IBM BladeCenter
SAS Expansion Card (CFFv)

Installation and User's Guide

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Note: Before using this information and the product it supports, read the general information inAppendix C, “IBM Statement of Limited Warranty Z125-4753-09 08/2006,” on page 61 and Appendix D, “Notices,” on page 83.

First edition (September, 2007)

Contents

Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الأمنية

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读 Safety Information
(安全信息)。

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προϊόν αυτό, διαβάστε τις πληροφορίες ασφάλειας (safety information).

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza.

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пред да се инсталира овој продукт, прочитајте информацијата за безбедност.

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Przed zainstalowaniem tego produktu, należy zapoznać się
z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед установкой продукта прочтите инструкции по
технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto, lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

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.**

Statement 21:

CAUTION:
Hazardous energy is present when the blade server is connected to the power source. Always replace the blade server-cover before installing the blade server.

Chapter 1. Introduction

This *Installation and User's Guide* contains instructions for installing your SAS Expansion Card (CFFv) for IBM® BladeCenter® products in a BladeCenter blade server or expansion unit. A Serial Attached SCSI (small computer system interface) (SAS) expansion card (CFFv) provides a connection to I/O module bays 3 and 4 in all BladeCenter units.

This document contains information about:

- Installing and configuring the SAS expansion card
- Updating the firmware and device drivers of the SAS expansion card

The expansion card is a SAS device that has two configurable-adapter ports. Data is sent and received from the high-speed connector on the SAS expansion card through the blade server to I/O-module bay 3 and bay 4 in the BladeCenter unit.

Notes:

1. The illustrations in this document might differ slightly from your hardware or software.
2. Unless otherwise stated, references to the SAS Expansion Card (CFFv) is also referred to throughout this document as the expansion card or the SAS adapter. All references to the IBM BladeCenter unit in this document apply to all BladeCenter and BladeCenter T units.
3. The modules in BladeCenter I/O-module bay 3 and bay 4 must support SAS operation.

Your expansion card comes with a one-year limited warranty. For information about your warranty, see Appendix C, "IBM Statement of Limited Warranty Z125-4753-09 08/2006," on page 61. You can obtain up-to-date information about your expansion card and other IBM blade server products at http://www.ibm.com/systems/x/.

This *Installation and User's Guide* and the most recent versions of other documents that provide detailed information about your BladeCenter unit, blade server, and available options are provided in Portable Document Format (PDF) at http://www.ibm.com/systems/support/.

For service or assistance, see Appendix B, "Getting help and technical assistance," on page 57.

SAS overview

SAS is a high-speed data transport technology used for mass storage attachments. The SAS expansion card allows you to attach a blade server or expansion unit to external storage. The expansion card provides up to 6 Gb of full-duplex bandwidth per port.

Related documentation

This *Installation and User's Guide* contains installation and configuration instructions for your expansion card, including information about getting started and how to configure your expansion card.

In addition to this *Installation and User's Guide*, there is a *Support* CD that includes:

- *SAS Expansion Card (CFFv) Getting Started Guide*
- *SAS Connectivity Module Installation and User's Guide*

The following related documentation is available from the IBM Web site at http://www.ibm.com/systems/support/:

- IBM *BladeCenter Installation and User's Guide* contains setup and installation instructions for your BladeCenter unit, including information about getting started and how to install a blade server.
- IBM BladeCenter blade server *Installation and User's Guide*

  Each type of blade server has a customized *Installation and User's Guide* that is provided in PDF on the IBM *BladeCenter Documentation* CD and at http://www.ibm.com/systems/support/.
- Multilingual *Safety Information*

  This multilingual document is provided in PDF on the IBM *BladeCenter Documentation* CD and at http://www.ibm.com/systems/support/. It contains translated versions of the caution and danger statements that appear in the documentation for your blade server. Each caution and danger statement has an assigned number, which you can use to locate the corresponding statement in your native language.
- IBM *Problem Determination and Service Guide*

  Depending on your BladeCenter type, one of these documents is provided in PDF on the IBM *BladeCenter Documentation* CD and at http://www.ibm.com/systems/support/. It contains information to help you solve BladeCenter problems yourself or to provide helpful information to a service technician.

Depending on your blade-server model, additional documents might be included on the IBM *BladeCenter Documentation* CD, with the most recent versions of all BladeCenter documents available at http://www.ibm.com/systems/bladecenter/.

In addition to reviewing the documentation in this library, be sure to review the IBM BladeCenter *Planning and Installation Guide* for your BladeCenter unit to help you prepare for system installation and configuration. For more information see http://www.ibm.com/systems/bladecenter/.

Features and specifications

The expansion card has the following features:

- Basic input/output system (BIOS) utility program to customize the configuration parameters on the BladeCenter expansion card and attached drives
- Support for Serial SCSI Protocol (SSP) and Serial Management Protocol (SMP)

The expansion card has the following specifications:

Table 1. Expansion card specifications

Type	Specification
SAS specifications	• Bandwidth: 3 Gb per second maximum at half-duplex and 6 Gb per second maximum at full-duplex per port • Support for SAS, SSP and SMP protocols • Support for full-duplex operation • Copper interface ac coupled
SAS device	Single-chip design with two completely independent 3 Gb SAS ports using an LSI 1064 integrated circuit.
BIOS ROM	BIOS ROM 2 MB of flash memory (the flash is field programmable)
NVDATA	NVRAM 32 KB, field programmable
Connectors (internal only)	• Board-to-board Molex HSM type for serial interfaces • 200 pin board-to-board for PCI-X interface
Dimensions	Approximately 8.4 cm x 5.3 cm (3.31 in. x 2.09 in.)
Operating power	Approximately 5 watts

Option package contents

The expansion-card option package includes the following items:

- SAS expansion card
- *SAS Expansion Card (CFFv) Getting Started Guide*
- *Support* CD (which includes My Storage application)
- Multilingual *Safety Information*

Notices and statements used in this document

The caution and danger statements used in this document are also in the multilingual *Safety Information* document provided on the IBM *BladeCenter Documentation* CD and at http://www.ibm.com/systems/support/. Each caution and danger statement is numbered for reference to the corresponding statement in the multilingual *Safety Information* document.

The following types of notices and statements are used in this document:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information or advice that might help you avoid inconvenient or problem situations.
- **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 statements indicate situations that can be potentially hazardous to you. A caution statement is placed just before the description of a potentially hazardous procedure step or situation.
- **Danger:** These statements indicate situations that can be potentially lethal or extremely hazardous to you. A danger statement is placed just before the description of a potentially lethal or extremely hazardous procedure step or situation.

Chapter 2. Installing the expansion card

This chapter provides information for installing the expansion card in a blade server or expansion unit.

Installation guidelines

Before you begin installing the expansion card in your blade server or expansion unit, read the safety information beginning on page vii and the guidelines in "Handling static-sensitive devices." This information will help you work safely with your blade server or expansion unit, and options.

Make sure that you are using the latest versions of device drivers and firmware for your blade server, expansion unit, management module, and I/O modules that are used by the expansion card. Go to the IBM support Web site, http://www.ibm.com/systems/support/ for the latest information about upgrading the device drivers and firmware for BladeCenter components. See the latest instructions in the documentation that came with the updates.

Before installing an expansion card into a blade server or expansion unit, consider that SAS BladeCenter I/O-module can only be inserted in Bay 3 or Bay 4.

Note: If I/O modules are installed in both I/O-module bays, both I/O modules must be of the same type. Installing a second I/O module in the BladeCenter unit provides a backup I/O module in case one I/O module fails.

See the following BladeCenter documentation for additional information:

- The *Installation and User's Guide* for your blade server or expansion unit provides server specific expansion card installation requirements.
- The *Installation Guide* for your BladeCenter unit shows I/O module bay locations.
- The *Installation Guide* for your I/O module has installation and configuration instructions for the I/O module.

Handling static-sensitive devices

Attention: Static electricity can damage electronic devices, including your blade server. To avoid damage, keep static-sensitive devices in their static-protective packages until you are ready to install them.

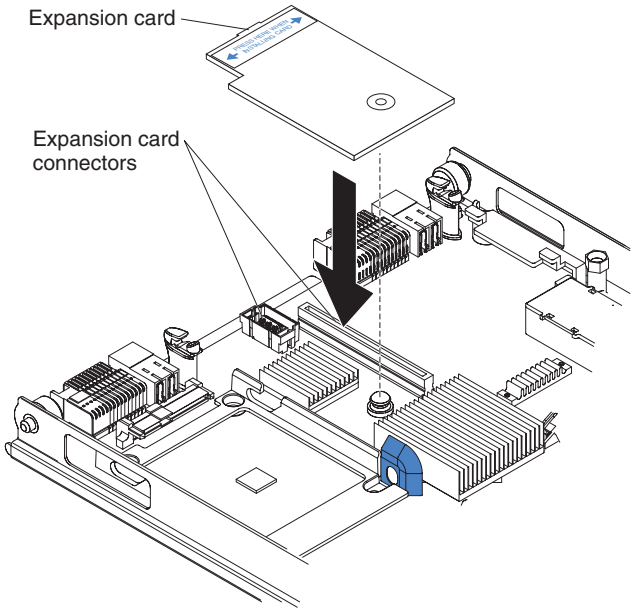
To reduce the possibility of damage from electrostatic discharge, observe the following precautions:

- When you work on a BladeCenter unit that has an electrostatic discharge (ESD) connector, use a wrist strap when you handle modules, optional devices, or blade servers. To work correctly, the wrist strap must have a good contact on both ends (touching your skin at one end and firmly connected to the ESD connector on the front or back of the BladeCenter unit).
- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or its frame.
- Do not touch solder joints, pins, or exposed circuitry.
- Do not leave the device where others can handle and damage it.
- While the device is still in its static-protective package, touch it to any *unpainted* metal surface of the BladeCenter unit or any *unpainted* metal surface on any other grounded component in the rack you are installing the device in for at least 2 seconds. (This drains static electricity from the package and from your body.)
- Remove the device from its package and install it directly into the blade server without setting down the device. If it is necessary to set down the device, place it back into its static-protective package. Do not place the device on your blade server cover or on a metal surface.
- Take additional care when handling devices during cold weather. Heating reduces indoor humidity and increases static electricity.

Installing the expansion card

See the blade server or expansion-unit documentation for detailed instructions about installing a standard-form-factor expansion card; installation of the SAS expansion card is similar. Figure 1 shows the installation of the expansion card on the system board of a HS21, LS21, or JS21 blade server; installing the expansion card in an expansion unit is similar. Figure 2 shows the removal of the retention clip from the expansion card . The appearance of your blade server or expansion unit might be different. See the documentation that came with your blade server or expansion unit for additional information.

Figure 1. Installing an expansion card into an HS21, LS21, or JS21 blade servers



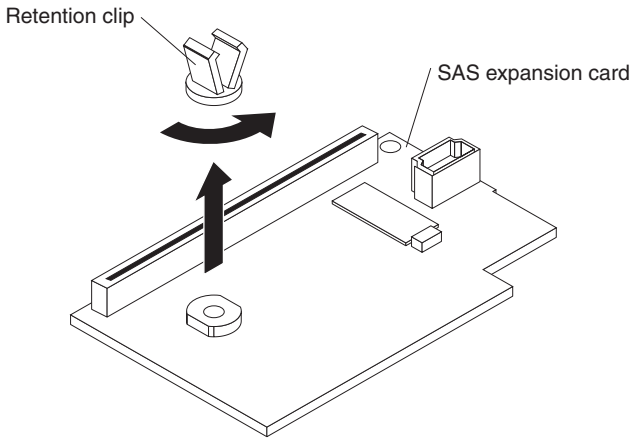
To install the expansion card in an HS20 or LS20 blade server, you must remove the retention clip on the expansion card to properly seat the card into the blade server.

To remove the retention clip, complete the following steps:

1. Read the safety information beginning on page "Installation guidelines" on page 5 and "Handling static-sensitive devices" on page 5.
2. If you have not already done so, touch the static-protective package that contains the SAS expansion card to any *unpainted* metal surface of the BladeCenter unit or any *unpainted* metal surface on any other grounded rack-component for at least 2 seconds.
3. Remove the expansion card from its static-protective package.

4. Locate the retention clip on the expansion card and twist it off to remove it from the expansion card.

Figure 2. Removing the retention clip from the expansion card



5. Store the retention clip for future use.

See the documentation that came with your blade server or expansion unit for additional information about installing the expansion card into a blade server or expansion unit.

Chapter 3. Updating the boot code and firmware and installing device drivers

After you install the expansion card, make sure that the latest boot code and firmware are installed; then, install the device drivers. For the latest information about supported operating systems, versions of device drivers, utilities, and documentation, go to http://www.ibm.com/systems/support/.

The following operating systems are supported for firmware upgrades:

- Microsoft® Windows®
- Red Hat Advanced Server
- SUSE LINUX Enterprise Server (SLES)

To customize the configuration of the expansion card installed in a BladeCenter HS20, HS21, LS20, LS21, LS41, or JS21 blade server, see Chapter 4, "Using the LSI Logic Configuration Utility program," on page 11 or the documentation that came with your blade server or expansion card for more information about customizing the configuration.

Chapter 4. Using the LSI Logic Configuration Utility program

This chapter provides configuration information for users who want to change the configuration of the expansion card when it is installed in a BladeCenter HS20, HS21, LS20, LS21, LS41, or JS21 blade server. You can configure the expansion card using the LSI Logic Configuration utility program.

You can use the Adapter List screen to view SAS adapters, change the boot order, and alter the boot list.

Note: If you configure the blade server to install the operating system to an external SAS storage array and the blade server does not contain local hard disk drives, disable the internal storage controller on the blade server. To disable the controller, press F1 during the initial boot sequence, and then choose **Devices and I/O Ports** and disable the onboard SAS or SCSI option. Save your changes and reboot the blade server.

Using the adapter list screen

You can use the Adapter List screen to view SAS adapters, change the SAS adapter boot order, or modify the SAS adapter boot list.

To view the Adapter List screen, complete the following steps:

1. Start or restart the blade server.
2. On the blade server control panel, press the keyboard/video/mouse (KVM) Select button. The expansion card BIOS initialization starts.
3. Press Ctrl+C during the expansion card BIOS initialization. It might take a few seconds for the LSI Logic Configuration Utility program to display the Adapter List screen. The Adapter List screen displays the SAS ID, PCI slot, firmware revision, status, and boot order of each SAS adapter.

Note: The name of the SAS adapter for the expansion card is SAS1064 and is visible in the Adapter List screen. To determine if the SAS adapter is the expansion card, select a SAS adapter and use the View SAS Topology screen to display whether the SAS adapter is connected to the internal hard disk drives or to the SAS connectivity modules in your BladeCenter chassis. For more information, see “Viewing SAS topology” on page 13.

To change the SAS adapter boot order, complete the following steps:

1. Open the Adapter List screen, and using the + or – keys, select a SAS adapter.
2. Use the + or – keys to reorder the adapters.

To alter the SAS adapter boot list, select a SAS adapter, and use the **Insert** or **Delete** key.

Using the Adapter Properties menu

Use the Adapter Properties menu described in this section to configure the expansion card. After you complete configuration changes, LSI Logic Configuration Utility program restarts the blade server or expansion unit to enable the new parameters.

The Adapter Properties menu includes options for:

- "Changing the adapter BIOS"
- "Viewing SAS topology" on page 13
- "Configuring adapter properties" on page 13
- "Exiting the LSI Logic Configuration Utility program" on page 15

Important: If the configuration settings are incorrect, the expansion card might not function properly. Do not modify the default configuration settings unless you are instructed to do so by an IBM support representative or in these installation instructions.

Note: For information about Remote Boot options, contact your IBM technical support representative or review the white paper documentation available at http://www.ibm.com/systems/support/.

Changing the adapter BIOS

You can enable or disable the BIOS for a SAS adapter using the Adapter List screen. By default the BIOS is enabled.

To disable the BIOS, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select **BIOS & OS** and press Enter to toggle the setting to Disabled.

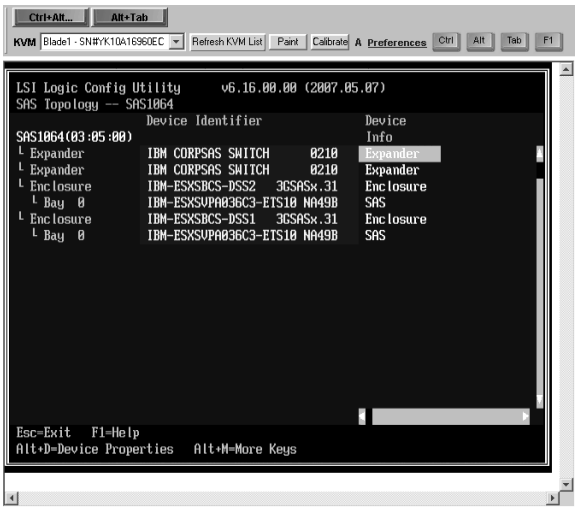
Note: The expansion-card settings and default values will vary, based on the version of BIOS code installed for the expansion card.

Viewing SAS topology

The SAS Topology screen lists SAS device identifiers, PHY information, and device information.

To view the SAS topology screen, complete the following steps:

1. Open the Adapter List screen. See “Using the adapter list screen” on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **SAS Topology** and press Enter. The SAS Topology screen opens.



4. (Optional) Press Alt+M to view more keys. You can use these additional keys to clear device mappings and refresh the topology view.

Note: When viewing the SAS topology of the BladeCenter S Type 8886, the hard disk drives within the storage modules are represented as Bay X, where X is the bay number of the chassis that contains the hard disk drive. The SAS topology screen lists the first hard disk drive as Bay 0 (zero) and the BladeCenter S Type 8886 labels the first integrated hard disk drive as Bay 1. For example, if the SAS topology screen displays a hard disk drive in Bay 3, that hard disk drive is physically installed into Bay 4 of the storage module in the BladeCenter S Type 8886.

Configuring adapter properties

The Adapter Properties menu is used to restore SAS adapter defaults and view advanced device properties, PHY properties and timing properties for your SAS adapter.

Restoring defaults

To restore SAS adapter defaults, complete the following steps:

1. Open the Adapter List screen. See “Using the adapter list screen” on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.

```
LSI Logic Config Utility    v6.01.03.00
  Adapter Properties -- SAS1068

       Adapter                          SAS1068
       PCI Slot                         03
       PCI Address(Bus/Dev/Func)        03:00:00
       MPT Firmware Revision            00.03.23.00-IT
       SAS Address                      500605B0:0000C580
       Status                           Enabled
       Boot Order                       1
       Boot Support                     [Enabled BIOS & OS]

       [RAID Properties]

       [SAS Topology]

       [Advanced Adapter Properties]

  Esc = Exit Menu       F1/Shift+1 = Help
  Enter = Select Item   -/+ = Change Item
```

3. Select **Advanced Adapter Properties** and press Enter. The Advanced Adapter Properties menu opens.

4. Select **Restore Defaults** and press Enter. The defaults for the SAS adapter are restored.

Viewing advanced device properties

To view advanced device properties, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **Advanced Adapter Properties** and press Enter. The Advanced Adapter Properties menu opens.
4. Select **Advanced Device Properties** and press Enter. The Advanced Device Properties screen opens.

Viewing advanced timing properties

To view SAS adapter timing properties, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **Advanced Adapter Properties** and press Enter. The Advanced Adapter Properties menu opens.
4. Select **Adapter Timing Properties** and press Enter. The Adapter Timing Properties screen opens.

Viewing PHY properties

To view PHY properties, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **Advanced Adapter Properties** and press Enter. The Advanced Adapter Properties menu opens.
4. Select **PHY Properties** and press Enter. The PHY Properties screen opens.

Exiting the LSI Logic Configuration Utility program

After you complete the configuration, press Esc several times until the LSI Logic Configuration Utility program exit menu opens. You can save your changes or exit the LSI Logic Configuration Utility program without saving changes and then restart the blade server.

Chapter 5. Integrated-mirroring overview

This chapter provides an overview of the integrated-mirroring (IM) and integrated-mirroring enhanced (IME) features.

Introduction

The LSI Logic mirroring feature provides data protection for the system boot volume and data.

This feature supports simultaneous mirrored volumes with two hard disk drives (IM) plus an optional hot-spare hard disk drive or up to 10 hard disk drives plus two hot-spare hard disk drives (IME), to provide fault-tolerant protection for critical data.

If a hard disk drive in a volume has failed, the mirroring function allows the volume to be rebuilt after the failed hard disk drive is replaced. Additionally, each SAS adapter can have one global hot-spare hard disk drive available to automatically replace a failed hard disk drive in the IM or IME configured on the SAS adapter. The hot spare makes the volume more fault-tolerant.

IM uses the same device drivers as the standard LSI Logic Fusion-MPT-based SAS adapters, providing seamless and transparent fault tolerance. To conserve system resources, this feature operates independently of the operating system. The BIOS-based LSI Logic Configuration Utility program makes it easy to configure volumes. For more information about the LSI Logic Configuration Utility program, see Chapter 4, “Using the LSI Logic Configuration Utility program,” on page 11.

IM and IME features

Both IM and IME support the following features:

- The volume can consist of two mirrored hard disk drives (IM) installed in the blade server, four mirrored hard disk drives (IME) installed in an expansion unit with two addition hard disk drives, or up-to-ten (total) hard disk drives with an external storage enclosure.
- If you have more than two hard disk drives in the system by using an expansion unit or external storage enclosure, you can have one global hot-spare hard disk drive per volume. If a global hot-spare hard disk drive is defined, the upper limit for an volume is three mirrored hard disk drives.
- Mirrored volumes running in optimal mode or in degraded mode
- Hot-swap capability
- Presents a single virtual disk to the operating system for each volume

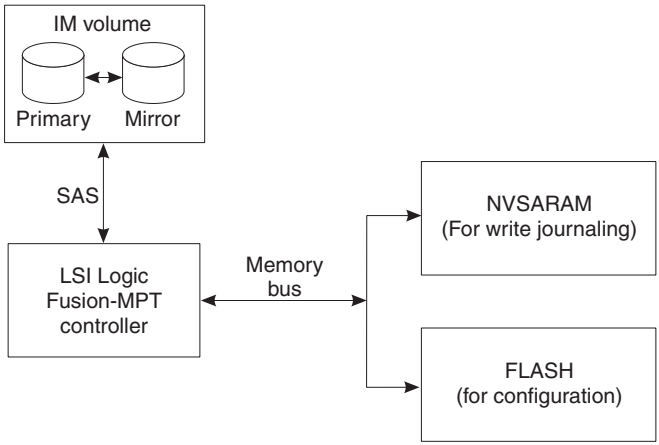
- Support for both SAS and SATA hard disk drives
- Fusion-MPT architecture
- BIOS-based configuration utility and a command-line utility
- Error notification: Operating-specific event log updated by device drivers and errors displayed inside the Fusion-MPT BIOS
- SES (SCSI Enclosure Services) - LED support for IM hard disk drives
- Write journaling, which allows automatic synchronization of potentially inconsistent data after unexpected power-down situations
- Use of metadata to store volume configuration on mirrored hard disk drives
- Automatic background resynchronization while host I/O continues
- Background media verification ensures that data on the volume is accessible

Mirroring feature descriptions

This feature supports one mirrored volume on each SAS adapter, usually, the boot volume. This is accomplished through the firmware on the SAS adapter that supports the standard Fusion-MPT interface. The runtime mirroring of the boot-hard disk drive is transparent to the BIOS, device drivers, and operating system. Host-based status software (My Storage) monitors the state of the mirrored-hard disk drives and reports any error conditions.

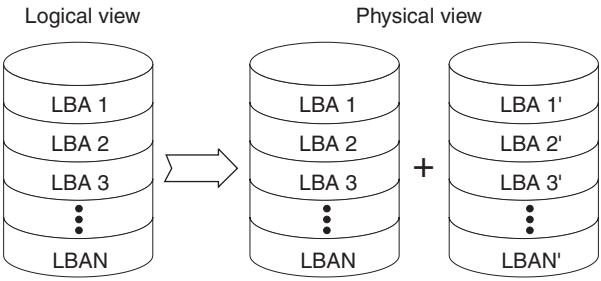
You can use hard disk drives of different sizes in creating volumes. The smallest hard disk drive determines the logical size of each hard disk drive in the volume. The excess space of the larger hard disk drive is not used.

The following illustration shows a typical IM implementation. The system is configured with a second hard disk drive as a mirror of the first (primary) hard disk drive.



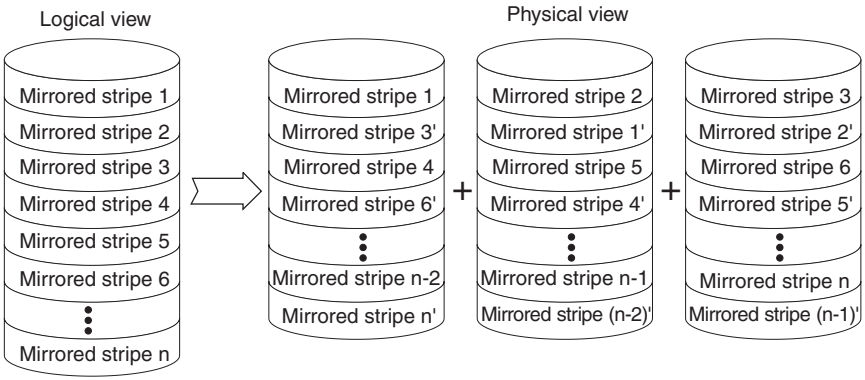
The advantage of IM (RAID 1) is that, assuming that both hard disk drives are functioning correctly, there is a copy of the data on both hard disk drives. The disadvantage is that write operations take longer since the SAS adapter has to write the data to both hard disk drives.

The following illustration shows the logical view and physical view of an IM configuration with two hard disk drives in the mirrored volume.



An IME volume can be configured with up to four mirrored disks, or three mirrored hard disk drives and a global hot spare.

The following illustration shows the logical view and physical view of an IME volume with three mirrored-hard disk drives. Each mirrored stripe is written to a hard disk drive and mirrored to an adjacent hard disk drive. This type of configuration is also called RAID 1E. For more information, see Chapter 6, “Integrated-mirroring volumes,” on page 23.



Firmware features

This section describes the features of the IM firmware.

Host interface

The host interface uses the Message Passing Interface, as described in the Fusion-MPT Message Passing Interface Specification. The host operating system has access to the volume and the physical-hard disk drives through the Fusion-MPT interface.

Resynchronization with concurrent host I/O operation

Resynchronization of hard disk drive data is attempted after a hot spare is activated due to a hard disk drive failure, or after a hard disk drive swap has occurred.

Metadata support

The firmware supports metadata, which describes the logical-drive configuration stored on each hard disk drive. When the firmware is initialized, the stored metadata for each hard disk drive is queried to verify the configuration. The usable disk space for each hard disk drive is adjusted down to leave room for this data.

Hot swapping

The hot-swapped hard disk drive is automatically resynchronized in the background, without any host or user intervention. The firmware detects hot-swap hard disk drive removal and installation.

After a hot-swap event, the firmware readies the new physical-hard disk drive by spinning it up and verifying that it has enough capacity for the mirrored volume. The firmware resynchronizes all hot-swapped hard disk drives that

are removed, even if the same hard disk drive is reinserted. In a two-hard disk drive mirrored volume, the firmware marks the hot-swapped hard disk drive as the secondary hard disk drive and marks the other mirrored hard disk drive as the primary hard disk drive. All data resynchronizes from the primary hard disk drive to the new secondary hard disk drive.

SMART support

SMART (Self-Monitoring Analysis and Reporting Technology) support is available on hard disk drives in the mirrored volume. To obtain SMART information on each physical hard disk drive they must be polled at regular intervals. The SAS expansion card firmware processes the SMART data and stores it in nonvolatile memory. Hard disk drive volumes do not support SMART directly, because they are a logical representation of the physical hard disk drives in the volume.

Hot-spare hard disk drive

One hard disk drive can be configured as a global hot-spare hard disk drive. If one of the mirrored hard disk drives fails then the SAS adapter firmware uses the hot-spare hard disk drive to replace the failed hard disk drive.

Upon detection that one of the mirrored hard disk drives has failed, the firmware automatically replaces it with the hot-spare hard disk drive. The firmware then starts copying the data from the functioning hard disk drive in the mirrored pair to the former hot-spare hard disk drive. You must replace the failed hard disk drive before you can designate a new hot-spare hard disk drive.

Media verification

The background media-verification feature runs at regular intervals when the volume is in optimal mode. If the verification command fails for any reason, the data on the other hard disk drive for this segment is read and written to the failing hard disk drive in an attempt to refresh the data. The current media-verification logical block address is written to nonvolatile memory occasionally, to enable media verification to continue in the case of a power failure.

Write caching

Hard disk drive write caching is disabled by default. This is important to increase data integrity, so that the hard disk drive write log stored in NVRAM is always valid. If hard disk drive write caching is enabled (not preferred), the hard disk drive write log might not be valid.

NVRAM usage

NVRAM is used to perform write journaling to verify that mirrored-hard disk drives in the volume are synchronized with each other.

Fusion-MPT support

To enable IM, the BIOS uses the LSI Logic Fusion-MPT interface to communicate with the SAS adapter and firmware. This includes reading the Fusion-MPT configuration to gain access to the parameters that are used to define behavior between the SAS adapter and the devices to which it is connected. The Fusion-MPT device drivers for all supported operating systems implement the Fusion-MPT interface to communicate with the SAS adapter and firmware.

Chapter 6. Integrated-mirroring volumes

This chapter describes how to create volumes using the LSI Logic Configuration Utility program. You can use hard disk drives of different sizes in creating volumes. The smallest hard disk drive determines the logical size of each hard disk drive in the volume. The excess space of the larger hard disk drive is not used.

Creating volumes overview

When the BIOS loads during startup and a message is displayed about the LSI Configuration utility program, press Ctrl+C to start it. The following message is displayed:

```
Please wait, invoking SAS Configuration Utility.
```

After a brief pause, the main menu of the LSI Logic Configuration Utility program is displayed; however, on some systems, the following message is displayed:

```
LSI Logic Configuration Utility will load following initialization!
```

After the server has completed its power-on self-test (POST), the LSI Logic Configuration Utility program loads.

The following guidelines apply when you create a volume:

- You can configure one IM or IME volume.
- All physical hard disk drives in the volume must be either SATA (with extended command set support) or SAS (with SMART support). SAS and SATA hard disk drives cannot be combined in the same volume.
- Hard disk drives must have 512-byte blocks and must not have removable media.
- An IM volume must have two drives, plus an optional global hot spare. An IME volume can have up to 10 hard disk drive drives plus 2 hot spares assigned to it.

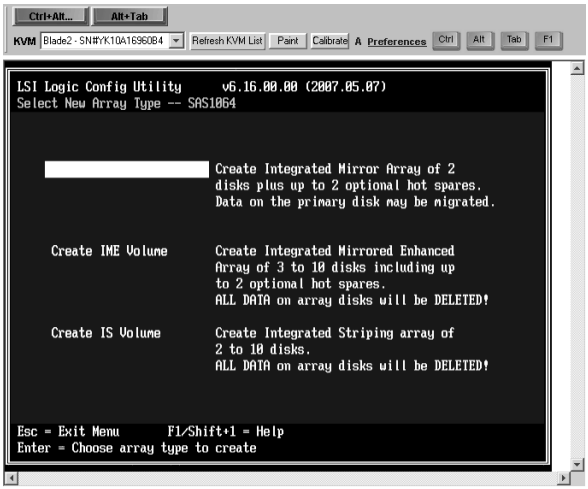
  Note: If a hard disk drive in a volume has failed, it is rebuilt on the global hot spare if one is available. Adding a global hot spare increases the level of data protection.

Creating an IM volume

To create an IM volume, complete the following steps:

1. Open the Adapter List screen. See “Using the adapter list screen” on page 11. The Adapter List screen opens.

2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The first time that you create an array, the Select New Array Type menu opens. After you create the first array, when accessing RAID Properties, the Create Array menu opens.



4. Select **Create IM Volume** and press Enter. The Create New Array screen opens and displays a list of hard disk drives that you can add to a volume.
5. Move the cursor to the **RAID Disk** column and select a hard disk drive. To add the hard disk drive to the volume, change the No to Yes by pressing the **+** key or **-** key.

   When the first hard disk drive is added, the LSI Logic Configuration Utility program prompts you to either keep existing data or overwrite existing data.
6. Press M to keep the existing data on the first hard disk drive or press D to overwrite it.

   If you keep the existing data, it is called a migration. The data on the first hard disk drive selected will be mirrored onto the second hard disk drive selected; therefore, make sure that the data you want to keep is on the first hard disk drive added to the volume. Any data on the second hard disk drive is overwritten. As hard disk drives are added, the **Array Size** field changes to reflect the size of the new volume.
7. (Optional) Add a global hot spare to the volume by moving the cursor to the **Hot Spare** column and pressing the + key, - key, or Spacebar.
8. After the volume is fully configured, press C and then select **Save changes then exit this menu**. The LSI Logic Configuration Utility program pauses while the array is created.

Creating an IME volume

To create an IME volume, complete the following steps:

1. Open the Adapter List screen. See “Using the adapter list screen” on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The first time that you create an array, the Select New Array Type menu opens. After you create the first array, when accessing RAID Properties, the Create Array menu opens.
4. Select **Create IME Volume** and press Enter. The Create New Array screen opens and displays a list of hard disk drives that you can add a volume.
5. Move the cursor to the **RAID Disk** column and select a hard disk drive. To add the hard disk drive to the volume, change No to Yes by pressing the + key, - key, or Spacebar.

   Repeat this step to select up to 10 hard disk drive drives plus 2 hot spares. All existing data on all the hard disk drives you select is overwritten. As you add hard disk drives, the **Array Size** field changes to reflect the size of the new volume.
6. (Optional) Add a global hot spare to the volume by moving the cursor to the **Hot Spare** column and pressing the **+** key, **-** key, or Spacebar.
7. After the volume configuration finishes, press C and select **Save changes then exit this menu**. The LSI Logic Configuration Utility program pauses while the array is created.

Managing hot spares

You can create one global hot-spare hard disk drive to protect the IM or IME volume that is defined on a SAS adapter. You can create the global hot-swap spare at the same time you create a volume.

Adding a hot spare

To add a global hot-spare hard disk drive for an existing volume, complete the following steps:

1. Open the Adapter List screen. See “Using the adapter list screen” on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens.
4. Select **View Array** and press Enter. The View Array screen opens.
5. Select **Manage Array** and press Enter. The Manage Array menu opens.

```
LSI Logic Config Utility    v6.01.03.00
  Manage Array -- SAS1068

       Identifier                  LSILOGICLogical Volume  3000
       Type                        IM
       Scan Order                  1
       Size(MB)                    34332
       Status                      Optimal

       [Manage Hot Spares]

       [Synchronize Array]

       [Activate Array]

       [Delete Array]


  Esc = Exit Menu       F1/Shift+1 = Help
  Enter = Select Item
```

6. Select **Manage Hot Spares** and press Enter. The Manage Hot Spares screen opens.
7. Select a hard disk drive from the list and press the + key, - key, or Spacebar to change the Hot Spare column to **Yes**.
8. After you select the global hot-spare hard disk drive, press C. A confirmation screen opens.

   An error message is displayed if the selected hard disk drive is not at least as large as the smallest hard disk drive used in the volume. The global hot-spare hard disk drive must have 512-byte blocks, it cannot have removable media, and the hard disk drive type must be either SATA with extended command set support or SAS with SMART support.

   If SATA hard disk drives are used for the volume, the hot-spare hard disk drive must also be a SATA hard disk drive. If SAS hard disk drives are used, the hot-spare hard disk drive must also be a SAS hard disk drive. An error message is displayed if the selected hard disk drive is not the same type as the hard disk drives used in the volumes.
9. Select **Save changes then exit this menu**. The LSI Logic Configuration Utility program pauses while the global hot spare is added.

Deleting a hot spare

To delete a global hot spare, complete the following steps:

1. Open the Adapter List screen. See “Using the adapter list screen” on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens.
4. Select **View Array** and press Enter. The View Array screen opens.

5. Select **Manage Array** and press Enter. The Manage Array menu opens.
6. Select **Manage Hot Spares** and press Enter. The Manage Hot Spares screen opens.
7. Select the hot spare to be deleted; then, change Yes to No by pressing the + key, - key, or Spacebar. The hot spare is deactivated.
8. Select **Save changes then exit this menu**. The LSI Logic Configuration Utility program pauses while the global hot spare is removed.

Other configuration tasks

This section explains how to perform other tasks related to configuring and maintaining IM and IME volumes.

Viewing volume properties

To view the properties of volumes, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens. The properties of the current volume and global hot spares are listed.

   Note: If you create one volume using SAS hard disk drives, another volume using SATA hard disk drives, and a global hot-spare hard disk drive, the hot-spare hard disk drive is displayed only when you view the volume that has the same type of hard disk drives as the hot-spare hard disk drive.
4. If two volumes are configured, press Alt+N to view the other array.
5. To manage the current array, select **Manage Array** and press Enter. The Manage Array menu opens and lists the volume properties for the SAS adapter.

Synchronizing an array

This command forces the firmware to resynchronize the data on the mirrored-hard disk drives in the array. It is usually not necessary to use this command, because the firmware automatically keeps the mirrored data synchronized during normal system operation. When you use this command, one hard disk drive of the array is placed in the Degraded state until the data on the mirrored hard disk drives is resynchronized.

To force the synchronization of an array, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.

2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens.
4. Select **View Array** and press Enter. The View Array screen opens.
5. Select **Manage Array** and press Enter. The Manage Array menu opens.
6. Select **Synchronize Array** and press Enter. The Synchronize Array screen opens.
7. Press Y to start the synchronization, or press N to cancel it.

Activating an array

An array can become inactive if, for example, it is moved from one SAS adapter or computer to another. This option allows you to reactivate an inactive array that has been added to a system. This option is available only when the selected array is currently inactive.

To activate an array, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens.
4. Select **View Array** and press Enter. The View Array screen opens.
5. Select **Manage Array** and press Enter. The Manage Array menu opens.
6. Select **Activate Array** and press Enter. The Activate Array confirmation screen opens.
7. Press Y to proceed with the activation, or press N to cancel it. After a pause, the array becomes active.

   Note: If there is a global hot-spare hard disk drive on the SAS adapter to which you have moved the array, the firmware checks when you activate the array to determine if the hot spare is compatible with the new array. An error message is displayed if the hard disk drives in the activated array are larger than the hot-spare hard disk drive or if the hard disk drives in the activated array are not the same type as the hot-spare hard disk drive (SATA versus SAS).

Deleting an array

Attention: To prevent the loss of data, before you delete an array, you must back up all data on the array that you want to keep.

To delete an array, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens.
4. Select **View Array** and press Enter. The View Array screen opens.
5. Select **Manage Array** and press Enter. The Manage Array menu opens.
6. Select **Delete Array** and press Y to delete the array. A confirmation screen opens.

   After a pause, the firmware deletes the array. If there is another remaining array and a global hot-spare hard disk drive, the firmware checks the hot-spare hard disk drive to determine if it is compatible with the remaining array. If the hot-spare hard disk drive is not compatible (too small or wrong hard disk drive type) the firmware deletes it also.

   Note: After a volume is deleted, it cannot be recovered. When a RAID 1 volume is deleted, the data is preserved on the primary hard disk drive. The master boot records (MBR) of other hard disk drives in the array are deleted. For other RAID types, the master boot records of all hard disk drives are deleted.

Locating a hard disk drive or multiple hard disk drives in a volume

You can use the LSI Logic Configuration Utility program to locate and identify a specific physical hard disk drive by making the hard disk drive activity LED flash. You can also use the LSI Logic Configuration Utility program to make the LEDs of all the hard disk drive drives in a RAID volume flash. There are several ways to do this:

- When you are creating an IM or IME volume, the hard disk drive activity LED flashes if it is part of the volume. The activity LED stops flashing when you are finished creating the volume.
- You can locate an individual hard disk drive from the SAS Topology screen by moving the cursor to the name of the hard disk drive in the **Device Identifier** column and pressing Enter. The activity LED on the hard disk drive flashes until the next key is pressed.
- You can locate all of the hard disk drives in a volume by selecting the volume on the RAID Properties screen. The activity LEDs flash on all hard disk drives in the volume.

Note: The activity LEDs on the hard disk drives flash if the firmware is correctly configured, and the hard disk drive or the disk enclosure support disk location.

Selecting a boot disk

You can select a boot disk in the SAS Topology screen. The selected hard disk drive is then designated to scan as ID 0 on the next restart and remains at this position. This makes it easier to set BIOS boot device options and to keep the boot device constant when a device is added or removed. There can be only one boot disk.

To select a boot disk, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select the SAS adapter and press Enter. The SAS Adapter Properties menu opens.
3. Select **SAS Topology** and press Enter. The SAS Topology screen opens.

   If the selection of a boot device is supported, the bottom of the screen displays the Alt+B option. This is the key combination for toggling the boot device. If a device is currently configured as the boot device, the word Boot is displayed in the **Device Info** column on the SAS Topology screen.
4. To select a boot disk, move the cursor to a hard disk drive and press Alt+B.
5. To remove the boot designator, move the cursor down to the current boot disk and press Alt+B.
6. To change the boot disk, move the cursor to the new hard disk drive and press Alt+B. The boot designator moves to this hard disk drive.

   Note: The firmware must be configured correctly for the Alt+B feature to work.

Chapter 7. Integrated-striping overview

This chapter provides an overview of the LSI Logic Integrated Striping (IS) feature.

Introduction

The IS feature is useful for applications that require the faster performance and increased storage capacity of striping. A single IS logical drive can be configured as the boot disk or as a data disk.

The IS feature is implemented with adapter firmware that supports the Fusion-MPT interface. IS provides better performance and more capacity than individual disks, without burdening the host processor. The firmware splits host I/O over multiple hard disk drives and presents the hard disk drives as a single logical drive. In general, striping is transparent to the BIOS, the device drivers, and the operating system.

The LSI Logic Configuration Utility program is used to configure IS volumes, which can consist of two-to-four hard disk drives.

Integrated-striping features

IS supports the following features:

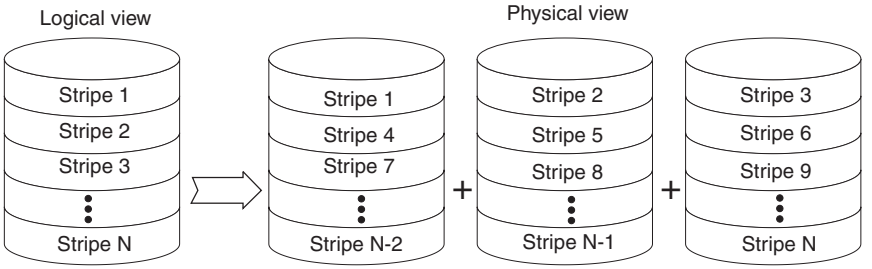
- Support for one volume with two to four drives
- Presents a single virtual drive to the operating system for each configured volume
- Support for both SAS and SATA drives, although the two types of drives cannot be combined in one volume
- Fusion-MPT architecture
- Easy-to-use LSI Logic Configuration Utility program
- Error notification
- Use of metadata to store volume configuration on hard disk drives
- Operating-system specific event log
- Error display inside the Fusion-MPT BIOS
- SAS status LED support for drives used in IS volumes

Integrated-striping description

This feature writes data across multiple hard disk drives instead of onto one hard disk drive. The storage space on each hard disk drive is partitioned into 64 KB stripes. These stripes are interleaved so that the combined storage space is composed alternately of stripes from each hard disk drive.

Segment 1 is written to hard disk drive 1, segment 2 is written to hard disk drive 2, and segment 3 is written to hard disk drive 3. When the system reaches the end of the hard disk drive list, it continues writing data at the next available segment of hard disk drive 1.

The following illustration shows a logical view and a physical view of an IS configuration.



Speed is the primary advantage of IS, because it transfers data to or from multiple hard disk drives at one time. However, there is no data redundancy; therefore, if one hard disk drive fails, that data is lost.

Firmware features

This section describes the features of the IS firmware.

Host interface

The IS host interface uses the Message Passing Interface, as described in the Fusion-MPT Message Passing Interface Specification, including IS. The host operating system has access to the logical IS drive and the physical hard disk drives through the Fusion-MPT interface.

Metadata support

The firmware supports metadata, which describes the IS logical-drive configuration stored on each hard disk drive. When the firmware is initialized,

the stored metadata for each hard disk drive is queried to verify the configuration. The usable disk space for each IS hard disk drive is adjusted down to leave room for this data.

SMART support

SMART support is available on IS hard disk drives. To obtain SMART information on each physical hard disk drive they must be polled at regular intervals. If a SMART ASC/ASCQ data is detected on a physical IS hard disk drive, the firmware processes the SMART data, and the last received SMART ASC/ASCQ data is stored in nonvolatile memory. The IS volume does not support SMART directly, because it is just a logical representation of the physical hard disk drives in the volume.

Write caching

Hard disk drive write caching is disabled by default on all IS volumes.

Fusion-MPT support

To enable IS, the BIOS uses the LSI Logic Fusion-MPT interface to communicate with the SAS adapter and firmware. This includes reading the Fusion-MPT configuration to gain access to the parameters that are used to define behavior between the SAS adapter and the devices to which it is connected. The Fusion-MPT device drivers for all supported operating systems implement the Fusion-MPT interface to communicate with the SAS adapter and firmware.

Chapter 8. Creating integrated striping volumes

This chapter describes how to create IS volumes using the LSI Logic Configuration Utility program.

Integrated striping configuration overview

You can use the LSI Logic Configuration Utility program to create one IS volume, with up to four drives total on a SAS adapter. The SAS adapter must be in the BIOS boot order.

You can use hard disk drives of different sizes in IS volumes. The smallest hard disk drive determines the logical size of each hard disk drive in the volume. The excess space of the larger hard disk drive is not used. Usable disk space for each hard disk drive in an IS volume is adjusted down to leave room for metadata. Usable disk space can be further reduced to maximize the ability to interchange hard disk drives in the same size classification. The supported stripe size is 64 KB.

For more information about IS volumes, see “Integrated-striping features” on page 31.

Creating an integrated-striping volume

When the BIOS loads during startup and a message is displayed about the LSI Logic Configuration Utility program, press Ctrl+C to start the utility. The following message is displayed:

```
Please wait, invoking SAS Configuration Utility.
```

After a brief pause, the LSI Logic Configuration Utility program main menu is displayed; however, on some blade servers the following message is displayed:

```
LSI Logic Configuration Utility will load following initialization!
```

In this case, the LSI Logic Configuration Utility program will load after the blade server has completed its power-on self-test (POST).

To create an IS volume, complete the following steps:

Note: The following procedure assumes that the required SAS adapters and hard disk drives are already installed in the blade server. You can configure both IM and IS volumes on the same SAS adapter.

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The first time that you create an array, the Select New Array Type menu opens. After you create the first array, when accessing RAID Properties, the Create Array menu opens.
4. Select **Create IS Volume** and press Enter. The Create New Array screen opens and displays the list of hard disk drives that can be added to a volume.
5. Move the cursor to the **RAID Disk** column. To add a hard disk drive to the volume, change the No to Yes by pressing the + key, - key, or Spacebar. As hard disk drives are added, the **Array Size** field changes to reflect the size of the new volume.

   The following illustration shows an IS volume configured with two drives.

```
LSI Logic MPT Setup Utility    v6.01.03.00
  Create New Array -- SAS1068

    Array Type:                         IS
    Array Size(MB)                      70032

  Slot  Device Identifier               RAID   Hot    Drive     Pred  Size
  Num                                   Disk   Spr    Status    Fail  (MB)
    1   MAXTOR ATLAS15K2_36SAS BG34     [Yes]  [No]   Ok        ---   35074
    2   MAXTOR ATLAS15K2_36SAS BG34     [Yes]  [No]   Ok        ---   35074
    8   MAXTOR ATLAS15K2_36SAS BG34     [No]   [No]   Ok        ---   35074
   11   MAXTOR ATLAS15K2_36SAS BG34     [No]   [No]   Ok        ---   35074









  Esc = Exit Menu       F1/Shift+1 = Help
  Space/+/- = Select disk for array or hot spare    C = Create array
```

   There are several limitations when creating an IS (RAID 0) volume:

   - All hard disk drives must be either SATA (with extended command set support) or SAS (with SMART support).
   - Hard disk drives must have 512-byte blocks and must not have removable media.
   - There must be at least two and no more than four drives in a valid IS volume. There is no support for hot-spare hard disk drives in an IS volume.

6. After the volume is fully configured, press C and select **Save changes then exit this menu**. The LSI Logic Configuration Utility program pauses while the array is created.

   Note: IS does not provide any data protection if a hard disk drive has failed. It is primarily used to increase speed.

Creating a second integrated striping volume

You can configure two IS volumes, or an IS volume and an IM or IME volume. You can add a second volume if one volume is already configured and if there are available hard disk drives.

To add a second IS volume, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens.
4. Select **Create IS Volume** and press Enter. The Create New Array screen lists the hard disk drives that can be added to a volume.
5. Move the cursor to the **RAID Disk** column. To add a hard disk drive to the volume, change the No to Yes by pressing the + key, - key, or Spacebar. As disks are added, the **Array Size** field changes to reflect the size of the new volume.
6. After the volume is fully configured, press C and select **Save changes then exit this menu**. The LSI Logic Configuration Utility program pauses while the array is created.

Other configuration tasks

This section explains how to perform other tasks related to configuring and maintaining integrated striping volumes.

Viewing integrated striping volume properties

To view the properties of IS volumes, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens listing the properties of the current volume.
4. To view the next array (if available), press Alt+N.

5. To manage the current array, select **Manage Array**, and then press Enter. The Manage Array menu opens.

Activating an array

An array can become inactive if, for example, it is moved from one SAS adapter or computer to another. The Activate Array option allows you to reactivate an inactive array that is added to a system. This option is available only when the selected array is currently inactive.

To activate a selected array, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties** and press Enter. The Create Array menu opens listing the properties of the current volume.
4. Select **Manage Array**, and press Enter. The Manage Array menu opens.
5. Select **Activate Array** and press Y. To cancel the activation, press N. After a pause, the array becomes active.
6. Select **Activate Array** and press Enter. The Activate Array confirmation screen opens.
7. Press Y to proceed with the activation, or press N to cancel it. After a pause, the array becomes active.

   Note: If there is a global hot-spare hard disk drive on the SAS adapter to which you have moved the array, the firmware checks when you activate the array to determine if the hot spare is compatible with the new array. An error message is displayed if the hard disk drives in the activated array are larger than the hot-spare hard disk drive or if the hard disk drives in the activated array are not the same type as the hot-spare hard disk drive (SATA versus SAS).

Deleting an array

Attention: To prevent the loss of data, before you delete an array, you must back up all data on the array that you want to keep.

To delete a selected array, complete the following steps:

1. Open the Adapter List screen. See "Using the adapter list screen" on page 11. The Adapter List screen opens.
2. Use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **RAID Properties**, and press Enter. The Create Array menu opens listing the properties of the current volume.

4. Select **Manage Array**, and press Enter. The Manage Array menu opens.
5. Select **Delete Array** and press Y to delete the array.

   After a pause, the firmware deletes the array.

   Note: After a volume is deleted, it cannot be recovered. The master boot records of all disks are deleted.

Locating a disk drive or multiple disk drives in a volume

You can use the LSI Logic Configuration Utility program to locate and identify a specific physical hard disk drive by making the hard disk drive activity LED flash. You can also use the LSI Logic Configuration Utility program to make the LEDs of all the hard disk drive drives in a RAID volume flash. There are several ways to do this:

- When you are creating an IM or IME volume, the hard disk drive activity LED flashes if it is part of the volume. The activity LED stops flashing when you are finished creating the volume.
- You can locate an individual hard disk drive from the SAS Topology screen by moving the cursor to the name of the hard disk drive in the **Device Identifier** column and pressing Enter. The activity LED on the hard disk drive flashes until the next key is pressed.
- You can locate all of the hard disk drives in a volume by selecting the volume on the RAID Properties screen. The activity LEDs flash on all hard disk drives in the volume.

  Note: The activity LEDs on the hard disk drives flash if the firmware is correctly configured, and the hard disk drive or the disk enclosure support disk location.

Selecting a boot disk

When you select a boot disk in the SAS Topology screen, the hard disk drive is designated as scan ID 0 on the next restart and remains at this position. This makes it easier to set BIOS boot device options and to keep the boot device constant when a device is added or removed. There can be only one boot disk.

To select a boot disk, complete the following steps:

1. Open the Adapter List screen. See “Using the adapter list screen” on page 11. The Adapter List screen opens.
2. Select a SAS adapter and press Enter. The Adapter Properties menu opens.
3. Select **SAS Topology** and press Enter. The SAS Topology screen opens.

   If the selection of a boot device is supported, the bottom of the screen displays the Alt+B option. This is the key combination for toggling the boot device. If a device is currently configured as the boot device, the word Boot is displayed in the **Device Info** column on the SAS Topology screen.

4. To select a boot disk, move the cursor to a hard disk drive and press Alt+B.
5. To remove the boot designator, move the cursor down to the current boot disk and press Alt+B.
6. To change the boot disk, move the cursor to the hard disk drive and press Alt+B. The boot designator moves to this hard disk drive.

Note: The firmware must be configured correctly for the Alt+B feature to work.

Chapter 9. Troubleshooting

If you are having a problem, use the following information to help you determine the cause of the problem and the action to take. Additional troubleshooting and debugging procedures are available in the *Hardware Maintenance Manuals* or *Problem Determination and Service Guide* for your blade server.

Make sure you are using the latest versions of device drivers and firmware for your blade server and management module. If these items are not up-to-date, the BladeCenter unit might not recognize the expansion card and might not turn it on. Go to the IBM support Web site at http://www.ibm.com/systems/support/ for the latest information about upgrading the device drivers, firmware, and BIOS for BladeCenter components. The latest instructions are in the documentation that come with the updates.

To determine whether your installation problem is caused by the hardware, perform the following tasks:

- Make sure that the expansion card is installed correctly. For instructions, see Chapter 2, "Installing the expansion card," on page 5.
- Make sure that all peripheral devices connected to the I/O modules are turned on, operating properly, and are properly connected:
  - If the expansion card is installed in a BladeCenter HS20, HS21, LS20, LS21, or LS41 blade server, see Chapter 4, "Using the LSI Logic Configuration Utility program," on page 11 or the documentation that came with your blade server for information about displaying attached SAS devices.
  - If the expansion card is installed in a BladeCenter JS21 blade server, see the documentation that came with your blade server for information about displaying attached SAS devices.
- Make sure that I/O modules that support SAS operation are installed in the correct I/O-module bays (Bay 3 or Bay 4) of the BladeCenter unit. See your BladeCenter documentation for detailed instructions about installing I/O modules into the BladeCenter unit.

To determine whether your installation problem is caused by the software, perform the following tasks:

- Make sure that the correct device driver is installed. To download or get information about the latest supported device drivers, utilities, and documentation, go to http://www.ibm.com/systems/support/. Also see the *Installation and User's Guide* for your blade server for additional information.
- Make sure that the BIOS code in the expansion card is at the latest level.

To determine whether your installation problem is caused by the system configuration, make sure that the blade server is configured properly:

- If the expansion card is installed in a BladeCenter HS20, HS21, LS20, LS21, or LS41 blade server, see Chapter 4, "Using the LSI Logic Configuration Utility program," on page 11 or the documentation that came with your blade server for additional information.
- If the expansion card is installed in a BladeCenter JS21 blade server, see the documentation that came with your blade server for additional information.

If you still have a system configuration problem, see the documentation that comes with your IBM BladeCenter unit or contact your IBM technical support representative to determine whether your system board requires a special configuration.

Appendix A. Using the CFGGEN IR configuration utility

This appendix describes how to use the CFGGEN IR Configuration utility to create integrated mirroring (IM), integrated mirroring enhanced (IME) and integrated striping (IS) volumes. CFGGEN is a command-line utility that runs in the DOS, Linux®, and Microsoft Windows Pre-Installation (WinPE) environments. CFGGEN is a minimally interactive program that you can run from a command prompt or a shell script.

Hardware and software requirements

The CFGGEN configuration utility works with any small computer systems interface (SCSI), serial advanced technology attachment (SATA), or serial attached SCSI (SAS) device that is compliant with existing SCSI standards.

The CFGGEN configuration utility is supported in the following operating system environments:

- **DOS version**

  CFGGEN runs in any environment that is fully DOS compatible and has at least 640 KB of memory. The system BIOS must support 32-bit BIOS services, including the PCI BIOS services. CFGGEN uses these services to locate the SAS adapter and its interface registers. CFGGEN must be able to directly access the interface registers on the SAS adapter chip.

  Note: You cannot run CFGGEN in a virtual DOS window from within Windows.

- **Linux version**

  CFGGEN is a statically linked Linux application. Static linking prevents any library version compatibility problems that might prevent CFGGEN from working with a specific release or distribution of Linux. Version 3.02.04 or later of the LSI mptlinux device driver must be installed on the system. The required modules include mptbase.o, mptscsih.o and mptctl.o.

  Important: The mptbase.o, mptscsih.o and mptctl.o modules must be loaded into the Linux kernel before CFGGEN can function correctly. They can be loaded using the Linux modprobe command.

- **WinPE version**

  CFGGEN will run on a Windows Pre-Installation Environment (WinPE) and is statically compiled with the LSI MptLib Library (MptLib.lib). The WinPE environment must have the applicable LSI Logic MPT Windows device driver (Miniport or Storport) installed and loaded to recognize and communicate with the I/O controller.

CFGGEN interface description

CFGGEN uses a command-line interface. Commands are formatted as follows:

```
cfggen <controller #> <command> <parameters>
```

The program name, controller number, command, and parameter fields must be separated by the ASCII space character. The format of the parameters is command specific, as described in "CFGGEN commands."

Information is passed between the user environment and CFGGEN using the command line, the standard output and standard error interfaces, and the program return value. You can redirect the output streams as permitted by the operating environment. The program return value is returned to you when the program exits. A value of 0 is returned if the command is successful. Otherwise, a value of 1 is returned.

CFGGEN commands

CFGGEN has the following commands:

CFGGEN is not case sensitive. You can type CFGGEN commands and parameters in uppercase, lowercase, or a combination of the two.

The following conventions are used in the command descriptions:

- Text in italics must be entered exactly as shown on the command line.
- Text surrounded by <> must be replaced with a required parameter.
- Text surrounded by [ ] can be replaced by an optional parameter.
- Parameters surrounded by {} must be entered one or more times, as is applicable for the command you are running.
- The command-line definition characters <>, [ ], and {} must not be entered on the command line.

Common command-line parameters

This section describes CFGGEN command-line parameters that are common to more than one command.

- **<controller #>**

  The unique controller number of a PCI function found in the system, starting with controller # 0. The controller # corresponds to a single SAS adapter. For example, in a server containing two SAS adapters, controller # 0 refers to the first controller and controller # 1 refers to the other controller. Valid SAS adapter number values are 0 - 255 (decimal).

- **<SCSI ID>**

  The SCSI bus address of a peripheral device attached to a SAS adapter. The valid SCSI ID values are 0 - 127 (decimal) per SAS adapter.

  Note: With PBSRAM, the SAS adapter can support more than 128 devices.

- **<Target ID>**

  The Target ID defines the SCSI address of the device.

Create command

This command creates IM, IME, and IS volumes on the SAS adapter. The firmware and hardware limitations for the SAS adapter determine the number of configurations that you can create.

When a hard disk drive is added to an IM, IME, or IS volume, its entire storage capacity might be used, depending on drive capacity and volume capacity. For example, if you add a 36 GB hard disk drive to a volume that only uses 9 GB of capacity on each hard disk drive, the remaining 27 GB of capacity on the hard disk drive is unusable.

The disk identified by the first SCSI ID on the command line is assigned as the primary disk drive when an IM volume is created. If the SAS adapter is allowed to resync the disk drives, the data on the primary disk drive is available when you access the newly created volume.

The following rules must be observed when creating IM, IME, and IS volumes and hot-spare hard disk drives on the SAS adapter:

- IM, IME, and IS volumes are supported.
- You can create only one IM, IME, or IS volume.
- The total number of hard disk drives in a volume, including hot-spare hard disk drives, cannot exceed four.
- An IS volume must have exactly two hard disk drives.
- An IME volume can have a minimum of three hard disk drives and a maximum of 10 hard disk drives.

Command line:

```
cfggen <controller #> create <volume type> <size> {<SCSI ID>} [qsync] [noprompt]
{<Target ID>} [qsync] [noprompt]
```

Parameters:

- `<controller #>` – Number of the SCSI bus or SAS adapter that is targeted by this command.
- `<volume type>` – Volume type for the new volume to be created. Valid values are IM or IME or IS.
- `<size>` – Size of the RAID volume in MB, or MAX for the maximum size available.
- `<SCSI ID>` – SCSI ID of a hard disk drive to be included in the RAID volume.
- `<Target ID>` – Target ID for the hard disk drive to be included in the RAID volume. This value can be obtained from the output of the `display` command.
- `qsync` – If this optional parameter is specified, a quick synchronization of the new volume is performed. If the volume type is integrated mirroring enhanced or integrated striping, a quick synchronization is always performed even if qsync is not specified. A quick synchronization means that the first 32 KB of the drives in the volume are cleared to 0.
- `noprompt` – Suppresses the display of warnings and prompts.

Program return values:

0x00	Command completed successfully.
0x01	Bad command-line argument or operational failure.

Defaults command

This command deletes any volumes and hot-spare hard disk drives created by the `create` and `Hotspare` commands. No other SAS adapter configuration parameters are changed.

Command line

```
cfggen <controller #> defaults [noprompt]
```

Parameters:

- `<controller #>` – Number of the SCSI bus or SAS adapter that is targeted by this command.
- `noprompt` – Suppresses the display of warnings and prompts.

Program return values:

0x00	Command completed successfully.
0x01	Bad command-line argument, or operational failure.

Display command

This command displays configuration information for the SAS adapter. The information includes controller type, firmware version, BIOS version, volume information, and physical hard disk drive information. An example of the information that is output by this command is provided in the sample output section.

Note: 1 MB = 1,048,576 bytes. All sizes displayed in MB are rounded down to the nearest MB.

Command line

```
cfggen <controller #> display [filename]
```

Parameters:

- `<controller #>` – Number of the SCSI bus or SAS adapter that is targeted by this command.
- `[filename]` – Optional valid file name to which the output of the command is stored.

Program return values:

0x00	Command completed successfully.
0x01	Bad command-line argument or operational failure.

Sample output:

The following example shows the output of the `create` command when used to create an IM configuration on a SAS adapter.

Note: The format and content of the `display` command output varies, depending on the CFGGEN version that is used.

```
LSI LOGIC Integrated RAID Configuration utility.  v2.00.10.00
Read configuration has been initiated for controller 0
------------------------------------------------------------------------
Controller information
------------------------------------------------------------------------
  Controller type                         : SAS1068E
  BIOS version                            : 6.08.04.00
  Firmware version                        : 1.15.00.00
  Channel description                     : 1 Serial Attached SCSI
```

```
  Initiator ID                          : 63
  Maximum physical devices              : 62
  Concurrent commands supported         : 511
  Slot                                  : 3
  Bus                                   : 13
  Device                                : 0
  Function                              : 0
  RAID Support                          : Yes
------------------------------------------------------------------------
IR Volume information
------------------------------------------------------------------------
IR volume 1
  Volume ID                             : 15
  Status of volume                      : Degraded (DGD)
  RAID level                            : 1
  Size (in MB)                          : 69618
  Physical hard disks (Target ID)       : 19 26
------------------------------------------------------------------------
Physical device information
------------------------------------------------------------------------
Initiator at ID #63
Target on ID #13
  Device is a Hard disk
  Enclosure #                           : 2
  Slot #                                : 3
  Target ID                             : 13
  State                                 : Ready (RDY)
  Size (in MB)/(in sectors)             : 70006/143374000
  Manufacturer                          : IBM-ESXS
  Model Number                          : GNA073C3ESTT0Z N
  Firmware Revision                     : BH0D
  Serial No                             : J20SX89K
  Drive Type                            : SAS
Target on ID #14
  Device is a Hard disk
  Enclosure #                           : 2
  Slot #                                : 2
  Target ID                             : 14
  State                                 : Ready (RDY)
  Size (in MB)/(in sectors)             : 70006/143374000
  Manufacturer                          : IBM-ESXS
  Model Number                          : GNA073C3ESTT0Z N
  Firmware Revision                     : BH0D
  Serial No                             : J20SDCHK
  Drive Type                            : SAS
Target on ID #16
  Device is a Hard disk
  Enclosure #                           : 2
  Slot #                                : 7
  Target ID                             : 16
  State                                 : Ready (RDY)
  Size (in MB)/(in sectors)             : 70006/143374000
  Manufacturer                          : IBM-ESXS
  Model Number                          : BBA073C3ESTT0Z N
  Firmware Revision                     : BH0C
  Serial No                             : K4049N0K
  Drive Type                            : SAS
```

```
Target on ID #17
  Device is a Hard disk
  Enclosure #                             : 2
  Slot #                                  : 6
  Target ID                               : 17
  State                                   : Ready (RDY)
  Size (in MB)/(in sectors)               : 70006/143374000
  Manufacturer                            : IBM-ESXS
  Model Number                            : GNA073C3ESTT0Z N
  Firmware Revision                       : BH0D
  Serial No                               : J20SDELK
  Drive Type                              : SAS
Target on ID #18
  Device is a Hard disk
  Enclosure #                             : 2
  Slot #                                  : 5
  Target ID                               : 18
  State                                   : Ready (RDY)
  Size (in MB)/(in sectors)               : 35074/71833096
  Manufacturer                            : MAXTOR
  Model Number                            : ATLAS15K2_36SAS
  Firmware Revision                       : BG3R
  Serial No                               : E20NEN2K
  Drive Type                              : SAS
Target on ID #19
  Device is a Hard disk
  Enclosure #                             : 2
  Slot #                                  : 0
  Target ID                               : 19
  State                                   : Online (ONL)
  Size (in MB)/(in sectors)               : 286102/585937500
  Manufacturer                            : IBM-ESXS
  Model Number                            : GNA300C3ESTT0Z N
  Firmware Revision                       : BH0D
  Serial No                               : D807AZFK
  Drive Type                              : SAS
Target on ID #20
  Device is a Hard disk
  Enclosure #                             : 2
  Slot #                                  : 11
  Target ID                               : 20
  State                                   : Ready (RDY)
  Size (in MB)/(in sectors)               : 70006/143374000
  Manufacturer                            : IBM-ESXS
  Model Number                            : GNA073C3ESTT0Z N
  Firmware Revision                       : BH0D
  Serial No                               : J20RK8FK
  Drive Type                              : SAS
Target on ID #21
  Device is a Hard disk
  Enclosure #                             : 2
  Slot #                                  : 10
  Target ID                               : 21
  State                                   : Ready (RDY)
  Size (in MB)/(in sectors)               : 70006/143374000
  Manufacturer                            : IBM-ESXS
  Model Number                            : GNA073C3ESTT0Z N
```

```
  Firmware Revision                     : BH0D
  Serial No                             : J20SX64K
  Drive Type                            : SAS
Target on ID #22
  Device is a Hard disk
  Enclosure #                           : 2
  Slot #                                : 9
  Target ID                             : 22
  State                                 : Ready (RDY)
  Size (in MB)/(in sectors)             : 70006/143374000
  Manufacturer                          : IBM-ESXS
  Model Number                          : GNA073C3ESTT0Z N
  Firmware Revision                     : BH0D
  Serial No                             : J20SMZRK
  Drive Type                            : SAS
Target on ID #23
  Device is a Hard disk
  Enclosure #                           : 2
  Slot #                                : 4
  Target ID                             : 23
  State                                 : Ready (RDY)
  Size (in MB)/(in sectors)             : 70006/143374000
  Manufacturer                          : IBM-ESXS
  Model Number                          : GNA073C3ESTT0Z N
  Firmware Revision                     : BH0D
  Serial No                             : D219NPLK
  Drive Type                            : SAS
Target on ID #24
  Device is a Hard disk
  Enclosure #                           : 2
  Slot #                                : 8
  Target ID                             : 24
  State                                 : Ready (RDY)
  Size (in MB)/(in sectors)             : 34715/71096640
  Manufacturer                          : IBM-ESXS
  Model Number                          : ST336754SS
  Firmware Revision                     : BA17
  Serial No                             : 3KQ10ESY000076101FS6
  Drive Type                            : SAS
Target on ID #25
  Device is a Enclosure services device
  Enclosure #                           : 2
  Slot #                                : 12
  Target ID                             : 25
  State                                 : Standby (SBY)
  Manufacturer                          : IBM
  Model Number                          : EXP3000
  Firmware Revision                     : 0142
  Serial No                             :
  Drive Type                            : SAS
Target on ID #26
  Device is a Hard disk
  Enclosure #                           : 2
  Slot #                                : 1
  Target ID                             : 26
  State                                 : Out of Sync (OSY)
  Size (in MB)/(in sectors)             : 70006/143374000
```

```
  Manufacturer                            : IBM-ESXS
  Model Number                            : BBA073C3ESTT0Z N
  Firmware Revision                       : BH0C
  Serial No                               : K405VVFK
  Drive Type                              : SAS
------------------------------------------------------------------------
Enclosure information
------------------------------------------------------------------------
Enclosure#                                : 1
  Logical ID                              : 500605b0:000704c0
  Numslots                                : 8
  StartSlot                               : 0
  Start TargetID                          : 0
  Start Bus                               : 0
Enclosure#                                : 2
  Logical ID                              : 100000a0:b81d2a12
  Numslots                                : 13
  StartSlot                               : 0
  Start TargetID                          : 0
  Start Bus                               : 0
```

A logical hard disk drive has the following status values:

- `Degraded (DGD)` – The volume is Active. The user data is not fully protected due to a configuration change or hard disk drive failure.
- `Inactive, Okay (OKY)` – The volume is inactive and the hard disk drives are functioning correctly. The user data is protected if the current volume is IM or IME.
- `Inactive, Degraded (DGD)` – The volume is inactive and the user data is not fully protected due to a configuration change or hard disk drive failure; a data resync or rebuild might be in progress.
- `Okay (OKY)` – The volume is Active and the drives are functioning correctly. The user data is protected if the volume is IM or IME.
- `Rebuilding (RBLD)` – A data resynchronization or rebuild might be in progress.

A physical device has the following status values:

- `Available (AVL)` – The hard disk drive might or might not be ready, and it is not suitable for inclusion in an array or hot-spare pool (for example, it did not spin up, its block size is incorrect, or its media is removable).
- `Failed (FLD)` – The hard disk drive was part of a logical hard disk drive or was a hot-spare hard disk drive, and it has failed. It has been taken offline.
- `Hot Spare (HSP)` – The hard disk drive is a hot-swap spare that is available for replacing a failed hard disk drive in an array.
- `Online (ONL)` – The hard disk drive is operational and is part of a logical hard disk drive.
- `Ready (RDY)` – The hard disk drive is ready for use as a normal hard disk drive; or it is available to be assigned to a disk array or hot-spare pool.

- Standby (SBY) – This status is used to tag all non-hard disk drive devices.

Format command

This command is used to perform a low-level format of a hard disk drive. The drive cannot be a hot-spare hard disk drive or a member of a volume.

Attention: A low-level format erases all of the data on the hard disk drive. To prevent irreparable damage to the hard disk drive, do not interrupt the format command.

Warning messages are displayed during the formatting, unless the noprompt parameter is included on the command line. If you do not quickly respond to a series of prompts, the command is cancelled. The answers are case sensitive and must be entered in uppercase.

The format command does not return to a shell prompt until the format operation is complete. This might take a long time for a large hard disk drive.

Command line:

```
cfggen <controller #> format <SCSI ID> [noprompt]
cfggen <controller #> format bay <Target ID> [noprompt]
```

Parameters:

- <controller #> – Number of the SCSI bus ID or SAS adapter that is targeted by this command.
- bay – Indicates that the Target ID values are specified instead of SCSI ID values.
- <SCSI ID> – SCSI ID of the hard disk drive to be formatted.
- <Target ID> – Target ID of the hard disk drive to be formatted. This value can be obtained from the output of the display command.
- noprompt – This parameter suppresses the display of warnings and prompts.

Program return values:

0x00	Command completed successfully.
0x01	Bad command-line argument or operational failure.

Hotspare command

This command creates a hot-spare hard disk drive, which is added to hot-spare pool 0. The number of hard disk drives in an IM volume must be two including a hot-spare hard disk drive. The number of hard disk drives in an

IME volume must be between three and ten disks plus up to three additional hot-spare hard disk drives. Hot spares are not supported with an integrated striping volume.

The capacity of the hot-spare hard disk drive must be greater than or equal to the capacity of the smallest hard disk drive in the logical drive. You can verify this using the `display` command.

The following rules must be observed when creating hot-spare hard disk drives:

- A hot-spare hard disk drives cannot be created unless at least one IM or IME volume is already created.
- CFGGEN does not allow adding a hot-spare hard disk drives of a type (SAS or SATA) that is different from the hard disk drives types in any of the volumes.

Command line:

```
cfggen <controller #> hotspare <SCSI ID>
cfggen <controller #> hotspare bay <Target ID>
```

Parameters:

- `<controller #>` – Number of the SCSI bus or SAS adapter that is targeted by this command.
- `<SCSI ID>` – SCSI ID of the hard disk drives targeted by this command.
- `<Target ID>` – Target ID of the hard disk drive to use for the new hot-spare hard disk drive. This value can be obtained from the output of the `display` command.
- `noprompt` – Suppresses the display of warnings and prompts.

Program return values:

0x00	Command completed successfully.
0x01	Bad command-line arguments or operational failure.

Status command

This command displays the status of any volume synchronization operation that is currently in progress on the SAS adapter. If no such operation is in progress, CFGGEN displays a message indicating this before it exits. The `status` command adds the flag `Inactive` to the Volume State field, if the SAS-adapter firmware marks the volume as Inactive.

Command line:

```
cfggen <controller #> status
```

Parameter:

<controller #> – Number of the SCSI bus or SAS adapter that is targeted by this command.

Program return values:

0x00	Command completed successfully.
0x01	Bad command-line argument or operational failure.

Sample output:

The following example shows the status information that is returned when a volume resynchronization is in progress:

```
Background command progress status for controller 0...
IR Volume 1
Current operation                       : Synchronize
Volume ID                               : 6
Volume status                           : Enabled
Volume state                            : Degraded
Physical disk I/Os                      : Not quiesced
Volume size (in sectors)                : 70311936
Number of remaining sectors             : 68250624
Percentage complete                     : 2.93%
```

The following example shows the status information that is returned when no background volume operation is in progress:

```
Background command progress status for controller 0...
IR Volume 1
Current operation                   : None
Volume ID                           : 6
Volume status                       : Enabled
Volume state                        : Optimal
Physical disk I/Os                  : Not quiesced
```

The status fields in the data displayed can have the following values:

Current operation: `Synchronize` or `None`

Volume status: `Enabled` or `Disabled`

Volume state: `[Inactive] Optimal`, `Degraded`, or `Failed`

Physical disk I/Os: `Quiesced` or `Not quiesced`

Setoffline command

This command takes a physical hard disk drive in a volume offline. A physical hard disk drive that is taken offline changes its state to Failed (FLD), but the hard disk drive is still associated with the volume and, therefore, cannot be addressed by normal I/O requests. If a new hard disk drive replaces an offline

disk, the new hard disk drive is automatically brought online. Otherwise, the hard disk drive remains offline until brought online by the Setonline command.

Command line:

```
cfggen <controller #> setoffline <SCSI ID>
```

Parameters:

- <controller #> – Number of the SCSI bus or SAS adapter that is targeted by this command.
- <SCSI ID> – SCSI target ID of the drive that is targeted by this command.

Program return values:

0x00	Command completed successfully.
0x01	Bad command-line argument or operational failure.

Setonline command

This command places a physical hard disk drive in a volume online, which is required only after the physical hard disk drive is taken offline by the Setoffline command. When a physical hard disk drive is brought online, the volume is synchronized.

Command line:

```
cfggen <controller #> setonline <SCSI ID>
```

Parameters:

- <controller #> – Number of the SCSI bus or SAS adapter that is targeted by this command.
- <SCSI ID> – SCSI target ID of the hard disk drive targeted by this command.

Program return values:

0x00	Command completed successfully.
0x01	Bad command-line argument or operational failure.

Appendix B. Getting help and technical assistance

If you need help, service, or technical assistance or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you. This section contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your system, and whom to call for service, if it is necessary.

Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself:

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system is turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system. Information about diagnostic tools is in the *Hardware Maintenance Manual and Troubleshooting Guide* or *Problem Determination and Service Guide* on the IBM *Support* CD that comes with your system.

  Note: For some IntelliStation models, the *Hardware Maintenance Manual and Troubleshooting Guide* is available only from the IBM support Web site.
- Go to the IBM support Web site at http://www.ibm.com/systems/support/ to check for technical information, hints, tips, and new device drivers or to submit a request for information.

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the online help or in the documentation that is provided with your IBM product. The documentation that comes with IBM systems also describes the diagnostic tests that you can perform. Most systems, operating systems, and programs come with documentation that contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the documentation for the operating system or program.

Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, online documents, readme files, and help files. See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The

troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to http://www.ibm.com/systems/support/ and follow the instructions. Also, you can order publications through the IBM Publications Ordering System at http://www.ibm.com/shop/publications/order/.

Getting help and information from the World Wide Web

On the World Wide Web, the IBM Web site has up-to-date information about IBM systems, optional devices, services, and support. The address for IBM System x™ and xSeries® information is http://www.ibm.com/systems/x/. The address for IBM BladeCenter information is http://www.ibm.com/systems/bladecenter/. The address for IBM IntelliStation® information is http://www.ibm.com/intellistation/.

You can find service information for IBM systems and optional devices at http://www.ibm.com/systems/support/.

Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems with System x and xSeries servers, BladeCenter products, IntelliStation workstations, and appliances. For information about which products are supported by Support Line in your country or region, see http://www.ibm.com/services/sl/products/.

For more information about Support Line and other IBM services, see http://www.ibm.com/services/, or see http://www.ibm.com/planetwide/ for support telephone numbers. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

Hardware service and support

You can receive hardware service through IBM Services or through your IBM reseller, if your reseller is authorized by IBM to provide warranty service. Seehttp://www.ibm.com/planetwide/ for support telephone numbers, or in the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

Parts listing

Replaceable components are of three types:

- **Tier 1 customer replaceable unit (CRU):** Replacement of Tier 1 CRUs is your responsibility. If IBM installs a Tier 1 CRU at your request, you will be charged for the installation.
- **Tier 2 customer replaceable unit:** You may install a Tier 2 CRU yourself or request IBM to install it, at no additional charge, under the type of warranty service that is designated for your server.
- **Field replaceable unit (FRU):** FRUs must be installed only by trained service technicians. For information about the terms of the warranty, see Appendix C, "IBM Statement of Limited Warranty Z125-4753-09 08/2006," on page 61.

Table 2. Parts listing

Part number	Description	Component type
39Y9188	Expansion card	Tier 1 CRU

IBM Taiwan product service

台灣 IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路 7 號 3 樓
電話：0800-016-888

IBM Taiwan product service contact information:
IBM Taiwan Corporation
3F, No 7, Song Ren Rd.
Taipei, Taiwan
Telephone: 0800-016-888

Appendix C. IBM Statement of Limited Warranty Z125-4753-09 08/2006

Part 1 - General Terms

Part 1 - General Terms

This Statement of Limited Warranty includes Part 1 - General Terms, Part 2 - Country-unique Terms, and Part 3 - Warranty Information. The terms of Part 2 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. 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. **NOTHING IN THIS STATEMENT OF LIMITED WARRANTY AFFECTS ANY STATUTORY RIGHTS OF CONSUMERS THAT CANNOT BE WAIVED OR LIMITED BY CONTRACT.**

This Statement of Limited Warranty is available, in multiple languages, at the following IBM Internet website: http://www.ibm.com/servers/support/machine_warranties/.

What this Warranty Covers

IBM warrants that each Machine is free from defects in materials and workmanship and conforms to its Specifications. "Specifications" is information specific to a Machine in a document entitled "Official Published Specifications" which is available upon request.

During the warranty period, IBM provides repair and exchange service for the Machine under the type of warranty service IBM designates for the Machine. The warranty period for the Machine is a fixed period starting on its original Date of Installation. The date on your purchase invoice or sales receipt is the Date of Installation unless IBM or your reseller informs you otherwise. The warranty period, type of warranty, and service level that apply to your Machine are designated in Part 3.

Many features, conversions, or upgrades involve the removal of parts and their return to IBM. An IBM part that replaces a removed part will assume the warranty service status of the removed part. An IBM part that is added to a Machine without replacing a previously-installed part is subject to warranty

effective on its Date of Installation. Unless IBM specifies otherwise, the warranty period, type of warranty, and service level of such part is the same as the Machine on which it is installed.

Unless IBM specifies otherwise, these warranties apply only in the country or region in which you purchased the Machine.

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

What this Warranty Does not Cover

This warranty does not cover the following:

1. failure or damage resulting from misuse (including but not limited to use of any Machine capacity or capability, other than that authorized by IBM in writing), accident, modification, unsuitable physical or operating environment, or improper maintenance by you;
2. failure caused by a product for which IBM is not responsible;
3. any non-IBM products, including those provided with, or installed on, an IBM Machine at your request;
4. accessories, supply items and consumables (e.g. batteries and printer cartridges), and structural parts (e.g. frames and covers);
5. service of Machine alterations; and
6. service of a Machine on which you are using capacity or capability, other than that authorized by IBM in writing.

The warranty is voided by removal or alteration of identification labels on the Machine or its parts.

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

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

How to Obtain Warranty Service

If the Machine does not function as warranted during the warranty period, contact IBM or your reseller to obtain warranty service. Contact information for IBM is provided in Part 3. If you do not register the Machine with IBM, you may be required to present proof of purchase as evidence of your entitlement to warranty service.

What IBM Will Do to Correct Problems

IBM will attempt to diagnose and resolve your problem over the telephone or electronically by access to an IBM Internet website. Certain Machines contain remote support capabilities for direct problem reporting, remote problem determination and resolution with IBM. When you contact IBM for service, you must follow the problem determination and resolution procedures that IBM specifies. Following problem determination, if IBM determines on-site service is required, a service technician will be scheduled for service at your location.

You are responsible for downloading or obtaining from IBM, and installing designated Machine Code (microcode, basic input/output system code (called "BIOS"), utility programs, device drivers, and diagnostics delivered with an IBM Machine) and other software updates in a timely manner from an IBM Internet website or from other electronic media, and following the instructions that IBM provides. You may request IBM to install Machine Code changes, however, you may be charged for that service.

Some parts of IBM Machines are designated as Customer Replaceable Units ("CRUs"). If your problem can be resolved with a CRU (e.g., keyboard, memory, hard disk drive), IBM will ship the CRU to you for you to install.

If the Machine does not function as warranted during the warranty period and your problem cannot be resolved over the telephone or electronically, through your application of Machine Code or software updates, or with a CRU, IBM or its subcontractor or a reseller that has been approved by IBM to provide warranty service, will either, at its discretion, 1) repair it to make it function as warranted, or 2) replace it with one that is at least functionally equivalent. If IBM or its subcontractor or the reseller is unable to do either, you may return the Machine to your place of purchase and your money will be refunded.

IBM or its subcontractor or the reseller will also manage and install selected engineering changes that apply to the Machine.

Exchange of a Machine or Part

When the warranty service involves the exchange of a Machine or part, the item IBM or its subcontractor or the reseller replaces becomes IBM's 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.

Your Additional Responsibilities

You agree:

1. before IBM or its subcontractor or the reseller exchanges a Machine or part, to remove all features, parts, options, alterations, and attachments not under warranty service and ensure that the Machine is free of any legal obligations or restrictions that prevent its exchange;
2. to obtain authorization from the owner to have IBM or its subcontractor or the reseller service a Machine that you do not own;
3. where applicable, before service is provided:
   a. follow the service request procedures that IBM or its subcontractor or its reseller provides;
   b. backup and secure all programs, data, and funds contained in the Machine; and
   c. inform IBM or its subcontractor or the reseller of changes in the Machine's location;
4. to provide IBM or its subcontractor or the reseller with sufficient and safe access to your facilities to permit IBM to fulfill its obligations;
5. to allow IBM or its subcontractor or the reseller to install mandatory engineering changes, such as those required for safety;
6. when the type of warranty service requires that you deliver a failing Machine to IBM, you agree to ship it suitably packaged, as IBM specifies, to a location IBM designates. After the Machine has been repaired or exchanged, IBM will return the repaired Machine or provide a replacement Machine to you at its expense, unless IBM specifies otherwise. IBM is responsible for loss of, or damage to, your Machine only while it is 1) in IBM's possession or 2) in transit in those cases where IBM is responsible for the transportation charges; and
7. to securely erase from any Machine you return to IBM for any reason all programs not provided by IBM with the Machine, and data, including without limitation the following: 1) information about identified or identifiable individuals or legal entities (“Personal Data”) and 2) your confidential or proprietary information and other data. If removing or deleting Personal Data is not possible, you agree to transform such information (e.g., by making it anonymous or encrypting it) so that it no longer qualifies as Personal Data under applicable law. You also agree to remove all funds from Machines returned to IBM. IBM is not responsible for any funds, programs not provided by IBM with the Machine, or data contained in a Machine that you return to IBM. You acknowledge that, to perform its responsibilities under this Statement of Limited Warranty, IBM may ship all or part of the Machine or its software to other IBM or third party locations around the world, and you authorize IBM to do so.

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), except for any liability that cannot be waived or limited by applicable laws, 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 charges (if recurring, 12 months' charges apply) for the Machine that is subject of the claim. For purposes of this item, the term "Machine" includes Machine Code and Licensed Internal Code ("LIC").

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

UNDER NO CIRCUMSTANCES IS IBM OR ITS SUPPLIERS, SUBCONTRACTORS, OR RESELLERS LIABLE FOR ANY OF THE FOLLOWING EVEN IF INFORMED OF THEIR POSSIBILITY: 1) THIRD PARTY CLAIMS AGAINST YOU FOR DAMAGES (OTHER THAN THOSE UNDER THE FIRST ITEM LISTED ABOVE); 2) LOSS OF, OR DAMAGE TO, DATA; 3) SPECIAL, INCIDENTAL, OR INDIRECT DAMAGES OR FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES; OR 4) LOST PROFITS, BUSINESS REVENUE, GOODWILL OR ANTICIPATED SAVINGS. SOME STATES OR JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

Governing Law

Both you and IBM consent to the application of the laws of the country in which you acquired the Machine to govern, interpret, and enforce all of your and IBM's rights, duties, and obligations arising from, or relating in any manner to, the subject matter of this Statement of Limited Warranty, without regard to conflict of law principles.

THESE WARRANTIES GIVE YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE OR JURISDICTION TO JURISDICTION.

Jurisdiction

All of our rights, duties, and obligations are subject to the courts of the country in which you acquired the Machine.

Part 2 - Country-unique Terms

AMERICAS

Jurisdiction: *The following sentence is added to this section as it applies to countries in bold print below:*

Any litigation arising from this Statement of Limited Warranty will be settled exclusively by 1) in **Argentina**; the Ordinary Commercial Court of the city of Buenos Aires; 2) in **Bolivia**; the courts of the city of La Paz; 3) in **Brazil**; court of Rio de Janeiro, RJ; 4) in **Chile**; the Civil Courts of Justice of Santiago; 5) in **Colombia**; the Judges of the Republic of Colombia; 6) in **Equador**; the civil judges of Quito for executory or summary proceedings (as applicable); 7) in **Mexico**; the courts located in Mexico City, Federal District; 8) in **Paraguay**; the courts of the city of Asuncion; 9) in **Peru**; the judges and tribunals of the judicial district of Lima, Cercado; 10) in **Uruguay**; the courts of the city of Montevideo; 11) in **Venezuela**; the courts of the metropolitan area of the city of Caracas.

BRAZIL

Exchange of a Machine or Part: *Delete the last sentence:*

The replacement assumes the warranty service status of the replaced item.

CANADA

What this Warranty Covers: *The following replaces the 2nd paragraph to this section:*

During the warranty period, IBM provides repair and exchange service for the Machine under the type of warranty service IBM designates for the Machine. The warranty period for the Machine is a fixed period starting on its original Date of Installation. The date on your purchase invoice or sales receipt is the Date of Installation unless IBM informs you otherwise. The warranty period, type of warranty, and service level that apply to your Machine are designated in Part 3.

Limitation of Liability: *The following replaces item 1 and item 2 of this section:*

1. damages for bodily injury (including death) or physical harm to real property and tangible personal property caused by IBM's negligence; and

2. the amount of any other actual direct damages, up to the greater of $100,000.00 or the charges (if recurring, 12 months' charges apply) for the Machine that is subject of the claim. For purposes of this item, the term "Machine" includes Machine Code and Licensed Internal Code ("LIC").

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*

laws in the Province of Ontario.

PERU

Limitation of Liability: *The following is added at the end of this section:*

In accordance with Article 1328 of the Peruvian Civil Code the limitations and exclusions specified in this section will not apply to damages caused by IBM's willful misconduct ("dolo") or gross negligence ("culpa inexcusable").

UNITED STATES

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*

laws of the State of New York

ASIA PACIFIC

AUSTRALIA

What this Warranty Covers: *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 similar legislation and are only limited to the extent permitted by the applicable legislation.

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 or other similar legislation, 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.

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*

laws of the State or Territory

CAMBODIA AND LAOS

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*

laws of the State of New York, United States of America

CAMBODIA, INDONESIA, AND LAOS

Arbitration: *The following is added under this heading:*

Disputes arising out of or in connection with this Statement of Limited Warranty shall be finally settled by arbitration which shall be held in Singapore in accordance with the Arbitration Rules of Singapore International Arbitration Center ("SIAC Rules") then in effect. The arbitration award shall be final and binding for the parties without appeal and shall be in writing and set forth the findings of fact and the conclusions of law.

The number of arbitrators shall be three, with each side to the dispute being entitled to appoint one arbitrator. The two arbitrators appointed by the parties shall appoint a third arbitrator who shall act as chairman of the proceedings. Vacancies in the post of chairman shall be filled by the president of the SIAC. Other vacancies shall be filled by the respective nominating party. Proceedings shall continue from the stage they were at when the vacancy occurred.

If one of the parties refuses or otherwise fails to appoint an arbitrator within 30 days of the date the other party appoints its, the first appointed arbitrator shall be the sole arbitrator, provided that the arbitrator was validly and properly appointed.

All proceedings shall be conducted, including all documents presented in such proceedings, in the English language. The English language version of this Statement of Limited Warranty prevails over any other language version.

HONG KONG S.A.R.

As applies to transactions initiated and performed in Hong Kong S.A.R., phrases throughout this Agreement containing the word "country" (for example, "country of purchase" and "country of Installation") are replaced with "Hong Kong S.A.R."

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; and
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 Limited Warranty, the charge paid by you for the individual Machine that is the subject of the claim. For purposes of this item, the term "Machine" includes Machine Code and Licensed Internal Code ("LIC").

Arbitration: *The following is added under this heading:*

Disputes arising out of or in connection with this Statement of Limited Warranty shall be finally settled by arbitration which shall be held in Bangalore, India in accordance with the laws of India then in effect. The arbitration award shall be final and binding for the parties without appeal and shall be in writing and set forth the findings of fact and the conclusions of law.

The number of arbitrators shall be three, with each side to the dispute being entitled to appoint one arbitrator. The two arbitrators appointed by the parties shall appoint a third arbitrator who shall act as chairman of the proceedings. Vacancies in the post of chairman shall be filled by the president of the Bar Council of India. Other vacancies shall be filled by the respective nominating party. Proceedings shall continue from the stage they were at when the vacancy occurred.

If one of the parties refuses or otherwise fails to appoint an arbitrator within 30 days of the date the other party appoints its, the first appointed arbitrator shall be the sole arbitrator, provided that the arbitrator was validly and properly appointed.

All proceedings shall be conducted, including all documents presented in such proceedings, in the English language. The English language version of this Statement of Limited Warranty prevails over any other language version.

JAPAN

Governing Law: *The following sentence is added to this section:*

Any doubts concerning this Statement of Limited Warranty will be initially resolved between us in good faith and in accordance with the principle of mutual trust.

MACAU S.A.R.

As applies to transactions initiated and performed in Macau S.A.R., phrases throughout this Agreement containing the word "country" (for example, "country of purchase" and "country of Installation") are replaced with "Macau S.A.R."

MALAYSIA

Limitation of Liability: *The word "**SPECIAL**" in item 3 of the fifth paragraph is deleted.*

NEW ZEALAND

What this Warranty Covers: *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.

PEOPLE'S REPUBLIC OF CHINA (PRC)

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*

laws of the State of New York, United States of America (except when local law requires otherwise).

PHILIPPINES

Limitation of Liability: *Item 3 in the fifth paragraph is replaced by the following:*

SPECIAL (INCLUDING NOMINAL AND EXEMPLARY DAMAGES), MORAL, INCIDENTAL, OR INDIRECT DAMAGES FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES; OR

Arbitration: *The following is added under this heading:*

Disputes arising out of or in connection with this Statement of Limited Warranty shall be finally settled by arbitration which shall be held in Metro Manila, Philippines in accordance with the laws of the Philippines then in effect. The arbitration award shall be final and binding for the parties without appeal and shall be in writing and set forth the findings of fact and the conclusions of law.

The number of arbitrators shall be three, with each side to the dispute being entitled to appoint one arbitrator. The two arbitrators appointed by the parties shall appoint a third arbitrator who shall act as chairman of the proceedings. Vacancies in the post of chairman shall be filled by the president of the Philippine Dispute Resolution Center, Inc. Other vacancies shall be filled by the respective nominating party. Proceedings shall continue from the stage they were at when the vacancy occurred.

If one of the parties refuses or otherwise fails to appoint an arbitrator within 30 days of the date the other party appoints its, the first appointed arbitrator shall be the sole arbitrator, provided that the arbitrator was validly and properly appointed.

All proceedings shall be conducted, including all documents presented in such proceedings, in the English language. The English language version of this Statement of Limited Warranty prevails over any other language version.

SINGAPORE

Limitation of Liability: *The words "**SPECIAL**" and "**ECONOMIC**" in item 3 in the fifth paragraph are deleted.*

EUROPE, MIDDLE EAST, AFRICA (EMEA)

THE FOLLOWING TERMS APPLY TO ALL EMEA COUNTRIES:

The terms of this Statement of Limited Warranty apply to Machines purchased from IBM or an IBM reseller.

How to Obtain Warranty Service:

*Add the following paragraph in **Western Europe** (Andorra, Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, Norway, Poland, Portugal, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Vatican State, and any country subsequently added to the European Union, as from the date of accession):*

The warranty for Machines acquired in Western Europe shall be valid and applicable in all Western Europe countries provided the Machines have been announced and made available in such countries.

If you purchase a Machine in one of the Western European countries, as defined above, 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, provided the Machine has been announced and made available by IBM in the country in which you wish to obtain service.

If you purchase a Machine in a Middle East or African country, you may obtain warranty service for that Machine from the IBM entity within the country of purchase, if that IBM entity provides warranty service in that country, or from an IBM reseller, approved by IBM to perform warranty service on that Machine in that country. Warranty service in Africa is available within 50 kilometers of an IBM approved service provider. You are responsible for transportation costs for Machines located outside 50 kilometers of an IBM approved service provider.

Governing Law: *The phrase "the laws of the country in which you acquired the Machine" is replaced by:*

1) "the laws of Austria" **in Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, FYR Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan;** 2) "the laws of France" **in Algeria, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo Republic, Djibouti, Democratic Republic of Congo, Equatorial Guinea, French Guiana, French Polynesia, Gabon, Gambia, Guinea, Guinea-Bissau, Ivory Coast, Lebanon, Libya, Madagascar, Mali, Mauritania, Mauritius, Mayotte, Morocco, New Caledonia, Niger, Reunion, Senegal, Seychelles, Togo, Tunisia, Vanuatu, and Wallis & Futuna;** 3) "the laws of Finland" **in Estonia, Latvia, and Lithuania;** 4) "the laws of England" **in Angola, Bahrain, Botswana, Burundi, Egypt, Eritrea, Ethiopia, Ghana, Jordan, Kenya, Kuwait, Liberia, Malawi, Malta, Mozambique, Nigeria, Oman, Pakistan, Qatar, Rwanda, Sao Tome, Saudi Arabia, Sierra Leone, Somalia, Tanzania, Uganda, United Arab Emirates, the United Kingdom, West Bank/Gaza, Yemen, Zambia, and Zimbabwe;** and 5) "the laws of South Africa" **in South Africa, Namibia, Lesotho and Swaziland.**

Jurisdiction: *The following exceptions are added to this section:*

1) **In Austria** the choice of jurisdiction for all disputes arising out of this Statement of Limited Warranty and relating thereto, including its existence, will be the competent court of law in Vienna, Austria (Inner-City); 2) **in**

Angola, Bahrain, Botswana, Burundi, Egypt, Eritrea, Ethiopia, Ghana, Jordan, Kenya, Kuwait, Liberia, Malawi, Malta, Mozambique, Nigeria, Oman, Pakistan, Qatar, Rwanda, Sao Tome, Saudi Arabia, Sierra Leone, Somalia, Tanzania, Uganda, United Arab Emirates, United Kingdom, West Bank/Gaza, Yemen, Zambia, and Zimbabwe all disputes arising out of this Statement of Limited Warranty or related to its execution, including summary proceedings, will be submitted to the exclusive jurisdiction of the English courts; 3) **in Belgium and Luxembourg**, all disputes arising out of this Statement of Limited Warranty or related to its interpretation or its execution, the law, and the courts of the capital city, of the country of your registered office and/or commercial site location only are competent; 4) **in France, Algeria, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo Republic, Djibouti, Democratic Republic of Congo, Equatorial Guinea, French Guiana, French Polynesia, Gabon, Gambia, Guinea, Guinea-Bissau, Ivory Coast, Lebanon, Libya, Madagascar, Mali, Mauritania, Mauritius, Mayotte, Morocco, New Caledonia, Niger, Reunion, Senegal, Seychelles, Togo, Tunisia, Vanuatu, and Wallis & Futuna** all disputes arising out of this Statement of Limited Warranty or related to its violation or execution, including summary proceedings, will be settled exclusively by the Commercial Court of Paris; 5) **in South Africa, Namibia, Lesotho and Swaziland**, both of us agree to submit all disputes relating to this Statement of Limited Warranty to the jurisdiction of the High Court in Johannesburg; 6) **in Turkey** all disputes arising out of or in connection with this Statement of Limited Warranty shall be resolved by the Istanbul Central (Sultanahmet) Courts and Execution Directorates of Istanbul, the Republic of Turkey; 8) in each of the following specified countries, any legal claim arising out of this Statement of Limited Warranty will be brought before, and settled exclusively by, the competent court of a) Athens for **Greece**, b) Tel Aviv-Jaffa for **Israel**, c) Milan for **Italy**, d) Lisbon for **Portugal**, and e) Madrid for **Spain**; and 8) **in the United Kingdom**, both of us agree to submit all disputes relating to this Statement of Limited Warranty to the jurisdiction of the English courts.

Arbitration: *The following is added under this heading:*

In Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Libya, FYR Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan all disputes arising out of this Statement of Limited Warranty or related to its violation, termination or nullity will be finally settled under the Rules of Arbitration and Conciliation of the International Arbitral Center of the Federal Economic Chamber in Vienna (Vienna Rules) by three arbitrators appointed in accordance with these rules. The arbitration will be held in Vienna, Austria, and the official language of the proceedings will be English. The decision of the arbitrators will be final and binding upon both parties. Therefore, pursuant to paragraph 598 (2) of the Austrian Code of Civil Procedure, the parties expressly waive the application

of paragraph 595 (1) figure 7 of the Code. IBM may, however, institute proceedings in a competent court in the country of installation.

In Estonia, Latvia and Lithuania all disputes arising in connection with this Statement of Limited Warranty will be finally settled in arbitration that will be held in Helsinki, Finland in accordance with the arbitration laws of Finland then in effect. Each party will appoint one arbitrator. The arbitrators will then jointly appoint the chairman. If arbitrators cannot agree on the chairman, then the Central Chamber of Commerce in Helsinki will appoint the chairman.

EUROPEAN UNION (EU)

THE FOLLOWING TERMS APPLY TO ALL EU COUNTRIES:

The warranty for Machines acquired in EU countries is valid and applicable in all EU countries provided the Machines have been announced and made available in such countries.

DENMARK, FINLAND, GREECE, ITALY, NETHERLANDS, NORWAY, PORTUGAL, SPAIN, SWEDEN AND SWITZERLAND

Limitation of Liability: *The following replaces the terms of this section in its entirety:*

Except as otherwise provided by mandatory law:

1. IBM's liability for any damages and losses that may arise as a consequence of the fulfillment of its obligations under or in connection with this Statement of Limited Warranty or due to any other cause related to this Statement of Limited Warranty is limited to the compensation of only those damages and losses proved and actually arising as an immediate and direct consequence of the non-fulfillment of such obligations (if IBM is at fault) or of such cause, for a maximum amount equal to the charges you paid for the Machine. For purposes of this item, the term "Machine" includes Machine Code and Licensed Internal Code ("LIC").

   The above limitation shall not apply to damages for bodily injuries (including death) and damages to real property and tangible personal property for which IBM is legally liable.
2. **UNDER NO CIRCUMSTANCES IS IBM, OR ITS SUPPLIERS, SUBCONTRACTORS, OR RESELLERS LIABLE FOR ANY OF THE FOLLOWING, EVEN IF INFORMED OF THEIR POSSIBILITY: 1) LOSS OF, OR DAMAGE TO, DATA; 2) INCIDENTAL OR INDIRECT DAMAGES, OR FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES; 3) LOST PROFITS, EVEN IF THEY ARISE AS AN IMMEDIATE CONSEQUENCE OF THE EVENT THAT GENERATED THE DAMAGES; OR 4) LOSS OF BUSINESS, REVENUE, GOODWILL, OR ANTICIPATED SAVINGS.**

FRANCE AND BELGIUM

Limitation of Liability: *The following replaces the terms of this section in its entirety:*

Except as otherwise provided by mandatory law:

1. IBM's liability for any damages and losses that may arise as a consequence of the fulfillment of its obligations under or in connection with this Statement of Limited Warranty is limited to the compensation of only those damages and losses proved and actually arising as an immediate and direct consequence of the non-fulfillment of such obligations (if IBM is at fault), for a maximum amount equal to the charges you paid for the Machine that has caused the damages. For purposes of this item, the term "Machine" includes Machine Code and Licensed Internal Code ("LIC").

   The above limitation shall not apply to damages for bodily injuries (including death) and damages to real property and tangible personal property for which IBM is legally liable.
2. **UNDER NO CIRCUMSTANCES IS IBM, OR ITS SUPPLIERS, SUBCONTRACTORS, OR RESELLERS LIABLE FOR ANY OF THE FOLLOWING, EVEN IF INFORMED OF THEIR POSSIBILITY: 1) LOSS OF, OR DAMAGE TO, DATA; 2) INCIDENTAL OR INDIRECT DAMAGES, OR FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES; 3) LOST PROFITS, EVEN IF THEY ARISE AS AN IMMEDIATE CONSEQUENCE OF THE EVENT THAT GENERATED THE DAMAGES; OR 4) LOSS OF BUSINESS, REVENUE, GOODWILL, OR ANTICIPATED SAVINGS.**

THE FOLLOWING TERMS APPLY TO THE COUNTRY SPECIFIED:

AUSTRIA AND GERMANY

What this Warranty Covers: *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 twelve months. In case IBM or your reseller is unable to repair an IBM Machine, you can alternatively ask for a price reduction 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.

The second paragraph does not apply.

What IBM Will Do to Correct Problems: *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.

Limitation of Liability: *The following paragraph is added to this section:*

The limitations and exclusions specified in the Statement of Limited Warranty will not apply to damages caused by IBM with fraud or gross negligence and for express warranty.

The following sentence is added to the end of item 2:

IBM's liability under this item is limited to the violation of essential contractual terms in cases of ordinary negligence.

IRELAND

What this Warranty Covers: *The following is added to this section:*

Except as expressly provided in these terms and conditions or Section 12 of the Sale of Goods Act 1893 as amended by the Sale of Goods and Supply of Services Act, 1980 ("the 1980 Act"), all conditions or warranties (express or implied, statutory or otherwise) are hereby excluded including, without limitation, any warranties implied by the Sale of Goods Act 1893 as amended by the 1980 Act (including, for the avoidance of doubt, section 39 of the 1980 Act).

Limitation of Liability: *The following replaces the terms of this section in its entirety:*

For the purposes of this section, a "Default" means any act, statement, omission, or negligence on the part of IBM in connection with, or in relation to, the subject matter of this Statement of Limited Warranty in respect of which IBM is legally liable to you, whether in contract or tort. A number of Defaults which together result in, or contribute to, substantially the same loss or damage will be treated as one Default occurring on the date of occurrence of the last such Default.

Circumstances may arise where, because of a Default, you are entitled to recover damages from IBM.

This section sets out the extent of IBM's liability and your sole remedy.

1. IBM will accept unlimited liability for death or personal injury caused by the negligence of IBM.

2. Subject always to the **Items for Which IBM is Not Liable** below, IBM will accept unlimited liability for physical damage to your tangible property resulting from the negligence of IBM.
3. Except as provided in items 1 and 2 above, IBM's entire liability for actual damages for any one Default will not in any event exceed the greater of 1) EUR 125,000, or 2) 125% of the amount you paid for the Machine directly relating to the Default.

Items for Which IBM is Not Liable

Save with respect to any liability referred to in item 1 above, under no circumstances is IBM, its suppliers or resellers liable for any of the following, even if IBM or they were informed of the possibility of such losses:
1. loss of, or damage to, data;
2. special, indirect, or consequential loss; or
3. loss of profits, business, revenue, goodwill, or anticipated savings.

SOUTH AFRICA, NAMIBIA, BOTSWANA, LESOTHO AND SWAZILAND

Limitation of Liability: *The following is added to this section:*

IBM's entire liability to you for actual damages arising in all situations involving nonperformance by IBM in respect of the subject matter of this Statement of Warranty will be limited to the charge paid by you for the individual Machine that is the subject of your claim from IBM.

SWITZERLAND

Your Additional Responsibilities: *The following sentence is added to this section:*

Personal Data also includes information about you as a legal entity.

TURKEY

What this Warranty Covers: *The following is added to this section:*

The minimum warranty period for Machines is 2 years.

UNITED KINGDOM

Limitation of Liability: *The following replaces the terms of this section in its entirety:*

For the purposes of this section, a "Default" means any act, statement, omission, or negligence on the part of IBM in connection with, or in relation to, the subject matter of this Statement of Limited Warranty in respect of which

IBM is legally liable to you, whether in contract or tort. A number of Defaults which together result in, or contribute to, substantially the same loss or damage will be treated as one Default.

Circumstances may arise where, because of a Default, you are entitled to recover damages from IBM.

This section sets out the extent of IBM's liability and your sole remedy.

1. IBM will accept unlimited liability for:
   a. death or personal injury caused by the negligence of IBM; and
   b. any breach of its obligations implied by Section 12 of the Sale of Goods Act 1979 or Section 2 of the Supply of Goods and Services Act 1982, or any statutory modification or re-enactment of either such Section.
2. IBM will accept unlimited liability, subject always to the **Items for Which IBM is Not Liable** below, for physical damage to your tangible property resulting from the negligence of IBM.
3. IBM's entire liability for actual damages for any one Default will not in any event, except as provided in items 1 and 2 above, exceed the greater of 1) Pounds Sterling 75,000, or 2) 125% of the total purchase price payable or the charges for the Machine directly relating to the Default.

These limits also apply to IBM's suppliers and resellers. They state the maximum for which IBM and such suppliers and resellers are collectively responsible.

Items for Which IBM is Not Liable

Save with respect to any liability referred to in item 1 above, under no circumstances is IBM or any of its suppliers or resellers liable for any of the following, even if IBM or they were informed of the possibility of such losses:

1. loss of, or damage to, data;
2. special, indirect, or consequential loss;
3. loss of profits, business, revenue, goodwill, or anticipated savings; or
4. third party claims against you for damages.

Part 3 - Warranty Information

SAS Expansion Card

Country or Region of Purchase	Warranty Period	Type of Warranty Service*	Service Level*
Worldwide	1 year	1	1
* See "Types of Warranty Service" and "Service Levels" for explanations of warranty-service types and service levels.			

Scheduling of a warranty service will depend upon the following: 1) the time your request for service is received, 2) Machine technology, and 3) availability of parts. Contact your local IBM representative or the subcontractor or reseller performing services on behalf of IBM for country and location specific information.

Types of Warranty Service

1. **Customer Replaceable Unit ("CRU") Service**

   IBM provides replacement CRUs to you for you to install. CRU information and replacement instructions are shipped with your Machine and are available from IBM at any time on your request. CRUs are designated as being either Tier 1 or a Tier 2 CRU. Installation of Tier 1 CRUs is your responsibility. If IBM installs a Tier 1 CRU at your request, you will be charged for the installation. You may install a Tier 2 CRU yourself or request IBM to install it, at no additional charge, under the type of warranty service designated for your Machine. IBM specifies in the materials shipped with a replacement CRU whether a defective CRU must be returned to IBM. When return is required, 1) return instructions and a container are shipped with the replacement CRU, and 2) you may be charged for the replacement CRU if IBM does not receive the defective CRU within 15 days of your receipt of the replacement.

2. **On-site Service**

   IBM or your reseller will either repair or exchange the failing Machine at your location and verify its operation. You must provide suitable working area to allow disassembly and reassembly of the IBM Machine. The area must be clean, well lit and suitable for the purpose. For some Machines, certain repairs may require sending the Machine to an IBM service center.

3. **Courier or Depot Service**

   You will disconnect the failing Machine for collection arranged by IBM. IBM will provide you with a shipping container for you to return your Machine to a designated service center. A courier will pick up your Machine and deliver it to the designated service center. Following its repair or exchange, IBM will arrange the return delivery of the Machine to your location. You are responsible for its installation and verification.

4. **Customer Carry-In or Mail-In Service**

   You will deliver or mail as IBM specifies (prepaid unless IBM specifies otherwise) the failing Machine suitably packaged to a location IBM designates. After IBM has repaired or exchanged the Machine, IBM will make it available for your collection or, for Mail-in Service, IBM will return it to you at IBM's expense, unless IBM specifies otherwise. You are responsible for the subsequent installation of the Machine and verification of its operation.

5. **CRU and On-site Service***

This type of Warranty Service is a combination of Type 1 and Type 2 (see above).

6. **CRU and Courier or Depot Service***

   This type of Warranty Service is a combination of Type 1 and Type 3 (see above).

7. **CRU and Customer Carry-In or Mail-In Service***

   This type of Warranty Service is a combination of Type 1 and Type 4 (see above).

8. **Machine Exchange Service**

   IBM will initiate shipment of a replacement Machine to your location. You are responsible for its installation and verification of its operation. You must pack the failing Machine into the shipping container that contained the replacement Machine and return the failing Machine to IBM. Transportation charges, both ways, are paid by IBM. You may be charged for the replacement Machine if IBM does not receive the failing Machine within 15 days of your receipt of the replacement Machine.

(*) When a 5, 6, or 7 type of warranty service is listed, IBM will determine which type of warranty service is appropriate for the repair.

Service Levels

Service levels specified below are response-time objectives only and are not guarantees. The specified service level may not be available in all worldwide locations. Charges may apply outside IBM's normal service area. Certain Machines with a Same Day On-site response-time objective may require the installation and use of remote connectivity tools and equipment for direct problem reporting, remote problem determination and resolution.

1. **Next Business Day (NBD), 9X5**

   After we receive your call, following problem determination, if IBM determines on-site service is required, a service technician will be scheduled to arrive at your location on the next business day. Service will be provided from 8:00 a.m. to 5:00 p.m. in your local time zone, Monday through Friday, excluding holidays.

2. **Same Business Day (SBD), 9X5**

   After we receive your call, following problem determination, if IBM determines on-site service is required, a service technician will be scheduled to arrive at your location within four hours. Service will be provided from 8:00 a.m. to 5:00 p.m. in your local time zone, Monday through Friday, excluding local IBM holidays. If after 1:00 p.m. it is determined that on-site service is required, a service technician will be scheduled to arrive the morning of the following business day.

3. **Same Day (SD), 24X7**

After we receive your call, following problem determination, if IBM determines on-site service is required, a service technician will be scheduled to arrive at your location within four hours. This type of service will be provided 24 hours a day, every day, including holidays.

IBM Contact Information

For IBM in Canada or the United States, call 1-800-IBM-SERV (or 1-800-426-7378). For IBM in the European Union (EU), Asia Pacific, and Latin America countries, contact IBM in that country or visit the following IBM Internet website: http://www.ibm.com/servers/support/machine_warranties/.

Appendix D. Notices

This information was developed for products and services offered in the U.S.A.

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Important notes

Processor speeds indicate the internal clock speed of the microprocessor; other factors also affect application performance.

CD drive speeds list the variable read rate. Actual speeds vary and are often less than the maximum possible.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for approximately 1000 bytes, MB stands for approximately 1 000 000 bytes, and GB stands for approximately 1 000 000 000 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1 000 000 bytes, and GB stands for 1 000 000 000 bytes. Total user-accessible capacity may vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives available from IBM.

Maximum memory may require replacement of the standard memory with an optional memory module.

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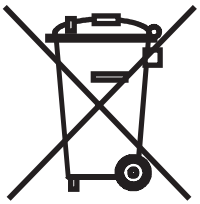
IBM makes no representations or warranties with respect to non-IBM products. Support (if any) for the non-IBM products is provided by the third party, not IBM.

Some software may differ from its retail version (if available), and may not include user manuals or all program functionality.

Product recycling and disposal

This unit must be recycled or discarded according to applicable local and national regulations. IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of product return programs and services in several countries to assist equipment owners in recycling their IT products. Information on IBM product recycling offerings can be found on IBM's Internet site at http://www.ibm.com/ibm/environment/products/index.shtml.

Esta unidad debe reciclarse o desecharse de acuerdo con lo establecido en la normativa nacional o local aplicable. IBM recomienda a los propietarios de equipos de tecnología de la información (TI) que reciclen responsablemente sus equipos cuando éstos ya no les sean útiles. IBM dispone de una serie de programas y servicios de devolución de productos en varios países, a fin de ayudar a los propietarios de equipos a reciclar sus productos de TI. Se puede encontrar información sobre las ofertas de reciclado de productos de IBM en el sitio web de IBM http://www.ibm.com/ibm/environment/products/index.shtml.



Notice: This mark applies only to countries within the European Union (EU) and Norway.

This appliance is labeled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to various products to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.

注意: このマークは EU 諸国およびノルウェーにおいてのみ適用されます。

この機器には、EU 諸国に対する廃電気電子機器指令 2002/96/EC(WEEE) のラベルが貼られています。この指令は、EU 諸国に適用する使用済み機器の回収とリサイクルの骨子を定めています。このラベルは、使用済みになった時に指令に従って適正な処理をする必要があることを知らせるために種々の製品に貼られています。

Remarque : Cette marque s'applique uniquement aux pays de l'Union Européenne et à la Norvège.

L'etiquette du système respecte la Directive européenne 2002/96/EC en matière de Déchets des Equipements Electriques et Electroniques (DEEE), qui détermine les dispositions de retour et de recyclage applicables aux systèmes utilisés à travers l'Union européenne. Conformément à la directive, ladite étiquette précise que le produit sur lequel elle est apposée ne doit pas être jeté mais être récupéré en fin de vie.

In accordance with the European WEEE Directive, electrical and electronic equipment (EEE) is to be collected separately and to be reused, recycled, or recovered at end of life. Users of EEE with the WEEE marking per Annex IV of the WEEE Directive, as shown above, must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to customers for the return, recycling, and recovery of WEEE. Customer participation is important to minimize any potential effects of EEE on the environment and human health due to the potential presence of hazardous substances in EEE. For proper collection and treatment, contact your local IBM representative.

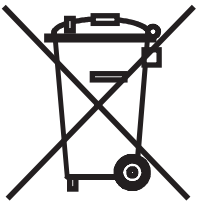
Battery return program

This product may contain a sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, go to http://www.ibm.com/ibm/environment/products/index.shtml or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used IBM sealed lead acid, nickel cadmium, nickel metal hydride, and battery packs from IBM equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Have the IBM part number listed on the battery available prior to your call.

For **Taiwan**: Please recycle batteries.

For the **European Union**:



Notice: This mark applies only to countries within the European Union (EU).

Batteries or packaging for batteries are labeled in accordance with European Directive 2006/66/EC concerning batteries and accumulators and waste batteries and accumulators. The Directive determines the framework for the return and recycling of used batteries and accumulators as applicable throughout the European Union. This label is applied to various batteries to indicate that the battery is not to be thrown away, but rather reclaimed upon end of life per this Directive.

Les batteries ou emballages pour batteries sont étiquetés conformément aux directives européennes 2006/66/EC, norme relative aux batteries et accumulateurs en usage et aux batteries et accumulateurs usés. Les directives déterminent la marche à suivre en vigueur dans l'Union Européenne pour le retour et le recyclage des batteries et accumulateurs usés. Cette étiquette est appliquée sur diverses batteries pour indiquer que la batterie ne doit pas être mise au rebut mais plutôt récupérée en fin de cycle de vie selon cette norme.

バッテリーあるいはバッテリー用のパッケージには、EU 諸国に対する廃電気電子機器指令 2006/66/EC のラベルが貼られています。この指令は、バッテリーと蓄電池、および廃棄バッテリーと蓄電池に関するものです。この指令は、使用済みバッテリーと蓄電池の回収とリサイクルの骨子を定めているもので、EU 諸国にわたって適用されます。このラベルは、使用済みになったときに指令に従って適正な処理をする必要があることを知らせるために種々のバッテリーに貼られています。

In accordance with the European Directive 2006/66/EC, batteries and accumulators are labeled to indicate that they are to be collected separately and recycled at end of life. The label on the battery may also include a chemical symbol for the metal concerned in the battery (Pb for lead, Hg for mercury, and Cd for cadmium). Users of batteries and accumulators must not dispose of batteries and accumulators as unsorted municipal waste, but use the collection framework available to customers for the return, recycling, and treatment of batteries and accumulators. Customer participation is important to minimize any potential effects of batteries and accumulators on the environment and human health due to the potential presence of hazardous substances. For proper collection and treatment, contact your local IBM representative.

For California:

Perchlorate material – special handling may apply. See http://www.dtsc.ca.gov/hazardouswaste/perchlorate/.

The foregoing notice is provided in accordance with California Code of Regulations Title 22, Division 4.5 Chapter 33. Best Management Practices for Perchlorate Materials. This product/part may include a lithium manganese dioxide battery which contains a perchlorate substance.

Electronic emission notices

Federal Communications Commission (FCC) statement

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

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

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

Industry Canada Class A emission compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Australia and New Zealand Class A statement

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

United Kingdom telecommunications safety requirement

Notice to Customers

This apparatus is approved under approval number NS/G/1234/J/100003 for indirect connection to public telecommunication systems in the United Kingdom.

European Union EMC Directive conformance statement

This product is in conformity with the protection requirements of EU Council Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to CISPR 22/European Standard EN 55022. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

European Community contact:

IBM Technical Regulations
Pascalstr. 100, Stuttgart, Germany 70569
Telephone: 0049 (0)711 785 1176
Fax: 0049 (0)711 785 1283
E-mail: tjahn@de.ibm.com

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警告使用者:
這是甲類的資訊產品，在
居住的環境中使用時，可
能會造成射頻干擾，在這
種情況下，使用者會被要
求採取某些適當的對策。

Chinese Class A warning statement

声　　明
此为 A 级产品。在生活环境中，
该产品可能会造成无线电干扰。
在这种情况下，可能需要用户对其
干扰采取切实可行的措施。

Japanese Voluntary Control Council for Interference (VCCI) statement

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Index

G

H

I

J

L

M

Part Number: 42C4877

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(1P) P/N: 42C4877