COVER Book Cover

IBM SSA RAID Adapter
for PC Servers

Installation and User's Guide

Document Number S32H-3816-00

Part Number 32H3816

COVER Book Cover

NOTICES Notices

```
+--- Note! -------------------------------------------------------+
¦                                                                 ¦
¦ Before using this information and the product it supports, be sure ¦
¦ to read the general information under "Notices" in topic D.2.   ¦
¦                                                                 ¦
+-----------------------------------------------------------------+
```

EDITION Edition Notice
First Edition (September 1996)

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FRONT_1 Safety Information

FRONT_1 Safety Information

⚠ DANGER:

Electrical current from power, telephone, and communication cables is hazardous. To avoid shock hazard, connect and disconnect cables as shown below when installing, moving or opening the covers of this product or attached devices. The power cord must be used with a properly-grounded outlet.

To Connect	To Disconnect
Turn everything OFF.	Turn everything OFF.
First, attach all cables to devices.[1]	First, remove power cord from outlet.[2]
Attach signal cables to receptacles.	Remove signal cables from receptacles.
Attach power cord to outlet.	Remove all cables from devices.
Turn device ON.	
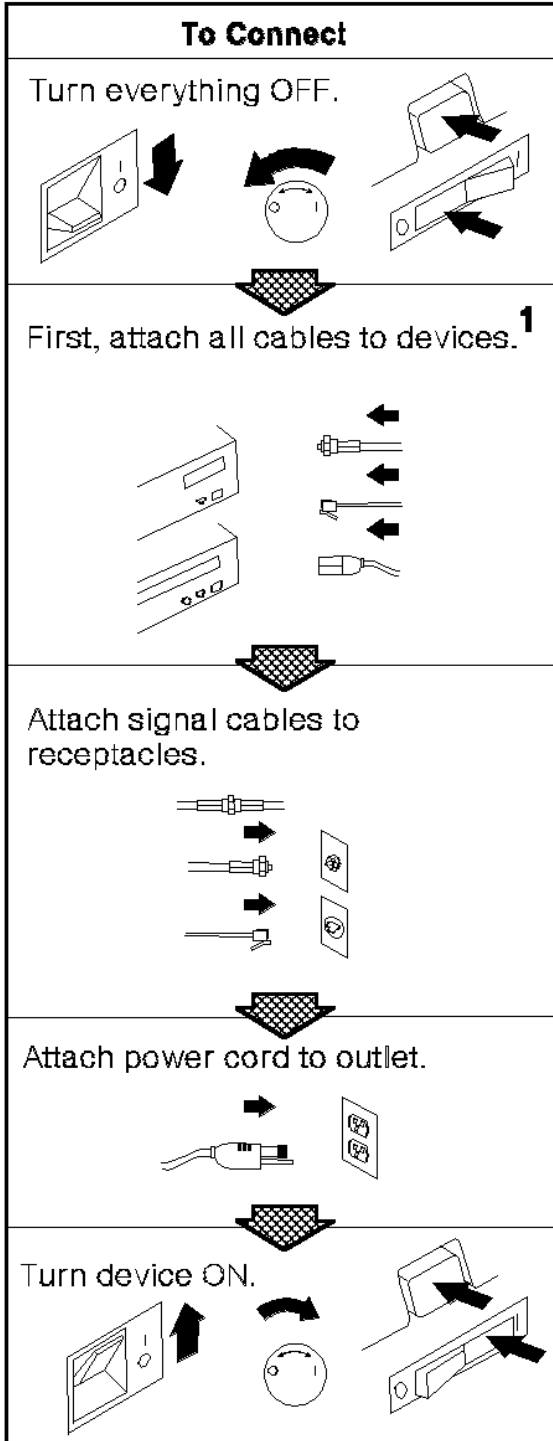
1 In the U.K., by law, the telephone cable must be connected after the
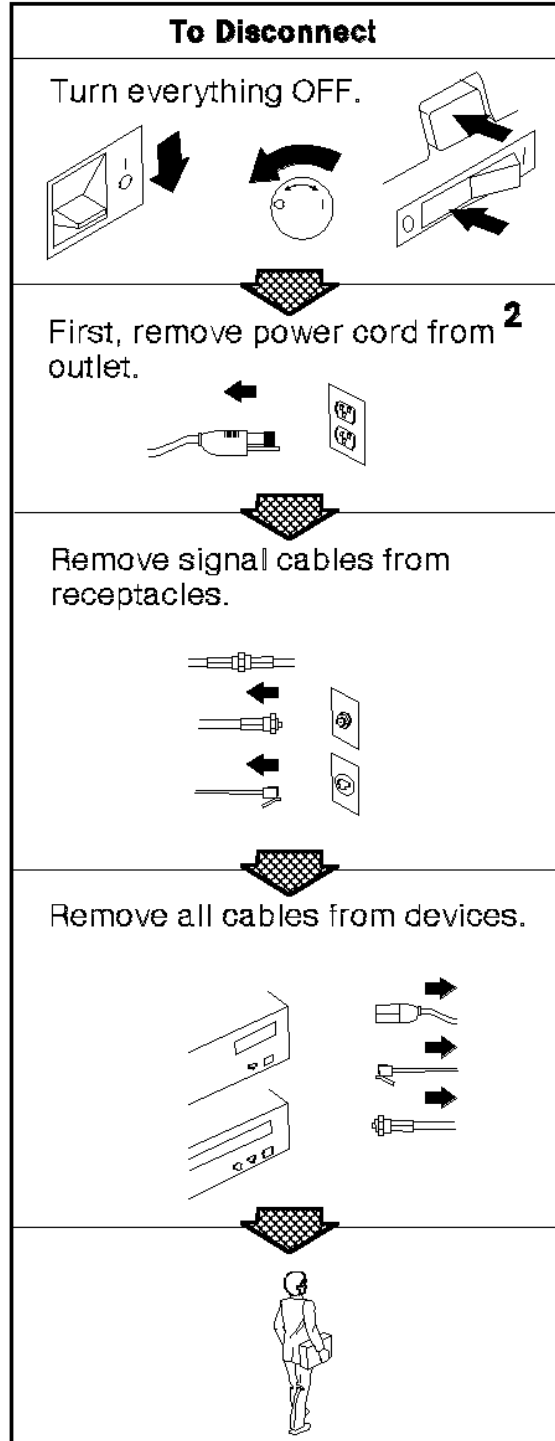
2 In the U.K., by law, the power cord must be disconnected after the

CAUTION:

A lithium battery can cause fire, explosion, or a severe burn. Do not recharge, disassemble, heat above 100°C (212°F), solder directly to the cell, incinerate, or expose cell to water. Keep away from children. Replace only with the part number specified for your system. Use of another battery might present a risk of fire or explosion.

The battery connector is polarized; do not try to reverse the polarity.

Dispose of the battery according to local regulations.

A module on the SSA RAID Adapter card contains a lithium battery.

PREFACE About This Book

This book is intended for a network administrator-that is, the individual responsible for configuring, maintaining, managing, and troubleshooting a PC server. It includes information about installing and using the SSA RAID Adapter, discusses disk-array technology, and describes tasks associated with disk arrays.

Subtopics
PREFACE.1 How This Book Is Organized.
PREFACE.2 Related Publications

PREFACE.1 How This Book Is Organized.

Chapter 1, "Introducing the SSA RAID Adapter" in topic 1.0 describes the adapter, what is provided with it, and the environments in which it works.

Chapter 2, "Installing an SSA RAID Adapter" in topic 2.0 describes how to install the adapter and its associated software.

Chapter 3, "Configuring SSA Subsystems" in topic 3.0 describes how to use the configuration utility function provided with the adapter to configure new disk arrays and add them to your system.

Chapter 4, "Dealing with Disk-Array Problems" in topic 4.0 describes what to do if you have trouble with your SSA subsystem.

Chapter 5, "Performing Other Disk-Array Tasks" in topic 5.0 describes other functions of the array utility programs supplied with the adapter.

Chapter 6, "Getting the Latest Information" in topic 6.0 describes where you can get more information about the adapter and SSA subsystems.

Appendix A, "Multiple-Adapter Installations" in topic A.0 describes the special considerations for setting up subsystems that have more than one adapter.

Appendix B, "SSA RAID Adapter Service Request Numbers" in topic B.0 provides more detail about the messages that the subsystem might give you.

Appendix C, "Introducing SSA and RAID" in topic C.0 gives background information on SSA and RAID in general.

PREFACE.2 Related Publications

Other manuals that you might find useful are:

SSA RAID Adapter: Maintenance Information, S32H-3817

SSA RAID Adapter: Technical Reference, SA33-3269

1.0 Chapter 1. Introducing the SSA RAID Adapter

The IBM SSA RAID Adapter for PC Servers is a PCI bus-master adapter that serves as the interface between systems using the Peripheral Component Interconnect (PCI) architecture and devices using the Serial Storage Architecture (SSA). The SSA RAID Adapter provides RAID functions.

Subtopics
1.1 SSA
1.2 The Adapter Card
1.3 RAID
1.4 Operating Systems
1.5 Before Installing the Adapter
1.6 Installation Requirements

1.0 Chapter 1. Introducing the SSA RAID Adapter

1.1 SSA

SSA is a high-performance serial-interconnect technology used to connect I/O devices and host adapters. SSA is an open standard, and SSA specifications have been approved by the SSA Industry Association and are in the process of being approved as an ANSI standard through the ANSI X3T10.1 subcommittee. SSA retains the SCSI-2 commands, queuing model, status, and sense bytes.

In SSA subsystems, transmissions to several destinations are multiplexed; the effective bandwidth is further increased by spatial reuse of the individual links. Commands are forwarded automatically from device to device along a loop until the target device is reached. Multiple commands can be travelling around the loop simultaneously.

1.1 SSA

1.2 The Adapter Card

The adapter provides 4 SSA ports for the attachment of storage devices such as hard disk drives. Each port operates at 20 MB/s full-duplex using point-to-point copper cables up to 25 meters long.
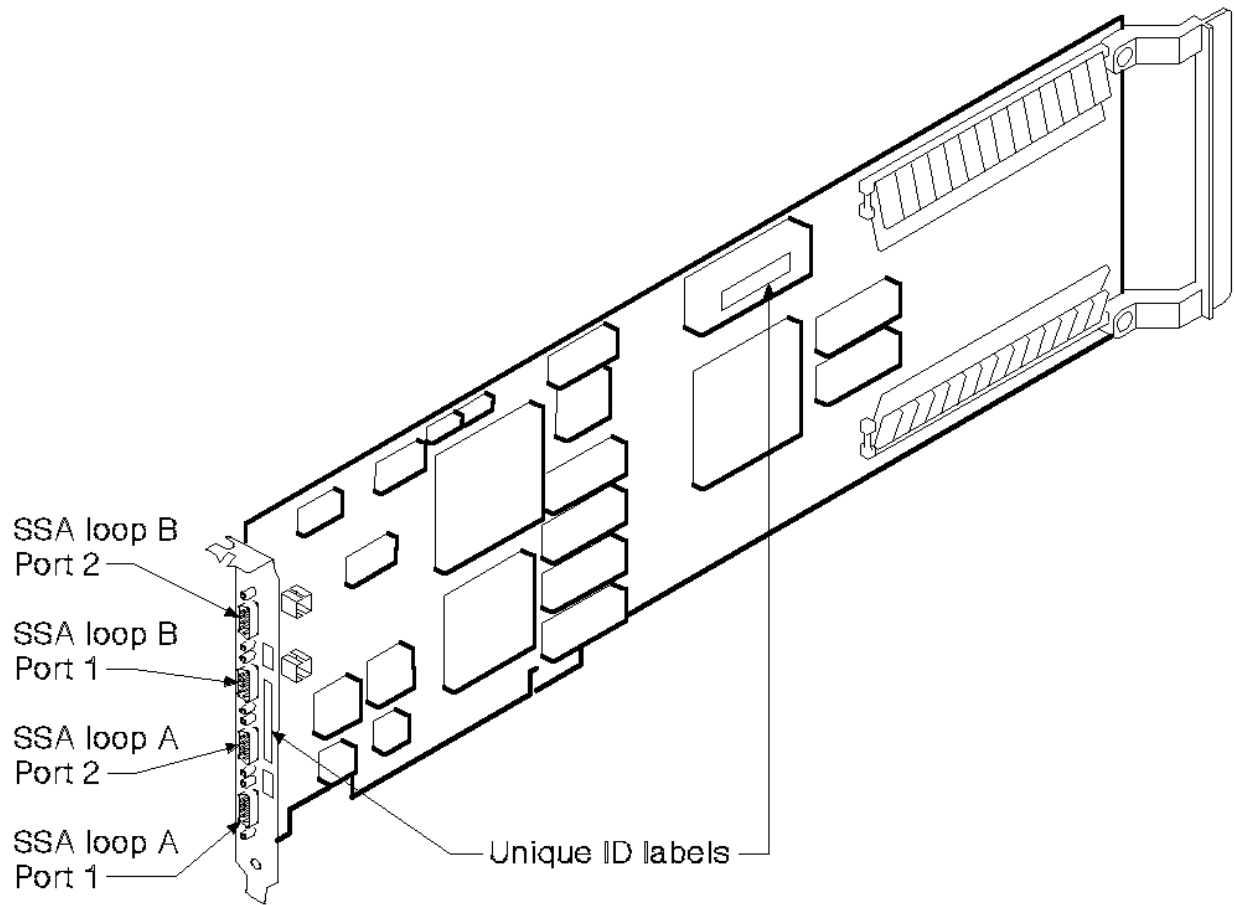
On the adapter card, there is a light next to the pair of SSA connectors (port 1 and port 2) for each SSA loop.

> The light is on continuously when power is turned on to the adapter and both ports for that loop are operational; that is, the devices connected next to the adapter in the loop have power turned on to them, are connected correctly to the adapter, and are operational.
> The light flashes continuously if one of the ports is not operational. That occurs when the cable to that port is not connected correctly or the device connected next to the adapter in the loop is not operational.
> The light is off if both ports are not operational

On the front panel of the adapter and on one of its modules are labels on which is printed the 15-character SSA unique ID of the adapter.

1.3 RAID

RAID (redundant array of independent disks) is the technology of grouping several hard disk drives into an *array* that is defined as a single logical disk drive. This grouping technique greatly increases logical-disk capacity and data availability. In addition, if one disk fails, the system continues to run (except in the case of RAID-0), with no operator intervention required, at reduced performance. The failed disk can be replaced without turning off the server (*hot swapping*).

The SSA RAID Adapter provides RAID functions within the interface between your server and its disk drives. Disk drives connected to the adapter can be configured as individual drives, as members of a RAID-0, RAID-1, or RAID-5 array, or as hot spares for future use in an array. The members of an array can be disk drives only; that is, an array cannot be a member of another array.

If you need some basic information about RAID technology, refer to Appendix C, "Introducing SSA and RAID" in topic C.0.

1.3 RAID

1.4 Operating Systems

The SSA RAID Adapter, its firmware, and the software supplied with it provide attachments of SSA devices to the following operating systems:

OS/2 2.11 SMP, OS/2 WarpServer Version

Novell NetWare 4.1, 4.1 SM

Windows NT 3.51 Serve

1.4 Operating Systems

1.5 Before Installing the Adapter

This book is intended for a network administrator-that is, the person responsible for configuring, maintaining, managing, and troubleshooting a PC server. The administrator should be familiar with RAID and hot-swapping technology.

Attention: Do not open the static-protective bag containing the adapter until instructed to do so.

This option package contains:

   SSA RAID Adapte

   Installation and User's Guide (this book

   Hardware Maintenance Manual Supplemen

   Diskette package containing

   -   OS/2 Device Driver and Utilities diskette
   -   Novell NetWare Device Driver and Utilities diskette
   -   Windows NT Device Driver and Utilities diskette
   -   PC-DOS Configurator and Utilities diskette.

Contact the place of purchase if any parts are missing or damaged.

1.5 Before Installing the Adapter

1.6 Installation Requirements

To install this option, you will need the following:

    The documentation that came with your serve

    A small flat-blade screwdriver

2.0 Chapter 2.   Installing an SSA RAID Adapter
To complete the installation, you must:

1. Install the adapter card

2. Connect the necessary SSA cables

3. Revise the system configuration information

4. Load an operating system, unless one is already loaded in the server

5. Load the device drivers and utility programs.

This chapter describes how to perform these tasks. How to configure disk arrays and attach them to your operating system is described in Chapter 3, "Configuring SSA Subsystems" in topic 3.0.

Subtopics
2.1 Installing the Adapter Card
2.2 Connecting the Disk Drives
2.3 Configuring the Disk Drives
2.4 Installing an Operating System
2.5 Installing the Device Drivers and Utility Programs
2.6 Selecting Your Boot Device

2.1 Installing the Adapter Card

Attention: Remove all power from your PC server and any attached devices before removing the cover.

To install the adapter card, refer to the documentation that came with your PC server. The *User's Handbook* for your server describes how to install an adapter. Perform the steps described in that book, ensuring that you perform the actions relating to the static-protective package correctly. When choosing a slot for the SSA RAID Adapter, take note of the following restrictions and recommendations:

The SSA RAID Adapter card is a long PCI adapter card. On some models of PC Server, there is only one slot in which a long PCI adapter card can be installed without interference with the heat sink on the processor. In these models, if might be necessary to move previously installed adapter cards before installing the SSA RAID Adapter card.

If you are installing one or two SSA RAID Adapter cards in a PC Server 720, to obtain the best performance, use the primary PCI bus (slots 6 and 7). If, because one or both of these slots is already occupied, you cannot use the primary bus for all the SSA RAID Adapter cards that you are installing, use the secondary PCI bus (slots 1 through 5) for all the SSA RAID Adapter cards.

If you want to boot from an SSA disk drive and the system has a SCSI PCI adapter, you must install the SSA adapter in a PCI slot with a higher priority than the slot used by the SCSI adapter. In some servers, slots with lower numbers have higher priority, in other servers, higher numbers mean higher priority; the *User's Handbook* for your server describes which rule applies.

2.1 Installing the Adapter Card

2.2 Connecting the Disk Drives

SSA loop B
Port 2

SSA loop B
Port 1

SSA loop A
Port 2

SSA loop A
Port 1

Unique ID labels
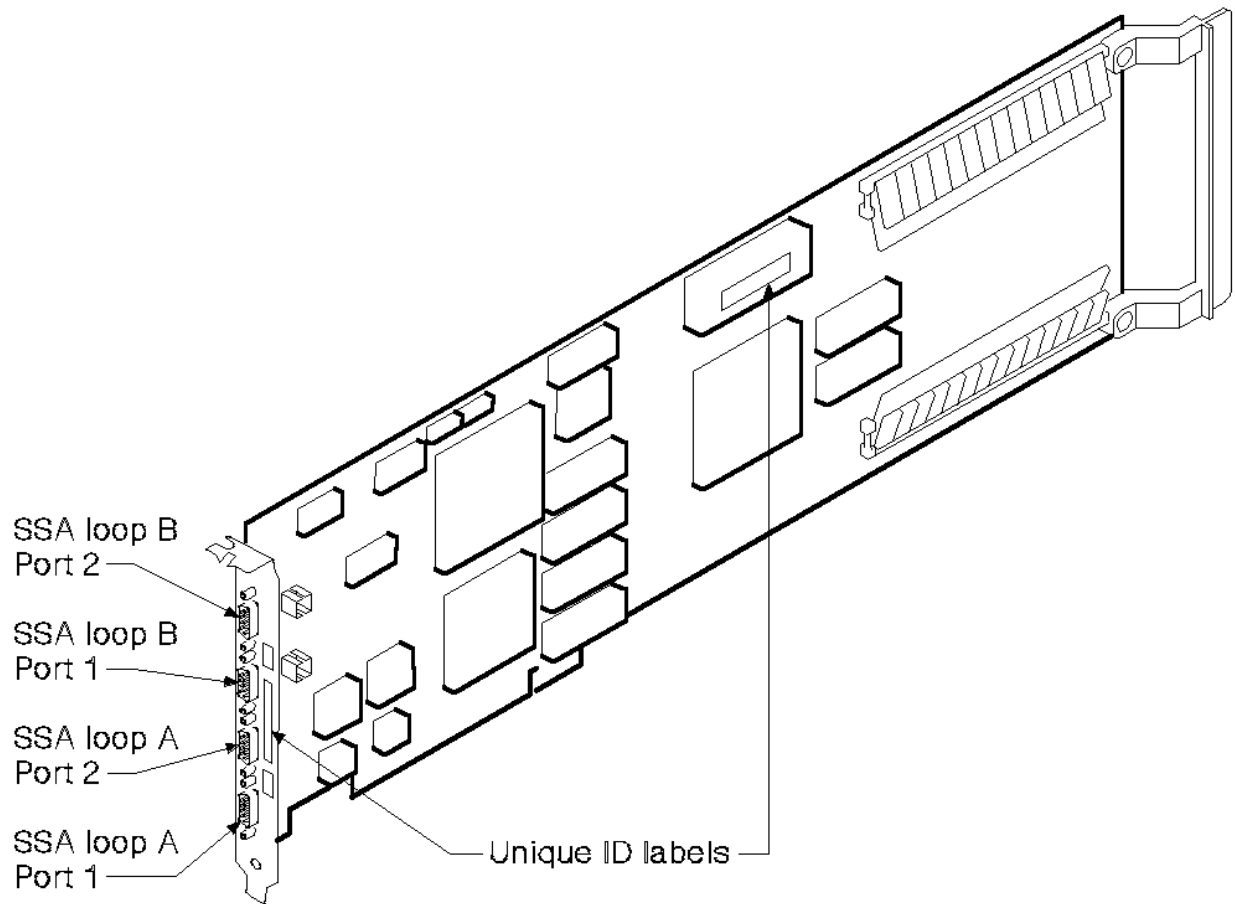
Each of the 2 pairs of SSA ports can attach up to 48 dual-port devices in a closed loop. Only one SSA adapter can be included in a loop.

"SSA Loops and Links" in topic C.1.1 provides a general description of SSA loops and some rules for cabling valid configurations.

To connect the cables:

1. Connect the cables from the devices to the appropriate pair of connectors on the adapter card.

2. Turn the retaining screws on the SSA cable connectors fully clockwise to ensure that a good ground connection is made.

2.3 Configuring the Disk Drives

Turn power on to the server unit and to the devices. Your system automatically performs the PCI configuration tasks, which recognize the new adapter and devices during the boot process.

2.3 Configuring the Disk Drives

2.4 Installing an Operating System

If an operating system is already loaded in your server, go to the next section, "Installing the Device Drivers and Utility Programs" in topic 2.5.

If you are installing an operating system on your new SSA RAID subsystem:

1. Boot DOS by:

    a. Inserting the PC-DOS Configurator and Utilities diskette provided with the adapter
    b. Turning power off and on again to the server.

    When the 'CBIOS is currently disabled' message is displayed, press the tab key; this enables the CBIOS.

2. Run the configuration utility which is provided on the PC-DOS Configurator and Utilities diskette. (The details of this procedure are given in Chapter 3, "Configuring SSA Subsystems" in topic 3.0.) This defines the way that the adapter uses the disk drives that are attached to it.

    Notes:

    a. Systems cannot access SSA disk drives until you have used the configuration utility to attach the disk drives and arrays.

    b. Installing an operating system on a single disk drive or RAID-1 array can give better performance.

3. Install the new operating system using the installation instructions provided with the operating system.

    Note: Some operating systems have restrictions on partition size.

4. Install the device drivers and utility programs; how to do this is described in "Installing the Device Drivers and Utility Programs" in topic 2.5.

5. The SSA subsystem is now ready for use with your system.

2.5 Installing the Device Drivers and Utility Programs

A README.TXT file on the SSA RAID Adapter diskette for your operating system provides detailed instructions on installing the device drivers.

Unless you have just installed an operating system, you must configure your disk arrays before you can use them with your system. Chapter 3, "Configuring SSA Subsystems" in topic 3.0 describes how to do this.

When you have configured your disk arrays, the SSA subsystem will be ready for use with your system.

The format in which the Event/Error Logger reports errors is controlled by the file EVNCTRLF.TXT in the install directory (which, by default, is c:\issa). Details of the settings and how to change them are contained in the header of the control file.

2.6 Selecting Your Boot Device

To boot from an SSA disk drive: during the boot process, if the message **CBIOS disabled** appears, press the tab key. After this action, whenever you boot your server, it will boot from the primary SSA disk drive and the message **CBIOS enabled** will appear.

To return to booting from the previous default device: if the message **CBIOS enabled** appears, press the tab key.

If you have problems booting from an SSA disk drive, refer to "Basic Problems" in topic 4.1.

2.6 Selecting Your Boot Device

3.0 Chapter 3.   Configuring SSA Subsystems

Before new SSA disk drives can be used by the operating system, you must configure them into the SSA subsystem. You use the configuration utility (which is provided on each of the diskettes supplied with the adapter) to do this. The actions that you must perform are:

1. Accept the new disk drives into the subsystem

2. Configure disk arrays, if required

3. Attach the disk arrays or individual disk drives to your system.

The following sections describe the details of these actions.

```
Subtopics
3.1 Running the Configuration Utility
3.2 Accepting New Disk Drives
3.3 Creating an Array
3.4 Attaching Resources
```

3.1 Running the Configuration Utility

To run the configuration utility, execute the following program:

    For OS/2:**ISSACFG**
    For Novell NetWare:**load ISSACFG**
    For Windows NT:**ISSACFG**
    For DOS:**ISSACFG**

or, if it is available, double click on the SSA Configurator icon.

The Main Menu screen is displayed:

```
+------------------------------------------------------------------------------------+
¦                                                                                    ¦
¦                                                                                    ¦
¦   +----------------------------------------------------------------------+         ¦
¦   ¦CONFIG    SSA Configurator and Service Aids      Vyymmdd     XX Version¦         ¦
¦   +----------------------------------------------------------------------+         ¦
¦         +---------------------------+                                              ¦
¦         ¦          Main Menu        ¦                                              ¦
¦         +---------------------------¦                                              ¦
¦         ¦                           ¦                                              ¦
¦         ¦    New Disks              ¦                                              ¦
¦         ¦    Free Resources         ¦                                              ¦
¦         ¦    System Resources       ¦                                              ¦
¦         ¦    SSA Adapter List       ¦                                              ¦
¦         ¦    Event/Error Logger     ¦                                              ¦
¦         ¦    Service Aids           ¦                                              ¦
¦         ¦    About                  ¦                                              ¦
¦         ¦                           ¦                                              ¦
¦         ¦                           ¦                                              ¦
¦         ¦                           ¦                                              ¦
¦         ¦                           ¦                                              ¦
¦         +---------------------------+                                              ¦
¦      +-------------------------------------------------------------+               ¦
¦      ¦<ESCAPE> Exit  <ENTER> Select  <F1> Help                     ¦               ¦
¦      +-------------------------------------------------------------+               ¦
¦                                                                                    ¦
¦                                                                                    ¦
¦                                                                                    ¦
+------------------------------------------------------------------------------------+
```

To choose an item from a configurator-utility menu, use the arrow keys to move the highlighting to that item and press the appropriate key, for example, press Enter to select that item,

To move to the previous menu, press Esc.

Help is available for every menu; press F1 to reach it.

3.2 Accepting New Disk Drives

To accept new disk drives into the SSA subsystem:

1. From the SSA Main Menu, select **New Disks**.

2. A window opens containing a list of all the disk drives not previously used in a PC server:

```
+--------------------------------------------------------------------------------+
|                                                                                |
|                                                                                |
|   +------------------------------------------------------------------------+   |
|   ¦CONFIG   SSA Configurator and Service Aids     Vyymmdd     XX Version¦   |
|   +------------------------------------------------------------------------+   |
|       +---------------------------+                                            |
|       |         Main Menu         |                                            |
|       +---------------------------|                                            |
|       |                           |                                            |
|       |    New D+-------------------------------------------------+           |
|       |    Free |            List of New Disks                    |           |
|       |    Syste+-------------------------------------------------|           |
|       |    SSA A|SSA UID/Array Name      Status         Adapter|           |
|       |    Event|xxxxxxxx                xxxxxxx            15  |           |
|       |    Servi|yyyyyyyy                yyyyyy             14  |           |
|       |    About+-------------------------------------------------+           |
|       |                           |                                            |
|       |                           |                                            |
|       |                           |                                            |
|       |                           |                                            |
|       |                           |                                            |
|       +---------------------------+                                            |
|     +------------------------------------------------------------------+       |
|     ¦<ESCAPE> Exit  <ENTER> Select  <DELETE> Delete  <F1> Help       ¦       |
|     ¦<F9> Flash On  <F10> Flash Off                                   ¦       |
|     +------------------------------------------------------------------+       |
|                                                                                |
|                                                                                |
+--------------------------------------------------------------------------------+
```

In this list, for each disk drive that you want to configure into your SSA subsystem, highlight its name and press Delete. At the prompt, confirm the deletion. Its name disappears from the list; it is now in the *free* state.

You can return to the Main Menu by pressing Esc.

You can display a list of all the disk drives that are in the free state by selecting **Free Resources** in the Main Menu.

You can define disk drives that are in the free state as members of an array; "Creating an Array" in topic 3.3 describes how to do this. Alternatively, disk drives can be accessed individually; for such disk drives, go directly to "Attaching Resources" in topic 3.4 for instructions on attaching them to the system.

Also, disk drives can be defined as hot spares. "Defining a Hot Spare" in topic 5.1 describes how to do this.

3.3 Creating an Array

This section describes how to create an array from the free disk drives in the SSA subsystem.

It is recommended that you define one or more hot spares (refer to "Defining a Hot Spare" in topic 5.1 for how to do this) before creating the first array on an adapter.

To create an array:

1. From the Main Menu screen, select **SSA Adapter List**.
2. The SSA Adapter List window opens:

```
+----------------------------------------------------------------------------------+
|                                                                                  |
|                                                                                  |
|   +------------------------------------------------------------------------+     |
|   |CONFIG    SSA Configurator and Service Aids     Vyymmdd     XX Version|     |
|   +------------------------------------------------------------------------+     |
|          +---------------------------+                                           |
|          |          Main Menu        |                                           |
|          +---------------------------|                                           |
|          |                           |                                           |
|          |   New Disks               |                                           |
|          |   Free Resources          |                                           |
|          |   Syst+----------------------------------------+                      |
|          |   SSA |         SSA Adapter List               |                      |
|          |   Even+----------------------------------------|                      |
|          |   Serv| Bus X  Device Y  Slot Z  Adapter   (Q) |                      |
|          |   Abou| Bus X  Device N  Slot T  Adapter   (S) |                      |
|          |       |                                        |                      |
|          |       +----------------------------------------+                      |
|          |                           |                                           |
|          |                           |                                           |
|          +---------------------------+                                           |
|     +----------------------------------------------------------------+           |
|     |<ESCAPE> Exit  <ENTER> Select  <F1> Help                        |           |
|     +----------------------------------------------------------------+           |
|                                                                                  |
|                                                                                  |
+----------------------------------------------------------------------------------+
```

Select the adapter that is to control the array. The disk drives that you define as members of the array must be connected to this adapter.

3. The Adapter Menu window opens:

```
+-----------------------------------------------------------------------------------+
|                                                                                   |
|                                                                                   |
|   +---------------------------------------------------------------------------+   |
|   |CONFIG    SSA Configurator and Service Aids     Vyymmdd     XX Version|   |
|   +---------------------------------------------------------------------------+   |
|          +---------------------------+                                            |
|          |        Main M+-----------------------------------------+             |
|          +-------------| Bus X  Device Y  Slot Z  Adapter   (Q) |             |
|          |             +-----------------------------------------|             |
|          |   New Disks  | RAID-0 Arrays                          |             |
|          |   Free Resour| RAID-1 Arrays                          |             |
|          |   Syst+------| RAID-5 Arrays                          |             |
|          |   SSA |      | Rejected Disks                         |             |
|          |   Even+------| Non-Volatile RAM                       |             |
|          |   Serv| Bus X| Hot-spare Disks                        |             |
|          |   Abou| Bus X| Run Concurrent Diagnostics             |             |
|          |       |      | Run Non-Concurrent Diagnostics         |             |
|          |       +------| View Adapter VPD                       |             |
|          |              | Disk Service Aids                      |             |
|          |              +-----------------------------------------+             |
|          +---------------------------+                                            |
|     +----------------------------------------------------------------+            |
|     |<ESCAPE> Exit  <ENTER> Select  <F1> Help                        |            |
|     +----------------------------------------------------------------+            |
|                                                                                   |
|                                                                                   |
+-----------------------------------------------------------------------------------+
```

Select the type of array to be created. You can scroll the contents of the window by using the arrow keys.

4. A list of the arrays of this type already controlled by this adapter appears in a new window (this list may be blank):

```
+--------------------------------------------------------------------------------+
|                                                                                |
|                                                                                |
|   +------------------------------------------------------------------------+   |
|   |CONFIG    SSA Configurator and Service Aids      Vyymmdd      XX Version|   |
|   +------------------------------------------------------------------------+   |
|          +---------------------------+                                         |
|          |          Main M+-----------------------------------------------+   |
|          +-------------| Bus X  Device Y  Slot Z  Adapter      (Q) |        |   |
|          |             |  +-----------------------------------------+        |   |
|          |    New Disks  | RAID-0 Arrays                           |        |   |
|          |    Free Resour| RAID-1 A+-------------------------------+|        |   |
|          |    Syst+------| RAID-5 A|    List of RAID-X Arrays      ||        |   |
|          |    SSA  |     | Rejected+-------------------------------||        |   |
|          |    Even+------| Non-Vola|Array name        Status       ||        |   |
|          |    Serv| Bus X| Hot-spar|1.  xxxxxxxx      yyyyyyy      ||        |   |
|          |    Abou| Bus X| Run Conc|                               ||        |   |
|          |        |      | Run Non-+-------------------------------+|        |   |
|          |        +------| View Adapter VPD                        |        |   |
|          |               | Disk Service Aids                       |        |   |
|          |               +-----------------------------------------+        |   |
|          +---------------------------+                                         |
|     +-------------------------------------------------------------------+      |
|     |<ESCAPE> Exit  <ENTER> Select  <INSERT> Insert  <DELETE> Delete |      |
|     |<F1> Help  <F9> FlashOn  <F10> FlashOff <F8> Modify Attributes  |      |
|     +-------------------------------------------------------------------+      |
|                                                                                |
|                                                                                |
+--------------------------------------------------------------------------------+
```

Press Insert.

5. A window opens showing the attributes for the type of array selected:

```
+--------------------------------------------------------------------------------+
|                                                                                |
|                                                                                |
|   +------------------------------------------------------------------------+   |
|   |CONFIG    SSA Configurator and Service Aids      Vyymmdd      XX Version|   |
|   +------------------------------------------------------------------------+   |
|          +---------------------------+                                         |
|          |          Main M+-----------------------------------------------+   |
|          +-------------| Bus X  Device Y  Slot Z  Adapter      (Q) |        |   |
|          |             |  +-----------------------------------------+        |   |
|          |    New Disks  | RAI+-------------------------------------+        |   |
|          |    Free Resour| RAI| Filter Attributes for RAID-X Arrays |        |   |
|          |    Syst+------| RAI+-------------------------------------|        |   |
|          |    SSA  |     | Rej| SSA UID/Array Name  : xxxxxxxx       |        |   |
|          |    Even+------| Non| attribute1          : xx            |        |   |
|          |    Serv| Bus X| Hot| attribute2          : yy            |        |   |
|          |    Abou| Bus X| Run|                                     |        |   |
|          |        |      | Run|                                     |        |   |
|          |        +------| Vie|                                     |        |   |
|          |               | Dis+-------------------------------------+        |   |
|          |               +-----------------------------------------+        |   |
|          +---------------------------+                                         |
|     +-------------------------------------------------------------------+      |
|     |<ESCAPE> Exit  <ENTER> Select  <F1> Help                        |      |
|     +-------------------------------------------------------------------+      |
|                                                                                |
|                                                                                |
|                                                                                |
+--------------------------------------------------------------------------------+
```

You must type in a unique array name (of up to 14 characters) for the new array. The default values for the attributes are shown. You can change these values by overtyping them. (The Help screen provides details of the values that are allowed.) Use the arrow keys to scroll the contents of the window, if necessary, to ensure that you check all the attributes. Press Enter to set each attribute in turn.

6. When you set the last attribute, the list (initially blank) of members of the array appears in a new window:

```
+--------------------------------------------------------------------------------+
|                                                                                |
|                                                                                |
|                                                                                |
```

_ Copyright IBM Corp. 1996
3.3 - 2

```
¦ +---------------------------------------------------------------------+ ¦
¦ ¦CONFIG    SSA Configurator and Service Aids      Vyymmdd      XX Version¦ ¦
¦ +---------------------------------------------------------------------+ ¦
¦         +---------------------------+                                    ¦
¦         ¦         Main M+---------------------------------------------+  ¦
¦         +-------------¦ Bus X +---------------------------+ (Q) ¦        ¦
¦         ¦             +-------¦ Members for RAID-X Arrays  ¦-----¦        ¦
¦         ¦    New Disks ¦ RAI+--+---------------------------¦---+ ¦        ¦
¦         ¦    Free Resour¦ RAI¦  ¦                          ¦   ¦+¦        ¦
¦         ¦    Syst+------¦ RAI+--¦1. xxxxxxxx        status  ¦---¦¦¦        ¦
¦         ¦    SSA ¦       ¦ Rej¦ S¦                          ¦   ¦¦¦        ¦
¦         ¦    Even+------¦ Non¦ a¦                           ¦   ¦¦¦        ¦
¦         ¦    Serv¦ Bus X¦ Hot¦ a¦                           ¦   ¦¦¦        ¦
¦         ¦    Abou¦ Bus X¦ Run¦  ¦                           ¦   ¦¦¦        ¦
¦         ¦        ¦       ¦ Run¦  ¦                          ¦   ¦+¦        ¦
¦         ¦       +------¦ Vie¦   +---------------------------+   ¦ ¦        ¦
¦         ¦        ¦       ¦ Dis+-----------------------------------+ ¦     ¦
¦         ¦       +---------------------------------------------+    ¦      ¦
¦         +---------------------------+                                    ¦
¦     +-----------------------------------------------------------+        ¦
¦     ¦<ESCAPE> Exit  <INSERT> Insert  <DELETE> Delete  <F1> Help ¦        ¦
¦     ¦<F9> FlashOn  <F10> FlashOff                               ¦        ¦
¦     +-----------------------------------------------------------+        ¦
¦                                                                          ¦
+--------------------------------------------------------------------------+
```

Select disk drives for the array from the list of candidates; to do this, **for each disk drive**:

a. Press Insert

b. A list of candidate disk drives is displayed:

```
+---------------------------------------------------------------------------+
¦                                                                           ¦
¦                                                                           ¦
¦   +---------------------------------------------------------------------+ ¦
¦   ¦CONFIG    SSA Configurator and Service Aids      Vyymmdd    XX Version¦ ¦
¦   +---------------------------------------------------------------------+ ¦
¦         +---------------------------+                                     ¦
¦         ¦         Main M+---------------------------------------------+   ¦
¦         +-------------¦ Bus X +-----------------------------+ (Q) ¦        ¦
¦         ¦             +-------¦ Members for RAID-X Arrays  ¦-----¦        ¦
¦         ¦    New Disks ¦ RAI+--+---------------------------¦---+ ¦        ¦
¦         ¦    Free Resour¦ RA+-----------------------------------+¦+¦      ¦
¦         ¦    Syst+------¦ RA¦   Candidates for RAID-X Arrays  ¦¦¦¦        ¦
¦         ¦    SSA ¦       ¦ Re+-----------------------------------¦¦¦¦     ¦
¦         ¦    Even+------¦ No¦1.  canUID111      status        ¦¦¦¦        ¦
¦         ¦    Serv¦ Bus X¦ Ho¦2.  canUID222      status        ¦¦¦¦        ¦
¦         ¦    Abou¦ Bus X¦ Ru¦3.  canUID333      status        ¦¦¦¦        ¦
¦         ¦        ¦       ¦ Ru¦4.  canUID444      status        ¦¦+¦        ¦
¦         ¦       +------¦ Vi¦5.  canUID555      status          ¦¦ ¦        ¦
¦         ¦        ¦       ¦ Di¦                               ¦+ ¦          ¦
¦         ¦        ¦       +---+-----------------------------------+--+      ¦
¦         ¦       +---------------------------+                              ¦
¦     +-----------------------------------------------------------+          ¦
¦     ¦<ESCAPE> Exit  <ENTER> Select  <F1> Help  <F9> FlashOn    ¦          ¦
¦     ¦<F10> FlashOff                                            ¦          ¦
¦     +-----------------------------------------------------------+          ¦
¦                                                                           ¦
¦                                                                           ¦
+---------------------------------------------------------------------------+
```

c. Select the disk drive that is to be included in the array. (You can identify the disk drive by highlighting its Unique ID in this list and pressing F9. This causes the Check light on the disk drive to flash. Pressing F10 stops the light flashing.)

    The previous window reappears now showing the selected disk drive as a member of the array.

7. When you have selected all the disk drives required, create the array by pressing Esc and following the prompt to confirm the creation of the array.

    The screen shown in step 4 reappears now showing the new array in the list. If the new array is a RAID-5 array, it is shown with *rebuilding* status while the adapter initializes the array and its member disk drives.

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3.3 - 3

You can return to the Main Menu by repeatedly pressing Esc.

The array created is in the *free* state. The next section describes how to attach the array to your system.

3.4 Attaching Resources

A resource is a disk drive that is to be accessed individually or an array of disk drives.

Before attaching an array, ensure that it has finished the rebuilding process and that no problems occurred during this process. Any problems are shown in the attributes of the array; "Viewing Resources and Their Attributes" in topic 5.3 describes how to see this information.

To attach a resource to your system:

1. From the SSA Main Menu screen, select **System Resources**.

   A list, initially blank, of the resources attached to the system is displayed; the resources are listed in drive-address order. (Drive addresses are allocated by the configurator.) Only resources that are *attached* can be accessed by the operating system.

```
+-----------------------------------------------------------------------------------+
|                                                                                   |
|                                                                                   |
|   +-----------------------------------------------------------------------+       |
|   ¦CONFIG    SSA Configurator and Service Aids      Vyymmdd      XX Version¦       |
|   +-----------------------------------------------------------------------+       |
|           +---------------------------+                                           |
|           ¦          Main Menu        ¦                                           |
|           +---------------------------¦                                           |
|           ¦               +------------------------------------------------+      |
|           ¦  New Disks    ¦          List of System Resources              ¦      |
|           ¦  Free Resour+------------------------------------------------- ¦      |
|           ¦  System Reso¦SSA UID/Array Name      Status       Adapter Disk ¦      |
|           ¦  SSA Adapter¦1. xxxxxxxx             Online          15    14h ¦      |
|           ¦  Event/Error¦                                                  ¦      |
|           ¦  Service Aid¦                                                  ¦      |
|           ¦  About       ¦                                                  ¦      |
|           ¦              ¦                                                  ¦      |
|           ¦              ¦                                                  ¦      |
|           ¦              +------------------------------------------------+       |
|           ¦              ¦                  ¦                                      |
|           +---------------------------+                                           |
|     +-----------------------------------------------------------------+           |
|     ¦<ESCAPE> Exit  <ENTER> Select  <INSERT> Insert  <DELETE> Delete ¦           |
|     ¦<F1> Help  <F9> FlashOn  <F10> FlashOff                         ¦           |
|     +-----------------------------------------------------------------+           |
|                                                                                   |
|                                                                                   |
+-----------------------------------------------------------------------------------+
```

To attach a resource:

a. For the first resource, just press Insert.

   To add a resource to an existing list, highlight the name of a resource already in the list (the new resource will be added immediately above this one) and press Insert.

   To add a resource to the end of the list, highlight the space below the current end of the list and press Insert.

   Notes:

   1) If you are going to boot from an SSA disk drive, that disk drive must be at the top of the list. For details of the requirements for booting from an SSA disk drive, refer to the README.TXT file on the Device Driver and Utilities diskette for your operating system.

   2) At the position in the list that you choose for the new resource, there must be a large enough gap in the sequence of drive addresses. If the gap is not large enough:

      For OS/2, the system creates a large enough gap by adjusting downward the drive addresses of resources below the gap.
      For Novell NetWare, the system rejects your choice of that position.
      For Windows NT, the system gives a warning that you might destroy data by selecting that position.

b. A list of candidate resources is displayed:

```
+-------------------------------------------------------------------------------------+
¦                                                                                     ¦
¦                                                                                     ¦
```

```
¦ +-------------------------------------------------------------------------+  ¦
¦ ¦CONFIG    SSA Configurator and Service Aids      Vyymmdd      XX Version¦  ¦
¦ +-------------------------------------------------------------------------+  ¦
¦        +---------------------------+                                          ¦
¦        ¦        Main Menu          ¦                                          ¦
¦        +---------------------------¦                                          ¦
¦        ¦              +-------------------------------------------------+     ¦
¦        ¦   New Disks  ¦         List of System Resources                ¦     ¦
¦        ¦   Free Resour+-------------------------------------------------¦     ¦
¦        ¦   System Reso¦SSA UID/Array Name      Status       Adapter Disk¦     ¦
¦        ¦   SSA Adapter¦   +--------------------------------------+  ¦      ¦     ¦
¦        ¦   Event/Error¦   ¦    Candidates for System Resources   ¦  ¦      ¦     ¦
¦        ¦   Service Aid¦   +--------------------------------------¦  ¦      ¦     ¦
¦        ¦   About      ¦   ¦                                      ¦  ¦      ¦     ¦
¦        ¦              ¦   ¦1.    CANUID111        Online         ¦  ¦      ¦     ¦
¦        ¦              ¦   ¦2.    CANUID222        Online         ¦  ¦      ¦     ¦
¦        ¦          +---¦   ¦                                      ¦  ¦-+    ¦     ¦
¦        ¦              ¦   +--------------------------------------+  ¦      ¦     ¦
¦        ¦              +-------------------------------------------------+     ¦
¦        +---------------------------+                                          ¦
¦     +-------------------------------------------------------------------+     ¦
¦     ¦<ESCAPE> Exit  <ENTER> Select  <F1> Help  <F9> FlashOn            ¦     ¦
¦     ¦<F10> FlashOff                                                    ¦     ¦
¦     +-------------------------------------------------------------------+     ¦
¦                                                                               ¦
¦                                                                               ¦
+-------------------------------------------------------------------------------+
```

These are the resources that are in the free state.

Select the resource that you want to attach. Its name disappears from this list.
   c. The System resources window reappears with the new resource added with the appropriate drive address assigned.

2. If you are using OS/2, exit the configurator, shutdown your system, and reboot. This enables the operating system to recognize the revised list of attached resources and drive addresses.

3. Use your operating system to assign logical partitions and drive identifiers to the new resources (for example, FDISK).

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4.0 Chapter 4.   Dealing with Disk-Array Problems
This chapter:

Provides general guidance on solving basic problems with your SSA subsyste

Describes how to get detailed information about errors and other events on the adapter and the disk drives attached to i

Describes the actions you must perform with the adapter utility programs while changing a disk drive

Subtopics
4.1 Basic Problems
4.2 Array Problems
4.3 Changing Failed Disk Drives

4.1 Basic Problems

If the system cannot work with the adapter, check the following:

Is CMOS setup required to enable PCI bus parameters

Is the adapter installed in a bus-master PCI slot

Are all the cables connected correctly

Does the configuration follow the SSA rules for this adapter

If the system cannot access the SSA disk drives, check the following:

Is power turned on to the disk drives

Has the configuration utility been run for all the required disk drives, and do they appear in the list of attached resources

Are the disk drives connected in a loop, either from SSA loop A port 1 to SSA loop A port 2, or from SSA loop B port 1 to SSA loop B port 2?

Is the light next to the adapter-loop ports on, showing that both ports are operational

If the system fails to boot from an SSA disk drive, check the following:

That there is**not** an IDE disk drive installed

That there is**not** a SCSI adapter with BIOS enabled installed in a higher-priority PCI slot than the SSA adapter

That the CBIOS enable

That the SSA device drivers are loaded before the SCSI device driver

That the address (drive letter) of the partition from which you are trying to boot has not changed. (Adding extra drives can cause the addresses of existing drives to be changed.)

4.1 Basic Problems

4.2 Array Problems

Many problems within an array are not seen by the users of the server. The RAID-1 and RAID-5 functions provide a continuing service to the users even when a member of an array has failed. However, unless the failure is corrected, a second failure within that array could cause the whole array to become unavailable. Therefore, it is very important that you check the error log for the adapter regularly. You could do this by making such a check part of the startup procedure for your operating system.

If you are using OS/2, a pop-up window appears when an error is logged for the adapter or the disk drives attached to it. Also, the pop-up window appears every hour while an error likely to affect the operation of the array remains on the log. The pop-up window recommends that you check the entries in the error log.

To check the error log:

1. Start the configuration utility by executing the following program:

    For OS/2: **ISSACFG**
    For Novell NetWare: **load ISSACFG**
    For Windows NT: **ISSACFG**
    For DOS: **ISSACFG**

    or, if it is available, double click on the SSA Configurator icon.

2. From the Main Menu, select **Event/Error Logger** and then **Analyze SSA Event Log**.

    The current list of errors appears in a new window:

```
+----------------------------------------------------------------------------+
|                                                                            |
|                                                                            |
|  +----------------------------------------------------------------------+  |
|  |CONFIG   SSA Configurator and Service Aids     Vyymmdd     XX Version| |
|  +----------------------------------------------------------------------+  |
|        +---------------------------+                                        |
|        |        Main Menu          |                                       |
|        +---------------------------|                                       |
|        |           +---------------------------------------+               |
|        |  New Di|           Error Log Report           |               |
|        |  Free R+---------------------------------------|               |
|        |  System|1. hh;mm;ss  dd-mm-yy   serialnum  SRNNN|               |
|        |  SSA Ad|2. hh;mm;ss  dd-mm-yy   serialnu2  SRNN2|               |
|        |  Event/|                                       |               |
|        |  Servic|                                       |               |
|        |  About |                                       |               |
|        |        |                                       |               |
|        |           +---------------------------------------+               |
|        |                         |                                         |
|        |                         |                                         |
|        +---------------------------+                                        |
|     +-------------------------------------------------------------+         |
|     |<ESCAPE> Exit  <DELETE> Delete  <F1> Help                    |         |
|     +-------------------------------------------------------------+         |
|                                                                            |
|                                                                            |
+----------------------------------------------------------------------------+
```

The SRNs (service request numbers) describe the errors.

Some SRNs describe errors with the adapter card or with the SSA configuration. These SRNs are listed inAppendix B, "SSA RAID Adapter Service Request Numbers" in topic B.0 with a description of what you should do to solve the problem.

Some SRNs describe errors with the SSA disk drives or the units in which they are installed. For a complete description of these, see the *Installation and User's Guide* or the *Maintenance Information* for that unit.

If one of the following SRNs appears, you can correct the problem by exchanging a disk drive for a new one:

```
Any SRN whose first character is 'l'
60210
D0100
D0300
```

The following section describes what you need to do with the array configuration utility while changing a disk drive.

4.3 Changing Failed Disk Drives

If you have one of the SRNs in the list above, you can change the disk drive using the following procedure:

1. From the Main Menu, select **SSA Adapter List**, select the adapter, and then select **Disk Service Aids**.

   A list of physical disk drives is displayed:

```
+--------------------------------------------------------------------------------+
|                                                                                |
|                                                                                |
|   +-----------------------------------------------------------------------+    |
|   |CONFIG   SSA Configurator and Service Aids      Vyymmdd      XX Version|    |
|   +-----------------------------------------------------------------------+    |
|         +---------------------------+                                          |
|         |        Main Me+-----------------------------+                        |
|         +--------------|        Disk Service Aids      |                       |
|         |              +-----------------------------|                         |
|         |    New Disks  |Link        SSA UID      Status|                      |
|         |    Free Resourc|                              |                      |
|         |    System Resou|Port A1                        |                      |
|         |    SSA Adapter |          uidxxxxx     Good    |                      |
|         |    Event/Error |          uidxxxxy     Good  |                        |
|         |    Service Aids|          uidxxxyy     Good  |                        |
|         |    About       |          uidxxzzz     Good  |                        |
|         |                |Port A2                        |                      |
|         |                |                              |                      |
|         |                |Port B1                        |                      |
|         |                |            No Disks           |                      |
|         |                |Port B2                        |                      |
|         +--------------+-----------------------------+                          |
|      +-------------------------------------------------------------+            |
|      |<ESCAPE> Exit  <ENTER> Select  <F1> Help  <F2> Format        |            |
|      |<F3> Certify  <F4> ServiceMode  <F5> Diagnostics  <F9> FlashOn |          |
|      |<F10> FlashOff                                               |            |
|      +-------------------------------------------------------------+            |
|                                                                                |
|                                                                                |
+--------------------------------------------------------------------------------+
```

   In this example, four disk drives are connected between ports A1 and A2 of the adapter, in a loop, in the order shown. There are no disks connected to ports B1 and B2.

   If a dotted line appears in the list of disk drives, it indicates that the SSA loop is broken at that place.

2. You can identify a disk drive by highlighting its entry in this list and pressing F9. This causes the Check light on the disk drive to flash (if it is not on already) and a > symbol appears beside the entry in the list. Pressing F10 stops the light flashing.

3. Highlight the entry for the disk drive that you are going to replace and press F4.

   This puts that disk drive into service mode; the Check light on the disk drive comes on (it might be on already) and a + symbol appears beside the entry in the list. Only one disk can be in service mode at a time.

4. Replace the physical disk drive. The *User's Handbook* for the unit containing the disk drive describes how to do this.

5. Highlight the entry for the disk drive that you are have just replaced and press F4.

   This removes that disk drive from service mode.

6. Press Esc to return to the Main Menu. (Leaving the Service Aids window automatically removes any disk drive from service mode.)

7. If the disk drive that failed was a member of an array for which no hot spare was available, the entry for the failed disk drive in the list of members of the array is replaced with

   ```
   blank      Not Present
   ```

   You must add the new disk drive to the array by exchanging this entry
   with that for the new disk drive, using the procedure described in
   "Exchanging a Member of an Array" in topic 5.5.

   If the disk drive that failed was a member of an array for which a hot spare was available, the hot spare will have been exchanged automatically with the faulty disk drive. You can either:

Define the new disk drive as a new hot spare, using the procedure described in "Defining a Hot Spare" in topic 5.1, or
Exchange the new disk drive with the previous hot spare, using the procedure described in "Exchanging a Member of an
Array" in topic 5.5.

5.0 Chapter 5.   Performing Other Disk-Array Tasks

This section describes some of the other uses of the SSA Configuration Utility. Other service-related tasks are described in the *SSA RAID Adapter: Hardware Maintenance Manual Supplement.*

All these tasks use the SSA Configurator Utility provided on the SSA RAID Adapter diskette for your operating system. To start this utility, execute the following program:

> For OS/2:**ISSACFG**
> For Novell NetWare:**load ISSACFG**
> For Windows NT:**ISSACFG**
> For DOS:**ISSACFG**

or, if it is available, double click on the SSA Configurator icon.

```
Subtopics
5.1 Defining a Hot Spare
5.2 Viewing the Physical Configuration
5.3 Viewing Resources and Their Attributes
5.4 Changing Array Attributes
5.5 Exchanging a Member of an Array
5.6 Deleting an Array
```

5.1 Defining a Hot Spare

To define a disk drive as a hot spare:

1. From the Main Menu screen, select **SSA Adapter List**.
2. The SSA Adapter List window opens:

```
+-------------------------------------------------------------------------------+
|                                                                               |
|                                                                               |
|   +-----------------------------------------------------------------------+   |
|   |CONFIG    SSA Configurator and Service Aids     Vyymmdd     XX Version|   |
|   +-----------------------------------------------------------------------+   |
|          +---------------------------+                                        |
|          |         Main Menu         |                                        |
|          +---------------------------|                                        |
|          |                           |                                        |
|          |    New Disks              |                                        |
|          |    Free Resources         |                                        |
|          |    Syst+---------------------------------------------+            |
|          |    SSA |          SSA Adapter List                   |            |
|          |    Even+---------------------------------------------|            |
|          |    Serv| Bus X   Device Y   Slot Z   Adapter    (Q) |            |
|          |    Abou| Bus X   Device N   Slot T   Adapter    (S) |            |
|          |    |    |                                             |            |
|          |    |    +---------------------------------------------+            |
|          |    |                        |                                      |
|          |    |                        |                                      |
|          +---------------------------+                                        |
|     +---------------------------------------------------------------+        |
|     |<ESCAPE> Exit  <ENTER> Select  <F1> Help                       |        |
|     +---------------------------------------------------------------+        |
|                                                                               |
|                                                                               |
+-------------------------------------------------------------------------------+
```

Select the adapter to which the disk drive that is to be the hot spare is attached. The hot spare can only be used by arrays defined on that adapter.

3. The Adapter Menu window opens:

```
+-------------------------------------------------------------------------------+
|                                                                               |
|                                                                               |
|   +-----------------------------------------------------------------------+   |
|   |CONFIG    SSA Configurator and Service Aids     Vyymmdd     XX Version|   |
|   +-----------------------------------------------------------------------+   |
|          +---------------------------+                                        |
|          |         Main M+---------------------------------------------+     |
|          +-------------| Bus X  Device Y  Slot Z  Adapter      (Q) |     |
|          |             +---------------------------------------------|     |
|          |    New Disks | RAID-0 Arrays                               |     |
|          |    Free Resour| RAID-1 Arrays                              |     |
|          |    Syst+------| RAID-5 Arrays                              |     |
|          |    SSA |      | Rejected Disks                             |     |
|          |    Even+------| Non-Volatile RAM                           |     |
|          |    Serv| Bus X| Hot-spare Disks                            |     |
|          |    Abou| Bus X| Run Concurrent Diagnostics                 |     |
|          |    |         | Run Non-Concurrent Diagnostics             |     |
|          |    +------| View Adapter VPD                           |     |
|          |    |         | Disk Service Aids                          |     |
|          |    |         +---------------------------------------------+     |
|          +---------------------------+                                        |
|     +---------------------------------------------------------------+        |
|     |<ESCAPE> Exit  <ENTER> Select  <F1> Help                       |        |
|     +---------------------------------------------------------------+        |
|                                                                               |
|                                                                               |
+-------------------------------------------------------------------------------+
```

Select **Hot-spare disks**.

4. A list of the hot spare disk drives that are controlled by the adapter is displayed.

    Note: The list might not contain any hot spares.

```
+------------------------------------------------------------------------------+
|                                                                              |
|                                                                              |
|   +------------------------------------------------------------------------+ |
|   |CONFIG    SSA Configurator and Service Aids      Vyymmdd     XX Version| |
|   +------------------------------------------------------------------------+ |
|           +---------------------------+                                      |
|           |        Main M+-------------------------------------------+      |
|           +-------------| Bus X  Device Y  Slot Z  Adapter     (Q) |      |
|           |             +-------------------------------------------|      |
|           |   New Disks | RAID-0 Arrays                             |      |
|           |   Free Resour| RA+-----------------------------------+  |      |
|           |   Syst+------| RA|    List of Hot-spare Disks       |  |      |
|           |   SSA |      | Re+-----------------------------------|  |      |
|           |   Even+------| No|1.  hsdUID111      status         |  |      |
|           |   Serv| Bus X| Ho|2.  hsdUID222      status         |  |      |
|           |   Abou| Bus X| Ru|3.  hsdUID333      status         |  |      |
|           |       |      | Ru|                                  |  |      |
|           |       +------| Vi|                                  |  |      |
|           |       |      | Di|                                  |  |      |
|           |       |      +---+----------------------------------+--+      |
|           +---------------------------+                                      |
|       +----------------------------------------------------------------+    |
|       |<ESCAPE> Exit  <INSERT> Insert  <DELETE> Delete  <F1> Help    |    |
|       |<F9> FlashOn  <F10> FlashOff                                  |    |
|       +----------------------------------------------------------------+    |
|                                                                              |
|                                                                              |
+------------------------------------------------------------------------------+
```

   Press Insert to add a new hot spare disk drive.

5. A list of candidate disk drives is displayed:

```
+------------------------------------------------------------------------------+
|                                                                              |
|                                                                              |
|   +------------------------------------------------------------------------+ |
|   |CONFIG    SSA Configurator and Service Aids      Vyymmdd      XX Version| |
|   +------------------------------------------------------------------------+ |
|           +----------------------------+                                     |
|           |        Main M+-------------------------------------------+      |
|           +-------------| Bus X  Device Y  Slot Z  Adapter     (Q) |      |
|           |             +-------------------------------------------|      |
|           |   New Disks | RAID-0                                    |      |
|           |   Free Resour| RA+-----------------------------------+  |      |
|           |   Syst+------| RA|  Candidates for Hot-spare Disks   |  |      |
|           |   SSA |      | Re+-----------------------------------|  |      |
|           |   Even+------| No|1.  canUID111      status         |  |      |
|           |   Serv| Bus X| Ho|2.  canUID222      status         |  |      |
|           |   Abou| Bus X| Ru|3.  canUID333      status         |  |      |
|           |       |      | Ru|4.  canUID444      status         |  |      |
|           |       +------| Vi|5.  canUID555      status         |  |      |
|           |       |      | Di|                                  |  |      |
|           |       |      +---+----------------------------------+--+      |
|           +----------------------------+                                     |
|       +----------------------------------------------------------------+    |
|       |<ESCAPE> Exit  <ENTER> Select  <F1> Help  <F9> FlashOn        |    |
|       |<F10> FlashOff                                                |    |
|       +----------------------------------------------------------------+    |
|                                                                              |
|                                                                              |
+------------------------------------------------------------------------------+
```

6. Highlight the entry for the disk drive that is to be the hot spare. (You can identify the disk drive by putting the cursor on its Unique
    ID in this list and pressing F9. This causes a light on the disk drive to flash. Pressing F10 stops the light flashing.) Press Enter
    to define this disk drive as a hot spare.

    The previous window is displayed with the new hot-spare added to the list.

5.2 Viewing the Physical Configuration

From the SSA Main Menu, select **SSA Adapter List** and then **Disk Service Aids**. A window opens showing the physical arrangement of the SSA disk drives attached to the adapter selected:

```
+--------------------------------------------------------------------------------+
|                                                                                |
|                                                                                |
|   +------------------------------------------------------------------------+   |
|   |CONFIG   SSA Configurator and Service Aids      Vyymmdd      XX Version|   |
|   +------------------------------------------------------------------------+   |
|        +---------------------------+                                           |
|        |        Main Me+------------------------------+                        |
|        +--------------|        Disk Service Aids      |                        |
|        |              +------------------------------|                        |
|        |    New Disks |Link        SSA UID     Status|                        |
|        |    Free Resourc|                            |                        |
|        |    System Resou|Port A1                     |                        |
|        |    SSA Adapter |          uidxxxxx    Good  |                        |
|        |    Event/Error |          uidxxxxy    Good  |                        |
|        |    Service Aids|          uidxxxyy    Good  |                        |
|        |    About       |          uidxxzzz    Good  |                        |
|        |                |Port A2                     |                        |
|        |                |                            |                        |
|        |                |Port B1                     |                        |
|        |                |              No Disks      |                        |
|        |                |Port B2                     |                        |
|        +--------------+------------------------------+                        |
|      +------------------------------------------------------------+            |
|      |<ESCAPE> Exit  <ENTER> Select  <F1> Help  <F2> Format      |            |
|      |<F3> Certify  <F4> ServiceMode  <F5> Diagnostics  <F9> FlashOn |        |
|      |<F10> FlashOff                                              |            |
|      +------------------------------------------------------------+            |
|                                                                                |
|                                                                                |
+--------------------------------------------------------------------------------+
```

In this example, four disk drives are connected between ports A1 and A2 of the adapter, in a loop, in the order shown. There are no disks connected to ports B1 and B2.

If a dashed line appears in the list of disk drives, it means that the SSA loop is broken at that point.

5.3 Viewing Resources and Their Attributes

From the SSA Main Menu, select **System Resources** and then the resource you want to view.

If you select an array, a window opens showing the attributes of the array:

```
+------------------------------------------------------------------------------------+
¦                                                                                    ¦
¦                                                                                    ¦
¦                                                                                    ¦
¦  +-----------------------------------------------------------------------------+   ¦
¦  ¦CONFIG    SSA Configurator and Service Aids      Vyymmdd      XX Version¦      ¦
¦  +-----------------------------------------------------------------------------+   ¦
¦          +---------------------------+                                             ¦
¦          ¦          Main Menu        ¦                                             ¦
¦          +---------------------------¦                                             ¦
¦          ¦              +----------------------+                                   ¦
¦          ¦   New Disks +----¦  View RAID-V Arrays   ¦---+                          ¦
¦          ¦   Free Resou¦    +----------------------¦   ¦                           ¦
¦          ¦   System Res+----¦ attrxxx    : aaa     ¦---¦                           ¦
¦          ¦   SSA Adapte¦    ¦ attrxvf    : b       ¦   ¦                           ¦
¦          ¦   Event/Erro¦    ¦ attrccc    : vvvvvvv ¦   ¦                           ¦
¦          ¦   Service Ai¦    ¦ atttttttff : q       ¦   ¦                           ¦
¦          ¦   About      ¦   ¦ View Members          ¦  ¦                           ¦
¦          ¦          +----¦  ¦                      ¦---+                           ¦
¦          ¦          ¦        ¦                      ¦                              ¦
¦          ¦          ¦        ¦                      ¦                              ¦
¦          ¦          ¦        +----------------------+                              ¦
¦          +---------------------------+                                             ¦
¦     +----------------------------------------------------------------+             ¦
¦     ¦<ESCAPE> Exit  <ENTER> Select  <F1> Help                        ¦             ¦
¦     +----------------------------------------------------------------+             ¦
¦                                                                                    ¦
¦                                                                                    ¦
+------------------------------------------------------------------------------------+
```

To see all the attributes of the array, use the arrow keys to scroll the window. If you select the last item in the list, **View Members**, a window opens containing a list of the members of the array:

```
+------------------------------------------------------------------------------------+
¦                                                                                    ¦
¦                                                                                    ¦
¦                                                                                    ¦
¦  +-----------------------------------------------------------------------------+   ¦
¦  ¦CONFIG    SSA Configurator and Service Aids      Vyymmdd      XX Version¦      ¦
¦  +-----------------------------------------------------------------------------+   ¦
¦          +---------------------------+                                             ¦
¦          ¦          Main Menu        ¦                                             ¦
¦          +---------------------------¦                                             ¦
¦          ¦              +----------------------+                                   ¦
¦          ¦   New Disks +----¦  View RAID-X Arrays   ¦---+                          ¦
¦          ¦   Free Resou¦    +----------------------¦   ¦                           ¦
¦          ¦   System Res+----¦ att+------------------------+                        ¦
¦          ¦   SSA Adapte¦    ¦ att¦ Members of RAID-X Arrays ¦                      ¦
¦          ¦   Event/Erro¦    ¦ att+------------------------¦                        ¦
¦          ¦   Service Ai¦    ¦ att¦                         ¦                       ¦
¦          ¦   About      ¦   ¦ Vie¦1.   UIDxxxxg     status ¦                       ¦
¦          ¦          +----¦  ¦    ¦2.   UIDyyyyg     status ¦                       ¦
¦          ¦          ¦        ¦    ¦3.   UIDggggg     status ¦                      ¦
¦          ¦          ¦        ¦    ¦                         ¦                       ¦
¦          ¦          ¦        +----+------------------------+                       ¦
¦          +---------------------------+                                             ¦
¦     +----------------------------------------------------------------+             ¦
¦     ¦<ESCAPE> Exit  <ENTER> Select  <F1> Help                        ¦             ¦
¦     ¦<F9> FlashOn  <F10> FlashOff  <F7> Exchange Members             ¦             ¦
¦     +----------------------------------------------------------------+             ¦
¦                                                                                    ¦
¦                                                                                    ¦
+------------------------------------------------------------------------------------+
```

If you select a member in this window, a new window opens showing the
attributes of that member:

```
+------------------------------------------------------------------------------------+
¦                                                                                    ¦
¦                                                                                    ¦
¦                                                                                    ¦
```

```
¦ +--------------------------------------------------------------------+        ¦
¦ ¦CONFIG    SSA Configurator and Service Aids      Vyymmdd     XX Version¦      ¦
¦ +--------------------------------------------------------------------+        ¦
¦        +----------------------------+                                         ¦
¦        ¦          Main Menu         ¦                                         ¦
¦        +----------------------------¦                                         ¦
¦        ¦                   +----------------------+                           ¦
¦        ¦    New+---------------------------+-X    ¦---+                        ¦
¦        ¦    Fre¦    View Physical Disk      ¦------¦   ¦                       ¦
¦        ¦    Sys+---------------------------¦----------+                        ¦
¦        ¦    SSA¦ attr1aaaa     : gg         ¦D-X Arrays ¦                      ¦
¦        ¦    Eve¦ attr2bbbb     : f          ¦---------- ¦                      ¦
¦        ¦    Ser¦                            ¦           ¦                      ¦
¦        ¦    Abo¦                            ¦     status ¦                     ¦
¦        ¦       ¦                            ¦     status ¦                     ¦
¦        ¦       ¦                            ¦     status ¦                     ¦
¦        ¦       ¦                            ¦           ¦                      ¦
¦        ¦       +---------------------------+----------+                        ¦
¦        +----------------------------+                                         ¦
¦    +------------------------------------------------------------+             ¦
¦    ¦<ESCAPE> Exit  <Enter> Select  <F1> Help  <F9> Flash On     ¦             ¦
¦    ¦<F10> FlashOff                                              ¦             ¦
¦    +------------------------------------------------------------+             ¦
¦                                                                              ¦¦
¦                                                                              ¦¦
+-----------------------------------------------------------------------------+
```

If, from the System Resources window, you select a disk drive that is not a member of an array, the View Physical Disk window appears immediately.

To see all the attributes of the disk drive, use the arrow keys to scroll the window.

5.4 Changing Array Attributes

To change one or more of the attributes of an existing array:

1. From the SSA Main Menu, select **SSA Adapter List**

2. The SSA Adapter List window opens:

```
+----------------------------------------------------------------------------------+
|                                                                                  |
|                                                                                  |
|   +--------------------------------------------------------------------------+   |
|   |CONFIG   SSA Configurator and Service Aids      Vyymmdd      XX Version|   |
|   +--------------------------------------------------------------------------+   |
|          +---------------------------+                                           |
|          |          Main Menu        |                                           |
|          +---------------------------|                                           |
|          |                           |                                           |
|          |    New Disks              |                                           |
|          |    Free Resources         |                                           |
|          |    Syst+-----------------------------------------+                    |
|          |    SSA |          SSA Adapter List               |                    |
|          |    Even+-----------------------------------------|                    |
|          |    Serv| Bus X  Device Y  Slot Z  Adapter    (Q) |                    |
|          |    Abou| Bus X  Device N  Slot T  Adapter    (S) |                    |
|          |        |                                         |                    |
|          |        +-----------------------------------------+                    |
|          |                           |                                           |
|          |                           |                                           |
|          |                           |                                           |
|          +---------------------------+                                           |
|      +------------------------------------------------------------------+        |
|      |<ESCAPE> Exit  <ENTER> Select  <F1> Help                          |        |
|      +------------------------------------------------------------------+        |
|                                                                                  |
|                                                                                  |
+----------------------------------------------------------------------------------+
```

   Select the adapter that controls the array.

3. The adapter-menu window opens:

```
+----------------------------------------------------------------------------------+
|                                                                                  |
|                                                                                  |
|   +--------------------------------------------------------------------------+   |
|   |CONFIG   SSA Configurator and Service Aids      Vyymmdd      XX Version|   |
|   +--------------------------------------------------------------------------+   |
|          +---------------------------+                                           |
|          |         Main M+-------------------------------------------+          |
|          +-------------| Bus X  Device Y  Slot Z  Adapter    (Q) |          |
|          |             +-------------------------------------------|          |
|          |    New Disks | RAID-0 Arrays                            |          |
|          |    Free Resour| RAID-1 Arrays                            |          |
|          |    Syst+------| RAID-5 Arrays                            |          |
|          |    SSA |      | Rejected Disks                           |          |
|          |    Even+------| Non-Volatile RAM                         |          |
|          |    Serv| Bus X| Hot-spare Disks                          |          |
|          |    Abou| Bus X| Run Concurrent Diagnostics               |          |
|          |        |      | Run Non-Concurrent Diagnostics           |          |
|          |        +------| View Adapter VPD                         |          |
|          |        |      | Disk Service Aids                        |          |
|          |        +-------------------------------------------+          |
|          +---------------------------+                                           |
|      +------------------------------------------------------------------+        |
|      |<ESCAPE> Exit  <ENTER> Select  <F1> Help                          |        |
|      +------------------------------------------------------------------+        |
|                                                                                  |
|                                                                                  |
+----------------------------------------------------------------------------------+
```

   Select the type of array whose attributes you want to change. You can scroll the contents of the window by using the arrow keys.

4. A list of the arrays of this type controlled by the adapter appears in a new window:

```
+-----------------------------------------------------------------------------+
|                                                                             |
|                                                                             |
|  +----------------------------------------------------------------------+   |
|  |CONFIG    SSA Configurator and Service Aids      Vyymmdd     XX Version|   |
|  +----------------------------------------------------------------------+   |
|          +---------------------------+                                       |
|          |          Main M+-------------------------------------------+     |
|          +-------------| Bus X  Device Y  Slot Z  Adapter      (Q) |     |
|          |             +-------------------------------------------|     |
|          |   New Disks | RAID-0 Arrays                             |     |
|          |   Free Resour| RAID-1 A+-------------------------------+|     |
|          |   Syst+------| RAID-5 A|    List of RAID-X Arrays      ||     |
|          |   SSA |      | Rejected+-------------------------------||     |
|          |   Even+------| Non-Vola|Array name          Status     ||     |
|          |   Serv| Bus X| Hot-spar|1.  xxxxxxxx        yyyyyyy     ||     |
|          |   Abou| Bus X| Run Conc|2.  yyyyyyyy        zzzzzzz     ||     |
|          |       |      | Run Non-+-------------------------------+|     |
|          |       +------| View Adapter VPD                         |     |
|          |       |      | Disk Service Aids                        |     |
|          |       |      +------------------------------------------+     |
|          +---------------------------+                                       |
|      +--------------------------------------------------------------+       |
|      |<ESCAPE> Exit  <ENTER> Select  <INSERT> Insert  <DELETE> Delete |      |
|      |<F1> Help  <F9> FlashOn  <F10> FlashOff <F8> Modify Attributes  |      |
|      +--------------------------------------------------------------+       |
|                                                                             |
|                                                                             |
+-----------------------------------------------------------------------------+
```

Highlight the array whose attributes you want to change, and press F8.

5. A window opens showing the attributes for the array selected:

```
+-----------------------------------------------------------------------------+
|                                                                             |
|                                                                             |
|  +----------------------------------------------------------------------+   |
|  |CONFIG    SSA Configurator and Service Aids      Vyymmdd     XX Version|   |
|  +----------------------------------------------------------------------+   |
|          +---------------------------+                                       |
|          |          Main M+-------------------------------------------+     |
|          +-------------| Bus X  Device Y  Slot Z  Adapter      (Q) |     |
|          |             +-------------------------------------------|     |
|          |   New Disks | RAI+--------------------------------------+     |
|          |   Free Resour| RAI|  Filter Attributes for RAID-X Arrays |     |
|          |   Syst+------| RAI+--------------------------------------|     |
|          |   SSA |      | Rej| SSA UID/Array Name  : xxxxxxxx       |     |
|          |   Even+------| Non| attribute1          : xx            |     |
|          |   Serv| Bus X| Hot| attribute2          : yy            |     |
|          |   Abou| Bus X| Run|                                     |     |
|          |       |      | Run|                                     |     |
|          |       +------| Vie|                                     |     |
|          |       |      | Dis+--------------------------------------+     |
|          |       |      +---------------------------------------+     |
|          +---------------------------+                                       |
|      +--------------------------------------------------------------+       |
|      |<ESCAPE> Exit  <ENTER> Select  <F1> Help                       |      |
|      +--------------------------------------------------------------+       |
|                                                                             |
|                                                                             |
+-----------------------------------------------------------------------------+
```

You can change the values of the attributes by overtyping them. (The Help screen provides details of the values that are allowed.) Use the arrow keys to scroll the contents of the window, if necessary, to ensure that you check all the attributes. Press Enter to set each attribute in turn.

5.5 Exchanging a Member of an Array

To exchange a member of an array with another disk drive:

1. From the SSA Main Menu, select **System Resources** and then the array in which you want to exchange a member. A window
    will open showing the attributes of the array:

```
+-----------------------------------------------------------------------------+
|                                                                             |
|                                                                             |
|   +-----------------------------------------------------------------+       |
|   |CONFIG    SSA Configurator and Service Aids     Vyymmdd    XX Version|    |
|   +-----------------------------------------------------------------+       |
|           +---------------------------+                                      |
|           |         Main Menu         |                                      |
|           +---------------------------|                                      |
|           |              +----------------------+                            |
|           |    New Disks +----|  View RAID-V Arrays  |---+                   |
|           |    Free Resou|    +----------------------|   |                   |
|           |    System Res+----| attrxxx   : aaa      |---|                   |
|           |    SSA Adapte|    | attrxvf   : b        |   |                   |
|           |    Event/Erro|    | attrccc   : vvvvvvv  |   |                   |
|           |    Service Ai|    | atttttfff : q        |   |                   |
|           |    About      |   | View Members         |   |                   |
|           |          +----|   |                      |---+                   |
|           |          |        |                      |                       |
|           |          |        |                      |                       |
|           |          |        +----------------------+                       |
|           |          |                                                        |
|           +---------------------------+                                      |
|      +-----------------------------------------------------------+           |
|      |<ESCAPE> Exit  <ENTER> Select  <F1> Help                   |           |
|      +-----------------------------------------------------------+           |
|                                                                             |
|                                                                             |
+-----------------------------------------------------------------------------+
```

2. Use the arrow keys to scroll to the last item in the list, **View Members**, and press Enter. A window opens showing a list of the
    members of the array:

```
+-----------------------------------------------------------------------------+
|                                                                             |
|                                                                             |
|   +-----------------------------------------------------------------+       |
|   |CONFIG    SSA Configurator and Service Aids     Vyymmdd    XX Version|    |
|   +-----------------------------------------------------------------+       |
|           +---------------------------+                                      |
|           |         Main Menu         |                                      |
|           +---------------------------|                                      |
|           |              +----------------------+                            |
|           |    New Disks +----|  View RAID-X Arrays  |---+                   |
|           |    Free Resou|    +----------------------|   |                   |
|           |    System Res+----| att+-------------------------+                |
|           |    SSA Adapte|    | att| Members of RAID-X Arrays |              |
|           |    Event/Erro|    | att+-------------------------|               |
|           |    Service Ai|    | att|                         |               |
|           |    About      |   | Vie|1.   UIDxxxxg    status  |               |
|           |          +----|   |    |2.   UIDyyyyg    status  |               |
|           |          |        |    |3.   UIDggggg    status  |               |
|           |          |        |    |                         |               |
|           |          |        +----+-------------------------+               |
|           +---------------------------+                                      |
|      +-----------------------------------------------------------+           |
|      |<ESCAPE> Exit  <ENTER> Select  <F1> Help                   |           |
|      |<F9> FlashOn  <F10> FlashOff  <F7> Exchange Members        |           |
|      +-----------------------------------------------------------+           |
|                                                                             |
|                                                                             |
+-----------------------------------------------------------------------------+
```

3. Select the member that you want to exchange and press F7. A window opens showing the disk drives that are candidates for
    exchange:

```
+-----------------------------------------------------------------------------+
```

```
|                                                                          |
|                                                                          |
|   +------------------------------------------------------------------+   |
|   |CONFIG    SSA Configurator and Service Aids     Vyymmdd    XX Version|  |
|   +------------------------------------------------------------------+   |
|         +---------------------------+                                    |
|         |          Main Menu        |                                    |
|         +---------------------------|                                    |
|         |            +----------------------+                           |
|         |  New Disks +----| View RAID-X Arrays  |---+                   |
|         |  Free Resou| +---------------------------------+              |
|         |  System Res+-|    Candidates for RAID-X Arrays  |             |
|         |  SSA Adapte| +---------------------------------|              |
|         |  Event/Erro| | 1.   UIDxxxxx          status    |             |
|         |  Service Ai| | 2.   UID2xxxx          status    |             |
|         |  About      | | 3.   UID3xxxx          status    |             |
|         |            +-|      Blank Reserved    Online     |            |
|         |              |                                   |            |
|         |              +-----------------------------------+            |
|         |                +----+---------------------+                   |
|         +---------------------------+                                   |
|    +------------------------------------------------------------+       |
|    |<ESCAPE> Exit  <ENTER> Select  <F1> Help  <F9> FlashOn       |       |
|    |<F10> FlashOff                                               |       |
|    +------------------------------------------------------------+       |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+
```

4. Select from this list the disk drive that you want to become the new member of the array. The window closes. The previous window now shows the new member, with the added status 'rebuilding' while the adapter rebuilds the data onto the disk drive from the rest of the array.

```
+----------------------------------------------------------------------------+
|                                                                            |
|                                                                            |
|   +--------------------------------------------------------------------+   |
|   |CONFIG   SSA Configurator and Service Aids     Vyymmdd    XX Version|   |
|   +--------------------------------------------------------------------+   |
|         +---------------------------+                                      |
|         |          Main Menu        |                                      |
|         +---------------------------|                                      |
|         |              +---------------------+                            |
|         |  New Disks +----| View RAID-X Arrays   |---+                    |
|         |  Free Resou|    +---------------------|   |                     |
|         |  System Res+----| att+-----------------------------------+      |
|         |  SSA Adapte|    | att|    Members of RAID-X Arrays   |     |      |
|         |  Event/Erro|    | att+-----------------------------------|      |
|         |  Service Ai|    | att|                                   |      |
|         |  About     |    | Vie|1.  UIDxxxxg    Online             |      |
|         |            +----|    |2.  UIDyyyyg    Online (rebuilding)|      |
|         |                 |    |3.  UIDggggg    Online             |      |
|         |                 |    |                                   |      |
|         |                 +----+-----------------------------------+      |
|         +---------------------------+                                      |
|    +------------------------------------------------------------+         |
|    |<ESCAPE> Exit  <ENTER> Select  <F1> Help                    |         |
|    |<F9> FlashOn  <F10> FlashOff  <F7> Exchange Members          |         |
|    +------------------------------------------------------------+         |
|                                                                            |
|                                                                            |
+----------------------------------------------------------------------------+
```

The old member returns to the free state.

5.6 Deleting an Array

Before deleting an array, delete any operating-system-partition definitions that affect the array.

There are two steps to be performed if you want to delete the definition of an array from the system:

1. From the Main Menu, select **System Resources**. A window opens showing the list of all resources currently defined to the system:

```
+-------------------------------------------------------------------------------+
|                                                                               |
|                                                                               |
|  +-------------------------------------------------------------------------+  |
|  |CONFIG   SSA Configurator and Service Aids     Vyymmdd     XX Version|  |
|  +-------------------------------------------------------------------------+  |
|         +---------------------------+                                          |
|         |           Main Menu       |                                          |
|         +---------------------------|                                          |
|         |               +-------------------------------------------------+  |
|         |  New Disks  |          List of System Resources               |  |
|         |  Free Resour+-------------------------------------------------|  |
|         |  System Reso|SSA UID/Array Name      Status      Adapter Disk |  |
|         |  SSA Adapter|1. xxxxxxxxx            Online         15     14h |  |
|         |  Event/Error|2. UID4xxxxx           Online         15     16h |  |
|         |  Service Aid|3. FUDI00xxx           Online         16     17h |  |
|         |  About      |                                                 |  |
|         |             |                                                 |  |
|         |             |                                                 |  |
|         |             +-------------------------------------------------+  |
|         |                          |                                       |
|         +---------------------------+                                       |
|    +-----------------------------------------------------------------+      |
|    |<ESCAPE> Exit  <ENTER> Select  <INSERT> Insert  <DELETE> Delete |      |
|    |<F1> Help  <F9> FlashOn  <F10> FlashOff                         |      |
|    +-----------------------------------------------------------------+      |
|                                                                               |
|                                                                               |
+-------------------------------------------------------------------------------+
```

Highlight the entry for the array that you want to delete, make a note of its adapter number and array name, press Delete, and confirm the deletion at the prompt.

2. From the SSA Main Menu, select **SSA Adapter List**. The SSA Adapter List window opens:

```
+-------------------------------------------------------------------------------+
|                                                                               |
|                                                                               |
|  +-------------------------------------------------------------------------+  |
|  |CONFIG   SSA Configurator and Service Aids     Vyymmdd     XX Version|  |
|  +-------------------------------------------------------------------------+  |
|         +---------------------------+                                          |
|         |           Main Menu       |                                          |
|         +---------------------------|                                          |
|         |                           |                                          |
|         |  New Disks                |                                          |
|         |  Free Resources           |                                          |
|         |  Syst+-----------------------------------------+                     |
|         |  SSA |          SSA Adapter List               |                     |
|         |  Even+-----------------------------------------|                     |
|         |  Serv| Bus X  Device Y  Slot Z  Adapter   (Q) |                     |
|         |  Abou| Bus X  Device N  Slot T  Adapter   (S) |                     |
|         |      |                                         |                     |
|         |      +-----------------------------------------+                     |
|         |                           |                                          |
|         |                           |                                          |
|         +---------------------------+                                          |
|    +-----------------------------------------------------------------+        |
|    |<ESCAPE> Exit  <ENTER> Select  <F1> Help                        |        |
|    +-----------------------------------------------------------------+        |
|                                                                               |
|                                                                               |
+-------------------------------------------------------------------------------+
```

Select the adapter that controls the array that you want to delete (you noted the details of this adapter in step 1). The adapter-menu window opens:

```
+-------------------------------------------------------------------------------+
|                                                                               |
|                                                                               |
|   +-----------------------------------------------------------------------+   |
|   |CONFIG   SSA Configurator and Service Aids     Vyymmdd     XX Version|   |
|   +-----------------------------------------------------------------------+   |
|          +---------------------------+                                         |
|          |         Main M+-------------------------------------------+         |
|          +-------------| Bus X  Device Y  Slot Z  Adapter    (Q) |         |
|          |             +-------------------------------------------|         |
|          |   New Disks  | RAID-0 Arrays                             |         |
|          |   Free Resour| RAID-1 Arrays                             |         |
|          |   Syst+------| RAID-5 Arrays                             |         |
|          |   SSA |      | Rejected Disks                            |         |
|          |   Even+------| Non-Volatile RAM                          |         |
|          |   Serv| Bus X| Hot-spare Disks                           |         |
|          |   Abou| Bus X| Run Concurrent Diagnostics                |         |
|          |       |      | Run Non-Concurrent Diagnostics            |         |
|          |       +------| View Adapter VPD                          |         |
|          |       |      | Disk Service Aids                         |         |
|          |       |      +-------------------------------------------+         |
|          +---------------------------+                                         |
|      +-----------------------------------------------------------+            |
|      |<ESCAPE> Exit  <ENTER> Select  <F1> Help                   |            |
|      +-----------------------------------------------------------+            |
|                                                                               |
|                                                                               |
+-------------------------------------------------------------------------------+
```

Select the type of the array that you want to delete. You can scroll the contents of the window by using the arrow keys. A list of the arrays of this type controlled by this adapter appears in a new window:

```
+-------------------------------------------------------------------------------+
|                                                                               |
|                                                                               |
|   +-----------------------------------------------------------------------+   |
|   |CONFIG   SSA Configurator and Service Aids     Vyymmdd     XX Version|   |
|   +-----------------------------------------------------------------------+   |
|          +---------------------------+                                         |
|          |         Main M+-------------------------------------------+         |
|          +-------------| Bus X  Device Y  Slot Z  Adapter    (Q) |         |
|          |             +-------------------------------------------|         |
|          |   New Disks  | RAID-0 Arrays                             |         |
|          |   Free Resour| RAID-1 A+-------------------------------+|         |
|          |   Syst+------| RAID-5 A|    List of RAID-X Arrays      ||         |
|          |   SSA |      | Rejected+-------------------------------||         |
|          |   Even+------| Non-Vola|Array name        Status       ||         |
|          |   Serv| Bus X| Hot-spar|1.  xxxxxxxx      yyyyyyy      ||         |
|          |   Abou| Bus X| Run Conc|2.  FF00xxxx      qqqqqqq      ||         |
|          |       |      | Run Non-+-------------------------------+|         |
|          |       +------| View Adapter VPD                          |         |
|          |       |      | Disk Service Aids                         |         |
|          |       |      +-------------------------------------------+         |
|          +---------------------------+                                         |
|      +-----------------------------------------------------------+            |
|      |<ESCAPE> Exit  <ENTER> Select  <INSERT> Insert  <DELETE> Delete |        |
|      |<F1> Help  <F9> FlashOn  <F10> FlashOff <F8> Modify Attributes  |        |
|      +-----------------------------------------------------------+            |
|                                                                               |
|                                                                               |
+-------------------------------------------------------------------------------+
```

Put the cursor against the array to be deleted, press Delete, and confirm the deletion at the prompt.

These steps delete the array and returns its member disk drives to the free state.

For OS/2, after deleting an array, shutdown and reboot your operating system.

6.0 Chapter 6.   Getting the Latest Information

For the latest device drivers, firmware, and utility programs, call the IBM PC Company Bulletin Board System at:

```
+-------------------------------------------------------------------------+
¦ In the U.S.     ¦ 1-919-517-0001                                        ¦
+----------------+--------------------------------------------------------¦
¦ In Canada      ¦ -                                                      ¦
+----------------+--------------------------------------------------------¦
¦                ¦ In Markham:   905-316-4255                             ¦
+----------------+--------------------------------------------------------¦
¦                ¦ In Montreal:   514-938-3022                            ¦
+----------------+--------------------------------------------------------¦
¦                ¦ In Toronto:   416-492-1823                             ¦
+----------------+--------------------------------------------------------¦
¦                ¦ In Vancouver:  604-664-6466                            ¦
+-------------------------------------------------------------------------+
```

For detailed maintenance information on the adapter and its subsystem, refer to the *SSA RAID Adapter: Maintenance Information* manual, S32H-3817.

For detailed information on the operation of the adapter, refer to the *SSA RAID Adapter: Technical Reference* manual, SA33-3268.

For more information on IBM products or services, browse the IBM home page on the World Wide Web, its URL is:

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

```
or, for information (such as Service & Support or new BIOS flashes)
specifically about PC Servers, refer to:
```

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

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6.0 - 1

A.0 Appendix A.   Multiple-Adapter Installations

The following limitations apply to servers with multiple SSA RAID Adapters:

Up to two SSA RAID Adapters can be installed in a member of the PC Server 720 family of servers. Only 1 SSA RAID Adapter can be installed in other PC servers.

If two SSA RAID Adapters are installed, they must both be on the primary PCI bus (slots 6 and 7), if possible, or both on the secondary bus (slots 1 through 5).

A.0 Appendix A.   Multiple-Adapter Installations

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A.0 - 1

B.0 Appendix B. SSA RAID Adapter Service Request Numbers

"Array Problems" in topic 4.2 describes how errors are reported and logged for the adapter and the disk drives attached to it. These reports and logs contain service request numbers (SRNs) which lead to detailed descriptions of the problems.

The following table lists the SRNs that apply to the adapter card, with descriptions of each problem and what you should do to solve the problem. The *SSA RAID Adapter: Hardware Maintenance Manual Supplement* provides more details of these SRNs; this information is primarily for service representatives.

Other SRNs refer to the disk drives that are attached to the adapter and to the unit in which those disk drives are installed. For details of those SRNs, refer to the *Installation and User's Guide* or the *Hardware Maintenance Manual Supplement* for that unit.

SRN	Description	Action
20PAA	An open SSA link has been detected.	Call for service
21PAA to 29PAA	An SSA 'Threshold exceeded' link error has been detected.	Call for service
2A002	Async code 02 has been received. Probably, a software error has occurred.	Call for service
2A003	Async code 03 has been received. Probably, a software error has occurred.	Call for service
2A004	Async code 04 has been received. Probably, a software error has occurred.	Call for service
2FFFF	An async code that is not valid has been received.	Call for service
40000	The SSA adapter card has failed.	Exchange the adapter for a new one or call for service.
40004	A 4 MB DRAM module in adapter card slot 0 has failed.	Call for service or exchange the DRAM for a new one.
40008	An 8 MB DRAM module in adapter card slot 0 has failed.	Call for service or exchange the DRAM for a new one.
40016	A 16 MB DRAM module in adapter card slot 0 has failed.	Call for service or exchange the DRAM for a new one.
40032	A 32 MB DRAM module in adapter card slot 0 has failed.	Call for service or exchange the DRAM for a new one.
40064	A 6 MB DRAM module in adapter card slot 0 has failed.	Call for service or exchange the DRAM for a new one.
40128	A 128 MB DRAM module in adapter card slot 0 has failed.	Call for service or exchange the DRAM for a new one.
41004	A 4 MB DRAM module in adapter card slot 1 has failed.	Call for service or exchange the DRAM for a new one.
41008	An 8 MB DRAM module in adapter card slot 1 has failed.	Call for service or exchange the DRAM for a new one.
41016	A 16 MB DRAM module in adapter card slot 1 has failed.	Call for service or exchange the DRAM for a new one.
41032	A 32 MB DRAM module in adapter card slot 1 has	Call for service or exchange the DRAM for a new one.

```
¦         ¦ failed.                    ¦                             ¦
+---------+----------------------------+-----------------------------+
¦  41064  ¦ A 64 MB DRAM module in     ¦ Call for service or exchange ¦
¦         ¦ adapter card slot 1 has    ¦ the DRAM for a new one.      ¦
¦         ¦ failed.                    ¦                             ¦
+---------+----------------------------+-----------------------------+
¦  41128  ¦ A 128 MB DRAM module in    ¦ Call for service or exchange ¦
¦         ¦ adapter card slot 1 has    ¦ the DRAM for a new one.      ¦
¦         ¦ failed.                    ¦                             ¦
+---------+----------------------------+-----------------------------+
¦  42000  ¦ The SSA adapter has detected ¦ Call for service or:        ¦
¦         ¦ that both DRAM modules are ¦                             ¦
¦         ¦ failing.                   ¦ 1.  Check whether both DRAM  ¦
¦         ¦                            ¦     modules are correctly   ¦
¦         ¦                            ¦     installed on the adapter ¦
¦         ¦                            ¦     card.  Make any         ¦
¦         ¦                            ¦     necessary corrections.  ¦
¦         ¦                            ¦                             ¦
¦         ¦                            ¦ 2.  If this problem has     ¦
¦         ¦                            ¦     occurred immediately    ¦
¦         ¦                            ¦     after an upgrade to the ¦
¦         ¦                            ¦     adapter card, check     ¦
¦         ¦                            ¦     whether the correct type ¦
¦         ¦                            ¦     of DRAM modules have    ¦
¦         ¦                            ¦     been installed.  Make   ¦
¦         ¦                            ¦     any necessary           ¦
¦         ¦                            ¦     corrections.            ¦
¦         ¦                            ¦                             ¦
¦         ¦                            ¦ 3.  If the problem remains, ¦
¦         ¦                            ¦     exchange the adapter    ¦
¦         ¦                            ¦     card for a new one.  Do  ¦
¦         ¦                            ¦     not exchange any DRAM   ¦
¦         ¦                            ¦     modules yet.            ¦
¦         ¦                            ¦                             ¦
¦         ¦                            ¦ 4.  Install the DRAM modules ¦
¦         ¦                            ¦     from the original       ¦
¦         ¦                            ¦     adapter card onto the   ¦
¦         ¦                            ¦     new adapter card, then  ¦
¦         ¦                            ¦     install the new adapter ¦
¦         ¦                            ¦     card.                   ¦
¦         ¦                            ¦                             ¦
¦         ¦                            ¦ 5.  If the problem remains, ¦
¦         ¦                            ¦     exchange the DRAM       ¦
¦         ¦                            ¦     modules for new modules. ¦
¦         ¦                            ¦                             ¦
¦         ¦                            ¦ 6.  Install the new DRAM    ¦
¦         ¦                            ¦     modules onto the        ¦
¦         ¦                            ¦     original adapter card.  ¦
¦         ¦                            ¦     Reinstall the original  ¦
¦         ¦                            ¦     adapter card.           ¦
+---------+----------------------------+-----------------------------+
¦  42500  ¦ The SSA adapter has detected ¦ Call for service           ¦
¦         ¦ a failure in the write cache. ¦                            ¦
+---------+----------------------------+-----------------------------+
¦  43PAA  ¦ An SSA device is preventing ¦ Call for service           ¦
¦         ¦ the completion of the loop ¦                             ¦
¦         ¦ configuration.             ¦                             ¦
+---------+----------------------------+-----------------------------+
¦  45PAA  ¦ The SSA adapter has detected ¦ Call for service           ¦
¦         ¦ an open SSA loop.          ¦                             ¦
+---------+----------------------------+-----------------------------+
¦  46000  ¦ A RAID array is the Offline ¦ Call for service           ¦
¦         ¦ state because more than one ¦                             ¦
¦         ¦ disk drive is not available. ¦                            ¦
¦         ¦ At least one member disk   ¦                             ¦
¦         ¦ drive of the array is      ¦                             ¦
¦         ¦ present, but more than one ¦                             ¦
¦         ¦ member disk drive is missing. ¦                           ¦
+---------+----------------------------+-----------------------------+
¦  47000  ¦ An attempt has been made to ¦ Call for service           ¦
¦         ¦ store in the SSA adapter the ¦                            ¦
¦         ¦ details of more than 32 RAID ¦                            ¦
¦         ¦ arrays.                    ¦                             ¦
+---------+----------------------------+-----------------------------+
```

47500	Part of the RAID array data might have been lost.	Call for service
48000	The SSA adapter has detected a loop configuration that is not valid.	Go to "SSA Loop Configurations that Are Not Valid" in topic B.1 or call for service
49000	A RAID array is in the Degraded state because a disk drive is not available to the array, and a write command has been sent to that array. A disk drive might not be available for one of the following reasons: The disk drive has failed. The disk drive has been removed from the subsystem. An SSA link has failed. A power failure has occurred.	Call for service
49100	A RAID array is in the Exposed state because a disk drive is not available to the array. A disk drive can become not available for several reasons: The disk drive has failed. The disk drive has been removed from the subsystem. An SSA link has failed. A power failure has occurred.	Call for service
49500	No hot-spare disk drives are available for a RAID array that is configured for hot-spare disk drives.	Call for service
49700	The parity for the RAID array is not complete.	Call for service
50000	The SSA adapter failed to respond to the device driver.	Exchange the adapter card for a new one or call for service
50001	A data parity error has occurred.	Exchange the adapter card for a new one or call for service
50002	An SSA adapter DMA error has occurred.	Exchange the adapter card for a new one or call for service
50004	Channel check.	Exchange the adapter card for a new one or call for service
50005	A software error has occurred.	Call for service
50006	A channel check has occurred.	Exchange the adapter card for a new one or call for

```
¦          ¦                            ¦ service                     ¦
+---------+----------------------------+-----------------------------¦
¦  50007  ¦ The IOCC detected an internal ¦ Exchange the adapter card ¦
¦         ¦ error.                     ¦ for a new one or call for   ¦
¦         ¦                            ¦ service                     ¦
+---------+----------------------------+-----------------------------¦
¦  50008  ¦ Unable to read or write the ¦ Exchange the adapter card  ¦
¦         ¦ PCI registers.             ¦ for a new one or call for   ¦
¦         ¦                            ¦ service                     ¦
+---------+----------------------------+-----------------------------¦
¦  50010  ¦ An SSA adapter or device   ¦ Call for service            ¦
¦         ¦ drive protocol error has   ¦                             ¦
¦         ¦ occurred.                  ¦                             ¦
+---------+----------------------------+-----------------------------¦
¦  50012  ¦ The SSA adapter microcode has ¦ Call for service         ¦
¦         ¦ hung.                      ¦                             ¦
+---------+----------------------------+-----------------------------¦
¦  D4000  ¦ The diagnostics cannot     ¦ Exchange the adapter card   ¦
¦         ¦ configure the SSA adapter. ¦ for a new one or call for   ¦
¦         ¦                            ¦ service                     ¦
+---------+----------------------------+-----------------------------¦
¦  D4100  ¦ The diagnostics cannot open ¦ Exchange the adapter card  ¦
¦         ¦ the SSA adapter.           ¦ for a new one or call for   ¦
¦         ¦                            ¦ service                     ¦
+---------+----------------------------+-----------------------------¦
¦  D4300  ¦ The diagnostics have detected ¦ Exchange the adapter card ¦
¦         ¦ an SSA adapter POST failure. ¦ for a new one or call for  ¦
¦         ¦                            ¦ service                     ¦
+---------+----------------------------+-----------------------------¦
¦  DFFFF  ¦ A command or parameter that ¦ Call for service           ¦
¦         ¦ has been sent or received is ¦                           ¦
¦         ¦ not valid.  This problem is ¦                            ¦
¦         ¦ caused either by the SSA   ¦                             ¦
¦         ¦ adapter, or by an error in ¦                             ¦
¦         ¦ the microcode.             ¦                             ¦
+--------------------------------------------------------------------+
```

Subtopics
B.1 SSA Loop Configurations that Are Not Valid

B.1 SSA Loop Configurations that Are Not Valid

Note: This section is related to SRN 48000.

SRN 48000 shows that the SSA loop contains more devices or adapters than are allowed.

Each of the 2 pairs of SSA ports on a SSA RAID Adapter can attach up to 48 devices in a closed loop.

Only one SSA RAID Adapter adapter can be included in a loop.

If the SRN occurred when you turned on the server:

1. Turn off the server.

2. Review the configuration that you are trying to make, and determine why that configuration is not valid.

3. Correct your configuration by reconfiguring the SSA cables or by removing the excess devices or adapters from the loop.

4. Turn on the server.

If the SRN occurred because additional devices or adapters were added to a working SSA loop:

1. Remove the additional devices or adapters that are causing the problem, and put the loop back into its original working configuration.

    Note: *It is important that you do these actions*, because they enable the configuration code to reset itself from the effects of the error.

2. Review the configuration that you are trying to make, and determine why that configuration is not valid.

3. Correct your configuration by reconfiguring the SSA cables or by removing the excess devices or adapters from the loop.

C.0 Appendix C.   Introducing SSA and RAID
This chapter describes:

    Serial storage architecture (SSA

    The RAID functions that are provided by the SSA RAID Adapter

```
Subtopics
C.1 Serial Storage Architecture (SSA)
C.2 RAID Functions
```

C.0 Appendix C.   Introducing SSA and RAID

C.1 Serial Storage Architecture (SSA)

Serial Storage Architecture (SSA) is an industry-standard interface that provides high-performance fault-tolerant attachment of I/O storage devices. SSA is an open standard, and SSA specifications have been approved by the SSA Industry Association and are in the process of being approved as an ANSI standard through the ANSI X3T10.1 subcommittee.

In SSA subsystems, transmissions to several destinations are multiplexed; the effective bandwidth is further increased by spatial reuse of the individual links. Commands are forwarded automatically from device to device along a loop until the target device is reached. Multiple commands can be travelling around the loop simultaneously. SSA retains the SCSI-2 commands, queuing model, and status and sense bytes.

```
Subtopics
C.1.1 SSA Loops and Links
C.1.2 Rules for SSA Loops
```

C.1.1 SSA Loops and Links

In the simplest SSA configuration, SSA devices are connected through two or more SSA links to an SSA adapter that is located in the system unit. The devices, SSA links, and SSA adapter are configured in loops. Each loop provides a data path that starts at one connector of the SSA adapter and passes through a link (SSA cable) to the devices. The loop continues through the devices, then returns through another link to a second connector on the SSA adapter.

The maximum permitted length for an external cable that connects two SSA nodes (for example, disk drives) is 25 meters (82 feet).

Details of the rules for configuring SSA loops are given for each SSA adapter in "Rules for SSA Loops" in topic C.1.2.

```
Subtopics
C.1.1.1 Loops and Data Paths
```

C.1.1 SSA Loops and Links

C.1.1.1 Loops and Data Paths

All devices that are attached to an SSA adapter card 1 are connected through SSA links 2 . The SSA links are configured in loops. Data and commands to a particular device pass through all other devices on the link between the adapter and the target device.

Data can travel in either direction round a loop. The adapter can, therefore, get access to the devices 3 (disk drives in this example) through two data paths. The system cannot detect which data path is being used.
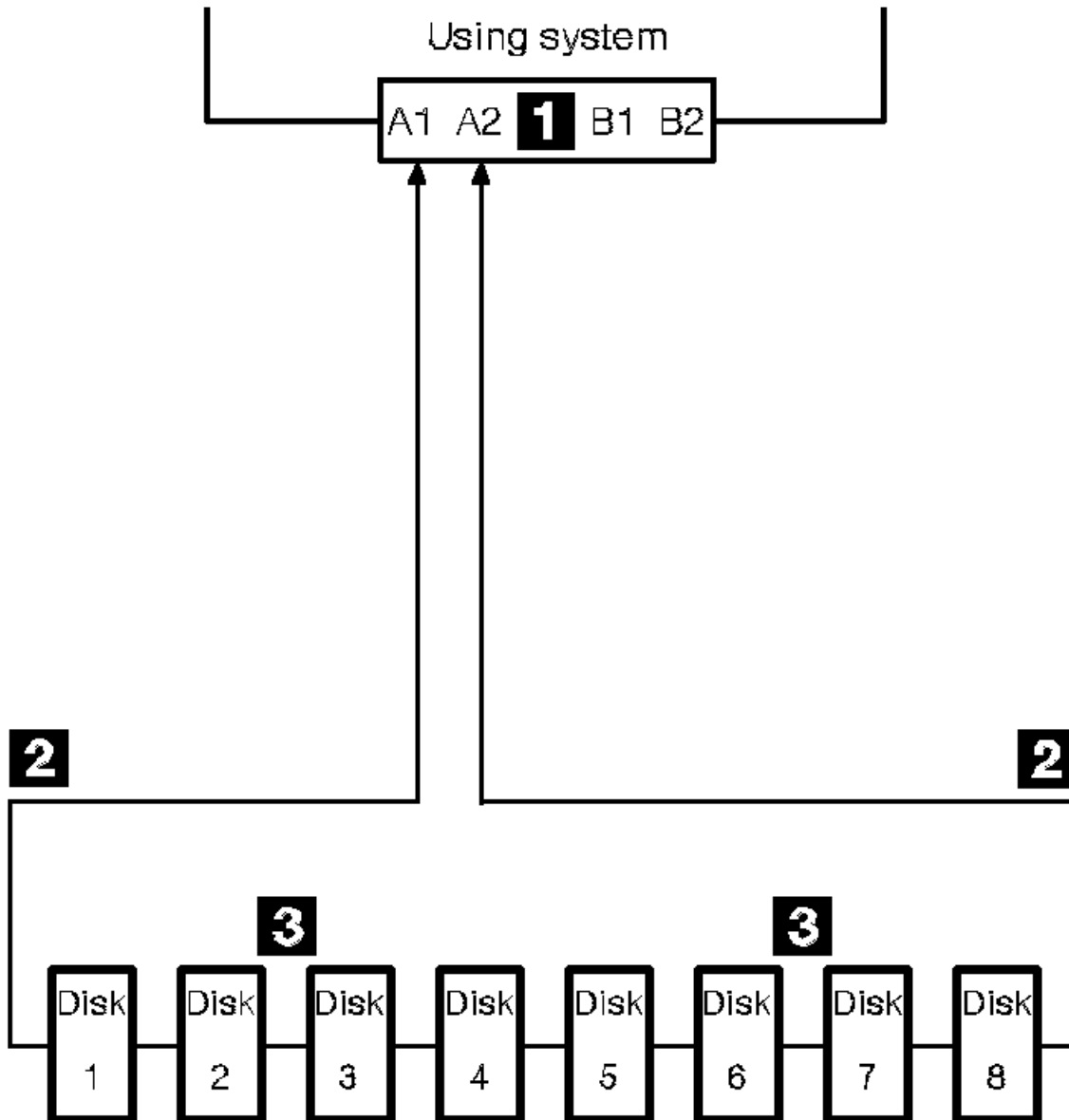
If a disk drive fails, or is turned off, the loop is broken, and one of the data paths to a particular disk drive is no longer available. The disk drives on the remains of the loop continue to work, but an error is reported to the system.

In the diagram, disk drive number 3 has failed. Disk drives 1 and 2 can communicate with the system only through connector A1 of the SSA adapter. Disk drives 4 through 8 can communicate only through connector A2 of the SSA adapter.

Using system

A1 A2 **1** B1 B2

Disk 1   Disk 2   ~~Disk 3~~   Disk 4   Disk 5   Disk 6   Disk 7   Disk 8
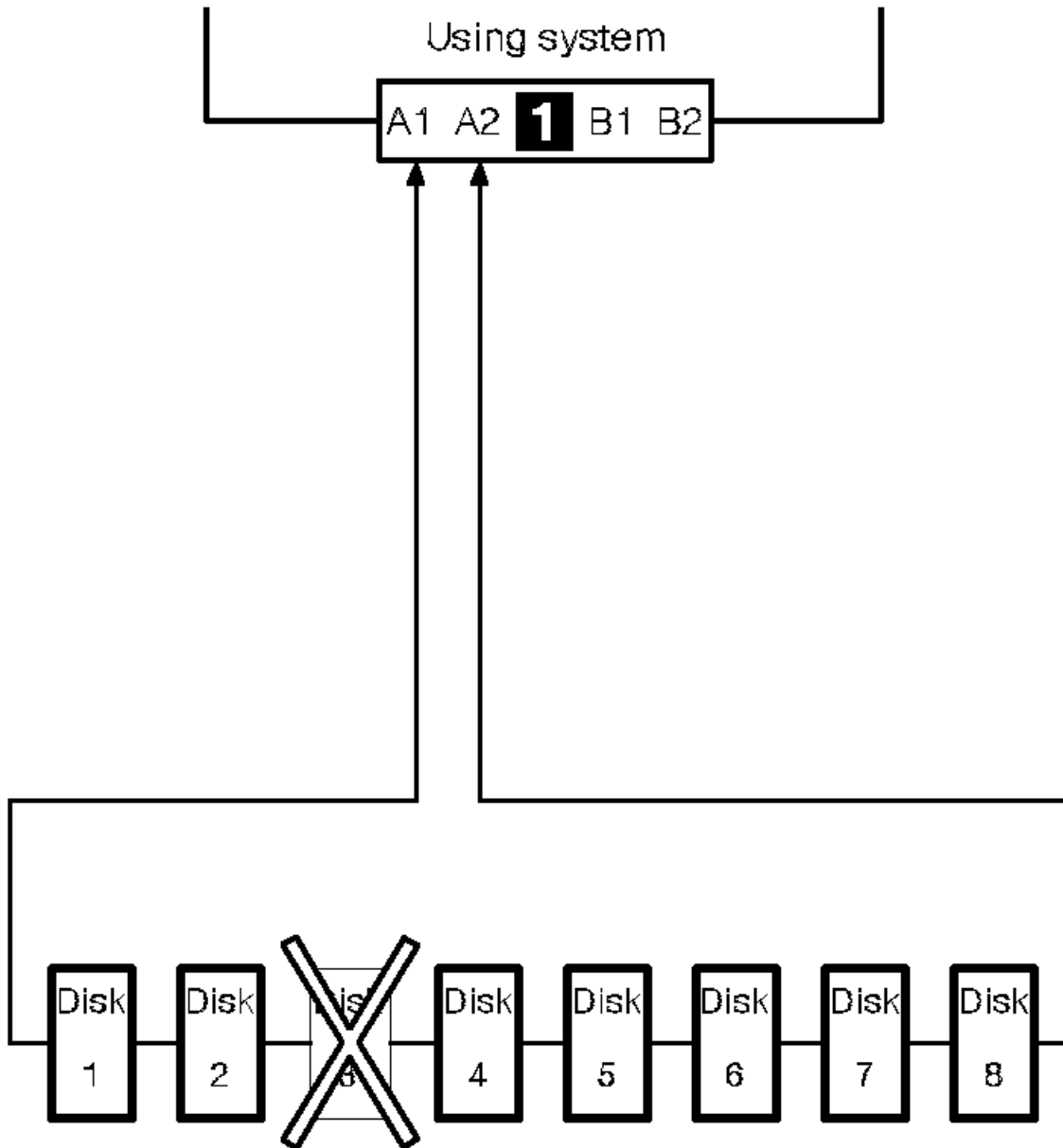
If two or more disk drives are turned off, fail, or are removed from the loop, some disk drives might become isolated from the SSA adapter.

In the diagram, disk drives 3 and 7 have been removed. Disk drives 1 and 2 can communicate with the system only through connector A1 of the SSA adapter. Disk drive number 8 can communicate with the system only through connector A2 of the SSA adapter. Disk drives 4, 5, and 6 are isolated from the SSA adapter.

Using system

A1 A2 **1** B1 B2

Disk
1

Disk
2

Disk
X
3

Disk
4

Disk
5

Disk
6

Disk
X
7

Disk
8

C.1.1.1 - 3
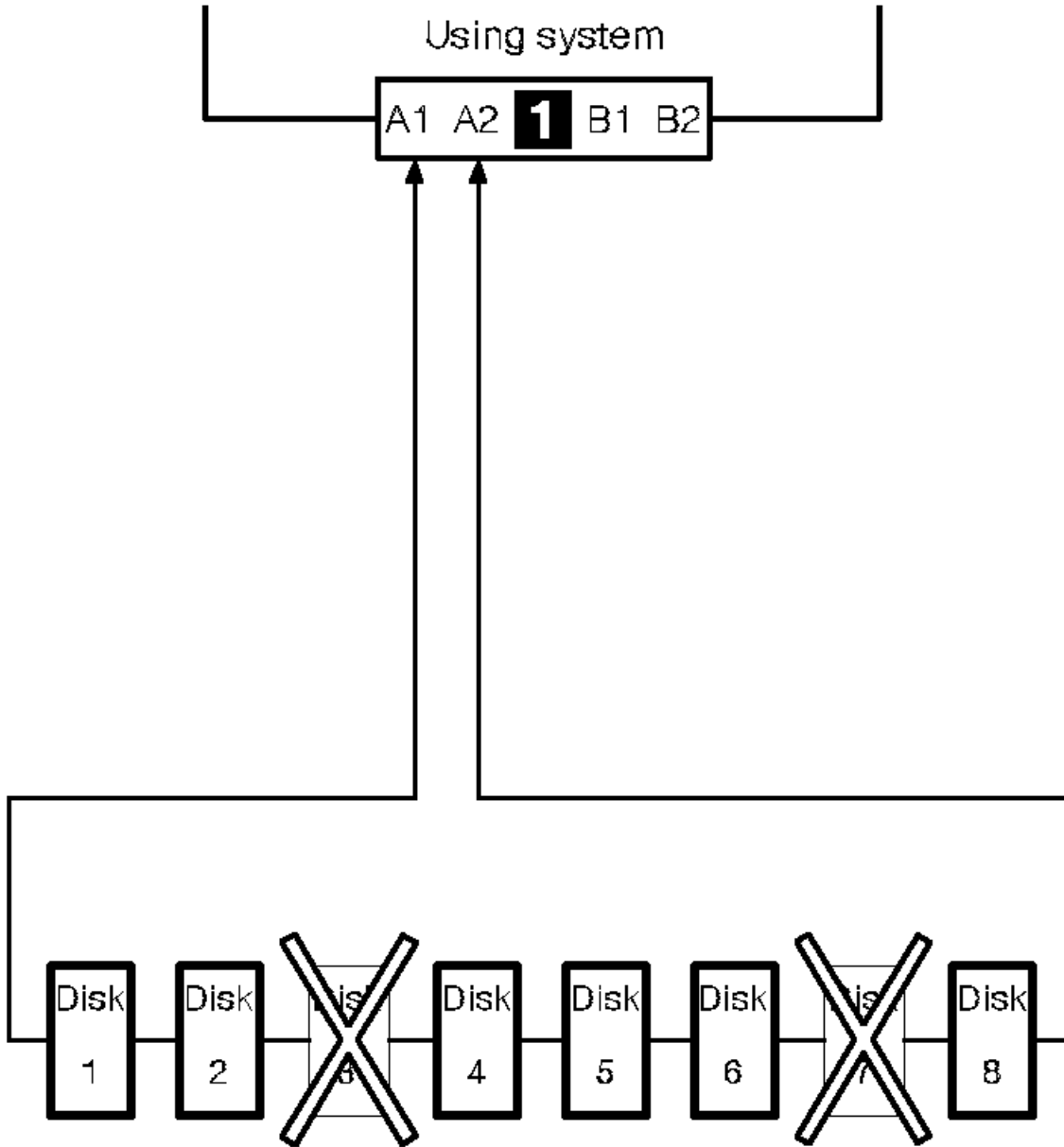
C.1.2 Rules for SSA Loops

For SSA loops that include the SSA RAID Adapter, the following rules apply:

Each SSA loop must be connected to a valid pair of connectors on the SSA adapter (that is, either connectors A1 and A2, or connectors B1 and B2).

A maximum of 48 devices can be connected in a particular SSA loop

Only one pair of adapter connectors can be connected in a particular SSA loop

C.1.2 Rules for SSA Loops

C.2 RAID Functions

Redundant Array of Independent Disks (RAID) technology gives you:

    Larger disk capacit
    Immediate availability and, depending on the RAID level, recovery of dat
    Redundancy of data at a level that you can choose

RAID technology stores data across groups of disk drives that are known as *disk arrays*. Subject to the level of RAID that you are using, this method of data storage provides the data redundancy that is needed for a secure system, and can allow faster retrieval of data through multiple channel access. Also, if a disk drive fails, you can normally exchange that disk drive without interruption of normal system operation.

The disk arrays can provide data redundancy that ensures that no data is lost if one disk drive in the array fails. The method that is used to write data to an array is related to the level of RAID that you are using. Disk arrays are contained in array subsystems. You can configure your subsystem with one or more arrays.

The SSA RAID Adapter provides RAID-0, RAID-1, and RAID-5 facilities and access to individual SSA disk drives that are not configured as members of an array.

Subtopics
C.2.1 RAID-0
C.2.2 RAID-1
C.2.3 RAID-5
C.2.4 Hot Spares
C.2.5 Disk Array States

C.2 RAID Functions

C.2.1 RAID-0

RAID-0 is also known as striping, it does not provide redundancy and, therefore, cannot survive the failure of a member. It does provide a single large data space with the operations spread evenly across members. Short operations usually involve only one member, longer transfers use several simultaneously and can, therefore, give higher data rates.

C.2.1 RAID-0

C.2.2 RAID-1

RAID-1 is also known as mirroring or dual copy. It provides redundancy with better performance than a single disk, but requires real disk capacity of two times the data size.

A RAID-1 array has two disk drive members. If the members have different capacities, the resulting RAID-1 array has the capacity of the smaller member. Each data block of the array is written on each of the two members.

If one member fails, operations continue, to the good member. Performance is degraded for read operations (because read operations cannot now be shared between the two members), and improved for write operations (because only a single member is written). So a mixed workload may not show any change in overall performance. When a member returns or it is replaced (either manually or automatically by the hot-spare mechanism), a rebuild occurs. This rebuild is performed in parallel with any activity to the array.

C.2.2 RAID-1

C.2.3 RAID-5

RAID-5 arrays write strips of data across all but one member of the array. Parity for the other strips is written on the last member. The members of the array are used in rotation for the parity data.

RAID-5 arrays offer data protection , good throughput, and require fewer disks than RAID-1.

C.2.3 RAID-5

C.2.4 Hot Spares

A hot-spare disk drive is a disk drive that is defined for automatic use if a disk drive within an array fails. The hot-spare must have a storage capacity greater than or equal to that of the smallest member of an array. You can define as many hot spares as you want. Any RAID-1 and RAID-5 array on an adapter can use the hot-spare disk drives on that adapter.

If a disk drive within an array fails, at the next write operation to the array, the adapter automatically uses a hot spare instead of the failed disk drive, and rebuilds the data that was on the failed disk on to the hot spare.

C.2.4 Hot Spares

C.2.5 Disk Array States

A disk array can be in one of several states. Those states are described here.

Subtopics
C.2.5.1 Good State
C.2.5.2 Exposed State
C.2.5.3 Degraded State
C.2.5.4 Rebuilding State
C.2.5.5 Offline State

C.2.5 Disk Array States

C.2.5.1 Good State

A disk array is in the Good state when all the member disk drives of that disk array are present and functioning correctly.

C.2.5.1 Good State

C.2.5.2 Exposed State

A disk array enters the Exposed state when a member disk drive becomes missing (logically or physically) from that array. When a disk array is in the Exposed state, you can reintroduce the missing disk drive, or exchange it for a new one. If necessary, the array management software rebuilds the data that was on the original disk drive before it became missing, then writes that rebuilt data to the replacement disk drive. When the data is correct, the array management software returns the disk array to the Good state.

Read Operations while in the Exposed State: When a read operation is performed on a disk array that is in the Exposed state, the array management software recreates (rebuilds) the data that was contained on the missing disk drive.

Write Operations while in the Exposed State: When a write command is sent to a disk array that is in the Exposed state, the state of the array is changed to Degraded.

C.2.5.2 Exposed State

C.2.5.3 Degraded State

A disk array enters the Degraded state if, while in the Exposed state, it receives a write command.

If a hot spare disk drive is enabled and available, when the first write command is sent, the array management software immediately exchanges the missing disk for the hot spare, rebuilds the data on it, and returns the disk to the Good state.

If no hot spare disk drive is available, and a write operation is performed on the array, the disk array remains in the Degraded state until you take action to return that disk array to the Good state. While in this state, there is an exposure to data loss if a write operation cannot be completed because of a loss of electrical power, for example. Therefore, it is recommended that you always have a hot spare available.

If no hot spare disk drive is available, you exchange the failed disk drive for a new one. The array management software starts a rebuild operation to write the original data to the new disk drive from the data that is contained in the other disk drives of the array. This action returns the disk array to the Good state.

Attention: In this mode of operation, one data check can cause the loss of a large amount of data (more than 64 KB). The array management software must do a complete rebuild of the disk array to recover the data.

C.2.5.4 Rebuilding State

A disk array enters Rebuilding state after a missing disk has been replaced. When the disk array is in this state, all the member disk drives are present, but the data and parity are being rebuilt on the replaced disk drive. The array management software allows read and write operations on a disk drive that is in Rebuilding state. If the power fails before the rebuilding is complete, the array management software continues the rebuilding operation when the power returns for those strips not yet rebuilt.

C.2.5.4 Rebuilding State

C.2.5.5 Offline State

A disk array enters Offline state when two or more disk drives become missing. Read and write operations are not allowed.

C.2.5.5 Offline State

D.0 Appendix D. Product Warranty and Notices

International Business Machines Corporation   Armonk, New York, 10504

D.1 Statement of Limited Warranty

The warranties provided by IBM in this Statement of Limited Warranty apply only to Machines you originally purchase for your use, and not for resale, from IBM or an IBM authorized reseller. The term "Machine" means an IBM machine, its features, conversions, upgrades, elements, or accessories, or any combination of them. Machines are subject to these terms only if purchased in the United States or Puerto Rico, or Canada, and located in the country of purchase. If you have any questions, contact IBM or your reseller.

```
+-----------------------------------------------------------------------+
¦                                                                       ¦
¦                                                                       ¦
¦  Machine:  SSA RAID Adapter for PC Servers                            ¦
¦                                                                       ¦
¦                                                                       ¦
¦  Warranty Period*:  Three years                                       ¦
¦                                                                       ¦
¦                                                                       ¦
¦  *Elements and accessories are warranted for three months.  Contact   ¦
¦  your place of purchase for warranty service information.             ¦
¦                                                                       ¦
+-----------------------------------------------------------------------+
```

Subtopics
D.1.1 Production Status
D.1.2 The IBM Warranty
D.1.3 Warranty Service
D.1.4 Extent of Warranty
D.1.5 Limitation of Liability

D.1.1 Production Status

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

D.1.1 Production Status

D.1.2 The IBM Warranty

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

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

For a feature, conversion, or upgrade, IBM or your reseller may require that the Machine on which it is installed be 1) the designated, serial-numbered Machine and 2) at an engineering-change level compatible with the feature, conversion, or upgrade. Some of these transactions (called "Net-Priced" transactions) may include additional parts and associated replacement parts that are provided on an exchange basis. All removed parts become the property of IBM and must be returned to IBM.

Replacement parts assume the remaining warranty of the parts they replace.

If a Machine does not function as warranted during the warranty period, IBM or your reseller will repair or replace it (with a Machine that is at least functionally equivalent) without charge. If IBM or your reseller is unable to do so, you may return it to your place of purchase and your money will be refunded.

If you transfer a Machine to another user, warranty service is available to that user for the remainder of the warranty period. You should give your proof of purchase and this Statement to that user.

D.1.2 The IBM Warranty

D.1.3 Warranty Service

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

Depending on the Machine, the service may be 1) a "Repair" service at your location (called "On-site") or at one of IBM's or a reseller's service locations (called "Carry-in") or 2) an "Exchange" service, either On-site or Carry-in.

When a type of service involves the exchange of a Machine or part, the item IBM or your reseller replaces becomes its property and the replacement becomes yours. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced.

It is your responsibility to:

1. obtain authorization from the owner (for example, your lessor) to have IBM or your reseller service a Machine that you do not own;

2. where applicable, before service is provided --

    a. follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provide,

    b. secure all programs, data, and funds contained in a Machine,

    c. inform IBM or your reseller of changes in a Machine's location, and

    d. for a Machine with exchange service, remove all features, parts, options, alterations, and attachments not under warranty service. Also, the Machine must be free of any legal obligations or restrictions that prevent its exchange; and

3. be responsible for loss of, or damage to, a Machine in transit when you are responsible for the transportation charges.

D.1.4 Extent of Warranty

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

Misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, or failure caused by a product for which IBM is not responsible may void the warranties.

THESE WARRANTIES REPLACE ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HOWEVER, SOME LAWS DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES. IF THESE LAWS APPLY, THEN ALL EXPRESS AND IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE WARRANTY PERIOD. NO WARRANTIES APPLY AFTER THAT PERIOD.

In Canada, warranties include both warranties and conditions.

Some jurisdictions do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

D.1.5 Limitation of Liability

Circumstances may arise where, because of a default on IBM's part (including fundamental breach) or other liability (including negligence and misrepresentation), you are entitled to recover damages from IBM. In each such instance, regardless of the basis on which you are entitled to claim damages, IBM is liable only for:

1. bodily injury (including death), and damage to real property and tangible personal property; and

2. the amount of any other actual loss or damage, up to the greater of $100,000 or the charge for the Machine that is the subject of the claim.

Under no circumstances is IBM liable for any of the following:

1. third-party claims against you for losses or damages (other than those under the first item listed above);

2. loss of, or damage to, your records or data; or

3. economic consequential damages (including lost profits or savings) or incidental damages, even if IBM is informed of their possibility.

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Some jurisdictions do not allow the exclusion or limitation of incidental
or consequential damages, so the above limitation or exclusion may not
apply to you.
```

This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

D.2 Notices

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Any examples of parameters or definitions are for guidance only. Some details may differ from the requirements in your environment. Contact your IBM representative if you need further assistance.

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D.2 Notices

D.3 Trademarks

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`IBM`   `OS/2`

NetWare is a trademark of Novell, Incorporated.

Microsoft and Windows are trademarks or registered trademarks of Microsoft Corporation.

D.3 Trademarks

_ Copyright IBM Corp. 1996
D.3 - 1

D.4 Communications Statements

The following statements apply to this product. The statements for other products intended for use with this product appear in their accompanying manuals.

```
Subtopics
D.4.1 Federal Communications Commission (FCC) Statement
D.4.2 VCCI Statement
D.4.3 International Electrotechnical Commission (IEC) Statement
D.4.4 Avis de conformité aux normes de l'Industrie Canada
D.4.5 Industry Canada Compliance Statement
D.4.6 United Kingdom Telecommunications Requirements
D.4.7 EC Council Directive
D.4.8 Radio Protection for Germany
```

D.4 Communications Statements

D.4.1 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 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 (part numbers 07H9163, 07H8985, 32H1465, 88G6404, 32H1466, or 88G6406, or their equivalents) must be used in order to meet FCC emission limits. Neither the provider nor the manufacturer is 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 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.

電波障害自主規制　届出装置の記述

```
　この装置は，第一種情報装置（商工業地域において使用されるべき情報装置）
で商工業地域での電波障害防止を目的とした情報処理装置等電波障害自主規制協
議会（VCCI）基準に適合しております。
　従って，住宅地域またはその隣接した地域で使用すると，ラジオ，テレビジョ
ン受信機等に受信障害を与えることがあります。
　取扱説明書に従って正しい取り扱いをしてください。
```

D.4.2 VCCI Statement

The following is a summary of the VCCI Japanese statement in the box above.

```
+------------------------------------------------------------------------+
¦ This equipment is Type 1 Data Processing Equipment and is intended for ¦
¦ use in commercial and industrial areas.  When used in a residential    ¦
¦ area, or areas of proximity, radio and TV reception may be subject to  ¦
¦ radio interference.  VCCI-1.                                           ¦
+------------------------------------------------------------------------+
```

D.4.3 International Electrotechnical Commission (IEC) Statement

This product has been designed and built to comply with (IEC) Standard 950.

D.4.4 Avis de conformité aux normes de l'Industrie Canada

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

D.4.5 Industry Canada Compliance Statement

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

D.4.6 United Kingdom Telecommunications Requirements

This apparatus is manufactured to the International Safety Standard EN60950 and as such is approved in the U.K. under approval number NS/G/1234/J/100003 for indirect connection to public telecommunications systems in the United Kingdom.

D.4.7 EC Council Directive

This product is in conformity with the requirements of the following EC directives:

Council Directive 73/23/EEC on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility

Neither the provider or the manufacturer can accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of option cards not supplied by the manufacturer.

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.

Properly shielded and grounded cables and connectors (part numbers 07H9163, 07H8985, 88G6403, 88G6404, 31H7962, or 88G6406, or their equivalents) must be used in order to reduce the potential for causing interference to radio and TV communications and to other electrical or electronic equipment. Such cables and connectors are available from the provider or manufacturer. Neither the provider or manufacturer can accept responsibility for any interference caused by using other than recommended cables and connectors.

D.4.8 Radio Protection for Germany

Dieses Gerät ist berechtigt in Übereinstimmung mit dem deutschen EMVG vom 9.Nov. das EG-Konformitätszeichen zu führen.

Der Aussteller der Konformitätserklärung ist die IBM Germany.

Dieses Gerät erfüllt die Bedingungen der EN 55022 Klasse A. Für diese Klasse von Geräten gilt folgende Bestimmung nach dem EMVG:

Geräte dürfen an Orten, für die sie nicht ausreichend entstört sind, nur mit besonderer Genehmigung des Bundesministers für Post und Telekommunikation oder des Bundesamtes für Post und Telekommunikation betrieben werden. Die Genehmigung wird erteilt, wenn keine elektromagnetischen Störungen zu erwarten sind.

(Auszug aus dem EMVG vom 9.Nov.92, Para.3, Abs.4)

Hinweis:

Dieses Genehmigungsverfahren ist von der Deutschen Bundespost noch nicht veröffeentlicht worden.

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