IBM® Netfinity®

ServeRAID™-4L Ultra160 SCSI Controller User's Reference

SC06-P461-10

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SC06-P461-10

Note: Before using this information and the product it supports, be sure to read the general information under “Appendix. Product warranties and notices” on page 81.

First Edition (June 2000)

Safety

Before installing this product, read the Safety Information book.

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Antes de instalar este produto, leia o Manual de Informações sobre Segurança.

安装本产品前请先阅读《安全信息》手册。

Prije instalacije ovog proizvoda pročitajte priručnik sa sigurnosnim uputama.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs hæftet med sikkerhedsforskrifter, før du installerer dette produkt.

Lue Safety Information -kirjanen, ennen kuin asennat tämän tuotteen.

Avant de procéder à l'installation de ce produit, lisez le manuel Safety Information.

Vor Beginn der Installation die Broschüre mit Sicherheitshinweisen lesen.

Πριν εγκαταστήσετε αυτό το προϊόν, διαβάστε το εγχειρίδιο Safety Information.

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

Przed zainstalowaniem tego produktu należy przeczytać broszurę Informacje Dotyczące Bezpieczeństwa.

Prima di installare questo prodotto, leggere l'opuscolo contenente le informazioni sulla sicurezza.

本製品を導入する前に、安全情報資料を御読みください。

이 제품을 설치하기 전에, 안전 정보 책자를 읽어보십시오.

Пред да го инсталирате овој производ прочитајте ја книгата со безбедносни информации.

Lees voordat u dit product installeert eerst het boekje met veiligheidsvoorschriften.

Les heftet om sikkerhetsinformasjon (Safety Information) før du installerer dette produktet.

Prije instalacije ovog proizvoda pročitajte priručnik sa sigurnosnim uputama.

Antes de instalar este produto, leia o folheto Informações sobre Segurança.

Перед установкой продукта прочтите брошюру по технике безопасности (Safety Information).

Pred inštaláciou tohto produktu si pre ítajte Informa nú brožúrku o bezpe nosti.

Preden namestite ta izdelek, preberite knjižico Varnostne informacije.

Antes de instalar este producto, lea la Información de Seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

在安裝本產品之前，也請先閱讀「安全性資訊」小冊子。

Statement 1


Danger
Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:

- **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**
- **Connect all power cords to a properly wired and grounded electrical outlet.**
- **Connect to properly wired outlets any equipment that will be attached to this product.**
- **When possible, use one hand only to connect or disconnect signal cables.**
- **Never turn on any equipment when there is evidence of fire, water, or structural damage.**
- **Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.**
- **Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.**

To connect:	To disconnect:
1. Turn everything OFF.	1. Turn everything OFF.
2. First, attach all cables to devices.	2. First, remove power cords from outlet.
3. Attach signal cables to connectors.	3. Remove signal cables from connectors.
4. Attach power cords to outlet.	4. Remove all cables from devices.
5. Turn device ON.	

Statement 2
CAUTION:

When replacing the lithium battery, use only IBM Part Number 33F8354 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

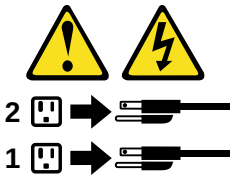
Do not:

- **Throw or immerse into water.**
- **Heat to more than 100 C (212 F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

Statement 5

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



Contents

Preface

This book provides information for configuring an IBM® Netfinity® ServeRAID™ controller, installing device drivers, and installing and using the ServeRAID utility programs.

Note: The IBM ServeRAID product can be either a controller on an adapter, such as the one in this option package, or a controller on the system board of your server. For consistency in this manual, the ServeRAID product is referred to as a ServeRAID controller, unless it is specifically noted otherwise.

To install device drivers and utility programs for an IBM ServeRAID controller that comes as a standard feature on an IBM Netfinity or PC Server system board, see the installation instructions and CDs provided with your server for instructions.

How this book is organized

Notices used in this book

This book contains notices to highlight information as follows:

- **Notes:** These notices provide important tips, guidance, or advice.
- **Attention:** These notices indicate possible damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage could occur.
- **Caution:** These notices indicate situations that can be potentially hazardous to you. A caution notice is placed just before descriptions of potentially hazardous procedure steps or situations.

Related publications

The following books are available on the *IBM ServeRAID Support* CD in the /BOOKS directory:

- *IBM Netfinity ServeRAID-4L Ultra160 SCSI Controller User's Reference* (4LRAIDUR.PDF)
- *IBM Netfinity ServeRAID-4L Ultra160 SCSI Controller Device Driver Installation Instructions* (4LDEVDRV.PDF)

The following booklets are extracted from the *IBM Netfinity ServeRAID-4L Ultra160 SCSI Controller User's Reference* and are available on the *IBM ServeRAID Support* CD in the /BOOKS directory:

- *IBM Netfinity ServeRAID-4L Ultra160 SCSI Controller Installation Guide* (4INSTALL.PDF)
- *Understanding IBM ServeRAID Technology* (4TECHNOL.PDF)

Note: Use Adobe Acrobat Reader to view these files. The *IBM ServeRAID Support* CD has the Acrobat Reader for Microsoft Windows in the /BOOKS/READERS directory.

Part 1. Installation and configuration

Chapter 1. Product information

This book provides information needed to install and configure an IBM ServeRAID-4L Ultra160 SCSI controller (hereafter referred to as IBM ServeRAID-4x Ultra160 SCSI controller). These high-performance, redundant array of independent disk (RAID) controllers are ideally suited for data-storage environments that require superior performance, flexibility, and reliable data storage. (See “Controller features” for more information.)

You also can use the configuration and reference information in this book to configure the IBM ServeRAID controllers provided on some IBM Netfinity and PC Server system boards.

Option package contents

In addition to this book, the ServeRAID option package contains:

- IBM Netfinity ServeRAID-4L Ultra160 SCSI controller

  Attention: Do not open the static-protective bag containing the controller until you are instructed to do so.
- *IBM ServeRAID Support* CD

  See “Obtaining ServeRAID updates” on page 21 and “Chapter 5. Installing ServeRAID device drivers” on page 35 for more detailed information.

Contact your place of purchase if any items are missing or damaged.

Controller features

Standard features of the ServeRAID controller are as follows.

Feature	ServeRAID-4L
Arrays (max.)	8
Battery-backup cache	No
Cache memory	16 MB
Hard disk drives (max.)	15
Logical drives (max.)	8
Microprocessor	100 MHz
SCSI channels	1
SCSI transfer speed (max.)	160 MB per sec.
Supported RAID levels	0, 1, 5, Enhanced-1 (1E), and Enhanced-5 (5E), 00, 10, 1E0, 50
System PCI data bus	64 bit at 33 MHz

Connector locations

This section provides illustrations of the SCSI channel connectors and cable connectors for the ServeRAID-4L controller.

The light-emitting diodes (LEDs) on the controllers indicate activity on the SCSI channels and provide diagnostic information for trained service technicians.

ServeRAID-4L controller

The ServeRAID-4L controller has one independent SCSI channel connector: Channel 1. This SCSI channels supports up to 15 physical devices.

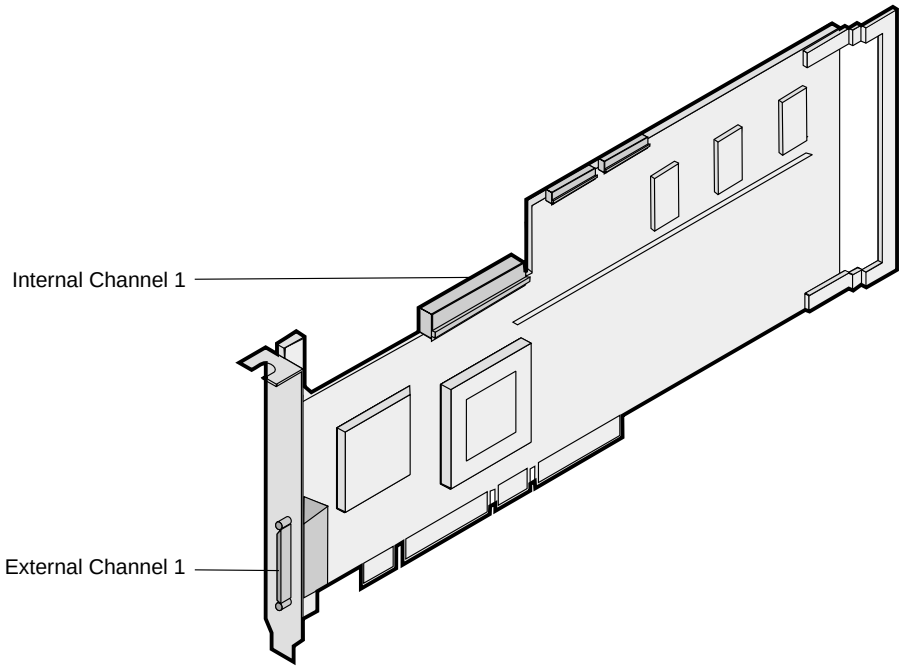


Figure 1. ServeRAID-4L controller

You can attach internal SCSI devices to the Channel 1 connector. You can attach external SCSI devices to the Channel 1 connector.

Note: The ServeRAID-4L controller uses the module (P/N 38L3386) containing a lithium battery.

Statement 2:

CAUTION:

When replacing the lithium battery, use only IBM Part Number 33F8354 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water.**
- **Heat to more than 100 C (212 F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

Chapter 2. Installing and cabling a ServeRAID controller

This chapter provides installation and cabling instructions for ServeRAID-4x controllers.

If you are using a ServeRAID controller on an IBM Netfinity or PC Server system board, you will not need the information in this section. Continue with “Chapter 3. Understanding RAID technology” on page 9.

Installing the ServeRAID controller

During the installation, you might need a small, flat-blade screwdriver and the documentation that comes with your server.

To install the ServeRAID-4x controller:

1. Review “Safety” on page iii and the Safety Information book provided with your Netfinity server.
2. Turn off the server and disconnect all power cords and cables from the server.
3. Remove the server cover and locate an empty PCI expansion slot for the controller. Choose a slot that is farthest from other installed components, such as the microprocessor. If necessary, see your server documentation for more detailed information about the expansion slots.

   Note: For Netfinity 3000 servers, the ServeRAID controllers are supported only when installed in PCI slot 3. *Do not* install these controllers in PCI slots 1 or 2. Before you can install a ServeRAID controller in a Netfinity 3000, you must first remove the standard SCSI controller that comes in PCI slot 3. You can install and use the standard SCSI controller in PCI slots 1 or 2, but devices attached to the standard SCSI controller will no longer provide startup (boot) support.
4. Remove the expansion-slot cover, if applicable.
5. Touch the static-protective package containing the controller to an unpainted metal expansion-slot cover on the server. This discharges any static electricity from the package and from your body.
6. Remove the controller from the static-protective package holding the controller by the edges. Do not touch any exposed components on the controller.
7. Insert the controller in the PCI expansion slot. Press the controller firmly into the slot so that it is fully seated.

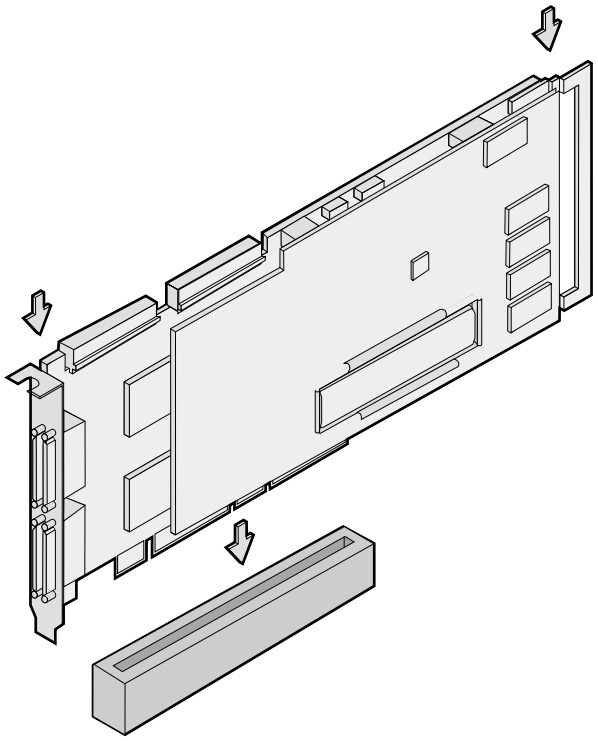


Figure 2. Inserting a ServeRAID-4H controller into the PCI expansion slot

8. Secure the controller by either tightening the expansion-slot screw on the top of the controller or closing the latch, depending on your server.
9. Connect the SCSI cables to the controller. If you intend to attach external devices only, go to step 13 on page 7. Otherwise, continue with step 10.
10. Connect one end of a 68-pin ANSI standard cable (separately purchased or already in your server) to the internal channel connector on the ServeRAID controller.

    Note: See “Connector locations” on page 3 for the channel connector locations.

1. ANSI stands for American National Standards Institute.

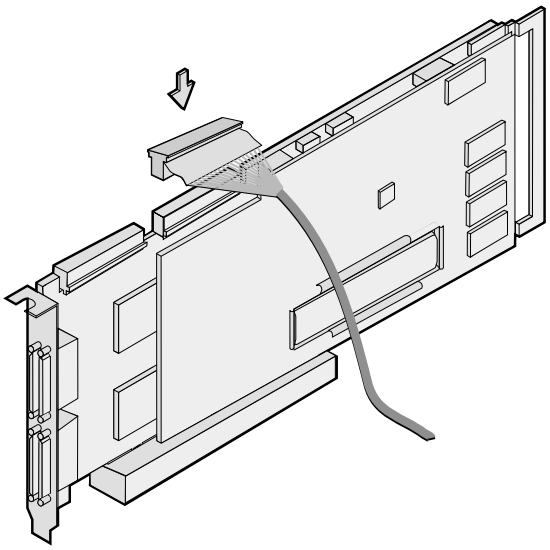


Figure 3. Connecting a ServeRAID-4H controller internal channel connector

11. Connect the other end of the SCSI cable to the SCSI PCI backplane or to a SCSI device in the server. (See your server documentation or the system label inside the server cover for the location of the SCSI connector on the backplane.)
12. If you have physical drives to install, install them now. See your server documentation for drive installation instructions.

    Note: The ServeRAID controllers use SCSI ID 7.
13. Install the server cover.
14. If you disconnected the cables and power cords in step 2 on page 5, reconnect the cables and cords. See your server documentation if you need detailed instructions.
15. If you want to attach an external SCSI device to the ServeRAID controller, continue with “Connecting external devices” on page 8. Otherwise, go to “Chapter 3. Understanding RAID technology” on page 9.

Connecting external devices

Note: The ServeRAID-4x controller does not support configurations that use both the internal and external connectors on the same channel *concurrently*. For example, you cannot use both external Channel 1 and internal Channel 1.

To attach SCSI devices to an external channel connector on the ServeRAID controller:

1. Connect one end of a 68-pin very high density connector interface (VHDCI) SCSI cable to an external channel connector on the ServeRAID controller.

   Note: See "Connector locations" on page 3 for the channel connector locations.

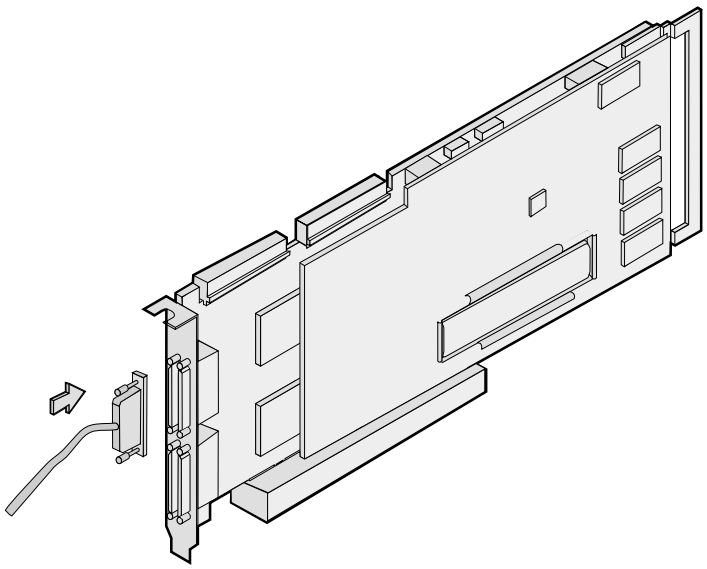


Figure 4. Connecting a ServeRAID-4H controller external channel connector

2. Connect the other end of the SCSI cable to the external SCSI device.
3. Continue with "Updating BIOS and firmware code" on page 23.

Chapter 3. Understanding RAID technology

RAID is the technology of grouping several physical drives in a computer into an *array* that you can define as one or more logical drives. Each *logical* drive appears to the operating system as a single drive. This grouping technique greatly enhances logical-drive capacity and performance beyond the physical limitations of a single physical drive.

When you group multiple physical drives into a logical drive, the ServeRAID controller can transfer data in parallel from the multiple drives in the array. This parallel transfer yields data-transfer rates that are many times higher than with nonarrayed drives. This increased speed makes the system better able to meet the *throughput* (the amount of data processed in a given amount of time) or productivity needs of the multiple-user network environment.

The ability to respond to multiple data requests provides not only an increase in throughput, but also a decrease in response time. The combination of parallel transfers and simultaneous responses to multiple requests allows disk arrays to provide a high level of performance in network environments.

Note: If you already understand these concepts, continue to “Chapter 4. Configuring ServeRAID controllers” on page 21.

Stripe-unit size

With RAID technology, data is *striped* across an array of physical drives. This data-distribution scheme complements the way the operating system requests data.

The granularity at which data is stored on one drive of the array before subsequent data is stored on the next drive of the array is called the *stripe-unit size.*

You can control the stripe-unit size and maximize the performance of your ServeRAID controller by setting a stripe-unit size to a value that is close to the size of the system I/O requests. You can set the stripe-unit size to 8 KB, 16 KB, 32 KB, or 64 KB. For example, performance in transaction-based environments, which typically involve large blocks of data, might be optimal when the stripe-unit size is set to 32 KB or 64 KB. However, performance in file and print environments, which typically involve multiple small blocks of data, might be optimal when the stripe-unit size is set to 8 KB or 16 KB.

The collection of stripe units, from the first drive of the array to the last drive of the array, is called a *stripe.*

The ServeRAID-4H controller supports 16 physical drives in an array if the stripe-unit size is set to 32 KB or 64 KB.

Supported RAID levels

Disk arrays are used to improve performance and reliability. The amount of improvement depends on the application programs that you run on the server and the RAID levels that you assign to the logical drives.

The ServeRAID controllers support RAID level-0, 1, 1E, 5, 5E, 00, 10, 1E0, and 50.

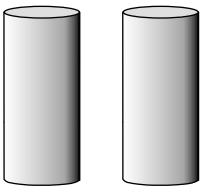
Understanding RAID level-0

RAID level-0 stripes the data across all the drives in the array. This offers substantial speed enhancement, but provides no data redundancy. RAID level-0 provides the largest storage capacity of the RAID levels that are offered, because no room is taken for redundant data or data-parity storage.

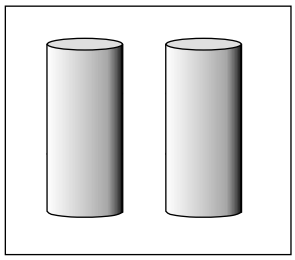
RAID level-0 requires a minimum of one drive and, depending upon the level of firmware and the stripe-unit size, supports a maximum of 8 or 16 drives.

The following illustration shows an example of a RAID level-0 logical drive.

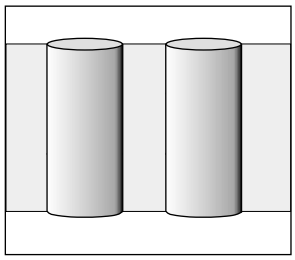
Start with two physical drives.



Create an array using the two physical drives.

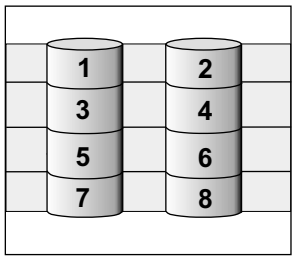


Then, create a logical drive within that array.



The data is striped across the drives, creating blocks.

Notice that the data is striped across all the drives in the array, but no redundant data is stored.



A physical drive failure within the array results in loss of data in the logical drive assigned RAID level-0, but only in that logical drive. If you have logical drives assigned RAID level-1, 1E, 5, or 5E in the same array, they will not lose data.

Note: If you have an array that contains only one physical drive, you can assign only RAID level-0 to the logical drive in that array.

When you replace a failed drive, the ServeRAID controller can rebuild all the RAID level-1E and RAID level-5E logical drives automatically onto the replacement physical drive. However, any data stored in a failed RAID level-0 logical drive is lost.

Although the risk of data loss is present, you might want to assign RAID level-0 to one of the logical drives to take advantage of the speed this RAID level offers. You can use this logical drive to store data that you back up each day and for which safety is not of primary importance, that is, data that you can re-create easily. You also might want to use a RAID level-0 logical drive when you require maximum capacity.

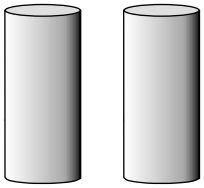
Understanding RAID level-1

RAID level-1 provides 100% data redundancy and requires only two physical drives. With RAID level-1, the first half of a stripe is the original data; the second half of a stripe is a *mirror* (that is, a copy) of the data, but written to the other drive in the RAID level-1 array.

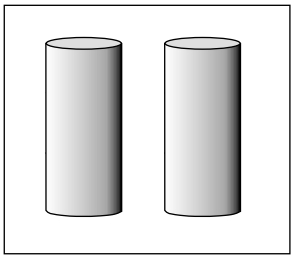
Because the data is mirrored, the capacity of the logical drive when assigned RAID level-1 is 50 percent of the array capacity.

The following illustration shows an example of a RAID level-1 logical drive.

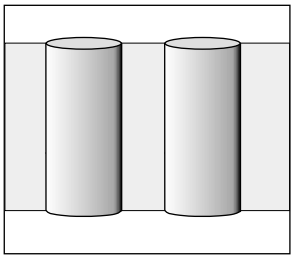
Start with two physical drives.



Create an array using the two physical drives.

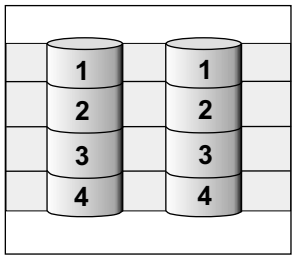


Then, create a logical drive within that array.



The data is striped across the drives, creating blocks.

Notice that the data on the drive on the right is a copy of the drive on the left.



With RAID level-1, if one of the physical drives fails, the ServeRAID controller switches read and write requests to the remaining functional drive in the RAID level-1 array.

Understanding RAID level-1 Enhanced

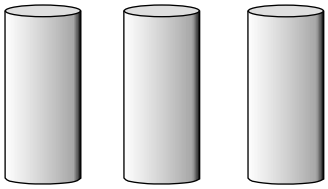
If you have three or more physical drives in the array, you cannot select RAID level-1; you can select RAID level-1 Enhanced (RAID level-1E).

RAID level-1E combines mirroring with data striping. This RAID level stripes data and copies of the data across all of the drives in the array. As with the standard RAID level-1, the data is mirrored, and the capacity of the logical drive is 50 percent of the array capacity of the grouping of physical drives in the array.

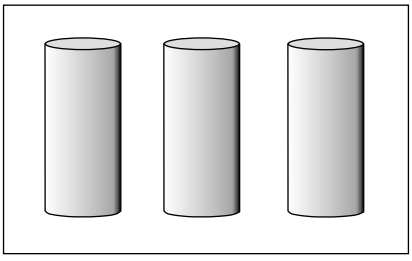
RAID level-1E requires a minimum of three drives and, depending upon the level of firmware and the stripe-unit size, supports a maximum of 8 or 16 drives.

The following illustration is an example of a RAID level-1E logical drive.

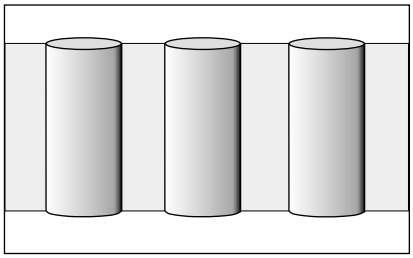
Start with three physical drives.



Create an array using the physical drives.

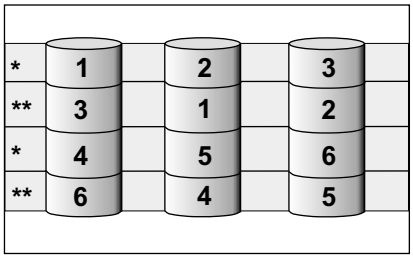


Then, create a logical drive within that array.



The data is striped across the drives, creating blocks.

Notice that the stripe labeled ★ is the data stripe and the stripe labeled ★★ is the copy of the preceding data stripe. Also notice that each block on the mirror stripe is shifted one drive.



With RAID level-1E, if one of the physical drives fails, the ServeRAID controller switches read and write requests to the remaining functional drives in the RAID level-1E array.

Understanding RAID level-5

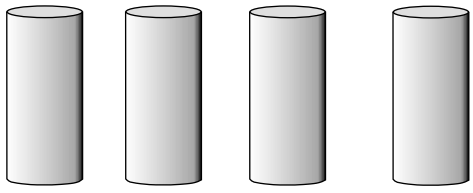
RAID level-5 requires a minimum of three physical drives. This RAID level stripes data and parity across all drives in the array. When you assign RAID level-5 to an array, the capacity of the array is reduced by the capacity of one drive (for data-parity storage).

RAID level-5 offers both data protection and increased throughput. RAID level-5 gives you higher capacity than RAID level-1, but RAID level-1 offers better performance.

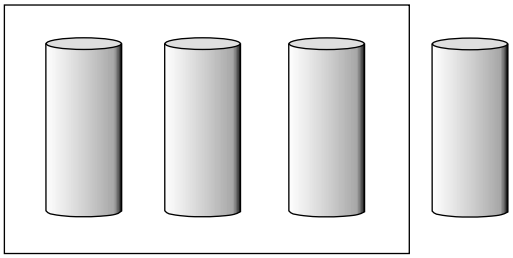
RAID level-5 requires a minimum of three drives and, depending upon the level of firmware and the stripe-unit size, supports a maximum of 8 or 16 drives.

The following illustration is an example of a RAID level-5 logical drive.

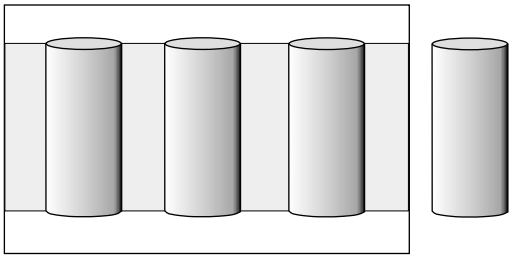
Start with four physical drives.



Create an array using three of the physical drives, leaving the fourth as a hot-spare drive.



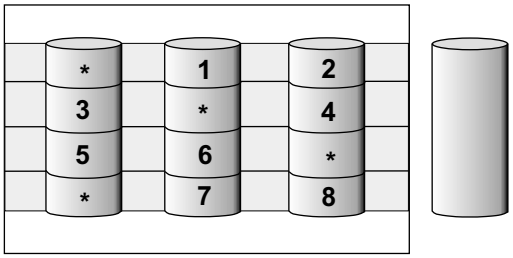
Then, create a logical drive within that array.



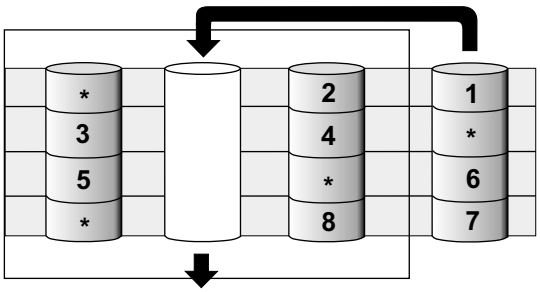
The data is striped across the drives, creating blocks.

Notice that the storage of the data parity (denoted by ★) also is striped, and it shifts from drive to drive.

A parity block (★) contains a representation of the data from the other blocks in the same stripe. For example, the parity block in the first stripe contains data representation of blocks 1 and 2.



If a physical drive fails in the array, the ServeRAID controller switches read and write requests to the remaining functional drive in the RAID level-5 array, which is a hot-spare drive.



Understanding RAID level-5 Enhanced

RAID level-5 Enhanced (RAID level-5E) requires a minimum of four physical drives. RAID level-5E is also firmware-specific. You can think of RAID level-5E as “RAID level-5 with a built-in spare drive.”

Reading from and writing to four disk drives is more efficient than three disk drives and an idle hot spare and therefore improves performance. Additionally, the spare drive is actually part of the RAID level-5E array, as shown in the following example. With such a configuration, you cannot share the spare drive with other arrays. If you want a spare drive for any other array, you must have another spare drive for those arrays.

Like RAID level-5, this RAID level stripes data and parity across all of the drives in the array. When an array is assigned RAID level-5E, the capacity of the logical drive is reduced by the capacity of two physical drives in the array (that is, one for parity and one for the spare).

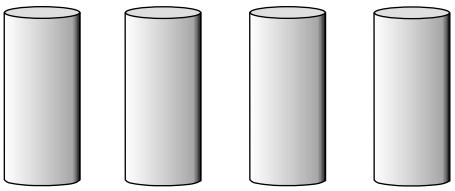
RAID level-5E offers both data protection and increased throughput, in addition to the built-in spare drive.

Note: For RAID level-5E, you can have only one logical drive in an array. When using RAID level-5E, you can have a maximum of seven logical drives on the controller.

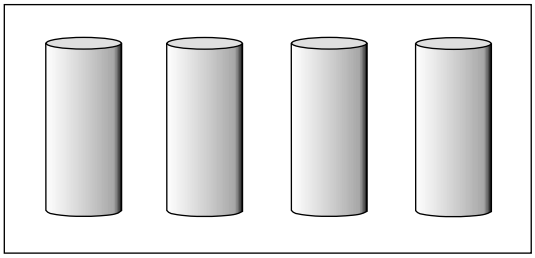
RAID level-5E requires a minimum of four drives and, depending upon the level of firmware and the stripe-unit size, supports a maximum of 8 or 16 drives.

The following illustration is an example of a RAID level-5E logical drive.

Start with four physical drives.

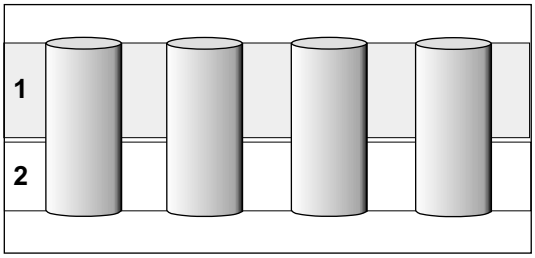


Create an array using all four physical drives.



Then, create a logical drive (labeled as 1) within the array.

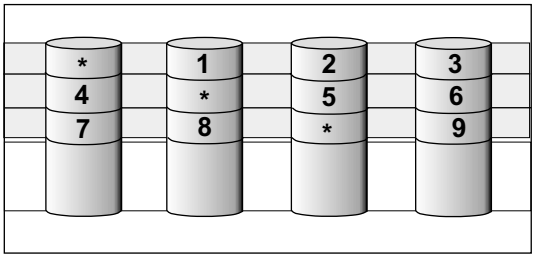
Notice that the distributed spare drive is the free space (labeled as 2) shown below the logical drive.



The data is striped across the drives, creating blocks in the logical drive.

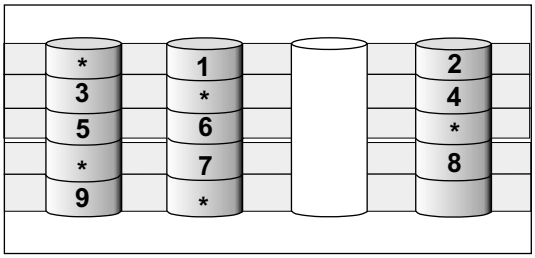
The storage of the data parity (denoted by *) is striped, and it shifts from drive to drive as it does in RAID level-5.

Notice that the spare drive is **not** striped.



If a physical drive fails in the array, the data from the failed drive is compressed into the distributed spare drive. The logical drive remains RAID level-5E.

When you replace the failed drive, the data for the logical drive decompresses and returns to the original striping scheme.



Note: The ServeRAID Manager program Express configuration does not default to RAID level-5E. If you have four physical drives, Express configuration defaults to RAID level-5 with a hot-spare drive.

Understanding RAID level-x0

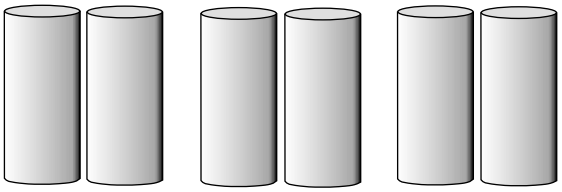
RAID level-x0 refers to RAID levels-00, 10, 1E0, and 50. RAID level-x0 includes more physical drives in an array. The benefits of doing so are larger logical drives, increased performance, and increased reliability. RAID levels-0, 1, 1E, 5, and 5E cannot use more than 16 physical drives in an array. However, RAID levels-00, 10, 1E0, and 50 include more physical drives by managing an array of arrays, or a *spanned array*. The operating system uses the spanned array logical drive the same as a regular array logical drive.

Note: RAID level-x0 is only available on the IBM ServeRAID-4x Ultra160 SCSI controller.

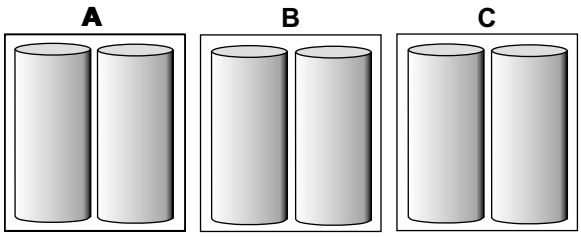
RAID level-x0 requires a minimum of two drives and supports a maximum of 60 drives.

The following illustration is an example of a RAID level-10 logical drive.

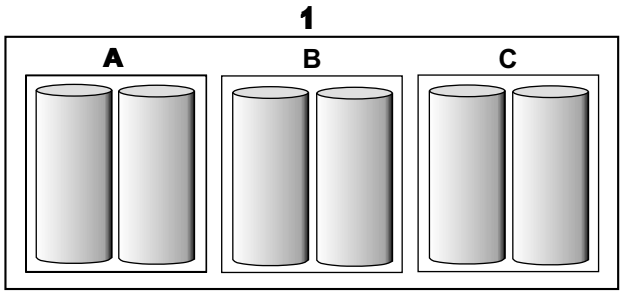
Start with six physical drives.



Create three arrays (labeled A, B, and C), each array using two physical drives.

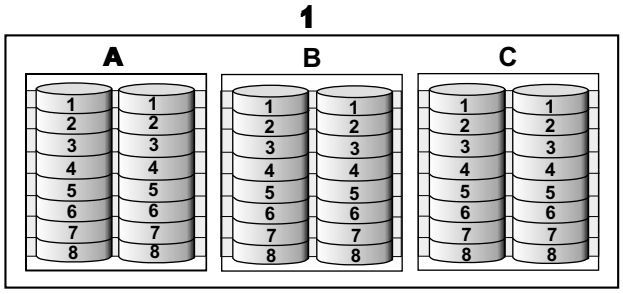


Then, create a *spanned* array (labeled as **1**) that spans the three arrays.

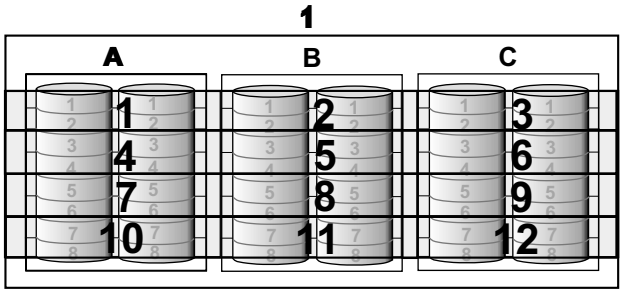


A sub-logical drive is created within *each* array (A, B, and C). Then, the data is striped across the physical drives in the array, creating blocks.

Notice that, in each array, the data on the drive on the right is a copy of the drive on the left. This is because the sub-logical drives (A, B, and C) are RAID level-1 in a RAID level-10 implementation (see the following table).



Then, create a logical drive within the spanned array (**1**). The data is striped across this logical drive, creating blocks. Notice that none of these blocks are redundant. This is because the logical drive (**1**) is RAID level-0 in a RAID level-x0 implementation (see the following table).



RAID level	Sub-logical drive	Spanned array logical drive
00	RAID level-0	RAID level-0
10	RAID level-1	RAID level-0
1E0	RAID level-1E	RAID level-0
50	RAID level-5	RAID level-0

With RAID level-10, 1E0, and 50, if one of the physical drives fails in a sub-logical drive, the ServeRAID controller switches read and write requests to the remaining functional drives in the sub-logical drive. With RAID level-00, a physical drive failure within the sub-logical drive results in loss of data.

Selecting a RAID level and performance tuning

When selecting a RAID level for your system, consider the following:

RAID level	Data redundancy	Hard disk drive capacity utilization	Read performance	Write performance	Built-in spare drive
RAID level-0	No	100%	Superior	Superior	No
RAID level-1	Yes	50%	Very high	Very high	No
RAID level-1E	Yes	50%	Very high	Very high	No
RAID level-5	Yes	67% to 94%	Superior	High	No
RAID level-5E	Yes	50% to 88%	Superior	High	Yes
RAID level-00	No	100%	Superior	Superior	No
RAID level-10	Yes	50%	Very high	Very high	No
RAID level-1E0	Yes	50%	Very high	Very high	No
RAID level-50	Yes	67% to 94%	Superior	High	No

Drive-state descriptions

This section provides descriptions of the physical and logical drive states. ServeRAID publications frequently refer to these states during instructions and procedures.

Physical drive-state descriptions

The following table provides descriptions of the valid physical drive states.

Drive state	Meaning
Defunct	A physical drive in the online, hot-spare, or rebuild state has become defunct. It does not respond to commands, which means that the ServeRAID controller cannot communicate properly with the drive. If a physical drive has become defunct, refer to “Rebuilding a defunct drive” on page 68.
Hot spare	A hot-spare drive is a physical drive that is defined for automatic use when a similar drive fails.
Online	The drive is online. It is functioning properly and is part of an array.
Rebuilding	The drive is being rebuilt. For more information on rebuilding a drive, refer to “Rebuilding a defunct drive” on page 68.
Ready	The ServeRAID controller recognizes a ready drive as being available for definition.
Standby hot spare	A standby hot spare is a hot-spare drive that the ServeRAID controller has spun down. If an online drive becomes defunct and no suitable hot-spare drive is available, a standby hot-spare drive of the appropriate size automatically spins up, and enters the rebuild state.

2. Disk utilization, read, and write performance depend on the number of drives in the array. Generally, the more drives in the array, the better your performance.

Logical drive-state descriptions

The following table provides descriptions of the valid logical drive states.

Drive state	Meaning
Blocked	During a rebuild operation, the ServeRAID controller sets the state of any RAID level-0 logical drives associated with a failed array to the blocked state; then, it reconstructs the data that was stored in RAID level-1, RAID level-1E, RAID level-5 and RAID level-5E logical drives. After the rebuild operation completes, you can unblock the RAID level-0 logical drives, and access them once again. However, the logical drive might contain damaged data. You must either re-create, reinstall, or restore the data from the most recent backup disk or tape to the RAID level-0 logical drive.
Critical migrating	A logical drive in the critical state that is undergoing a logical drive migration (LDM).
Critical system	The ServeRAID controller uses this reserved state during a logical drive migration (LDM) when the logical drive is in the critical state.
Critical	A RAID level-1, RAID level-1E, RAID level-5, or RAID level-5E logical drive that contains a defunct physical drive is in the critical state. A critical logical drive is accessible, despite a physical drive failure. **Attention:** If the state of the logical drive is critical, refer to “Rebuilding a defunct drive” on page 68.
Migrating	The logical drive is undergoing a logical drive migration; that is, a change in RAID levels, a change in logical drive size, an increase in free space, or a RAID level-5E compression or decompression.
Offline	The logical drive is offline and not accessible. This state occurs when one of the following is true. • One or more physical drives in a RAID level-0 logical drive are defunct. • Two or more physical drives in a RAID level-1, RAID level-1E, or RAID level-5 logical drive are defunct. • Three or more drives in a RAID level-5E logical drive are defunct. If any of these is true, refer to “Rebuilding a defunct drive” on page 68.
Okay	The logical drive is okay. It is in a good, functional state.
System	The ServeRAID controller uses this reserved state during logical drive migration (LDM).

Chapter 4. Configuring ServeRAID controllers

This chapter provides information on obtaining ServeRAID updates, updating ServeRAID BIOS and firmware, and configuring ServeRAID controllers.

Obtaining ServeRAID updates

IBM periodically makes updated versions of the ServeRAID firmware, device drivers, and utility programs available from the IBM Support page on the World Wide Web. In addition to the updated device drivers and utility programs, there is a command-line program available from the World Wide Web.

Note: If you need to update any ServeRAID software, you must update *all* ServeRAID software at the same time to ensure compatibility with all of the levels of the software. This includes:

- BIOS and firmware
- Device drivers
- ServeRAID Manager program
- Command-line programs

You can download the most current versions of the ServeRAID device drivers and utility programs or a copy of the *IBM ServeRAID Command-Line Programs* diskette from the World Wide Web (see “Downloadable files from the World Wide Web” on page 22).

When you update your ServeRAID software, use the following procedure to ensure the code levels of the software components are compatible:

1. Start your server.
2. Update the device drivers. See “Chapter 5. Installing ServeRAID device drivers” on page 35 for additional information.
3. Update the ServeRAID Manager program. See “Chapter 8. Installing and starting the ServeRAID Manager program” on page 51 for additional information.
4. Shut down your server.
5. Update the ServeRAID BIOS and firmware. See “Updating BIOS and firmware code” on page 23 for additional information.

Refer to the README file on your CD for additional installation instructions.

If you do not have access to the World Wide Web, contact your place of purchase, your IBM reseller, or your IBM marketing representative for replacement CDs.

The *IBM ServeRAID Support* CD contains the following:

- ServeRAID Manager program. Use this program to configure arrays and logical drives using ServeRAID controllers. This program is available in the following directory:

  d:/PROGRAMS/*operatingsystem*/MANAGER

  where *d* is the CD-ROM drive and *operatingsystem* is the specific operating system you are using in the ServeRAID installation.
- Device drivers. These files are available in the following directory:

d:/PROGRAMS/*operatingsystem*/DRIVER

where *d* is the CD-ROM drive and *operatingsystem* is the specific operating system you are using in the ServeRAID installation.

Note: The ServeRAID device drivers that are for Microsoft® Windows® 2000 are in the following directory:

d:/WIN2K/*controller*

where *d* is the CD-ROM drive and *controller* is the ServeRAID controller model.

- Command-line programs. These command-line programs are available in the following directory:

  d:/PROGRAMS/*operatingsystem*/CMDLINE

  where *d* is the CD-ROM drive and *operatingsystem* is the specific operating system you are using in the ServeRAID installation.
- ServeRAID diskette images. Use these images to create ServeRAID diskettes. These diskettes include the following:
  - The *IBM ServeRAID Device Drivers* diskette, which contains the device drivers for Microsoft Windows NT and Windows 2000.
  - The *IBM ServeRAID Command-Line Programs* diskette, which contains the IPSSEND command-line program.
  - The *IBM ServeRAID BIOS and Firmware Update* diskette.

  These files are available in the following directory:

  d:/IMAGES

  where *d* is the CD-ROM drive.
- ServeRAID publications. These publications are available as PDFs in the following directory:

  d:/BOOKS

  where *d* is the CD-ROM drive. For additional information, refer to “Related publications” on page xii.

Downloadable files from the World Wide Web

You can download new and updated files for the IBM ServeRAID and Clustering products from the IBM Support Web site:

http://www.ibm.com/pc/support/

To access ServeRAID and Clustering support, follow these steps:

1. Click **Servers** on the IBM Support page. The IBM Netfinity and PC Server Support page opens.
2. Select **ServeRAID** or **Clustering** from the **Family** list box. The ServeRAID or Clustering Support page opens.
3. On this page, you can select from the following categories in the left margin:

   Downloadable files

   Download the latest versions of Clustering software, the ServeRAID Manager program, BIOS/firmware, device-driver updates, and other important information.

Hints and tips
Obtain useful information for the IBM Clustering and for ServeRAID products and troubleshooting potential problems.

Online publications
Download the installation and user's guides, references, redbooks, and other IBM publications.

You can also review information on parts, products, and software.

Updating BIOS and firmware code

Before configuring the ServeRAID controller, you must have the latest BIOS and firmware code installed on your server.

1. Insert the *IBM ServeRAID Support* CD into the server CD-ROM drive.
2. Turn on the server. The IBM ServeRAID ROM Update wizard automatically starts.

   The IBM ServeRAID ROM Update wizard is an easy-to-use program that simplifies updating the BIOS and firmware code on ServeRAID controllers. The wizard automatically scans and identifies each ServeRAID controller in your system. After scanning completes and if an update is required, a report screen opens with the following information:
   - Controller types found.
   - Controller slot number, if known.
   - Firmware version.
   - BIOS version.
   - Update status. If a controller has outdated BIOS or firmware, the IBM ServeRAID ROM Update wizard marks the controller as a candidate for update.

   If the BIOS and firmware code do not require updating, the wizard automatically exits and the ServeRAID Manager program opens. Continue with "Configuring the ServeRAID controller".

   If the BIOS and firmware code require updating, the IBM ServeRAID ROM Update wizard asks if you want to update. You decide whether to update your controllers, but you must update all the controllers or none (that is, you cannot selectively update).
3. Click **Update**. The IBM ServeRAID ROM Update wizard displays a progress indicator as it updates the controllers. If the wizard detects an error, it displays the error message and saves the error message to a file on the disk.

   If you do not want to update your ServeRAID controllers, click **Cancel**.
4. When all updates are complete, scroll through the Features window. This window reports the changes that the IBM ServeRAID ROM Update wizard applied to your ServeRAID controllers.
5. Leaving the *IBM ServeRAID Support* CD in the CD-ROM drive, shut down and restart the server.

Configuring the ServeRAID controller

This section provides information about starting and using the ServeRAID Manager program. You can use the ServeRAID Manager program to configure your ServeRAID controllers, view the ServeRAID configuration and associated devices, create arrays and logical drives, delete an array, dynamically increase the logical-drive size, change RAID levels, and much more.

The information in this section is an overview of the ServeRAID Manager program and its capabilities. For instructions on specific processes using the ServeRAID Manager program, refer to the ServeRAID Manager online help.

Using the ServeRAID Manager program

When you start the ServeRAID Manager program from the startable *IBM ServeRAID Support* CD, you can configure your ServeRAID controller *before* you install your operating system. In startable-CD mode, you can also change specific ServeRAID controller settings after you have configured the ServeRAID controller and installed the operating system. Refer to “Using Information mode” on page 34 for additional information.

The ServeRAID Manager program runs in two modes: *Configuration* mode and *Information* mode.

In Configuration mode, you can create disk arrays, create logical drives, and define your hot-spare drives. When this mode is active, a limited set of functions is available from the menu and tool bars. See “Using Configuration mode” on page 26 for more information.

In Information mode, you can view and modify the existing device and configuration information for your ServeRAID subsystem. When this mode is active, you can use the functions available from the menu and tool bars to customize settings for your ServeRAID controllers. See “Using Information mode” on page 34 for more information.

To start the ServeRAID Manager program, do the following:

1. Turn on the server; then, insert the *IBM ServeRAID Support* CD (or the CD that contains the ServeRAID Manager program that came with your server) into the CD-ROM drive.

   One of the following windows will open:

   - If the ServeRAID Manager program detects unconfigured ServeRAID controllers, the program starts in Configuration mode and a window similar to the following opens.

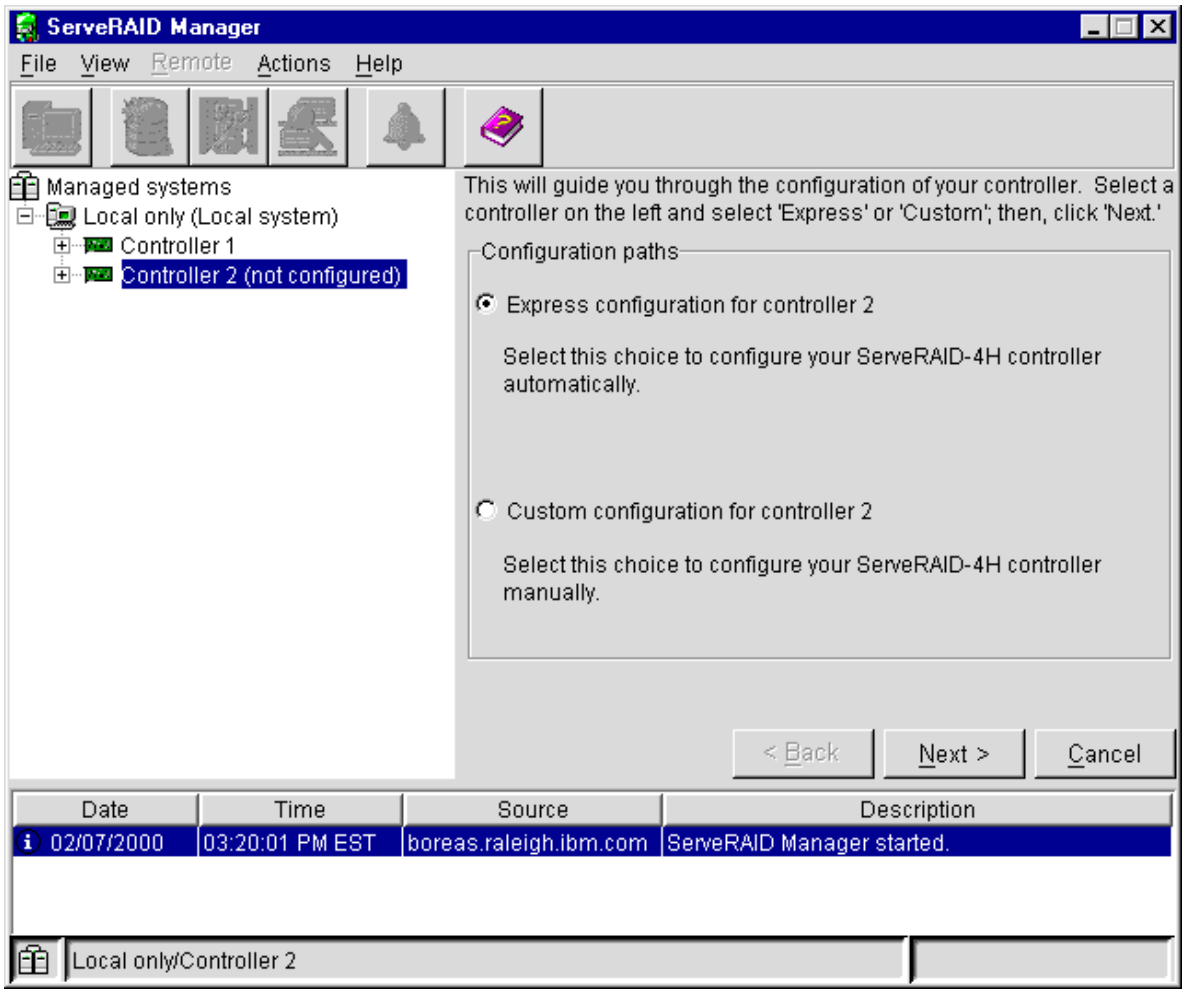


Figure 5. Configuration mode window

Follow the instructions in the right panel to create logical drives on your ServeRAID controller. If you do not want to configure your ServeRAID controller, click **Cancel**. This will switch the program from Configuration mode to Information mode.

- If the ServeRAID Manager program detects that all ServeRAID controllers in the server are configured, the program starts in Information mode and a window similar to the following opens.

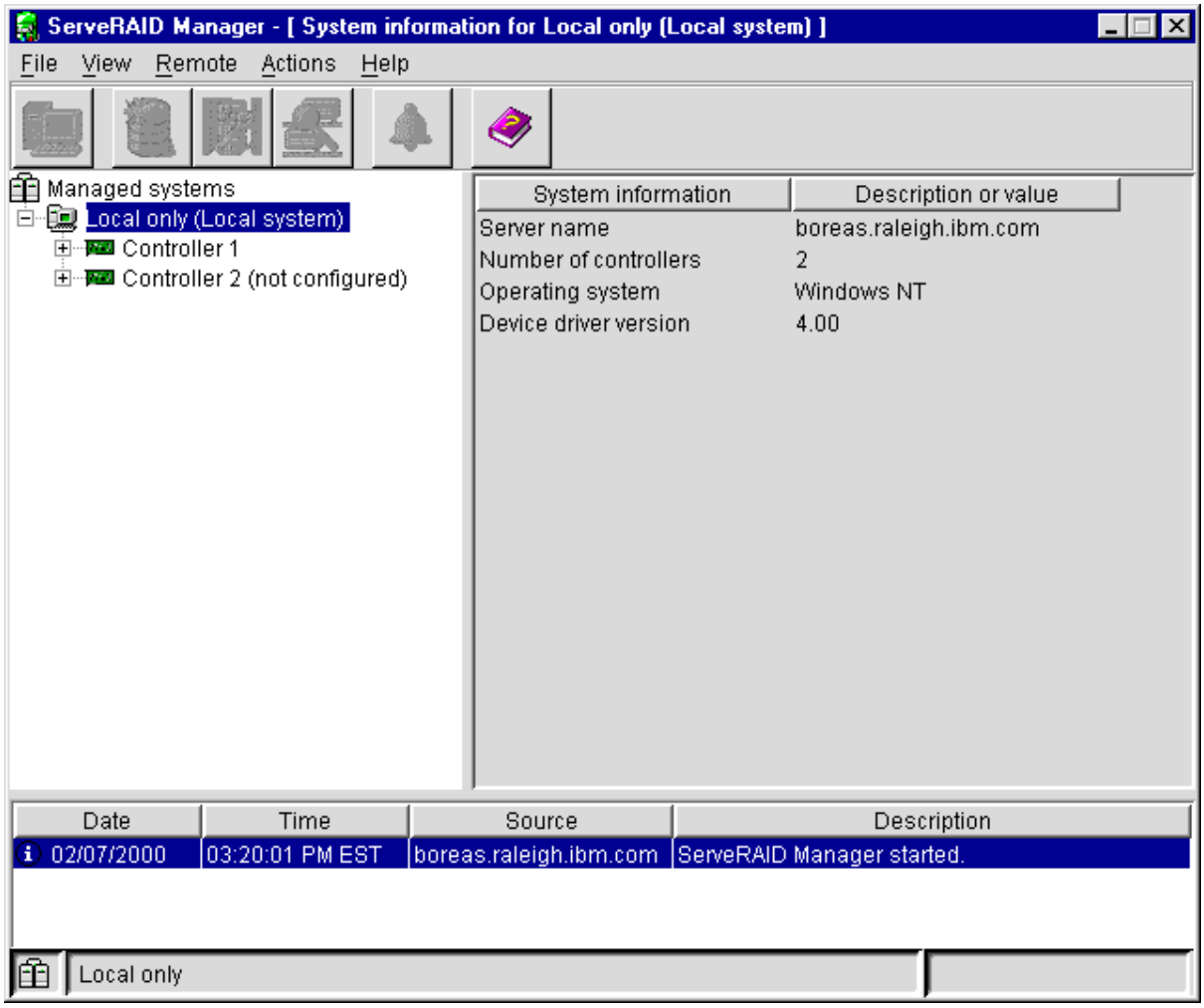


Figure 6. Information mode window

Click  (`Create arrays`) on the tool bar to switch from Information mode to Configuration mode.

2. Continue with one of the following:
   - "Using Configuration mode".
   - "Using Information mode" on page 34.

Using Configuration mode

You can use Configuration mode to create up to eight independent disk arrays for each ServeRAID controller. Configuration mode provides two configuration options Express configuration and Custom configuration (see Figure 5 on page 25). You can also use Custom configuration to create spanned arrays and configure the logical drive to RAID level-x0. For more information about RAID level-x0, refer to "Understanding RAID level-x0" on page 16.

Attention: The new controller stripe-unit size is set at the factory to 8 KB. If you need to change this setting, you must change the stripe-unit size before you store data in the logical drives. After you store data in the logical drives, you cannot change the stripe-unit size without destroying data in the logical drives. To change the stripe-unit size, do the following:

1. Click  (`Create arrays`) on the tool bar to switch from Configuration mode to Information mode.
2. In the Main Tree, click the new controller.
3. Click **Actions → Change stripe-unit size**.
4. Click the new stripe-unit size for your installation on the menu.

Using Express configuration: To use Express configuration:

Note: If the Express configuration mode or Custom configuration mode buttons do not display on the right panel, click  (`Create arrays`) on the tool bar.

1. In the Main Tree, click the ServeRAID controller that you want to configure.
2. If it is not already selected, click the **Express configuration** button.
3. Click **Next**. The Configuration summary window opens.
4. Review the information that displays in Configuration summary window.

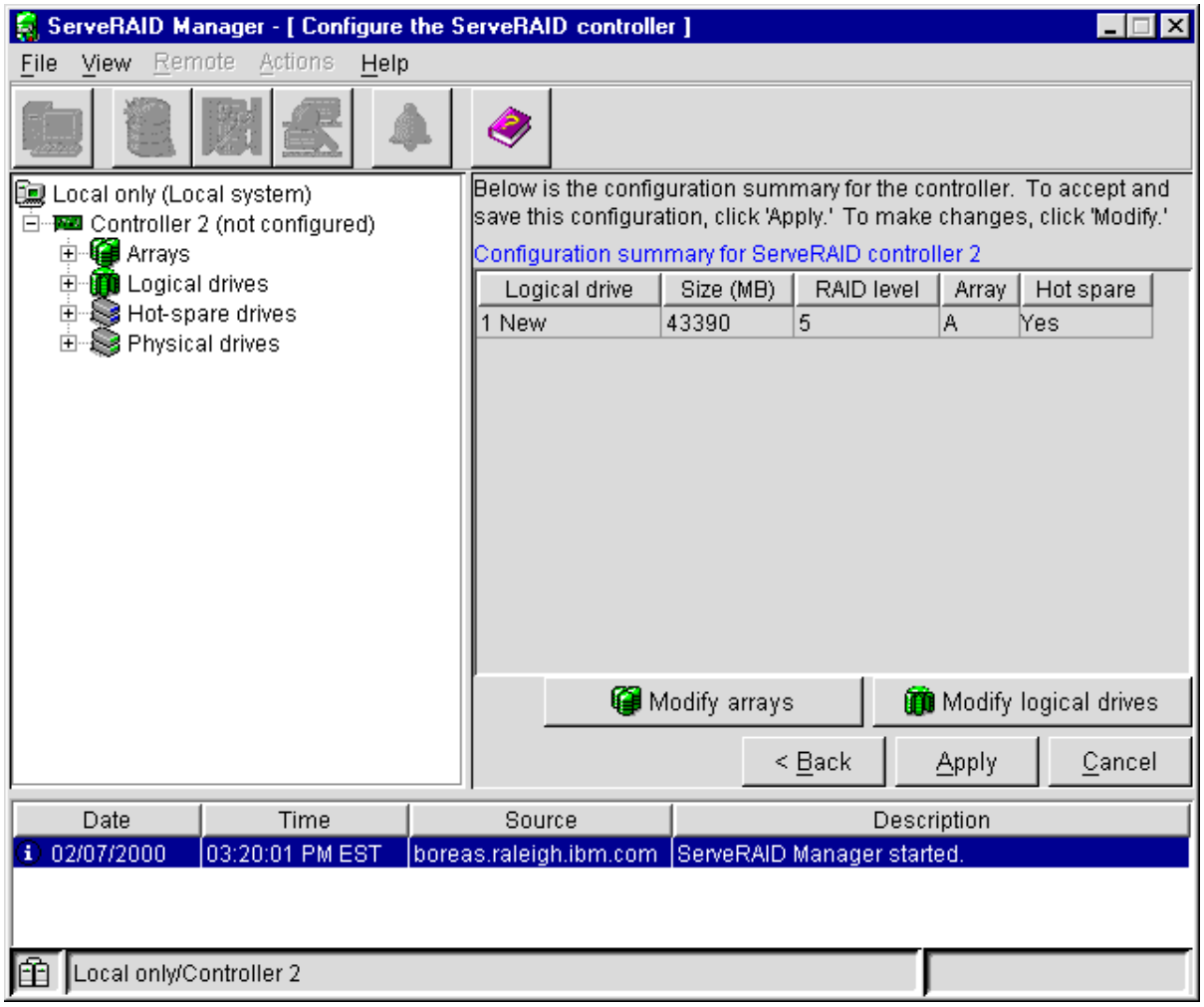


Figure 7. Configuration summary window

Notes:

a. Some operating systems have size limitations for logical drives. Before you save the configuration, verify that the size of the logical drive is appropriate for your operating system. See your operating-system documentation for more detailed information.

b. To change the configuration, click **Modify arrays** or **Modify logical drives**.

5. Click **Apply** to accept and save the configuration. The configuration is saved in the ServeRAID controller and in the physical drives.
6. If you have multiple controllers, for each controller repeat steps 1 on page 27 through step 5.
7. When you have completed configuration, you can change to Information mode and change controller settings. See “Using Information mode” on page 34 for more information. If you do not want to change any settings, exit the ServeRAID Manager program and remove the CD from the CD-ROM drive.
8. Restart the server.
9. Continue with “Chapter 5. Installing ServeRAID device drivers” on page 35 to install the ServeRAID device driver while installing your operating system.

Note: If you are configuring your startup (boot) ServeRAID controller, you *must* install the device driver while installing the operating system.

Using Custom configuration: To use Custom configuration:

Note: If the Express configuration mode or Custom configuration mode buttons do not display on the right panel, click  (`Create arrays`) on the tool bar.

1. In the Main Tree, click the ServeRAID controller that you want to configure.
2. Click the **Custom configuration** button.
3. Click **Next**. The Create arrays window opens.

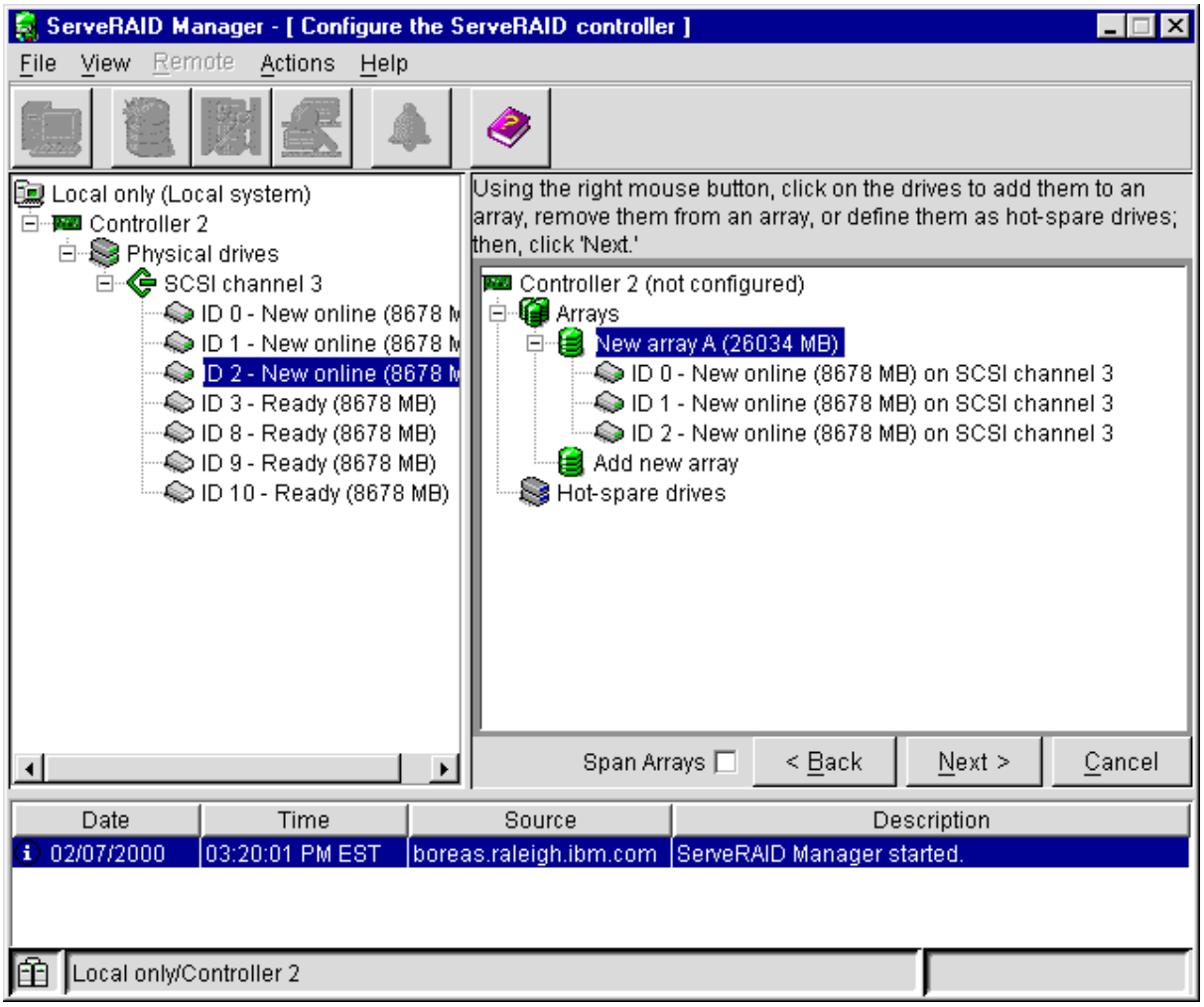


Figure 8. Create arrays window

4. Using the right mouse button, click the drive or SCSI channel icons in the Main Tree to select the drives that you want to add to your arrays, delete from your arrays, or define as hot-spare drives; then, select a choice from the pop-up list.

   If you want to create a spanned array, click the **Span Arrays** box.
5. After you select the ready drives for your arrays and define your hot-spare drives, click **Next**. If you are not creating spanned arrays, the Create logical drives window opens. Continue with step 8 on page 31.

If you are creating spanned arrays, the Create spanned arrays window opens.

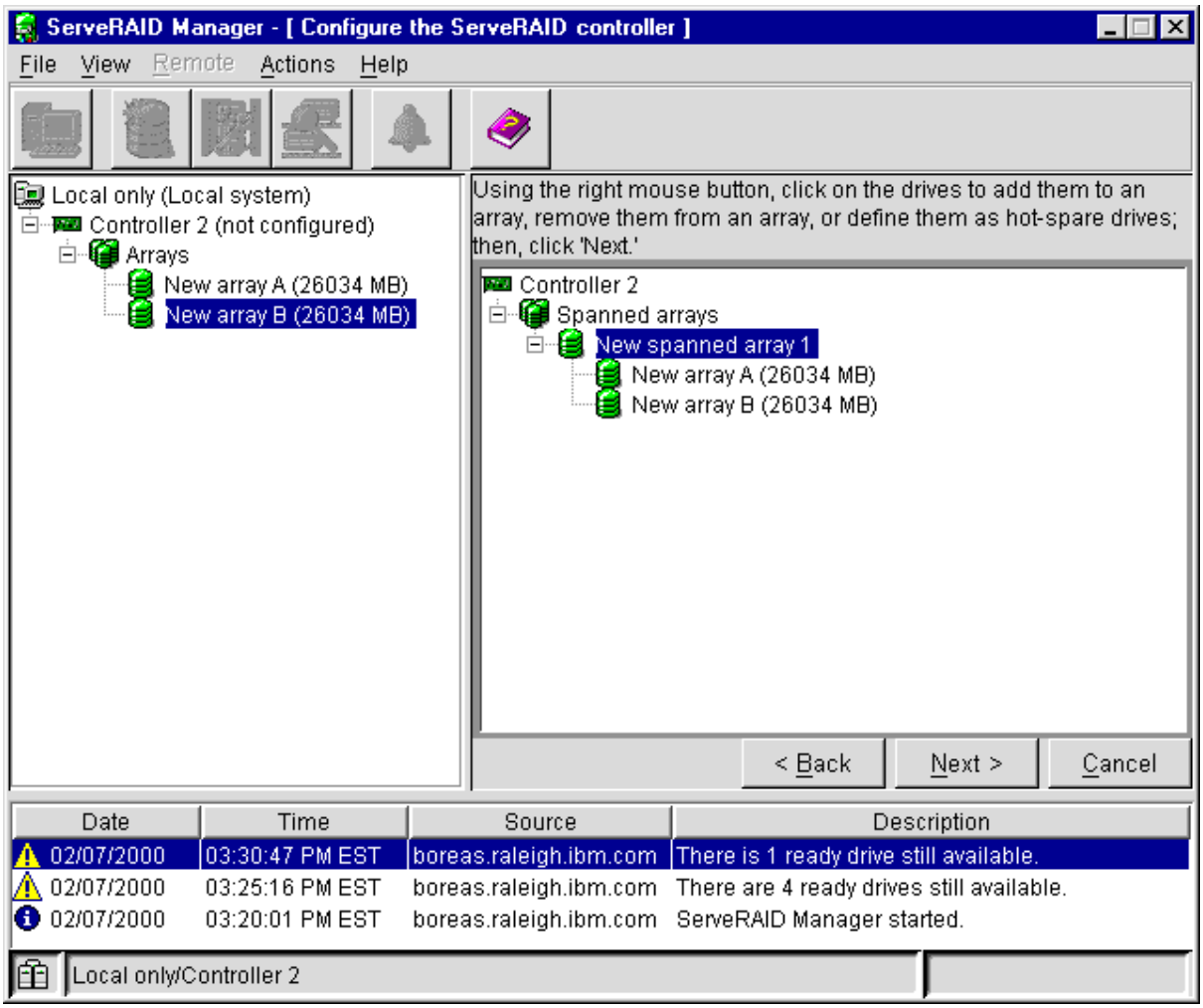


Figure 9. Create spanned arrays window

6. Using the right mouse button, click the array icons in the Main Tree to select the arrays that you want to add or delete to your spanned arrays; then, select a choice from the pop-up list.
7. After you select the arrays for your spanned arrays, click **Next**. The Create logical drives window opens.

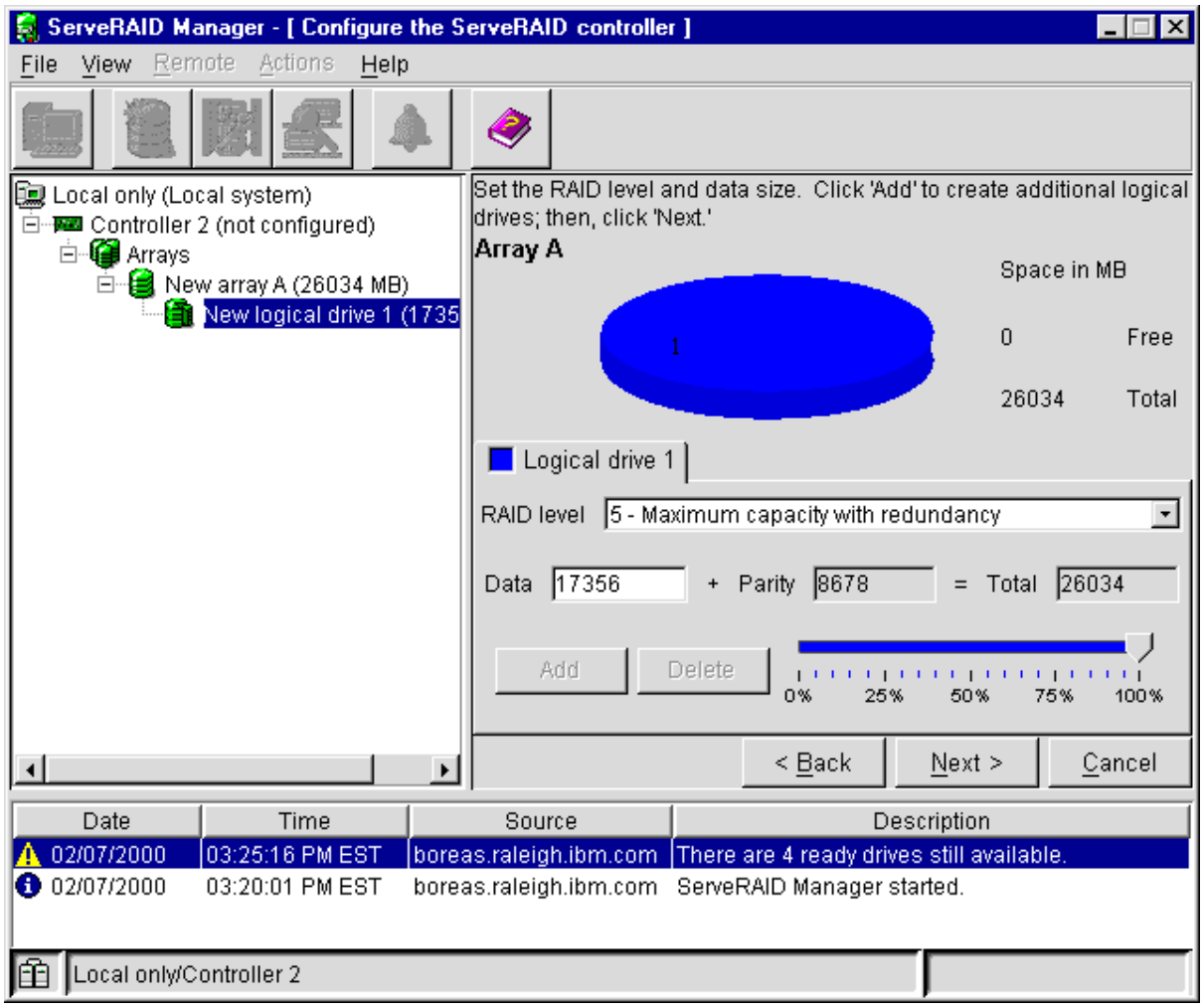


Figure 10. Create logical drives window

8. When creating your logical drives, you might change your mind about the arrays you created. If so, you can:
   - Remove a specific drive from a newly defined array or delete an entire newly defined array. To do this, click **Back**; then, using the right mouse button, click the specific drive or Array icon in the Main Panel on the right. Select **Remove from new array** or **Delete new array**.
   - Remove a specific hot-spare drive or all newly defined hot-spare drives. To do this, click **Back**; then, using the right mouse button, click the Hot-spare drive icon in the Main Panel on the right, and then select **Remove new hot-spare drive** or **Remove all new hot-spare drives**.
9. Select a RAID level for the logical drive from the RAID pull-down menu in the Main Panel. (Refer to “Supported RAID levels” on page 9.)
10. If you do not want to use the maximum size for the logical drive, move the sliding bar in the Main Panel from right to left to allot data and parity space for the logical drive, or type in the size in the data field.

    Notes:

    a. You can define from one to eight logical drives.

b. Some operating systems have size limitations for logical drives. Before you save the configuration, verify that the size of the logical drive is appropriate for your operating system. See your operating-system documentation for more detailed information.

c. Typically, the first logical drive defined on the first ServeRAID controller found by system BIOS during startup will be your startup (boot) drive.

11. If free space is available and you want to define another logical drive, click **Add** in the Main Panel.

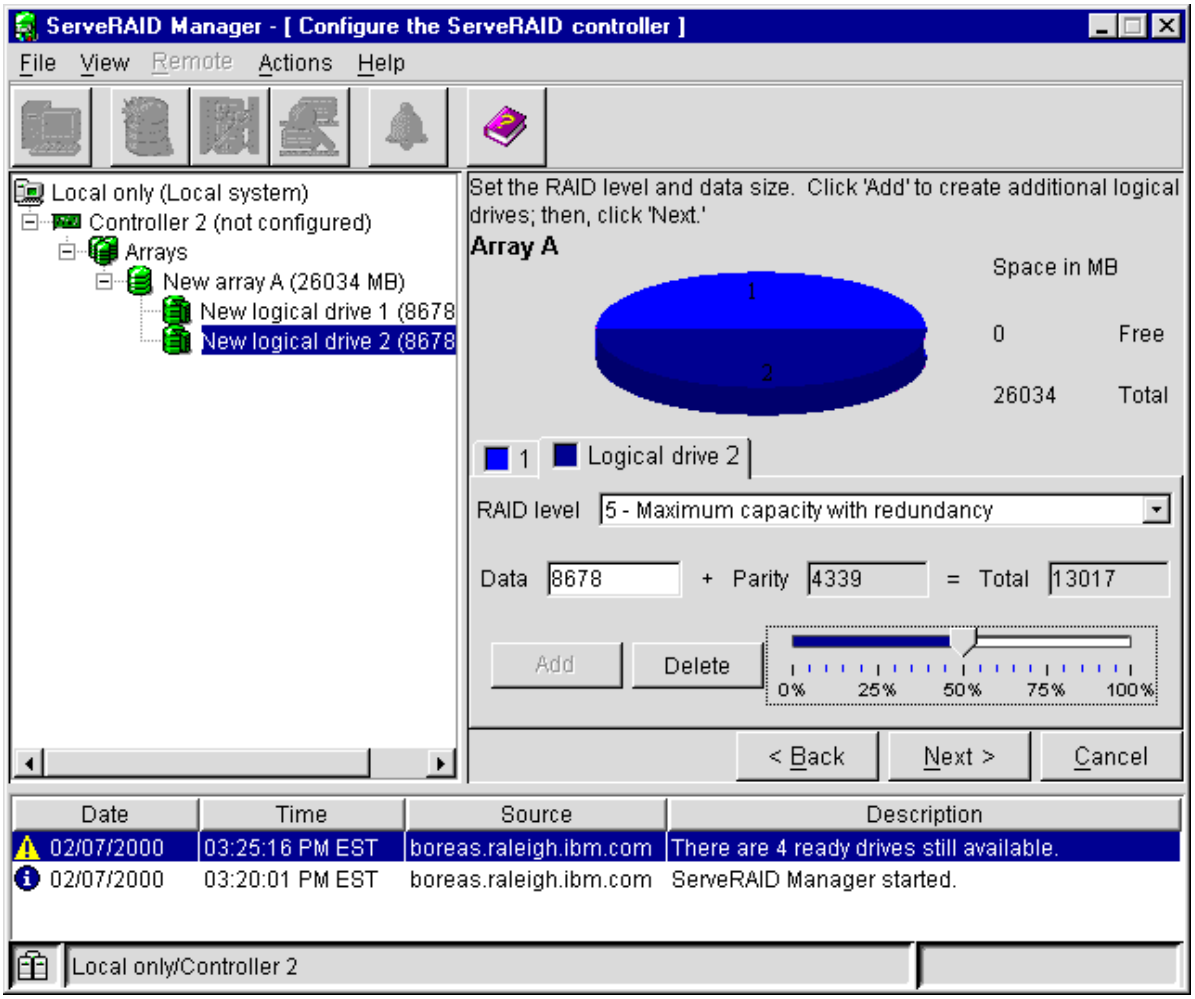


Figure 11. Adding another logical drive

12. Repeat steps 9 on page 31 through 11 for each logical drive that you want to define in this array; then, continue with step 13.
13. If you are defining multiple arrays, click the next New array tree node; then, repeat steps 9 on page 31 through 12. When you are finished, go to step 14.
14. Click **Next**. The Configuration summary window opens.
15. Review the information that displays in the Configuration summary window.

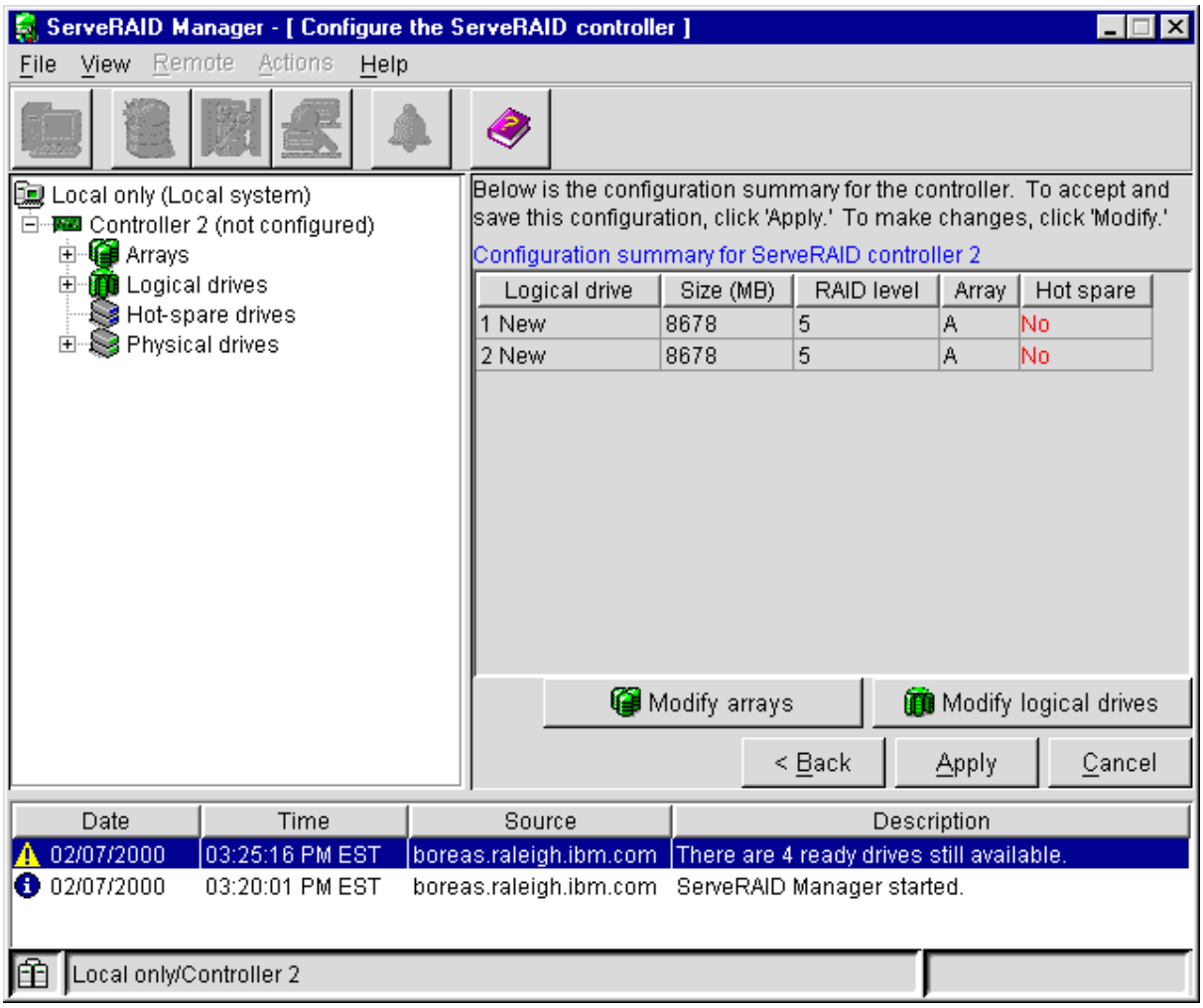


Figure 12. Configuration summary window

Note: To change the configuration, click **Modify arrays** or **Modify logical drives**.

16. Click **Apply** to accept and save the configuration. The configuration is saved in the ServeRAID controller and on the physical drives.
17. If you have multiple controllers, for each controller repeat steps 1 on page 29 through step 16.
18. When you have completed configuration, you can change to Information mode and change controller settings. See “Using Information mode” on page 34 for more information. If you do not want to change any settings, exit the ServeRAID Manager program and remove the CD from the CD-ROM drive.
19. Restart the server.
20. Continue with “Chapter 5. Installing ServeRAID device drivers” on page 35 to install the ServeRAID device driver while installing your operating system.

Note: If you are configuring your startup (boot) ServeRAID controller, you *must* install the device driver while installing the operating system.

Using Information mode

You can use Information mode to view the configuration information of ServeRAID controllers, arrays, logical drives, hot-spare drives, and physical drives that make up your ServeRAID subsystem (see Figure 6 on page 26). You also can use this mode to change some of the ServeRAID controller settings. These settings include:

- Write-cache mode
- Controller and partner names
- SCSI initiator IDs
- Merge group numbers
- Read-ahead cache mode
- Stripe-unit size
- Unattended mode
- BIOS compatibility mapping
- Rebuild rate
- SCSI transfer speed

Click an item in the Main Tree and select the **Actions** menu to display available actions for that item.

Viewing the device and configuration information: To view the current settings:

1. Click the plus (+) box next to the object in the Main Tree to expand that portion of the tree.
2. Click the icon for the server, ServeRAID controller, array, logical drive, hot-spare drive, or physical drive to view its current settings.

Detailed information about the selected device will be displayed in the Main Panel on the right.

Chapter 5. Installing ServeRAID device drivers

Install the ServeRAID device drivers that are provided with the IBM ServeRAID controllers on the *IBM ServeRAID Support* CD. Refer to the *IBM Netfinity ServeRAID-4L Ultra160 SCSI Controller Device Driver Installation Instructions* (4LDEVDRV.PDF) in the /BOOKS directory on the *IBM ServeRAID Support* CD. This booklet provides detailed instructions for installing the device drivers on the following operating systems:

- Microsoft Windows 2000
- Microsoft Windows NT

If you are installing files for an IBM ServeRAID controller that comes as a standard feature on your IBM Netfinity or PC Server system board, use the installation instructions and CDs provided with your server to install these files.

Part 2. Utility programs

Chapter 6. Using the ServeRAID Mini-Configuration program

This chapter provides the information that is needed to start and use the ServeRAID Mini-Configuration program.

The ServeRAID Mini-Configuration program provides a quick way to display the current settings for the ServeRAID controller. You also can use this program to perform a limited set of the configuration functions without using the *IBM ServeRAID Support* CD.

Accessing the Mini-Configuration program

To access the Mini-Configuration program:

1. Turn on the server. If the server already is running, shut down the operating system, and then restart the server.
2. When the ServeRAID Mini-Configuration prompt appears, press Ctrl+I.
3. If your server contains more than one ServeRAID controller, a selection screen will appear. To continue:
   a. Use the Up Arrow (↑) or Down Arrow (↓) key to select a controller.
   b. Press Enter.

   If your server contains only one ServeRAID controller, or after you select a ServeRAID controller, the Main Menu appears.

   Descriptions of the choices available from the Main Menu of the Mini-Configuration program are as follows:
   - **View Controller Status** shows the current status of the ServeRAID controller. (See “Viewing the controller status” for more information.)
   - **View Configuration** shows the current configuration information for the ServeRAID controller. (See “Viewing the configuration” on page 40 for more information.)
   - **Advanced Functions** is used to initialize the configuration, import configuration from drives, configure BIOS settings, and view the controller and PCI information. (See “Using the advanced configuration functions” on page 40 for more information.)
4. Use the Up Arrow (↑) or Down Arrow (↓) key to highlight your choice; then, press Enter.
5. Follow the instructions that appear on the screen.
6. Click **Exit**; then, press Enter.

Viewing the controller status

When you select **View Controller Status** from the Main Menu, the following information displays on the screen:

- All physical drives and their states
- **Unattended** shows the current state of the Unattended mode.
  - When this option is set to **Off**, you can choose the recovery method when a ServeRAID controller startup error occurs.
  - When this option is set to **On**, the ServeRAID controller chooses the recovery method when a startup error occurs.
- **Read Ahead** shows the current state of the read-ahead cache mode.

- **CompMode** shows the current BIOS compatibility mode. **On** indicates 8 gigabyte (GB) Extended; **Off** indicated 2 gigabyte (GB) Limited.
- **Clustered** shows the current state for clustering.
- **BBWC** shows the cache size of the battery-backup write cache, if it is installed (8 = 8 MB or 32 = 32 MB) or **No** if there is no battery-backup write cache installed.
- **Boot Blk** shows the version number of the startable microcode (or firmware) loaded for the ServeRAID controller.
- **Code Blk** shows the current version number of the microcode (or firmware) loaded for the ServeRAID controller.
- **Rebuild Rate** shows the current speed setting for rebuilds: High, Medium, or Low.
- **Number of Defunct drives** shows the current number of defunct physical drives.
- **Number of Offline drives** shows the current number of offline logical drives.
- **Number of Critical drives** shows the current number of critical logical drives.
- **Config. Updates** shows the number of times that the configuration has been changed since it has been initialized. When you initialize the configuration, the Config. Update resets to zero.
- **Bad Stripe, Locked Stripe, or Blocked Drive** identifies the logical drives that are affected.
  - **Bad Stripe Drives** indicates logical drives that have inaccessible areas.
  - **Locked Stripe Drives** is a reserved field.
  - **Blocked Drives** indicates the logical drives that are blocked. You must unblock a blocked drive before you can use it. See “Logical drive-state descriptions” on page 19 for more information.

Viewing the configuration

You can select **View Configuration** from the Main Menu to display the number of each logical drive, and to display the size, RAID level, state, stripe-unit size, write policy, read-ahead status, and creation date for each logical drive.

Using the advanced configuration functions

You can select the **Advanced Functions** to restore the controller configuration to factory default settings, copy the configuration to the controller from the connected physical drives, configure BIOS settings, and view the controller and PCI information.

When you select the **Advanced Functions** from the Main Menu, the following choices are displayed.

Attention: Be careful when making selections from this menu. If you change the configuration, you might lose data.

- **Restore to Factory Default Settings** is used to reset the configuration. When you reset the configuration, you will not have access to any data stored on the logical drives attached to the selected ServeRAID controller.

  This choice deletes the existing configuration information, sets all functional physical drives attached to the controller to the ready state, and deletes all logical drives defined for the controller.

  This choice *does not* change any of the ServeRAID controller settings (such as the stripe-unit size, rebuild rate, and so on) from their current values.

- **Copy the Configuration from Drives to Controller** reads the most common configuration from the drives in the server and copies it to the ServeRAID controller.
- **Configure BIOS Settings** is used to modify the BIOS settings, such as the BIOS Compatibility Mapping, for the ServeRAID controller.

  Note: The Multiple Controller mode for extra BIOS has two settings: **Erase** and **Shrink**. When this parameter is set to **Erase**, redundant copies of the ServeRAID BIOS are erased. When this parameter is set to **Shrink**, the redundant copies of the ServeRAID BIOS are removed from memory but stored in the controller for future use. When multiple ServeRAID controllers are installed, you need only one active copy of ServeRAID BIOS. However, to ensure that you have a copy of the ServeRAID BIOS available if your active copy becomes defective or unavailable, leave the Multiple Controller parameter set to **Shrink**.
- **View Controller and PCI Information** shows the ServeRAID controller hardware and PCI register information.
- **Exit** is used to exit from the Mini-Configuration program.

Chapter 7. Installing and using the IPSSEND command-line program

This chapter provides the information that is needed to install, start and use the IPSSEND command-line program.

IPSSEND is an advanced command-line program that you can use to manage your ServeRAID controllers. This utility program is provided on the *IBM ServeRAID Command-Line Programs* diskette and the *IBM ServeRAID Support* CD.

Notes:

1. If you use a diskette, you must create the diskette using the instructions and diskette images on the *IBM ServeRAID Support* CD. These files are available in the following directory:

   d:/IMAGES

   where *d* is the CD-ROM drive.

Installing the IPSSEND command-line program

You can use the IPSSEND program to view the configuration of a ServeRAID controller, initialize logical drives, synchronize logical drives.

You can use the IPSSEND program with the following operating systems:
- Microsoft Windows NT
- Microsoft Windows 2000

Installing IPSSEND for Windows 2000, Windows NT 4.0

To install this program for Windows NT or Windows 2000, do the following:

1. Start the server.
2. After the operating system starts, insert the *IBM ServeRAID Support* CD into the CD-ROM drive.
3. Create an IPSADM directory on your hard disk. To do this, go to the operating system command prompt and type:

   md *c*:\ipsadm

   where *c* is the drive letter of the drive where Windows NT or Windows 2000 is installed.
4. Press Enter.
5. Copy the IPSSEND.EXE file to your hard disk drive by typing one of the following at the command prompt:

For Windows 2000	copy *z*:\programs\winnt\cmdline\win2k\ipssend.exe *c*:\ipsadm
For Windows NT	copy *z*:\programs\winnt\cmdline\nt4_0\ipssend.exe *c*:\ipsadm

   Note: Where *z* is the drive letter for the CD-ROM drive that contains the *IBM ServeRAID Support* CD and *c* is the drive letter where Windows NT or Windows 2000 is installed.
6. Press Enter. Remove the CD from the CD-ROM drive.

Using the IPSSEND command-line program

The IPSSEND command-line program provides a quick way to do the following for the ServeRAID controller:

- Copy ServeRAID controller configurations from one server to another (see "Server roll-out functions")
- Recover from a failed physical drive and rebuild an affected logical drive (see "Error-recovery functions" on page 45)
- Isolate problems and debug their cause (see "Problem-isolation and debug functions" on page 47)
- Display or modify a limited set of configuration settings (see "RAID configuration functions" on page 48).

Note: If you do not have the IPSSEND program installed, refer to "Installing the IPSSEND command-line program" on page 43.

When you run IPSSEND with no parameters, a list of available functions and their specific parameters is displayed. The available functions and their parameters are described in the sections that follow.

To run the IPSSEND program with no parameters, do the following:

For Windows 2000 and Windows NT	1. Type: *c:*\ipsadm\ipssend where c is the drive letter of the drive where Windows NT 4.0 or Windows 2000 is installed. 2. Press Enter.

Server roll-out functions

The IPSSEND server roll-out functions include the following:

autosync Use the **autosync** function to synchronize a new logical drive. Use this function only on RAID level-5 logical drives. This function starts a background synchronization so you can use the logical drive immediately.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend autosync** *controller logicaldrive* [**noprompt**]

where:
- *controller* is the ServeRAID controller number (1–12)
- *logicaldrive* is the logical drive number (1–8)
- **noprompt** is an optional parameter that overrides the user prompt

backup Use the **backup** function to save a ServeRAID controller configuration and BIOS settings to a diskette or to a physical drive. The ServeRAID controller configuration must be valid.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend backup** *controller filename* [**noprompt**]

where:
- *controller* is the ServeRAID controller number (1–12)
- *filename* is the path and file name where the configuration is to be written

- **noprompt** is an optional parameter that overrides the user prompt.

init

Use the **init** function to initialize the first 0.5 MB of a logical drive. This process will erase the partition tables and all data on the disk.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend init** *controller drivenum* [**noprompt**]

where:
- *controller* is the ServeRAID controller number (1–12)
- *drivenum* is the logical drive number (1–8)
- **noprompt** is an optional parameter that overrides the user prompt.

restore

Use the **restore** function to load a configuration from a file stored on a diskette or a hard disk. The configuration must be a valid configuration file from the backup option in IPSSEND. This operation overwrites the existing configuration information and BIOS settings stored for the ServeRAID controller.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend restore** *controller filename* [**noprompt**]

where:
- *controller* is the ServeRAID controller number (1–12)
- *filename* is the path and file name where the configuration is to be written
- **noprompt** is an optional parameter that overrides the user prompt.

synch

Use the **synch** function to synchronize the parity information on redundant logical drives. If the parity information is inconsistent, the IPSSEND program will repair it automatically.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend synch** *controller drive drivenum*

where:
- *controller* is the ServeRAID controller number (1–12)
- *drive* indicates the number of logical drives:
  - DRIVE is a single logical drive
  - GROUP is a Merge Group
- *drivenum* specifies the *scope* item:
  - If DRIVE, specifies the logical drive number (1–8)
  - If GROUP, specifies the Merge Group number

Error-recovery functions

The IPSSEND error-recovery functions include the following:

getstatus

Use the **getstatus** function to display the current logical-drive status for the most recent rebuild, synchronization, or logical-drive migration. The status includes such information as the remaining size of the logical drive, the percentage completed for the function in process, and information about the most recently completed logical-drive function.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend getstatus** *controller*

where:
controller is the ServeRAID controller number (1–12)

rebuild

Use the **rebuild** function to rebuild a designated disk drive. This function is valid for disk arrays that contain one or more logical drives that are in the critical state. Progress is indicated during the rebuild operation, but you can also use the **getstatus** function to obtain progress information about the rebuild.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend rebuild** *controller dch dsid nch nsid*

where:
- *controller* is the ServeRAID controller number (1–12)
- *dch* is the channel number for the defunct drive (1–4)
- *dsid* is the SCSI ID for the defunct drive (0–15)
- *nch* is the channel number for the new drive (1–4)
- *nsid* is the SCSI ID for the new drive (0–15)

setstate

Use the **setstate** function to change the state of a physical device from its current state to a new state.

Attention: You must be very careful when you use this function. For example, you might lose data if you reset a defunct device to online without first performing a rebuild operation.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend setstate** *controller channel sid nstate*

where:
- *controller* is the ServeRAID controller number (1–12)
- *channel* is the channel number for the drive (1–4)
- *sid* is the SCSI ID for the drive (0–15)
- *nstate* is the new state for the drive. Valid states are:
  - EMP for Empty
  - RDY for Ready
  - HSP for Hot spare
  - SHS for Standby hot spare
  - DDD for Defunct disk drive
  - DHS for Defunct hot spare
  - RBL for Rebuild
  - SBY for Standby
  - ONL for Online.

unblock

Use the **unblock** function to gain access to a blocked logical drive. RAID level-0 logical drives become blocked if they are in an array that contains RAID level-1 or level-5 logical drives and the array is being rebuilt. Because the RAID level-0 logical drives cannot be rebuilt, the data stored on the RAID level-0 logical drives is damaged and should not be accessed. After you issue the **unblock** function, you must re-create or restore the data previously stored on the RAID level-0 logical drives.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend unblock** *controller drivenum*

where:

- *controller* is the ServeRAID controller number (1–12)
- *drivenum* is the logical drive number (1–8)

Problem-isolation and debug functions

The IPSSEND problem-isolation and debug functions include the following:

eraseevent Use the **eraseevent** function to clear all logged entries in the designated event log. See **getevent** help for information about the contents of the device event log and the controller soft and hard event logs.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend eraseevent** *controller options*

where:
- *controller* is the ServeRAID controller number (1–12)
- *options* is the designated event log:
  - DEVICE for the device event log
  - SOFT for the ServeRAID controller soft event log
  - HARD for the ServeRAID controller hard event log

getbst Use the **getbst** function to display the number of bad stripes in the bad stripe table for each logical drive.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend getbst** *controller*

where:

controller is the ServeRAID controller number (1–12)

getevent Use the **getevent** function to display information about various unexpected events. IBM service representatives use the soft and hard event logs for development and debugging purposes only. The device event log contains event counters for each attached physical device. These counters include:

- Parity: An unexpected event occurred while data was being transferred on the SCSI bus. This usually indicates a problem with the SCSI cable, connectors, or terminators.
- Soft: A SCSI device detected a check-condition event.
- Hard: The SCSI controller detected an unexpected event. The controller is the most likely cause.
- Misc: The ServeRAID controller detected an event that was most likely caused by the device.

The device event log also provides PFA alerts, which indicate that the device has signaled the ServeRAID controller that it might fail in the near future.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend getevent** *controller options*

where:
- *controller* is the ServeRAID controller number (1–12)
- *options* is the designated event log:
  - DEVICE for the device event log

- SOFT for the ServeRAID controller soft event log
- HARD for the ServeRAID controller hard event log

RAID configuration functions

The IPSSEND RAID configuration functions include the following:

devinfo Use the **devinfo** function to retrieve information (such as size and state) about a specific device.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend devinfo** *controller channel sid*

where:
- *controller* is the ServeRAID controller number (1–12)
- *channel* is the channel number for the device (1, 2, 3, or 4)
- *sid* is the SCSI ID for the device (0–15)

drivever Use the **drivever** function to display the vendor ID, microcode version, and serial number of a SCSI device. The IPSSEND program retrieves this information directly from the device.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend drivever** *controller channel sid*

where:
- *controller* is the ServeRAID controller number (1–12)
- *channel* is the channel number for the device (1, 2, 3, or 4)
- *sid* is the SCSI ID for the device (0–15)

getconfig Use the **getconfig** function to display the ServeRAID controller configuration information. This includes information about the firmware version; initiator ID and rebuild rate; logical-drive status, RAID level, and size; and physical device type, SCSI ID, and PFA error.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend getconfig** *controller options*

where:
- *controller* is the ServeRAID controller number (1–12)
- *options* is one of the following:
  - AD for the controller information
  - LD for the logical drive information
  - PD for the physical device information
  - AL for all information. This is the default option.

hsrebuild Use the **hsrebuild** function to turn on the ServeRAID controller hot-swap rebuild feature or display the current status of the hot-swap rebuild feature.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend hsrebuild** *controller options*

where:
- *controller* is the ServeRAID controller number (1–12)
- *options* is one of the following:
  - ON enables the hot-swap feature
  - ? displays the status of the hot-swap rebuild feature.

readahead Use the **readahead** function to enable, disable, or set the adaptive mode for the read-ahead feature of the ServeRAID controller.

Supported operating systems: Windows NT

Command: **ipssend readahead** *controller options*

where:
- *controller* is the ServeRAID controller number (1–12)
- *options* is one of the following:
  - ON enables the read-ahead feature
  - OFF disables the read-ahead feature
  - ADAPTIVE indicates that the controller will determine the best mode to use at any given time.
  - ? displays the current read-ahead feature mode being used.

unattended Use the **unattended** function to enable or disable the unattended feature of the ServeRAID controllers.

Supported operating systems: Windows NT, Windows 2000

Command: **ipssend unattended** *controller options*

where:
- *controller* is the ServeRAID controller number (1–12)
- *options* is one of the following:
  - ON to enable the feature
  - OFF to disable the feature
  - ? to display the current setting of this feature.

Chapter 8. Installing and starting the ServeRAID Manager program

After installing the operating system on your server, you can install the ServeRAID Manager program on your server. The ServeRAID Manager program provides a graphical interface that you can use to monitor ServeRAID configuration changes being performed on your server while your server is fully operational. You can create an array, delete an array, create a logical drive, change the RAID level, dynamically increase the logical drive size, rebuild an array, and perform other ServeRAID configuration functions.

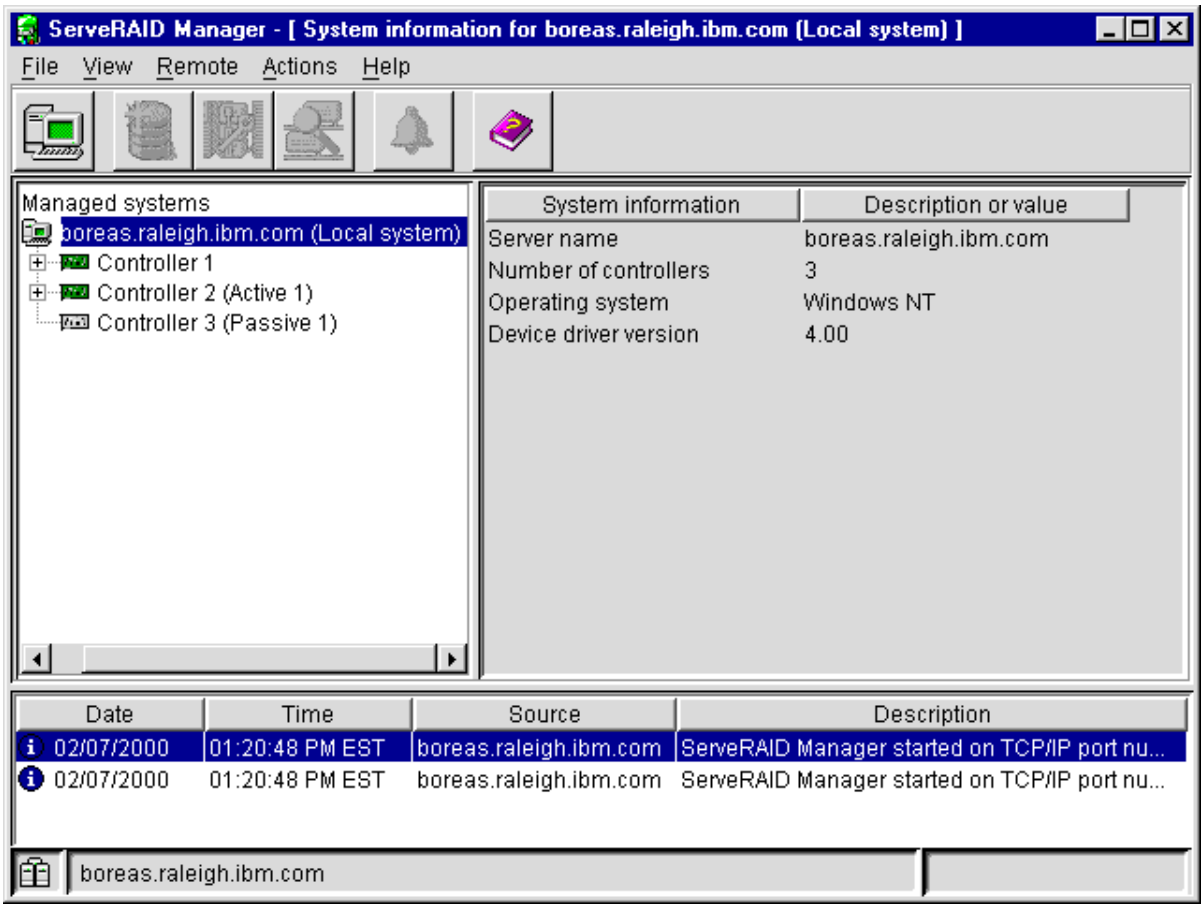


Figure 13. ServeRAID Manager installed on a server

To use the ServeRAID Manager program, see the ServeRAID Manager online help or refer to “Configuring the ServeRAID controller” on page 23.

Installing the ServeRAID Manager program

This section provides instructions for installing the ServeRAID Manager program.

When using:	Go to:
Windows 2000	“Installing ServeRAID Manager on Windows 2000, Windows NT 4.0, Windows 98, or Windows 95” on page 52.
Windows NT 4.0	“Installing ServeRAID Manager on Windows 2000, Windows NT 4.0, Windows 98, or Windows 95” on page 52.

When using:	Go to:
Windows 98	“Installing ServeRAID Manager on Windows 2000, Windows NT 4.0, Windows 98, or Windows 95”.
Windows 95	“Installing ServeRAID Manager on Windows 2000, Windows NT 4.0, Windows 98, or Windows 95”.

Installing ServeRAID Manager on Windows 2000, Windows NT 4.0, Windows 98, or Windows 95

Note: This version of the ServeRAID Manager program supports up to 12 ServeRAID controllers when using Microsoft NT 4.0 or Windows 2000.

To install the ServeRAID Manager program for Windows NT 4.0, Windows 2000, Windows 98, or Windows 95, do the following:

1. Insert the *IBM ServeRAID Support* CD into the CD-ROM drive.
2. The installation program starts. Follow the instructions on the screen to install the program.

Starting the ServeRAID Manager program

After you have configured your ServeRAID controller, installed the device drivers, installed the operating system, and installed the ServeRAID Manager program on your server, you can administer and monitor your ServeRAID controllers, as well as modify the ServeRAID controller configuration.

Starting the ServeRAID Manager program in Windows 2000, Windows NT, Windows 98, or Windows 95

To start the ServeRAID Manager program in Windows 2000, Windows NT, Windows 98, or Windows 95, click **Start → Programs → ServeRAID Manager → ServeRAID Manager**. The Control panel window opens. The program starts in Information mode and a window similar to the following opens.

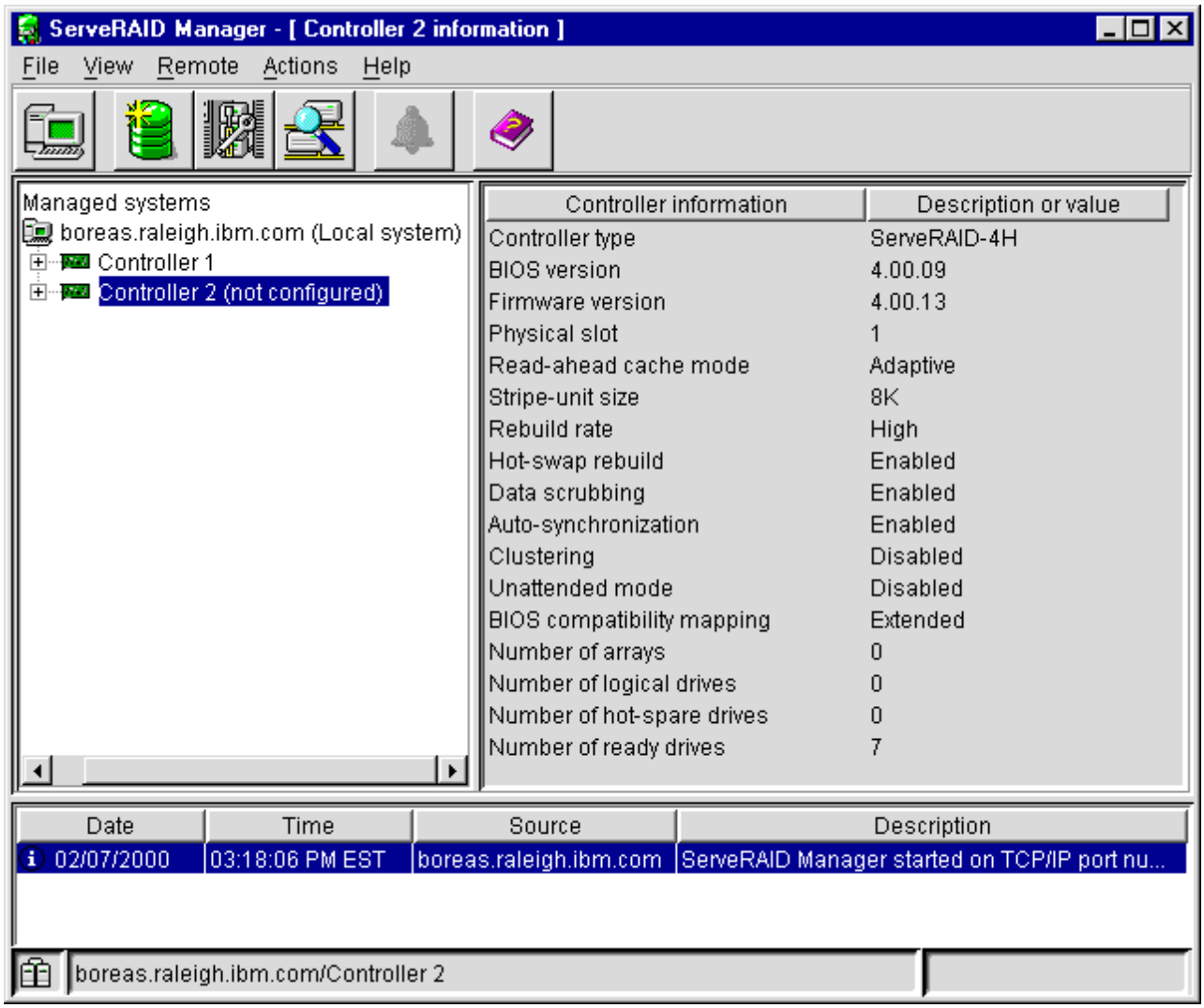


Figure 14. Information mode window

Part 3. Maintenance and troubleshooting

Chapter 9. Solving ServeRAID problems

This section describes the ServeRAID text and numeric messages that might be displayed during startup. This section also includes some basic information about rebuilding a defunct drive.

In addition to the information provided in this section, you might want to use the ServeRAID IPSSEND program to help isolate ServeRAID problems. See “Chapter 7. Installing and using the IPSSEND command-line program” on page 43 and “Problem-isolation and debug functions” on page 47 for information about using the IPSSEND program.

IBM ServeRAID Support CD fails to start

If you start a server with the *IBM ServeRAID Support* CD in the CD-ROM drive and the ServeRAID Manager does not start, you must reduce the number of FAT partitions with assigned drive letters on the server.

For the startable (boot) *IBM ServeRAID Support* CD to work, the server cannot have more than 22 FAT partitions with assigned drive letters.

ServeRAID controller messages

This section lists the ServeRAID messages that might appear during system startup.

The ServeRAID controllers provide a Device Event Log that collects statistics on the number and types of events that occur on a selected physical drive. After correcting a problem with the disk array, clear the log so that you can identify any subsequent errors quickly. For information about clearing the event log, see “**eraseevent**” on page 47.

All physical drives contain unique identifiers, such as the drive serial number and manufacturer. During configuration, the ServeRAID controller stores this information.

Following are messages associated with the ServeRAID subsystem in alphabetical order.

Message	Explanation	Action
A new drive was installed.	When the ServeRAID controller detects a new drive that is not part of the current configuration, the following message appears: *x* new Ready drives found where *x* is the number of Ready drives found.	This is an information message. No action is required.
Auto rearrange.	Auto rearrange is enabled or disabled.	This is an information message. No action is required.
Battery-backup cache not responding	BIOS code detected a bad or failed battery-backup cache.	Press F9 to remove the battery-backup cache from the configuration, or press F10 to exit without change.

Message	Explanation	Action
Battery-backup cache replacement	The ServeRAID controller detects that the battery-backup cache is defective.	Press F8 if you replaced the battery-backup cache, or press F10 if you have not replaced the battery-backup cache.
Configured drives are missing.	When the ServeRAID controller detects that a previously configured drive is missing, the following message appears: *x* Online drives not responding where *x* is the number of drives not responding. Example of a possible message: `Online Drive on Channel 3 SCSI ID 3 is not responding.`	Press one of the following keys: **F2** Detailed description. Press this key for a detailed description of the problem, such as the example message above. **F4** Retry. Press this key after correcting a problem. For example, press F4 after you turn on the external storage enclosure that contains the physical drive. **F5** Change the configuration and set the drives to defunct. Press this key to accept the new state that the ServeRAID controller will assign to the drive. For example, the ServeRAID controller will assign the drive a state of defunct or empty. You can also press F5 when you must remove a drive. RAID level-1 and RAID level-5 logical drives are present, and performance in a degraded mode is acceptable. The ServeRAID controller will assign the drive a state of defunct, but the server can complete startup. However, the array will remain in Critical mode and the potential for data loss will exist until you replace and rebuild the defunct drive. To prevent the loss of data, replace and rebuild the defunct drive in a timely manner. **Note:** A physical drive in the defunct state does not necessarily mean that you need to replace the drive. Before you replace the drive, ensure that: 1. All cables are connected properly to the backplane and to the physical drive. Also, ensure that all cables inside the server are connected properly. 2. The hot-swap drive trays are seated properly in the drive bay. 3. If multiple drives fail in separate arrays (one physical drive per array), then replace each of the defunct physical drives. If multiple physical drives fail at the same time within the *same* array, contact your IBM service representative. See “Rebuilding a defunct drive” on page 68 for more information. After you perform these steps, if the physical drive does not function properly, replace the drive. **F10** Continue starting without changing the configuration. Press this key to continue without change to the configuration.

Message	Explanation	Action

Configured drives are not in the configured location.	When the ServeRAID controller detects that a previously configured drive is present, but the drive is in a new location, the following message appears:
	
	x Online drive has been rearranged where *x* is the number of drives that have been rearranged.
	
	For example:
	
	Examples of possible messages are:
	`Online Drive on Channel 3 SCSI ID 4 moved to Channel 3 SCSI ID 3`
	`Online Drive on Channel 3 SCSI ID 3 moved to Channel 3 SCSI ID 4`
		Press one of the following keys:
		
		F2 Detailed description. Press this key for a detailed description of the problem, such as the example messages above.
		
		F4 Retry. Press this key after correcting a problem. For example, press F4 after you move the physical drive to its previously assigned location.
		
		F5 Change the configuration and set the drive to defunct. Press this key to accept the new state that the ServeRAID controller will assign to the drive. For example, the ServeRAID controller will assign the drive a state of defunct or empty.
		Note: A physical drive in the defunct state does not necessarily mean that you need to replace the drive. Before you replace the drive, ensure that:
		1. All cables are connected properly to the backplane and to the physical drive. Also, ensure that all cables inside the server are connected properly.
		2. The hot-swap drive trays are seated properly in the drive bay.
		3. If multiple drives fail in separate arrays (one physical drive per array), then replace each of the defunct physical drives. If multiple physical drives fail at the same time within the *same* array, contact your IBM service representative. See “Rebuilding a defunct drive” on page 68 for more information.
		
		After you perform these steps, if the physical drive does not function properly, replace the drive.
		
		F6 Change the configuration and accept the rearrangement. Press this key to change the configuration to match the current drive location.
		
		You might remove the hot-swap drives from the server for security or maintenance reasons. If you replace the drives but install them in different drive bays, you can press F6 to accept the new locations, and the ServeRAID controller will update the configuration.
		
		F10 Continue startup without changing the configuration. Press this key to continue without change to the configuration.

Controller is not responding to commands. No logical drives are installed.	The ServeRAID controller is not operational.	Have the server serviced.

Message	Explanation	Action
Error: Cannot disable this controller BIOS.	The ServeRAID controller was unable to prevent an extra copy of its BIOS code from being stored on the server. This condition occurs when the server contains multiple ServeRAID controllers.	Have the server serviced.
Installation stopped.	The server cannot access the ServeRAID controller.	This is a follow-on message to a preceding message. Follow the Action instructions for the preceding message to resolve the problem.

New controller installed in a configured server or drives are imported.	When the ServeRAID controller detects that the identifiers of the drives do not match the controller configuration information, the following message appears:
	
	x Online drive(s) found with mismatch configuration
	
	Examples of possible messages:
	`Configuration mismatch Channel 1 SCSI ID 0 with Host ID`
	`Configuration mismatch Channel 2 SCSI ID 0 with Host ID`
		Press one of the following keys:
		
		F2 Detailed description. Press this key for a detailed description of the problem, such as the example messages above.
		
		F4 Retry. Press this key after correcting the problem. For example, press F4 after you move the physical drive to its previously assigned location, or after you install the original physical drives back in the server.
		
		F5 Change the configuration and set the drive to defunct. Press this key to accept the new state that the ServeRAID controller will assign to the drive. For example, the ServeRAID controller will assign the drive a state of defunct or empty.
		Note: A physical drive in the defunct state does not necessarily mean that you need to replace the drive. Before you replace the drive, ensure that:
		1. All cables are connected properly to the backplane or system board, and to the physical drive. Also, ensure that all cables inside the server are connected properly.
		2. The hot-swap drive trays are seated properly in the drive bay.
		3. If multiple drives fail in separate arrays (one physical drive per array), then replace each of the defunct physical drives. If multiple physical drives fail at the same time within the *same* array, contact your IBM service representative. See “Rebuilding a defunct drive” on page 68 for more information.
		
		After you perform these steps, if the physical drive does not function properly, replace the drive.

Message	Explanation	Action
		F7 Import configuration information from drive. Press this key to restart the server. Press this key to import the configuration information from the drive and to update the configuration information for the ServeRAID controller. This choice is useful when you replace the ServeRAID controller in an existing ServeRAID subsystem. You also might press F7 if you replace a whole set of drives with drives that were configured in another server with a ServeRAID controller. **Note:** When you install drives in a server that has no logical drives defined, the F7 choice will not appear. The ServeRAID controller does not contain any logical drives in its factory configuration. Therefore, F7 will not appear. In this case, do the following: 1. Restart the server and press Ctrl+I to enter the Mini-Configuration program (see “Chapter 6. Using the ServeRAID Mini-Configuration program” on page 39 for more information). 2. Select **Advanced Functions**. 3. Select **Copy the Configuration from Drives to the Controller** and follow the instructions on the screen.
Recoverable configuration error	The configuration data stored in NVRAM does not match the configuration data stored in the EEPROM.	1. Press Ctrl+I to access the ServeRAID Mini-Configuration menu. (See “Chapter 6. Using the ServeRAID Mini-Configuration program” on page 39 for instructions.) 2. Select **Advanced Functions** from the Main Menu. 3. Then, select **Copy the Configuration from Drives to the Controller**. (See “Using the advanced configuration functions” on page 40 for more information.)
Unrecoverable configuration error	The configuration data stored in NVRAM does not match the configuration data stored in the EEPROM.	1. Press Ctrl+I to access the ServeRAID Mini-Configuration menu. (See “Chapter 6. Using the ServeRAID Mini-Configuration program” on page 39 for instructions.) 2. Select **Advanced Functions** from the Main Menu. 3. Then, select **Restore to the Factory Default Settings**. (See “Using the advanced configuration functions” on page 40 for more information.) **Note:** Restoring to factory default settings sets all online drives in array to ready. You must import the configuration from the drives or diskette. Otherwise, you must create a new array, install the operating system, and restore data from backup.
WARNING: **n** logical drives are critical; **n** logical drives are offline.	One or more physical drives have failed.	Replace the defunct drives as soon as possible to prevent data loss.

Message	Explanation	Action
Your server has an error due to a Blocked Logical Drive.	One or more logical drives are blocked. A blocked logical drive cannot be accessed. See “Logical drive-state descriptions” on page 19 for additional information.	Press F4 to unblock the logical drive, or press F5 to continue without unblocking.

ServeRAID startup (POST) messages

During power-on self-test (POST), the ServeRAID controller 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.

```
                    IBM ServeRAID BIOS
                Copyright IBM Corp. 1995, 2000
                     BIOS Version: 4.10.05


Controller 1 Slot 4, Logical Drive=1, Firmware=4.00.20, Status= Fail

   2 Drive(s) not responding or found at new location(s)

Press:  F2 - Detailed information
        F4 - Retry
        F5 - Change the configuration and set drive(s) defunct
        F10 - Continue booting without changing the configuration
```

When you press F2 for detailed information, register information displays on the screen, as follows:

```
                          Detailed information
------------------------------------------------------------------------------
   Online Drive on Channel 2 SCSI ID 0 is not responding
   Online Drive on Channel 2 SCSI ID 1 is not responding
------------------------------------------------------------------------------
         Controller Status Codes: ISPR = EF10  BCS = 07  ECS = 08

       Press PgUp = Page Up    PgDn = Page Down    Esc = Exit panel
```

ISPR displays the four-digit Interrupt Status Port Register code, BCS displays the Basic Configuration Status Register code, and ECS displays the Extended Configuration Status Register code.

If no errors occur:

ISPR = EF10 BCS = 0F or 09 ECS = 00

If an error occurs, refer to: “ISPR (Interrupt Status Port Register) codes” on page 63 for the ISPR error codes and “Basic and Extended Configuration Status Register Codes” on page 63 for the BCS and ECS error codes.

ServeRAID ISPR, BCS, and ECS POST error codes

Notes:

1. When the ServeRAID controller requires your input, a list of function keys will appear below the message.
2. Where the Action information tells you to start the IBM ServeRAID configuration program, insert the *IBM ServeRAID Support* CD into the CD-ROM drive; then, restart the server. The Action column also provides general information about the message.
3. Where *sid* or *ch* appears in these messages, *sid* is the SCSI ID for the device, and *ch* is the channel to which the device is attached.
4. Where *m* or *n* appears in these messages, a number will appear in the actual message.

ISPR (Interrupt Status Port Register) codes

Code	Explanation	Action
1xxx to 7xxx	The POST detected an internal error.	Have the server serviced.
2601 to 260B	The POST detected an error with the ServeRAID subsystem.	Have the server serviced.
2610	The POST detected an error with the ServeRAID controller hardware.	Have the server serviced.
2620	The POST detected that a ServeRAID configuration or hard disk error occurred.	Start the *IBM ServeRAID Support* CD and view the existing device and configuration information for your ServeRAID subsystem. If you cannot locate and correct the configuration problem or the failing device, or if the problem persists, have the server serviced.
8xxx to Bxxx	The POST detected an error with the SCSI interface.	Verify that the SCSI cables are correctly connected and the SCSI termination is set properly for each installed SCSI device. If you cannot locate and correct the SCSI problem, or if the problem persists, have the server serviced.

Basic and Extended Configuration Status Register Codes

BCS	ECS	Explanation and possible recovery action
Code not in table	**Code not in table**	**Explanation:**The ServeRAID controller is not functioning properly. **Action:**Have the server serviced.
00	**01**	**Explanation:**Invalid flash configuration. **Action:**Start the *IBM ServeRAID Support* CD and follow the instructions that appear on the screen. If no instructions appear or if the problem persists, have the server serviced.

BCS	ECS	Explanation and possible recovery action
00	**02**	**Explanation:**Invalid NVRAM configuration. **Action:**Start the *IBM ServeRAID Support CD* and follow the instructions that appear on the screen. If no instructions appear or if the problem persists, have the server serviced.
00	**03**	**Explanation:**Invalid flash and NVRAM configuration. **Action:**Start the *IBM ServeRAID Support CD* and follow the instructions that appear on the screen. If no instructions appear or if the problem persists, have the server serviced.
01	**08**	**Explanation:**No configuration was found in drives, or Online/Rebuild drives are not responding. **Action:**Press F4, F5, F7, or F10.
01	**18**	**Explanation:**No configuration was found in drives, or Online/Rebuild and Hot-Spare/Standby Hot-Spare drives are not responding. **Action:**Press F4, F5, F7, or F10.
01	**28**	**Explanation:**No configuration was found in drives, or Online/Rebuild and Ready/Standby drives are not responding. **Action:**Press F4, F5, F7, or F10.
01	**38**	**Explanation:**No configuration was found in drives, or Online/Rebuild, Hot-Spare/Standby Hot-Spare, and Ready/Standby drives are not responding. **Action:**Press F4, F5, F7, or F10.
01	**48**	**Explanation:**No configuration was found in drives, or Online/Rebuild drives are not responding and unidentified drives were found. **Action:**Press F4, F5, F7, or F10.
01	**58**	**Explanation:**No configuration was found in drives, or Online/Rebuild and Hot-Spare/Standby Hot-Spare drives are not responding and unidentified drives were found. **Action:**Press F4, F5, F7, or F10.
01	**68**	**Explanation:**No configuration was found in drives, or Online/Rebuild and Ready/Standby drives are not responding and unidentified drives were found. **Action:**Press F4, F5, F7, or F10.
01	**78**	**Explanation:**No configuration was found in drives, or Online/Rebuild, Hot-Spare/Standby Hot-Spare, and Ready/Standby drives are not responding and unidentified drives were found. **Action:**Press F4, F5, F7, or F10.
03	**88**	**Explanation:**A drive was imported from another server and it has valid configuration, and Online/Rebuild drives are not responding. **Action:**Press F4, F5, F7, or F10.
03	**98**	**Explanation:**A drive was imported from another server and it has valid configuration, and Online/Rebuild and Hot Spare/Standby Hot-Spare drives are not responding. **Action:**Press F4, F5, F7, or F10.
03	**A8**	**Explanation:**A drive was imported from another server and it has valid configuration, and Online/Rebuild and Ready/Standby drives are not responding. **Action:**Press F4, F5, F7, or F10.

BCS	ECS	Explanation and possible recovery action
03	B8	**Explanation:**A drive was imported from another server and it has valid configuration, and Online/Rebuild, Hot-Spare/Standby Hot-Spare, and Ready/Standby drives are not responding. **Action:**Press F4, F5, F7, or F10.
03	C8	**Explanation:**A drive was imported from another server and it has valid configuration, and Online/Rebuild drives are not responding and unidentified drives were found. **Action:**Press F4, F5, F7, or F10.
03	D8	**Explanation:**A drive was imported from another server and it has valid configuration, and Online/Rebuild and Hot-Spare/Standby Hot-Spare drives are not responding and unidentified drives were found. **Action:**Press F4, F5, F7, or F10.
03	E8	**Explanation:**A drive was imported from another server and it has valid configuration, and Online/Rebuild and Ready/Standby drives are not responding and unidentified drives were found. **Action:**Press F4, F5, F7, or F10.
03	F8	**Explanation:**A drive was imported from another server and it has valid configuration, and Online/Rebuild, Hot-Spare/Standby Hot-Spare, and Ready/Standby drives are not responding and unidentified drives were found. **Action:**Press F4, F5, F7, or F10.
07	00	**Explanation:**The specified drive is not responding. **Action:** To correct the problem: 1. If the specified physical drive is in an external enclosure, check to make sure the enclosure is powered on. If the enclosure is not powered on, turn on the power and press F4 to retry. 2. Download and install the latest version of IBM ServeRAID software. See “Obtaining ServeRAID updates” on page 21 for more information. 3. Replace the failed physical drive.
07	08	**Explanation:**The specified drives are not responding. **Action:** To correct the problem: 1. If the specified physical drives are in an external enclosure, check to make sure the enclosure is powered on. If the enclosure is not powered on, turn on the power and press F4 to retry. 2. Download and install the latest version of IBM ServeRAID software. See “Obtaining ServeRAID updates” on page 21 for more information. 3. Replace the failed physical drives.
07	0C	**Explanation:**Online/Rebuild drives are not responding, and a drive was found at the incorrect SCSI ID. **Action:**Press F4, F5, F6, or F10.
07	18	**Explanation:**Online/Rebuild and Hot-Spare/Standby Hot-Spare drives are not responding. **Action:**Press F4, F5, or F10.
07	1C	**Explanation:**Online/Rebuild and Hot Spare/Standby Hot-Spare drives are not responding, and a drive was found at the incorrect SCSI ID. **Action:**Press F4, F5, F6, or F10.
07	28	**Explanation:**Online/Rebuild and Ready/Standby drives are not responding. **Action:**Press F4, F5, or F10.

BCS	ECS	Explanation and possible recovery action
07	2C	**Explanation:**Online/Rebuild and Ready/Standby drives are not responding, and a drive was found at the incorrect SCSI ID. **Action:**Press F4, F5, F6, or F10.
07	38	**Explanation:**Online/Rebuild, Ready/Standby, and Hot-Spare/Standby Hot-Spare drives are not responding. **Action:**Press F4, F5, or F10.
07	3C	**Explanation:**Online/Rebuild, Ready/Standby, and Hot-Spare/Standby Hot-Spare drives are not responding, and a drive was found at the incorrect SCSI ID. **Action:**Press F4, F5, F6, or F10.
07	48	**Explanation:**Online/Rebuild drives are not responding, and unidentified drives were found. **Action:**Press F4, F5, or F10.
07	4C	**Explanation:**Online/Rebuild drives are not responding, and a drive was found at the incorrect SCSI ID, and unidentified drives were found. **Action:**Press F4, F5, F6, or F10.
07	58	**Explanation:**Online/Rebuild and Hot Spare/Standby Hot-Spare drives are not responding, and unidentified drives were found. **Action:**Press F4, F5, or F10.
07	5C	**Explanation:**Online/Rebuild and Hot Spare/Standby Hot-Spare drives are not responding, a drive was found at the incorrect SCSI ID, and unidentified drives were found. **Action:**Press F4, F5, F6, or F10.
07	68	**Explanation:**Online/Rebuild and Ready/Standby drives are not responding, and unidentified drives were found. **Action:**Press F4, F5, or F10.
07	6C	**Explanation:**Online/Rebuild and Ready/Standby drives are not responding, a drive was found at the incorrect SCSI ID, and unidentified drives were found. **Action:**Press F4, F5, F6, or F10.
07	78	**Explanation:**Online/Rebuild, Ready/Standby, and Hot-Spare/Standby Hot-Spare drives are not responding, and unidentified drives were found. **Action:**Press F4, F5, or F10.
07	7C	**Explanation:**Online/Rebuild, Ready/Standby, and Hot-Spare/Standby Hot-Spare drives are not responding, a drive was found at the incorrect SCSI ID, and unidentified drives were found. **Action:**Press F4, F5, F6, or F10.
09	00	**Explanation:**No error occurred. **Action:**No action is required.
09	10	**Explanation:**Hot-Spare/Standby Hot-Spare drives are not responding. **Action:**Press F4, F5, or F10.
09	20	**Explanation:**Ready/Standby drives are not responding. **Action:**Press F4, F5, or F10.
09	30	**Explanation:**Hot-Spare/Standby Hot-Spare and Ready/Standby drives are not responding. **Action:**Press F4, F5, or F10.

BCS	ECS	Explanation and possible recovery action
0F	**00**	**Explanation:**No error occurred. **Action:**No action is required.
0F	**10**	**Explanation:**Hot-Spare/Standby Hot-Spare drives are not responding. **Action:**Press F4, F5, or F10.
0F	**20**	**Explanation:**Ready/Standby drives are not responding. **Action:**Press F4, F5, or F10.
0F	**30**	**Explanation:**Hot-Spare/Standby Hot-Spare and Ready/Standby drives are not responding. **Action:**Press F4, F5, or F10.

Rebuilding a defunct drive

A physical drive is marked defunct when there is a loss of communication between the controller and the physical drive. This can be caused by any of the following:

- An improperly connected cable, physical drive, or controller
- Loss of power to a drive
- An improperly assembled SCSI channel in an unsupported configuration
- A defective cable, backplane, physical drive, or controller
- Connecting unsupported SCSI devices (such as tape drives or CD-ROM drives) to the same SCSI channel used for an array.

In each case, after the communication problem is resolved, a rebuild operation is required to reconstruct the data for the device in its disk array. The ServeRAID controllers can reconstruct RAID level-1 and RAID level-5 logical drives, but they cannot reconstruct data stored in RAID level-0 logical drives because, RAID level-0 is not redundant. If an array contains only RAID level-0 logical drives, the logical drives in the array are marked offline and the logical drives might contain damaged data. You cannot rebuild the logical drives. You must replace the physical drives and restore your data.

To prevent data-integrity problems, the ServeRAID controllers set the RAID level-0 logical drives in the affected array to blocked during the rebuild operation for RAID level-1 or RAID level-5. After the rebuild operation completes, you can unblock the RAID level-0 logical drives, and access them once again. Remember, however, that the RAID level-0 logical drives might contain damaged data.

Steps for recovering from defunct drives

If the defunct drives are not part of an array, contact your IBM service representative.

If the defunct drives are part of an array, do the following:

- If more than one physical drive in an array is defunct, contact your IBM service representative.
- If a rebuild operation is in progress, wait until the rebuild is complete.
- If a rebuild is not in progress and only one physical drive in the array is defunct, do the following:
  1. Verify the cables, physical drives, and controllers are installed properly.
  2. Attempt to rebuild the defunct physical drive by performing a Hot-Swap Rebuild. Refer to “Rebuilding a hot-swap drive” for instructions.

     Note: If multiple drives fail in separate arrays (one physical drive per array), then replace each defunct physical drives. If multiple physical drives fail at the same time within the *same* array, contact your IBM service representative.
  3. If the Hot-Swap Rebuild fails, contact your IBM service representative.

Rebuilding a hot-swap drive

A Hot-Swap Rebuild refers to a Rebuild operation that is started by the ServeRAID controller when it detects that a drive that is part of an array and in the defunct state has been removed and reinserted on the SCSI cable or backplane. The reinsertion of the physical drive, whether it is the same drive or a new drive, will trigger the ServeRAID controller to start the rebuild operation. During the rebuild

operation, the drive being rebuilt is in the rebuild state, and the logical drive remains critical until the rebuild operation has been successfully completed.

On IBM servers, when a hot-spare drive is available, the Rebuild operation begins automatically without the need to replace the failed drive. If more than one drive fails within the same array, no rebuild takes place. If multiple drives fail in separate arrays (one physical drive per array), the controller initiates a Rebuild operation for the logical drives within the array containing the first failed physical drive. This Rebuild operation is performed on the *first* hot-spare drive of sufficient size to become a valid member of the array.

To start a Hot-Swap Rebuild, do the following:

1. Reseat the ServeRAID controller and SCSI cables.
2. Without removing the drive completely, gently remove the physical drive from the server, using the handle of the hot-swap tray. If necessary, refer to the documentation that comes with your server on removing a physical drive.
3. Wait 20 seconds to allow the physical drive to completely spin down.

   Note: When power is removed from a hot-swap drive, the drive immediately parks the heads, locks the actuator in the “landing zone”, and begins spinning down. However, the spinning down of the disk might require up to 20 seconds after power is removed. Do not move the drive while it is spinning down. Moving the drive while it is spinning down might damage the drive.
4. If you are certain there is nothing wrong with the physical drive you removed, gently reinstall the drive into the server.

   Note: If multiple drives fail in separate arrays (one physical drive per array), then replace each defunct physical drives. If multiple physical drives fail at the same time within the *same* array, contact your IBM service representative.

   Make sure the drive is completely installed in the backplane connector.

   Note: While it is possible to rebuild a defunct physical drive to an online physical drive that is defective, avoid doing so.

   Otherwise, replace the physical drive with a new drive that is the same size (or larger) and continue with the Rebuild operation.

Recovering from an incomplete format of a physical drive

During formatting of a physical drive, if the format process is stopped by a system reset, system shut down, power outage, or by some other means, the physical drive becomes inoperable.

To enable the physical drive to communicate with the ServeRAID controller again, do the following:

1. Note the channel of the ServeRAID controller to which the physical drive is connected.
2. Note the SCSI ID of the physical drive.
3. Use the **ipssend format** function to restart the format of the physical drive. The syntax is: **ipssend format** *controller channel sid*

   where:

- *controller* is the ServeRAID controller number (1–12)
- *channel* is the channel number for the device (1, 2, 3, or 4)
- *sid* is the SCSI ID for the device (0–15)

After the **format** is complete, the ServeRAID controller will be able to recognize the drive again.

Chapter 10. Getting help, service, and information

If you need help, service, technical assistance, or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you.

For example, IBM maintains pages on the World Wide Web where you can get information about IBM products and services, find the latest technical information, and download device drivers and updates. Some of these pages are:

http://www.ibm.com	Main IBM home page
http://www.ibm.com/pc	IBM Personal Computing
http://www.ibm.com/pc/support	IBM Personal Computing Support
http://www.ibm.com/pc/us/ibmpc	IBM Commercial Desktop PCs (U.S.)
http://www.ibm.com/pc/us/intellistation	IBM IntelliStation Workstations (U.S.)
http://www.ibm.com/pc/us/accessories	Options by IBM (U.S.)
http://www.ibm.com/pc/us/netfinity	IBM Netfinity Servers (U.S.)
http://www.ibm.com/pc/us/server/sguide	IBM ServerGuide (U.S.)
http://www.ibm.com/pc/us/netfinity/system_management	IBM Systems Management (U.S.)
http://www.ibm.com/software/os/warp-server	IBM OS/2 Warp Server
http://www.ibm.com/pc/techconnect	IBM TechConnect

You can select a country-specific Web site from these pages.

You might also want to visit the Web pages of other companies for information about other operating systems, software, and accessories. The following are some other Web sites you might find helpful:

http://www.lotus.com

http://www.tivoli.com

http://www.microsoft.com

http://www.novell.com

http://www.sco.com

http://www.adaptec.com

http://www.apcc.com

http://www.norton.com

Help is also available from bulletin boards and online services, as well as by fax and telephone. This section provides information about these sources.

Services available and telephone numbers listed are subject to change without notice.

Service support

With the original purchase of an IBM hardware product, you have access to extensive support coverage. During the IBM hardware product warranty period, you may call the IBM Personal Computer HelpCenter (1-800-772-2227 in the U.S.) for hardware product assistance covered under the terms of the IBM hardware warranty. See “Getting help by telephone” on page 74 for HelpCenter telephone numbers in other countries.

The following services are available during the warranty period:

- Problem determination - Trained personnel are available to assist you with determining if you have a hardware problem and deciding what action is necessary to fix the problem.
- IBM hardware repair - If the problem is determined to be caused by IBM hardware under warranty, trained service personnel are available to provide the applicable level of service.
- Engineering change management - Occasionally, there might be changes that are required after a product has been sold. IBM or your reseller, if authorized by IBM, will make Engineering Changes (ECs) available that apply to your hardware.

Be sure to retain your proof of purchase to obtain warranty service.

Please have the following information ready when you call:

- Machine Type and Model
- Serial numbers of your IBM hardware products
- Description of the problem
- Exact wording of any error messages
- Hardware and software configuration information

If possible, be at your computer when you call.

The following items are not covered:

- Replacement or use of non-IBM parts or nonwarranted IBM parts

  Note: All warranted parts contain a 7-character identification in the format IBM FRU XXXXXXX.
- Identification of software problem sources
- Configuration of BIOS as part of an installation or upgrade
- Changes, modifications, or upgrades to device drivers
- Installation and maintenance of network operating systems (NOS)
- Installation and maintenance of application programs

Refer to your IBM hardware warranty for a full explanation of IBM’s warranty terms.

Before you call for service

Many computer problems can be solved without outside assistance, by using the online help or by looking in the online or printed documentation that comes with your computer or software. Also, be sure to read the information in any README files that come with your software.

Most computers, operating systems, and application programs come with documentation that contains troubleshooting procedures and explanations of error

messages. The documentation that comes with your computer also contains information about the diagnostic tests you can perform.

If you receive a POST error code when you turn on your computer, refer to the POST error-message charts in your hardware documentation. If you do not receive a POST error code, but suspect a hardware problem, refer to the troubleshooting information in your hardware documentation or run the diagnostic tests.

If you suspect a software problem, consult the documentation (including README files) for the operating system or application program.

Getting customer support and service

Purchasing an IBM PC hardware product entitles you to standard help and support during the warranty period. If you need additional support and services, a wide variety of extended services are available for purchase that address almost any need.

Using the World Wide Web

On the World Wide Web, the IBM Personal Computing Web site has up-to-date information about IBM Personal Computer products and support. The address for the IBM Personal Computing home page is:

`http://www.ibm.com/pc`

You can find support information for your IBM products, including supported options, on the IBM Personal Computing Support page at:

`http://www.ibm.com/pc/support`

If you select Profile from the support page, you can create a customized support page that is specific to your hardware, complete with Frequently Asked Questions, Parts Information, Technical Hints and Tips, and Downloadable Files. You will have the information you need, all in one place. In addition, you can choose to receive e-mail notifications whenever new information becomes available about your registered products. You also can access online support forums, which are community sites monitored by IBM support staff.

For information about specific Personal Computer products, visit the following pages:

`http://www.ibm.com/pc/us/intellistation`

`http://www.ibm.com/pc/us/ibmpc`

`http://www.ibm.com/pc/us/netfinity`

`http://www.ibm.com/pc/us/thinkpad`

`http://www.ibm.com/pc/us/accessories`

`http://www.direct.ibm.com/content/home/en_US/aptiva`

You can select a country-specific Web site from these pages.

Using electronic support services

If you have a modem, you can get help from several popular services. Online information services provide assistance through question-and-answer message areas, live chat rooms, searchable databases, and more.

Technical information is available on a wide range of topics, such as:

- Hardware setup and configuration
- Preinstalled software
- Windows, OS/2, and DOS
- Networking
- Communications
- Multimedia

In addition, the latest device driver updates are available.

Commercial online services, such as America Online (AOL), contain information about IBM products. (For AOL, use the keyword **IBM**.)

Getting information by fax

If you have a touch-tone telephone and access to a fax machine, in the U.S. and Canada you can receive by fax marketing and technical information on many topics, including hardware, operating systems, and local area networks (LANs). You can call the IBM Automated Fax System 24 hours a day, 7 days a week. Follow the recorded instructions, and the requested information will be sent to your fax machine.

In the U.S. and Canada, to access the IBM Automated Fax System, call 1-800-426-3395.

Getting help online

Online Housecall is a remote communication tool that allows an IBM technical-support representative to access your PC by modem. Many problems can be remotely diagnosed and corrected quickly and easily. In addition to a modem, a remote-access application program is required. This service is not available for servers. There might be a charge for this service, depending on the request.

For more information about configuring your PC for Online Housecall:

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

Getting help by telephone

During the warranty period, you can get help and information by telephone through the IBM PC HelpCenter. Expert technical-support representatives are available to assist you with questions you might have on the following:

- Setting up your computer and IBM monitor
- Installing and setting up IBM options purchased from IBM or an IBM reseller
- 30-day, preinstalled-operating-system support
- Arranging for service (on-site or carry-in)
- Arranging for overnight shipment of customer-replaceable parts

In addition, if you purchased an IBM PC Server or IBM Netfinity Server, you are eligible for IBM Start Up Support for 90 days after installation. This service provides assistance for:

- Setting up your network operating system
- Installing and configuring interface cards
- Installing and configuring network adapters

Please have the following information ready when you call:

- Machine Type and Model
- Serial numbers of your computer, monitor, and other components, or your proof of purchase
- Description of the problem
- Exact wording of any error messages
- Hardware and software configuration information for your system

If possible, be at your computer when you call.

In the U.S. and Canada, these services are available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9:00 a.m. to 6:00 p.m.[3]

Country		**Telephone number**
Austria	Österreich	1-546 585 075
Belgium - Dutch	Belgie	02-717-2504
Belgium - French	Belgique	02-717-2503
Canada	Canada	1-800-565-3344
Denmark	Danmark	03-525-6905
Finland	Suomi	9-22-931805
France	France	01-69-32-40-03
Germany	Deutschland	069-6654-9003
Ireland	Ireland	01-815-9207
Italy	Italia	02-4827-5003
Luxembourg	Luxembourg	298-977-5060
Netherlands	Nederland	020-504-0531
Norway	Norge	2-305-3203
Portugal	Portugal	01-791-5147
Spain	España	091-662-4270
Sweden	Sverige	08-632-0063
Switzerland - German	Schweiz	01-212-1810
Switzerland - French	Suisse	022-310-0418
Switzerland - Italian	Svizzera	091-971-0523
United Kingdom	United Kingdom	01475-555555
U.S.A. and Puerto Rico	U.S.A. and Puerto Rico	1-800-772-2227

In all other countries, contact your IBM reseller or IBM marketing representative.

Getting help around the world

If you travel with your computer or need to move it to another country, you can register for International Warranty Service. When you register with the International Warranty Service Office, you will receive an International Warranty Service Certificate that is honored virtually worldwide, wherever IBM or IBM resellers sell and service IBM PC products.

3. Response time will vary depending on the number and complexity of incoming calls.

For more information or to register for International Warranty Service:
- In the U.S. or Canada, call 1-800-497-7426.
- In Europe, call 44-1475-893638 (Greenock, U.K.).
- In Australia and New Zealand, call 61-2-9354-4171.

In all other countries, contact your IBM reseller or IBM marketing representative.

Purchasing additional services

During and after the warranty period, you can purchase additional services, such as support for IBM and non-IBM hardware, operating systems, and application programs; network setup and configuration; upgraded or extended hardware repair services; and custom installations. Service availability and name might vary by country.

Enhanced PC support line

Enhanced PC Support is available for desktop and mobile IBM computers that are not connected to a network. Technical support is provided for IBM computers and IBM or non-IBM options, operating systems, and application programs on the Supported Products list.

This service includes technical support for:
- Installing and configuring your out-of-warranty IBM computer
- Installing and configuring non-IBM options in IBM computers
- Using IBM operating systems in IBM and non-IBM computers
- Using application programs and games
- Tuning performance
- Installing device drivers remotely
- Setting up and using multimedia devices
- Identifying system problems
- Interpreting documentation

You can purchase this service on a per-call basis, as a multiple-incident package, or as an annual contract with a 10-incident limit. For more information about purchasing Enhanced PC Support, see “Ordering support line services” on page 77.

900-number operating system and hardware support line

In the U.S., if you prefer to obtain technical support on a pay-as-you-go basis, you can use the 900-number support line. The 900-number support line provides support for IBM PC products that are out of the warranty period.

To access this support, call 1-900-555-CLUB (2582). You will be notified of the charge per minute.

Network and server support line

Network and Server Support is available for simple or complex networks made up of IBM servers and workstations using major network operating systems. In addition, many popular non-IBM adapters and network interface cards are supported.

This service includes all of the features of the Enhanced PC Support Line, plus:
- Installing and configuring client workstations and servers
- Identifying system problems and correcting problems on the client or the server
- Using IBM and non-IBM network operating systems

- Interpreting documentation

You can purchase this service on a per-call basis, as a multiple-incident package, or as an annual contract with a 10-incident limit. For more information about purchasing Network and Server Support, see “Ordering support line services”.

Ordering support line services

Enhanced PC Support Line and Network and Server Support Line services are available for products on the Supported Products list. To receive a Supported Products list:

- In the U.S.:
  1. Call 1-800-426-3395.
  2. Select document number 11683 for Network and Server support.
  3. Select document number 11682 for Enhanced PC support.
- In Canada, contact IBM Direct at 1-800-465-7999, or:
  1. Call 1-800-465-3299.
  2. Select the HelpWare catalog.
- In all other countries, contact your IBM reseller or IBM marketing representative.

For more information or to purchase these services:
- In the U.S., call 1-800-772-2227.
- In Canada, call 1-800-465-7999.
- In all other countries, contact your HelpCenter.

Warranty and repair services

You can upgrade your standard hardware warranty service or extend the service beyond the warranty period.

Warranty upgrades in the U.S. include:

- Carry-in service to on-site service

  If your warranty provides carry-in repair service, you can upgrade to on-site repair service, either standard or premium. The standard upgrade provides a trained servicer within the next business day (9 a.m. to 5 p.m., local time, Monday though Friday). The premium upgrade provides 4-hour average response, 24 hours a day, 7 days a week.
- On-site service to premium on-site service

  If your warranty provides for on-site service, you can upgrade to premium on-site service (4-hour average on-site response, 24 hours a day, 7 days a week).

You also can extend your warranty. Warranty and Repair Services offers a variety of post-warranty maintenance options, including ThinkPad EasyServ Maintenance Agreements. Availability of the services varies by product.

For more information about warranty upgrades and extensions:
- In the U.S., call 1-800-426-4968.
- In Canada, call 1-800-465-7999.
- In all other countries, contact your IBM reseller or IBM marketing representative.

Ordering publications

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

- In the U.S., Canada, and Puerto Rico, call 1-800-879-2755.
- In other countries, contact your IBM reseller or IBM marketing representative.

Part 4. Appendixes

Appendix. Product warranties and notices

This chapter contains warranty and emission notices. It also contains trademarks and general-information notices.

Warranty Statements

The warranty statements consist of two parts: Part 1 and Part 2. Part 1 varies by country. Part 2 is the same for all countries. Be sure to read both the Part 1 that applies to your country and Part 2.

- **United States, Puerto Rico, and Canada (Z125-4753-05 11/97)**

  (“Part 1 - General Terms”)
- **Worldwide except Canada, Puerto Rico, Turkey, and United States (Z125-5697-01 11/97)**

  (“Part 1 - General Terms” on page 84)
- **Worldwide Country-Unique Terms**

  (“Part 2 - Worldwide Country-Unique Terms” on page 86)

IBM Statement of Limited Warranty for United States, Puerto Rico, and Canada (Part 1 - General Terms)

This Statement of Limited Warranty includes Part 1 - General Terms and Part 2 - Country-unique Terms. ***The terms of Part 2 may replace or modify those of Part 1.***The warranties provided by IBM in this Statement of Limited Warranty apply only to Machines you purchase for your use, and not for resale, from IBM or your reseller. The term ″Machine″ means an IBM machine, its features, conversions, upgrades, elements, or accessories, or any combination of them. The term ″Machine″ does not include any software programs, whether pre-loaded with the Machine, installed subsequently or otherwise. Unless IBM specifies otherwise, the following warranties apply only in the country where you acquire the Machine. Nothing in this Statement of Warranty affects any statutory rights of consumers that cannot be waived or limited by contract. If you have any questions, contact IBM or your reseller.

Machine - IBM ServeRAID-4L Ultra160 SCSI Controller

Warranty Period* - Three Years

*Contact your place of purchase for warranty service information. Some IBM Machines are eligible for On-site warranty service depending on the country where service is performed.

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

During the warranty period IBM or your reseller, if approved by IBM to provide warranty service, will provide repair and exchange service for the Machine, without charge, under the type of service designated for the Machine and will manage and install engineering changes that apply to the Machine.

If a Machine does not function as warranted during the warranty period, and IBM or your reseller are unable to either 1) make it do so or 2) replace it with one that is at least functionally equivalent, you may return it to your place of purchase and your money will be refunded. The replacement may not be new, but will be in good working order.

Extent of Warranty The warranty does not cover the repair or exchange of a Machine resulting from misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, or failure caused by a product for which IBM is not responsible. The warranty is voided by removal or alteration of Machine or parts identification labels.

THESE WARRANTIES ARE YOUR EXCLUSIVE WARRANTIES AND REPLACE ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THESE WARRANTIES GIVE YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF EXPRESS OR IMPLIED WARRANTIES, SO THE ABOVE EXCLUSION OR LIMITATION MAY NOT APPLY TO YOU. IN THAT EVENT, SUCH WARRANTIES ARE LIMITED IN DURATION TO THE WARRANTY PERIOD. NO WARRANTIES APPLY AFTER THAT PERIOD.

Items Not Covered by Warranty IBM does not warrant uninterrupted or error-free operation of a Machine.

Unless specified otherwise, IBM provides non-IBM machines **WITHOUT WARRANTIES OF ANY KIND.**

Any technical or other support provided for a Machine under warranty, such as assistance via telephone with ″how-to″ questions and those regarding Machine set-up and installation, will be provided **WITHOUT WARRANTIES OF ANY KIND.**

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

IBM or your reseller provides certain types of repair and exchange service, either at your location or at a service center, to keep Machines in, or restore them to, conformance with their Specifications. IBM or your reseller will inform you of the available types of service for a Machine based on its country of installation. IBM may repair the failing Machine or exchange it at its discretion.

When warranty service involves the exchange of a Machine or part, the item IBM or your reseller replaces becomes its property and the replacement becomes yours. You represent that all removed items are genuine and unaltered. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced. The replacement assumes the warranty service status of the replaced item.

Any feature, conversion, or upgrade IBM or your reseller services must be installed on a Machine which is 1) for certain Machines, the designated, serial-numbered Machine and 2) at an engineering-change level compatible with the feature, conversion, or upgrade. Many features, conversions, or upgrades involve the

removal of parts and their return to IBM. A part that replaces a removed part will assume the warranty service status of the removed part.

Before IBM or your reseller exchanges a Machine or part, you agree to remove all features, parts, options, alterations, and attachments not under warranty service.

You also agree to

1. ensure that the Machine is free of any legal obligations or restrictions that prevent its exchange;
2. obtain authorization from the owner to have IBM or your reseller service a Machine that you do not own; and
3. where applicable, before service is provided
   a. follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provides,
   b. secure all programs, data, and funds contained in a Machine,
   c. provide IBM or your reseller with sufficient, free, and safe access to your facilities to permit them to fulfill their obligations, and
   d. inform IBM or your reseller of changes in a Machine's location.

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

Neither IBM nor your reseller is responsible for any of your confidential, proprietary or personal information contained in a Machine which you return to IBM or your reseller for any reason. You should remove all such information from the Machine prior to its return.

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

Limitation of Liability Circumstances may arise where, because of a default on IBM's part or other liability, you are entitled to recover damages from IBM. In each such instance, regardless of the basis on which you are entitled to claim damages from IBM (including fundamental breach, negligence, misrepresentation, or other contract or tort claim), IBM is liable for no more than

1. damages for bodily injury (including death) and damage to real property and tangible personal property; and
2. the amount of any other actual direct damages, up to the greater of U.S. $100,000 (or equivalent in local currency) or the charges (if recurring, 12 months' charges apply) for the Machine that is the subject of the claim.

   This limit also applies to IBM's suppliers and your reseller. It is the maximum for which IBM, its suppliers, and your reseller are collectively responsible.

UNDER NO CIRCUMSTANCES IS IBM LIABLE FOR ANY OF THE FOLLOWING: 1) THIRD-PARTY CLAIMS AGAINST YOU FOR DAMAGES (OTHER THAN THOSE UNDER THE FIRST ITEM LISTED ABOVE); 2) LOSS OF, OR DAMAGE TO, YOUR RECORDS OR DATA; OR 3) SPECIAL, INCIDENTAL, OR INDIRECT DAMAGES OR FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES (INCLUDING LOST PROFITS OR SAVINGS), EVEN IF IBM, ITS SUPPLIERS OR YOUR RESELLER IS INFORMED OF THEIR POSSIBILITY. SOME

JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

IBM Statement of Warranty Worldwide except Canada, Puerto Rico, Turkey, United States (Part 1 – General Terms)

This Statement of Warranty includes Part 1 - General Terms and Part 2 - Country-unique Terms. ***The terms of Part 2 may replace or modify those of Part 1***. The warranties provided by IBM in this Statement of Warranty apply only to Machines you purchase for your use, and not for resale, from IBM or your reseller. The term ″Machine″ means an IBM machine, its features, conversions, upgrades, elements, or accessories, or any combination of them. The term ″Machine″ does not include any software programs, whether pre-loaded with the Machine, installed subsequently or otherwise. Unless IBM specifies otherwise, the following warranties apply only in the country where you acquire the Machine. Nothing in this Statement of Warranty affects any statutory rights of consumers that cannot be waived or limited by contract. If you have any questions, contact IBM or your reseller.

Machine - IBM ServeRAID-4L Ultra160 SCSI Controller

Warranty Period* - Three Years

*Contact your place of purchase for warranty service information. Some IBM Machines are eligible for On-site warranty service depending on the country where service is performed.

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

During the warranty period IBM or your reseller, if approved by IBM to provide warranty service, will provide repair and exchange service for the Machine, without charge, under the type of service designated for the Machine and will manage and install engineering changes that apply to the Machine.

If a Machine does not function as warranted during the warranty period, and IBM or your reseller are unable to either 1) make it do so or 2) replace it with one that is at least functionally equivalent, you may return it to your place of purchase and your money will be refunded. The replacement may not be new, but will be in good working order.

Extent of Warranty The warranty does not cover the repair or exchange of a Machine resulting from misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, or failure caused by a product for which IBM is not responsible. The warranty is voided by removal or alteration of Machine or parts identification labels.

THESE WARRANTIES ARE YOUR EXCLUSIVE WARRANTIES AND REPLACE ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THESE WARRANTIES GIVE YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM JURISDICTION TO

JURISDICTION. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF EXPRESS OR IMPLIED WARRANTIES, SO THE ABOVE EXCLUSION OR LIMITATION MAY NOT APPLY TO YOU. IN THAT EVENT, SUCH WARRANTIES ARE LIMITED IN DURATION TO THE WARRANTY PERIOD. NO WARRANTIES APPLY AFTER THAT PERIOD.

Items Not Covered by Warranty IBM does not warrant uninterrupted or error-free operation of a Machine.

Unless specified otherwise, IBM provides non-IBM machines **WITHOUT WARRANTIES OF ANY KIND.**

Any technical or other support provided for a Machine under warranty, such as assistance via telephone with ″how-to″ questions and those regarding Machine set-up and installation, will be provided **WITHOUT WARRANTIES OF ANY KIND.**

Warranty Service To obtain warranty service for the Machine, contact your reseller or IBM. You may be required to present proof of purchase.

IBM or your reseller provides certain types of repair and exchange service, either at your location or at a service center, to keep Machines in, or restore them to, conformance with their Specifications. IBM or your reseller will inform you of the available types of service for a Machine based on its country of installation. IBM may repair the failing Machine or exchange it at its discretion.

When warranty service involves the exchange of a Machine or part, the item IBM or your reseller replaces becomes its property and the replacement becomes yours. You represent that all removed items are genuine and unaltered. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced. The replacement assumes the warranty service status of the replaced item.

Any feature, conversion, or upgrade IBM or your reseller services must be installed on a Machine which is 1) for certain Machines, the designated, serial-numbered Machine and 2) at an engineering-change level compatible with the feature, conversion, or upgrade. Many features, conversions, or upgrades involve the removal of parts and their return to IBM. A part that replaces a removed part will assume the warranty service status of the removed part.

Before IBM or your reseller exchanges a Machine or part, you agree to remove all features, parts, options, alterations, and attachments not under warranty service.

You also agree to

1. ensure that the Machine is free of any legal obligations or restrictions that prevent its exchange;
2. obtain authorization from the owner to have IBM or your reseller service a Machine that you do not own; and
3. where applicable, before service is provided
   a. follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provides,
   b. secure all programs, data, and funds contained in a Machine,
   c. provide IBM or your reseller with sufficient, free, and safe access to your facilities to permit them to fulfill their obligations, and
   d. inform IBM or your reseller of changes in a Machine's location.

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

Neither IBM nor your reseller is responsible for any of your confidential, proprietary or personal information contained in a Machine which you return to IBM or your reseller for any reason. You should remove all such information from the Machine prior to its return.

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

Limitation of Liability Circumstances may arise where, because of a default on IBM's part or other liability, you are entitled to recover damages from IBM. In each such instance, regardless of the basis on which you are entitled to claim damages from IBM (including fundamental breach, negligence, misrepresentation, or other contract or tort claim), IBM is liable for no more than

1. damages for bodily injury (including death) and damage to real property and tangible personal property; and
2. the amount of any other actual direct damages, up to the greater of U.S. $100,000 (or equivalent in local currency) or the charges (if recurring, 12 months' charges apply) for the Machine that is the subject of the claim.

   This limit also applies to IBM's suppliers and your reseller. It is the maximum for which IBM, its suppliers, and your reseller are collectively responsible.

UNDER NO CIRCUMSTANCES IS IBM LIABLE FOR ANY OF THE FOLLOWING: 1) THIRD-PARTY CLAIMS AGAINST YOU FOR DAMAGES (OTHER THAN THOSE UNDER THE FIRST ITEM LISTED ABOVE); 2) LOSS OF, OR DAMAGE TO, YOUR RECORDS OR DATA; OR 3) SPECIAL, INCIDENTAL, OR INDIRECT DAMAGES OR FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES (INCLUDING LOST PROFITS OR SAVINGS), EVEN IF IBM, ITS SUPPLIERS OR YOUR RESELLER IS INFORMED OF THEIR POSSIBILITY. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

Part 2 - Worldwide Country-Unique Terms

ASIA PACIFIC

AUSTRALIA: The IBM Warranty for Machines: The following paragraph is added to this Section: The warranties specified in this Section are in addition to any rights you may have under the Trade Practices Act 1974 or other legislation and are only limited to the extent permitted by the applicable legislation.

Extent of Warranty: The following replaces the first and second sentences of this Section: The warranty does not cover the repair or exchange of a Machine resulting from misuse, accident, modification, unsuitable physical or operating environment, operation in other than the Specified Operating Environment, improper maintenance by you, or failure caused by a product for which IBM is not responsible.

Limitation of Liability: The following is added to this Section: Where IBM is in breach of a condition or warranty implied by the Trade Practices Act 1974, IBM's liability is limited to the repair or replacement of the goods or the supply of

equivalent goods. Where that condition or warranty relates to right to sell, quiet possession or clear title, or the goods are of a kind ordinarily acquired for personal, domestic or household use or consumption, then none of the limitations in this paragraph apply.

PEOPLE'S REPUBLIC OF CHINA: Governing Law: The following is added to this Statement: The laws of the State of New York govern this Statement.

INDIA: Limitation of Liability: The following replaces items 1 and 2 of this Section:

1. liability for bodily injury (including death) or damage to real property and tangible personal property will be limited to that caused by IBM's negligence;
2. as to any other actual damage arising in any situation involving nonperformance by IBM pursuant to, or in any way related to the subject of this Statement of Warranty, IBM's liability will be limited to the charge paid by you for the individual Machine that is the subject of the claim.

NEW ZEALAND: The IBM Warranty for Machines: The following paragraph is added to this Section: The warranties specified in this Section are in addition to any rights you may have under the Consumer Guarantees Act 1993 or other legislation which cannot be excluded or limited. The Consumer Guarantees Act 1993 will not apply in respect of any goods which IBM provides, if you require the goods for the purposes of a business as defined in that Act.

Limitation of Liability: The following is added to this Section: Where Machines are not acquired for the purposes of a business as defined in the Consumer Guarantees Act 1993, the limitations in this Section are subject to the limitations in that Act.

EUROPE, MIDDLE EAST, AFRICA (EMEA)

The following terms apply to all EMEA countries.

The terms of this Statement of Warranty apply to Machines purchased from an IBM reseller. If you purchased this Machine from IBM, the terms and conditions of the applicable IBM agreement prevail over this warranty statement.

Warranty Service

If you purchased an IBM Machine in Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland or United Kingdom, you may obtain warranty service for that Machine in any of those countries from either (1) an IBM reseller approved to perform warranty service or (2) from IBM.

If you purchased an IBM Personal Computer Machine in Albania, Armenia, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Georgia, Hungary, Kazakhstan, Kirghizia, Federal Republic of Yugoslavia, Former Yugoslav Republic of Macedonia (FYROM), Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, or Ukraine, you may obtain warranty service for that Machine in any of those countries from either (1) an IBM reseller approved to perform warranty service or (2) from IBM.

The applicable laws, Country-unique terms and competent court for this Statement are those of the country in which the warranty service is being provided. However, the laws of Austria govern this Statement if the warranty service is provided in

Albania, Armenia, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Federal Republic of Yugoslavia, Georgia, Hungary, Kazakhstan, Kirghizia, Former Yugoslav Republic of Macedonia (FYROM), Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, and Ukraine.

The following terms apply to the country specified:

EGYPT: Limitation of Liability: The following replaces item 2 in this Section: 2. as to any other actual direct damages, IBM's liability will be limited to the total amount you paid for the Machine that is the subject of the claim.

Applicability of suppliers and resellers (unchanged).

FRANCE: Limitation of Liability: The following replaces the second sentence of the first paragraph of this Section: In such instances, regardless of the basis on which you are entitled to claim damages from IBM, IBM is liable for no more than: (items 1 and 2 unchanged).

GERMANY: The IBM Warranty for Machines: The following replaces the first sentence of the first paragraph of this Section: The warranty for an IBM Machine covers the functionality of the Machine for its normal use and the Machine's conformity to its Specifications.

The following paragraphs are added to this Section: The minimum warranty period for Machines is six months.

In case IBM or your reseller are unable to repair an IBM Machine, you can alternatively ask for a partial refund as far as justified by the reduced value of the unrepaired Machine or ask for a cancellation of the respective agreement for such Machine and get your money refunded.

Extent of Warranty: The second paragraph does not apply.

Warranty Service: The following is added to this Section: During the warranty period, transportation for delivery of the failing Machine to IBM will be at IBM's expense.

Production Status: The following paragraph replaces this Section: Each Machine is newly manufactured. It may incorporate in addition to new parts, re-used parts as well.

Limitation of Liability: The following is added to this Section: The limitations and exclusions specified in the Statement of Warranty will not apply to damages caused by IBM with fraud or gross negligence and for express warranty.

In item 2, replace ″U.S. $100,000″ with ″1.000.000 DEM.″

The following sentence is added to the end of the first paragraph of item 2: IBM's liability under this item is limited to the violation of essential contractual terms in cases of ordinary negligence.

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Applicability of suppliers and resellers (unchanged).

The following paragraph is added at the end of this Section: IBM's entire liability and your sole remedy, whether in contract or in tort, in respect of any default shall be limited to damages.

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Applicability of suppliers and resellers (unchanged).

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The following item is added to this paragraph: 3. breach of IBM's obligations implied by Section 12 of the Sale of Goods Act 1979 or Section 2 of the Supply of Goods and Services Act 1982.

Applicability of suppliers and resellers (unchanged).

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NORTH AMERICA

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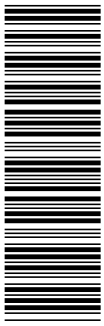

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