

Power-on Password

A power-on password must be set on the server before you can set the unattended start mode because it locks the keyboard and mouse when the system is powered on.

5 Set privileged-access mode

This option allows you to set a privileged-access password (also called an administrator password). If set, this password is needed to start the system programs.

Before the privileged-access password can be set, the privileged-access switch at location JMP2 on the system board must be placed in the change state (position 0).

Attention!

Do not forget the privileged-access password. If you forget this password, the system board must be replaced before you can regain access to your system.

6 Change privileged-access password

This option allows you to change the administrator password. You must know the current privileged-access password in order to complete the procedure.

7 Remove privileged password

This option removes the administrator password. You must know the current privileged-access password in order to complete the procedure.

8 Set unauthorized-access monitor

If your system is equipped with a tamper-evident cover, you can select this option to enable or disable the unauthorized-access monitor feature. This feature works with the privileged-access password. If both features are enabled, the server will alert you if someone attempts to tamper with the locked covers. If tampering is detected, the actions taken are dependent upon the operating system. Some possible actions include halting the system and/or displaying and logging an error message.

If this feature is set and it then gets subsequently activated by cover tampering, on the next boot, the system will display a message and force the operator to enter the administrator password. If this password is not entered correctly, the system will not come up.

2.4.1.8 Test the Computer

This option is the primary method of testing the system. It can be used to test both the internal components of the system as well as the keyboard and some external devices. The amount of time required to test all components depends on the number of components. The more optional adapters and devices you have attached to the server, the longer the testing takes.

If you cannot determine whether a problem is caused by the hardware or by software, you can run the diagnostic programs to confirm that the hardware is working properly. If a hardware problem is detected, an error message appears explaining the cause of the problem and the action to take.

Note: If you start the system programs from the reference diskette and select this option, a message prompts you to insert the diagnostic diskette.

2.4.1.9 More Utilities Menu

When you select this option from the Main Menu, a panel similar to the one in Figure 22 on page 34 will appear.

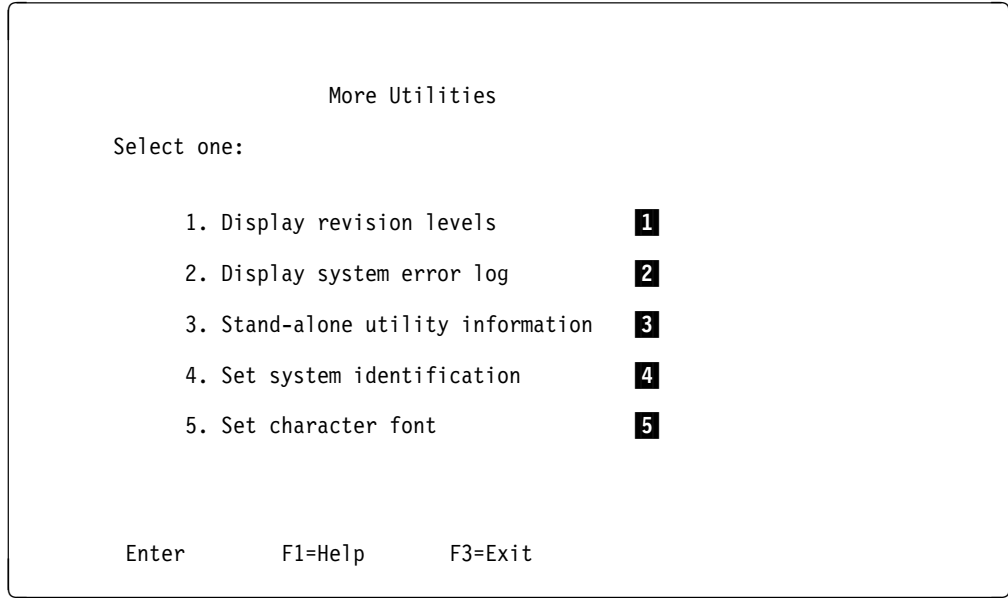


Figure 22. More Utilities Menu

This panel has the following options:

1 Display revision levels

This displays information that you might need if you required service. If you have a printer attached, you can print the information presented on the panel by pressing the Print Screen key. Figure 23 is an example of a panel displayed with this option.

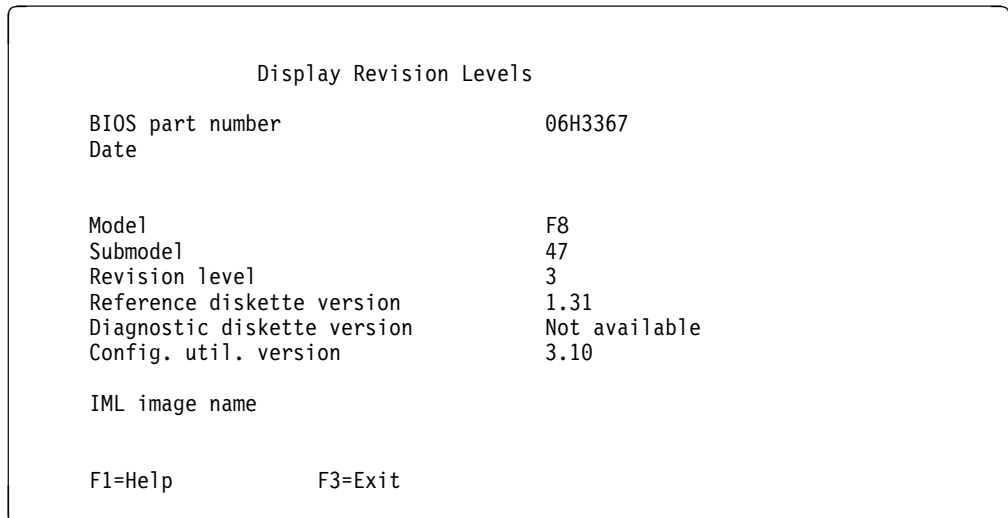


Figure 23. Display Revision Level Panel

2 Display system error log

This displays and resets the entries in the error log. As errors occur, they are recorded in this log. Error log information is helpful when service is required. Figure 24 on page 35 is the System Error Log panel.

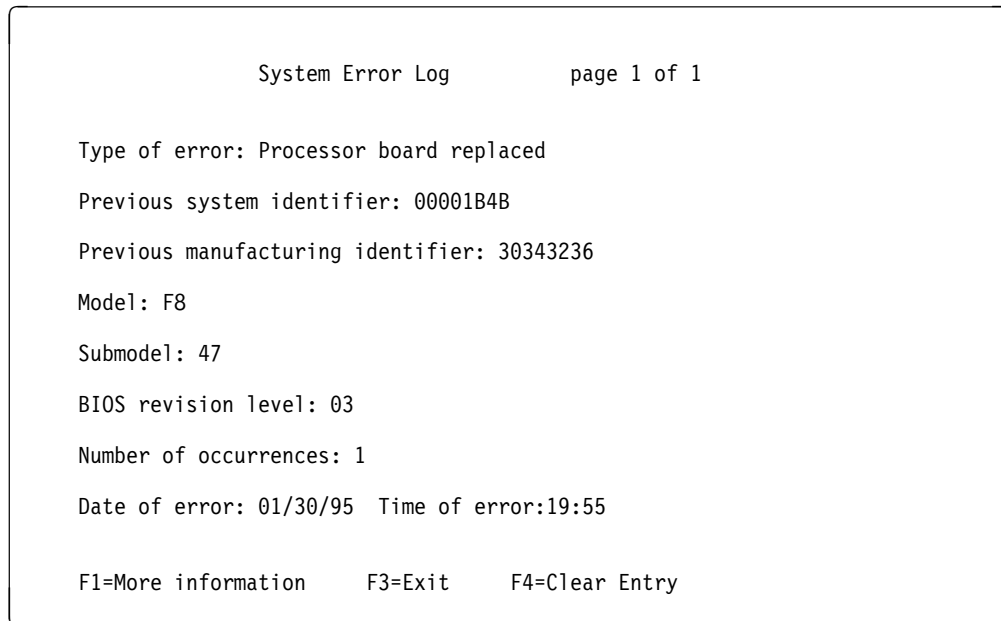


Figure 24. System Error Log Panel

3 Stand-alone utility information

This describes how to use the additional utilities available on the diagnostic diskette. Some of these programs can be used only with specific operating systems.

4 Set and view system identification

This lets you view the system's vital product data (VPD). VPD includes the machine and model number, serial number, and part identification codes for the system board and processor board.

5 Set character font

This option allows to change the default font in the server. It displays examples of the available fonts and allows you to choose one. This will become the default font at the next cold boot time.

2.4.1.10 Advanced Diagnostic Program

The advanced diagnostic program is intended to be used by trained service technicians or very experienced users who can correctly interpret the advanced diagnostic panel messages. It is an alternative method of testing the server.

An advantage of running the Advanced Diagnostic program is that if you suspect a specific area of the server is causing a problem, you can choose to test only that area. This will take less time than testing all of the components in the server.

To start the Advanced Diagnostic program:

1. Start the system programs.
2. When the system programs main menu appears, press and hold Ctrl and then press A. A message appears telling you to insert the diagnostic diskette.
3. Insert the diagnostic diskette.

After a few seconds, a panel similar to the one in Figure 25 on page 36 appears.

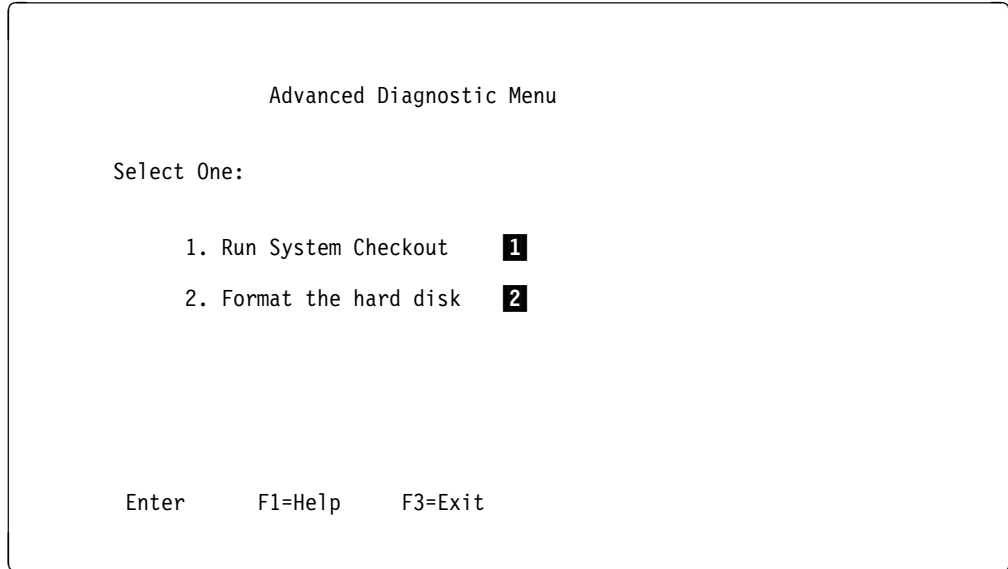


Figure 25. Advanced Diagnostic Menu

The following choices are available:

1 Run System Checkout

This option allows you to test individual components in the system either one time or continuously. You can then view any errors that were logged in the process.

2 Low-Level Format Program

On non-disk array models, you have the option of formatting your hard disk during the advanced diagnostic testing. The advanced diagnostic format program is a low-level format program. It will completely reformat the disk, which includes removing the system partition.

Depending on the hard disk capacity, the low-level format program could take up to two hours.

Use the low-level format program in the following cases:

- When you are installing software that requires a low-level format
- When you get re-occurring messages from the diagnostic test directing you to run the low-level format program on the hard disk
- As a last resort before replacing a failing hard disk drive
- If you want to erase the system partition

Servers with RAID Adapters

For non-disk array models, you must run the low-level format program from the diskette.

For disk-array models, you must use the programs provided on the RAID utility diskette to format the hard disk drives.

2.5 RAID Adapter Utilities

On PC Servers with SCSI RAID adapters, the RAID utility is used to configure the attached SCSI devices. This section describes two of the utilities used on IBM PC Servers:

1. The utility for the IBM SCSI-2 Fast/Wide Streaming RAID Adapter/A and the IBM SCSI-2 Fast/Wide PCI RAID adapters. See 2.5.1, “SCSI-2 F/W PCI RAID and Streaming RAID Adapter.”
2. The utility for the PC ServeRAID SCSI Adapter. Refer to 2.5.2, “PC ServeRAID SCSI Adapter” on page 50.

2.5.1 SCSI-2 F/W PCI RAID and Streaming RAID Adapter

This utility comes on a bootable diskette that is shipped with every RAID Server. Also, it can be rebuilt if necessary with the Diskette Factory option from the ServerGuide.

The IBM RAID utility allows you to configure disk arrays as well as view the status of the arrays already defined. It provides a graphical display of the defined arrays and provides diagnostic information to assist you if a hard disk within the array malfunctions.

The common configuration tasks that are described here are as follows:

1. Verify the configuration
2. Low-level format of the disks
3. Defining a hot-spare drive
4. Creating a disk array
5. Defining logical drives
6. Look at the drives information
7. Back up/restore the configuration

After booting with the RAID Controller program diskette, if more than one RAID adapter is installed, it will prompt you to select the adapter you want to work with (see Figure 26 on page 38). Otherwise, a panel similar to the one in Figure 27 on page 38 will appear.

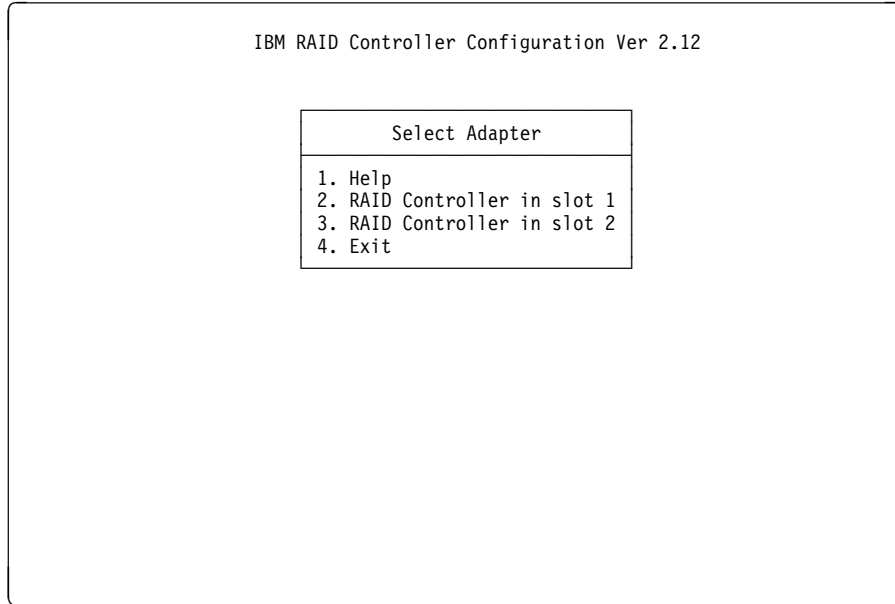


Figure 26. RAID Configuration Program - Adapter Selection

Use the arrow keys to select the adapter you want to configure and press Enter.

A panel similar to the one in Figure 27 will appear.

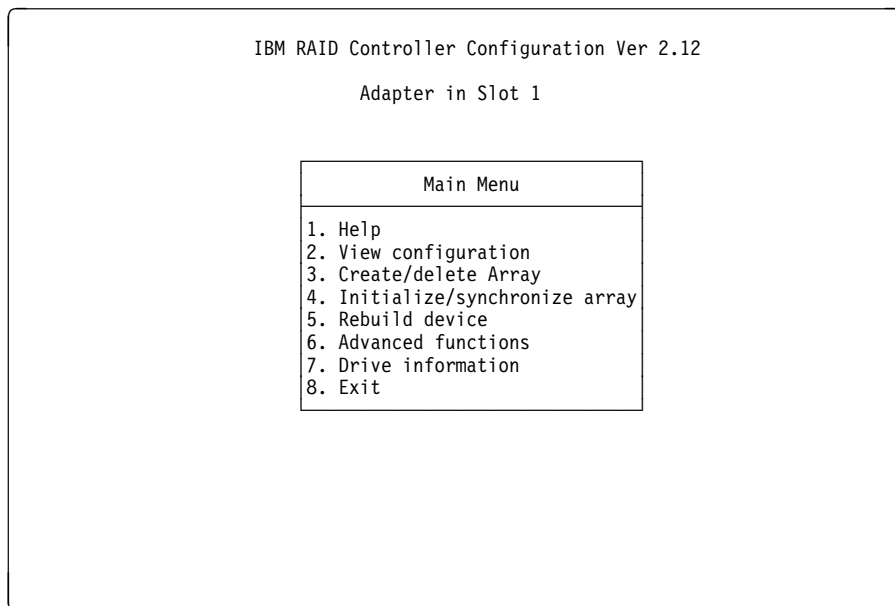


Figure 27. RAID Configuration Program - Main Menu

2.5.1.1 Drive Information

During this first step, we verify that all the installed units are recognized and available for future use.

Select **Drive Information** on the main menu.

The following panel appears:

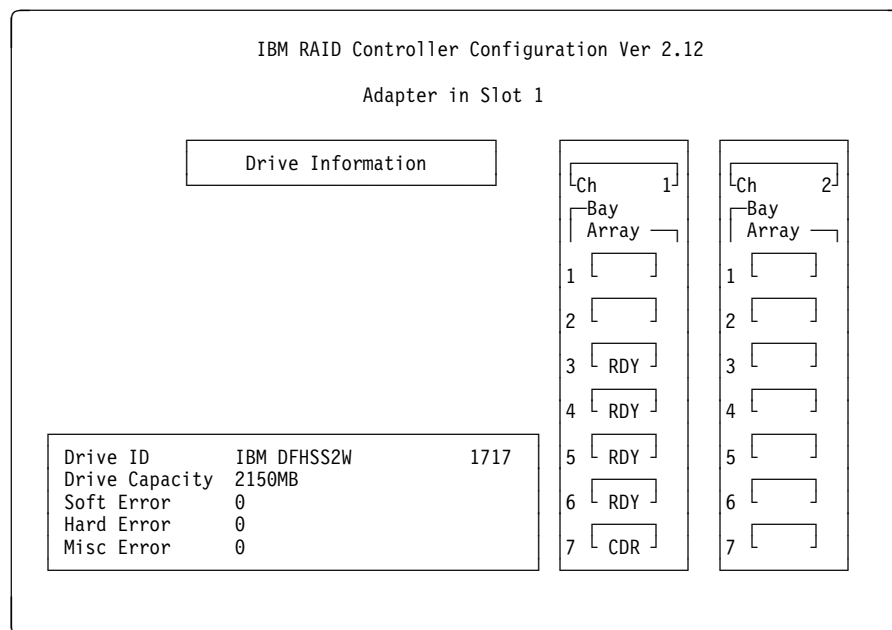


Figure 28. RAID Configuration Program - Drive Information

The columns on the right show any devices attached to each channel on the adapter. The box on the left shows information about a specific device. The unit whose information is displayed is highlighted on the right.

Use the up and down arrow keys to display the information for other devices.

The RAID Utility shows device type and/or status for each device that it recognizes. The devices may take on several states that you may encounter when running the Utility.

Here is a list of indicators we used along with a description of each:

- **CDR** = A CD-ROM device.
- **DDD** = A hard disk which is defunct.
- **FMT** = A hard disk which is being formatted.
- **HSP** = A hard disk which ch has been defined as hot-spare drive.
- **OFL** = A hard disk which is being used to rebuild a defunct drive. This is an intermediate state between DDD and ONL.
- **ONL** = A hard disk which has been assigned to an array.
- **RDY** = A hard disk which is ready to use but not assigned to an array or defined as hot-spare drive.
- **TAP** = A tape drive.
- **UFM** = A hard disk which is unformatted. The drive requires a low-level format before it can be used.

2.5.1.2 Formatting the Disks

If your DASD devices appear as UNF, or if you have experienced some problems with them, you can low-level format the disks.

If your disks appear as RDY, and you don't want to reformat, then you can skip over this section.

To format a device:

1. From the main menu, select **Advanced Functions**.

The following menu appears:

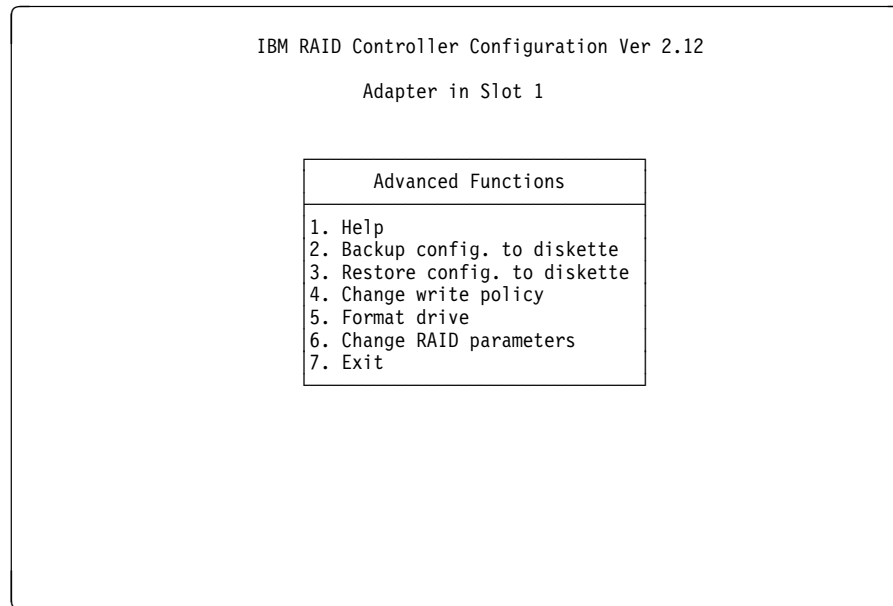


Figure 29. RAID Configuration Program - Advanced Functions Menu

2. Select **Format drive**.
3. With the spacebar, select the devices to format. They appear as FMT.
4. Press Enter to format the selected drives.

Notes

All the desired devices may be selected and formatted together to reduce the time necessary for formatting.

The operation can be time consuming. It takes approximately 20 minutes to format six 2 GB disks attached to the same adapter.

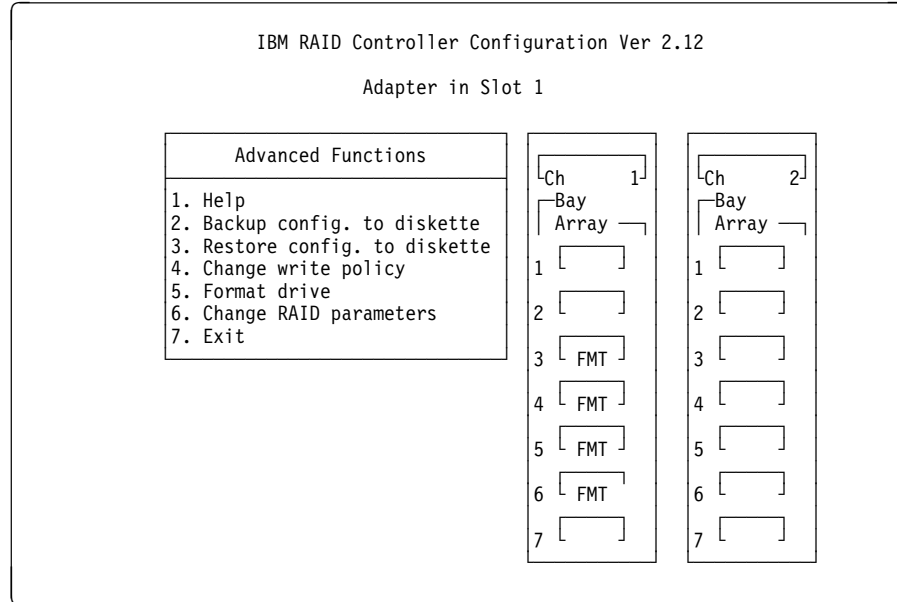


Figure 30. RAID Configuration Program - DASD Formatting

Change RAID Parameters: The panel for changing RAID parameters is shown in Figure 31.

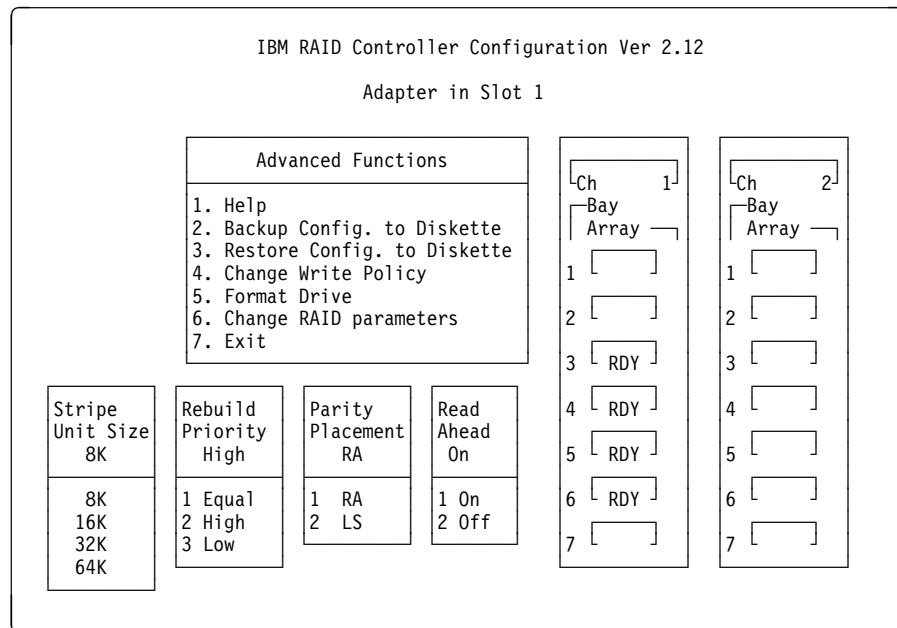


Figure 31. RAID Configuration Program - Change RAID parameters

The following fields are configurable:

- Stripe Unit Size

This parameter should be chosen such that the stripe unit size is close to the size of the system I/O requests. The default is set to 8 KB.

Note: Once data is stored in the logical drive, the stripe unit cannot be changed without destroying data in the logical drives.

- Rebuild Priority

This parameter sets the priority of the execution order of the rebuild I/O requests with respect to the system I/O requests. The rebuild priority can be changed without affecting data in the logical drive.

- Parity Placement

Parity placement defines how parity is placed in the disk array with respect to the data. Figure 32 shows the differences between left symmetric and right asymmetric parity placement.

AAA-LLL are the data stripe units; PP0-PP3 are the corresponding parity units.

Right Asymmetric (RA)				Left Symmetric (LS)			
Disk 1	Disk 2	Disk 3	Disk 4	Disk 1	Disk 2	Disk 3	Disk 4
PP0	AAA	BBB	CCC	AAA	BBB	CCC	PP0
DDD	PP1	EEE	FFF	EEE	FFF	PP1	DDD
GGG	HHH	PP2	III	III	PP2	GGG	HHH
JJJ	KKK	LLL	PP3	PP3	JJJ	KKK	LLL

Figure 32. Parity Placement in a RAID Subsystem

The default value is right asymmetric. In some situations, you may want to try Left Symmetric to improve performance.

Note: Once a parity placement scheme is chosen and data is stored in the logical drives, it cannot be changed without destroying data in the logical drives.

- Read-Ahead

Normally the IBM SCSI-2 Fast/Wide Streaming RAID adapter transfers data from a disk to its local cache in steps of stripe unit size. This provides excellent overall performance when workloads tend to be sequential. However, if the workload is random and system I/O requests are smaller than stripe unit size, reading ahead to the end of the stripe unit will result in a wasted SCSI bus bandwidth and wasted disk utilization.

When Read-Ahead is set to Off, the size of data transfer from the disk to the local cache is equal to the system I/O request size, and no read-ahead to the end of the stripe unit size is performed.

Note: The Read-Ahead setting can be modified without destroying data in a logical unit.

2.5.1.3 Defining a Hot-Spare Disk

After selecting **Create/Delete Array** from the main menu of the IBM RAID Configuration program, the following panel appears:

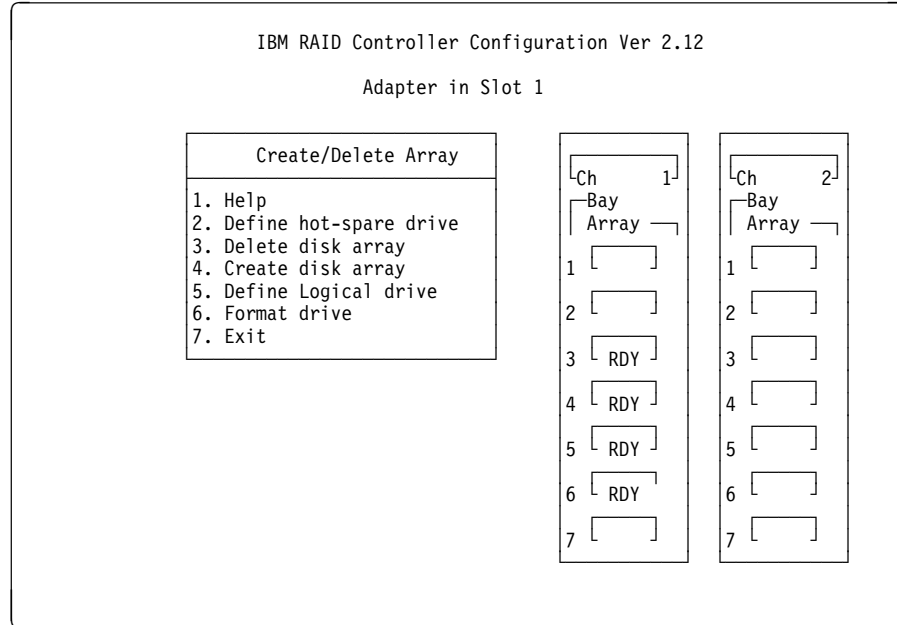


Figure 33. RAID Configuration Program - Create/Delete Array Menu

1. Select **Define hot-spare drive**. The cursor becomes active in the Bay/Array selection list.
2. Use the up and down arrow keys to select the RDY (ready) drive to be used as a hot-spare and press Enter. The RDY status changes to HSP (hot-spare). Figure 34 on page 44 shows an example where a hot-spare disk has been defined.
3. Press Esc to validate.

Notes:

1. The hot-spare drive is not associated with any array. If more than one array is defined, you need only one hot-spare drive for all the arrays.
2. If the disks have different sizes, the hot-spare drive must be the largest.

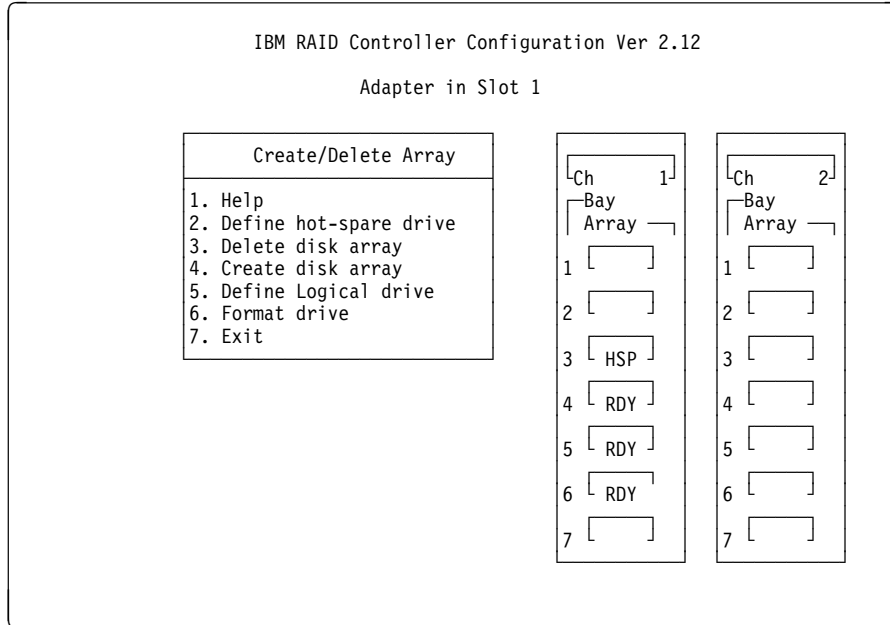


Figure 34. RAID Configuration Program - Hot-Spare Disk Definition

2.5.1.4 Creating a Disk Array

1. Select **Create/Delete Array** from the Main Menu.
2. Select **Create Disk Array** from the Create/Delete Array menu and press Enter.
3. Using the Enter key, select each drive you want included in the array you are now defining. The devices will be highlighted as they are selected and the status changes from RDY to ONL (online). Also, the array ID (A for the first one, then B and so on) appears behind the drives that make up the array.
4. Press Esc to validate.

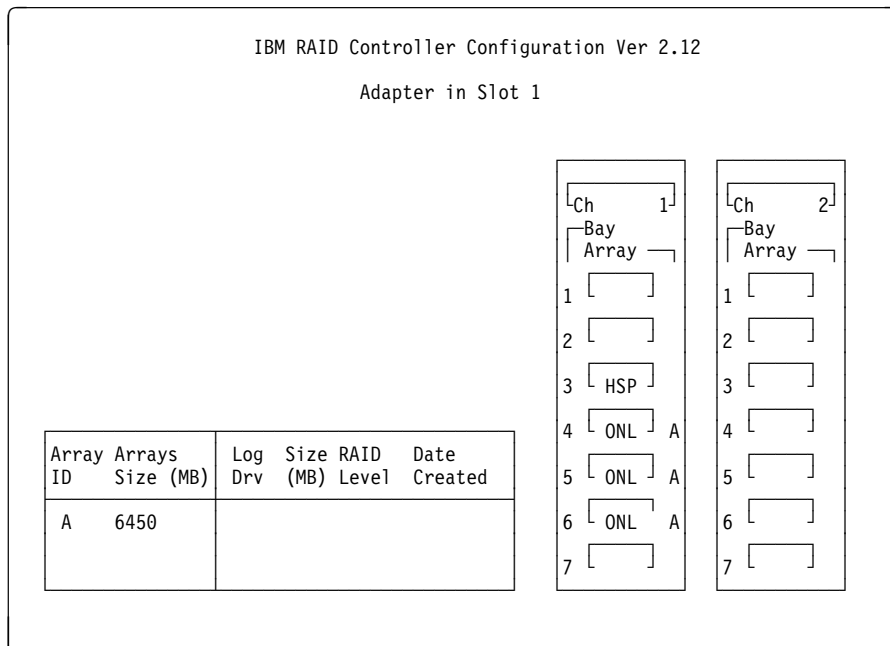


Figure 35. RAID Configuration Program - Disk Array Creation

5. Press any key to return.

Now that an array has been defined, it is necessary to create the logical drives on this array. Logical drive definitions for created arrays must be done before exiting the Create/Delete Array menu.

Notes:

1. Up to four arrays can be defined per controller.
2. An array can be defined across the two channels of one controller.
3. You cannot define an array across two controllers.
4. For maximum performance and configuration flexibility, all installed drives should be configured into a single-disk array. Where data separation is desired, use separate logical drives on the same disk array. Each of these logical drives will appear as a separate physical disk to software programs like FDISK, and may be further divided into logical partitions. With this approach, if additional physical drives are added at a later date, they can be easily added as a second array without reconfiguring the original drives.

2.5.1.5 Defining Logical Drives

1. Select **Define Logical drive** from the Create/Delete Array menu. The following panel appears:

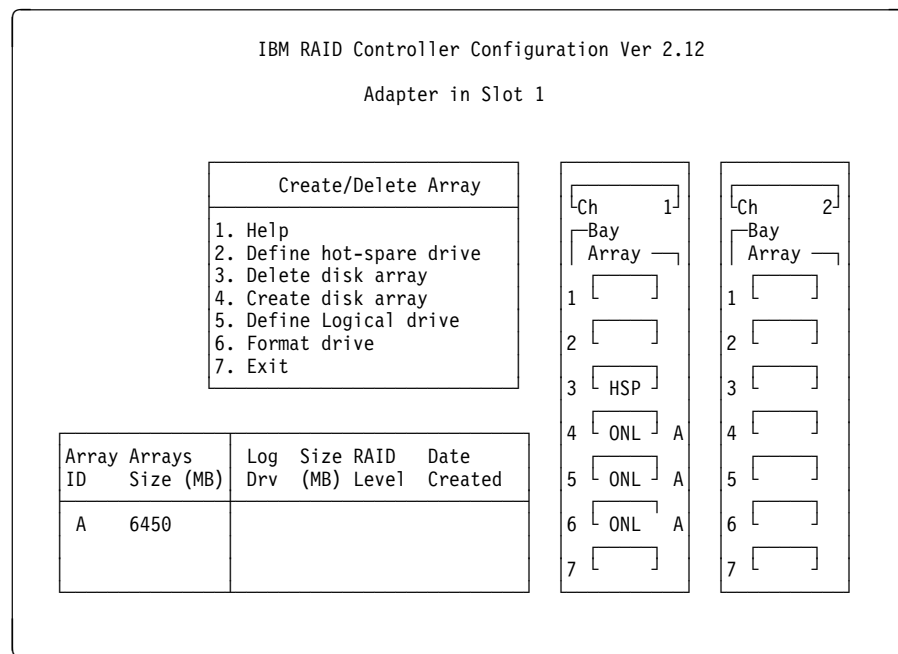


Figure 36. RAID Configuration Program - Logical Drive Definition

2. Highlight the array to be defined and press Enter.
The define logical drive pop-up window appears.

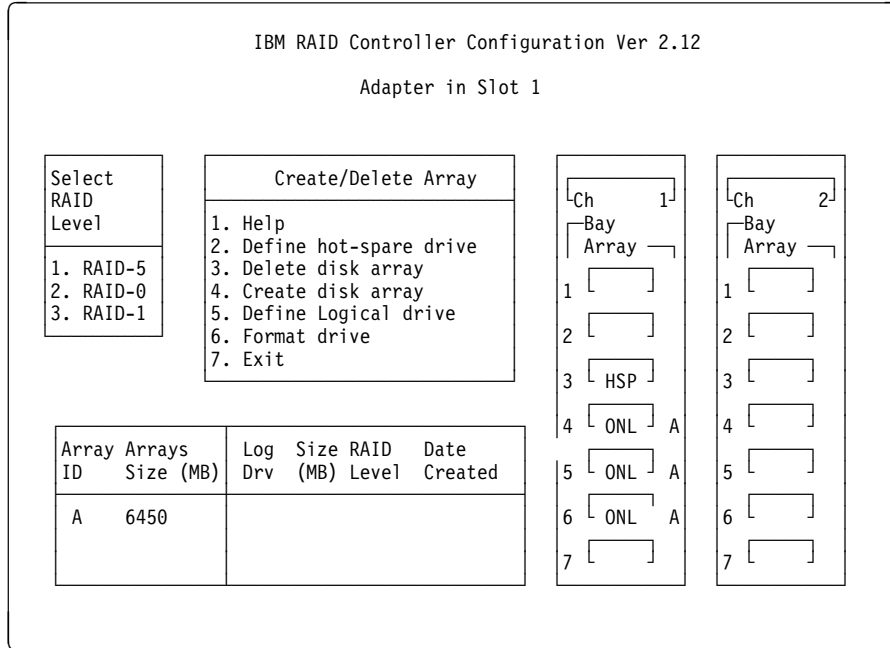


Figure 37. RAID Configuration Program - Logical Drive Definition - Array Selection

Notes:

- a. If only one hard disk has been assigned to the array, RAID level 0 will be automatically assigned and the pop-up menu does not appear.
 - b. If only two hard disks are assigned to the array, RAID-5 is not selectable, since at least three hard disk drives in an array are necessary to assign RAID level 5 to one of the logical drives.
 - c. Define any RAID-5 logical drives first. This is because the first logical drive seen will be the first RAID-5 drive created and will be assigned drive letter C. In this way, the operating system will be installed on a RAID-5 drive.
 - d. The three RAID levels (0, 1 and 5) can be mixed in the same array allowing the user to chose the optimum RAID level for each data type.
 - e. It is, however, not recommended to mix RAID-0 with the others levels if a hot-spare drive is defined, since an automatic rebuild would not be possible.
3. Assign the RAID level wanted and press Enter.

The logical drive size pop-up menu shows the space available in this array for logical drives.

RAID-5 has been chosen in this example.

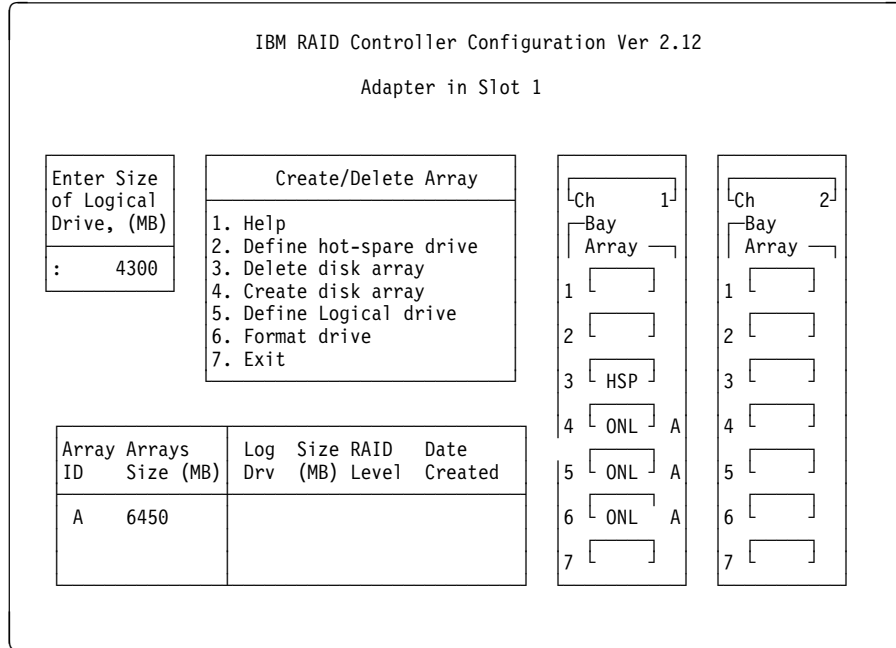


Figure 38. RAID Configuration Program - RAID Level Selection

4. Enter the size needed, within the limitation (for example, 400).
5. Press Enter to confirm.
6. As shown in Figure 39, information about the new logical drive appears in the logical drive list.

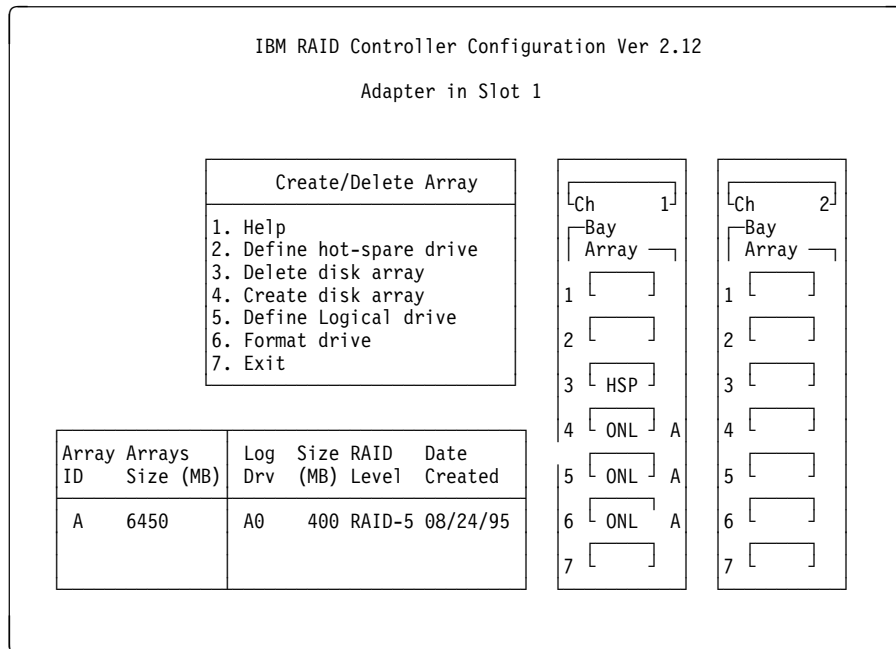


Figure 39. RAID Configuration Program - Size Definition

7. Repeat the procedures for the other logical drives and arrays.

Note

It is not necessary to define multiple logical drives of the same RAID level. You can partition these logical drives the same way you partition a real disk when you install the operating system.

- 8. Select **Exit** to leave this menu.
- 9. Select **Yes** to save the changes.

Figure 40 shows an example of a completed array definition that includes two logical drives: one 400MB RAID-5 array and one 2925MB RAID-1 array.

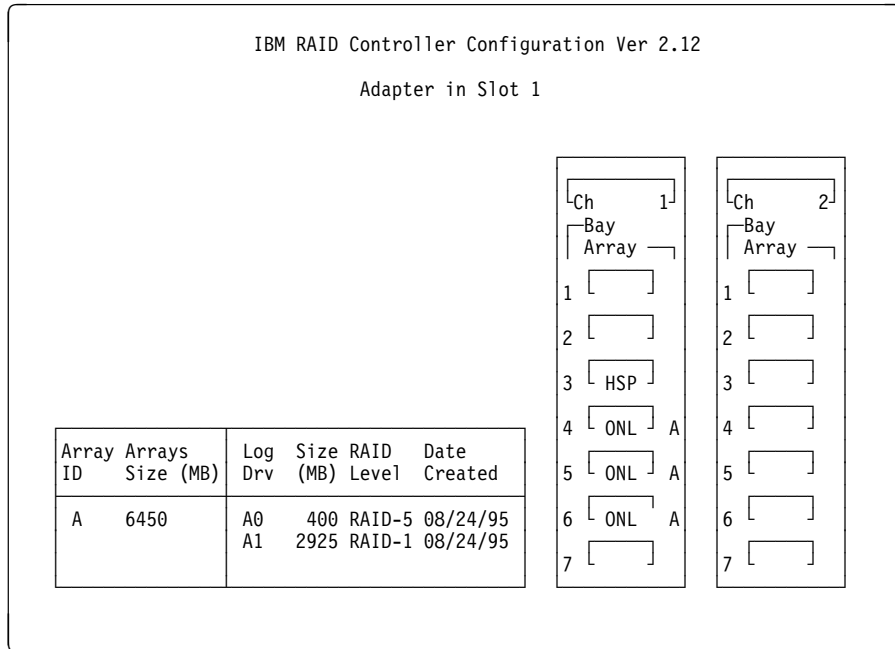


Figure 40. RAID Configuration Program - Result

2.5.1.6 Setting the Write Policy

Now that the logical drives have been created, you may wish to change the write policy for these drives.

If you want to change the write policy:

- 1. Select **Advanced functions** from the main menu.
- 2. Select **Change write policy**.
- 3. Use the up and down arrow keys to select the logical drive.
- 4. Press Enter to toggle the write policy.

The different options are as follows:

- WB for Write-Back

In the write-back mode, the completion status is sent before the data is actually written to the drives. While this mode will yield higher performance, it is critical to protect the DASD power to ensure the write operations actually complete, since the processor thinks the operation has been completed.

- WT for Write-Through

In write-through mode, the data is written directly to the disk and no acknowledgement is sent until the operation is complete. This is the default.

2.5.1.7 Initializing the Array

If you are using RAID level 1 or 5, you must select **Initialize logical drives** for proper operation. This sets the drive to a predetermined state. Any data existing on the drive is overwritten with zeros, and the corresponding parity is initialized to the correct value.

1. Select **Initialize/synchronize array** from the main menu.
2. Select **Initialize logical drive**.
3. Select the logical drive you want to initialize by pressing the spacebar.
4. Press Enter to start the initialization.
5. Select **Yes** to confirm.

2.5.1.8 Backup/Restoring the Configuration

The array configuration is stored on EEPROM on the adapter. It is very important to back up this configuration on a diskette. If the adapter ever needs to be replaced, the configuration can be restored to the new adapter without the need to reconfigure the array. Otherwise, the array would need to be redefined and your data would be lost.

This is important not only at installation time but whenever the array configuration changes. For example, if a hot-spare drive is defined and subsequently, a drive fails and the hot-spare is enabled, the array configuration is updated. If you are unable to restore the configuration *exactly* as it was before, it would have the same effect as re-initializing the arrays: all data would be lost.

Backup Recommended

We *strongly* recommend that the configuration be backed up.

To back up the configuration:

1. Select **Advanced functions** from the Main Menu.
2. Select **Backup config. to diskette**.
3. Press Enter.
4. Enter the filename you want for backup (CONFIG is the default).
5. Insert a diskette to hold the backup file.
6. Press Enter.

To restore the configuration:

1. Select **Advanced functions** from the Main Menu.
2. Select **Restore config. from diskette**.
3. Press Enter.
4. Enter the filename you used for backup.
5. Insert the diskette used for backup.
6. Press Enter.

A panel similar to the one in Figure 41 on page 50 will appear. This shows you the date when the backup was performed.

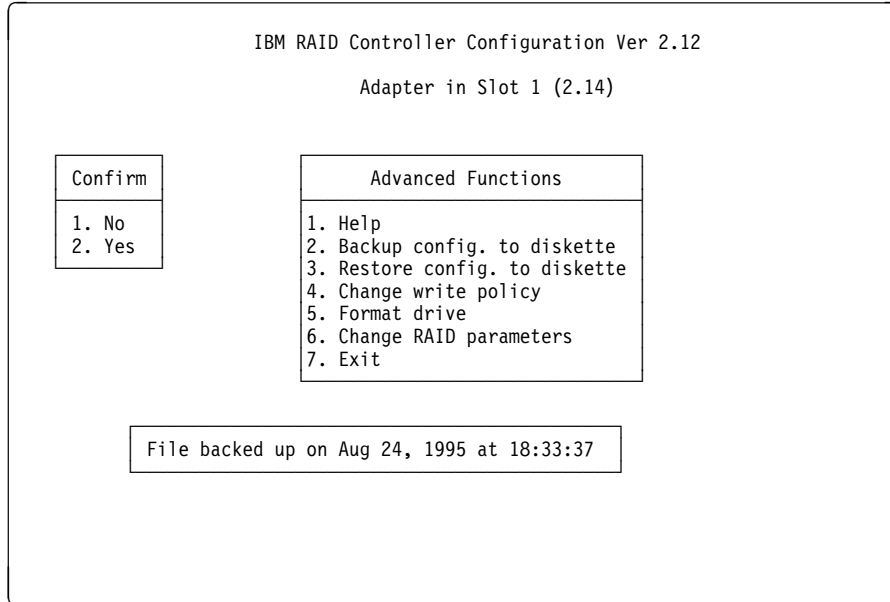


Figure 41. RAID Configuration Program - Advanced Functions Menu

7. Select **Yes** to confirm.

2.5.2 PC ServeRAID SCSI Adapter

The ServeRAID Adapter is a high-performance, three-channel PCI RAID adapter. This technologically advanced RAID controller supports up to 45 SCSI-2 Fast/Wide or UltraSCSI hard drives to satisfy mission critical applications that require protection for large amounts of data.

The ServeRAID Adapter achieves outstanding performance through the use of a RISC processor, 4 MB of cache, and a dual PCI bus architecture with a local PCI bus. These attributes significantly improve system performance by reducing traffic on the system local bus and by rapidly processing complex RAID algorithms with a high-speed processor.

IBM incorporates logical drive migration with the ServeRAID Adapter. This new technology allows changes to be made to the RAID configuration while the PC Server is up and running. Using online utilities, new RAID arrays can be added and RAID levels modified without deleting the original array, or requiring the data to be restored from a backup source.

For added security, the ServeRAID Adapter stores critical RAID configuration information in multiple locations on the adapter and hard disk making disaster recovery or migrating hard drives from one server to another quick and easy. This means hard drives can now be removed from your server and installed in another server or external enclosure in any order. The ServeRAID Adapter takes care of getting the configurations from the hard drives and remapping them as necessary.

This adapter contains three internal connectors, one for each channel, and one external connector. Three of the four connectors can be used for attachment of SCSI devices.

2.5.2.1 ServeRAID Adapter Support Diskettes

Prior to publication, IBM released version 2.0 of the support diskettes for the ServeRAID Adapter. The two major functional enhancements that this new version provided are:

1. Internal Hot-Swap Drive Support for the IBM PC Server 704

The IBM PC ServeRAID SCSI Adapter is now supported on the IBM PC Server 704, for both internal hot-swap disk drives and externally attached hot-swap disk drives. This enhances the already-robust PC Server 704 and adds flexibility to its RAID configurations.

To use the IBM PC ServeRAID SCSI adapter in the PC Server 704, the server must be at BIOS Level 7 or higher and the PC ServeRAID SCSI Adapter firmware and BIOS must be at Level 2.

2. Logical Drive Migration capabilities

Logical Drive Migration (LDM) for the IBM PC ServeRAID SCSI Adapter is now available, extending the power and control of your IBM PC Server RAID implementations.

The primary LDM functions allow you to add capacity to your RAID arrays by increasing the size of the logical drives, or by creating additional free space to create new logical drives.

The new LDM code provides the following functions:

- Expand the array by adding up to three physical drives at a time. While expanding the array, the logical drive size can be increased or kept unchanged. While the logical drive size remains unchanged, the increased space can be used to define additional logical drives.
- Change the RAID level on-the-fly from RAID-0 to RAID-5 by adding a drive and from RAID-5 to RAID-0 by removing a drive. All logical drives in the array must be at the same RAID level.
- Change RAID level on-the-fly from two-drive RAID-1 to RAID-5 by adding one physical drive.
- Concurrent I/O support: During the LDM process logical drives can be accessed by users.
- Degraded Mode support: While LDM is in progress and the logical drive goes to Critical mode due to physical drive failure, LDM will continue to run normally. LDM will not start if the logical drive is already in Critical mode.
- Power Failure Recovery: Should a power failure occur during LDM, the operation restarts from the point of interruption when power is restored.

Logical Drive Migration functions are controlled from the ServeRAID Administration and Monitoring Utility. Refer to 2.5.2.5, "Administration and Monitoring Utility" on page 58 for information about this utility.

At the time of publication, the current levels of the ServeRAID software are:

- ServeRAID Configuration Disk V2.00
- ServeRAID Driver and Utility Disk V2.00
- ServeRAID SCO BTLD Disk V2.00
- ServeRAID Administration and Monitoring Utility V2.00
- ServeRAID BIOS/Firmware V2.00

Images of these diskettes plus an online (HTML) version of the ServeRAID Installation and User's Guide are available from IBM's PC Server Web site. Refer to Appendix A, "Sources of Drivers and Information" on page 147 for details.

2.5.2.2 IBM PC Server Support

To support the ServeRAID firmware, you should update the BIOS level of your IBM PC Servers to the latest level. Refer to Appendix A, "Sources of Drivers and Information" on page 147 for information on where to get the latest BIOS code. As a minimum, the BIOS must be at the following BIOS levels:

Server	BIOS Level Required
PC Server 310	Not Supported
PC Server 320 PCI/MCA	19A
PC Server 320 PCI/EISA	M54PE-15T3
PC Server 325	All
PC Server 330	All
PC Server 520 PCI/MCA	19A
PC Server 520 PCI/EISA	M54PE-15T3
PC Server 720	07
PC Server 704	7

PC Server 704 Considerations:

The 704's internal drive bays are managed directly over the SCSI bus (rather than through a separate DASD status cable) via an intelligent SCSI processor device embedded in each internal hot-swap backplane.

All devices on a single SCSI channel must be assigned a unique ID. Since the 704's internal backplanes are themselves SCSI devices, one of the SCSI IDs on each of the ServeRAID adapter's internal channels will be assigned to each backplane. The PC Server 704 assigns each internal hot-swap backplane to SCSI ID 6 (which corresponds to bay 7).

To view the ServeRAID's current SCSI device ID assignments, please use one of the ServeRAID utilities (such as the Configuration Diskette, the Monitor utility, or the BIOS-based Mini-Config Utility). The bay/ID assigned to the backplane will appear as a SBY (standby) or PRC (processor) device.

2.5.2.3 ServeRAID Configuration Utility

The configuration utility allows you to do maintenance on your ServeRAID configuration. Boot from the diskette to run the utility. The main menu will appear (Figure 42 on page 53):

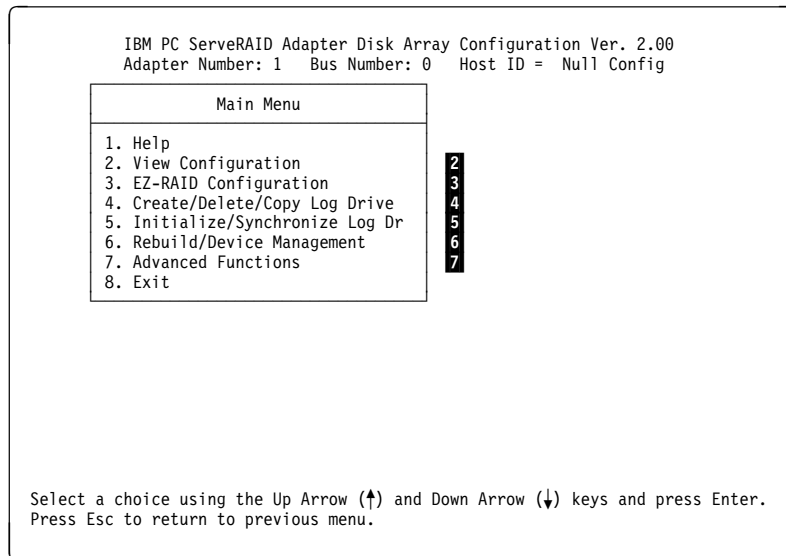


Figure 42. ServeRAID Adapter Main Menu

Your choices from the main menu are:

2 View Configuration

This option lets you see how your system is presently configured. The physical drives will have the following states:

- CDR** device is a CD-ROM
- DDD** the drive has become defunct; it does not respond to commands
- DHS** the drive is defined as a hot-spare, but is now defunct
- EMP** the drive was present but has now been removed and the slot is empty
- HSP** the drive is a hot-spare for use when a similar drive fails
- INI** the device is the ServeRAID controller itself (initiator)
- ONL** the drive is online and part of an array (the array letter A,B etc is listed to the right of the status in the View Configuration panel)
- PRC** Reserved. In use by a component of the system (eg the backplane)
- RBL** the drive is being rebuilt
- RDY** the drive is available but not in use
- SBY** the drive has been spun down by the adapter and is in standby mode
- SHS** the drive is a standby hot-spare
- TAP** the device is a tape drive

The status of the logical drives can be:

- CRT** the logical drive is in a critical state, although it is still functioning despite the failure of one of its physical devices
- FRE** the logical drive is not defined
- LDM** the logical drive is undergoing a RAID level change using Logical Drive Migration functions
- OKY** The logical drive is functioning correctly
- OFL** The logical drive is offline and not accessible. This occurs when more physical drives fail that the RAID level can cope with (that is, 1 for RAID-0 and 2 for RAID-1 and RAID-5)
- SYS** Reserved state

3 EZ-RAID Configuration

This option give you an automatic method to create an IBM PC ServeRAID configuration based on the number of physical drives that are in the ready (RDY) state. The bays are scanned for the physical drives in the RDY state. A maximum of nine drives will be selected on a first-found, first-selected basis. The following configurations will be created based on the number of RDY physical drives:

Physical Drives Available	RAID Level Created	Hot-Spare Defined
1	0	no
2	1	no
3	5	no
4-9	5	yes

Upon defining this configuration, EZ-RAID will automatically initialize and synchronize your logical array.

Note: If you require a configuration other than these, you will need to manually configure your arrays using Create/Delete/Copy.

4 Create/Delete/Copy

Select this option if you are configuring your system for the first time or if you have added or removed a disk drive. More panels will be provided for you to accomplish your task.

5 Initialize/Synchronize

Select Initialize/Synchronize logical drive if you want to prepare a freshly created logical drive for use or if you want the system to recompute the parity data in the drive.

6 Rebuild/Device Management

This choice is used when you replace a defunct drive and/or reconstruct the data on a failed drive. You can also select Drive information to view SCSI devices connected to the RAID Adapter. You can view drive IDs, capacities, and error records. The Device Error Table can also be erased.

7 Advanced Functions

This choice shows you a menu as shown in Figure 43 on page 55 gives you access to a number of advanced functions:

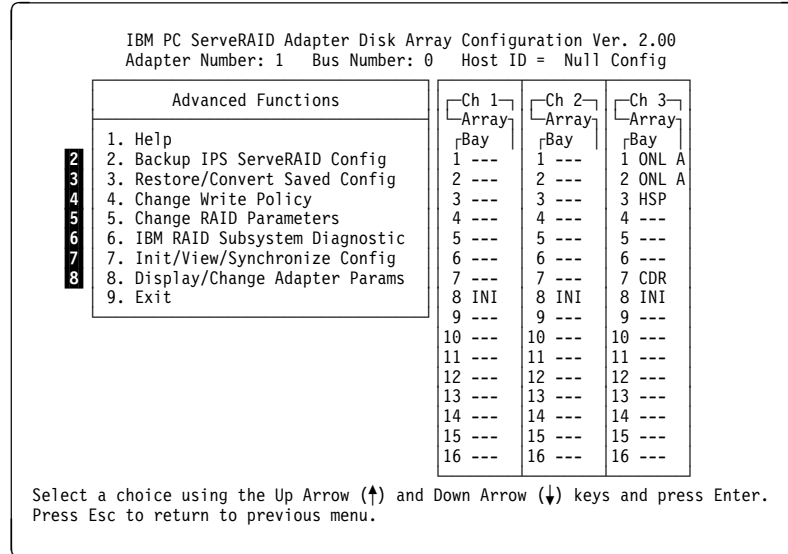


Figure 43. ServeRAID Adapter Advanced Functions Menu

- 2** Backup IPS ServeRAID Config; and
- 3** Restore/Convert Saved Config

These two options let you back up or restore the disk array configuration to or from a diskette. This should be done when ever the configuration changes (either manually by you, or automatically when a hot-spare is used to replace a defunct drive).

Back up to Diskette!

We strongly recommend you back up your ServeRAID configuration to diskette whenever a change is made.

The Restore/Convert option also helps you upgrade from a PCI RAID or Streaming RAID adapter by converting your previous configuration.

Note: There are some limitations to this conversion option. See the ServeRAID User's Guide for more information.

- 4** Change Write Policy

Select Change write policy to configure a logical drive of an array to work in either the write-through mode or the write-back mode. In the write-back mode, the completion status is sent before the data is actually written to the drives. Write-back mode generally provides higher performance with increased risk of data loss in the event of power failure. In Write-through mode completion status is sent after the data is written to the drives.

- 5** Change RAID Parameters

Change RAID Parameters allows you fine tune the RAID subsystem:

- Stripe unit size - should be set to the size of I/O requests
- Rebuild priority - specify which has higher priority: rebuild I/O or system I/O
- Auto rearrange - allows the adapter to resolve configuration related conflicts automatically.
- Read ahead - toggles the cache read ahead up to the end of stripe unit.

6 IBM RAID Subsystem Diagnostic

Select this option to run the ServeRAID Adapter self test. Low-level formatting of drives is provided as well as a drive media test.

7 Init/View/Synchronize Config

This option lets you initialize the configuration of the adapter back to the factory defaults. The ServeRAID Adapter stores critical configuration information in a number of locations to ensure the data is not lost:

- NVRAM on the adapter
- EEPROM on the adapter
- On each online (ONL) or rebuilt (RBL) drive
- On diskette (upon request)

This option lets you view each of these stored configurations, and when a discrepancy exists, you can select which one to use as a basis for synchronization.

The RAID adapter also maintains a list of all changes to its RAID configuration. A power-on change list, wrong SCSI ID list, and an unidentified drive list are updated when devices are added or moved. Changes to the devices' state also affect these list. This option allows the user to view all of this information.

8 Display/Change Adapter Params

Select **Display/Change Adapter Params** to display the adapter's status or to write a new adapter configuration Host ID. The adapter's SCSI channel ID and speed may also be changed.

2.5.2.4 Mini-Configuration Utility

The mini-configuration program is a quick way to display the adapter settings and to perform a limited set of configuration functions without using the configuration utility on diskette.

Upon booting the server with the ServeRAID controller installed, you will see:

Press <Ctrl+I> for MiniConfig Utility

If you have more than one adapter installed, you can select which adapter to work with. The main menu now appears (Figure 44 on page 57):

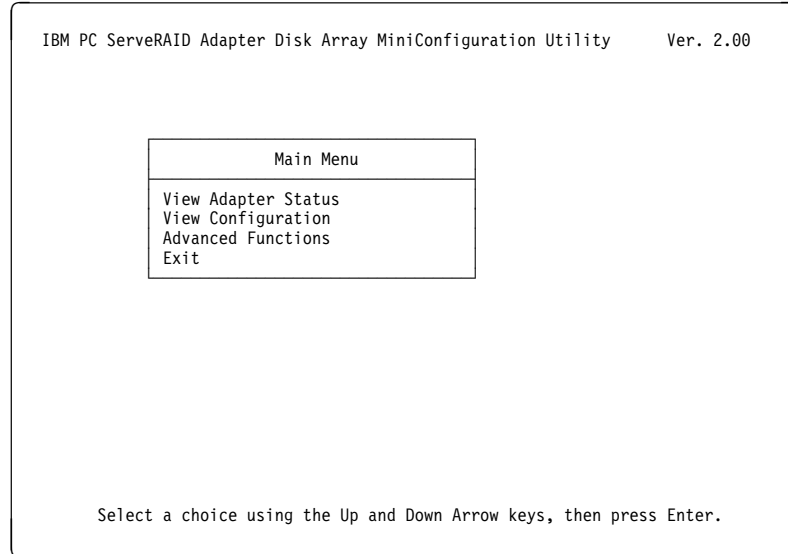
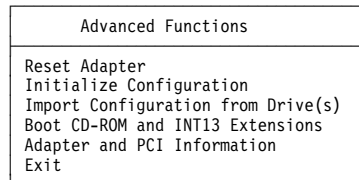


Figure 44. ServeRAID Adapter Mini-Configuration Utility

As well as viewing both the adapter status and the logical drive configuration, you can perform a subset of administrative functions that you can do with the configuration utility. Selecting **Advanced Functions** from the menu gives you a window:



The options you can select here are:

- **Reset Adapter**

The option resets the adapter and runs all internal diagnostics. This does not affect the data on the drives.

- **Initialize Configuration**

This option resets the adapter configuration to factory defaults, and places all drives in the ready (RDY) state.

Note: All configuration data will be lost.

- **Import Configuration from Drive(s)**

This option reads the configuration from the drives and copies it to NVRAM and EEPROM on the adapter.

Note: Configurations store in the adapter will be lost.

- **Boot CD-ROM and INT13 Extensions**

Figure 45 on page 58 appears to allow you to configure the CD-ROM boot options. See “Boot CD-ROM Configuration” on page 58 for more information.

- **Adapter and PCI Information**

This displays data about the adapter hardware and the PCI registers.

2.5.2.6 Possible POST Errors

During POST, the ServeRAID adapter compares the stored configuration information to the configuration that is actually present. If a discrepancy exists, one or more status messages appear after POST completes, but before the operating system loads. You will be given a list of choice to select from. Possible messages include:

New drives installed: You will see:

```
Following new drives found
(old state: new state: ch: bay)
[...a list of drives...]
```

This is an informational message only.

Configured drives are missing: You will see:

```
Following drives not responding
(old state: new state: ch: bay)
[...a list of drives...]
```

Possible choices here are:

- F4** Retry. You would select this, for example, if you forgot to turn on an external enclosure.
- F5** Accept the new state that the adapter will assign to the drives. You might press F5 when, in a RAID-5 or RAID-1 configuration, a drive has started in DDD (defunct) mode. In this instance, you can continue to boot the server in critical mode to enable you to replace the faulty drive while the server is running.

Configured drives are not in the configured location: When the adapter detects that a previously configured drive is present, but the drive is in a new location, the following message appears:

```
Following drives found in new location
(old ch: old bay: > new ch: new bay)
[...a list of drives...]
```

Here you can select:

- F4** Retry. You might press F4 once you have moved the drives back to their original locations.
- F6** Accept the drives in their new locations.

New adapter or Imported Drives: Unlike the “New drives installed” message, here the adapter has detected that the drives installed in the server are new to this machine, but were part of a different ServeRAID adapter configuration. You will see:

```
Following new drives found
("host id": old ch: old bay: new ch: new bay)
[...a list of drives...]
```

or

```
Identifiers for the following drives do not match configuration
("host id": channel: bay > channel: bay)
[...a list of drives...]
```

Included in the message is the identifier (Host ID) of the other ServeRAID Adapter. From here, you have the following choices:

- F4** Retry.
- F7** Restore the configuration from diskette. Press F7 when you replace a faulty adapter or when you move an entire disk array from one system to another without also moving the adapter.

New Adapter

There may be situations (for example using a factory-fresh adapter as the replacement) where the F7 option does not appear. If you need to restore a configuration from diskette, do the following:

1. Restart the server.
2. When prompted during POST, press Ctrl+I to enter the MiniConfiguration Utility.
3. Select **Advanced Functions**.
4. Select **Import Configuration from Drives to Adapter**.
5. Follow the instructions on the panel.

Chapter 3. Pre-installation Considerations

This chapter is aimed at providing guidelines regarding hardware, software and capacity consideration requirements when installing NT 4.0.

Windows NT Server 4.0 is a 32-bit operating system and is very hardware intensive. With most 16-bit operating systems, such as DOS, hardware is not accessed until it is required. Under Windows NT, hardware drivers are written to and polled much more heavily for input/output (I/O) instructions. Hardware problems that have gone unnoticed or have seemed to be minor under other operating systems are likely to be amplified when running under Windows NT.

3.1 Hardware Requirements

The following are the minimum hardware requirements for installing NT 4.0:

- 16 MB of RAM
- VGA level video support
- Keyboard
- IDE, EIDE, SCSI, or ESDI hard disk drive
- 486/25 processor or better
- CD-ROM drive, 1.44 MB or 1.2 MB floppy disk drive, or active network connection
- Network card

IBM Adapters

Refer to Appendix D, "Tips on Windows NT and IBM Hardware" on page 155 for information about common problems found with IBM network adapters.

Although the minimum memory requirement is 16 MB, this offers only minimal functionality. As a result, Microsoft recommends 32 MB of RAM or more. Microsoft also recommends a 486DX2/50 or better processor. The minimum space requirements for Windows NT Server 4.0 is 124 MB.

See 3.2, "Setup Options" on page 63 for more information.

Verify that there are no power-on self-test (POST) errors prior to starting the installation process. Also, make certain that each adapter and peripheral device is set to an independent IRQ, memory address, and DMA channel.

3.1.1 Enhanced IDE (EIDE) Drive Considerations

NT 4.0 supports only the following EIDE addressing schemes:

- Logical Block Addressing (LBA)
- ONTrack Disk Manager
- EZDrive
- Extended Cylinder Head Sector (ECHS)

Note: Only the IBM PC Server 310 has an EIDE controller as standard.

3.1.2 Hardware Configuration

In order to successfully install Windows NT, we recommend that you obtain the following information:

Adapter Card	Required information
Video	Adapter or chipset type
Network Card	IRQ, I/O address, DMA (if used) connector type (BNC, twisted pair, etc)
SCSI Controller	Adapter model or chipset, IRQ and bus type
Mouse	Mouse type, port (COM1, COM2, bus or PS/2(R))
I/O Port	IRQ, I/O address, DMA (if used) for each I/O port
Sound Card	IRQ, I/O address, DMA (if used) for each card
Internal Modem card	IRQ, I/O address, DMA (if used) for each modem
External Modem	IRQ, I/O address, DMA (if used) for each modem

To aid you in obtaining this information, two utilities are provided on the Windows NT installation CD-ROM: NTHQ and SCSITOOL.

3.1.2.1 The NTHQ Utility

NTHQ utility is provided on the Windows NT installation CD-ROM, which you will find in the SUPPORT\HQTOOL directory. This utility will obtain most of the necessary hardware setting information required to complete the installation.

Note: If you have all the required information, it is not necessary to use this utility.

To create the NTHQ bootable utility diskette, do the following:

1. Go to the X:\SUPPORT\HQTOOL directory (where X: is your CD-ROM drive).
2. Insert a floppy disk in drive A:.
3. Run MAKEDISK.
4. With the disk in the drive, restart the computer.
5. The utility will run a cut-down Windows 3.1 system from the diskette to enable you to view the detected configuration.

Note: The MAKEDISK command will run under DOS or Windows NT.

3.1.2.2 The SCSITOOL Utility

Also on the Windows NT CD-ROM is the SCSITOOL utility for obtaining SCSI information. This tool currently only supports SCSI adapters from Adaptec and BusLogic. If you have all the required information it is not necessary to use this utility.

Note: If you use a SCSI adapter that requires a driver diskette, such as the ServeRAID Adapter, then this utility will not detect your SCSI subsystem.

To create the SCSITOOL bootable utility diskette, do the following:

1. Go to the X:\SUPPORT\SCSITOOL directory (where X: is your CD-ROM drive).
2. Insert a floppy disk in drive A:.
3. Run MAKEDISK.
4. With the disk in the drive, restart the computer.

Note: The MAKEDISK command will run under DOS or Windows NT.

3.1.2.3 Unsupported Hardware

NT 4.0 does not currently support the following controller and BIOS enhancements:

- 32-bit I/O BIOS switch
- Enhanced drive access
- Multiple block addressing or rapid IDE
- Write-back cache on disk controllers
- Power management features

3.2 Setup Options

There are three options you can use to install NT 4.0 that are supported by Microsoft:

1. Standard Setup

Installing directly from the CD-ROM as described in Chapter 5, "Installing Windows NT Server 4.0" on page 81 or from diskettes is almost always the best method of setting up your Windows NT system. It offers the best support for alternate Hardware Abstraction Layers (HALs), timing and third-party drivers. If you have a supported CD-ROM drive, you should choose this setup method. This installation method requires a minimum of 124 MB of free space.

This is the method we recommend for use with IBM PC Servers.

— Creating Boot Diskettes? —

If you misplace the setup disks for the standard setup, run either `WINNT /OX` or `WINNT32 /OX` from the I386 directory on the installation CD-ROM to create new boot disks for a standard setup.

You can also ServerGuide to build these diskettes. Refer to 4.3.2, "AutoPilot" on page 76 for more information.

2. WINNT or WINNT32 Setup

This method was designed for network installations or for computers with unsupported CD-ROM drives. It builds the boot disks and performs a file copy of the setup directory to the hard disk drive before the setup procedure begins. It is the second best choice after the standard setup. This installation method also requires a minimum of 124 MB of free space.

See 3.2.2, "The WINNT Command" on page 64 for more information on the WINNT command.

3. Installing over a Network

For networks where the Windows NT installation files are kept on a central server, network installations can be accomplished using the WINNT command or by copying the entire I386 directory from the setup CD-ROM to the hard disk drive and then running WINNT from the local disk drive. This can reduce network traffic and dependency. The stability of your network can have a detrimental impact on your installation process when installing across the network. One of the more common problems is that the NetBIOS protocol time-outs are set incorrectly. This will cause the installation process to fail, especially if the server you are installing from is busy. If you copying the entire I386 directory from the CD-ROM to the hard disk you will need 223 MB of free space.

See 3.10, "Installation Over the Network" on page 68 for more details.

Note: The method of copying the I386 directory can also be used when there are drive or driver issues that otherwise block the use of the CD-ROM.

We used the standard setup method (option 1) in our testing.

3.2.1 Unsupported Setup Methods

WINNT /B or WINNT32 /B is used for a floppy-less setup. It copies the boot files to the root of drive C and then uses the hard disk as if it were the boot disk. If you have timing issues on your computer, such as problems accessing the hard disk drive or similar error messages, this method can be used, but WINNT is much more reliable. Please note that this method will fail if you are running BIOS-level virus protection.

WINNT /W allows you to set up Windows NT from within Windows, bypassing the drive locking and enhanced driver issues involved with a Windows NT setup. Again, this bypasses many of the Windows NT setup safety features and is not recommended.

WINNT /U is the command for unattended setup. This can only be used on systems where all the components are standard and no user input is required. If there are any problems, the setup will stop until the problem is resolved.

3.2.2 The WINNT Command

Windows NT includes both a 16-bit and a 32-bit version of setup. Both provide the same basic functionality but the 32-bit version, WINNT32.EXE, will only run on Windows NT and can be used to upgrade an existing installation of Windows NT.

The WINNT.EXE and WINNT32.EXE command line parameters are:

```
WINNT [/S[:]sourcepath] [/T[:]tempdrive] [/I[:]inffile] [/U[:]scriptfile] [/R[X]:directory] [/E:command]
```

Where the parameters have the following meanings:

- /S[:]sourcepath** Specifies the source location of Windows NT files. Must be a full path of the form x:[path] or \\server\share[path]. The default is the current directory.
- /T[:]tempdrive** Specifies a drive to contain temporary setup files. If not specified, setup will attempt to locate a drive for you.
- /I[:]inffile** Specifies the filename (no path) of the setup information file. The default is DOSNET.INF.
- /B** Floppyless operation (requires /s).
- /U** Unattended operation and optional script file (requires /s).
- /R:** Specifies optional directory to be installed.
- /RX** Specifies optional directory to be copied.
- /E:** Specifies command to be executed at the end of GUI setup.
- /W** Used with WINNT.EXE only for starting setup from within Windows 3.x or Windows 95. The /B option is disabled in this mode.

3.3 Viruses

NT 4.0 will not install on a system infected by a virus.

One of the common problems associated with a virus infection rears its head while you are busy installing, as described in Chapter 5, "Installing Windows NT Server 4.0" on page 81. You may encounter an error stop (a blue screen with error codes) right after the FAT file system has loaded. This symptom is usually associated with a boot sector virus infection. The troubleshooting guide documents several other errors caused by viruses. You can find the latest troubleshooting guide from Microsoft at the following URL:

<http://www.microsoft.com/kb>

If your system is infected, use IBM AntiVirus to remove the virus prior to attempting a Windows NT setup. You can create AntiVirus diskettes from ServerGuide's Diskette Factory. Refer to 4.3, "ServerGuide Main Menu" on page 73 for more information.

3.4 Disk Compression

NT 4.0 will not access any drives if they are compressed by any method other than the NTFS file compression in NT 3.51. All compression methods, including Microsoft DoubleSpace, Stacker, or any other hardware compression method is not compatible with NT 4.0.

In order to allow NT 4.0 to access data on a drive compressed with Microsoft double space, you could run the following command to uncompress the drive. In this example, C: is the boot drive.

```
COMPACT C:\ /U
```

Note: You will not be able to compress the root of the NT 4.0 boot drive. Any upgrade or installation to the compressed root will fail.

3.5 HPFS Support

The high-performance file system (HPFS) is no longer addressable or convertible under Windows NT 4.0. If you have an HPFS volume, conversion must occur prior to upgrading your system to Windows NT 4.0.

If there is no previous version of Windows NT on your system, and the data on an HPFS partition needs to be accessed from Windows NT, you must back up the data on the partition and reformat the partition to FAT or NTFS. Some partition information created for HPFS or the Boot Manager installation of OS/2 should be removed using the tools they were created with. For example, use OS/2's FDISK.EXE to remove the Boot Manager partition.

3.6 Disk Partitioning

Microsoft recommends NT 4.0 be installed on a partition of at least 300 MB in size, although we recommend a 400 MB or larger system partition.

We also suggest the boot partition be formatted as FAT for servers that do not require C2 secure classification, and NTFS for those that do. This space is used for the Windows NT code, page file and DOS or Windows 95 installation. Formatting the boot partition with the FAT file system gives you the ability to boot to DOS if necessary, to copy over drivers, or boot files in the event of a file corruption or upgrade problem.

We recommend that all other partitions on your server be formatted with NTFS for performance reasons.

Partition Size

DOS uses the FAT file system, which limits partitions to 2 GB. During the installation process, Windows NT creates your boot partition as FAT and then later converts them to NTFS if you requested it. As a result, Windows NT imposes a 2 GB upper limit on the size of your boot drive partition.

We recommend that only one logical drive should initially be defined to install NT 4.0 because, in our experience, we have found that when defining more than one logical drive, Windows NT may hang during the initial installation process. Additional logical drives can be defined after the NT 4.0 installation is complete, using Windows NT's disk administrator.

We also recommend that any partitioning be performed under DOS prior to starting the installation. The DOS FDISK program (compared to the NT 4.0 facilities during the setup phase) allows greater flexibility in deleting and redefining partitions that already exist. A problem sometimes occurs when you have previously defined partitions on your hard drive and you try to delete them during the NT 4.0 installation process. You delete them but they do not show as combined free space but as separate free space. That is, you are not able to reclaim the free space as a single entity to create partitions that differ in size from the original ones.

Tip

If your system is partitioned in such a fashion as to keep the operating system and the data separate and you lose the administrative password, you could destroy the partition where the operating system is installed. Re-install Windows NT and take ownership of all the files on the data partition.

This will give you access to the files but you will lose any security settings of your system in the process. Depending on the way your system was configured, you could lose all your data, so the method described should be used as a last resort.

3.7 Plug and Play

Windows NT Server 4.0 does not use the plug and play BIOS features that the IBM servers support. Plug and play support is planned for the next version of NT.

The problem that you could encounter while the plug and play BIOS features of your server is enabled occurs during the POST (power-on self-test). The plug and play BIOS feature changes settings on the adapters to avoid any conflicts. NT 4.0 is not aware of any of these changes and the device drivers that address these adapters will fail.

We recommend that, if possible, you should disable these BIOS features of your server and on any adapters in the server.

Note: Some of the IBM PC Servers, such as the PC Server 320 have the ability to disable the BIOS. This is usually in the advanced section of the BIOS utility. Other servers, such as the PC Server 330 do not have the ability to disable plug and play, however this should not present any problems.

3.7.1.1 Using Windows 95 to Install Plug and Play Devices

If you have a combination of devices that you find great difficulty in setting up due to classes in interrupts, DMA settings or I/O addresses, you could try the following (although they are tedious and time consuming).

Enable all the plug and play features of your devices as well as of the server. Install Windows 95 and reboot the server several times. During this process, Windows 95 will address the plug and play features and try to find the optimal settings. This procedure works best if all the devices are plug and play enabled.

After you have established the correct hardware settings, disable the plug features and proceed with the installation process as described in Chapter 5, "Installing Windows NT Server 4.0" on page 81.

3.8 Upgrading from Windows 95

There is currently no provision made within NT 4.0 to upgrade from Windows 95. This should be addressed in the upcoming release of Microsoft Windows NT 5.0. It is unfortunate since most of the 32-Bit applications that run under Windows 95 will run under NT 4.0.

Note: You will have to check the documentation of the individual applications to determine which of the Windows 95 applications will run under NT 4.0.

3.9 Upgrading from Windows NT 3.51

We recommend that you install NT 4.0 in a new directory instead of upgrading your present version. There are some basic precautions that you have to adhere to in order to make your upgrade successful:

1. We recommend that you start by making an ERD (emergency repair disk). This can be done by running `RDISK.EXE` from the `\WINNT\SYSTEM32\` directory. This will keep a safe copy of your user security database as well as all the setting information of your server.

Note: Remember to keep a note of the administrator password when you make the ERD, as you might need it when you restore information from it. Only the administrator password you choose at the time of making the ERD will apply, even if you subsequently change the password.

2. Make a full backup of your server and remember to include the registry information.
3. Make a note of all the installed devices and their hardware settings.
4. Find any device driver diskettes that pertain to adapters installed in your server. If possible, try to establish by checking the time and date stamp of the files if they are newer than any supplied with NT 4.0.
5. Refer to both the Microsoft and IBM hardware compatibility lists. These can be found on the Web. Refer to Appendix A, "Sources of Drivers and Information" on page 147 for the URLs.
6. Make a note of any IP addresses, server name, share names or any other relevant information in case you have to rebuild the server.
7. Start the installation process as described in Chapter 5, "Installing Windows NT Server 4.0" on page 81.
8. Proceed to the point in the installation process where you are asked whether you want to install a fresh copy or you want to upgrade to the newer version. Choose to upgrade.
9. Complete the installation.

3.10 Installation Over the Network

The preferred method of installing Windows NT is by using the installation diskettes and CD-ROM provided by Microsoft. If you are unable to use this method as described in Chapter 5, "Installing Windows NT Server 4.0" on page 81, you could consider the method described below. This method is intended to demonstrate how to install NT from an existing Microsoft NT network server, workstation or Windows 95 device. It should deliver the same results as the method described in Chapter 5, "Installing Windows NT Server 4.0" on page 81, although it is slower.

1. Insert the NT 4.0 CD-ROM disk in a CD-ROM drive that you can connect to from the new server. Alternatively, copy the contents of at least the I386 directory to a server.
2. Share the CD-ROM or data directory where you copied the NT code to to allow the new server to access it.
3. Partition the new server by using the DOS `FDISK.EXE` utility.

Note: Be careful to make sure that you specify the first partition as active; otherwise, you will not be able to boot from it.
4. Format the first partition with the FAT file system using DOS or the Windows 95 `FORMAT /S` command.
5. Install the DOS network client on your server. You can find the DOS client software on the NT Installation CD, in the `\CLIENTS\` directory.
6. Reboot the new server and log on to the network.
7. Connect to the CD-ROM drive or directory in the existing server using the `NET USE` command, for example:

```
NET USE * \\BIGMOTHER\I386
```

This will connect the first available drive letter to the I386 share located on the specified server.

8. From the shared drive, enter the command `WINNT /B`. This will start the installation process by copying the NT code across the network to your local disk.
9. Once the copying process is complete, NT 4.0 will modify the boot partition. The server will reboot and the installation process continues.

Chapter 4. Installation Using ServerGuide 3.0

ServerGuide is a set of CD-ROMs containing installation tools and code designed to aid users to install their operating systems with a minimum of effort. It is included with all new IBM PC Servers.

The current version, ServerGuide 3.0, aids the installation of all major operating systems and either provides the encrypted operating system code for use after the purchase of the encryption key, or it aids the installation of the (customer-supplied) retail version of the operating system.

ServerGuide 3.0 provides encrypted versions of the following:

- OS/2 2.11 SMP
- LAN Server 4.0 Entry
- LAN Server 4.0 Advanced
- Windows NT Server 3.51
- NetWare from IBM Version 3.12
- NetWare from IBM Version 4.1
- NetWare from IBM Version 4.1 SMP
- SCO Open Server 5.0.2 Enterprise System
- SCO SMP Extensions

ServerGuide 3.0 provides aids in the installation of the following customer-supplied retail packages:

- OS/2 2.11 SMP
- OS/2 Warp Server Version 4
- OS/2 Warp Server Advanced Version 4
- Windows NT Server 3.51
- Windows NT Server 4.0
- NetWare from IBM Version 3.12
- NetWare from IBM Version 4.1
- NetWare from IBM Version 4.1 SMP
- NetWare Version 4.11
- SCO Open Server 5.0.2 Enterprise System

In addition, ServerGuide 3.0 provides the following products and installation tools at no additional charge:

- Lotus Notes Release 4.1
- Lotus Internotes Publisher
- IBM AntiVirus Desktop Edition Version 2.5
- APC PowerChute plus
- TME 10 NetFinity Manager and Services Version 4.0
- AutoPilot
- Book Factory
- Diskette Factory

This redbook discusses the installation of Windows NT Server 4.0.

4.1 ServerGuide 3.0 and NT 4.0

For the purposes of this document, this chapter concentrates on the aspects of ServerGuide 3.0 as it pertains to the installation of Windows NT Server 4.0.

For the installation of NT 4.0, ServerGuide provides assistance building driver diskettes for the various IBM products and the installation diskettes for Windows NT. However, you will have to make sure that the drivers that you create from the ServerGuide CD-ROM are newer than those provided with the product. You can do this by checking their time and date stamps.

Essentially the Windows NT installation diskettes created by ServerGuide are the same as the disks supplied in the NT 4.0 CD-ROM retail packaging. If you have all the necessary driver diskettes available for the hardware that you are installing, you can proceed directly to Chapter 5, "Installing Windows NT Server 4.0" on page 81, which covers the installation process.

Note

The NT 4.0 code is not included in CD-ROM disks that are included in the ServerGuide 3.0 package. You will have to supply a commercial version to install NT 4.0.

4.2 Starting ServerGuide

Make sure that the write protect tab of the ServerGuide boot diskette is set to write enable. ServerGuide needs to write to the diskette from time to time to store information about your configuration and choices across reboots.

Write Protect Tab

If the write protect tab on the ServerGuide startup diskette is set to the write protect position, the server will continuously reboot and ServerGuide will not start. Ensure the diskette is write enabled.

To start ServerGuide, perform the following steps:

1. Insert the ServerGuide boot diskette.
2. Place the CD-ROM marked Main in the CD-ROM drive.
3. Power up or reboot the server.

Server Reboots

During this initial phase of ServerGuide, your server may reboot once or twice. This is normal. These reboots are necessary as ServerGuide adds a partition to your drive to accommodate the code it temporarily installs to control the process.

4. Choose a language.

The first panel to be displayed after the booting process completes is the one to select your keyboard and language, as shown in Figure 47 on page 73.

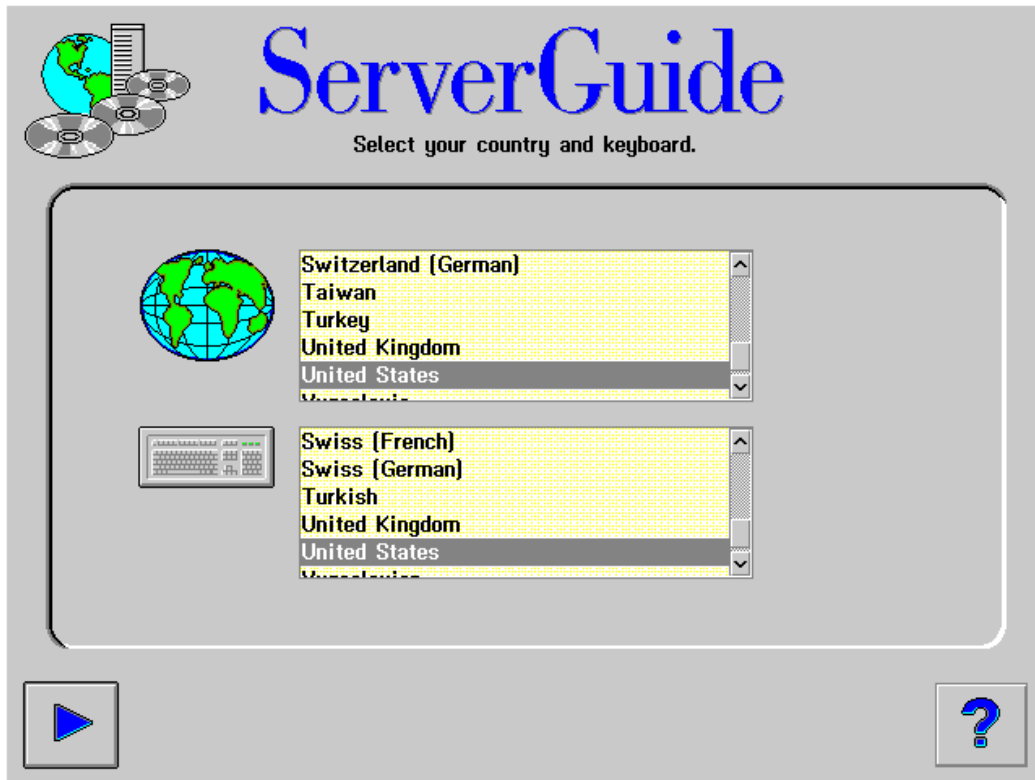


Figure 47. ServerGuide 3.0 Country and Keyboard Selections

Select your country and keyboard; then on the following panel, confirm these choices.

Note: ServerGuide will now perform a hardware detection function to determine which IBM components are installed in the server.

- At this point, the main menu is displayed (Figure 48 on page 74).

4.3 ServerGuide Main Menu

From the main menu (Figure 48 on page 74), you can select a number of different options:

- **Read Me**

This displays some further information about ServerGuide 3.0. It describes how to recreate your ServerGuide diskette should it be damaged, machine requirements for installation using ServerGuide, and any particular restrictions for each operating system including unsupported IBM adapters. It is recommended that you review the README file before you start.

Note: The README file can be viewed on a separate OS/2 machine directly from the main CD-ROM by issuing the command (where x: is your CD-ROM drive):

```
view x:\mri\en\readme.inf
```

- **Overview**

This option introduces you to ServerGuide, and explains what functions it can perform to help you install your operating systems.

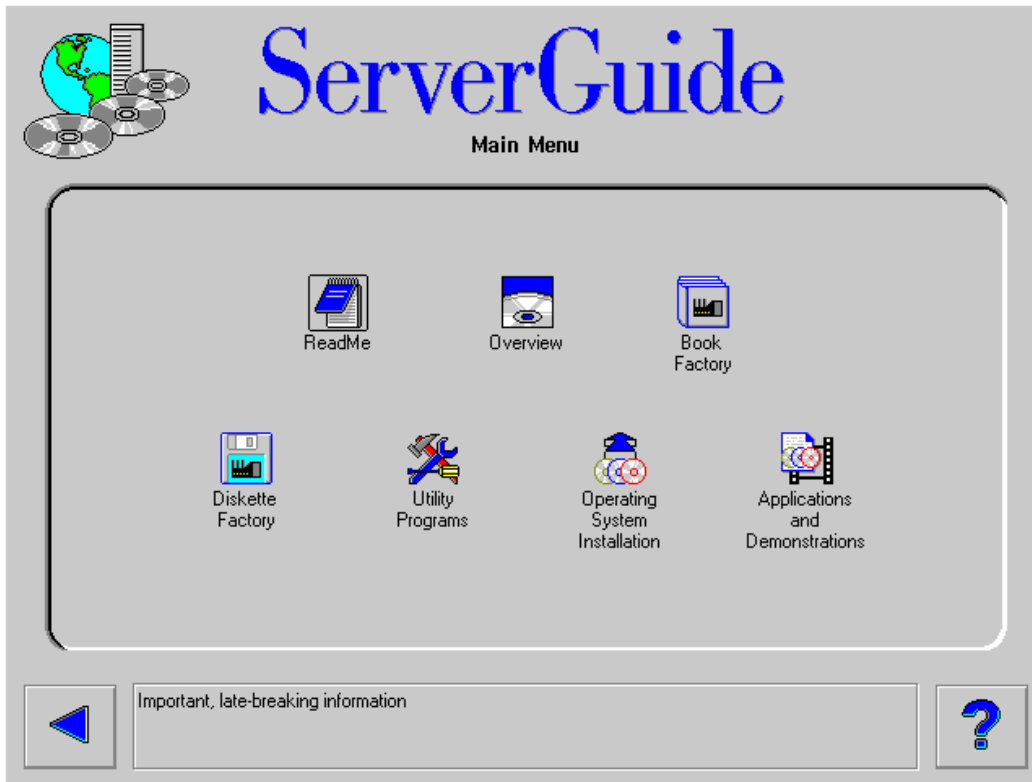


Figure 48. ServerGuide 3.0 Main Menu

- **Book Factory**

From here, you can view online or print (in PostScript format) any of the following:

- Manuals that came with your IBM PC Server
- The TME 10 NetFinity publications
- The various integration guides, including the previous version of this book
- The PC Server Selection Guide

- **Diskette Factory**

This lets you create reference, driver, diagnostic and utility diskettes for your hardware and operating system. You can select diskettes suitable for your PC Server (which ServerGuide automatically detects), diskettes for IBM and some non-IBM adapters, and diskettes to install IBM AntiVirus, and TME 10 NetFinity.

- **Utility Programs**

From here, you can:

- View your hardware configuration using the System Information Tool.
- Perform RAID administration on your SCSI RAID subsystem using TME 10 NetFinity's RAID Administration.
- Start AutoPilot to guide you through the process of configuring your server in preparation for operating system installation. AutoPilot is discussed in more detail in 4.3.2, "AutoPilot" on page 76.

- **Operating System Installation**

Here you can install any of the supported operating systems using either your own license or an activation key purchased from IBM.

For NT 4.0, you can use your own license code only; an activation key is not available for this version. You will then be prompted to insert your retail CD-ROM (US version only) to verify your license before ServerGuide will create your custom installation diskettes. Blank diskettes are provided for this use.

- **Applications and Demonstrations**

This option shows product demonstrations on APC PowerChute and SCO OpenServer as well as instructions on how to install the Lotus Notes 4.1, Lotus Notes InterNotes Web Publisher, IBM AntiVirus and APC PowerChute and TME 10 NetFinity.

4.3.1 CoPilot

ServerGuide CoPilot is a facility to install the additional software that is provided in the ServerGuide package. CoPilot can be started by running \SCW95.EXE from the CoPilot CD-ROM #1 (SCW95.EXE works for Windows NT as well as Windows 95).

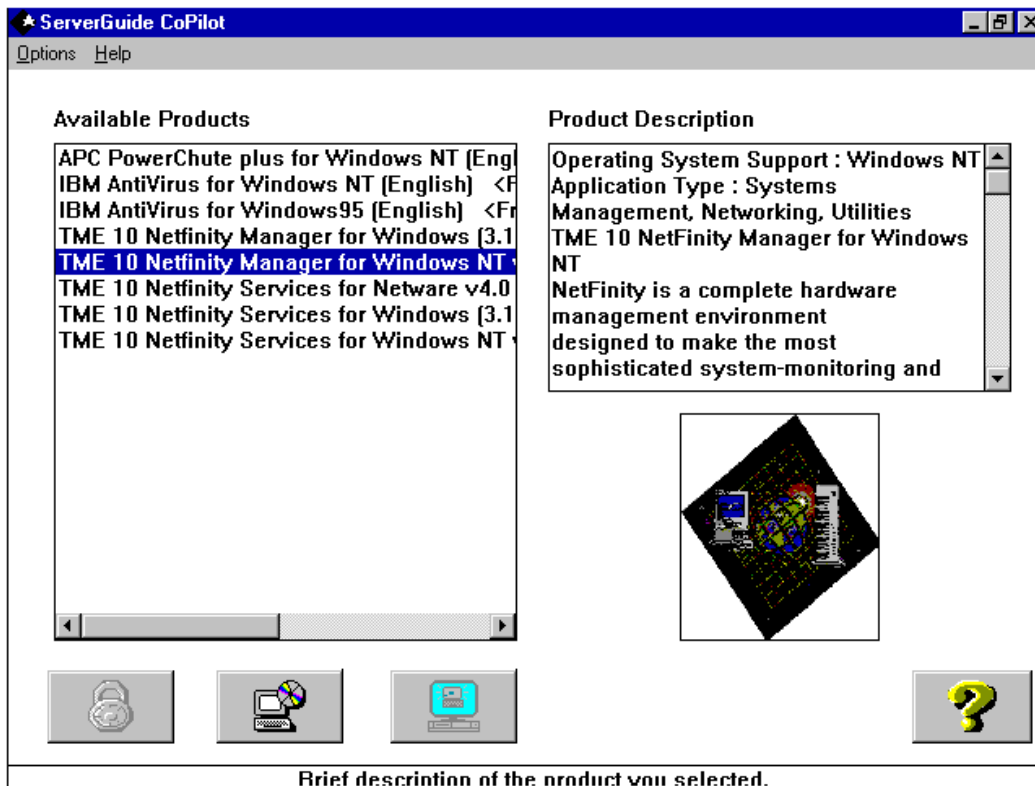




Figure 49. ServerGuide 3.0 CoPilot

The CoPilot utility is shown in Figure 49. By selecting the appropriate product you wish to install on this machine, and clicking on the install button (), the install utility for that product will start.

For APC PowerChute, you can also view a demonstration of the product by clicking on the demonstration button ().

Note: The demonstration button is only active when there is a demo to show for that particular application.

4.3.2 AutoPilot

AutoPilot lets you learn about ServerGuide and then be guided step-by-step through the hardware configuration of the server. It includes checking (and if necessary updating) the BIOS level, configuring the adapters, and configuring the disk arrays. At each stage, the server online documentation is available for reference.

AutoPilot will display some of the following choices. An example of this is shown in Figure 50.

- ServerGuide overview
- RAID configuration (when a RAID adapter is detected in your system)
- Micro Channel configuration (when detected)
- EISA configuration (when detected)
- Flash BIOS update (when the update is available)



Figure 50. ServerGuide 3.0 AutoPilot

Many of the options will help you create the appropriate diskettes and then request that you reboot the server to perform the action.

4.4 Installing Windows NT Using ServerGuide

ServerGuide aids your installation by helping you build the necessary diskettes for use during the installation process. To install Windows NT using ServerGuide 3.0, perform the following steps:

1. From the main menu, select **Operating System Installation**.

2. The list of supported operating systems is shown. Click on **Microsoft Windows NT Server**.
3. The panel shown in Figure 51 appears.



Figure 51. Selecting NT 4.0 from ServerGuide 3.0


Notice that Transfer License from retail package option is the only option available. ServerGuide 3.0 only supports installing NT 4.0 from the retail version of the code supplied by you.

4. Select Installed Adapters

ServerGuide 3.0 automatically detects what hardware you have installed in your server. For our test Server 320, Figure 52 on page 78 is displayed. If your network adapter is not listed, continue with the installation. The drivers required may either be part of the NT 4.0 CD-ROM or they may be on the Web. See Appendix A, "Sources of Drivers and Information" on page 147 for information about suitable Web sites.

Notes:

- a. If your hard disk adapter is not listed and the adapter does not have a problem, then you may not be able to use ServerGuide to install NT 4.0.
- b. ISA network adapters cannot be detected by ServerGuide 3.0.

Once you are satisfied with this panel, click on the forward button () to continue with the installation.

5. A message box now appears saying:

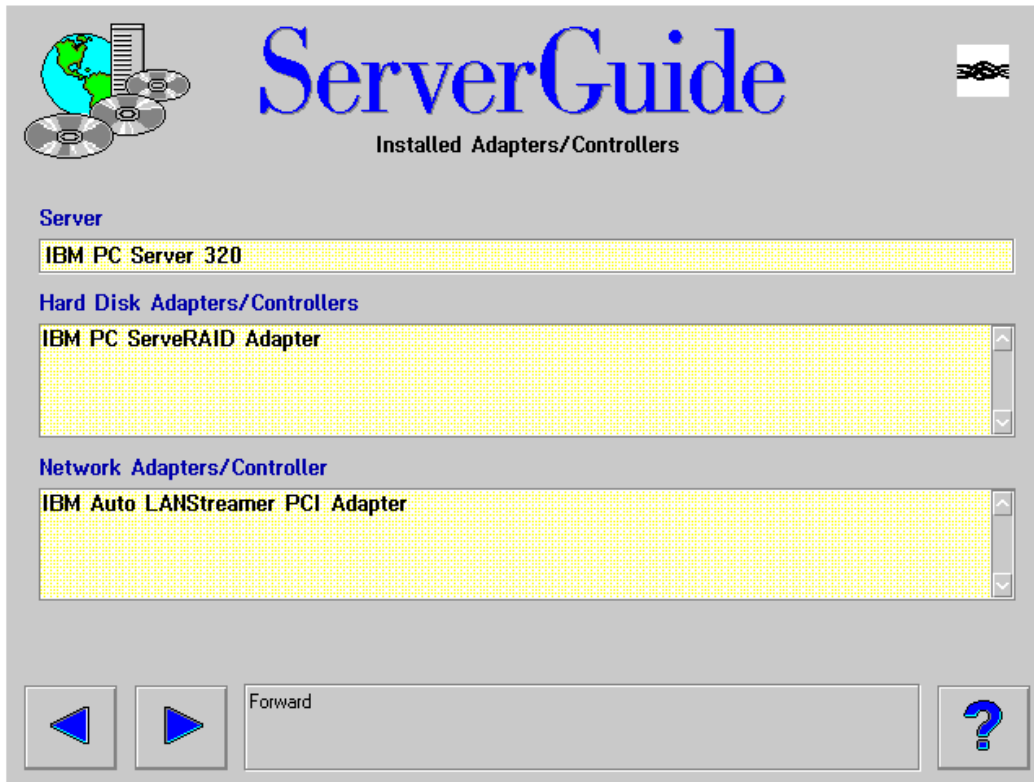


Figure 52. ServerGuide 3.0 Installed Adapters/Controllers. ServerGuide automatically detects what adapters you have installed. This figure shows the result on our test Server 320.

If your Network Adapter is not listed under Optional Diskette Packages, your CD includes the latest device drivers (or you have an adapter requiring manual configuration).

If your adapter is listed, create the diskette package to ensure you have the latest device drivers provided with ServerGuide. Click on ? for more information.

Click on **OK** to remove this message box to display the diskette packages.


6. A listbox now appears showing recommended diskette packages and optional diskette packages. Select the ones you want to build.

For our test Server 320, Figure 53 on page 79 is displayed. The optional diskette packages may include drivers that are at a later level than those supplied on the NT 4.0 CD-ROM.

Note: Packages such as TME 10 NetFinity can be installed directly from CD-ROM onto your server without the use of diskettes by using the CoPilot installation utility. Refer to 4.3.1, "CoPilot" on page 75 for more information.



Figure 53. ServerGuide 3.0 Installation Diskette Packages. The Setup Diskettes package contains the three boot diskettes for NT 4.0. The TME 10 NetFinity package contains diskettes for TME 10 NetFinity Manager.

7. If you wish to build any of the packages, ensure they are selected. Then press the forward button () to continue.

You will then be given the opportunity to de-select any specific diskettes within the packages. After clicking on the forward button, you will be prompted to insert appropriate CD-ROMs and insert successive blank diskettes into your diskette drive to create the diskettes. Write the appropriate label information on each diskette for future reference.

Note: Some diskette packages (for example, the NT 4.0 Setup Diskettes) require that the diskettes be blank as well as formatted prior to being used in the process. You may need to use another computer to prepare the diskettes you wish to use.

8. Insert the NT 4.0 Setup Boot Disk and click on the forward button to begin the NT 4.0 installation.

Your server reboots and the installation process continues at Chapter 5, “Installing Windows NT Server 4.0” on page 81.

Note: If you wish to go back and create other diskettes you can click on the backward button.

Chapter 5. Installing Windows NT Server 4.0

This chapter describes the installation of Windows NT Server 4.0 using the commercially available version of the software. The installation process will be specified in general terms that relate to all IBM PC server models. Any information relating to specific models of the server range are noted.

5.1 IBM Servers Used

We tested this installation process with the full range of currently available IBM PC servers with various combinations of the following devices:

- SCSI adapters
 - Integrated SCSI-2 Ultra F/W controller
 - IBM PCI SCSI-2 F/W RAID adapter
 - IBM ServeRAID adapter
 - IBM Streaming RAID adapter/A
- SCSI drives
 - 3 x 2.25 GB drives in a non-RAID setup
 - 3 x 2.25 GB drives configured as one RAID-5 array
- NIC adapters
 - Integrated AMD Ethernet controller
 - PCI Auto LANStreamer

5.2 Pre-installation Checklist

You should ensure you have done the following before you start:

- Prepared your RAID array and initialized all logical drives created using the RAID administration utility provided with the server.
- Partitioned your logical drives. We recommend certain configuration parameters, as discussed in 3.6, "Disk Partitioning" on page 66.
- Checked that you have all the necessary device driver diskettes ready or can access them from another computer if required.
- Checked that you have the Install from CD-ROM installation diskettes and not the Install from Network installation diskettes. To build the correct diskettes from the Windows NT CD-ROM, run the command `WINNT /OX` from DOS, or `WINNT32 /OX` from an existing Windows NT machine.

Note: Read Chapter 3, "Pre-installation Considerations" on page 61 for some helpful hints.

5.3 Installing NT 4.0

The installation process is divided into two components:

1. Hardware setup
2. Software/network setup

The first component is text-based and asks you to make selections, such as hardware, disk controller, Hardware Abstraction Layer (HAL), and any partitioning that you may require. The second component, following a reboot, sets up the software options and builds the networking environment for this machine.

5.3.1 Starting the Process

Insert the NT 4.0 installation diskette 1 in drive A: and the NT 4.0 CD-ROM in your server's CD-ROM drive, and boot the server. When prompted, remove diskette 1 and insert diskette 2. At the bottom of your panel, a message is displayed indicating the progress of files loading and the files currently being loaded.

Note

If your system error traps (a blue panel is displayed with error codes) after loading the FAT file system, it is highly probable that your server is infected with a boot sector virus. Use a commercial anti-virus application to disinfect your server before continuing.

The Windows NT kernel starts and the initial setup panel appears (see Figure 54).

```
Windows NT Server Setup
=====
Welcome to Setup.

The Setup program for the Microsoft(R) Windows NT operating system
version 4.0 prepares Windows NT to run on your computer.

* To learn more about Windows NT Setup before continuing, press F1.
* To set up Windows NT version 4.0 now, press ENTER
* To repair a damaged Windows NT version 4.0 installation, press R.
* To quit Setup without installing Windows NT, press F3.

ENTER=Continue  R=Repair  F3=Exit
```

Figure 54. Initial Setup Panel

If you are re-installing Windows NT, press R; otherwise press Enter to continue. Windows NT now attempts to detect any standard floppy controllers, as well as any hard disk controllers and devices attached to it.

5.3.2 Choosing a Disk Controller

The disk controller chosen is critical because NT will not function if the wrong one is chosen.

Tip

Check the location (path) of the device drivers on the diskettes supplied by the manufacturers before you start the installation process, as you will not have the opportunity during the next section of the installation process.

NT 4.0 setup displays the following panel (Figure 55 on page 83):

```
Windows NT Server Setup
=====

Setup automatically detects floppy disk controllers and standard
ESDI/IDE hard disks without user intervention. However on some
computers detection of certain other mass storage devices, such as
SCSI adapters and CD-ROM drives, can cause the computer to become
unresponsive or to malfunction temporarily.

For this reason you can bypass Setup's mass storage device detection
and manually select SCSI adapters, CD-ROM drives, and special disk
controllers (such as drive arrays) for installation.

* To continue, press ENTER.
  Setup will attempt to detect mass storage devices in your
  computer.

* To skip mass storage device detection, press S.
  Setup will allow you to manually select SCSI adapters,
  CD-ROM drives, and special disk controllers for installation.

F3=Exit  ENTER=Continue  S=Skip Detection
```

Figure 55. Selecting a Disk Controller During Installation

Streaming RAID Adapter

In the Server 720 and Server 500, the Micro Channel SCSI-2 Streaming RAID Adapter/A may not be correctly recognized by Windows NT. The symptoms are that the operating system cannot find the CD-ROM drive.

The solution is to press S to skip detection of disk controllers and when prompted insert the Driver/Configuration diskette in the drive to select "IBM RAID Controller" instead.

See Appendix A, "Sources of Drivers and Information" on page 147 for information on where to get the latest driver diskettes.

Press Enter to continue. Setup asks you to insert setup diskette 3 to continue the device detection and installation process. At the bottom of the setup panel, the device drivers currently being loaded is shown. Each detected adapter or device is shown. For the PC Servers 325, 330 and 704, the panel shown is similar to Figure 56 on page 84.

If the disk controllers that Windows NT detects are all the ones you have in your server, press Enter to continue and proceed to 5.3.5, "System Analysis" on page 88.



Figure 56. Disk Controllers Detected During Installation. This panel applies to the PC Servers 325, 330 and 704; other servers are similar.

5.3.3 Specifying Additional Adapters

If the listed disk controllers do not include all the disk controllers in use in your server, continue on here; otherwise skip to 5.3.5, “System Analysis” on page 88.

There are two major reasons why your disk controller may not have been automatically detected:

1. You have more than one controller (for example, an integrated controller and an adapter in a slot) and the controller detected was not the one you have your disks attached to.
2. You have an adapter for which the driver required was not included on the NT 4.0 CD-ROM (for example, the ServerRAID adapter).

In either instance, you will need to press S when the panel shown in Figure 56 is displayed.

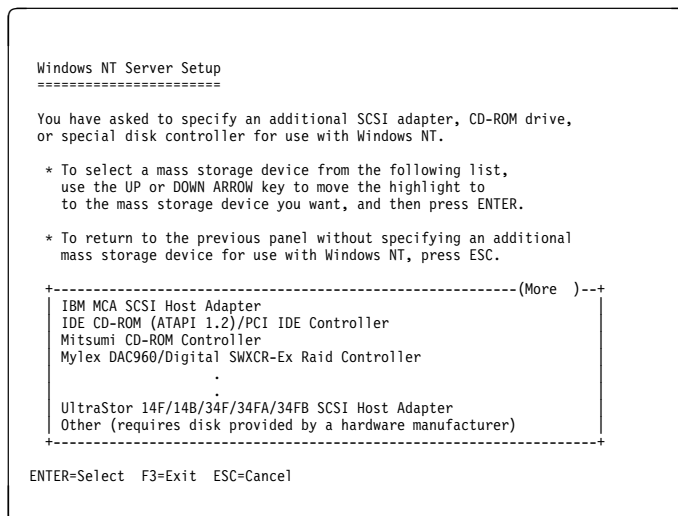


Figure 57. Installing Additional Disk Controllers

Select the appropriate adapter and press Enter. If the adapter you are using or the device is not listed on the panel shown above, select the following option:

Other (requires disk provided by a hardware manufacturer)

After selecting this option, the system will prompt you to insert the Manufacturer-supplied hardware support disk into the diskette drive. This will usually be supplied with the adapter. If it is an IBM adapter, the diskette will be available from the ServerGuide Diskette Factory, or from the IBM PC Company Web site. Refer to Appendix A, "Sources of Drivers and Information" on page 147 for more information on where to get drivers.

If the diskette supplied has the correct files, the following window will be displayed (Figure 58):

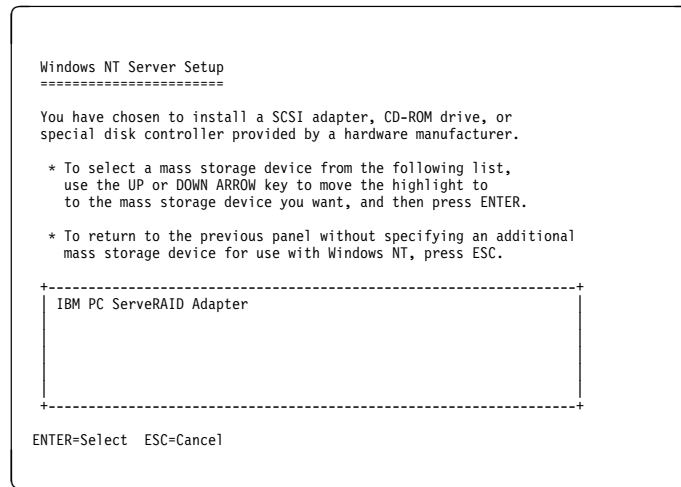


Figure 58. Installing Drivers from Diskette

Select the adapter you have installed in your server (in this example, the IBM PC ServeRAID adapter), and press Enter.

Setup then returns you to the panel showing all the currently selected adapters (Figure 59 on page 86). You may repeat the process in selecting additional adapters until you have finished the mass storage device selection process.

```
Windows NT Server Setup
=====

Setup has recognized the following mass storage devices in your
computer:

Adaptec AHA-294X-394X/AIC-78XX SCSI Controller
IBM PC ServeRAID Adapter

* To specify additional SCSI adapters, CD-ROM drives, or special
disk controllers for use with Windows NT, including those for
which you have a device support disk from a mass storage device
manufacturer, press S.

* If you do not have any device support disks from a mass storage
device manufacturer, or do not want to specify additional
mass storage device for use with Windows NT, press ENTER.

S=Specify Additional Device  ENTER=Continue  F3=Exit
```

Figure 59. Listing All Recognized Disk Adapters (Detected and Selected)

If all the required adapters and devices are displayed, then press Enter to continue; otherwise press S and to repeat the mass storage device selection process as shown above.

5.3.4 Potential Errors Detecting Disk Controllers

There are typically two possible reasons why unexpected messages occur at this point:

1. No controllers or the wrong disk controllers listed.

If you have additional or other mass storage device adapters installed in your server, you should supply any driver diskette supplied by the manufacturers; otherwise, the installation process could fail. In addition, it is a good idea before starting the installation process to check the location (path) of the device drivers on the diskette.

Some manufacturers provide the drivers and the OEMSETUP.INF file on the diskette's root directory, others in a subdirectory usually called NT for the Windows NT device drivers.

2. Incorrect installation diskettes used.

There are two possible sets of three installation diskettes that can be built by running a program from the CD-ROM:

- a. "Install from CD-ROM" diskettes, using the command WINNT /OX
- b. "Install from Network" diskettes, using the command WINNT /X

In this section, we are installing from the NT 4.0 CD-ROM, so the command WINNT /OX (or WINNT32 /OX if running it from an existing Windows NT system) should be used. If you use the /X switch when you wish to install from the CD-ROM, the following two error panels are likely to occur at this point (see Figure 60 on page 87 and Figure 61 on page 87).

```
Windows NT Server Setup
=====

Setup has determined that your computers startup disk is new or has
been erased, or that an operating system is installed on your computer
with which Windows NT cannot coexist.

If such an operating system is installed on your computer, continuing
Setup may damage or destroy it.

If the hard disk is new or has been erased, or you want to discard its
current contents, you can choose to continue Setup.

. To continue Setup, press C. WARNING: Any data currently on your
  computer's startup hard disk will be permanently lost.

. To exit Setup, press F3

C=Continue Setup F3=Exit
```

Figure 60. Detecting Freshly Configured Arrays

After pressing C, the following panel will appear (see Figure 61):

```
Windows NT Setup
=====

Setup is unable to locate the hard drive partition prepared by the
MS-DOS portion of Setup.

When you run the MS-DOS Windows NT Setup program, you must specify a
temporary drive that is supported by Windows NT. See your System Guide
for more information.

Setup cannot continue. Press F3 to exit.

F3=Exit
```

Figure 61. Setup is Unable to Locate MS-DOS Partition

These panels appear because the incorrect command line parameters were used when the installation disks were created for the CD-ROM installation. You have boot-up diskettes that have been created using the /X or command line parameters. These startup diskettes fail at this point because they are expecting the installation process to have been started from a network drive or directly from the CD-ROM after booting from DOS. If started in this fashion, Windows NT creates two temporary directories on the temporary partition and expects to be able to access the hard drives where the temporary installation files have been transferred to. At this point, Windows NT has not loaded the device drivers needed to access the RAID controller. To overcome the problem, recreate the installation disks. The correct syntax is WINNT /OX from a DOS prompt or WINNT32 /OX while running NT 3.5 or later. This will correct the problem in most cases when the installation process is restarted with the freshly created installation disks.

On the Windows NT Server Setup panel, press Enter if this information is correct, or S to specify additional devices or adapters that you have in your server. You will

need to provide the driver diskette when prompted. If you pressed S, continue reading. If you pressed Enter, go to 5.3.5, "System Analysis" on page 88.

5.3.5 System Analysis

At this point, all of the disk controllers should have been specified, either automatically detected by Windows NT, or manually selected by you. The setup program will now continue the installation process.

Windows NT will then load the required device drivers and the file system (NTFS) drivers.

You may see the panel shown in Figure 62. This will appear if you have any disks (or logical disks as defined in the RAID configuration) that are larger than 1024 cylinders (approximately 528 MB). Press Enter to continue. In most cases you can ignore this message and Windows NT will work correctly with the IBM disk controllers that it supports.

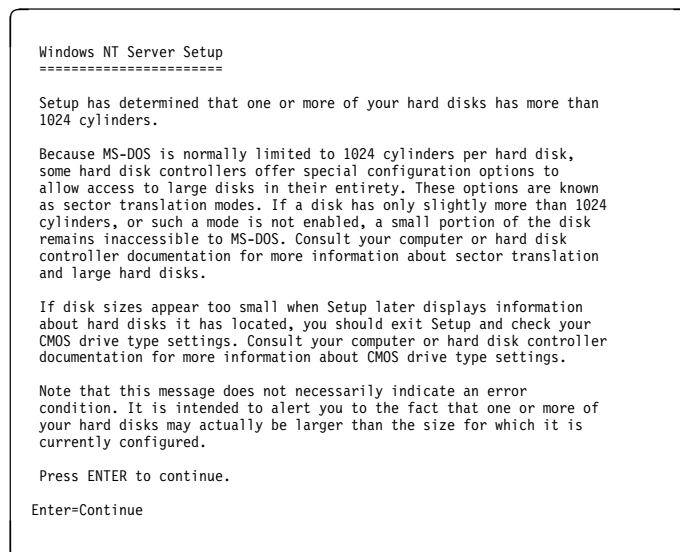


Figure 62. Disks Larger Than 1024 Cylinders

As this may be the first installation, your hard disks may need to be partitioned and/or formatted. You will see the display shown in Figure 63 on page 89. Press C to continue.

RAID Arrays and Logical Drives

Remember, when using drives attached to an IBM RAID controller, the physical drives are combined into a RAID array. Within this array, you can specify how much of the total available (drive array) disk space will be assigned to a certain RAID level (RAID-0, -1 or -5). This particular disk space is called a logical drive. However, this logical drive is presented by the RAID controller as a single disk drive to Windows NT. This (logical) drive needs to be partitioned and formatted in the same fashion as any other disk drive.

```
Windows NT Server Setup
=====

Setup has Determined that your computer's startup hard disk is new
or has been erased, or that an operating system is installed on your
computer with which Windows NT cannot coexist.

If such an operating system is installed on your computer; continuing
Setup may damage or destroy it.

If the hard disk is new or has been erased, or you want to discard
its current contents, you can choose to continue Setup.

* To continue Setup, press C. Warning: Any data currently on
  your computer's startup hard disk will be permanently lost.

* To exit Setup, press F3.

C=Continue Setup   F3=Exit
```

Figure 63. Unformatted or Unsupported Operating System Already Installed

Setup displays the Windows NT Licensing Agreement. Please read it carefully and make sure you do not violate any terms or conditions of this licensing agreement. Use the Page Down key to scroll through the licensing conditions and press F8 to comply and to continue with the NT 4.0 installation.

5.3.6 Basic Configuration and HAL Options

The next panel shown in Figure 64 is where you define the basic configurations of your server. For example at this point you can choose to install your server as either a uni- or multiprocessor system. You can also specify what kind of display is attached, the type of keyboard, its layout, and so on. Each option may be selected and modified according to the type and configuration of your server.

```
Windows NT Server Setup
=====

Setup has determined that your computer contains the following
hardware and software components:

    Computer: MPS Multiprocessor PC
    Display: Auto Detect
    Keyboard: XT, AT, or Enhanced Keyboard (83-104 Keys)
    Keyboard Layout: US
    Pointing Device: Microsoft Mouse Port Mouse (includes Ball Point)

    No Changes: The above list matches my computer.

If you want to change any item in the list, press the UP or DOWN
ARROW key to move the highlight to the item you want to change.
Then press ENTER to see alternatives for that item.

When all items in the list are correct, move the highlight to
"The above list matches my computer" and press ENTER.

ENTER=Select   F3=Exit
```

Figure 64. Initial Hardware Configuration

5.3.7 Selecting the Correct HAL

Now you need to select the correct Hardware Abstraction Layer (HAL) code. Refer to Appendix E, "The Hardware Abstraction Layer (HAL)" on page 159 for a discussion about the HAL.

Select the **Computer** option and press Enter. The panel in Figure 65 will be displayed.

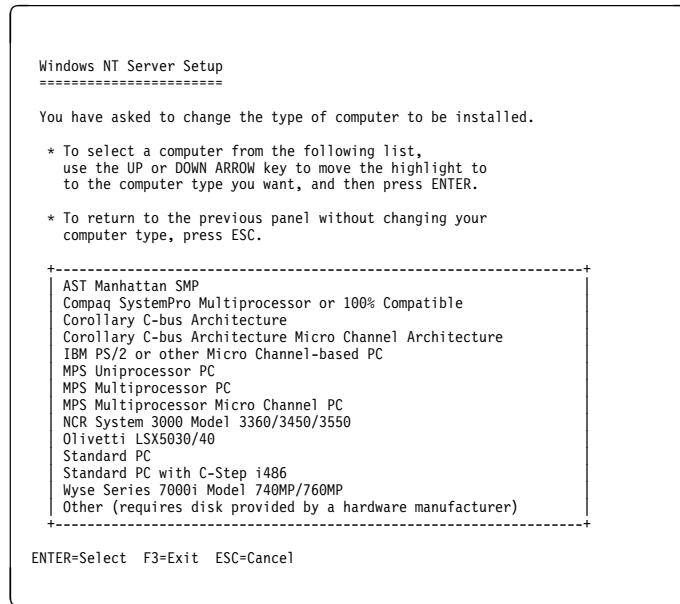


Figure 65. Selecting the HAL

You are now presented with a list of Hardware Abstraction Layer choices. Table 4 lists the appropriate HAL choices for each server.

PC Server	Recommended "computer type"
310	Standard PC
320	MPS Multiprocessor PC
325	MPS Multiprocessor PC
330	MPS Multiprocessor PC
520	MPS Multiprocessor PC
704	MPS Multiprocessor PC
720	Corollary C-bus Architecture Micro Channel Architecture

It is also recommended that you use any IBM-supplied HAL diskette if it is more current than the one supplied with the NT 4.0 CD-ROM. To confirm which version of the HAL is more current, check the time/date stamps on the files on the diskette and compare them to the equivalent files on the CD-ROM.

Note: The files on the CD-ROM may be compressed and may have different file extensions that indicate they are compressed.

Change the default selections as appropriate. To continue the installation process, select **The above list matches my computer** and press Enter to continue.

5.3.7.1 Multiprocessor Capable Machines

If your server is multiprocessor capable, but it is currently equipped with one processor only, setup will detect a single processor and thus select the **MPS Uniprocessor PC** option. However, it is strongly recommended that you change this selection to **MPC Multiprocessor PC**. Windows NT will also support a single processor even though the multiprocessor kernel is loaded.

If you intend to upgrade your system later with a second processor, all you need to do is to shut down and power off your server, install the second processor and then reboot your server. Windows NT automatically recognizes the existence of a second processor and will activate it during the boot process.

If you don't select the **MPC Multiprocessor PC** option during the initial NT 4.0 installation process, you need to use the multiprocessor upgrade utility that is supplied with the resource kit (it is often not successful). Alternatively, you will have to reinstall Windows NT in order to provide multiprocessor support.

Note: Refer to Appendix E, "The Hardware Abstraction Layer (HAL)" on page 159 for details on how to use the multiprocessor upgrade utility.

5.3.8 Partitioning

We recommend that you partition your disk prior to commencing the installation process, as discussed in 3.6, "Disk Partitioning" on page 66. If you have followed the recommendations, a panel similar to the one in Figure 66 on page 92 will appear. However, it will show the partition you created plus any unpartitioned (free) space left on the disk. You can press Enter and continue with 5.3.9, "Formatting" on page 93.

If you have not partitioned your disk, you can do so now. We recommend that you create only one partition at this stage, as we have found that creating more than one partition may hang Windows NT during the installation process. You can define all other partitions using Disk Manager once the installation is complete. Figure 66 on page 92 shows the display of a logical disk under the control of the IBM ServeRAID RAID adapter.

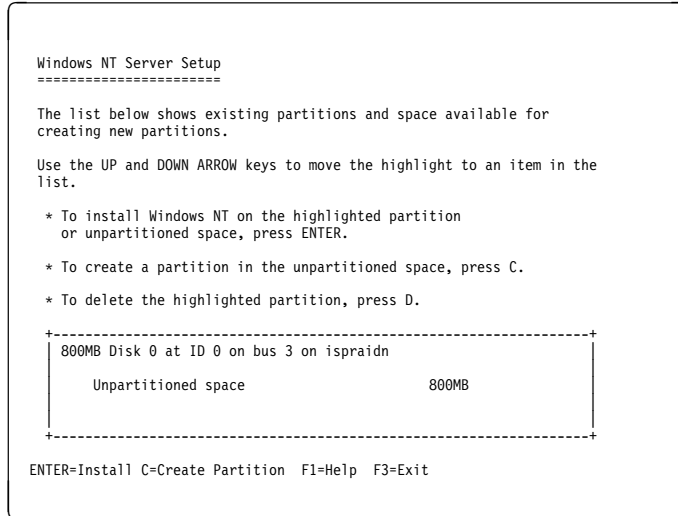


Figure 66. Selecting the Installation Partition

The display shown in the window above can be interpreted as follows:

- Total disk capacity: 800 MB
- It is the first disk: Disk 0
- SCSI ID: 0
- SCSI Bus#: 3 (the third channel of the ServeRAID controller)
- Adapter device driver: ISPRAIDN (the driver for the ServeRAID adapter)

Press C to create a new partition. A panel similar to the one in Figure 67 appears.

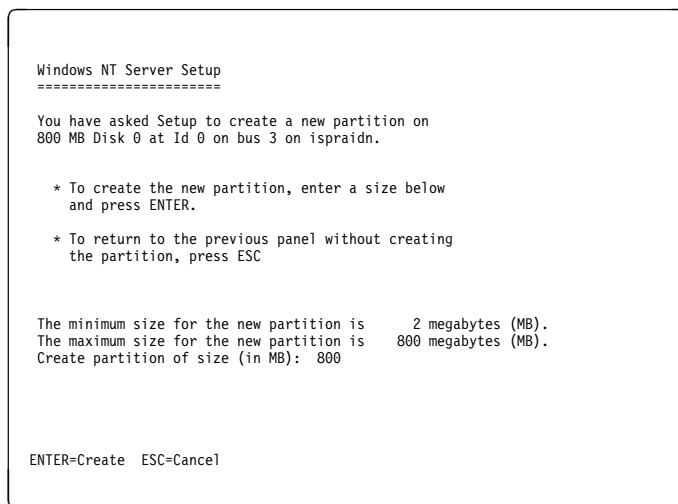


Figure 67. Creating a New Partition

Windows NT setup assumes by default that only one partition of the maximum available size will be created. Specify the size of the partition you want to create or accept the default by pressing Enter.

Note: We recommend certain configurations when creating Windows NT system partitions. Please refer to 3.6, “Disk Partitioning” on page 66 for our recommendations.

You will then be returned to the panel depicted in Figure 66.

Select the partition on which to install NT 4.0 (recommended) or press C to install more partitions (not recommended!).

5.3.9 Formatting

Setup gives you the option of formatting the partition in a FAT format or the NTFS format. Our recommendation for non-C2 installations is that you format the partition as FAT. Refer to 3.6, "Disk Partitioning" on page 66 for more information. Select the file system you require and press Enter.

Specify the directory on your disk into which setup is to install NT 4.0. You may either accept the default of \WINNT, or you may type in the directory name of your choice and press Enter. We recommend that you accept the default.

Setup checks the disks for corruption. A panel now appears asking if you wish to allow setup to perform a more exhaustive secondary examination of your disks. If you are using a RAID controller, you may skip this step by pressing Esc because the initialization process performed by the controller in setting up the logical drives is sufficient.

If you are not using a RAID controller, we recommend that you allow setup to perform the analysis, as this will reduce the risk of data corruption caused by faulty disk drives.

As requested, re-insert any manufacturer-supplied driver diskettes such as the IBM PC ServeRAID Adapter diskette.

5.3.10 File Transfer

Windows NT Setup copies all required files from the CD-ROM to your hard disk. A progress indicator shows the file copy operations. Once it completes, the server reboots and the installation process continues.

As requested, remove both the diskette and the CD-ROM disk before pressing Enter to reboot the server. If the server fails to reboot, power off the machine, wait a couple of seconds and then power it back on again.

Once the server reboots, it will be in a graphical mode and the NT 4.0 Setup Wizard will guide you through the software and network installation phases.

5.4 If Your Server Fails to Restart

If your server does not start at this point and keeps on entering the diagnostic mode, also called the *blue screen of death*, you most probably have a device driver that is failing.

Analyze any error messages to determine where to start checking for errors. When the blue screen is displayed, it shows the order of device drivers loaded; the last driver shown is probably the one that has failed. The adapter that uses the failed driver is a good place to start checking hardware settings.

If you are convinced that your hardware settings are correct, download the latest version of the driver in question from the hardware supplier. See Appendix A, "Sources of Drivers and Information" on page 147 for sources of drivers on the Web.

5.5 Gathering Information

After the computer restarts and setup initializes, you are asked to enter your name, organization, and the CD key for the CD-ROM you have. You will then select which licensing mode you wish to use.

If you have more than one server being accessed by the majority of the users, the per seat licensing mode is possibly the more advantageous option. A typical example would be where you have separate SQL, exchange, application, SMS and data servers being accessed by 80% of your users concurrently. If you have departmental or single multipurpose servers, you could gain a cost benefit by using the per server licensing mode. With the per server mode you could limit the amount of concurrent user access to the server.

Note: You have the option to change the mode later but you may only do this once during the lifetime of the server.

If you used the default (per server), enter the required number of concurrent connections to this server.

5.5.1 Naming the Server

Enter the name you want to assign to this server.

This name identifies this server on the network and it has to be unique on the network. Put some thought into naming your servers, as it will save you a lot of duplication and effort during the life cycle of your network. You have the option to change the name of the server later but some of the server-based applications that you will install are dependent on the server name when they are operating. These applications will cause you endless pain and effort if you want to change their settings.

The name must be unique. You will not be allowed to use a name that is the name of an existing domain in your network.

Note: Avoid using the name you intend to assign as the domain name later in the process, as you will run into some obstacles when you reach that phase of the process.

5.5.2 Selecting the Server Type

At this point you will be asked to select the server type. Setup gives you three choices:

1. Primary domain controller (PDC)

Depending on the design of your network, you may have one or more domains. For each domain, you will have only one primary domain controller, which will have a unique domain name (as well as a unique computer name). You can have several domains but only one primary domain controller can exist on a network for any domain.

2. Backup domain controller (BDC)

For each primary domain controller, it may be appropriate that you also have a backup domain controller to take over domain management functions if the primary controller fails. The BDC keeps a copy of the account database that resides on the primary controller.

3. Stand-alone server

This server type is typically secondary to the domain controllers. Depending on your network design, it may be a single function server. The stand-alone server acts in a peer-to-peer network capacity without the advanced security features found on the primary domain controller.

Refer to the NT 4.0 documentation for more information on these server types.

In our testing, we selected our computer to function as the primary domain controller. At this point, setup asks for the domain name. By default, setup offers DOMAIN as the domain name. Refer to your network administrator for your site's naming conventions. If you specify a domain name already in use, the Windows NT server service will not start.

5.5.3 The Administrator Password

When prompted, set the administrator user ID and password. Do not forget this password as there is no way of resetting the password if it is lost or forgotten. We recommend that you put a password administration policy in place where authorized personnel have access to the password, and any changes are documented.

Tip

If your system is partitioned in such a fashion as to keep the operating system and the data separate and you lose the administrative password, you could destroy the partition where the operating system is installed. Re-install Windows NT and take ownership of all the files on the data partition.

This will give you access to the files but you will lose any security settings of your system in the process. Depending on the way your system was configured, you could lose all your data, so the method described should be used as a last resort.

5.5.4 The Emergency Repair Disk

You will be prompted to create an *emergency repair disk*. (ERD) at this point. We strongly recommend that you create the ERD in order to be able to repair a damaged Windows NT installation.

If you elect to create the ERD, you will be prompted to insert the diskette towards the end of the installation process.

Note: This is an important step and should not be skipped, because the ERD can be a life saver if it is available and is properly updated.

If you make any changes or additions to the system at a later date, use the RDISK.EXE utility found in the \WINNT\SYSTEM32 directory to update the ERD.

Note: Each Windows NT installation creates a unique ERD and these are not transferable between different Windows NT servers.

5.5.5 Selecting General Components

A panel will appear where you will select or deselect NT 4.0 components. Components are grouped under the following headings:

- Accessibility Options
- Accessories
- Communications
- Games
- Multimedia
- Electronic Mail and Messaging Utilities

You are able to add any of these now, or selectively add or remove any of them once the installation is complete.

5.6 Installing Windows NT Networking

This next phase of the installation concentrates on the networking side of the NT 4.0 configuration.

5.6.1 Network Options

At this point, you will specify and install the networking components of NT 4.0. First, specify how the machine will be connected: either directly wired to the network or via a modem. As this is the server, you most likely have one or more network adapters.

Depending on your requirements, you may or may not want to install the Microsoft Internet Information Server (IIS). You would use IIS if your server is going to be an Internet or intranet server. Consult your network administrator and the NT 4.0 installation guides for more information about this service. In our test environment, we did not install the IIS, so the option is unchecked.

5.6.2 Installing Network Adapters

The next steps will be very important for the functionality of your computer, acting as the NT 4.0 server in the network. You need to select the network adapters you want to install, the appropriate device drivers, as well as the protocols you intend to use, for example, TCP/IP, NetBIOS, etc. More importantly, you will choose the services that your server requires to perform the needed functions.

To make the selection process as convenient and easy as possible, NT 4.0 has the capability to auto-detect the most common network adapters. It also provides a list of adapters whose device drivers are included on the NT 4.0 CD-ROM. It is recommended, however, that you always use the latest adapter device drivers that you can find. Refer to Appendix A, "Sources of Drivers and Information" on page 147 for more information on where to obtain the latest drivers.

Click on **Start Search** to let NT 4.0 automatically search for the network adapters installed in your system. Windows NT Setup now investigates your computer and tries to auto-detect the installed network adapters. Please be aware that the auto-detection process stops the moment the first adapter is detected.

If there are multiple adapters installed, you need to click on **Find Next** to resume the adapter auto-detection process. Figure 68 on page 97 shows two adapters detected, the PC Server 330 integrated AMD Ethernet adapter and an additional IBM Auto LANStreamer PCI adapter.

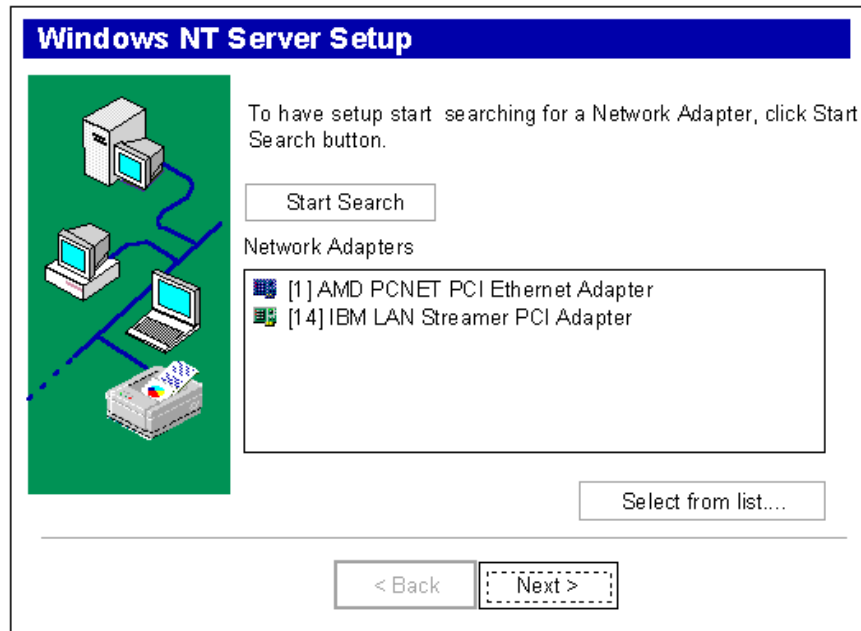


Figure 68. Auto-Detection of Network Adapters

If your adapter is not auto-detected by setup, you may either select the adapter from the list provided by Setup or you need to provide a hardware manufacturer's adapter support diskette. To select an adapter from the list, click on **Select from list....**

To load any drivers you have on diskette, click on **Have Disk**. You may get the following error message (Figure 69):

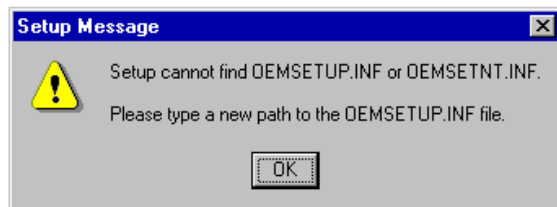


Figure 69. OEMSETUP.INF Not Found

This message is displayed if setup does not find the OEMSETUP.INF or OEMSETNT.INF file on the diskette's root directory. To solve the problem, simply provide the correct path information to the OEMSETUP.INF or OEMSETNT.INF file. You may also skip the installation of one particular adapter, continue the NT 4.0 installation and add this particular adapter support at a later time. To continue, click on **OK** and provide the correct path information. A dialog box then displays the adapters supported by this driver diskette (Figure 70 on page 98).

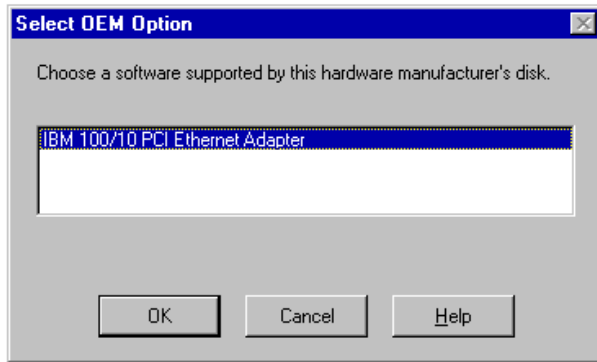


Figure 70. Adapter Drivers Found on the OEM Diskette

5.6.3 Network Protocols

After the network adapters are selected, you need to define the network protocol stacks to be used for network communication. Select the required network protocols from the list provided by setup (Figure 71).

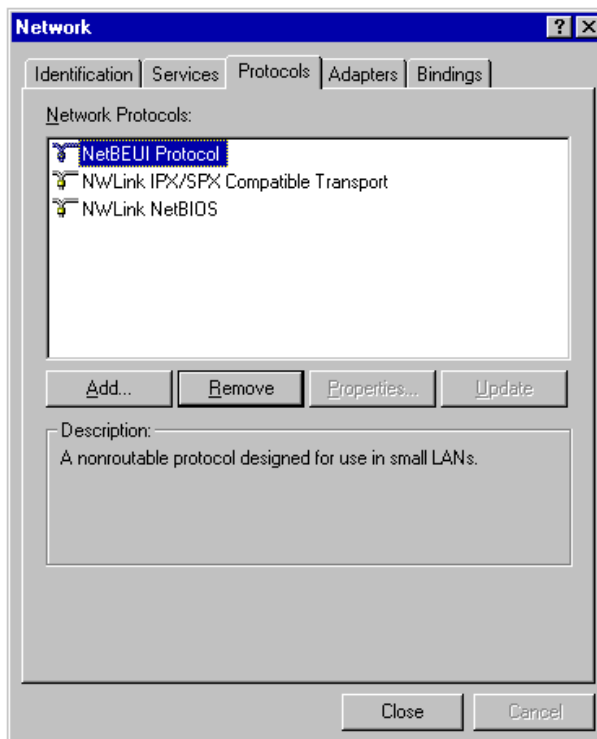


Figure 71. Selecting Protocols

If you need additional protocol support, click on **Select from list...** and for additional protocols to select.

5.6.3.1 Choice of Protocols

The protocols you choose will impact the way your network performs.

If you have existing equipment that makes use of certain protocols, then you do not have a choice unless you embark on a major revamp of your network. Your choice of protocol will depend on the scope and design of your network. For example, if you have less than 30 devices on your Ethernet LAN or 50 on your token-ring LAN and you have no intention of ever subnetting your network or communicating with other networks, then the best choice would be the NetBEUI protocol. This limitation is due to the fact that NetBEUI is a broadcast-intensive protocol with no routing capabilities. It can be bridged, increasing the broadcasting on all bridged subnets.

If you intend to extend your network to the intranet or Internet level with multiple subnets interconnected via routers, the protocol of choice would be TCP/IP.

Refer to network design texts for more information on this topic.

5.6.4 Selecting Services

After you have selected the adapters and the protocols, you need to select the Windows NT services required to use your computer as a server in the network. These services include the following:

- Workstation
- Server
- NetBIOS Interface

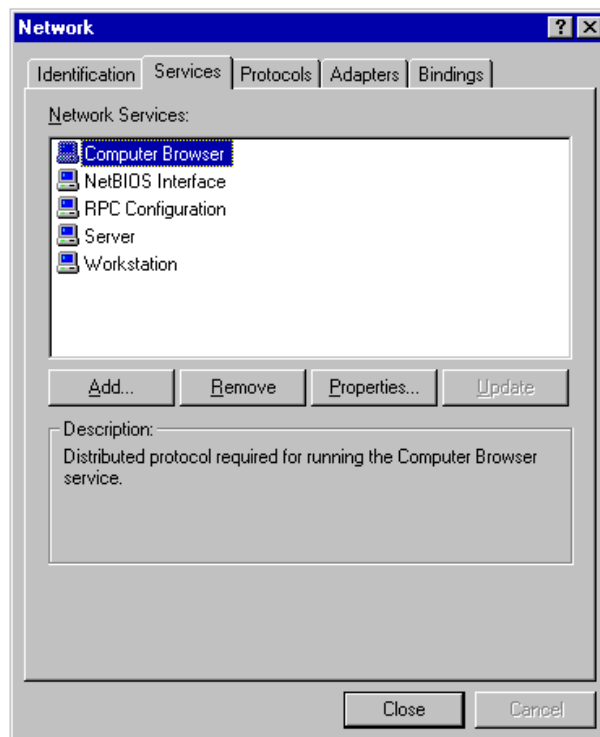


Figure 72. Selecting Services

Additional services you may need include Remote Boot Service and Internet Information Server. Others can be selected from the list of additional services by clicking on the **Select from list** option.

Note: In this example, we did not select any additional services.

You have now completed the networking component selection process and setup will install the selected components.

5.6.5 Specifics of the Auto LANStreamer PCI Adapter

As a result of selecting the Auto LANStreamer PCI Token-Ring Adapter, the window in Figure 73 is displayed. You can either accept the defaults or modify them according to your requirements. In this example, we changed the default (the adapter's burned-in address) to a locally administered address (LAA). This may be required if there are bridges, routers and gateways interconnecting different networks or network segments.

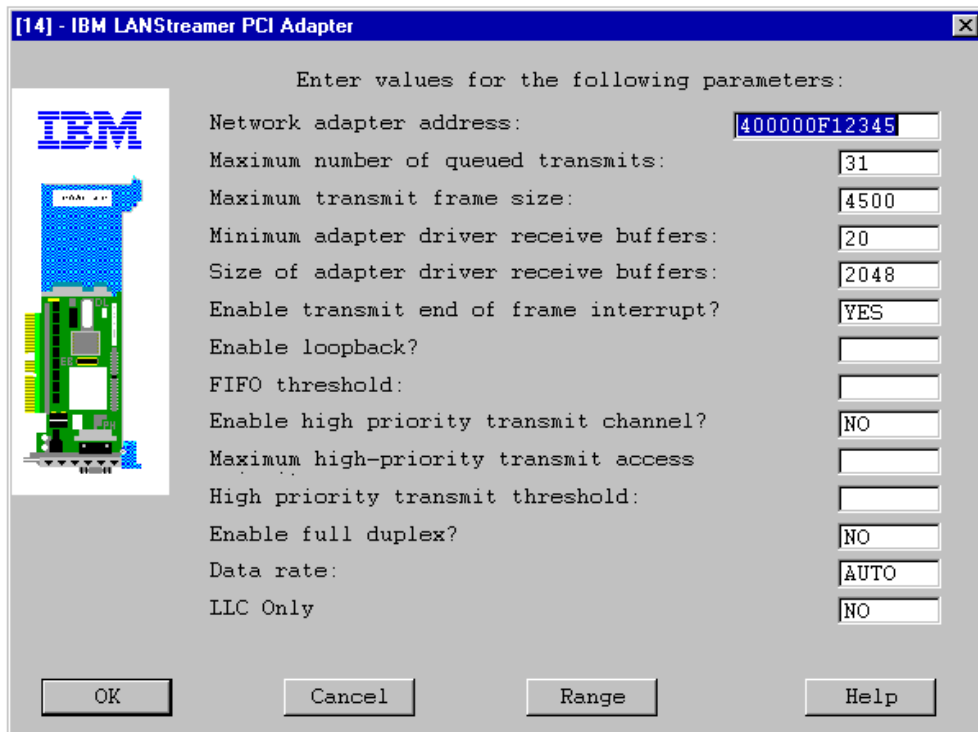


Figure 73. Setting the IBM LANStreamer PCI Adapter

When using other adapters, the window displayed could look different due the differences in characteristics.

Note

The Auto LANStreamer MCA Adapter driver supplied with NT 4.0 will not work. Please refer to Appendix A, "Sources of Drivers and Information" on page 147 for details on where to get the latest update of the driver.

Also, when the server shuts down with this adapter installed, it might not reset the adapter properly, forcing you to power off the server completely to correct the problem.

5.6.6 Changing the Protocol Binding Order

Before continuing the installation process, Windows NT Setup gives you the opportunity to review and modify the bindings between adapters, protocols, and services you decided to use with your server. The window in Figure 74 is displayed. Normally, you can leave the current bindings unchanged. After the installation process is complete and NT 4.0 is restarted, you still have the opportunity to modify the bindings and their sequence, depending on your requirements.

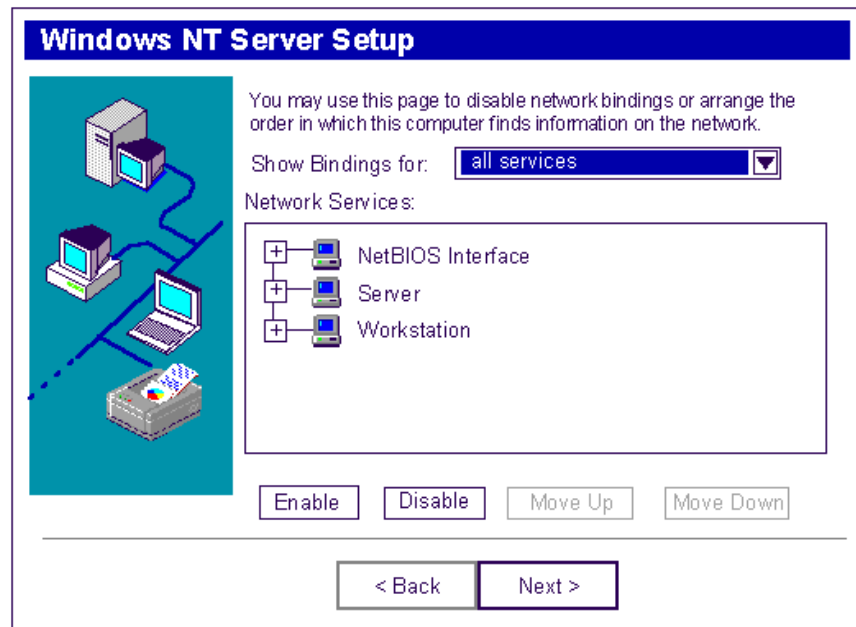


Figure 74. Reviewing Network Bindings

NT 4.0 will now start the network and complete the networking installation. Setup will also start the networking functionality. This may take a while, depending on the services and adapters you have selected.

5.6.7 Joining a Domain

To join an existing domain, you need to know what the existing administrator password is, or the administrator needs to add you to the domain using Server Administration.

The network is now checked for duplicate names. If no duplicate names are found, setup continues to the third and final phase.

5.7 Finishing Setup

In this final phase of setup, perform the following tasks:

1. Specify a time zone.
2. Select the correct display adapters and set display properties.
3. Copy the remaining program files from the CD-ROM.
4. Build an emergency repair disk if you requested it earlier.

Setup has now finished the installation. Reboot the server.

5.8 Basic Trouble Shooting

After restarting Windows NT, it is a good idea to check that all the functions and services you have selected during the installation and definition process has started and are working properly. If Windows NT detects any conflicts or incorrect definitions, it displays a message box (Figure 75) to indicate that a problem exists that may impact the server.

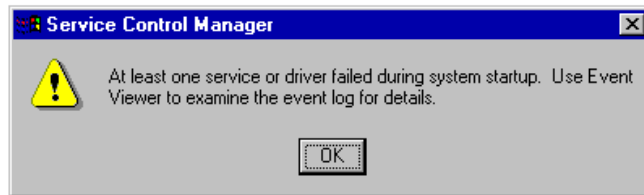


Figure 75. Service Failed During Startup

5.8.1 Determining Which Services Have Started

To inspect which of the services have started, use the services function located in the control panel.

From the task bar at the bottom of your screen, click on the **Start** button. Select the **Settings** option. Next, click on the **Control Panel** icon.

In the Control Panel window, click on the **Services** icon. The option box displayed looks similar to the one in Figure 76.

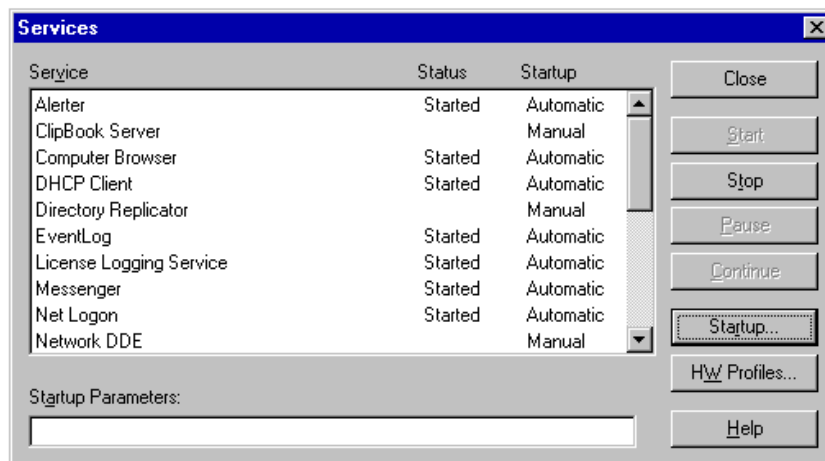


Figure 76. Reviewing Bindings

This window shows all services, how they should be started and their actual status.

5.8.2 Using the Event Log

The next step is to investigate the event log to determine whether all the services have started and are functioning properly. The event log is an invaluable source of information that highlights potential problems and guides you in solving them.

Start the Event Viewer by clicking on **Start** → **Programs** → **Administrative Tools** → **Event Viewer**.

The Event Viewer is used to display and investigate the event log. The following three figures (Figure 77 on page 103 to Figure 79 on page 104) show the event log displaying errors, the source of an error and the event log after the problem has been corrected and the server has been restarted.

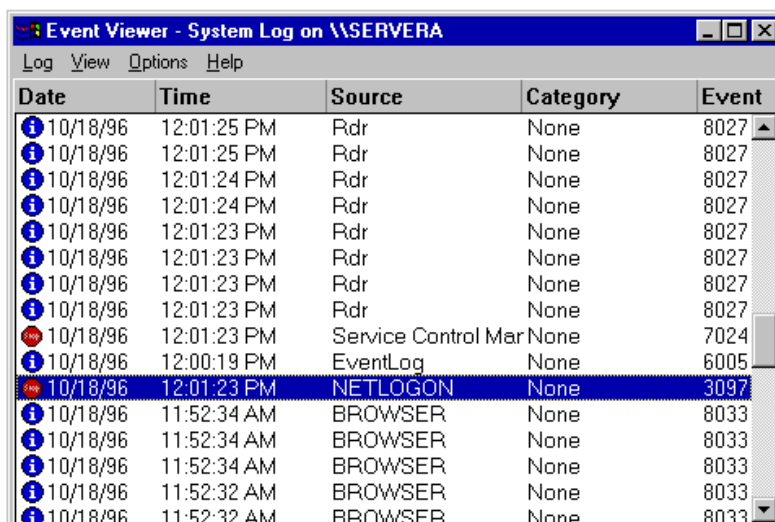


Figure 77. Event Viewer. This window shows two items marked with a red stop symbol that indicates a problem or failure was detected by the service listed in this row.

In order to obtain more detailed information about the nature of the problem, double-click on the error as highlighted in Figure 77. You will now see a brief description of the problem as shown in Figure 78.

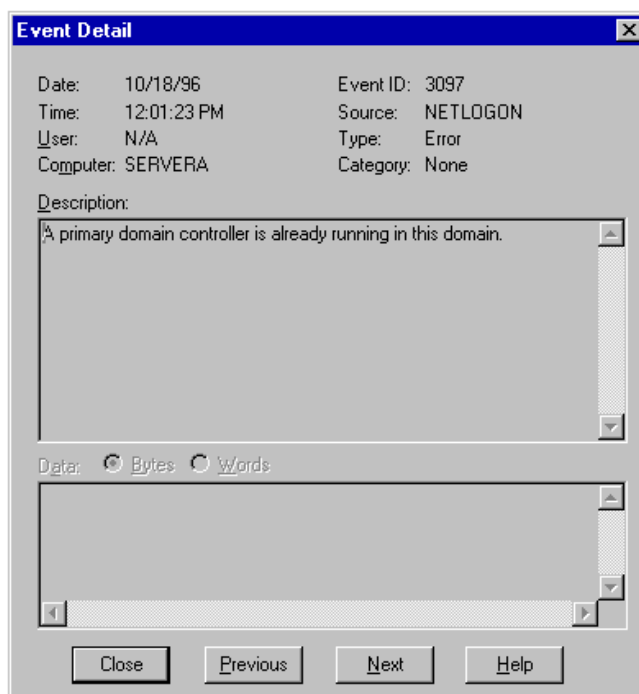


Figure 78. Details of an Event. The event detail window provides an immediate problem source explanation (here, the problem is a duplicate domain name).

Subsequent errors are most likely the result of the initial service failures, as shown in Figure 79 on page 104.

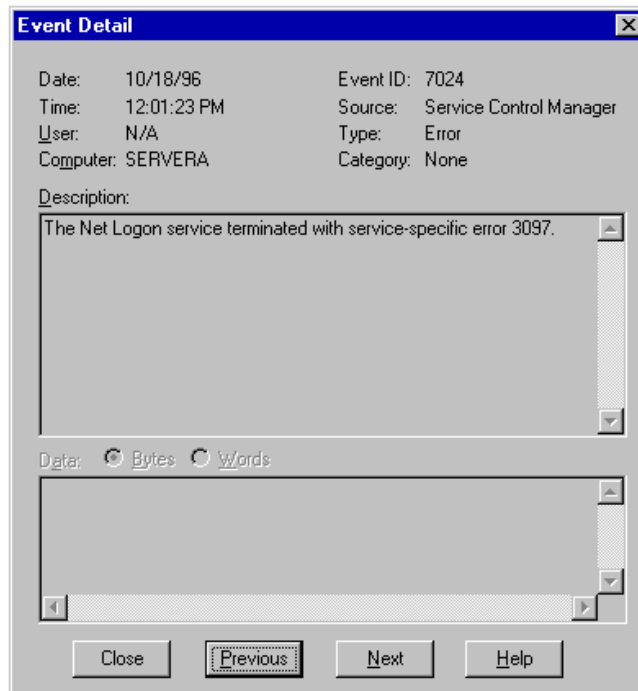


Figure 79. Details of a Spurious Error. This window shows a spurious or misleading error that occurred only because the previous error occurred (see Figure 78 on page 103).

Note: The rule to remember here is to fix the preceding errors first.

To correct this error, simply click on the icon network in the control panel, select identification and change the (duplicate) domain ID to a valid domain name (here ITSODOM1) as shown in Figure 80 on page 105.

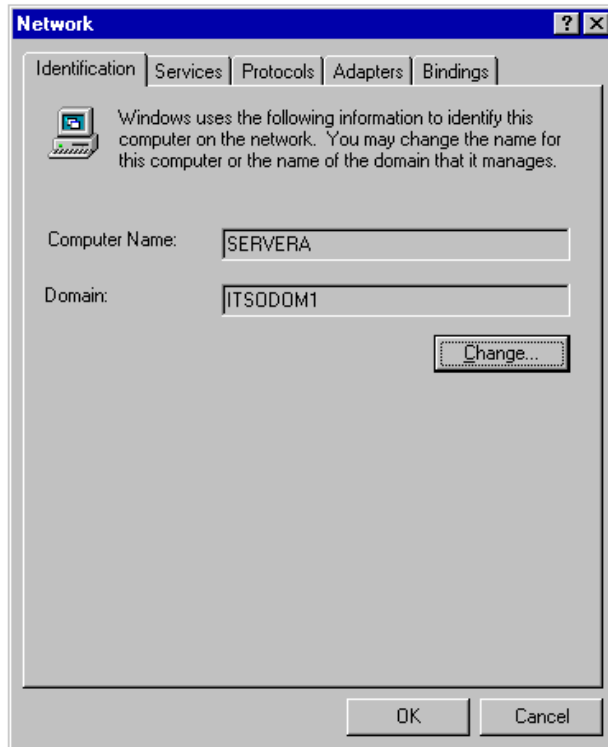


Figure 80. Changing the Domain Name

Once you restart your computer, you will see that the event log no longer shows any error entries, thus indicating that your problem is fixed.

Chapter 6. TME 10 NetFinity Overview

This chapter provides an overview of the TME 10 NetFinity product. It also shows how to install and configure TME 10 NetFinity on the NT 4.0 platform (including hardware and software requirements).

6.1 What is TME 10 NetFinity under Windows NT?

TME 10 NetFinity is a set of applications used for systems management and monitoring capabilities. Due to its product structure, it is very flexible and allows updating of existing product components and new features without having to re-install the product.

TME 10 NetFinity enables you to monitor and manage systems locally and remotely without any interruptions to your users. It helps keep you informed about actual problems within your network as well as helping you to fix them. It is also very flexible when it comes to connecting to its clients.

From a functional perspective, the transport protocol used for connectivity does not determine which services are available. When connecting to its clients, it uses just the network device drivers, which makes it very convenient if you want to change the network adapters. If you change transport protocols, you don't have to make any changes within TME 10 NetFinity, just the operating system device drivers.

TME 10 NetFinity is designed to help solve problems for your clients whether their workstations are notebooks, desktops or servers, as long as the workstations are systems that are running under an operating system supported by TME 10 NetFinity.

TME 10 NetFinity is part of the TME 10 product family, which also means that it will cooperate with all the other systems management products on the MVS, AIX and OS/400 platforms, as well as with other TME 10 products.

6.2 Connectivity Options

There are different ways to connect your TME 10 NetFinity manager to your workstations. Also, several operating systems and communication protocols are supported.

1. LAN Connection

You can use any hardware connection to your clients and servers as long as you provide a supported network device driver. This may be a connection on a LAN such as a token-ring or Ethernet or a WAN connection using LAN distance or bridges and routers, depending on the protocols that are used.

2. Serial Connection

You also may use a modem connection for your access. Here you can dial-in from one TME 10 NetFinity manager to another and thereby interconnect otherwise separate networks.

3. Internet/Intranet

Another way to connect to your remote workstations is to use the Internet or your company's intranet. TME 10 NetFinity provides an easy-to-use interface to manage remote clients over the WWW.

For more information about TME 10 NetFinity you can also read *Systems Management from an NT Server Point of View*, SG24-4723.

6.3 Installing TME 10 NetFinity from Windows NT

In this section, we describe how to install TME 10 NetFinity under Windows NT as a manager and as a client.

There are two components of TME 10 NetFinity, *Manager* and *Services*:

1. On each server and workstation where you plan to manage your network, you should install *TME 10 NetFinity Manager*.
2. On every other workstation or server that you need to manage but don't plan to do the managing from, you should install *TME 10 NetFinity Services*.

For server installation, you can install the code directly from CD-ROM using ServerGuide 3.0's CoPilot. Refer to 4.3.1, "CoPilot" on page 75 for more information. You may also use ServerGuide 3.0's Diskette Factory to build diskettes.

Note: Ensure you do not violate the licensing conditions of TME 10 NetFinity by installing it on more than one machine.

6.3.1 Installation of TME 10 NetFinity Services

1. Insert the first diskette for the TME 10 NetFinity services.
2. Go to an MS-DOS command prompt and type:

```
NETFINST
```

This results in execution of the installation program for TME 10 NetFinity.

3. A window will pop up indicating a default drive and directory where you will install the code. You can override the default by typing in a new location (see Figure 81 on page 109). The installation can be from a diskette, CD or a LAN drive. The same applies to the target drive. You should also define the subdirectory where the code will be installed.
4. After you have defined the source and target drives, define the type of TME 10 NetFinity client you want to install. There are different types of clients that can be installed. Figure 82 on page 109 shows the installation options.

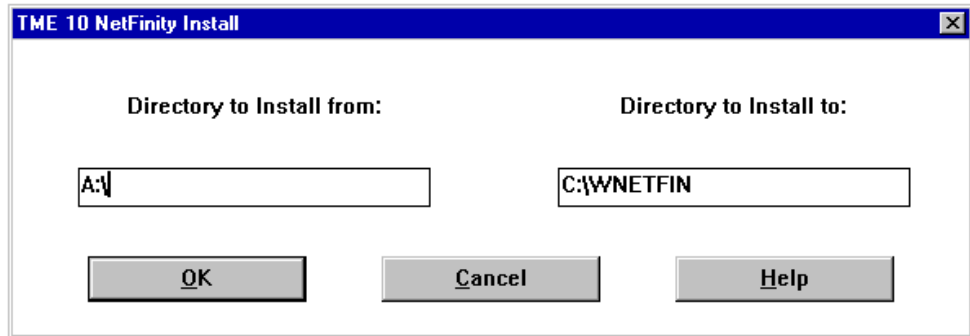


Figure 81. Drive Selection for TME 10 NetFinity Installation

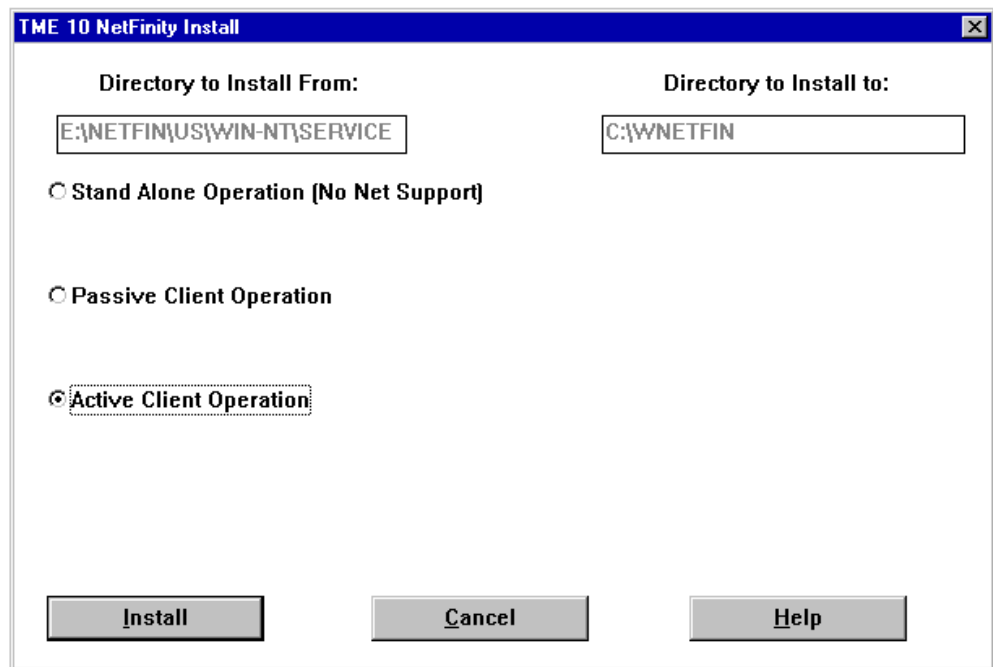


Figure 82. Choice of TME 10 NetFinity Client

5. The following are the different types of clients that you can install. Figure 82 depicts what the options are.

- Stand-alone client

The stand-alone client can only perform TME 10 NetFinity functions locally and has no network interface support installed. This means that the network administrator has no access to this workstation over the LAN using TME 10 NetFinity.

- Passive client

The passive client can't perform most of the TME 10 NetFinity functions locally. Only the TME 10 NetFinity services for the alert, security manager and for the serial control are available. For the other services, it can only respond and react to requests from a TME 10 NetFinity manager.

- Active client

The active client can perform all TME 10 NetFinity services locally. It also can react to requests from a TME 10 NetFinity manager over the LAN.

If you are installing TME 10 NetFinity services on your server, you would normally install the active client code. This will allow you to do perform NetFinity functions on the server directly. You may choose to install TME 10 NetFinity Manager instead.

6. You will see a window that shows you the actual status of the installation in progress. If you are installing from diskette, you will be prompted to insert the additional diskettes.
7. If you are installing either an active or passive client (that is, not stand-alone), you are prompted to configure the TME 10 NetFinity client. This definition is described in detail in 6.4, "TME 10 NetFinity Configuration" on page 112.



Figure 83. Completion of the Installation

Figure 83 shows the end of the installation process. In this dialog box you are reminded to run the security manager in order to prevent unauthorized users from gaining access to your server.

8. Reboot the server.

Failure to do so may cause unpredictable results.

For more information on the installation, refer to *Systems Management from an NT Server Point of View*, SG24-4723.

6.3.2 Installation of TME 10 NetFinity Manager

You would normally install either the active client or the manager code on your server. To install the TME 10 NetFinity Manager code on your server, use ServerGuide 3.0's CoPilot to install the code from CD-ROM. See 4.3.1, "CoPilot" on page 75 for more information.

Alternatively, build the diskettes from ServerGuide 3.0's Diskette Factory, then run NETFINST from this first diskette. See 4.3, "ServerGuide Main Menu" on page 73 for more information about Diskette Factory.

The installation of the TME 10 NetFinity Manager is similar to the services installation, except that instead of being asked for the type of client, you are asked whether you want to use your manager with Web Enhancement support or without it. Refer to Figure 84 on page 111.

The Web Enhancement function enables you to access your TME 10 NetFinity Manager from any Web browser. Refer to Chapter 6 of *Systems Management from an NT Server Point of View*, SG24-4723, for more information about this function.

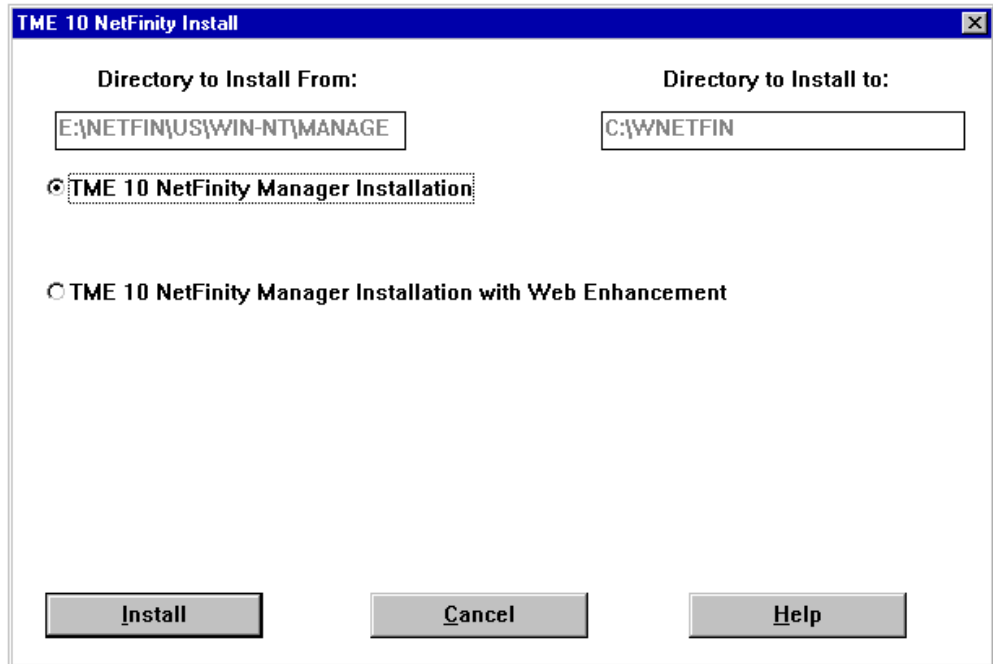


Figure 84. Installation Options for the TME 10 NetFinity Manager for NT 4.0



Figure 85. The Windows NT Folder for TME 10 NetFinity Manager

The TME 10 NetFinity folder for managers, as seen in Figure 85, includes the following services:

- NetFinity Service Manager

The TME 10 NetFinity Manager gives you the management functions provided by TME 10 NetFinity. When started, it provides the graphical user interface for the TME 10 NetFinity services. The detailed description of the functions can be found in Chapter 2 of *Systems Management from an NT Server Point of View*, SG24-4723.

A brief description of the system monitor found in the NetFinity service manager is given in 6.6, “System Monitor” on page 116.

- Read Me First

This is a typical README file that provides some hints and tips as well as some general information on TME 10 NetFinity.

- TME 10 NetFinity Database Tables

If you select this function, you will get detailed information on how the database tables created by TME 10 NetFinity are structured. This might be very useful if

you create your own databases and want to include the TME 10 NetFinity information in that database. More details about the databases and their structure can be found in Chapter 5 of *Systems Management from an NT Server Point of View*, SG24-4723.

- TME 10 NetFinity Database Administration

The administration functions are used to define the kind of database being used. You may select IBM DB2 using ODBC or Microsoft SQL Server using ODBC.

- Network Driver Configuration

It is important to be careful with the configuration done in the network driver configuration because it is used to define the possible connections for the TME 10 NetFinity workstations. See 6.4, "TME 10 NetFinity Configuration" for more information.

6.4 TME 10 NetFinity Configuration

In this section, we describe how the configuration of TME 10 NetFinity services and Manager is done and also explain the contents of the fields that are in Figure 86.

Note: This does not apply to the stand-alone client.

The main configuration menu within the TME 10 NetFinity configuration is the Network Driver Configuration menu, which is shown in Figure 86. The network configuration menu will automatically show up at the end of the installation process, so you are able to check and correct your network support definitions for TME 10 NetFinity. You can also change them later by clicking on **Start** → **Programs** → **NetFinity** → **Network Driver Configuration**.

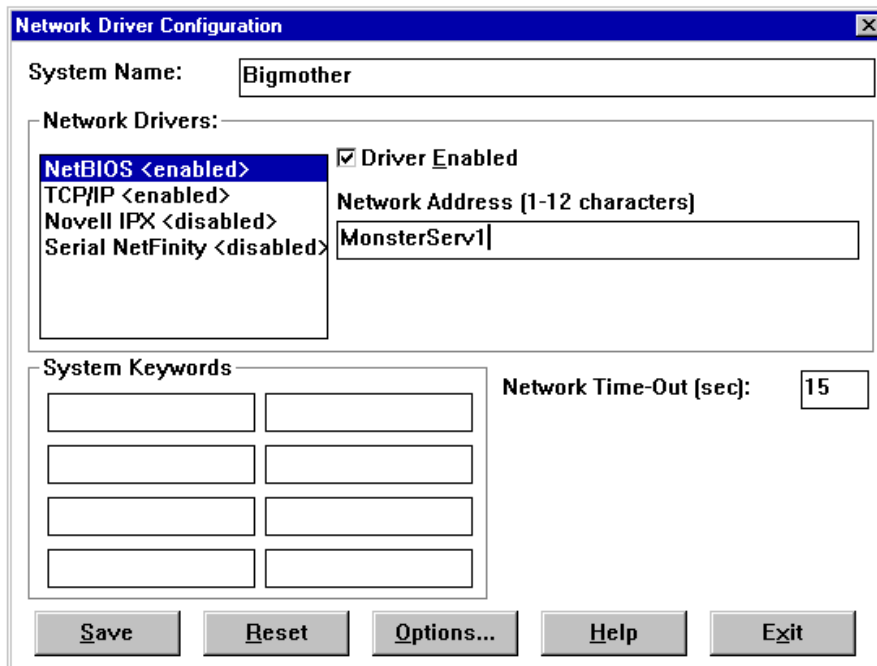


Figure 86. Network Driver Configuration

The main purpose of the network driver configuration is to define the connections to and from other workstations using TME 10 NetFinity. The following are the definition fields within this menu and their meanings:

- System Name

The System Name field can be any combination of alphanumeric characters including blanks. It shows the name of the workstation. This name can be seen later in the management process when monitoring the client groups. It is used to easily identify your workstations.

- Network Drivers

The Network Drivers field automatically shows you all the installed network device drivers such as NetBIOS, IPX, TCP/IP and serial support. In parentheses you can find the status of this driver, which means, whether or not this driver has been activated for TME 10 NetFinity usage. You can easily activate or deactivate any of the drivers by selecting it with the mouse and marking the check box **Driver Enabled**. If TME 10 NetFinity is already running, you will need to restart it to add the additional protocols.

The Network Driver Configuration window is shown in Figure 86 on page 112. In this window, you can see that the NetBIOS and TCP/IP drivers are enabled, which means they can be used by TME 10 NetFinity. The IPX and serial driver support are installed, but disabled. In this example, we selected the NetBIOS driver (highlighted) and marked the Driver Enabled check box. The Network Address field shown in this figure shows some additional required information depending on the device driver. For NetBIOS, this will be a NetBIOS name that is used for communication between the manager and its clients.

- System Keywords

The system keywords are not required for TME 10 NetFinity, but it makes life easier for the network administrators. They are used to identify and group the workstations and servers within the network. The keywords are used within a network environment to identify and define groups among the workstations.

- Network Time-Outs

This defines the timeout interval before you get an error message when you try to use one of the remote functions of TME 10 NetFinity.

If you click on the **Options...** button, the NetFinity Options window appears (Figure 87).



Figure 87. Driver Configurations Options

The options here are:

1. Force Remote Logons

If you are accessing remote workstations, such as a TME 10 NetFinity Manager, you can choose to save a user ID and a password for the different workstations. The next time you access the same workstation, TME 10 NetFinity will automatically provide the same user ID and password that was specified on your first connection.

This might be risky, because if somebody else gets access to your managing workstation, they can access your clients without providing a user ID and password.

If you select **Force Remote Logons**, you are not able to save the user ID and password. Therefore, every time you access another workstation you will be prompted to provide a user ID and a password.

2. Service Execution Alerts

With this selected, whenever a TME 10 NetFinity manager accesses your workstation, TME 10 NetFinity will send an alert. This is true for every access of the TME 10 NetFinity services. An alert will be created with the information about who is using one of the TME 10 NetFinity services on your workstation. You can then decide what you want to do about it. This can be done using an EXEC to take some specific action by using the alert editor, or by something as simple as providing a pop-up window.

3. Show Support Program

The Show Support Program function is only available on Windows 3.1, Windows for Workgroups, Windows 95 and Windows NT workstations. In NetWare and OS/2, this function is automatically enabled and you cannot deselect it. This function puts the TME 10 NetFinity support program (NETFBASE.EXE) in the task list so that you are able to shut it down.

This is useful if you are working with the network configuration. With the support program in the task list, you can just shut it down and restart it, rather than rebooting Windows NT.

If you don't want to have it visible, so that your users cannot shut down the TME 10 NetFinity support program, don't enable this function. Disabling this function is probably a good idea on client workstations so that the users do not shut down the TME 10 NetFinity client by mistake and hinder the problem determination process.

6.5 TME 10 NetFinity Main Menu

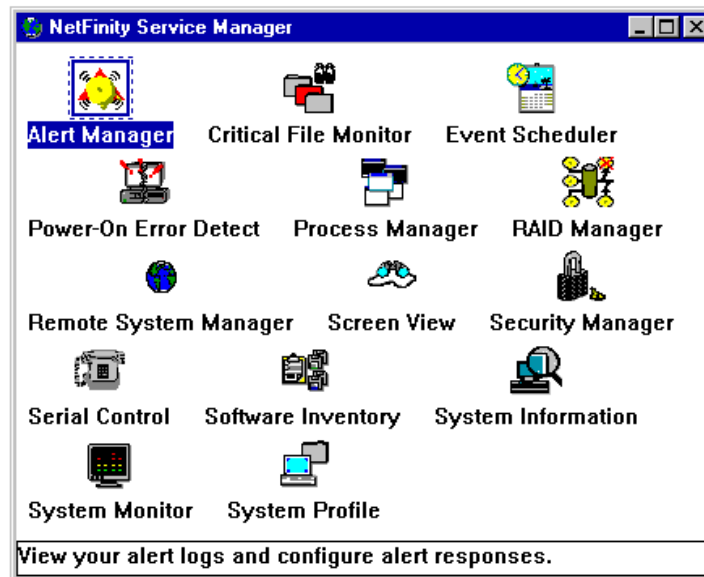


Figure 88. NetFinity Services Manager. Some of these icons may not be visible if you have installed the client code.

The main menu of TME 10 NetFinity Manager is shown in Figure 88. The icons provide access to the following functions.

Note

Only System Monitor is described in detail in this redbook for the purposes of monitoring NT 4.0's performance. Refer to *Systems Management from an NT Server Point of View*, SG24-4723, for more information about these functions.

- Alert Manager - allows you to set up monitors to alert you or another system of a predefined event or threshold. Alerts can be actioned or forwarded to others via a number of methods.
- Critical File Monitor - monitors specific files on your server and alerts you when they have been modified.
- Event Schedule - allows you to set up actions to be performed at certain times. Events include transferring files and rebooting the server.
- Power-on Error Detect - for Micro Channel machines, allows NetFinity to log and action errors that occurred during POST.
- Process Manager - allows you to examine, start and terminate processes on your server.
- RAID Manager - allows you to maintain your RAID subsystem.
- Remote System Manager - gives you access to other NetFinity machines in your network, via the TCP/IP, NetBIOS, IPX and Serial connections.
- Screen View - shows a snapshot of your screen (useful from another system)
- Security Manager - lets you set who can access your system and what functions they can perform

- Serial Control - configures the ability to dial into and out of this system
- Service Configuration Manager
- Software Inventory - shows what software you have installed on your system (useful when collecting this data from many machines in your network)
- System Information - shows the hardware and software configuration of your system
- System Monitor - allows you to monitor the performance of your system
- System Profile - lets you enter information about this system to enable network and user records to be maintained

Refer to *Systems Management from an NT Server Point of View*, SG24-4723, for more information about these functions.

6.6 System Monitor

After starting the TME 10 NetFinity Service Manager, the main menu appears as shown in Figure 88 on page 115.

Double-click on the **System Monitor** icon to start it. The System Monitor main menu and initially the CPU Utilization monitor appear (Figure 89).

Tip

If you don't see the CPU Utilization monitor when System Monitor starts, and it is not in the list of selectable monitors, it is likely you have not rebooted your machine after installation of the software. Do so and try again.

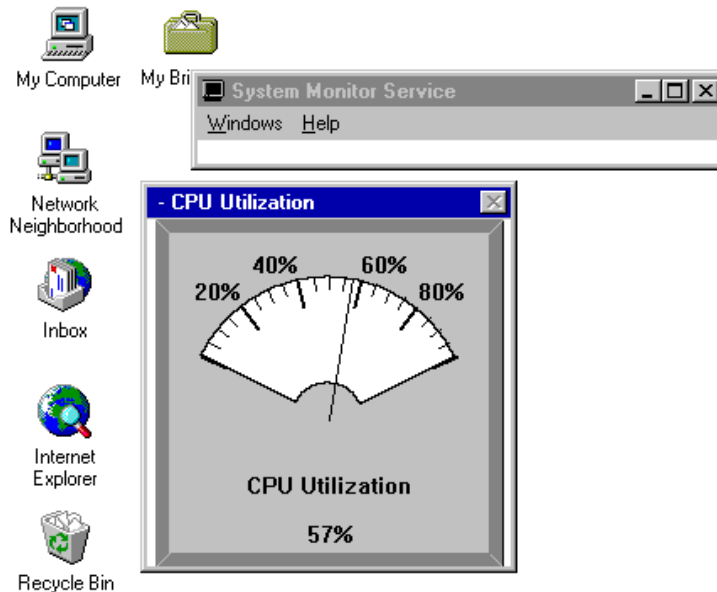


Figure 89. System Monitor

From the System Monitor Service window, select **Show Monitors...** from the Windows pull-down menu. You will now see a window similar to the one in Figure 90 on page 117.

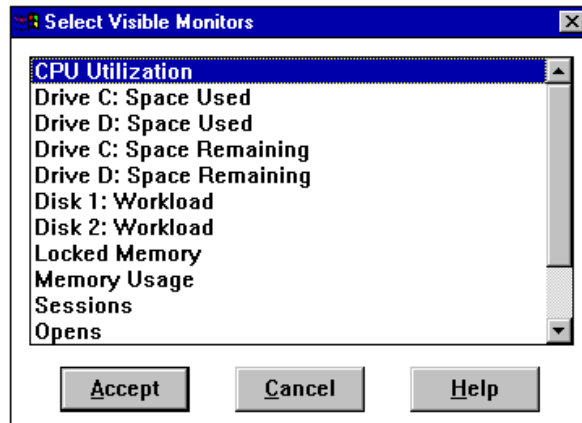


Figure 90. Available System Monitors

Figure 90 may differ slightly from what will be displayed in your window, depending on which devices you have installed. You can select one or more monitors. For example, you can select monitors for CPU and the C drive utilization, as per Figure 91.

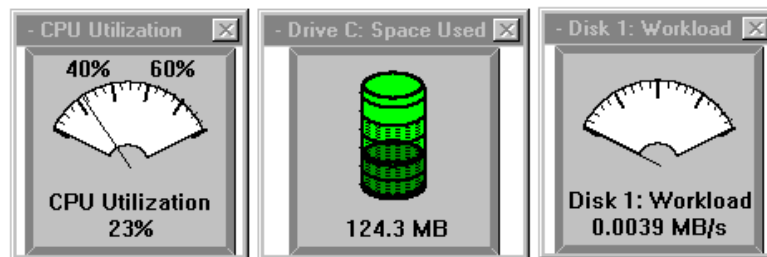


Figure 91. Displaying Monitors

For a discussion on what these objects mean and how they can be used, refer to Chapter 8, “Monitoring and Performance Tuning” on page 131.

6.7 Hints and Tips

We didn't experience any major problems during the installation and configuration of this product. However, the following hints might be of interest to you:

1. After you have installed TME 10 NetFinity, make sure you reboot your server before starting it. Not doing so may produce unpredictable results.
2. Make sure that the network drivers have been installed before installing TME 10 NetFinity; otherwise, you will not be able to define the appropriate network connection during the installation process and you will have to do it later.
3. Set the option Force Remote Logon in the Driver Configuration Options menu. This will ensure only authorized people can access other workstations.
4. Don't forget to define the security service for each workstation. You will find a detailed description on how to do this in Chapter 2 of *Systems Management from an NT Server Point of View*, SG24-4723.
5. It might also be useful to define Show Execution Alerts within the Network Driver Configuration Options menu. This enables your users to monitor the network administrator actions when accessing the user's workstation. The

information from these actions may also be logged in the alert log. If any problem occurs later, then there is a chance that you can tell who accessed the workstation, what services they tried to use and what the problem might be.

Chapter 7. Performance Monitor Overview

Performance Monitor is one of the most valuable tools that NT has to offer. It can measure a wide variety of system components, and can be extended by other compliant applications, such as Microsoft's SQL Server.

This chapter covers some of the built-in functions that NT provides in Performance Monitor, including the following:

- Logs critical system values
- Sends alerts when important events occur in the network
- Provides a view of resource usage

The last task, measuring resource usage, is the most important and often least understood aspects of Performance Monitor. We will cover this topic in detail in Chapter 8, "Monitoring and Performance Tuning" on page 131.

7.1 Starting Performance Monitor

You can activate Performance Monitor by clicking on **Start** → **Programs** → **Administrative Tools** → **Performance Monitor**, or by typing PERFMON on the command line. In either case, you will see the window shown in Figure 92.

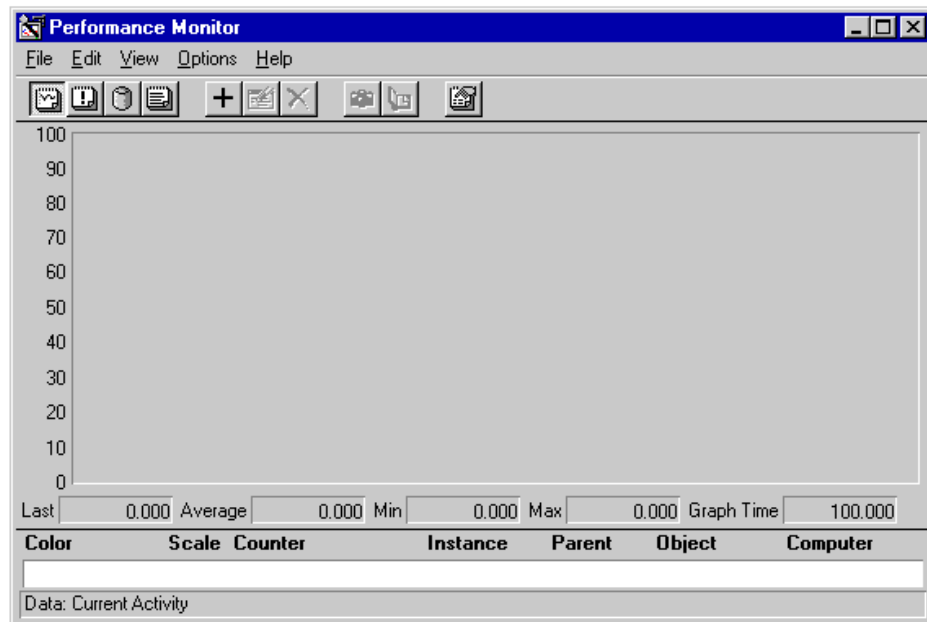


Figure 92. Windows NT Performance Monitor

Note

No disk activity will be monitored by Performance Monitor unless you first issue DISKPERF -Y on the command line and reboot the server.

By enabling the disk monitoring you are placing additional loads on the processor. We recommend that you disable this feature once you have completed your tests. This can be done by executing DISKPERF -N from the command line.

7.2 Collecting Data with Performance Monitor

To collect and display Performance Monitor data, you can either choose from the View pull-down menu one of the following options, or you can click on one of the smart icons located at the top of the Performance Monitor main panel.

The options are:

1. Chart (smart icon )


It graphically displays (in real-time) how the values of counters change in response to changes in system load conditions. Two display modes are available: line graph or histogram. Refer to 7.3, "Chart View" for more details.

2. Alert (smart icon )

This view, discussed in 7.4, "Alert View" on page 124, is particularly useful for monitoring servers in a distributed environment where centralized administration and alerts are tracked by the logging mechanism. For each alert that you are monitoring, you have to supply a threshold value. When the specified alert threshold value is reached, the alert is written to the application log. You also have the option to start a corrective procedure to perform tasks that are aimed at containing the problem that triggered the alert.


3. Log (smart icon )

In order to perform time-lapse analysis, real-time data is stored to disks for retrieval later. This view is described in 7.5, "Log View" on page 126.

4. Report (smart icon )

This is useful for observing numeric values of multiple counters simultaneously and helps in deciding which counters to place in a chart. This view, detailed in 7.6, "Report View" on page 130, is also useful for the exportation of specific sets of numeric data from Performance Monitor to applications such as Excel or Lotus 1-2-3.

7.3 Chart View

The chart view can be displayed by selecting **Chart View** from the View pull-down menu, or clicking on smart icon  .

When a system object is selected for display, the values of the specified counter is charted in a graphical format as shown in Figure 93 on page 121. This graph is displayed in real-time and reflects any changes in system load. The example in

Figure 93 on page 121 shows only one object being measured, but multiple objects can be selected for simultaneous charting.

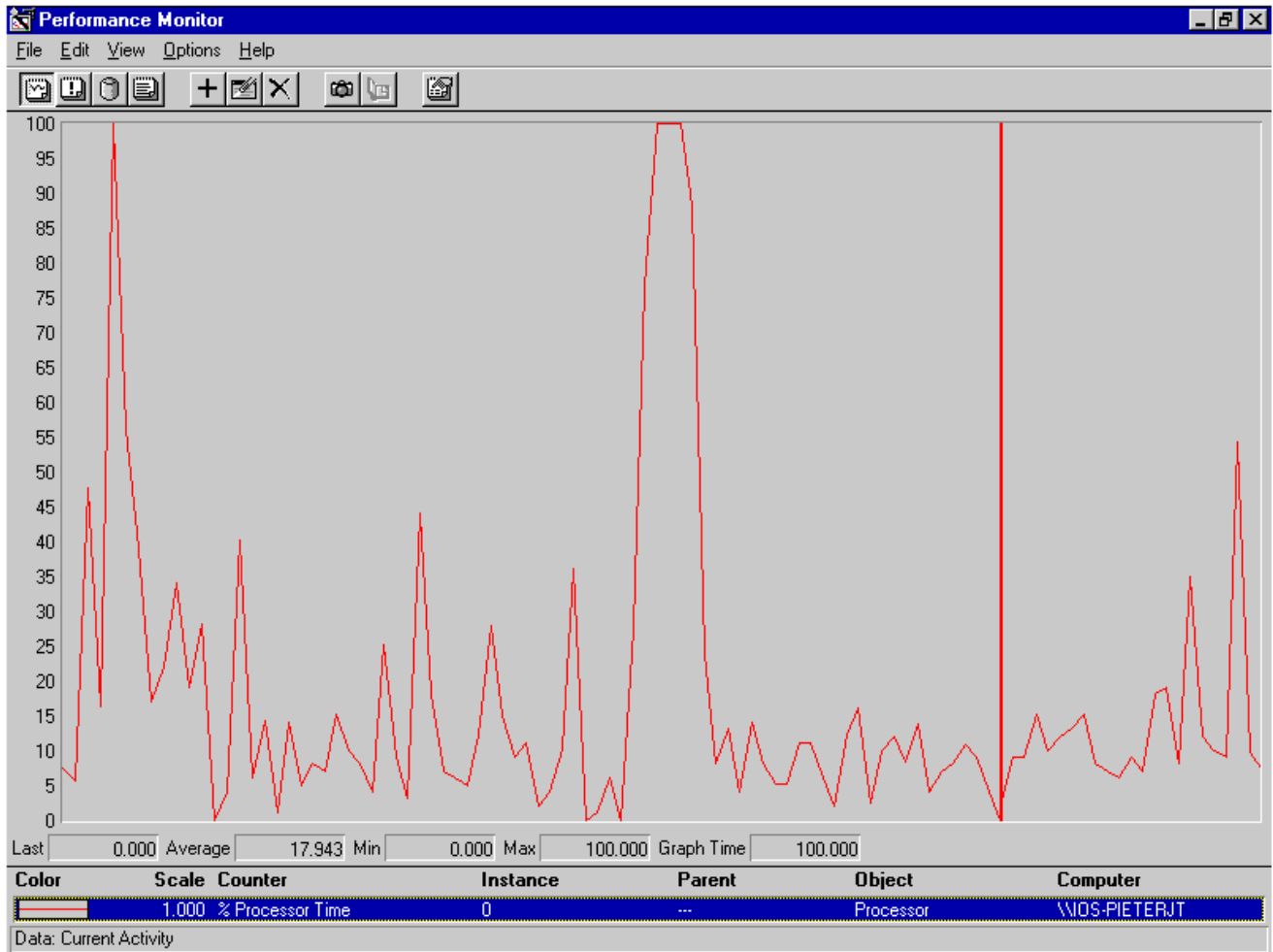



Figure 93. Performance Monitor - Chart View

7.3.1.1 Adding Objects to be Monitored

From the Edit pull-down menu of the Performance Monitor, select **Add to chart**, or click on smart icon . To select an object to monitor, first choose an object and a related counter (see Figure 94 on page 122).

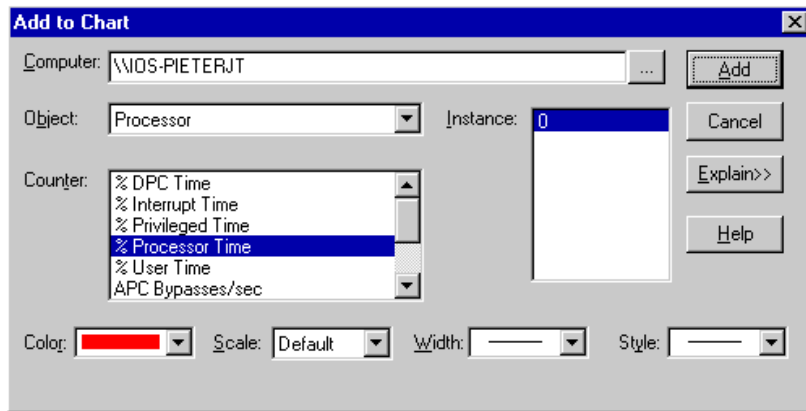



Figure 94. Adding Objects to be Monitored

The Select Computer button () to the right of the Computer: field lets you select a remote server running Windows NT. You can then monitor components on that machine. Figure 95 shows an example of this window.

Note: It may take a while to display this window while the network is checked for other Windows NT systems.

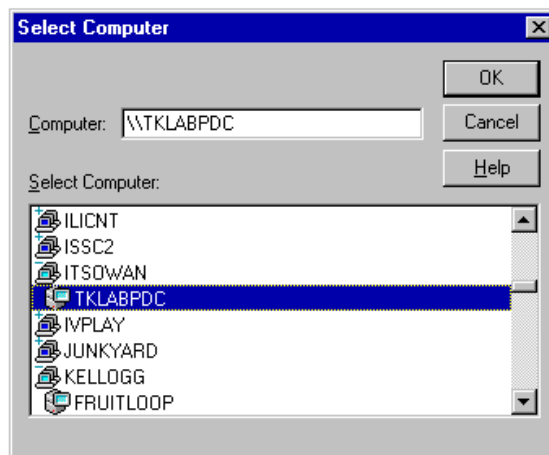


Figure 95. Adding Objects from Remote Servers

7.3.1.2 Knowing What the Objects are Measuring

If you click on the **Explain >>** button, you will see a brief description of the selected object (see Figure 96 on page 123). This option is extremely useful and can usually provide valuable information regarding the selected object.

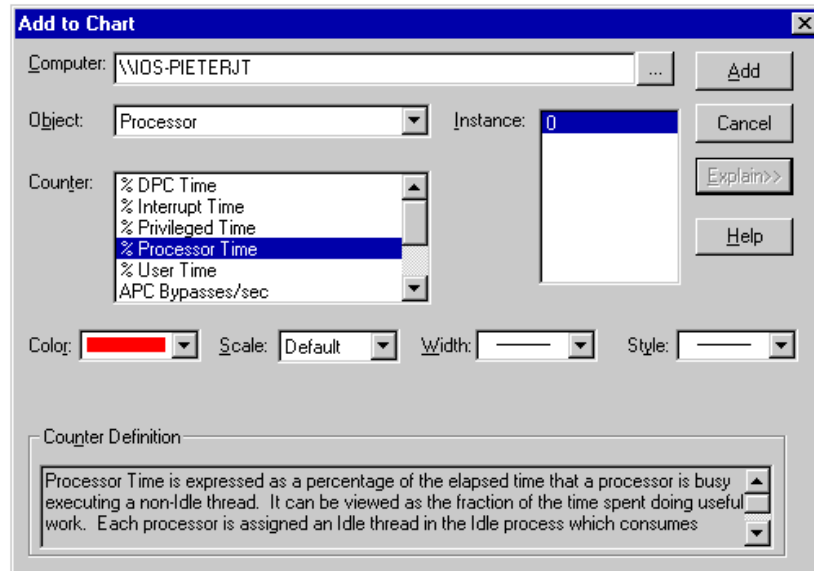


Figure 96. Using the Explain button to Get Details

7.3.1.3 Determining Which Objects Can Be Measured

In Figure 97, you can see a list of objects that can be selected. Notice that the only objects displayed are components that have been installed in your server. For example, if you do not have the IPX protocol installed on your system, you will not see any objects relating to this protocol.

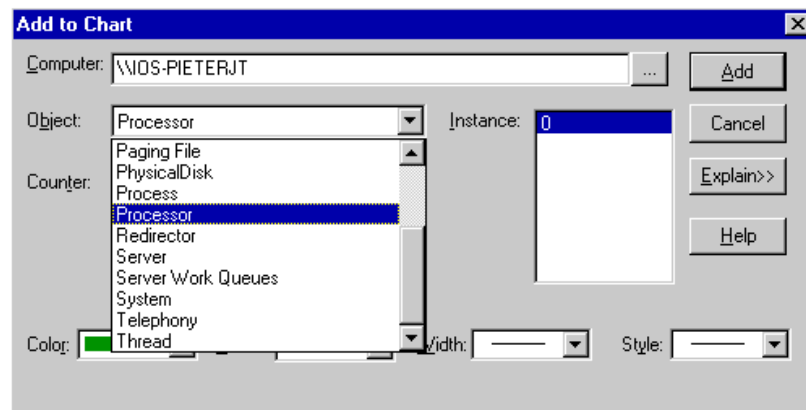


Figure 97. A List of Installed Objects

7.3.1.4 Choosing an Object Instance

Some objects have multiple instances. For example, a counter can have multiple instances relating to the same measurement but for different but equivalent devices, such as multiple CPUs. This is shown in Figure 98 on page 124.

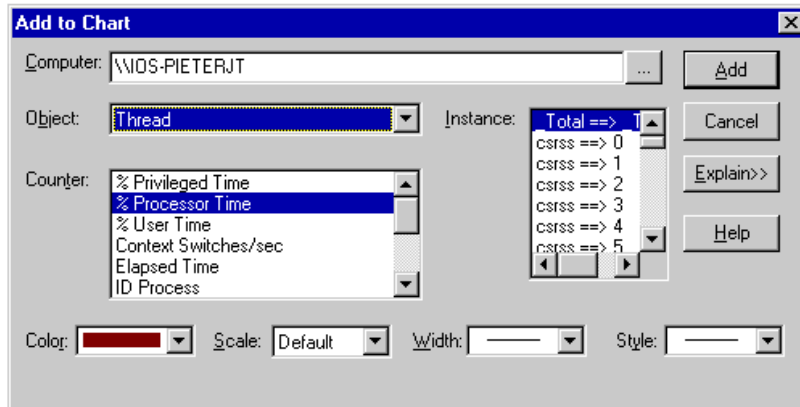



Figure 98. Several Instances of the Same Object

7.3.1.5 Changing the Chart Appearance

There are various options relating to the appearance of the charts. To change them, select **Chart** from the Options pull-down menu, or click on the Options smart icon (). You will see a window similar to the one in Figure 99.

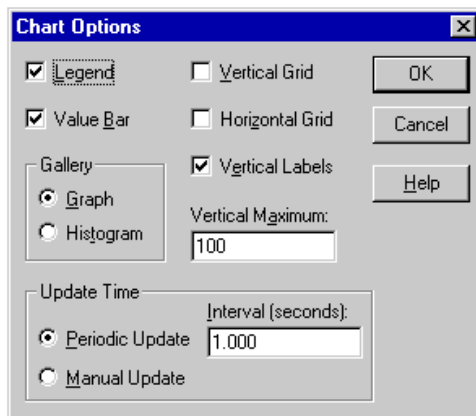


Figure 99. Chart Options Window

Selecting **Histogram** from the Gallery box can be useful for simultaneously monitoring many instances of a given counter. With the Histogram view, you cannot see the history of the measured objects but will be able to gain a feel for how they relate to each other.

7.4 Alert View

Alert view is useful when you want to determine how many times a certain occurrence takes place in relation to a certain object. Alternatively, use Alert view if you want to take corrective action when the measured object reaches a predetermined threshold.


To select the Alert view, click on the **View** pull-down menu and then select the **Alert** option. Alternatively, you can click on smart icon  .

Figure 100 on page 125 shows the Alert view with some alerts generated for the processor object that has exceeded the predetermined 10% utilization threshold.

Times and dates are shown in the panel, as well as the server from which the measurement was taken.

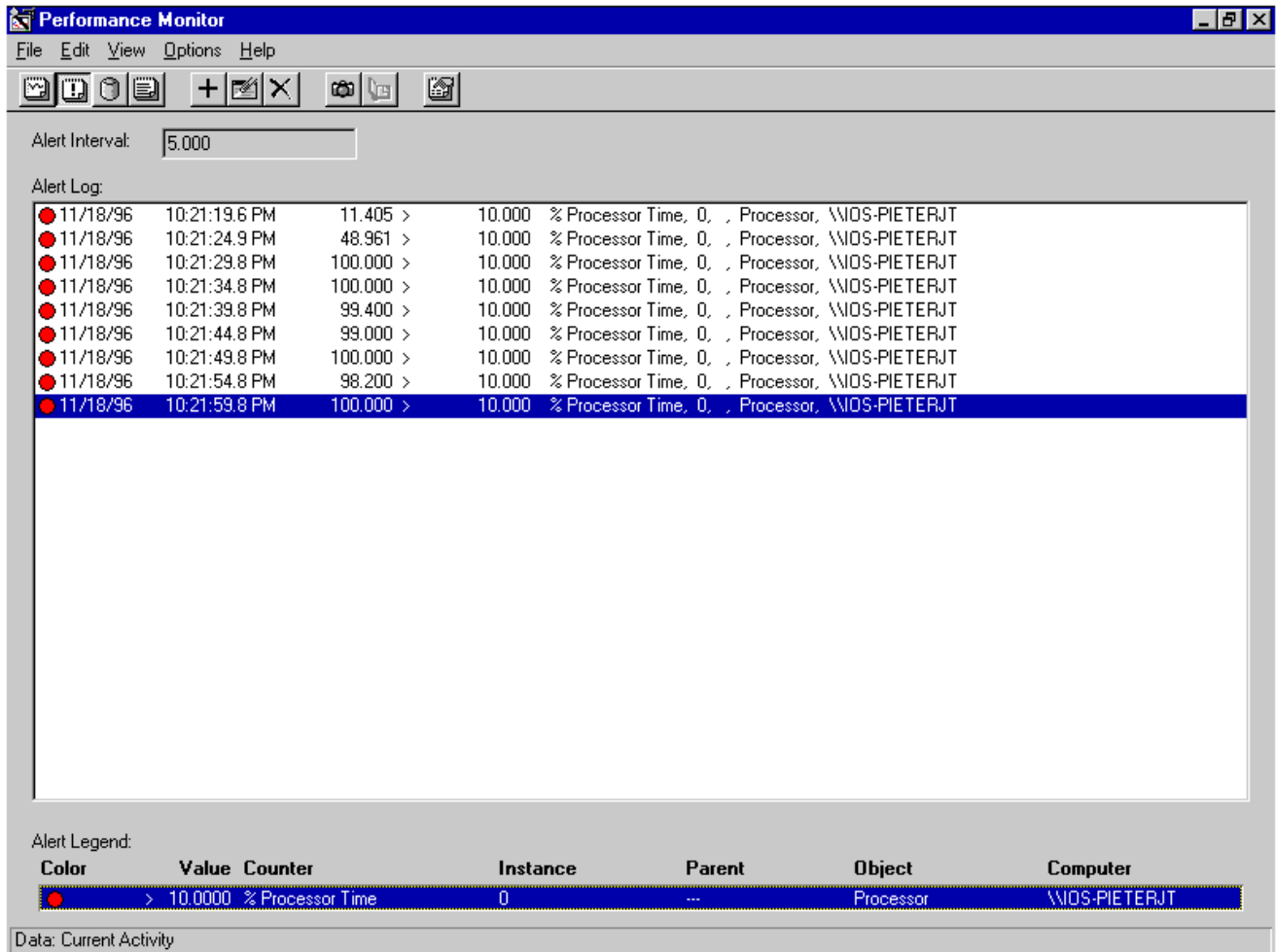



Figure 100. Performance Monitor - Alert View

7.4.1.1 How to Measure Objects Using Alert View

To add an object for monitoring in Alert view, click on **Add to Alert** from the Edit pull-down menu, or click on smart icon . You will see a window similar to the one in Figure 101 on page 126.

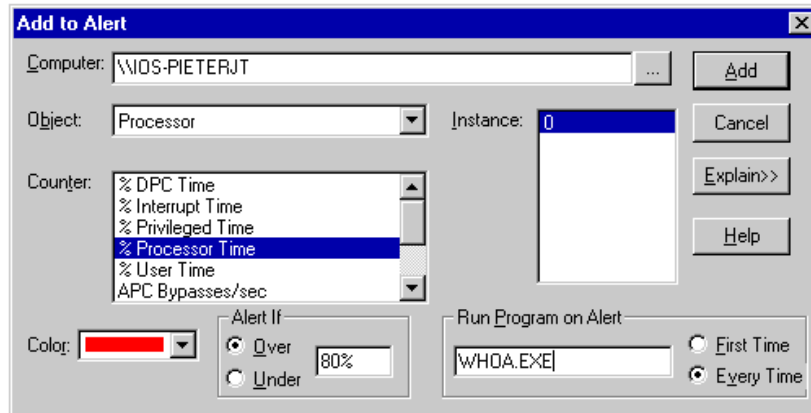


Figure 101. Adding an Alert


7.4.1.2 How to Set Up Alerts

The procedure for adding an object to be measured in Alert view is similar to the Chart view function, but you also have to complete the Alert If field. The steps are as follows:

1. Choose an object to measure.
2. Choose the counter to measure.
3. Choose the instance of the object to measure.
4. Supply a numeric value in the Alert If field (see Figure 101). This value is the threshold upon which the alert will be generated when the object measured reaches it.
5. You can supply an optional program or batch file name in the Run Program on Alert field (see Figure 101). This program or batch file will be triggered once the threshold value is reached.

7.5 Log View

Log view is useful for capturing and storing data to disk for analysis at a later stage.

To select the Log view, click on the **View** pull-down menu and then select the **Log** option. Alternatively, you can click on smart icon . You will see a panel that resembles the one in Figure 102 on page 127.

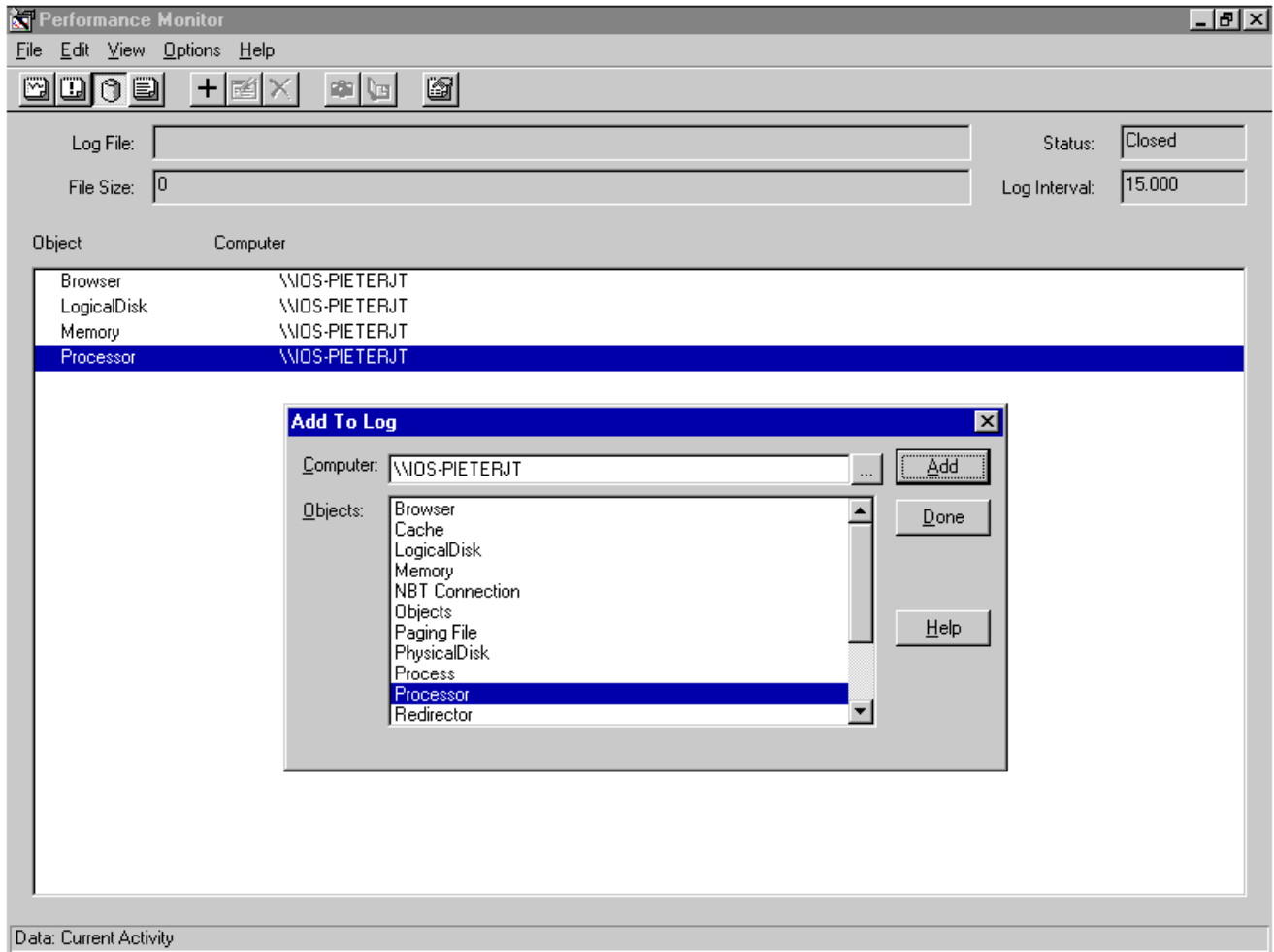



Figure 102. Performance Monitor - Log View

7.5.1.1 Selecting Objects to be Added to the Log File

On the pull-down menu bar, click on **Edit** then **Add to Log** or click on the smart icon . Figure 103 appears. Select each object you wish to log and click on the **Add** button. When you are finished selecting objects to log, click on the **Done** button.

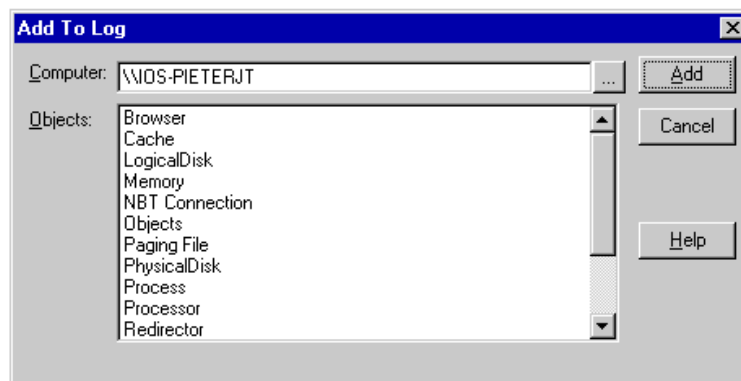



Figure 103. Adding Objects to the Log File

Other Servers

You will notice that you do not have the option to select individual counters. You can, however, select objects from different servers by changing the Computer field.

7.5.1.2 Starting or Stopping the Log File

Once you have selected the objects to log, you can choose the **Options**→**Log** or click on smart icon . You will see a window similar to the one in Figure 104.

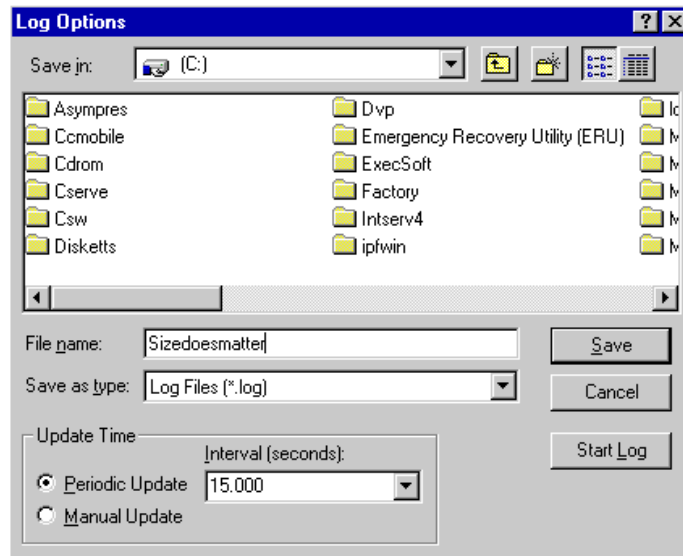


Figure 104. Log Options Window

Type in a filename to save the log to. Modify the logging interval as required.

To start the logging, click on the **Start Log** button.

To stop the logging once it starts, click on **Stop Log** from the Log Options window.

Note: To create a log file, first select the objects that you want to capture data from. If you have not selected any objects, the Start Log button shown in Figure 104 will be grayed out.

7.5.1.3 Retrieving Data from the Log File

By default, Performance Monitor displays current data. In order to view logged data instead you need to *switch* the source of data from Current to Log File.

To use the data collected in the log file, click on **Options** → **Data From...** from the main window. Figure 105 on page 129 appears.

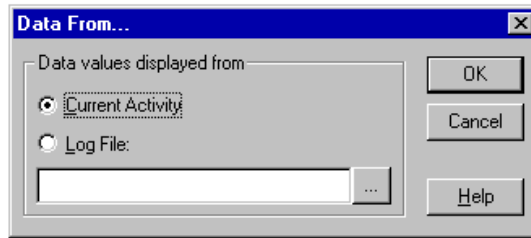


Figure 105. Selecting the Source of Data

Select **Log File** and type in the filename of the log you specified in 7.5.1.2, “Starting or Stopping the Log File” on page 128.

Now, you have the ability to use the other views (Chart, Report and Alert) to view the data you have captured. You add the objects and counters to the selected view as before, using the **+** smart icon. See 7.3, “Chart View” on page 120, 7.6, “Report View” on page 130 and 7.4, “Alert View” on page 124 for details.

7.5.1.4 Selecting a Time Slice from the Log File to Analyze

To select a particular time frame from the log file that you want to analyze, select **Time Window** from the Edit menu. The Input Log File Timeframe window will be displayed (Figure 106).

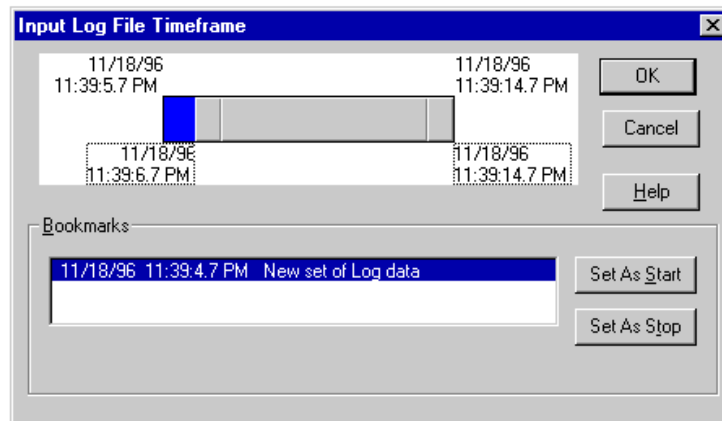


Figure 106. Time Slice Option Window

You can use the slider bar in Figure 106 to change the time window of the data that you are analyzing.


7.5.1.5 Exporting the Log

Once you have displayed the log information using either the Chart, Report or Alert views, you can export that view in text format for analysis by other applications. The data can be exported in

- .TSV format (tab separated variable)
- .CSV format (comma separated variable)

To export data, select **File** → **Export...** from the main pull-down menu bar.

7.6 Report View

The report view can be displayed by selecting **Report View** from the View pull-down menu, or clicking on smart icon  .

Report view is useful for displaying measurements from the individual objects in a numerical form. You can export this data for trend analysis to an application such as Excel or Lotus 1-2-3 by choosing the **Export** function from the File menu.

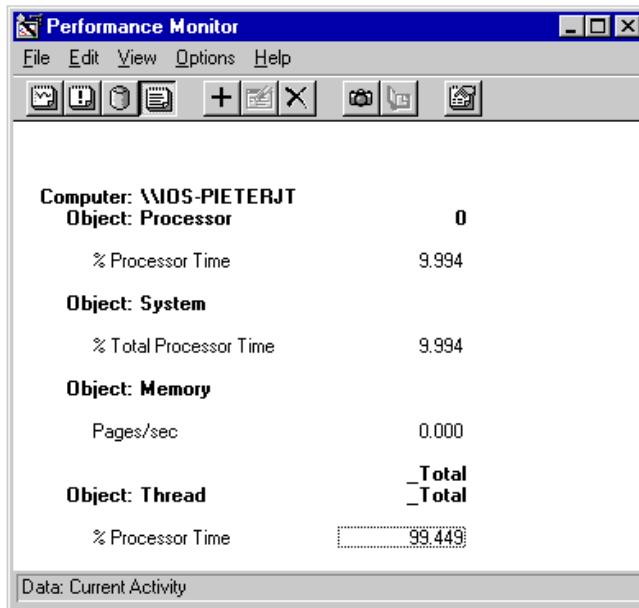


Figure 107. Chart Options Window

You can select multiple objects to be added in the Report view, as shown in Figure 107. Unlike charts, there is no graphical display, but the real-time numeric values of the objects are shown.

Chapter 8. Monitoring and Performance Tuning

Windows NT Server 4.0 is one of the few operating systems that has the ability to self optimize. This can be deceptive, as it will only administer certain aspects of the operating system. Self tuning of the operating system focuses on pagefile and memory management optimization. This is where the system administrator has the task to best use the resources available without spending money on unnecessary upgrades that often have no real benefit.

Note: See Appendix A, "Sources of Drivers and Information" on page 147 for other sources of tuning information.

8.1 Performance Bottlenecks

There are some reasons for poor server performance that are difficult to measure or control. They include a poor choice of hardware, a badly written application and a network infrastructure that is badly designed and managed. This chapter focuses on the most important areas of concern when it comes to tuning and optimizing the available resources of your server, which includes the following:

- Multitasking
- Virtual memory
- CPU
- Memory
- Hard disk
- Network

Note

Always remember to document and measure any changes that you make, and if possible, *not* to make more than one change at a time. This way you will know which changes you made had the desired result and you will be able to replicate the knowledge you have gained in the process.

8.2 Multitasking

Windows NT will pre-emptively prioritize the process threads the CPU has to attend to. However, you have some control over the rules governing this process. Open the Control Panel by clicking on **Start** → **Settings** → **Control Panel**. Open **System** and select the **Performance** tab. You will see a window similar to Figure 108 on page 132.

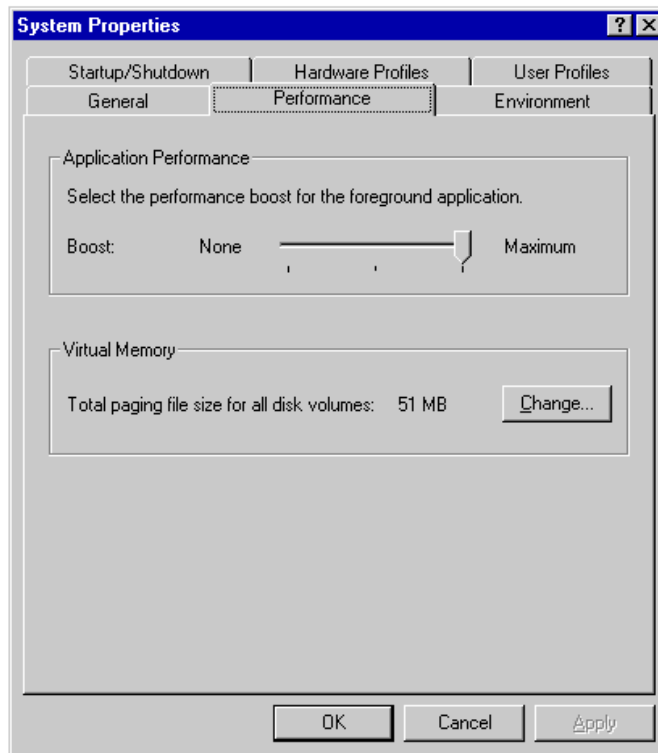


Figure 108. System Performance Properties

If you are not planning to run applications interactively on the server console, move the Boost indicator to **None**. This will give all background applications higher priority when multitasking takes place.

For an application or a database server, moving the Boost indicator to half way may prove to be a better choice. The implication is that foreground and background applications receive equal attention from the CPU.

8.3 Virtual Memory

Windows NT often allocates up to half of the system's RAM to a disk cache. As a result, the operating system is often in need of physical memory. A procedure called *paging* allows it to run applications. Paging is the procedure whereby blocks of data from physical memory are swapped to a file located on disk.

The paging file of Windows NT is PAGEFILE.SYS. This is a contiguous area of disk that allows the Windows NT kernel to bypass the file system to read/write requested pages.

You can control the amount of pre-allocated space used by PAGEFILE.SYS on your disk. From the System icon in Control Panel, select the **Performance** tab. You will see Figure 108.

Now click on the **Change** button. You will now see the following dialog box Figure 109 on page 133.

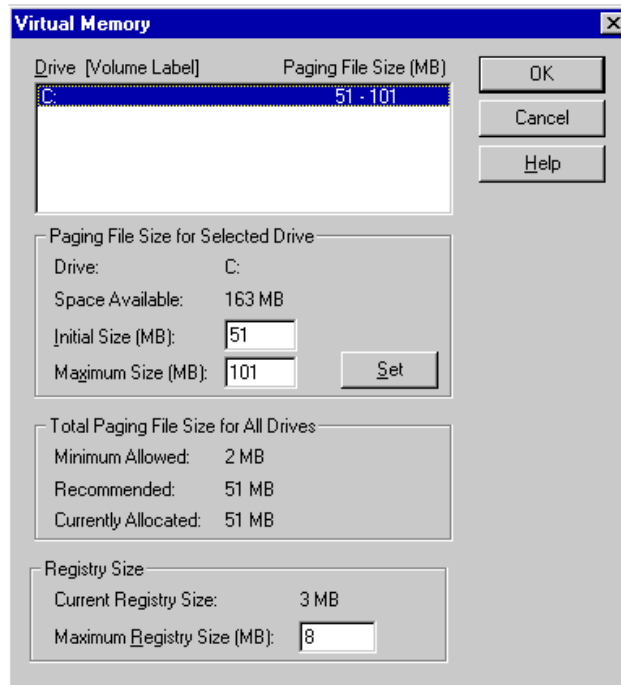


Figure 109. Specifying Virtual Memory Values

You can set the Initial Size and the Maximum Size of the paging file for a specific drive. It is not necessary to make changes to the registry size and it will only waste space if you increase it unnecessarily.

To test the effectiveness of the paging file, use the Performance Monitor to check for the following values (refer to Figure 110). See Chapter 7, “Performance Monitor Overview” on page 119 for information on how to use Performance Monitor.

Object: Paging file
Counter: % Usage peak

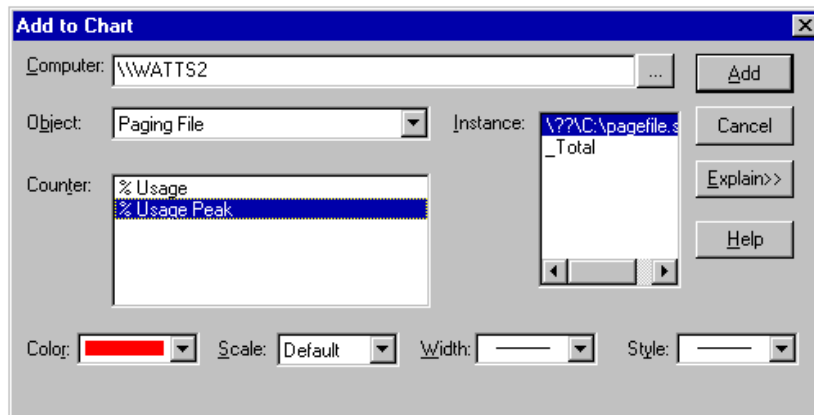


Figure 110. Checking Page File Usage using Performance Monitor

A high value indicates that your paging file is constantly used to its maximum specified size. Increase the maximum size of the paging file when this value is constantly high. The inference, however, is that your system's paging file is either too small or the server needs more memory.

Another way to gain better performance from your virtual memory system would be to establish paging files on more than one drive.

Minimums and Maximums

When specifying a pagefile size, increase the minimum value to equal the maximum value. When the pagefile needs to grow past the minimum value, it will slow down your server in the process. By setting both values equal, you will waste some disk space but the system does not need to spend time sizing the pagefile. If, on the other hand, the pagefile partition has decreased in size since the maximum size value was set, and this partition does not contain enough disk space when the pagefile is expanded, NT will fail with some odd results.

8.4 CPU Bottlenecks

There are several CPUs available on the market that have different characteristics, some with better performance levels than others. However, all of them are hampered by the relatively slow access they have to memory, that is, where the caching design employed by the server of your choice will ultimately be the differentiating factor between the available servers.

This becomes more critical when you plan to use multiprocessor machines. Servers with shared cache design can gain as much as 30% benefit by the addition of a second processor. Additional processors provide very little incremental gain. IBM Servers 320, 325, 330 and 520 are examples of servers with shared cache designs.

The IBM Server 720 is one of the few on the market that make use of a dedicated caching controller for each CPU that is added to the server. This makes the design highly complex and costly to produce, but the performance gains are as much as 80% with the addition of a CPU.

The IBM Server 704 does not make use of caching circuitry on the motherboard, but does rely on the L2 cache circuitry that is built into the Pentium Pro processor. This simplifies the design of the motherboard and has some definite performance gains over other designs.

The role your server will perform impacts the strain being placed on the CPU. Typically, a server running client/server applications, such as the Microsoft SQL Server or Microsoft Exchange Server, will place higher demands on CPU utilization than the typical file server where users store data. Thus, in most circumstances, upgrading other components of your system will produce better results.

Use the Performance Monitor to get an indication of what the CPU utilization is. Check the following (see Figure 111 on page 135):

Object: Processor
Counter: % Processor Time

If this counter, as shown in Figure 111 on page 135, averages 80% utilization and network counter values are low, it indicates that you should consider a CPU upgrade or the addition of a CPU. Making this choice and how much should be done is difficult and is usually governed by your budget restraints.

Note: Refer to 8.7, “Network Components Bottleneck” on page 142 for more details on network object monitoring.

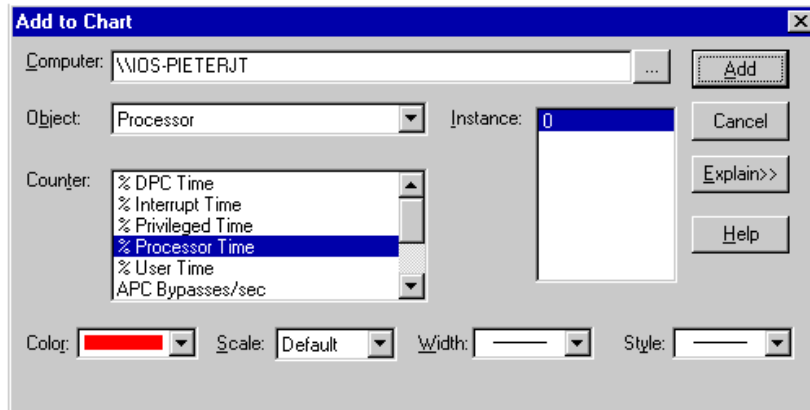


Figure 111. Checking CPU Use using Performance Monitor

Note

Be careful when making this measurement since the amount of foreground applications that are open drastically influences what you see in your results.

Also, most of the 3D Open GL screen savers can place unnecessary strain on your server when they are used. These screen savers could be the cause of the problem and should not be used.

Other checks using Performance Monitor:

Object: System
Counter: Processor Queue Length

A sustained processor queue length greater than 2 generally indicates a processor bottleneck.

Object: Processor
Counter: Interrupts/sec

A dramatic increase in this counter value without a corresponding increase in system activity indicates a hardware problem (typically, a failed adapter).

Object: Processes (_Total)
Counter: %Processor Time

If more than a couple of processes are contending for the majority of the processor time, a faster processor or an additional processor should be considered.

You can also use TME 10 NetFinity's System Monitor to display the CPU load as per Figure 112 on page 136. Refer to 6.6, “System Monitor” on page 116 for more information.

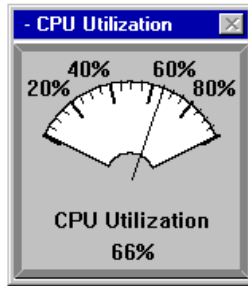


Figure 112. CPU Utilization with TME 10 NetFinity

8.4.1.1 Measuring Multiprocessor Load

In a multiprocessor server, the best way to measure the overall load experienced by the combination of CPUs is to check the following object (Figure 113):

Object: System
Counter: % Total Processor Time

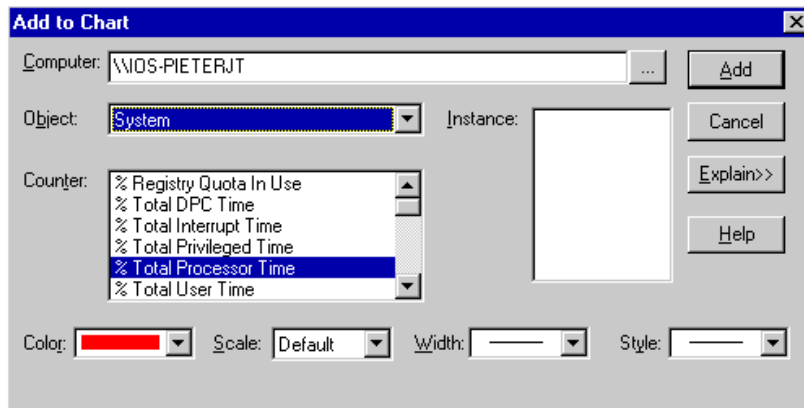


Figure 113. Multiprocessor Load Measurement

If this value is consistently high (80% or more) and disk as well as network counter values are low, then an upgrade to the processor may be the solution.

Note: Refer to 8.7, "Network Components Bottleneck" on page 142 for more details on network object monitoring.

With TME 10 NetFinity, you will see that as soon as you have multiple CPUs installed, you will have monitors available for each CPU. Refer to 6.6, "System Monitor" on page 116 for more information.

8.5 Memory Bottlenecks

Windows NT has the ability to self-optimize certain aspects of the system. This self-optimization or tuning is focused on memory caching and pagefile administration. The tuning is achieved by using memory caching and balancing it by growing the size of the pagefile in anticipation of the load demand that the system expects. The memory management pre-emptively adjusts the amount of caching memory available to best suit the operating conditions.

This is why, on a system that is heavily used, the amount of unused memory seems to be high. The system is trying to buffer the ultra-high demand peaks that it could experience. The opposite is also true when the system experiences medium- or low-load conditions; the amount of unused memory could decrease as a result of the memory cache being flushed and decreased in size. There are well-thought-through memory algorithms that control the memory use of the operating system.

However, a server has finite resources, and the more benefit users see from the system, the more they will demand from it. The amount of memory that your system has available will influence the performance of your server. If your server has a limited amount of memory and demand is placed on the server, even for ordinary tasks, Windows NT will start swapping memory blocks to the pagefile, which can slow your server. The less memory your server has, the slower it will be.

Upgrading server memory is comparatively one of the least expensive of your options when you have to upgrade.

8.5.1.1 Using Task Manager

The Windows NT Task Manager, shown in Figure 114, is useful when quickly assessing the memory and CPU use of your server. Although it is not as accurate as some of the methods described below, it is handy when you just want a quick look at CPU use.

To start Task Manager, click with the right button on the **Task Bar**, and select **Task Manager....** Select the **Performance** tab and Figure 114 is displayed.

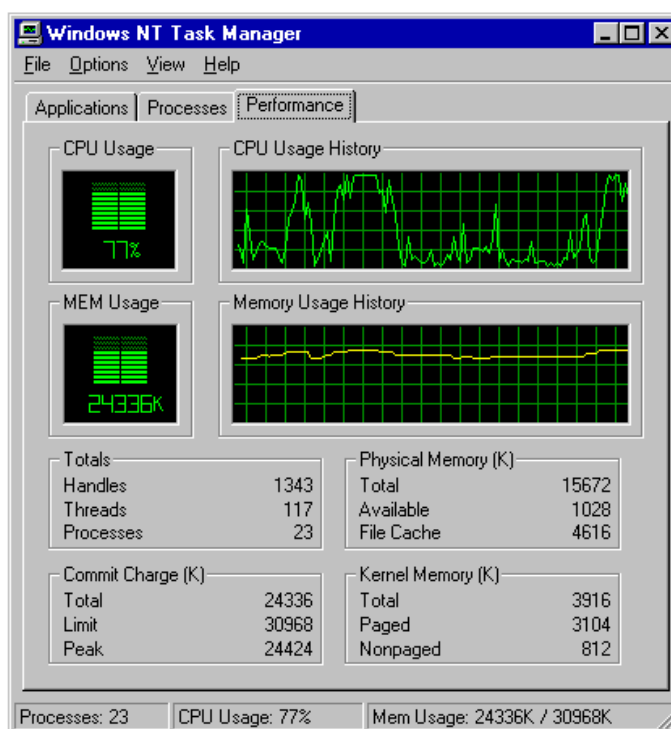


Figure 114. Using Task Manager to Show Memory Usage

8.5.1.2 Using Performance Monitor

A good place to start measuring memory usage is the Performance Monitor. Check the following object (Figure 115):

Object: Memory
Counter: Pages/sec.

This counter should be in the range of 5 or less. Anything above this level indicates that your system is thrashing and could benefit from upgrading the memory.

Note

Be careful. This value could be influenced by a poorly written application that misbehaves. Carefully shut down all applications on your server when you know you will not be impacting the users, until you are able to determine which of your applications is causing the thrashing.

If you cannot find any application running on the server that is the cause of the thrashing, you know that the server has insufficient resources and would benefit from a memory upgrade. If you do find an application that does cause the server to thrash, you will know which application to measure once you have completed the memory upgrade.

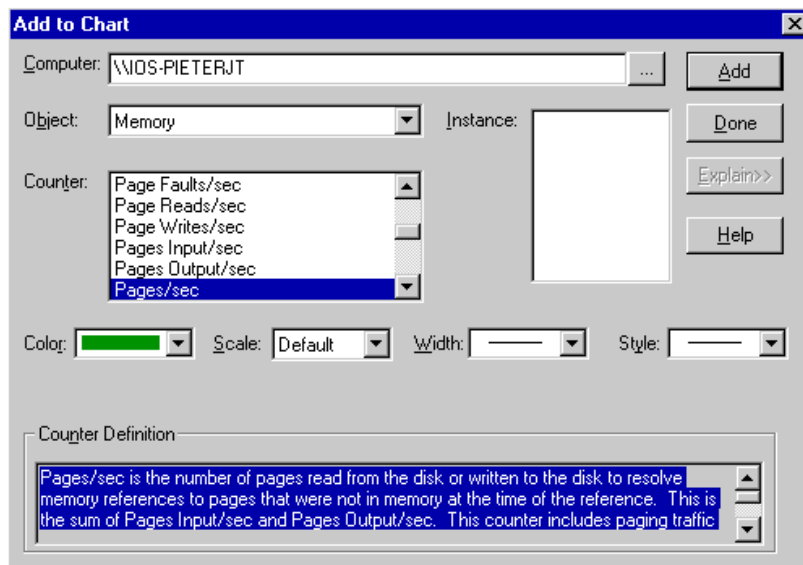


Figure 115. Determining Memory Use

Pages/sec is the number of pages read from the disk or written to the disk to resolve memory references to pages that were not in memory at the time of the reference. This is the sum of Pages Input/sec and Pages Output/sec. This counter includes paging traffic on behalf of the system cache to access file data for applications. This value also includes the pages to/from uncached mapped memory files. This is the primary counter to observe if you are concerned about excessive memory pressure (that is, thrashing), and the excessive paging that may result.

Use the Performance Monitor to check the following:

Object: Memory
Counter: Pages/sec

and

Object: Logical Disk (location of the PAGEFILE.SYS)
Counter: Avg. Disk sec/Transfer

The product of these two counters equals the percentage of the disk access time used by paging memory blocks to disk. If the product of these two counters is greater than 10 on a sustained basis, the system is spending too much time swapping to pagefile and needs more memory.

Use the Performance Monitor to check the following:

Object: Server
Counter: Pool Nonpaged Failures

This measures the number of times allocations from nonpaged pool have failed. If it is too high, it indicates that the computer's physical memory is too small.

Note: The measurement for this object, as well as the next object, may vary from server to server due to operating conditions. You can gain a good feel of what a good value is by observing similar servers that are running adequately.

Using the Performance Monitor, check the following:

Object: Server
Counter: Pool Paged Failures

A high value of Pool Paged Failures indicates that either physical memory or a paging file is near capacity.

Using the Performance Monitor, check:

Object: Server
Counter: Pool Nonpaged Peak

This measures the maximum number of bytes of nonpaged pool the server has had in use at any one point. It also indicates how much physical memory the computer should have and gives a good feel as to what extent you should upgrade your server's memory to.

8.5.1.3 Using TME 10 NetFinity

With TME 10 NetFinity, you have the following displays available to measure memory usage. Locked memory, as depicted in Figure 116 on page 140, is the base amount of memory that the operating system uses.

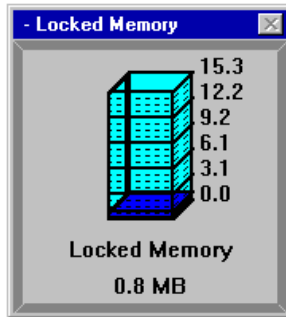


Figure 116. Monitoring Locked Memory Utilization

Memory Usage in Figure 117 is the usage of the total amount of memory available.

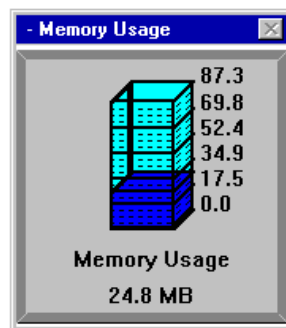


Figure 117. Monitoring Percentage Memory Use

Note

SQL Server and Sybase have parameters that can be set to limit the amount of memory used by these products. Thus, upgrading memory but not changing these parameters might not produce the desired performance increase.

8.6 Hard Disk Bottlenecks

Hard disk bottlenecks are difficult to measure, but careful examination of the results from Performance Monitor and TME 10 NetFinity can aid in this process.

Note

By default, disk performance monitoring is not enabled by the operating system. Enable it by issuing the command `DISKPERF -Y` and rebooting the server. This monitoring will consume extra resources and should be turned off once your testing is complete. Disable monitoring with the command `DISKPERF -N`.

8.6.1.1 Using TME 10 NetFinity

This section describes the use of TME 10 NetFinity's System Monitor to monitor disk performance.

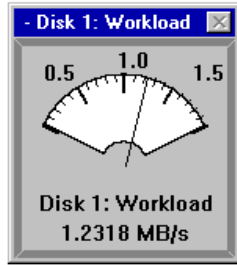


Figure 118. Monitoring Disk Workload with NetFinity

System Monitor, as shown in Figure 118 is useful for gaining a feel for the workload that each drive experiences. You will notice that each logical drive presented to the operating system will have a separate monitor.

You should also check the amount of drive space available on each drive. If any of the drives are near capacity you will not be able to cope with surge load conditions and it will have detrimental impact on the confidence that the user is supposed to have in your system. System Monitor can provide this information, as per Figure 119.

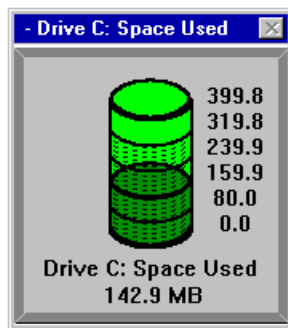


Figure 119. Monitoring the Amount of Disk Space Used

8.6.1.2 Using Performance Monitor

To check for hard disk bottlenecks, use the Performance Monitor to check for the following:

Object: Physical Disk
Counter: Avg. Que. Length

If the value averages 2 or greater, it indicates that the operating system is waiting for the controlling hardware to write information to it.

Check the following:

Object: Physical Disk
Counter: Average Disk sec/Transfer

A high value (values greater than 0.3 seconds) may mean that the disk controller is continually retrying the disk because of failures.

The Average Queue Time is the average amount of time for a disk transfer (either reads or writes) to complete. Measure the following:

Object: Physical Disk

Counter: Disk Queue Length

and

Object: Physical Disk

Counter: Average Disk sec/Transfer

Use the following formula to find the average disk queue time for the Physical Disk Object:

Avg. Queue Time = Disk Queue Length x Avg. Disk sec/Transfer

This information is a relative performance measurement and should be compared with other hard disk drivers in your system. Compute the figures for all logical disks in your system. The number of disk commands waiting in the queue is normally the factor that slows disk performance by increasing the average disk queue time.

Use the Performance Monitor to check the following:

Object: Physical Disk

Counter: Disk Bytes/sec

A Disk Bytes/sec count lower than 20,000 may indicate that an application is accessing a disk inefficiently.

Note

Be careful when analyzing this data. The excessive swapping to disk caused by the lack of memory may give the false impression that the server has a hard disk bottleneck, when the counters measuring the disks indicate that they are over used.

8.7 Network Components Bottleneck

The components that should be investigated that affect the network functionality are described in this section.

Using the Performance Monitor, check the following:

Object: Redirector

Counter: Current commands

If this number is greater than one per network adapter, the redirector may be a bottleneck in the system for one or more of the following reasons:

- The server the redirector is communicating with is slower than the redirector.
- The network may be experiencing capacity problems.
- The redirector is busier than the adapter can keep up with.

If network capacity problems are identified, it may be necessary to subnet the network in an attempt to partition network traffic.

Using the Performance Monitor, check:

Object: Redirector

Counter: Network Errors/sec

If any network errors are logged, check the Event Log for more details.

Using the Performance Monitor, check:

Object: Redirector
Counter: Reads Denies/sec

and

Object: Redirector
Counter: Write Denies/sec

These high values may indicate if the remote servers are having problems with memory allocation.

Using the Performance Monitor, check:

Object: Server
Counter: Work Item Shortage

An increase in Work Item Shortage should cause a change in the registry value(s) InitialWorkItems and/or MaximumWorkItems (depending on when the outage occurred).

Using the Performance Monitor, check the following:

Object: Server
Counter: Raw Reads Rejected/sec

and

Object: Server
Counter: Raw Writes Rejected/sec

Rejections indicate the exhaustion of RAW work items used when busy doing large file transfers. The increase of the registry value RawWorkItems can possibly solve this bottleneck.

8.8 Network Bottlenecks

Use the Performance Monitor to measure the following:

Object: Server
Counter: Bytes Total/sec

If the sum of Bytes Total/sec for all servers is roughly equal to the maximum transfer rates of your network, you may need to segment the network.

This measurement and the ones obtained from Figure 120 on page 144 and Figure 121 on page 144 are indications of the amount of data that is transmitted across your network. These values can vary according to the type of networking topology you are using. In general, a figure of 900 Kbps is usually an indication that your network is saturated and needs segmenting.

The 900 Kbps limitation is a result of the combination of devices that make up your system and the server's ability to transmit and receive data across the network. In particular, this is affected by the ability of the hard disk and network adapter to effectively absorb the data transmission.

The System Monitor function of TME 10 NetFinity can help measure network utilization. Figure 120 on page 144 will measure the amount of data transmitted and Figure 121 on page 144 measures the amount of data received across the network.

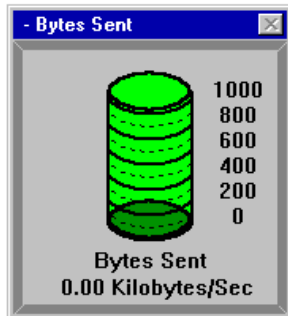


Figure 120. Monitoring Data Transmitted on the Network

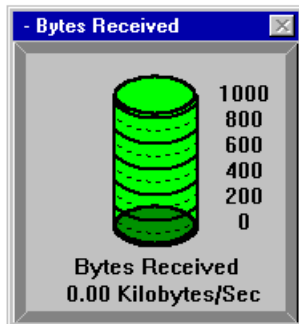


Figure 121. Monitoring Data Received via the Network

To measure these values accurately, we recommend that you use any one of the commercially available network monitoring and measuring devices available. Fluke is only one of many companies that produce these devices in a wide variety of models.

8.8.1 Network Design Issues

Network design and stability issues are often the cause of the perception that a server is slow. It is more difficult to measure some of the common problems that are experienced on networks but Windows NT has some tools to expose possible problem areas.

One of the most common mistakes is the overuse or incorrect use of protocols. The basic principle to follow is that least is best. The binding order will influence how your server performs. Having your most commonly used protocol set as the default protocol will give your system more time to attend to requests originating from the default protocol.

8.8.1.1 Changing the Binding Order of the Protocols

Performance benefits can be gained by optimizing the binding order. For example, if you have a network of 12 users or less, NetBEUI will perform faster than most other protocols. If, however, you also need to communicate with remote servers via TCP/IP on a less frequent basis it would be to your advantage to change the binding order so that the most frequently used protocol is used first.

In this example NetBEUI should be given higher priority. A general rule of thumb is that NetBEUI is fastest up to 12 users and for larger networks, TCP/IP should be considered. However, experimentation in this regard should be done to establish the optimal binding order for a particular environment.

As shown in Figure 122, right-click on the **Network Neighborhood** icon located on the desktop, and click on **Properties**.

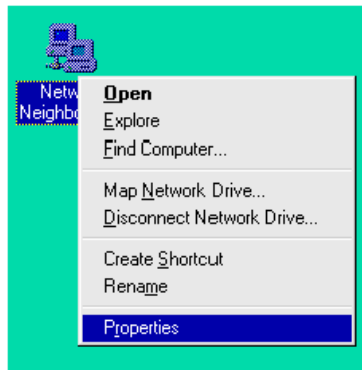


Figure 122. Changing the Network Object Properties

Select the **Bindings** tab at the top of the panel, as seen in Figure 123 on page 146.

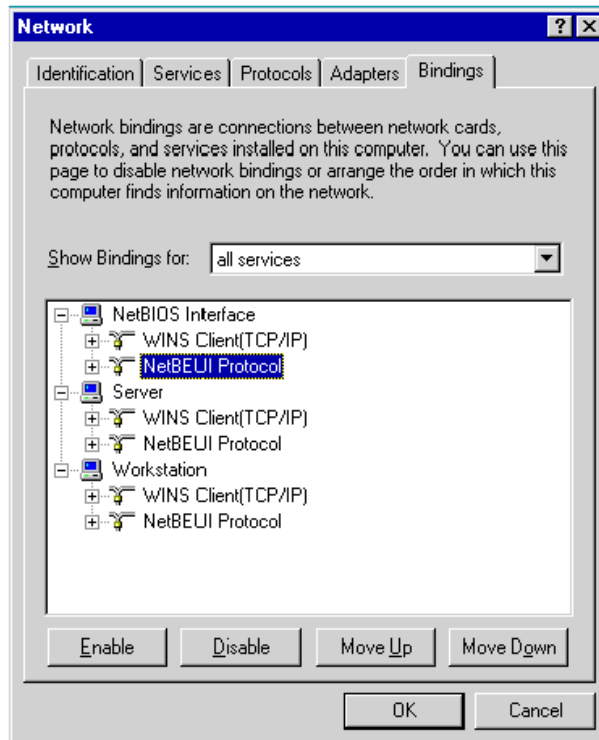


Figure 123. Changing the Protocol Binding Order

By selecting a protocol and clicking on the **Move Up** and **Move Down** buttons, you will be able to change the binding order of your protocols.

By experimenting with the binding order you should be able to achieve faster response times, depending on the protocol mix and the network infrastructure that you are using.

8.8.1.2 Network Design Hints

Some sound network design guidelines include the following:

- Keep 10Base-T devices to less than 35 per segment.
- Use good-quality Category 5 cable in UTP installations.
- Keep Cat 5 cable under the 100 m total length limit.
- Keep 10Base2 segments to under 185 m.
- Keep token-ring devices to less than 70 per ring.
- Employ switching to segment your network or use the IBM Quad PeerMaster Ethernet adapter. Avoid using the server to achieve this.
- Keep your protocol mix simple (least is better).
- The IPX protocol is, in most circumstances, slower than both NetBEUI or TCP/IP.
- Change the binding order to use your default protocol more efficiently.
- Standardize as much as possible. Products from some manufacturers will react slightly differently from the expected in a mixed environment.
- Check for cabling faults, which is most frequently the cause of network slowdowns.

Appendix A. Sources of Drivers and Information

One of the challenges that LAN administrators face is ensuring that the adapters they want to use are supported and then finding the latest level of device drivers for these adapters. Another problem they face is trying to find information about known software bugs and their corresponding fixes. This appendix is included to help readers solve these problems.

For a general source of information and support for IBM PC servers, go to the World Wide Web (WWW) at the following Universal Resource Locators (URLs):

<http://www.pc.ibm.com/servers>
<http://www.pc.ibm.com/techlink/tcsrvsp1.html>

The latter URL is part of IBM TechConnect program. Refer to Appendix B, "IBM TechConnect Program" on page 151 for more information.

A.1 Compatibility Information

IBM does extensive testing on each new system before it is introduced to ensure that it is compatible with the wide variety of IBM and non-IBM hardware and software. Compatibility information is available from the following Web site:

<http://www.pc.ibm.com/compat/compat.html>

This site has a wealth of valuable information. It contains the following:

- A comprehensive listing of products that have been tested for compatibility with these servers and a technical description of each server.
- Compatibility reports and information about network and workstation operating systems, showing detailed information on hardware configurations, adapters, device drivers, and code levels used in the testing.
- Direct access to device drivers, flash BIOS updates, and other server code.
- An overview of how IBM conducts compatibility and certification tests.

This is an excellent source of information to ensure your hardware and software are supported by IBM servers. It is updated regularly with the latest NOS certifications and driver updates.

Microsoft also has a *hardware compatibility list*, which lists all hardware from many vendors that has been tested to be compatible with NT 4.0. Drivers can also be found here. The HCL can be found at either of two URLs:

<http://www.microsoft.com/BackOffice/ntserver/hcl/hclintro.htm>
<http://www.microsoft.com/isapi/hwtest/hsearchn4.idc>

A.2 Device Drivers

The IBM PC Company Home Page has a very good file repository containing drivers and BIOS updates, as well as other documentation and drivers, including the new ServeRAID software:

<http://www.pc.ibm.com/servers/#files>

In addition to this Web site, IBM has another site that contains a file that has LAN adapter device driver information. This file is a matrix of adapters and drivers and version levels. It is updated frequently as new drivers become available. The file is named DRVRLIST.EXE and is a self-extracting ZIP file containing a Word 6.0 document. It can be obtained from the PC Company BBS at either:

<ftp://ftp.pcco.ibm.com/pub/pccbbs/network>

or via modem at (919) 517-0001 in Raleigh, North Carolina, USA. There are also IBM bulletin boards in other countries where IBM operates.

If it is an IBM adapter, the driver itself can be obtained from the same site. In addition, the IBM Networking Hardware Division maintains an FTP site at URL:

<ftp://lansupport.raleigh.ibm.com/pub/products/lanprods>

Microsoft's *hardware compatibility list* also points to drivers that are available. URLs that will get you there are:

<http://www.microsoft.com/BackOffice/ntserver/hcl/hclintro.htm>

<http://www.microsoft.com/isapi/hwtest/hsearchn4.idc>

For OEM adapters, many manufacturers have Web and FTP sites. Examples include:

<http://www.adaptec.com>

<http://www.mylex.com>

<http://www.madge.com>

<http://www.3com.com>

There are also useful Web sites run by people not necessarily related to hardware or software vendors. One such site is the LAN Drivers Page at:

<http://sunsite.unc.edu/~towfiq/lan-drivers.html>

A.3 Tuning Information

On Microsoft's Web site, you can get other information and white papers about tuning Windows NT. One such source is:

<http://www.microsoft.com/syspro/technet/boes/bo/winntas/technote/nt301.htm>

A.4 Other Information

Microsoft's *Knowledge Base* on the Web is an excellent source of information regarding NT 4.0 installation and operation. The URL is:

<http://www.microsoft.com/kb>

For product information, check the IBM PC Company home page as well as the NT 4.0 home page. These are at:

<http://www.pc.ibm.com/servers>

<http://www.microsoft.com/ntserver>

There are also various sources of hints and tips on the Web. One recent addition is from CNET:

<http://www.cnet.com/Content/Features/Howto/NT4tips/index.html>

Tips come under the following headings:

- Customize your user interface
- Get up and running - fast
- Put NT on the Net
- Gain control of your network
- Manage more efficiently
- Unlock security secrets
- Pick up NT's performance

Appendix B. IBM TechConnect Program

The IBM TechConnect program is a server training, certification and information resource program. It is designed to help network specialists increase their technical skills and proficiency on IBM servers as well as networking and open computing solutions.

IBM TechConnect will offer server technical specialists value-added capabilities by offering state of the industry hands-on PC Server training and certification as well as:

- Industry-leading PC Server products and technical field support
- Technical specialist peer networking opportunities
- Unique incentives and rewards in recognition of re-seller and individual's technical achievements

In today's competitive environment, business customers of every size are relying on increasingly sophisticated PC Server networks to support, run and profitably manage their businesses. In addition to requiring advanced, fault-tolerant PC Servers, customers require highly skilled, qualified technical professionals to design, install and support their growing networks. The IBM TechConnect program is designed to meet these customer challenges. TechConnect focuses on informing, training, educating, and developing highly skilled people to fully support IBM PC Server customers from a total networking solutions perspective.

The program works at two levels:

1. The *Associate path* is an information connection, a quarterly mailing of our TechConnect CD that contains technical information designed specifically for networking specialists.
2. The *Certification path* includes hands-on lab training with real-life problem solving opportunities on IBM PC Server products. Course content will focus on underlying technology, in addition to specific products, to maximize value and provide transferable skills.

B.1 Certification

By attending the technical training being run through the IBM PC institute, individuals are working towards certification as an IBM Professional Server Specialist (PSS) or an IBM Professional Server Expert (PSE), which provides unique incentives and rewards in recognition of re-seller and individual's technical achievements.

The courses descriptions and codes are:

- IBM Server Technical Training (V5051): PSS and PSE designation
- IBM Server/Novell NetWare Installation and Performance (V5052): PSE designation
- IBM Server/IBM LAN Server Installation and Performance (V5053): PSE designation
- IBM Server/Microsoft Windows NT (V5055): PSE designation

The professional roles being certified by IBM are:

- IBM Professional Server Specialist (PSS)
- IBM Professional Server Expert (PSE) - Novell NetWare
- IBM Professional Server Expert (PSE) - IBM LAN Server
- IBM Professional Server Expert (PSE) - Microsoft Windows NT
- IBM Professional Server Enterprise Expert (PSEE)

The Professional Server Enterprise Expert (PSEE) curriculum, open to those holding PSE designations, will include client/server-mainframe connectivity specialization paths with course work covering LAN, WAN, network management, backup/recovery and security.

To certify as a Professional Server Specialist (PSS) individuals must complete the IBM Server Technical Training course and gain a pass mark in the certification test. The PSS will receive a TechConnect PSE Priority mailing that includes the TechLink plus audio and video tapes and CDs.

To certify as a Professional Server Expert (PSE) individuals must complete the IBM server technical training course and one of the three IBM server/network operating system installation and performance courses. Individuals may choose more than one IBM server/network operating system installation and performance course.

In addition, two certification tests must be passed covering topics from the IBM server technical training course and one of the IBM server/network operating system installation and performance courses.

IBM will provide support to Professional Server Experts (PSEs) by offering the following benefits:

- Priority access to the IBM network and server support center via Internet to enable support of networks and effective problem determination and resolution of server/LAN issues.
- TechConnect PSE Priority mailing
- PSEs working for IBM business partners will enable their employer to take advantage of additional incentives on the purchase of IBM server product.
- Recognition programs will be run to recognize technical excellence in our IBM PSEs.

As a prerequisite to certifying as a Professional Server Expert, an individual must show proof of one of the following network operating systems certifications:

- Novell Certified NetWare Engineer (CNE)
- Certified OS/2 LAN Server Engineer
- Microsoft Certified Systems Engineer (MCSE)

For more information on TechConnect on the Web, go to the TechConnect home page:

<http://www.pc.ibm.com/techlink>

For information about OS/2 LAN Server certification, go to URL:

<http://www.austin.ibm.com/pspinfo/proroad.htm>

Appendix C. Windows NT Server 4.0 Service Packs

It is advisable to install the latest service pack available from Microsoft, as this will contain the most recent bug fixes for the product.

Service packs for NT 4.0 are available from Microsoft on CD-ROM, or they can be downloaded from the Internet at the following URL:

`ftp://ftp.microsoft.com/bussys/winnt/winnt-public/fixes/usa/nt40`

At the time of publication, service pack 2 was available for download from this FTP site. Service packs are cumulative, that is, they contain the fixes of all previous service packs. Therefore, if you are installing service pack 2, you do not have to install service pack 1 first.

The README file associated with each service pack list what fixes are included. The updated symbols for the service packs are also available at the FTP site.

Note: Ensure you obtain the symbols and service packs for the Intel platform. The FTP site contains code for MIPS, Alpha and PowerPC hardware as well.

C.1.1 Installing the Service Pack

1. If installing the service pack from CD-ROM, insert the service pack CD-ROM disk into the CD-ROM drive.
2. At the Windows NT command prompt, change to I386 on the CD-ROM drive or to the drive/directory where you have downloaded and unpacked the service pack.
3. Enter the following command:
`UPDATE`
4. Follow the instructions on the panel.

All encryption related components in the version of service pack 2 are limited to exportable 40-bit cryptography. During installation, as shown in Figure 124 on page 154, you will be prompted when an existing component on your system, containing 128-bit encryption, is about to be replaced by an updated component with 40-bit encryption. If you require 128-bit support, you should click the **Cancel** button on the dialog box.

A version of this service pack with 128-bit encryption is also available on request from Microsoft. To obtain it, refer to URL:

`ftp://ftp.microsoft.com/bussys/winnt/winnt-public/fixes/usa/nt40/ussp2/read128.txt`

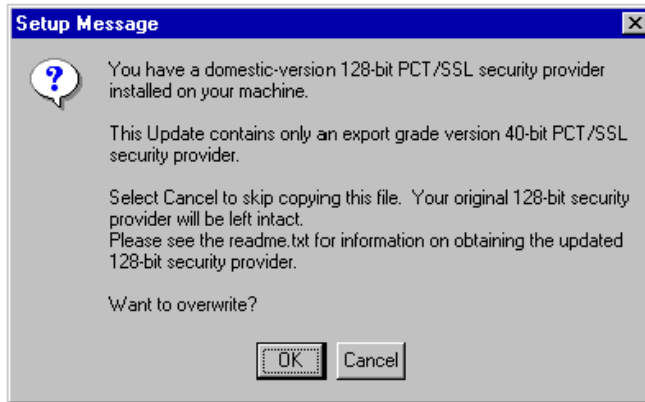


Figure 124. Encryption Components in the Service Pack. If you use 128-bit encryption, you should click on **Cancel** in order not to overwrite the encryption files.

If you choose not to install the encryption components, you will gain some security benefits in a secure C2 environment. Either choice does not have any impact on the functionality of your server.

C.2 Emergency Repair Disk (ERD)

If it is necessary to use the Windows NT ERD to repair your Windows NT system after you apply the service pack, you will need to re-apply the service pack after the repair has completed.

The ERD repairs your system by restoring your original Windows NT Setup information, which subsequently changed, thus resulting in the need to re-apply the service pack. After the repair has completed, simply follow the above installation instructions to re-apply the service pack.

It is *advisable* to update your ERD after you make any changes to the system.

You can do this by running RDISK.EXE from the \WINNT\SYSTEM32\ directory.

C.3 Adding New Components to the System

If new software or hardware components are changed or added to your system after you have applied the service pack, it will be necessary to re-apply the service pack. This is because the files taken from the original Windows NT disk set may not be equivalent to the files on the service pack disk set.

It is not possible to install new components directly from the Service Pack media (such as a new keyboard or printer driver); they must be installed from the original product media.

Don't Forget!

Remember to recreate the emergency repair disk.

Appendix D. Tips on Windows NT and IBM Hardware

This chapter provides hints and tips about some common problems experienced by end users installing Windows NT on IBM platforms.

Please refer to Appendix A, "Sources of Drivers and Information" on page 147 for more details on where to get the latest service packs, updated drivers and where you can query the Microsoft Knowledge Base.

Another source of information is IBM's TechConnect program. Refer to Appendix B, "IBM TechConnect Program" on page 151 for more information.

D.1 IBM SCSI-2 Streaming RAID Adapter/A

The Micro Channel SCSI-2 Streaming RAID Adapter/A may not be correctly recognized by Windows NT. The symptoms are that the operating system cannot find the CD-ROM drive. This adapter is standard in RAID models of the Server 720 and Server 500.

The solution is to press S to skip detection of disk controllers in the early stages on the installation and when prompted insert the Driver/Configuration diskette in the drive to select "IBM RAID Controller" instead.

See Appendix A, "Sources of Drivers and Information" on page 147 for information on where to get the latest driver diskettes.

D.2 IBM Auto ISA Token-Ring Adapter

The following is a list of tips associated with the IBM Auto ISA Token-Ring adapter:

- When replacing the adapter, we suggest that you remove the drivers from Windows NT and re-install them. Sometimes Windows NT has a problem recognizing the new adapter.
- Disable Plug and Play BIOS feature on the adapter. NT 4.0 does not detect any changes made by the PnP BIOS. Therefore, any changes that the PnP BIOS makes will cause the IBM Auto ISA device drivers to fail.
- If the adapter is inserting at the wrong ring speed, you will experience odd problems. Run the LANAIID utility and make sure that Auto-Sensing is enabled; this should correct the problem.

D.3 Micro Channel Network Adapters

Reference: Knowledge Base entry Q156324

There is a known bug in the base NT 4.0 code that prevents Micro Channel network adapters from functioning. When you start Windows NT on a server with such an adapter installed, you may receive errors:

At least one service or driver failed during system startup.
Use Event Viewer to examine the event log for details.

When you look at the event log, you see the following entry:

A device connect to the system is not functioning.

As per the Knowledge Base entry the cause of this bug is:

The MCA Setup program and the adapter's OEMSETUP.INF file identify the slots on an MCA bus differently than the Windows NT hardware abstraction layer (HAL). The Windows NT HAL identifies the slots beginning with 0 (for example, physical slot 1 is SlotID 0), but the MCA setup program and the OEMSETUP.INF file start with 1.

The fix is a new NDIS.SYS driver and is contained in Windows NT 4.0 Service Pack 2.0. The fix can also be obtained separately from the following URL:

```
ftp://ftp.microsoft.com  
/bussys/winnt/winnt-public/fixes/usa/nt40/hotfixes-postSP1/mcanet-fix/  
NDIS40I.EXE
```

This is a self-extracting EXE which contains a README.TXT file with installation information.

Note: If the server is a Primary Domain Controller (PDC) or a stand-alone server, then this bug will not prevent the completion of the installation of Windows NT. It will, however, prevent successful completion on a Backup Domain Controller (BDC) because the installation routines go out onto the network to find the PDC. To solve this, you can do either of two things:

- Install a non-MCA network adapter, configure to use it during installation, then migrate to the MCA adapter upon completion.
- Install Windows NT 3.51 first and connect to the network (NT 3.51 does not have this bug), then upgrade to NT 4.0. The server will fail to connect at this point, but you can install Service Pack 2 to fix the problem.

D.4 IBM 100/10 PCI Ethernet Adapter Hangs with IBM Server 320/520

Download the latest drivers from IBM to overcome the problem. See Appendix A, "Sources of Drivers and Information" on page 147.

D.5 Micro Channel LANStreamer Adapter

The Auto LANStreamer MCA Adapter driver supplied with NT 4.0 will not work. Please refer to Appendix A, "Sources of Drivers and Information" on page 147 for details on where to get the latest update of the driver.

Also, when the server shuts down with this adapter installed, it might not reset the adapter properly, forcing you to power off the server completely to correct the problem.

D.6 PCI LANStreamer Adapter Hangs When Shutting Down

When the following adapters are installed, you could experience a problem while shutting down your server. Installing the latest service pack should solve the problem. See Appendix A, "Sources of Drivers and Information" on page 147.

The following adapters are affected:

1. IBM Auto LANStreamer PCI Adapter FRU part 04H8098 (Option part 04H8095)

2. IBM Triple LANStreamer PCI Adapter FRU part 25H6305 (Option part 25H6304)

D.7 Problems Associated with Third Party OEM Network Driver Diskettes

When installing NT 4.0 you might experience problems during the installation phase. You will see error messages relating to the network adapter, for example:

```
An error has occurred  
Unable to open the file d:\I386\oem-file-name
```

There is a bug in the installation process that overwrites critical files on the OEM diskette. To overcome this problem, we suggest that you first install an adapter that is listed in the hardware compatibility list and then replace it with the adapter requiring the OEM driver once the installation process has completed.

This is done in order establish a domain or become part of a domain. Where your server is not part of a domain, you could just skip the network adapter selection process and install one later.

D.8 Token-Ring Adapters

If you are using token-ring adapters, we recommend that once you have completed the installation, you shut down and power off the machine before restarting it. We have found instances when the adapter did not function correctly until it was powered off.

Appendix E. The Hardware Abstraction Layer (HAL)

The Hardware Abstraction Layer is a software interface between the hardware and the rest of the operating system that makes Windows NT portable across platforms. The HAL also acts as the interface between the operating system and the controlling hardware of symmetric multiprocessing processor machines (SMP).

Windows NT Server 4.0 is shipped with a HAL for both the single or multiprocessor platforms available from Intel, MIPS, PowerPC and Alpha. The HAL for each platform is different; even the HAL for variants of the same platform could differ drastically. However, the virtualized processor presented by each HAL to the microkernel is identical.

Depending on the design of the platform, the addition of more processors in an SMP environment could improve the performance of the server substantially.

On a machine with only one processor installed, Windows NT will, by default, try to install the single processor version of a HAL. This is the case even when the machine is multi-processor capable. If you accept the default of a single-processor HAL and later wish to add a second processor, you will need to upgrade your system. This may be a difficult task.

There are two methods to achieve this:

1. Upgrade the HAL
2. Reinstall Windows NT

These are described in the following sections.

Note

If you have a server that is multi-processor capable, we recommend that you initially install a multiprocessor HAL. This will save you time and effort later when and if you decide to upgrade to a multiprocessor environment.

E.1 Upgrading the HAL for Multiprocessor Use

The method described in this section makes use of the UPTOMP.EXE utility that is available from Microsoft in the Microsoft Windows NT Server Resource Kit (ISBN: 1-57231-344-7). When you want to upgrade a single processor computer with Windows NT 4.0 installed to a multiprocessor system, several files have to be changed.

Backup Your System FIRST!

We strongly recommend you backup your server before you proceed with this process.

The affected files are:

- NTOSKRNL.EXE (NTKRNLMP.EXE has to be copied and renamed to NTOSKRNL.EXE)

- HAL.DLL (system-specific HAL*.DLL has to be copied and renamed to HAL.DLL)
- KERNEL32.DLL
- NTDLL.DLL
- WINSRV.DLL
- WIN32K.SYS (new for NT 4.0)

Although the UPTOMP.EXE file from the Windows NT 4.0 Resource Kit does copy the correct files, WIN32K.SYS is *not* copied with this utility.

E.1.1 Resolving Problems with the UPTOMP.EXE Utility

There are some problems associated with the current release of the UPTOMP.EXE utility. The following are the steps to resolve them:

1. Locate the WIN32K.SYS file on the NT 4.0 CD, and copy it to the \WINNT\SYSTEM32 directory.

Note: The file might be compressed as WIN32K.SY_. Use EXPAND.EXE to uncompress the file.

2. Copy all the files of the UPTOMP.EXE utility to a temporary directory.
3. Edit the UPTOMP.INI file in the Resource Kit and add the WIN32K.SYS to the end of the list of files as follows:

```
hal.dll = 1, 2, hal.dll
ntoskrnl.exe = 0, 2, ntkrnlmp.exe
ntdll.dll = 0, 2, ntdll.dll
kernel32.dll = 0, 2, kernel32.dll
winsrv.dll = 0, 2, winsrv.dll
win32k.sys = 0, 2, win32k.sys
```

4. Run the UPTOMP.EXE utility from the temporary directory. Select the HAL you wish to change to (see Table 4 on page 90).

E.2 Reinstalling Windows NT to Upgrade the HAL

If you were unsuccessful when using the UPTOMP utility, you will need to completely reinstall Windows NT and thereby install a new HAL. This will mean your user definitions and any other configuration of your server will be lost. You should save this information prior to reinstallation.

Note: If the server whose HAL you wish to upgrade is the Primary Domain Controller (PDC), it is possible to use another spare server to hold the user configurations while you are reinstalling. See E.2.1, "Using the Backup Domain Controller" on page 161.

To do this, the process is a standard installation as per Chapter 5, "Installing Windows NT Server 4.0" on page 81. Follow those steps until after you read/agree to the license agreement. At this point you will see Figure 125 on page 161.

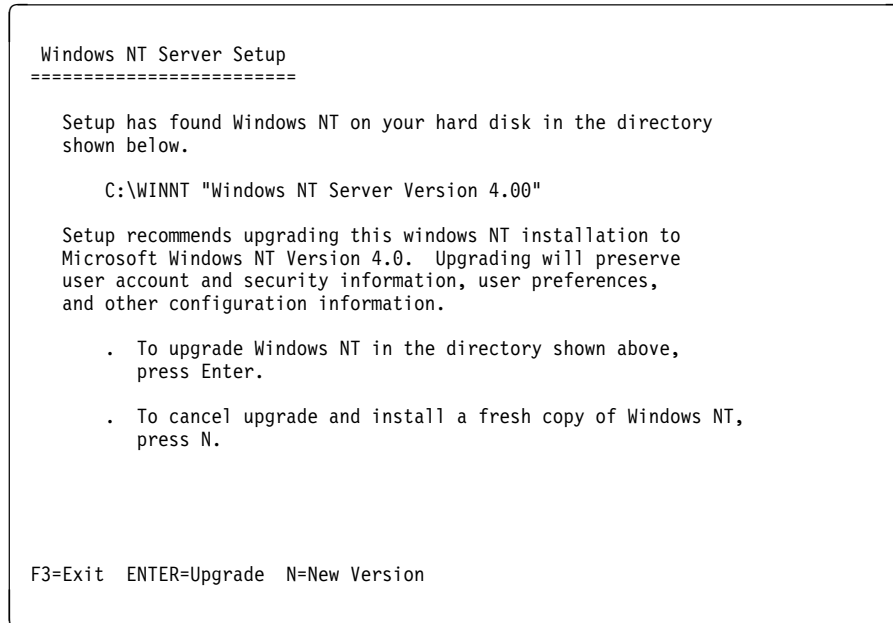


Figure 125. Previous Version of Windows NT Detected

Press N to install Windows NT from scratch. You will then be asked to select the type of computer (that is, select the HAL) as per Figure 64 on page 89. Ensure you select the correct multiprocessor HAL as per Table 4 on page 90.

The installation process as described in Chapter 5, “Installing Windows NT Server 4.0” on page 81 continues, although some steps will be skipped as part of the upgrade process.

Note

After the installation process has completed, make sure that you reload any service packs that had been installed prior to starting this procedure, and recreate your emergency repair disk.

E.2.1 Using the Backup Domain Controller

If the server whose HAL you wish to upgrade is the Primary Domain Controller (PDC), you can use your Backup Domain Controller (BDC) to take on the functions of the PDC while you reinstall. If you do not have a BDC, you will need to obtain a machine that has sufficient memory, disk and CPU capacity to act as the PDC. Install NT 4.0 on that server and set it as the BDC.

Backup

We recommend that you back up your system before proceeding, including the registry (backing up the registry is not the default). Promoting the BDC to PDC will maintain the user security database (that is, all user accounts, passwords and rights), but nothing else.

Now, promote the BDC to be the PDC. From the BDC, click on **Start** → **Programs** → **Administrative Tools** → **Server Manager** to start the Server Manager. From Server Manager, select the **BDC** (if it isn't already selected). Then from the

pull-down menu bar, select **Computer** then **Promote to Primary Domain Controller**. This will promote the BDC to the PDC function, and demote the PDC to be the BDC.

You can then take the BDC (which was the original PDC) offline, and reinstall it, specifying the correct HAL.

Once the installation is complete, use Server Manager again to promote your newly installed server back to being the PDC and restore all missing data and applications.

Appendix F. Special Notices

This publication is intended to help IBM customers, business partners, systems engineers and consultants implement Windows NT Server 4.0 on an IBM PC Server platform. The information in this publication is not intended as the specification of any programming interfaces that are provided by IBM. See the PUBLICATIONS section of the IBM Programming Announcements for IBM PC Servers for more information about what publications are considered to be product documentation.

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Appendix G. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

G.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see "How to Get ITSO Redbooks" on page 167.

- *Systems Management from an NT Server Point of View*, SG24-4723

G.2 Redbooks on CD-ROMs

Redbooks are also available on CD-ROMs. **Order a subscription** and receive updates 2-4 times a year at significant savings.

CD-ROM Title	Subscription Number	Collection Kit Number
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G.3 Other Publications

These publications are also relevant as further information sources:

- *Microsoft Windows NT Server Resource Kit*, ISBN: 1-57231-344-7

How to Get ITSO Redbooks

This section explains how both customers and IBM employees can find out about ITSO redbooks, CD-ROMs, workshops, and residencies. A form for ordering books and CD-ROMs is also provided.

This information was current at the time of publication, but is continually subject to change. The latest information may be found at URL <http://www.redbooks.ibm.com>.

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```
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```

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```
TOOLCAT REDBOOKS
```

To get lists of redbooks:

```
TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET ITSOCAT TXT
TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET LISTSERV PACKAGE
```

To register for information on workshops, residencies, and redbooks:

```
TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ITSOREGI 1996
```

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```
TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ORGCARD PACKAGE
```

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