IBM PC Servers

IBM Advanced SerialRAID/X Adapter: User's Guide and Maintenance Information

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IBM Advanced SerialRAID/X Adapter: User's Guide and Maintenance Information

SA33-3288-02

Contents

Safety Notices

Before servicing an IBM product, be sure to review the Safety Information in the manual for your system.

Definitions of Safety Notices

A *danger* notice indicates the presence of a hazard that has the potential of causing death or serious personal injury.

This book contains no *danger* notices.

A *caution* notice indicates the presence of a hazard that has the potential of causing moderate or minor personal injury.

This book contains two *caution* notices. Those caution notices are in this safety section.

An *attention* notice indicates an action that could cause damage to a program, device, system, or data.

Safety Notice for Installing, Relocating, or Servicing

Before connecting or removing any cables to or from connectors at the system unit, be sure to follow the steps in the installation or relocation checklist specified in the *Installation and Service Guide*, or equivalent, for your system unit. For safety checks when servicing, refer to that manual and to the *Installation and Service Guide* for your SSA enclosure (or subsystem).

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 contents to water. Keep away from children. Replace only with the part number specified with 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 Advanced SerialRAID/X Adapter contains a lithium battery.

CAUTION:
The fast-write cache card contains a nickel-cadmium (NiCad) battery. To avoid possible explosion, do not incinerate the battery. Exchange it only with an IBM-approved part. Recycle or discard the battery as instructed by local regulations and where recycling facilities exist.

In the United States, IBM has established a process for the collection of this battery. Please call 1-800-426-4333 for information. Before you call, please have available the IBM part number for the battery assembly.

About This Book

Who Should Use This Book

This book is for people who operate or service a PC server that contains an Advanced SerialRAID/X Adapter. To follow the instructions in this book, you should be familiar with the basic operational procedures for a PC server.

What This Book Contains

Part 1 of this book is mainly for the user. It describes:

- The IBM Advanced SerialRAID/X Adapter
- SSA loops
- The RAID facilities that are provided by the adapter
- How to use the RAID configuration utility to configure arrays of SSA disk drives, and how to deal with problems such as the failure of a disk drive in a RAID array
- How to configure and manage multiple-domain array configurations
- How to configure the Fast-Write feature
- SSA error logs

Part 2 of this book is mainly for service representatives. It describes:

- General technical topics about the IBM Advanced SerialRAID/X Adapter
- Removal and replacement procedures
- The SSA service aid functions
- Problem determination procedures, including Service Request Numbers (SRNs) and Maintenance analysis procedures (MAPs)

Information about resource numbers and the communications statements for the adapter are provided in the appendixes.

A glossary and an index are provided.

If You Need More Information

Other books that you might need are:
- The operator guide for your system
- Service information for your system unit
- *IBM Advanced SerialRAID/X Adapter: Technical Reference*, SA33-3289
- *IBM Advanced SerialRAID/X Adapter: Installation Guide*, SA33-3290

For the latest device drivers, microcode, and utility programs, refer to the IBM SSA Customer Support Homepage at:

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

For new information about this and other SSA adapters and subsystems, refer to:

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

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

`http://www.ibm.com`

or, for information (such as Service and Support or new CBIOS flashes) specifically about IBM PC Servers, refer to:

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

Numbering Convention

In this book:

> **KB** means 1 000 bytes.
>
> **MB** means 1 000 000 bytes.
>
> **GB** means 1 000 000 000 bytes.

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Part 1. User Information

Chapter 1. Introducing SSA and the IBM Advanced SerialRAID/X Adapter

This chapter describes:

- Serial storage architecture (SSA)
- The Advanced SerialRAID/X Adapter

Serial Storage Architecture (SSA)

Serial Storage Architecture (SSA) is an industry-standard interface that provides high-performance fault-tolerant connection of I/O storage devices. 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.

The IBM Advanced SerialRAID/X Adapter

The IBM® Advanced SerialRAID/X Adapter (see Figure 1) is a 40-MB-per-second Peripheral Component Interconnect (PCI) adapter. It serves as the interface between systems that use PCI architecture and devices that use Serial Storage Architecture (SSA). This adapter has four ports, which can be connected in pairs to provide two SSA loops. Each loop can contain a maximum of two pairs of adapter connectors and a maximum of 48 disk drives. See also "Rules for SSA Loops" on page 14.

1	Connector B2	**4**	Connector A2
2	Green light	**5**	Green light
3	Connector B1	**6**	Connector A1
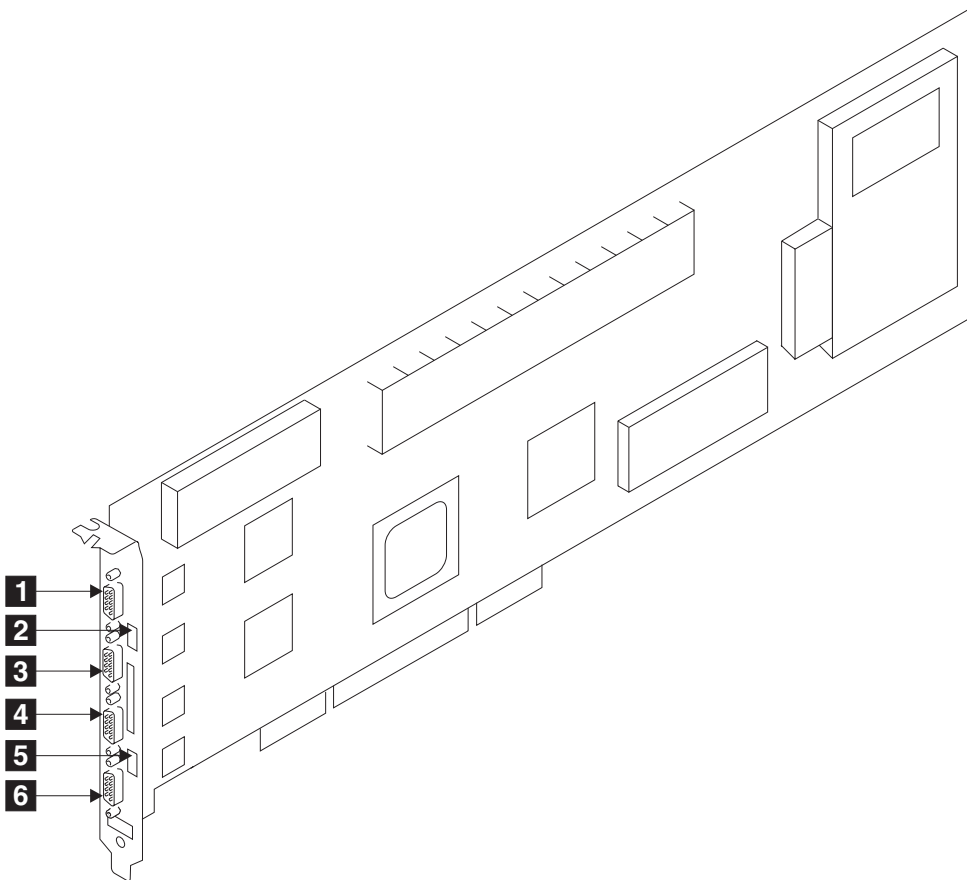
Figure 1. An Advanced SerialRAID/X Adapter Card

The adapter card has four SSA connectors that are arranged in two pairs. Connectors A1 and A2 are one pair; connectors B1 and B2 are the other pair.

The SSA links must be configured as loops. Each loop is connected to a pair of connectors at the SSA adapter card. These connectors *must* be a valid pair (that is, A1 and A2 or B1 and B2); otherwise, the disk drives on the loop are not fully configured, and the diagnostics fail. Operations to all the disk drives on a particular loop can continue if that loop breaks at any one point.

This adapter also contains *array management software* that provides RAID functions to control the *arrays* of the RAID subsystem (see also "Chapter 3. RAID Functions and Array States" on page 23). An array can contain several *component (or member) disk drives.* Each array is handled as one disk by the operating system. The array management software translates requests to this disk into requests to the component disk drives. Although this adapter is a RAID adapter, it can be configured so that all, some, or none of the disk drives that are connected to it are component disk drives of arrays.

The Advanced SerialRAID/X Adapter can be connected, by way of one or two SSA loops, to other SSA adapters. These adapters must be in separate system units. (See "Rules for SSA Loops" on page 14 for details of valid configurations.)

Fast-Write Cache

The fast-write cache allows the adapter to return completion status for write commands earlier than it can under normal conditions. The fast-write cache does this by caching write data in its battery-backed static random access memory. Status is returned immediately when data has been stored in static RAM. The status is returned in less time than it takes to write the data to the disk. The adapter later writes data from static RAM to disk. This process is called destaging. Data is destaged automatically when required by the operating conditions.

Although the fast-write cache improves response time (the time from when the host issues a command to when the host receives the status for that command), it puts additional work onto the adapter. Total throughput might, therefore, be reduced under heavy load. The fast-write cache gives the greatest improvement in performance when it is used with RAID-5 arrays.

Arrays and disk drive resources can use the fast-write function of the Advanced SerialRAID/X Adapter.

Note: SSA adapters that are on SSA loops of up to two SSA adapters can use the Fast-Write cache functions. For a two-way configuration, each of the two adapters must be in a different PC server. Fast-write functions can be enabled for single disk drives or for RAID arrays. Performance improvements are related to the type of disk drive (single disk or RAID array type) and the workload.

| **Operating System Software**

The Advanced SerialRAID/X Adapter, its microcode, and the supplied software allow the connection of SSA devices to servers that are running:

| • Microsoft® Windows NT® 4.0 Server Standard Edition or Microsoft Windows NT 4.0
| Server Enterprise Edition with service pack 3, 4, or 5 installed (service pack 5 is
| recommended).

| **Note:** For Microsoft Cluster Services, service pack 5 is required.
| • Novell® NetWare 4.2.
| • Novell NetWare 5.0.

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Lights of the Advanced SerialRAID/X Adapter

Each pair of connectors has a green light that indicates the operational status of its related loop:

Status of Light	**Meaning**
Off	Both SSA connectors are inactive. If disk drives or other SSA adapters are connected to these connectors, either those disk drives or adapters are failing, or their SSA links are not active.
Permanently on	Both SSA links are active (normal operating condition).
Slow Flash	Only one SSA link is active.

Port Addresses of the Advanced SerialRAID/X Adapter

The port addresses used in some SRNs that relate to these adapters can be numbers 0 through 3. They correspond to the port connectors on the SSA adapter:

0 = Connector A1
1 = Connector A2
2 = Connector B1
3 = Connector B2

The Configuration Utilities

The adapter is supplied with two configuration tools, the Disk Operating System (DOS) configurator and the Remote Systems Management (RSM) configurator. Apart from differences in the user interface, these two configurators provide generally similar functions. The DOS configurator, however, does not provide error logging.

Use the DOS configurator for initial configuration tasks. Use the RSM configurator for your normal daily work.

The DOS Configurator

The DOS configurator is a DOS program that enables you to configure adapters and their resources.

An SSA loop can consist of adapters that are in the local server and adapters that are in other servers. The configurator recognizes all these adapters because they are in the same SSA loop. You can, therefore, configure resources that are connected to any adapter in the SSA loop, although that particular adapter might not be in the server in which the DOS configurator is running.

The DOS configurator is supplied on a DOS bootable diskette. Always run the configurator from the DOS that is supplied on that diskette. Do not run it from an NT command prompt.

For more information about the DOS configurator, see "Chapter 5. Configuring SSA Resources" on page 45 and "Chapter 6. The DOS Configurator" on page 51.

The RSM Configurator

The RSM configurator is a browser-based SSA configurator. Four versions are available:
- One version for Novell NetWare 5.0
- Three versions for Windows NT Server 4.0:
  - A stand-alone Windows NT service (stand-alone version)
  - A web extension for Netfinity Manager (Netfinity® 5.0 and 5.1 version)
  - A web extension for Netfinity Manager (Netfinity 5.2 version)

All versions enable you to configure remote and local SSA subsystems. They provide all the functions of the DOS configurator and some additional functions; for example:
- Logical, Physical, Enclosure, and Explorer views of the SSA subsystem
- A facility for the online checking of the level of microcode and the level of host software.
- An interface to the dedicated SSA event logger. In a server that is running under Windows NT, the event logger runs as a service in Windows NT and can send SSA events to other system management tools.

The compact disk read-only memory (CD-ROM) that is supplied with the adapter contains a setup program. You can use this program to install the RSM configurator (either the stand-alone version, or the Netfinity versions), the event logger, and the microcode download utilities.

For more details of the RSM configurator, see "Chapter 5. Configuring SSA Resources" on page 45 and "Chapter 7. The RSM Configurator" on page 69.

Chapter 2. Introducing SSA Loops

This chapter describes the principles of SSA loops, how SSA devices are known to the system programs, and the rules that you must observe when you configure your SSA loops.

Loops, Links, and Data Paths

In the simplest SSA configuration, SSA devices are connected through two or more SSA links to an SSA adapter that is located in a 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 copper cable that connects two SSA nodes (for example, disk drives) is 25 meters (82 feet).

The maximum permitted length for an external fibre optic cable that connects two SSA nodes (for example, disk drives) is 10 kilometers (32800 feet) if particular requirements are met. For details of those requirements, see the service information for your disk enclosure (subsystem).

Details of the rules for configuring SSA loops are given for each SSA adapter in "Rules for SSA Loops" on page 14.

Simple Loop

Figure 2 shows a simple SSA loop. The devices that are connected to the SSA adapter card **1** are connected through SSA links **2** . These SSA links are configured as a loop. 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 the loop. The adapter can, therefore, get access to the devices **3** (disk drives in this example) through two data paths. The system unit cannot detect which data path is being used.
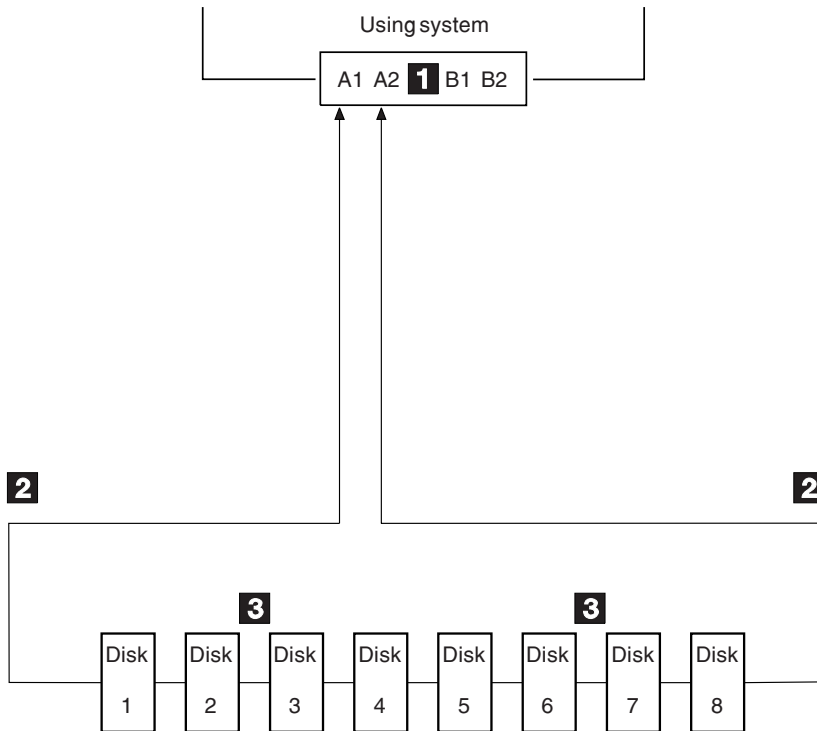
Figure 2. Simple Loop

Simple Loop — One Disk Drive Missing

If a disk drive fails, or is switched 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 remainder of the loop continue to work, but an error is reported to the system.

In Figure 3, disk drive number 3 has failed. Disk drives 1 and 2 can communicate with the system unit only through connector A1 of the SSA adapter. Disk drives 4 through 8 can communicate only through connector A2 of the SSA adapter.
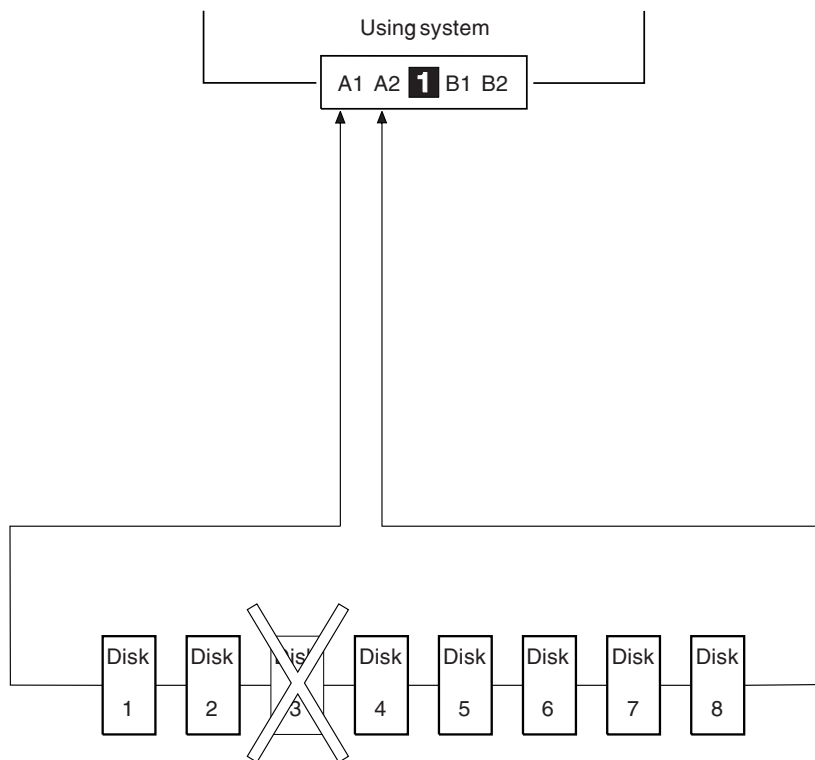
Figure 3. Simple Loop with One Disk Drive Missing

Simple Loop — Two Disk Drives Missing

If two or more disk drives are switched off, fail, or are removed from the loop, some disk drives might become isolated from the SSA adapter.

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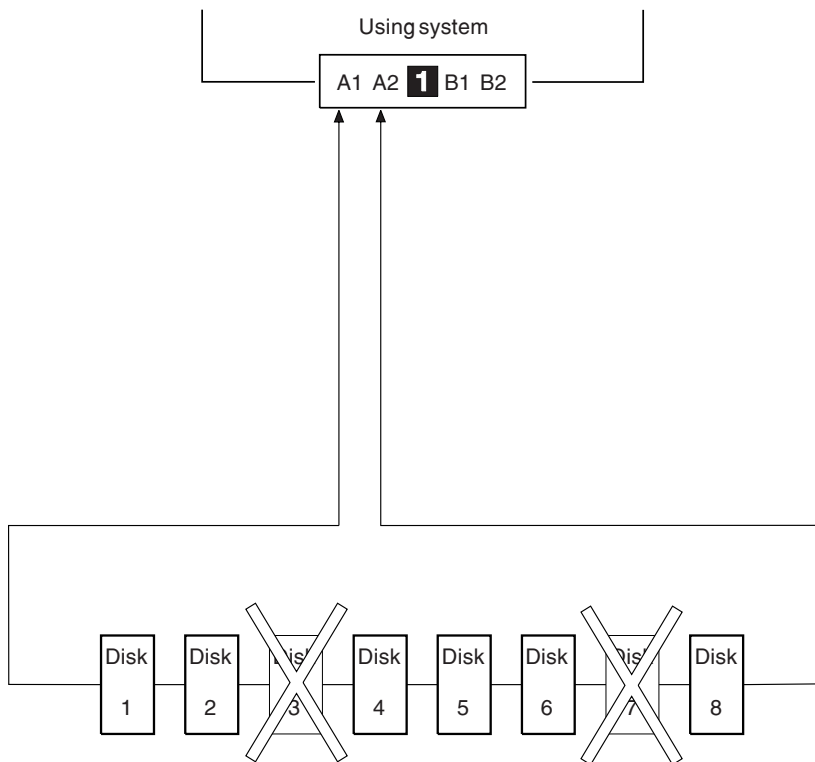
Figure 4. Simple Loop with Two Disk Drives Missing

Two Loops with One Adapter

If only one SSA adapter is contained in the SSA loops, the adapter can provide support for up to 96 disk drives (a maximum of 48 per loop).

Figure 5 shows an example configuration that has two loops and one adapter:
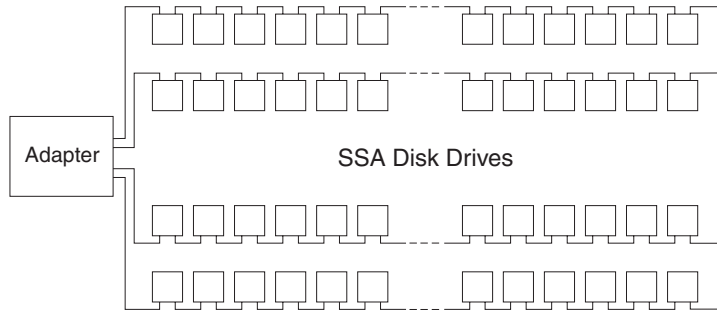
Figure 5. Two Loops with One Adapter

Two Loops with Two Adapters

The two adapters can provide support for up to 96 SSA disk drives (a maximum of 48 per loop).

Figure 6 shows an example configuration that has two loops and two adapters:
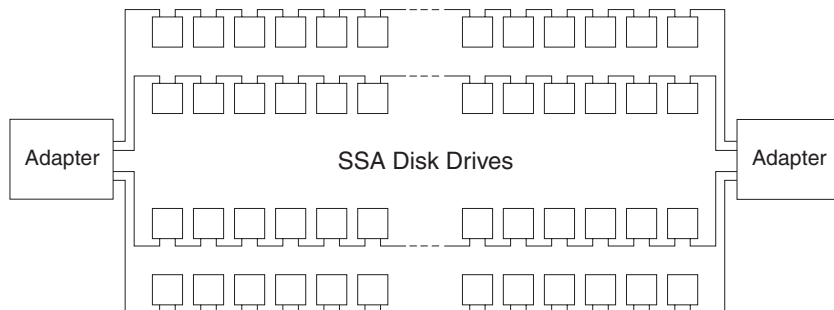
Figure 6. Two Loops with Two Adapters

Rules for SSA Loops

For SSA loops that include an Advanced SerialRAID/X 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).
- Only one pair of adapter connectors can be connected in a particular SSA loop.
- Only one adapter can be connected in a particular loop if any drives in that loop are configured as RAID-0 arrays.
- Only two adapters can be connected in a particular loop if any drives in that loop are configured for RAID-1, RAID-5, or RAID-10. Each adapter must be in a separate PC server.
- All component disk drives of an array must be on the same loop.
- A maximum of 48 devices can be connected in a particular SSA loop.
- A maximum of two adapters can be connected in a particular SSA loop.
- When an SSA adapter is connected to two SSA loops, and each loop is connected to other adapters, all adapters must be connected to both loops.

SSA Link Speed

Some SSA devices can run at 20 MB per second; others can run at 40 MB per second. Both types of devices can exist in a particular configuration, but for best performance all links should run at the same speed. Two types of SSA cable are available:

- 20-MB-per-second SSA cables (color coded black)
- 40-MB-per-second SSA cables (color coded blue).

The speed at which a link runs is automatically agreed between its two nodes. Under some fault conditions, a link that normally runs at 40 MB per second might run at 20 MB per second. The automatic diagnostic, which runs each hour, searches for pairs of 40-MB-per-second nodes that are running at only 20 MB per second. Such a condition can occur if you are using 20-MB-per-second cables to connect 40-MB-per-second SSA nodes.

SSA Unique IDs

Each SSA device has a specific identifier that is not used by any other SSA device in the whole world. This identifier is called the IEEE SSA Unique ID (UID) of the device. It is written into the device during manufacture.

The full UID consists of 16 characters. The label on the side of a disk drive shows the full UID. The label on the front of a disk drive shows the serial number of the disk drive. The serial number is actually part of the UID. Also part of the UID, the Connection Address consists of the LUN name and the device-type identifier. The software uses this information to access the device.

```
 Full UID                      0000XXXXXXNNNNNN
 Disk drive serial number            XXNNNNNN
 Resource name                 XXXXXXNNNNNNLLD
```

where:

XXXXXX	=	IEEE Organization Identifier (manufacturer)
NNNNNN	=	Product / ID (assigned unique number)
LL	=	LUN (always 00 for a LUN device)

Rules for the Physical Relationship between Disk Drives and Adapters

The physical relationship between the disk drives and the adapters in an SSA loop can affect the performance of the subsystem. The following rules help you to get best performance from your subsystem.

One Pair of Adapter Connectors in the Loop

The following sequence enables you to determine the best relationship between the disk drives and the adapter on an SSA loop that contains only one pair of adapter connectors.

1. Determine which data is accessed most frequently.
2. Assign that data to those disks drives that are farthest (round the loop) from the adapter connectors. By doing this, you prevent the activity of the busiest disk drive from obstructing the data path to the other disk drives.

For example, the loop that is shown in Figure 7 contains 16 disk drives, and the adapter connectors are between disk drives 1 and 16. The most-frequently-accessed data, therefore, should be on disk drives 8 and 9.
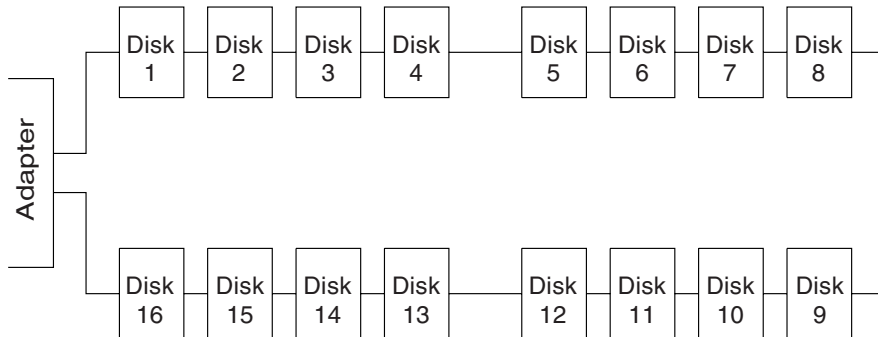
Figure 7. One Pair of Connectors in the Loop

Pairs of Adapter Connectors in the Loop – Some Shared Data

The following sequence enables you to determine the best relationship between the disk drives and the adapter on an SSA loop that contains two or more pairs of adapter connectors. Some of the disk drives share data access with other disk drives.

1. For each pair of connectors, identify all the data that the loop is to access.

2. For each pair of connectors, identify the data that the loop is to access most frequently.

3. Assign the data for each pair of adapter connectors to the disk drives that are connected immediately next to the pair of connectors in the loop. Assign the most-frequently-accessed data to those disk drives that are farthest from the adapter connectors. By doing this, you prevent the activity of the busiest disk drive from obstructing the data path to the other disk drives.

For example, the loop that is shown in Figure 8 contains 16 disk drives. The connectors of adapter A are between disk drives 1 and 16, and the connectors of adapter B are between disks 8 and 9. Therefore:

- Adapter A should access disk drives 1 through 4 and disk drives 13 through 16. The most-frequently-accessed data should be on disk drives 4 and 13.

- Adapter B should access disk drives 5 through 8 and disk drives 9 through 12. The most-frequently-accessed data should be on disk drives 5 and 12.
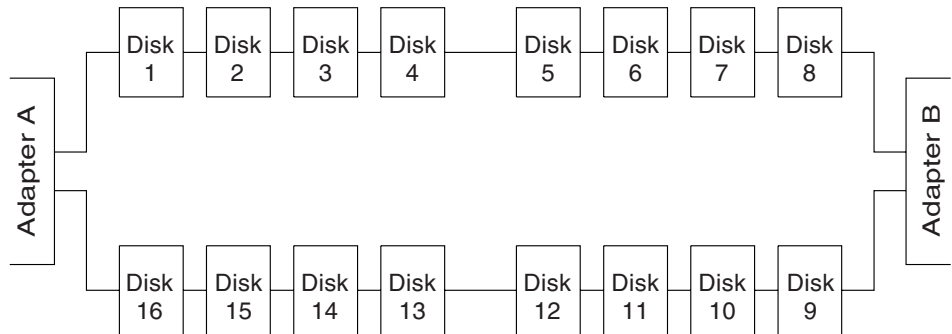
Figure 8. Pairs of Connectors in the Loop – Some Shared Data

Adapter Configuration Capabilities

Resource Types

The configuration software that is supplied with the adapter enables you to configure the resources that manage the data flow between the operating system and SSA devices that are connected to the adapter.

The Advanced SerialRAID/X Adapter allows you to create and configure the following types of resource:
- Disk
- RAID-0
- RAID-1
- RAID-5
- RAID-10
- Hot-spare pools
- Fast Write
- NVRAM

Ownership and Usage Type

Resources can be configured in ownership hierarchies; that is, resources can consist of other appropriate resources. For example, a RAID-5 resource typically consists of a number of disk drive resources. Each type of resource handles input to, and output from, the resources of which it is formed. For example, when the system writes data to a RAID-5 resource, the RAID-5 resource is responsible for distributing the data among its disk drive resources. At a lower level, a disk drive resource is responsible for writing data to, or reading data from, the physical disk with which it is associated.

At any one time, a resource belongs to a given usage type. Usage types that are supported by the Advanced SerialRAID/X Adapter and configuration programs are:

New   The resource:
- Is new from the manufacturer
- Has previously been used in an AIX environment
- Is a component of a RAID type for which the selected adapter does not provide support
- Has had a low-level SSA format performed on it

New resources must be placed into the Free Resources list before they can be configured for use in SSA subsystems. Before you reconfigure a new resource, however, ensure that the resource does not contain required data from an AIX® system.

In the Remote Systems Management (RSM) configurator, new resources are shown as **System (AIX)** resources.

Free   The resource has no existing defined usage, and can be used to create other resources, or can be added to the System Resources list.

To change the usage of a resource, first put it into the Free Resources list.

System

The resource is in the System Resources list, and can be directly accessed by the operating system.

The operating system can address only those resources that belong in the system usage class.

In the RSM configurator, system resources are shown as **System (PC)** resources. System (PC) resources are described as being *attached*. The actions of moving resources to and from the System (PC) type of use are normally called *attaching* and *detaching* those resources.

Hot-Spare

The resource might automatically become a component of an array that has been configured to use hot-spare disk drives, if a component of the array fails or becomes unavailable.

Rejected

A Rejected Resource is one that was a component of an array. An array rejects a component if that component fails or is found to contain corrupt data.

Note: If an array rejects a component, replaces it with a hot-spare disk drive, and the original component becomes available again, that component is handled as a Rejected resource.

The configuration programs enable you to manage resources by maintaining a list of each usage type.

In addition, you can use the configuration utility to create, modify, and delete array and Fast Write resources. For example, you can use five disk drive resources to make a single RAID-5 resource. For details of how to manage the lists, see "Chapter 5. Configuring SSA Resources" on page 45.

Sample Configuration

The sample configuration in Figure 9 shows the principles of the logical interface that the adapter provides.
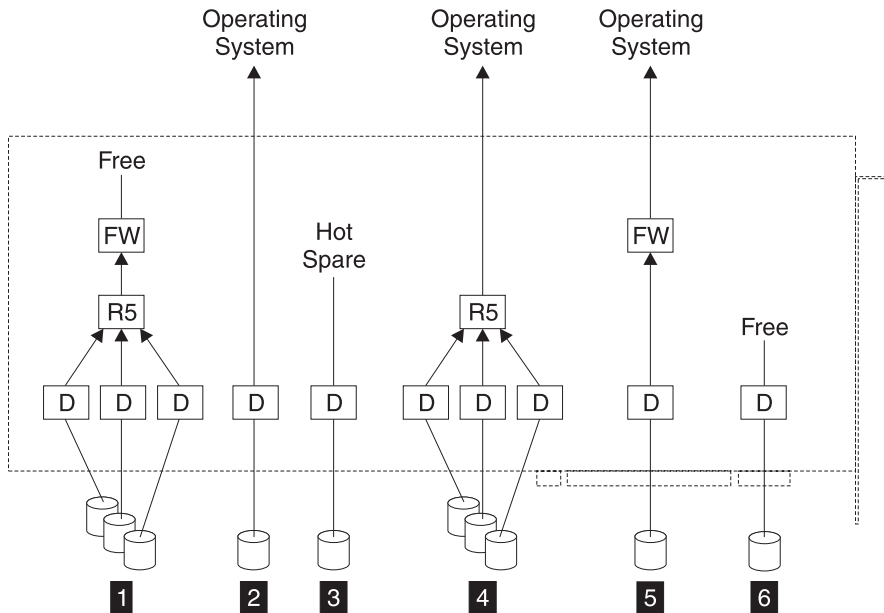
Figure 9. Sample Configuration

In Figure 9:

- Items marked "D" are disk drive resources.
- Items marked "R5" are RAID-5 resources.
- Items marked "FW" are fast-write resources.
- The arrow heads show ownership of the resources.
- In example 1, the adapter has one fast-write RAID-5 resource in the Free Resources list. Items in the Free Resources list are not visible to the operating system.

    If this resource is added to the System Resources list, the system can perform input and output operations to the fast-write resource. The fast-write resource can then handle input and output to the RAID-5 resource, which can, in turn, handle input and output to its component disk drive resources.

    Note: The fast-write resource is in the Free Resources list, but the resources that it contains are not.

- In example 2, the adapter has one disk drive resource defined for use by the system.

    The system owns this disk drive resource, and can perform input or output operations to this resource.

This resource can be returned to the Free Resources list.

Because this disk drive is a system resource, the operating system can be installed onto it.

- In example **3** , the adapter has one disk drive resource that is defined as a hot-spare disk drive.

  This hot-spare disk drive is not owned. It is, however, a candidate for automatic use by any suitably configured array that is in the same loop as this hot-spare disk drive. If this hot-spare disk drive is used by an array, it becomes a component of that array.

  This hot-spare disk drive can be returned to the Free Resources list. It is, however, the only hot-spare resource that is available. If any array is configured to use a hot-spare disk drive, and this resource has been returned to the Free resources list, the adapter generates and logs an error message for each such array at regular intervals.

- In example **4** , the adapter has one RAID-5 resource that is defined for use by the system.

  The system owns this RAID-5 resource, and can perform input or output operations to this resource. The RAID-5 resource handles input and output to the individual disk drive resources that it contains.

  This resource can be returned to the Free Resources list, but note that its component disk drive resources will not be free.

  Because this RAID-5 resource is a system resource, the operating system can be installed onto it.

- In example **5** , the adapter has one disk drive resource that is defined for use by the system through fast-write operations.

  The system owns this fast-write resource, and can perform input and output operations to it. The fast-write resource, in turn, manages input and output operations to the disk drive resource that is associated with it.

  Because this disk drive is a system resource, the operating system can be installed onto it.

- In example **6** , the adapter has one disk drive resource in the Free Resources list. This resource can be added to the system resources list or to the Hot-Spares list, or it can be made into a component of an array.

All resources can be configured as fast-write resources, but note the restrictions that are give in the Note in "Fast-Write Cache" on page 5.

Chapter 3. RAID Functions and Array States

This chapter describes the RAID functions and the states of RAID arrays.

RAID Functions

Redundant Array of Independent Disks (RAID) technology stores data across groups of disk drives that are known as *arrays*. These arrays are contained in array subsystems, which can be configured with one or more arrays. All arrays, except RAID-0 arrays, can provide data redundancy that ensures that no data is lost if one disk drive in the array fails.

An Advanced SerialRAID/X Adapter that uses microcode below level 5000 provides RAID-0 and RAID-5 functions to control the arrays of the RAID subsystem. An Advanced SerialRAID/X Adapter that uses microcode at or above level 5000, provides RAID-0, RAID-1, RAID-5, and RAID-10 functions.

The main characteristics of the various RAID types are as follows:
- RAID-0 provides data striping across disk drives, but provides no added protection against loss of data.
- RAID-1 provides data mirroring across two member disk drives to protect against loss of data.
- RAID-5 provides data striping with parity data across disk drives to provide protection against loss of data.
- RAID-10 provides data striping and data mirroring across disk drives to provide protection against loss of data.

Availability

Availability is an important consideration that can affect the way you configure your arrays. It is the ability of a system to *continue operating*, although one or more of its components have failed.
- RAID-0 provides data *availability* equivalent to that of a standard disk drive, but with better performance for long data transfer operations.
- RAID-1 provides good data availability because data is mirrored on two member disk drives, as it is with RAID-10. RAID-1 arrays, however, have only two member disk drives. Member disk drives of a RAID-1 array can be configured to be in separate domains. Separate domains ensure that data remains available if, for example, a complete domain fails through loss of power.
- RAID-5 provides good data *availability* with good performance for workloads that include many read operations.
- RAID-10 provides good data *availability* and performance that is better than that provided by RAID-5, especially when a member disk drive has failed. For long data transfer operations, performance is better than that provided by RAID-1 because data is striped across member disk drives. For short data transfer operations, performance

is better because operations are distributed across the member disk drives, and the effect of skew is reduced. Member disk drives of a RAID-10 array can be configured to be in separate domains. Separate domains ensure that data remains available if, for example, a complete domain fails through loss of power.

Disk Drives That Are Not in Arrays

Disk drives that are connected to an Advanced SerialRAID/X Adapter do not need to be components of an array. The Advanced SerialRAID/X Adapter handles such disk drives in the same way as a non-RAID SSA adapter does. It transfers data directly between the disk drives and the system, and uses no RAID functions.

When first installed, all disk drives are, by default, defined as AIX system disks; that is, they are not components of an array. Before they can be used in a PC server, whether as single disk drives or in RAID arrays, you must redefine them as free resources.

RAID-0 Array States

A RAID-0 array can be in either of two states. A knowledge of those states is useful when you are configuring your arrays. The states are described here.

Good State

A RAID-0 array is in the Good state when all the component disk drives of that array are present.

Offline State

A RAID-0 array enters the Offline state when one or more component disk drives become missing. Read and write operations are not allowed.

RAID-1 Array States

RAID-1 array states are the same as RAID-10 array states. For details, see "RAID-10 Array States" on page 29.

In RAID-1 arrays, the first member disk drive of the array is defined as the primary disk drive and the second member disk drive is defined as the secondary disk drive. These definitions prevent operation on separate member disk drives of the array when the array becomes split, but separate systems can still access one of the member disk drives. RAID-10 defines the first and third disk drives to be primary member disk drives. RAID-1 defines the first disk drive to be the equivalent of the first and third disk drives together. If the first disk drive is missing in RAID-1, it is equivalent to the first and third disk drives being missing in RAID-10.

RAID-5 Array States

A RAID-5 array can be in one of several states. A knowledge of those states is useful when you are configuring your arrays. The states are described here. A flowchart for the RAID-5 array states is shown in Figure 10 on page 28.

Good State

A RAID-5 array is in the Good state when all the component disk drives of that array are present.

Exposed State

A RAID-5 array enters the Exposed state when a component disk drive becomes missing (logically or physically) from that array. When an array is in the Exposed state, you can reintroduce the missing disk drive, or exchange it for a new one. If the missing disk drive is reintroduced, the array returns to the Good state. The array management software does not need to rebuild the data. If a new disk drive is exchanged for the missing disk drive, 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 array to the Good state.

Read Operations while in the Exposed State

When a read operation is performed on an array that is in the Exposed state, the array management software recreates the data that was contained on the missing disk drive. On the Advanced SerialRAID/X Adapter, the array management software immediately exchanges a hot spare disk drive for the missing disk drive, if a hot-spare disk drive is enabled and available when the read command is sent.

Write Operations while in the Exposed State

When a write command is sent to an array that is in the Exposed state, the array management software does the following:

- If a hot-spare disk drive is enabled and available when the write command is sent, the array management software immediately exchanges the hot-spare disk drive for the missing disk drive, and returns the array to the Rebuilding state.
- If no hot-spare disk drive is enabled and available, the first write operation causes the array to enter the Degraded state. The written data is not protected. If the power fails during a write operation, data might be lost (64 KB) unless the array is configured to allow read-only operations while in the Exposed state. Most application programs, however, cannot be run when write operations are not allowed.

Degraded State

A RAID-5 array enters the Degraded state if, while in the Exposed state, it receives a write command. If a hot-spare disk drive is available, the array management software immediately exchanges the hot-spare disk drive for the missing disk drive, and returns the array to the Rebuilding state. If no hot-spare disk drive is available, and a write operation is performed on the array, the array remains in the Degraded state until you take action to return that array to the Good state.

While in the Degraded state, an array is not protected. If another disk drive in the array fails, or the power fails during a write operation, data might be lost.

You can return the disk drive to the array, or install another disk drive by using the procedure in step 32 on page 182 of MAP 2324: SSA RAID to logically add the device to the array. The array management software starts a rebuilding operation to synchronize the new disk drive with the data that is contained in the other disk drives of the array. This action returns the array to the Good state.

Rebuilding State

A RAID-5 array enters the Rebuilding state when:

- That array is first created
- A component disk drive is replaced
- An adapter is replaced, but a correct shutdown has not been performed

Initial Rebuilding Operation

When an array is first created, it enters the Rebuilding state while parity is rebuilt. If a disk drive fails during the initial rebuilding operation, no hot-spare disk drive is exchanged for the failing disk drive.

Disk Drive Replacement

An array enters the Rebuilding state after a missing disk drive has been returned to the array or exchanged for a replacement disk drive. When the array is in this state, all the

component disk drives are present, but the data and parity are being rebuilt on the returned or replacement 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 restarts the complete rebuilding operation when the power returns.

Adapter Replacement

If, for any reason, an adapter is exchanged for a replacement adapter, and a correct shutdown has not been performed, the parity is rebuilt on *all* the associated arrays when the replacement adapter powers on.

Offline State

A RAID-5 array enters the Offline state when two or more component disk drives become missing. Read and write operations are not allowed.

RAID-5 Array State Flowchart
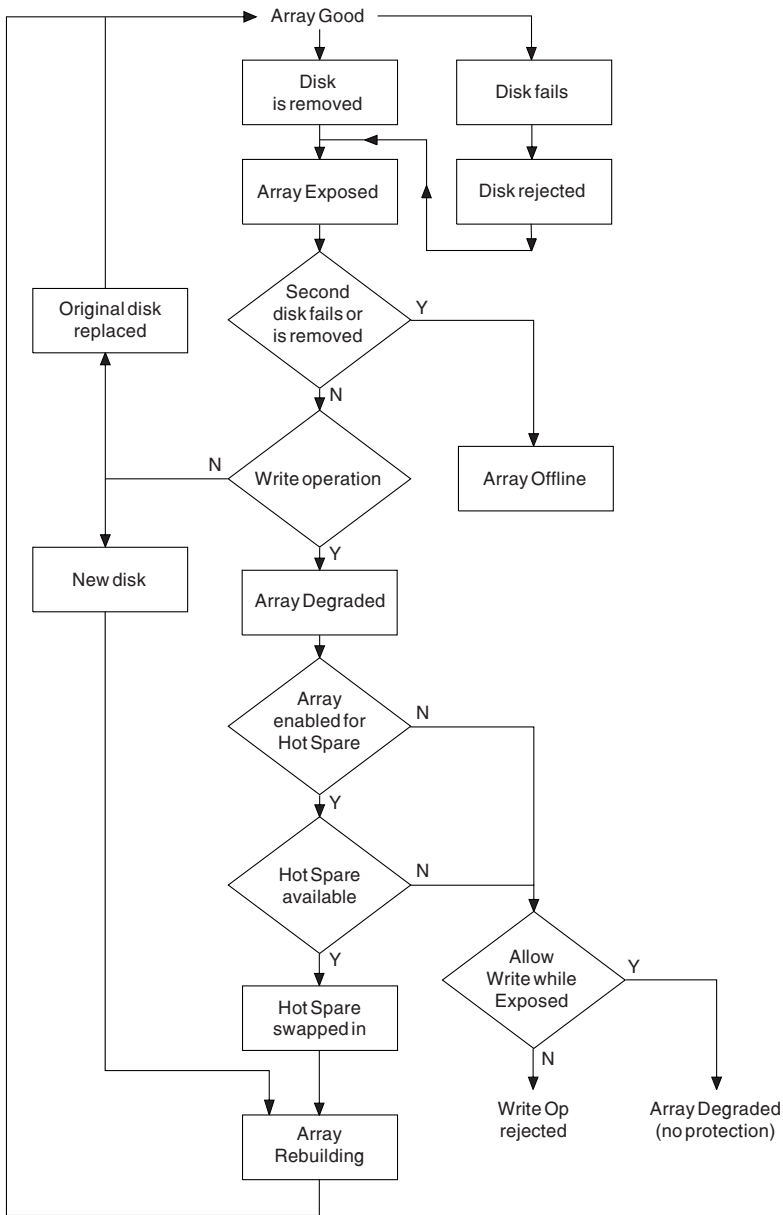
Figure 10. RAID-5 Array State Flowchart

RAID-10 Array States

Configuration information of the array is held in a reserved area sector on each of the first three member disk drives of the array. If fewer than two of these sectors can be read or written, the array normally goes into the Offline state.

An important characteristic of RAID-10 is that the mirrored pairs can be located in different sites in different power domains. The availability of a RAID-10 array is, therefore, better than that of RAID-5 array. However, if both domains of a two-site configuration are both operational, but communication is lost between the sites, it is important to ensure that each system does not continue to operate on its own copy of the array. Under this condition the data might not be consistent. To prevent this problem from occurring, the first, third, and fifth member disk drives of the array are the primary members; the second, fourth, and sixth member disk drives are the secondary members. Access to at least one of the primary disk drives that contain the configuration information is normally required for array operations to continue. Therefore:

- If a network partition exists, the using system that has access to the primary configuration disk drives continues to operate. The using system that has access to only the secondary configuration disk drives cannot normally access the array.

- If the using system fails at the site that contains the secondary member disk drive, the using system that has access to the primary configuration disk drives continues to operate.

- If the using system that has access to the primary configuration disk drives fails and the primary configuration disk drives also fail, only the site that contains the secondary configuration disk drives remains operational. Normally, the using system that is at the secondary site is not allowed access to the array. To allow this using system access to the array, the user must use the RAID array configurator to set a flag that allows the using system to operate on only the secondary disk drives.

Different member disk drives of a RAID-10 array can be in different states. For example, one mirrored pair might be rebuilding while, in a different pair, one member disk drive is missing and the remaining member is in the Degraded state. A priority of array states of the different members is used when the state of an array is reported (highest priority first):

1. Unknown
2. Offline
3. Exposed
4. Degraded
5. Rebuilding

An error is logged whenever the state of an array changes, unless the state changes to Good or Rebuilding.

A knowledge of the states is useful when you are configuring your arrays. The states are described here.

Good State

A RAID-10 array is in the Good state when:

- All the member disk drives of that array are present.
- No member disk drive is deconfigured.
- Read and write operations can be done on the array.
- No rebuilding operations need to be done.

The array is fully protected from the loss of multiple member disk drives if one copy of the mirrored data is still available. Some unsynchronized records might still be under repair.

Exposed State

A RAID-10 array is in the Exposed state when member disk drives are missing but still configured. Read and write operations can be performed on the array, although write operations put the array into the Degraded state. When the missing member disk drives are reintroduced, the array returns to the Good state.

Degraded State

A RAID-10 array is in the Degraded state when one or more member disk drives are missing or deconfigured, and a write operation has occurred. Read and write operations can be performed on the array. The missing member disk drives are deconfigured so that they are permanently excluded from the array. If they become available again, they can be introduced only as new members.

A RAID-10 array is in the Degraded state also if the secondary half of the array operates while the primary half is deconfigured. Under this condition, the secondary half holds information about the members of the primary half to track recovery.

Rebuilding State

A RAID-10 array is in the Rebuilding state when a rebuilding operation is running on one or more member disk drives. Read and write operations can be performed on the array.

When an array is created, it enters the Rebuilding state to synchronize the member disk drives. When the rebuilding operation is complete, the array returns to the Good State.

If the medium-error table fills during a rebuilding operation, the array remains in the Rebuilding state until space becomes available in the table.

Offline State

A RAID-10 array can be in the Offline state for any of the following reasons:

- No NVRAM is available to operate the array.

- The array is split across SSA loops.
- **All** these three conditions exist:
  - In the secondary half of the array, the member disk drive that contains the configuration sector is present.
  - In the primary half of the array, no members that hold configuration sectors are present.
  - The Split Array Resolution flag is set to **Primary**.
- **All** these three conditions exist:
  - In the primary half of the array, disk drive members that hold configuration sectors are present.
  - In the secondary half of the array, the member disk drive that contains the configuration sector is not present.
  - The Split Array Resolution flag is set to **Secondary**.
- In the primary and secondary halves of the array, member disk drives that hold configuration sectors are present, and the Split Array Resolution flag is set to **Secondary** on the secondary half. The array, however, was not initialized correctly.
- Two failures in a configuration update (configuration sectors, fence sector, label sector, medium-error table, or unsync table).
- Both member disk drives of a mirrored pair are missing, deconfigured, or rebuilding.

Unknown State

A RAID-10 array is in the Unknown state when not enough array members are present for the array configuration to be determined; that is, fewer than two of the first three members are present. Unless the Split Array Resolution flag is set to **Secondary**, the array enters the Offline state to allow split arrays to operate if:

- The member disk drive that holds the configuration sector in the secondary half of the array is available

and

- Neither of the member disk drives that hold configuration sectors in the primary half of the array is available.

Chapter 4. Hot-Spare Management

With all levels of adapter code, disk drives can be configured to be hot-spare disk drives. These hot-spare disk drives can be used in any array that is on the same SSA loop. If the adapter microcode level is at, or higher than, level 5000, each hot-spare disk drive can be configured to a particular hot-spare pool. The components of arrays can also be configured to hot-spare pools. You can, therefore, control which hot-spare disk drive is to replace a particular failed member of an array. This chapter describes the ways in which you can use hot-spare pools.

Deciding how to Configure Hot-Spare Disk Drive Pools

RAID-1 and RAID-10 arrays provide data protection by writing the same data to two disk drives at the same time. You can provide more data protection if you put the two disk drives into separate physical domains. These physical domains can be separate SSA disk enclosures, separate power sources, or separate rooms or buildings. When you use separate physical domains, you provide some capability to recover from an unrecoverable loss of power.

For a RAID-1 or RAID-10 array to be able to recover after the failure of a physical domain, at least one copy of the data must remain available. It is important, therefore, that the action of replacing a failing disk drive with a hot-spare disk drive does not cause an array member to move to another physical *domain*, as described in the following example.

Figure 11 shows an array that has its primary disk drives (disk2, disk3, disk10, and disk11) in building 1, and its secondary disk drives (disk5, disk6, disk7, and disk8) in building 2. Disk1 and disk4 have been assigned as hot-spare disk drives, but only one hot-spare pool has been defined (A0). This hot spare pool contains all the components of the array and both the hot-spare disk drives disk1 and disk4.
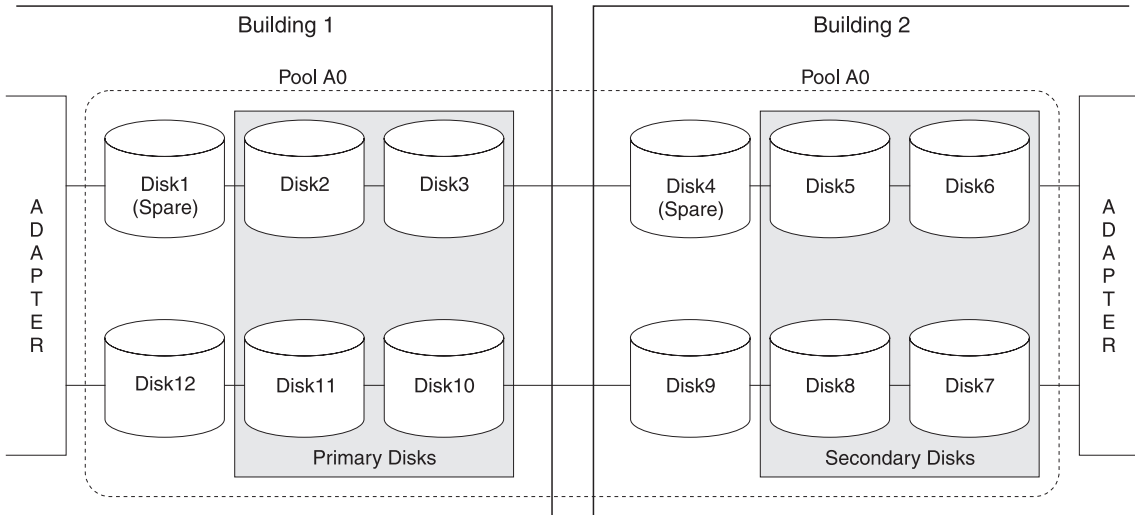
Figure 11. Primary Disks in Building 1; Secondary Disks in Building 2

Note: In Figure 11, the one hot-spare pool A0 includes both buildings, and provides no method that allows the Hot-Spare Management mechanism to distinguish where each hot-spare disk drive is physically located.

If disk2 fails, the hot-spare disk drive disk4 might replace disk2 as one of the primary disk drives in the array, as shown in Figure 12.
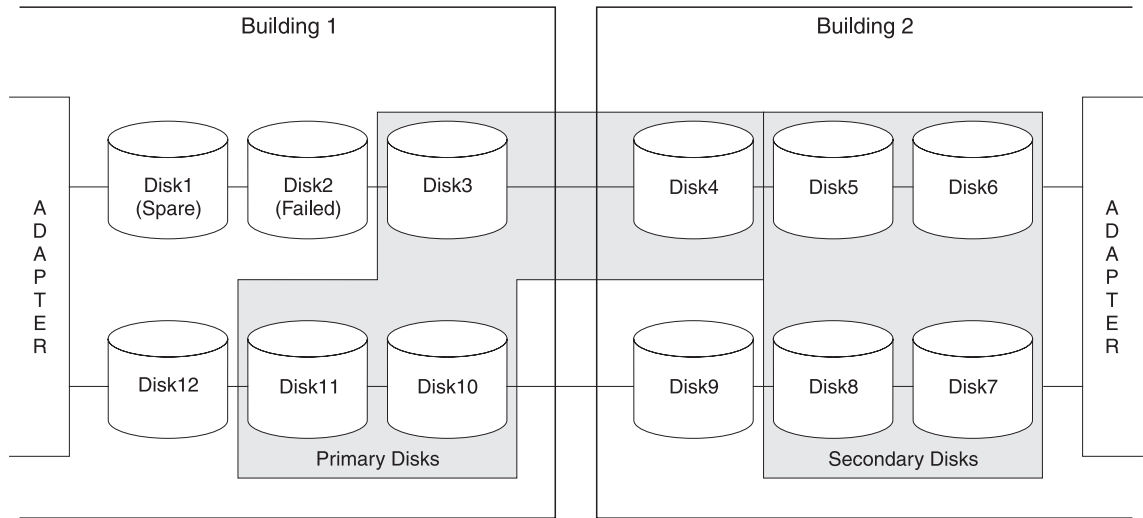
Figure 12. Primary Disk in Building 1; Secondary Disks in Building 2; Distributed Spares

Now, assume that for some reason, the disk drives in building 2 are no longer available. The example array is now in the Offline state because one of its four primary disk drives is in building 2. Only the three primary disk drives that are in building 1 are operational.

This problem can be solved if, in each building, a hot-spare pool is created for the disk drives. In Figure 13, all the disk drives in building 1 have been made members of pool A1, and all the disk drives in building 2 have been made members of Pool A2. A failure of an array component disk drive in Pool A1 now causes disk1 or disk12 to be selected as the hot-spare disk drive.
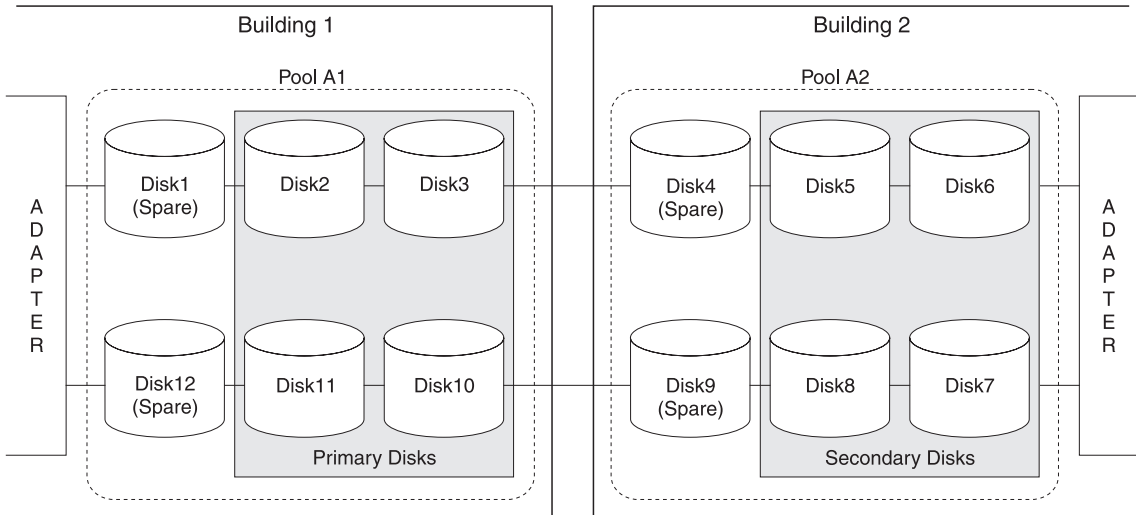
Figure 13. Primary Disk in Building 1; Secondary Disks in Building 2; Hot-Spare Pools

Hot-spare pools can be configured in other ways, as shown in figures 14 through 16.

Figure 14 shows how RAID-5 arrays can be protected against the complete failure of an SSA enclosure. Each component of each array is in a different SSA enclosure. The hot-spare disk drives are also in a different enclosure. Pools A1 and A2 each contain an array and a hot-spare disk drive. The pools ensure that, if any one SSA enclosure fails completely, three disk drives are always available for each array.

Figure 14. Hot-Spare Pools and RAID-5 Arrays across Enclosures

Figure 15 shows an alternative method of protecting RAID-5 arrays against the complete failure of an SSA Enclosure. This method uses a different hot-spare disk drive to protect each component of the array.
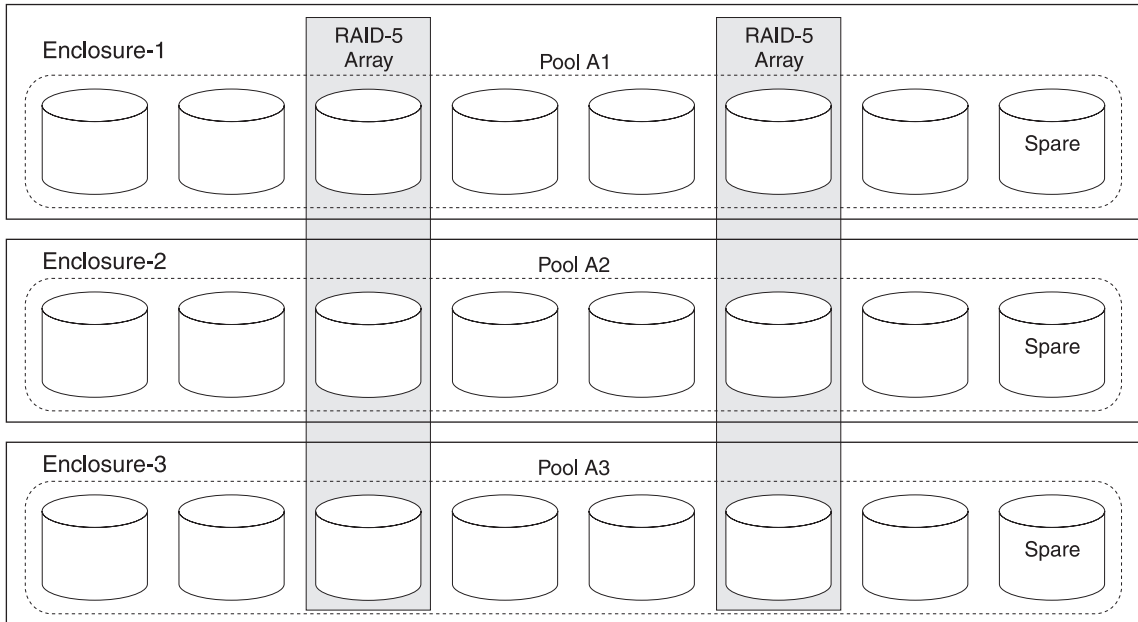
Figure 15. Hot-Spare Pools along, and RAID-5 Arrays across, Enclosures

Figure 16 shows how RAID-10 arrays can be protected against the complete failure of an SSA enclosure.
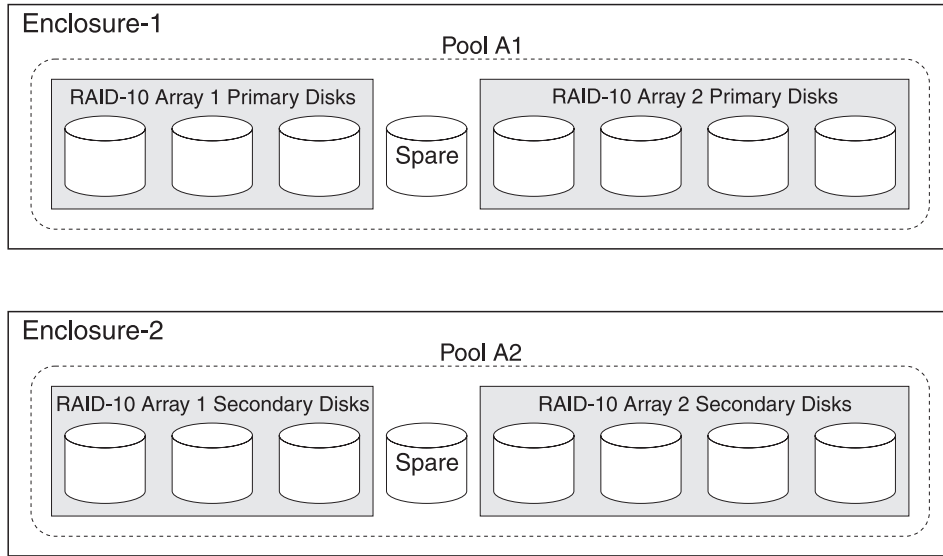
Figure 16. Hot-Spare Pools and RAID-10 Arrays along Enclosures

The primary disk drives of each array are in enclosure 1; the secondary disk drives are in enclosure 2. The secondary disk drives contain the same data as do the primary disk drives. Pool A1 contains all the primary disk drives of the arrays and a hot-spare disk drive; pool A2 contains all the secondary disk drives and a hot-spare disk drive. If one enclosure fails completely, the other enclosure can still recover from a disk drive failure because its disk drives and the hot-spare disk drive are in the same pool.

Choosing How Many Hot-Spare Disk Drives to Include in Each Pool

The number of hot-spare disk drives that can be included in a hot-spare pool is limited only by the number of disk drives that are permitted on a single SSA loop. When choosing how many disk drives to include in a hot-spare pool, think about how many disk drives the hot-spare disk drive is protecting and how much time might elapse before a failed disk drive can be replaced.

Choosing the Error Threshold (Alarm) Level for a Hot-Spare Pool

Normally, a hot-spare pool reports an error when any hot-spare disk drive has been used. Under some conditions, such as a disk drive failure at an unattended site, you might prefer to delay service activities until more than one disk drive in a hot-spare pool has failed. You can do this when you create a hot-spare pool. When you create a hot-spare pool, set the Hot-Spare Minimum parameter to be equal to the minimum

number of hot-spare disk drives that is needed to protect the array in the selected pool. No error log entry is made until the number of hot-spare disk drives that remains in the pool is less than the Hot-Spare Minimum parameter.

Rules for Hot-Spare Disk Drive Pools

Note: If you also administer AIX systems, you will find some differences in the way hot-spare disk drives are managed in the PC server environment.

- All hot-spare pools except pool 0 are empty unless they are explicitly created.
- Arrays that are created by use of the Automatic facility of Remote System Management (RSM) configurator are assigned to the "default" pool (pool 0); that is, when the **Auto** button is used.
- If any hot-spare disk drives have been created with an IBM SSA RAID Adapter, an IBM SSA RAID Cluster Adapter, or an IBM SerialRAID Adapter; or with an IBM Advanced SerialRAID/X Adapter whose microcode level is below 5000, those hot-spare disk drives are assigned to the "default" pool (pool 0).
- If no hot-spare pool exists and a hot-spare disk drive is created, that hot-spare disk drive is assigned to the "default" pool (pool 0).
- If only one hot-spare pool exists, hot-spare disk drives of all newly-created arrays are assigned to that pool unless the **Auto** button is used. For example, if pool B2 is the only pool that contains hot-spare disk drives in loop B, and a new array is created in that loop, all the hot-spare disk drives for that array are assigned to pool B2. If the **Auto** button is used, the hot-spare disk drives are assigned to the "default" pool (pool 0).
- If two or more hot-spare pools exist, the hot-spare disk drives of all newly-created arrays can be assigned to any of those pools, or to the "default" pool (pool 0).
- Pool 0 is called A0 for hot-spare disk drives that are on SSA loop A, and B0 for hot-spare disk drives that are on SSA loop B.
- Hot-spare pool numbers are in the range A0 through A31 and B0 through B31. The pool number is selected when the pool is created.
- Each free disk can be assigned to a hot-spare pool.
- Each component of a RAID array can be assigned to a different hot-spare pool.
- Disk drives can be added to a hot-spare pool only if those disk drives are free.
- If a disk drive is removed from a hot-spare pool, that disk drive becomes free.
- If a non-zero hot-spare pool is completely deleted in one action, each hot-spare disk drive from that pool moves to pool 0.
- A hot-spare pool can exist only on an SSA loop. For example, hot-spare pool B1 on adapter S9072103 has no physical or logical connection to hot-spare pool B1 on adapter S9072053, unless the two adapters operate in the same SSA loop.
- A hot-spare pool can contain any number of hot-spare disk drives. For instructions on how to configure hot-spare pools, see the chapters on using the DOS Configurator or the RSM configurator.
- If the **Hot-Spare Preferred** attribute is set to **on**, hot-spare disk drives are selected only from the hot-spare pool that contains the failing component disk drive.

- If the **Hot-Spare Preferred** attribute is set to **off**, a hot-spare disk drive can be selected (in the following priority) from:
  1. The hot-spare pool that contains the failing component disk drive
  2. Hot-spare pool 0
  3. Any other hot-spare pool
- Arrays in pool 0 can never use hot-spare disk drives that are assigned to other hot-spare pools.
- If more that one hot-spare disk drive is available in a pool, and the hot-spare disk drives are of different sizes, the smallest appropriate disk drive is selected.

Solving Hot-Spare Pool Problems

Hot-spare pool problems are indicated by the state of the pool and by error codes in the system error log. When configuring or reconfiguring hot-spare pools, it is recommended that you use the state of the hot-spare pool to help guide your actions. If hot-spare pool problems occur during normal operations, use the Service Request Number (SRN) that is generated by the diagnostics to guide your actions.

- If you are using the DOS configurator, do the following actions to display the operating state of a hot-spare pool :
  1. From the Adapter List select the adapter to which the pool is connected.
  2. From the Adapter Resources menu, select **Hot-Spare Resources**.

  The state of each resource is listed. For more information about the pool, highlight the pool entry in the list and press Enter.
- If you are using the RSM configurator, do the following actions to display the operating state of a hot-spare pool:
  1. *Either:*
     From the Explorer frame, expand the adapter resources tree if necessary, and select **Hot-spare pools**,
     Or:
     From the **Logical View** in the right-hand frame, select **Hot-spare pools**
  2. From the Hot-spare pool list, select the pool to examine its attributes and contents.

The normal operating state for a hot-spare pool is Full. Any other state indicates that a problem exists or some configuration actions are required. The possible states are:

Full   The number of hot-spare disk drives that are in the pool is equal to the number of hot-spare disk drives that were in the pool when the pool was last configured.

Empty No hot-spare disk drives are in the pool.

        If any arrays that have components are in the pool, those arrays are unprotected. It is recommended that you add some spares to the pool.

Reduced

        The number of hot-spare disk drives that are in the pool is less than the number of hot-spare disk drives that were in the pool when the pool was last configured, but greater than the minimum number that is specified for this pool.

        This condition does *not* cause an error to be logged.

        If you removed a disk drive from the configuration on purpose, it is recommended that you verify that the contents of the pool are as you require. You can do this by displaying the operating state of the hot-spare pool as described earlier in this chapter.

If you have exchanged a failed disk drive, you might now want to add the exchanged disk drive to this pool. If you do want to exchange the disk drive:

1. Start the RSM configurator.
2. Select the **Hot-Spare Pool View** for the required pool.
3. Add the disk drive to the pool:
   a. From the **Hot-Spare Pool View** , click on the **Add Hot-Spare** button.
   b. Select the new hot-spare disk drive from the **Create Hot-Spare CANDIDATES View**.
   c. Click on the **Add** button.

Critical The number of hot-spare disk drives that are in the pool is less than the specified minimum number for that pool.

If you removed a disk drive from the configuration on purpose, you might want to add a hot-spare disk drive. Alternatively, if the specified minimum is too high for existing requirements, you might want to reduce the **Minimum Number of Hot-spares In Pool** attribute for this pool.

If you have exchanged a failed disk drive, you must now add the exchanged disk drive to this pool:

1. Start the RSM configurator.
2. Select the **Hot-Spare Pool View** for the required pool.
3. Add the disk drive to the pool:
   a. From the **Hot-Spare Pool View** , click on the **Add hot-spare** button.
   b. Select the new hot-spare disk drive from the **Create Hot-Spare CANDIDATES View**.
   c. Click on the **Add** button.

Inadequate
The hot-spare pool does not contain a hot-spare disk drive that is big enough to replace a component in at least one of the arrays that the pool protects. An array component that belongs to this pool is bigger than any hot-spare disk drive that is available in the pool. If that component fails, it might not be protected because no replacement component is available from the pool.

Inconsistent
The array components in the pool do not agree about the size of the hot-spare disk drives, or about the minimum number of hot-spare disk drives that is required.

This state is probably caused by changes to the SSA loop; for example, the addition of disk drives or changes to the SSA cabling. If you did not intend to make such changes, and you correct them, the pool returns to its original state.

If you did intend to make the changes, it is recommended that you verify that the contents of the pool are as you require. You can do this by displaying the operating state of the hot-spare pool as described earlier in this chapter.

Mixed An array in this pool has used a hot-spare disk drive from another pool.

When replacement disk drives are installed in exchange for failed disk drives, the replacement disk drives are assigned as hot-spare disk drives or as free disk drives. The hot-spare pools, however, are no longer configured as intended. To correct the configuration, start the RSM configurator and:

1. Observe the Components associated table and find the component that has a status of **wrong_pool**.
2. Note the serial number of the component.
3. From the RAID column, note the name of the array to which the component belongs.
4. Select the **Array View** for the named array.
5. Select the serial number of the component that has a status of wrong_pool. On the **Disk View** of this disk drive, click on the **Assign Hot-Spare Pool** button.
6. On the popup window, type in the number of the pool that has a status of **Mixed**, then click on the **OK** button.
7. Select the **Hot-Spare Pool View** for the pool concerned and confirm that it now no longer has a status of **Mixed**. Otherwise, repeat the process for other components marked wrong_pool.

Unused

Hot-spare disk drives exist in a pool, but they are not protecting any member disk drive.

This condition does *not* cause an error to be logged. While this state exists, however the RSM configurator Hot-Spare Pool list displays the message:

```
There are hot-spare pools which are not protecting any components.
```

If required, you can move hot-spare disk drives from this pool to a pool that contains RAID arrays. Alternatively, you can change the use of hot-spare disk drives that are in this pool.

Chapter 5. Configuring SSA Resources

Before new SSA disk drives can be used by the operating system, you must configure them as SSA resources. You can use either the DOS configurator or the Remote Systems Management (RSM) configurator to do this.

It is assumed that adapters have been installed and disk drives have been connected as described in the adapter *Installation Guide*.

This chapter summarizes the configuration process.

Information about the DOS configurator is given in "Chapter 6. The DOS Configurator" on page 51.

Information about the RSM configurator is given in "Chapter 7. The RSM Configurator" on page 69.

To help you decide which configurator to use, see "Choosing an SSA Configurator" on page 48.

The configuration tools enable you to manage several lists (or classes) of resources. One of these lists, the System Resource list, is special; the operating system directly performs input or output operations to resources that are in this list. Also, the sequence in which the resources are stored in the System Resource list is the sequence in which they are presented to the operating system at boot time.

Notes:

1. If, after configuration for a Windows NT server, a system resource is not visible through Windows NT Disk Administrator, restart the server.
2. The drive letters that are assigned to resources are a result of the combination of resource numbering and the partitioning of the resources. See "Appendix A. Resource Numbers" on page 193 for more details.

The SSA Configuration Programs

The configuration tools supplied with the adapter provide the functions summarized in the following table:

Function	Summary
Managing arrays	Allows you to create or delete an array, or to inspect or change an existing array configuration.
Managing New Resources	Lists all the new, system (AIX), or preconfigured resources. These resources can be moved to the Free Resources list. **Note:** • In the RSM configurator, new disk drive resources are shown as **System (AIX)**. • A *preconfigured resource* is any component of a type of RAID (or fast-write resource) that is not supported by this adapter.
Managing Free Resources	Allows you to identify and optionally use resources that are not now being used for any purpose.
Managing System Resources	Maintains a list of the resources that are visible to the operating system. This list is sorted in resource number sequence. You can add resources to this list. Candidates for adding are those resources that are in the Free list. You can also delete (remove) resources from this list. When they are removed, they become free resources. If the adapter allows, you can set privacy information for system resources.
Configuring Rejected Resources	If a RAID array discovers a component resource that is corrupt, unusable in some way, or that has been superseded by a hot-spare disk drive, it changes the status of the component to Rejected. Such resources can be tested and put back into the pool of free resources, then reused.
Configuring Hot-Spares	Hot-spare disk drives can be used with any array that supports redundancy (that is, RAID-1, RAID-5 or RAID-10). If an array is configured to use hot-spare disk drives and a component fails, the adapter uses a hot-spare disk drive (if available) to replace the failed component. Adapters that have a suitable level of microcode allow the creation of separate pools of hot-spare disk drives. You can, therefore, specify more accurately which hot-spare disk drives are to be used to replace particular components of arrays if those components fail (see "Chapter 4. Hot-Spare Management" on page 33).

Function	Summary
Managing NVRAM	Nonvolatile RAM (NVRAM) is used to maintain a record of parity updates in progress on the disk drives. When the adapter first initializes, it examines the nonvolatile RAM. If it identifies records that indicate that some parity is out of date (probably because a write operation was interrupted for some reason), the adapter starts to repair the parity across the whole array. If an array is removed from the system by any unusual method, a dormant entry is made in the adapter NVRAM. You can use the DOS configurator or the RSM configurator to inspect and delete the dormant entries.
Concurrent Diagnostics	Run a level of diagnostics that enables the SSA subsystem to function without a decrease in performance.
Nonconcurrent Diagnostics	Run a detailed diagnostic that involves stopping input to, and output from, the SSA disk drive resources. For these diagnostics, operations on the system must be stopped.
Viewing the SSA Configuration	Displays the list of SSA devices that are connected to each SSA port of the selected adapter. The position of a resource in the list represents its physical position in the SSA loop.
Event Logging	The RSM configurator enables the event log to be analyzed. You can also specify the types of events to be sent to other alert managers (for example, Netfinity).

General Configuration Process

The general configuration process is:

1. New resources are deleted from the New Resources list, and become free resources as a result.

2. Before creating arrays, you can (optionally) designate some free resources as members of a hot-spare pool, to protect against failure of array components.

3. You can (optionally) make free resources into RAID resources, fast-write resources, or both.

4. You can (optionally) designate some free resources as hot-spare resources, to protect against failure of array components.

5. You can add free resources to the System Resources list to make them visible to the operating system. You might need to reboot the system to make the system resources visible to the operating system.

To perform any configuration task, you must select an adapter before the required functions are available.

For information about how to use the DOS configurator, see "Chapter 6. The DOS Configurator" on page 51.

For information about how to use the RSM configurator, see "Chapter 7. The RSM Configurator" on page 69.

Choosing an SSA Configurator

The DOS configurator can be run only on a PC system that has been started from a DOS diskette. The DOS configurator allows you to set up SSA data storage resources on a PC system that does not yet have any other operating system installed. The DOS configurator is, therefore, necessary when no fixed disk drive data storage is yet available on the system.

Because the DOS configurator does not provide all the facilities that the RSM configurator provides, however, (for example, it does not allow you to set up multiple hot-spare pools), it is recommended that you use the following method to set up your SSA storage:

- If you intend to install your operating system onto a non-SSA disk drive:

  1. Install your operating system.

  2. When the system is running, use the RSM configurator to set up all your SSA resources including hot-spare disk drives and hot-spare pools.

- If you intend to install your operating system onto an SSA disk resource and to perform system startup from that resource, use the DOS configurator as described here. Ensure that you use the DOS configurator only for the purposes stated.

1. Use the DOS configurator to create only the resource on which you intend to install your operating system. Do **not** make the resource into a fast-write resource.
2. Use the DOS configurator to attach the resource to the system (that is, put it into the System Resources list).
3. If you intend to use a two-way configuration (that is, a configuration in which an adapter in a second system can access the SSA resources), make the resource Private to this (first) system.

   Note: With Windows NT only, you can use the RSM configurator to make the resource Private while the system is running under the operating system that is installed on this resource. You must, however, reboot the system to bring the change into effect.
4. Install your operating system onto the SSA resource that you have created.
5. When your system is running, use the RSM configurator to set up all your other SSA resources, including hot-spare disk drives and hot-spare pools.

See the *Installation Guide* for full details about how to set up your SSA system.

Chapter 6. The DOS Configurator

The DOS configurator is a DOS program that enables you to configure adapters and their resources. For guidance on when to use the DOS configurator instead of the RSM configurator, see "Choosing an SSA Configurator" on page 48.

To use the DOS configurator:

1. Either shut down Windows NT (if it is running), or leave Novell NetWare to return to the DOS command prompt.
2. Reboot the server from the DOS configurator diskette.

To run the DOS configurator, run the following program from the DOS command prompt:

ISSACFG

Note: This program does not run under a Windows NT command prompt.

The SSA **Main** menu is displayed:

```
ISSACFG   SSA Configurator and Service Aids       yymmdd      DOS


              Main Menu


         SSA Adapter List
         Dump Configuration Details
         Service Aids
         About






   <ESCAPE> Exit  <ENTER> Select  <F1> Help
```
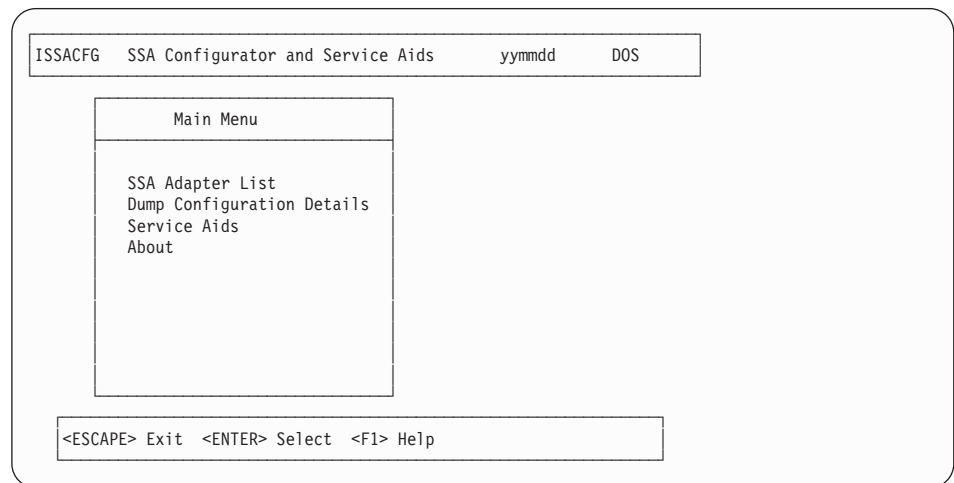
To choose an item from a menu, use the arrow keys to move the highlight to that item and press the appropriate key (for example, Enter) to select that item.

To move to the previous menu, press Esc.

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

Note: The **Service Aids** command on the **Main** menu displays a help panel that contains introductory information about the disk service aids. You can access the disk service aids via the **Disk Service Aids** command on the **Adapter List** menu. You can use the service aids to:
- Set and reset service mode for disks

- Format disks
- Certify disks
- Run diagnostics on disk drives

The Adapter Resources Menu

The **Adapter List** menu in the DOS configurator provides access to adapters that are currently visible to the configurator, and to resources that are controlled by those adapters. The adapters return information to the configuration program about the resources that they control, and about the existing usage of those resources.

When you select an adapter, the **Adapter Resources** menu appears:

```
ISSACFG   SSA Configurator and Service Aids      yymmdd    DOS

         Main M
                  XXXXXXXX Busn - Slotn (N)

     SSA Adapter  New Resources
     Dump         Free Resources
     Serv         System Resources
     Abou         Hot Spare Resources
           YYYY   Rejected Resources
           YYYY   Fast Write Resources
                  RAID 0 Resources
                  RAID 1 Resources
                  RAID 5 Resources
                  RAID 10 Resources
                  Non-volatile RAM
                  Run Concurrent Diagnostics
                  Run Non-Concurrent Diagnostics


     <ESCAPE> Exit  <ENTER> Select  <F1> Help
```

Note: The menu contains more items than can be shown on the screen at one time. An arrowhead at the top or bottom of the list indicates that items are out of view above or below the visible items.

The items that are listed in this menu have the following meanings:

New Resources
A new resource is a resource that has not been used previously by the type of system in which it is now installed. For example, in a PC server, a new disk drive might have come directly from the factory, or it might have been used previously in an AIX system. (In either event, the disk drive is recognized as an AIX system resource.) To be usable in this PC server, the new disk drive must be added into the Free Resources list.

Free Resources	A free resource is a resource that has not been assigned to any particular *usage* type, such as a *system* resource or a *hot-spare* resource. You can add a free resource to another type of resource. When you add the resource, that resource moves from the Free Resources list to the list for your selected resource type. You can also remove a resource from a resource list. When you remove the resource, that resource returns to the Free Resources list.
System Resources **Hot-Spare Resources** **Rejected Resources** **Fast-Write Resources** **RAID-0 Resources** **RAID-1 Resources** **RAID-5 Resources** **RAID-10 Resources**	When you select one of these types of resource, a list of resource of that type is displayed. You can add, delete, or change resources that are displayed in these lists.
Nonvolatile RAM	Nonvolatile RAM (NVRAM) is used to maintain a record of parity updates that are in progress on the array components. When the adapter first initializes, it examines the NVRAM. If it identifies records that indicate that some parity is obsolete (probably because a write operation was interrupted for some reason), the adapter begins a process to repair the parity across the whole array.
Concurrent Diagnostics	Concurrent diagnostics run a level of diagnostics that enables the SSA subsystem to function without a decrease in performance.
Nonconcurrent Diagnostics	Nonconcurrent diagnostics run detailed diagnostics. For these diagnostics, input to, and output from, the SSA disk drive resources must be stopped, and all operations on the system must be stopped.
Vital Product Data	Vital Product Data (VPD) contains information about the level and type of microcode that is installed on the adapter.
Disk Service Aids	Disk Service Aids provides a list of SSA devices that are connected to each SSA port of the adapter card. The position of a resource in the list represents its physical position in the SSA loop.

Converting a New Resource Into a Free Resource

To configure new resources as free resources:

1. From the SSA **Main** menu, select **SSA Adapter List**. The SSA Adapter List window opens:

```
ISSACFG   SSA Configurator and Service Aids       yymmdd      DOS

        ┌──────────────────────────────────┐
        │        Main Menu                 │
        │                                  │
        │ SSA Adapter List                 │
        │ Dump ┌──────────────────────────────────┐
        │ Serv │         SSA Adapter List          │
        │ Abou │                                   │
        │      │ XXXXXXXXX Bus0 - Slot3   (11)      │
        │      │ YYYYYYYYY           via(11)        │
        │      └──────────────────────────────────┘
        │                                  │
        │                                  │
        └──────────────────────────────────┘

 ┌──────────────────────────────────────────────────────┐
 │ <ESCAPE> Exit  <ENTER> Select  <F1> Help  <F11> Refresh │
 └──────────────────────────────────────────────────────┘
```
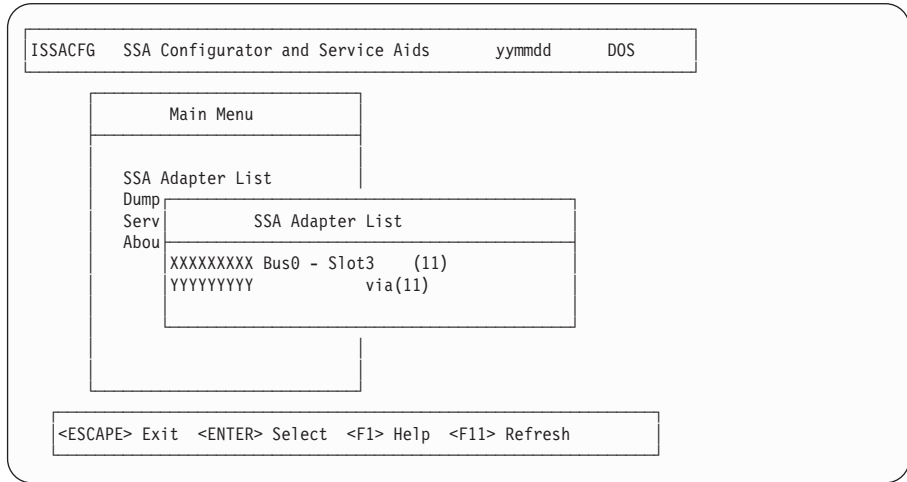
The window shows a list of installed SSA adapters. Each adapter is identified by:

Serial Number
> As on the adapter label.

Bus(n) PCI Bus number.

Slot(n) PCI Slot number.

Adapter(n)
> Node number. The node number is assigned to the adapter by the software.

Actions available on this screen are:

Enter Selects the adapter at the cursor position. After selection, a menu of options is displayed.

F11 Refreshes the existing menu screen.

Remote adapters (that is, adapters on the same loop, but installed in another system unit) are shown as '(via node)', where *node* is the node number of the local adapter.

2. From the list, select the adapter whose resource you are converting.

   The **Adapter Resources** menu is displayed.

```
┌─────────────────────────────────────────────────────────────────────────┐
│                                                                          │
│  ┌────────────────────────────────────────────────────────────────┐     │
│  │ ISSACFG   SSA Configurator and Service Aids      yymmdd    DOS  │     │
│  └────────────────────────────────────────────────────────────────┘     │
│                                                                          │
│         ┌──────────────────────┐                                         │
│         │     Main M┌───────────────────────────────────────────┐        │
│         │           │ XXXXXXXX Busn - Slotn (N)                  │        │
│         │           ├───────────────────────────────────────────┤        │
│         │ SSA Adapter│ New Resources                            │        │
│         │ Dump┌──────┤ Free Resources                           │        │
│         │ Serv│      │ System Resources                         │        │
│         │ Abou├──────┤ Hot Spare Resources                      │        │
│         │     │ YYYY │ Rejected Resources                       │        │
│         │     │ YYYY │ Fast Write Resources                     │        │
│         │     │      │ RAID 0 Resources                         │        │
│         │     │      │ RAID 1 Resources                         │        │
│         │     │      │ RAID 5 Resources                         │        │
│         │     │      │ RAID 10 Resources                        │        │
│         │     └──────│ Non-volatile RAM                         │        │
│         │            │ Run Concurrent Diagnostics               │        │
│         │            │ Run Non-Concurrent Diagnostics           │        │
│         └────────────└───────────────────────────────────────────┘        │
│                                                                          │
│  ┌────────────────────────────────────────────────────────────────┐     │
│  │ <ESCAPE> Exit  <ENTER> Select  <F1> Help                       │     │
│  └────────────────────────────────────────────────────────────────┘     │
│                                                                          │
└─────────────────────────────────────────────────────────────────────────┘
```

3. Select **New Resources**.

   A window opens and displays a the New Resources list:

```
┌─────────────────────────────────────────────────────────────────────────┐
│                                                                          │
│  ┌────────────────────────────────────────────────────────────────┐     │
│  │ ISSACFG   SSA Configurator and Service Aids      yymmdd    DOS  │     │
│  └────────────────────────────────────────────────────────────────┘     │
│                                                                          │
│         ┌──────────────────────┐                                         │
│         │     Main M┌───────────────────────────────────────────┐        │
│         │           │ XXXXXXXX Busn - Slotn (N)                  │        │
│         │           ├───────────────────────────────────────────┤        │
│         │ SSA Adapter│ New Resources                            │        │
│         │ Dump Config│ Free Res                                 │        │
│         │ Serv┌──────│ System R    List of New Disks            │        │
│         │ Abou│      │ Hot-Spar┌──────────────────────────┐     │        │
│         │     │      │ Rejected│ Resource Name      Status │     │        │
│         │     │ Busn │ Fast Wri│ 1. xxxxxxx         wwwwww │     │        │
│         │     │ Busn │ RAID 0 R│ 2. yyyyyyy         zzzzzzz│     │        │
│         │     │      │ RAID 1 R└──────────────────────────┘     │        │
│         │     │      │ RAID 5 Resources                         │        │
│         │     │      │ RAID 10 Resources                        │        │
│         │     │      │ Non-volatile RAM                         │        │
│         │     │      │ Run Concurrent Diagnostics               │        │
│         │     │      │ Run Non-Concurrent Diagnostics           │        │
│         └────────────└───────────────────────────────────────────┘        │
│                                                                          │
│  ┌────────────────────────────────────────────────────────────────┐     │
│  │ <ESCAPE> Exit  <ENTER> Select  <DELETE> Delete  <F1> Help      │     │
│  │ <F9> FlashOn  <F10> FlashOff                                   │     │
│  └────────────────────────────────────────────────────────────────┘     │
│                                                                          │
└─────────────────────────────────────────────────────────────────────────┘
```

The status of a new resource can be:

Online The resource is available.

Offline The resource is not available.

When a resource was previously configured for a function that is not supported on this adapter, the word "Preconfigured" is displayed at the end of the resource row.

Use the cursor up and down keys to select the required resource.

The possible actions for the selected resource are:

Enter   Displays more information about the resource.

Delete   Removes the resource from the new class and moves it to the free class from where it can be made into a system resource, or used for creating arrays, fast-write resources, or both.

F9   Identifies the resource by continuously flashing the Check light on the disk drive.

F10   Stops the Check light flashing on the disk drive.

F11   Refreshes the existing display.

4. For each disk drive that you want to configure into the SSA subsystem, highlight its name in the Free Resources list, and press Delete. The resource moves from the New Resources list to the Free Resources list. At the prompt, confirm (verify) the deletion.

   If you want to return to the menu for this adapter, press Esc.

   If you want to work with the Free Resources list, select **Free Resources** from the **Adapter Resources** menu.

You can make arrays from the resources that are in the Free Resources list; "Managing Arrays" on page 57 describes how to do this. Alternatively, you can get access to each disk drive resource (see "Managing System Resources" on page 64).

Also, you can define disk resources to be hot-spare disk drives (Hot-Spares). See Help.

Managing Arrays

An array is a resource that consists of a group of physical disk drives that the host PC operating system recognizes as a single disk drive.

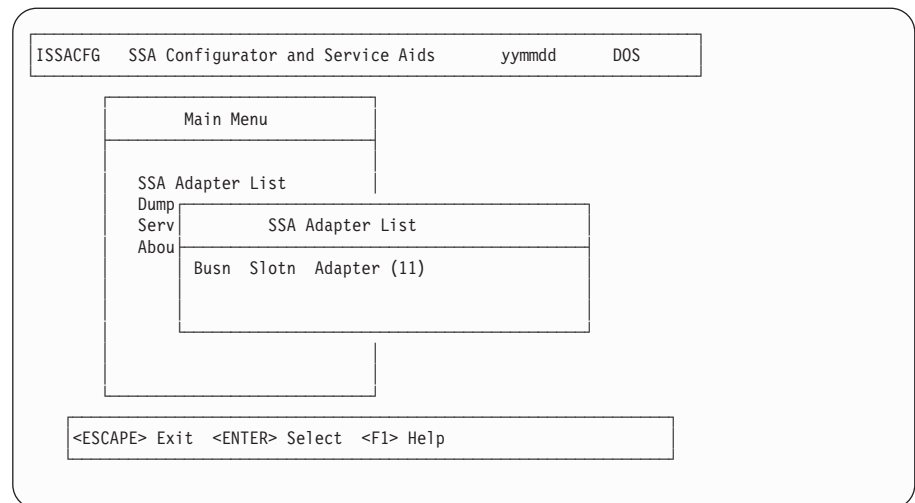This section describes how to create arrays from single disk drives in the SSA subsystem.

An array can be created and configured to use suitable available hot-spare disk drives (Hot-Spares) if one of its components fails. If you plan to configure any arrays to use hot-spare disk drives, you must define one or more disk drives as Hot-Spares.

Note: The DOS configurator provides no support for hot-spare pools. Any hot-spare pools that are created with the DOS configurator are assigned to pool 0 of the relevant loop.

To look at array attributes, or to create a new array:

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

   The SSA Adapter List window opens:

```
ISSACFG   SSA Configurator and Service Aids      yymmdd      DOS

              ┌──────────────────────────────┐
              │        Main Menu             │
              │                              │
              │  SSA Adapter List            │
              │  Dump┌───────────────────────────────────┐
              │  Serv│         SSA Adapter List          │
              │  Abou│                                   │
              │      │  Busn  Slotn  Adapter (11)        │
              │      │                                   │
              │      │                                   │
              │      └───────────────────────────────────┘
              │                              │
              │                              │
              └──────────────────────────────┘

  ┌───────────────────────────────────────────────────────┐
  │ <ESCAPE> Exit  <ENTER> Select  <F1> Help              │
  └───────────────────────────────────────────────────────┘
```
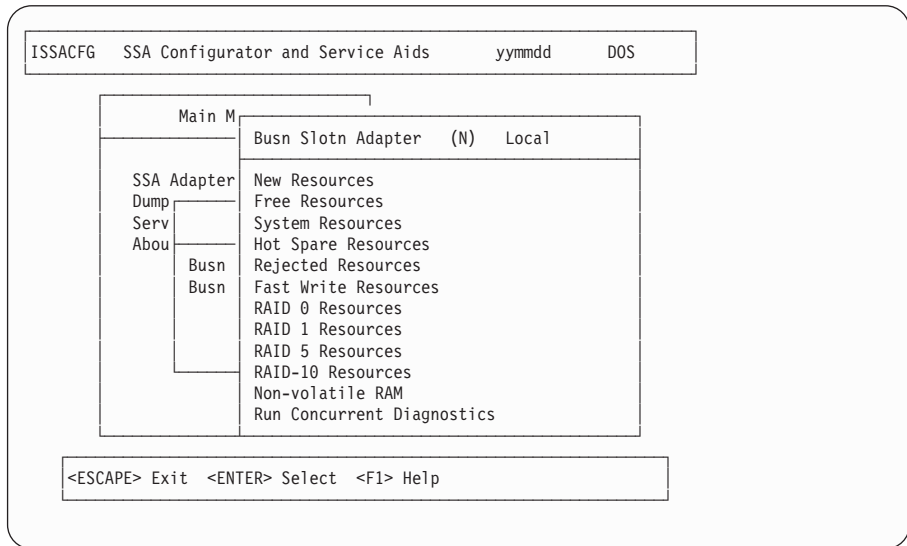
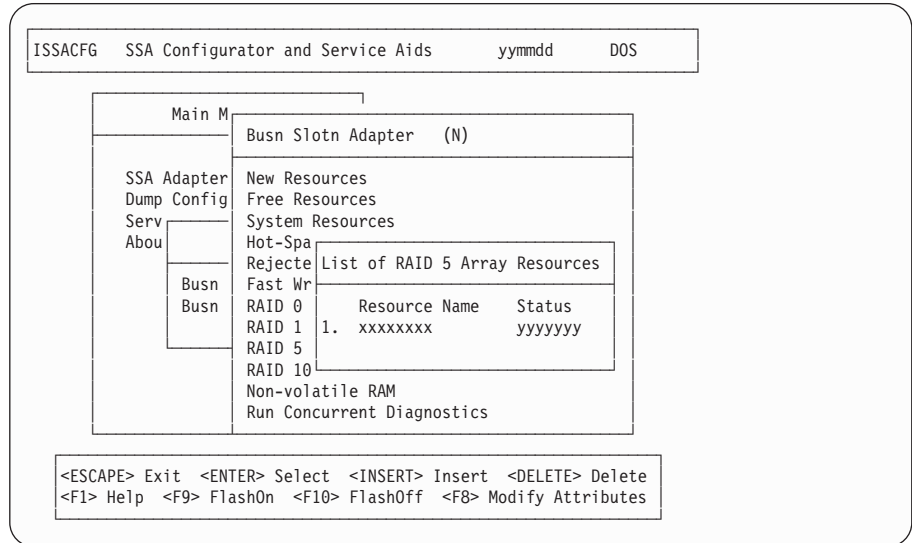2. Select the adapter that is to control the array, and press Enter.

All the disk drives that you define as components of a particular new array must be connected in the same loop.

The Adapter Resources menu window opens:

```
┌─────────────────────────────────────────────────────────────────────────┐
│ ┌───────────────────────────────────────────────────────────────────┐   │
│ │ ISSACFG   SSA Configurator and Service Aids        yymmdd    DOS   │   │
│ └───────────────────────────────────────────────────────────────────┘   │
│         ┌──────────────────┐                                             │
│         │     Main M┌───────┴──────────────────────────────────┐        │
│         ├──────────┐│ Busn Slotn Adapter   (N)    Local         │        │
│         │SSA Adapter│ New Resources                             │        │
│         │Dump ┌─────┤ Free Resources                            │        │
│         │Serv │     │ System Resources                          │        │
│         │Abou │     │ Hot Spare Resources                       │        │
│         │     │ Busn│ Rejected Resources                        │        │
│         │     │ Busn│ Fast Write Resources                      │        │
│         │     │     │ RAID 0 Resources                          │        │
│         │     │     │ RAID 1 Resources                          │        │
│         │     │     │ RAID 5 Resources                          │        │
│         │     └─────┤ RAID-10 Resources                         │        │
│         │           │ Non-volatile RAM                          │        │
│         └───────────┤ Run Concurrent Diagnostics                │        │
│                     └───────────────────────────────────────────┘        │
│   ┌───────────────────────────────────────────────────────────────┐     │
│   │ <ESCAPE> Exit  <ENTER> Select  <F1> Help                       │     │
│   └───────────────────────────────────────────────────────────────┘     │
└─────────────────────────────────────────────────────────────────────────┘
```

3. Select the array resource type that you want. (An Advanced SerialRAID/X Adapter that uses microcode below level 5000 provides support for RAID-0 and for RAID-5; an Advanced SerialRAID/X Adapter that uses microcode at or above level 5000 provides support for RAID-0, RAID-1, RAID-5, and RAID-10.)

A new window appears. It contains a list of the existing arrays of the chosen type that are controlled by this adapter. (If no arrays of the chosen type exist, the list reads "No resources".)

```
ISSACFG   SSA Configurator and Service Aids        yymmdd     DOS


          Main M
                 Busn Slotn Adapter   (N)

     SSA Adapter  New Resources
     Dump Config  Free Resources
     Serv         System Resources
     Abou         Hot-Spa
                  Rejecte List of RAID 5 Array Resources
          Busn    Fast Wr
          Busn    RAID 0       Resource Name     Status
                  RAID 1  1.  xxxxxxxx          yyyyyyy
                  RAID 5
                  RAID 10
                  Non-volatile RAM
                  Run Concurrent Diagnostics


   <ESCAPE> Exit  <ENTER> Select  <INSERT> Insert  <DELETE> Delete
   <F1> Help  <F9> FlashOn  <F10> FlashOff  <F8> Modify Attributes
```

If any arrays are listed, the entry for each shows the array name and status. The array name was supplied when the array was created.

The operational status of the array can be one of a set of array states that are related to the array type. For more information about array states, see "Chapter 3. RAID Functions and Array States" on page 23.

4. Use the cursor up and down keys to select the required array from the list.

The possible actions for the selected array are:

Enter Displays more information about the resource.

Insert Begins creation of a new resource.

Delete Deletes the selected resource. Component resources are returned to the pool of Free Resources.

F8 Enables modification of changeable resource attributes.

F9 Identifies a resource by continuously flashing the Check light of each disk drive that is contained in the resource.

F10 Stops the Check light flashing on each disk drive that is contained in the resource.

F11 Refreshes the existing menu screen.

5. To create a new array, press Insert.

   A window opens that shows the attributes for the type of array selected (for details of the attributes, use the Help function).

```
 _____
|                                                                 |
|  _____   |
| | ISSACFG   SSA Configurator and Service Aids      yymmdd    DOS | |
| |_____|  |
|                                                                 |
|        _____                 |
|       | Main M_____ |                 |
|       |      | Busn Slotn Adapter    (N)      |                 |
|       |      |                                |                 |
|  SSA Adapter| New Resources                   |                 |
|  Dump Config| Free Resources                  |                 |
|  Serv _____ | Syst _____            |
|  Abou|     || Hot- |   Filter Attributes for RAID X Arrays |    |
|      |     || Reje |                                       |    |
|   Busn|    || Fast | Resource Name      : xxxxxxxx         |    |
|   Busn|    || RAID | attribute1         : xx               |    |
|      |_____|| RAID | attribute2         : yy               |    |
|      |      | RAID |                                       |    |
|      |      | RAID |                                       |    |
|      |_____| Non- |_____|    |
|       |_____|                 |
|                                                                 |
|   _____            |
|  | <ESCAPE> Exit  <ENTER> Select  <F1> Help          |           |
|  |_____|          |
|_____|
```
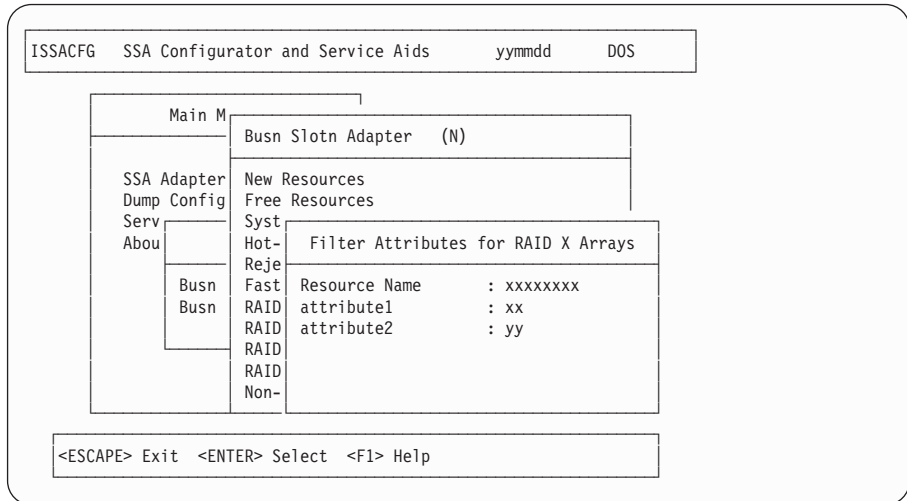
6. Type a unique array name (up to 14 alphanumeric characters) for the new array.

   Notes:

   a. When you create an array or other resource, you must supply a unique resource name. Although the resource name need be unique only on a particular adapter for a given resource type, it is recommended that you supply a name that is unique among all machines in the organization.

      You can make a name unique if you include the machine name and date of installation in the name. For example, instead of giving the name "Array1" to a RAID-5 array, give a name such as 557A4DBArray1, where 557A4DB is the network name or serial number of the machine containing the adapter that controls Array1.

   b. The resource name of a disk drive resource is related to the SSA Unique ID of that disk drive. The ID is determined when the disk drive is manufactured.

7. The screen shows the default values for the attributes. If you want to change any values, overtype 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.

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

```
ISSACFG    SSA Configurator and Service Aids        yymmdd      DOS


              Main M
                     Busn Slotn Adapter    (N)


        SSA Adapter  New Resource
        Dump Config  Free Resourc  Members of RAID  X Arrays
        Serv         System Resou
                     Hot Spare Re  1. xxxxxxxx         status
        Abou         Rejected Res
                     Fast Write R
                Busn  RAID 0 Resou
                Busn  RAID 1 Resou
                      RAID 5 Resou
                      RAID 10 Reso
                      Non-volatile
                      Run Concurre


   <ESCAPE> Exit   <INSERT> Insert   <DELETE> Delete   <F1> Help
   <F9> FlashOn  <F10> FlashOff
```
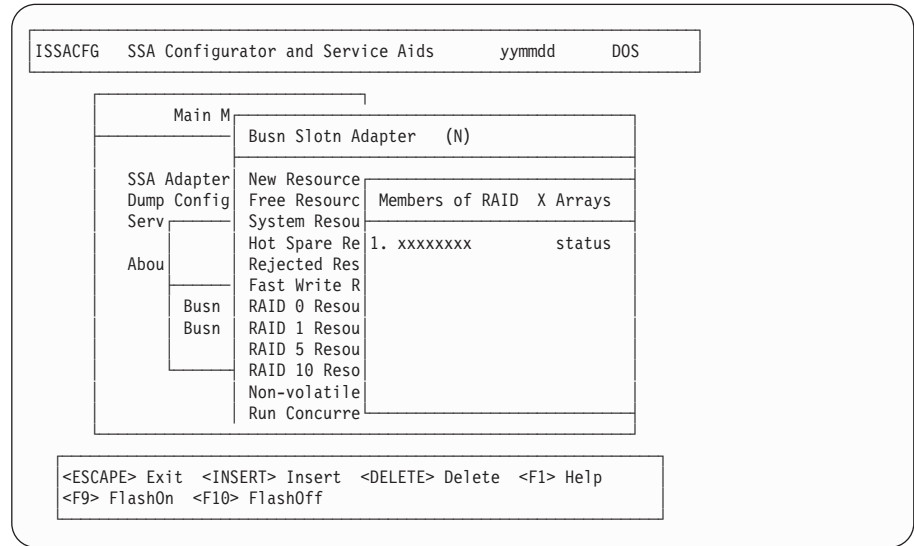
The list shows the components of the array, each with its resource name, and its status.

Note: To view or exchange components of an array at any time, select **View Members** from the **Adapter Resources** menu.

The status of an array component can be one of the following:

Present
> The adapter has detected that this array component is available for use by the array.

Present (Rebuilding)
> This array component is present in the array, but is currently being rebuilt from other components.

Present (Needs rebuild)
> This array component is present, but needs rebuilding.

Not present
> The adapter has detected that this array component is *not* available for use by the array.

Not present (Blank Slot)
> The array is configured with a gap where this component should be.

Not present (DeConfigured)
> The array deconfigured this component from the array, perhaps because of a failure of the component.

Notes:

a. A RAID-0 array must consist of 2 through 16 components.

b. A RAID-1 array must consist of 2 components.

c. A RAID-5 array must consist of 3 through 16 components.

d. A RAID-10 array must consist of an even-numbered quantity (4 through 16) of components.

e. To delete a component of the array, select the component and press Delete. The component goes into the Free Resources list.

f. You can also delete the complete array and return it (though not its components) to the Free Resources list. You can also destroy the array and return all its components to the Free Resources list.

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

a. Press Insert. A list of candidate resources is displayed. (The screen shown here is for a RAID-5 array.)

```
ISSACFG   SSA Configurator and Service Aids       yymmdd      DOS


         ┌─────────── Main M┌──────────────────────────────────────
         │                  │ Busn Slotn Adapter    (N)
         │                  │
         │ SSA Adapter│ New Resource
         │ Dump Config│ Fr┌──────────────────────────────────────
         │ Serv┌──────┤ Sy│    Candidates for RAID 5 Resources
         │ Abou│      │ Ho├──────────────────────────────────────
         │     │      │ Re│Resource Name      Status     Size
         │     │ Busn │ Fa│1.  canUID111      status     4.5GB
         │     │ Busn │ RA│2.  canUID222      status     4.5GB
         │     │      │ RA│3.  canUID333      status     4.5GB
         │     └──────┤ RA│4.  canUID444      status     4.5GB
         │            │ RA│5.  canUID555      status     4.5GB
         │            │ No└──────────────────────────────────────
 ┌──────────────────────────────────────────────────────────────┐
 │ <ESCAPE> Exit  <ENTER> Select  <F1> Help  <F9> FlashOn
 │ <F10 FlashOff
```

b. Select each disk drive that is to be included in the array.

To identify the disk drive, highlight its resource name in this list and press F9. This causes the Check light on the disk drive to flash. If an array is selected, the Check lights on its components flash. To stop the lights flashing, press F10.

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

9. When you have selected all the disk drives that you need, press Esc to create the array, then reply to the prompt to verify that the array has been created.

You can return to the **Main** menu by repeatedly pressing Esc.

Note that the new array is in the Free Resources list. Only resources that are in the System Resources list can be accessed by the operating system. "Managing System Resources" on page 64 describes how to add resources to the System Resources list.

Notes:
1. The candidate list is a filtered list of resources that are suitable for making an array with the previously specified attributes. The list is generated from data that the selected adapter has returned.
2. Some unused disk drives might not be suitable for use in an array of the chosen type.
3. If any arrays are configured to use hot-spare disk drives, ensure that a suitable hot-spare disk drive is available. If you want an array to use hot-spare disk drives, set the Hot-Spare Enabled attribute, and, optionally, the Hot-Spare Exact attribute.

   The configuration programs do not verify that hot-spare disk drives are available; they allow you to configure an array to use hot-spare disk drives whether or not hot-spare disk drives are defined.
4. If you define an array so that it does not use hot-spare disk drives, you might get a condition in which a component of the array fails and leaves the array in the Degraded state until manual intervention occurs.
5. An array can be a free resource, but if it is, it is not suitable to become a component of another array.

Managing System Resources

To enable the system to perform input and output operations to a resource, that resource must be put into the System Resources list.

If a resource is put into the System Resources list of one host of a dual-host system, that resource is automatically put into the System Resources list of the other host, unless that resource is defined as private to one host.

To make a resource into a system resource, select **System Resources** from the menu for this adapter. A list, initially blank, of the system resources is displayed:

```
ISSACFG   SSA Configurator and Service Aids        yymmdd      DOS

              Main M
                         Busn Slotn Adapter    (N)

      SSA Adapter   New Resources
      Dump Conf
      Serv                  List of System Resources
      Abou
                     Resource Name        Status    Access   Res #
                Bus  1. xxxxxxxx          Online    Public    14h
                Bus



     <ESCAPE> Exit  <ENTER> Select  <INSERT> Insert  <DELETE> Delete
     <F1> Help  <F9> FlashOn  <F10> FlashOff
```
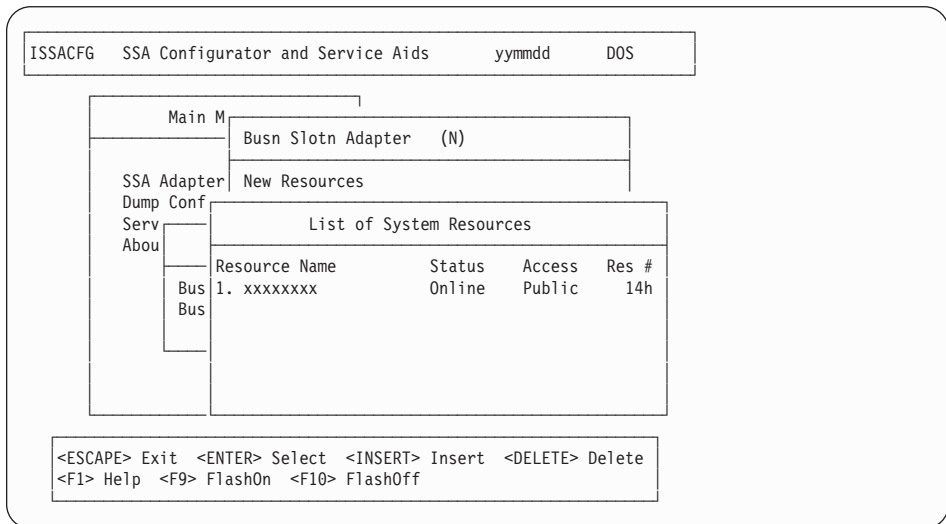
Each resource is listed with its name, status, and number.

The status can be one of the following:

Online   The resource is available.

Offline   The resource is not available. If the resource is an array, this status can mean that more than one component is missing. A temporary array name can be reported for the array if its configuration has not previously been determined.

The sequence of the resources in the list is the sequence in which they are presented to the operating system.

Possible actions for the selected system resource are:

Enter   Display more information about the resource.

Insert   Add a resource from the Free Resources list into the position that is directly before the selected resource in the list. For more details, see "Adding a Resource to the System Resources List" on page 66.

Delete Remove the selected resource from the System Resources list, and put it into the Free Resources list.

You might need to do this if you want to change the sequence of the system resources list to change the resource numbers.

F6 Public: Set the selected resource to be usable via any adapter.

F7 Private: In a two-way environment, set the selected resource to be usable via only the selected adapter.

F8 No Access: Prevent the selected resource from being used by any adapter.

F9 Identify the associated disk drive. The Check light of the disk drive flashes continuously. If an array is identified, the Check light on each component of the array flashes continuously.

F10 Stop the Check lights flashing on the resources.

F11 Refresh the existing menu screen.

Public, Private, and No Access relate only to adapters that operate in a multi-initiator mode; that is, adapters that allow more than one adapter to be connected to a resource. These include the IBM SSA RAID Cluster Adapter, IBM SerialRAID Adapter, and the IBM Advanced SerialRAID/X Adapter.

Adding a Resource to the System Resources List

1. On the System Resources list, press Insert.

   To add a resource to the list, highlight the name of a resource that is already in the list, and press Insert. The new resource is added directly above the highlighted resource if a suitable gap exists in the numbering sequence.

   Note: To add a resource to the end of the list, highlight the first empty space after the end of the list, and press Insert. The configurator assigns a resource number that is 1 greater than that of the last entry in the list.

   A list of candidate resources is displayed:

```
ISSACFG   SSA Configurator and Service Aids       yymmdd      DOS


           Main M
                      Busn Slotn Adapter    (N)

   SSA Adapter  New
   Dump Config  Fre      Candidates for System Resources
   Serv         Sys
   Abou         RAI        Resource Name   Status
                Rej
         Busn   Non   1.  CANUID111       Online
         Busn   Hot   2.  CANUID222       yyyyyy
                Run
                Run
                Vie
                      Disk Service Aids


 <ESCAPE> Exit  <ENTER> Select  <F1> Help  <F9> FlashOn
 <F10> FlashOff
```

2. Select the resource that you want to add to the System resources list. The Request for Input window opens:

```
┌─────────────────────────────────────────────────────────────────────────────┐
│  ┌──────────────────────────────────────────────────────────────────────┐    │
│  │ ISSACFG   SSA Configurator and Service Aids        yymmdd     DOS     │    │
│  └──────────────────────────────────────────────────────────────────────┘    │
│          ┌──────────────────────┐                                             │
│          │      Main M┌──────────────────────────────────────────────┐       │
│          │    ┌───────│ Busn Slotn Adapter    (N)                     │       │
│          │    │       └──────────────────────────────────────────────┘       │
│          │ SSA Adapter│ New┌──────────────────────────────────────────────┐  │
│          │ Dump Config│ Fre│     Candidates for System Resources          │  │
│          │ Serv┌──────│ Sys└──────────────────────────────────────────────┘  │
│          │ Abou│      │ Hot│                     Status                     │  │
│          │     │      │ Rej│                                                │  │
│          │ ┌───┤  Busn│ Fas│  1.  CANUID111      Online                     │  │
│          │ │   │  Busn│ RAI│  2.  CANUID222      yyyyyy                     │  │
│          │ │   │      │ Non│                                                │  │
│          │ │   │      │ Run┌──────────────────────────────────────────────┐  │
│          │ │   │      │ Run│    Request for Input                         │  │
│          │ │   │      │ View──────────────────────────────────────────────┤  │
│          │ │   └──────┤    │ Please enter the following information       │  │
│          │ │          │    │                                              │  │
│          │ │          │    │ Resource number(hex) = = > xx                │  │
│          │ └──────────┘    └──────────────────────────────────────────────┘  │
│  ┌──────────────────────────────────────────────────────────────────────┐    │
│  │ <ESCAPE> Exit  <ENTER> Select  <F1> Help                             │    │
│  └──────────────────────────────────────────────────────────────────────┘    │
└─────────────────────────────────────────────────────────────────────────────┘
```
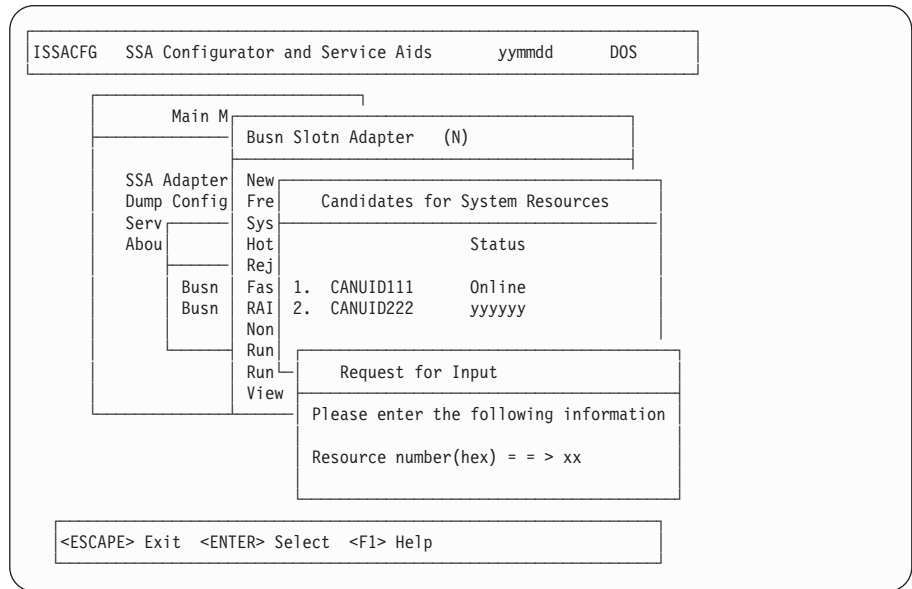
The assigned resource number for the new resource is shown.

You can enter a specific resource number or accept the default number. If required, change the resource number by overtyping it (see the Help function and "Appendix A. Resource Numbers" on page 193).

3. Press Enter.

   The List of System Resources window reappears, showing the new resource with its resource number.

   Attention. The resource number of existing resources in the System Resources list might change when a resource is added to the list.

4. Repeat the process for all the resources that you want to add to the list.

5. Reboot the system to configure the new resources into the system.

6. Use facilities in the operating system to assign logical partitions and drive letters to the new resources. For example:

   • FDISK in DOS

   • Disk Administrator in Windows NT

   • INSTALL.NLM in NetWare 4

   • NWCONFIG.NLM in NetWare 5

Chapter 7. The RSM Configurator

The RSM configurator is a browser-based tool that allows you to configure SSA adapters and devices. With this configurator, you can configure SSA devices that are attached to any SSA adapter that is running the Remote Systems Management Service, locally or remotely, via any of the supported browsers.

The RSM configurator requires Microsoft NT Server 4.0 (Standard or Enterprise Edition) with service pack 3 or above. Networking must be installed on the server that contains the adapter and devices that are to be configured.

Four versions of the RSM configurator are supplied:

Stand-Alone version
> This version runs as a Windows NT service.

Netfinity 5.0, 5.1 version
> This version runs as a Netfinity SM Web Extension for Netfinity SM versions 5.0 and 5.1.

Netfinity 5.2 version
> This version runs as a Netfinity SM Web Extension for Netfinity SM version 5.2.

Novell NetWare 5.0 version
> This version runs as a NetWare module. This version starts automatically if you add the load command to the autoexec.ncf file. Alternatively, you can load and unload it as required.

For the NT stand-alone version and the NetWare version, TCP/IP networking must be installed, and the target server must be accessible via a TCP/IP connection. For the Netfinity versions, Netfinity System Manager (version 5.0, 5.1, or 5.2) with Web Manager Services must be installed and enabled.

With the NT stand-alone version only, use the server name or the server IP address to target the local server. If you have installed TCP/IP on a non-networked machine, you can access the RSM configurator on that machine via the TCP/IP loopback address **127.0.0.1**.

The Netfinity versions use the same network protocols as those that you have configured with your Netfinity SM software.

All versions of the RSM configurator require one of the following browsers:
- Microsoft Internet Explorer 4.72 service pack 2, IE5
- Netscape Communicator 4.0x, Netscape Communicator 4.5x, or Netscape Communicator 4.6x

The installation CD-ROM contains a README file for each version:

readmenf.txt
> For Netfinity

readmesa.txt
> For the Stand-Alone version.

readmenw.txt
> For the Novell NetWare version.

When installed, the stand-alone version runs as the Windows NT service 'SSA Remote System Management'. You can start and stop this version if you select Services in the Control Panel.

You can use the RSM configurator to perform all the functions of the DOS Configurator; for example, managing resources.

In addition, the following facilities are provided:

Event logging and analysis
> Checks the error log and gets help for individual service request numbers (SRNs).

'Check level' function
> Downloads updates of the adapter microcode, disk drive and enclosure microcode, the RSM configurator software, the device driver, and the event logger, as appropriate. This function does not install the code onto the host server; it downloads the code to a local disk drive. For more details of how to install the microcode, see the README file in the \issa directory, or see the adapter *Installation Guide*.

Context-sensitive help
> Provides help with the items and functions that are available on the current page.

RAID-10 and Hot Spare Pools
> Provides confirmation (verification) steps when you are creating multiple-domain RAID-10 arrays. The facility also allows you to generate hot-spare pools, and to select the resources that are protected by a particular hot-spare disk drive (or drives).

Remote configuration
> Configures local servers, and remote servers on an intranet or via the Internet.

Security and access control
> Three levels of security are provided in the stand-alone version (the Netfinity version uses the Netfinity Security Manager):

> **View** The user can run the RSM configurator but cannot perform any updates.

> **Config** The user can run the RSM configurator with full resource configuration capabilities.

> **Admin** In addition to Config level capabilities, the user has security administration access.

> The stand-alone version uses TCP/IP SSL (Secure Socket Layer) when it sends information over a network.

Event Logger control file
> The RSM configurator allows the user to modify the SSA Event Logger control file, which specifies:
> * The location and maximum size of the files that are used by the Event Logger
> * The type of errors that are to be sent to other alert managers (for example, Netfinity)

> The event log control file (evntctrl.txt) resides in the directory into which the event log has been installed. The default directory is c:\issa (for NT), or SYS:SYSTEM (for NetWare).

SSA event forwarding
> The NT event logger can be configured to route events to the Netfinity Alert Manager.

Specialized views

These views are: Logical, Physical, and Enclosure.

The **Logical View** shows resources listed by their type. All configuration is performed via this view.

The **Physical View** shows resources listed in physical sequence; that is, exactly as they are connected to the adapter ports and to each other. This view supports identification of individual resources, enables you to run disk service aids on specific resources, and is useful as an aid in performance tuning.

The **Enclosure View** shows, for 7133 Models D40 and T40 Serial Disk Systems, any enclosures and their individual components (for example, controller card, bypass cards, fan assemblies, power supply assemblies), and enables configuration of these individual components. For details, see the information that is provided with the enclosure.

Checking the error log and getting help with individual SRNs

When observing the event log via the Analysis page, click on a service request number if you want help information about the SRN.

For details of the SRNs, see "Service Request Numbers (SRNs)" on page 133.

Installing the RSM Configurator

All versions of the RSM configurator are supplied on the CD-ROM that is provided with the adapter. To install the RSM configurator:

1. Read the README file for the version of the RSM configurator that you are installing. The README file is in the \docs\readme directory on the CD-ROM.

   If you are installing the NT stand-alone version or the NetWare version, take particular note of the section about security.

2. For the NT version, run the setup program <cd>:\nt\setup.exe (where <cd> is the drive letter of the CD-ROM), and select the version (either the Stand-Alone version or the Netfinity version) when prompted.

   For the NetWare version, extract the zip file directly into a directory that is on the NetWare server. Ensure that you keep the sub-directory structure. It is recommended that you create directory SYS:SYSTEM\RSM and extract the zip file to this directory.

All versions of the RSM configurator (and updates to them) can also be downloaded either as a single self-extracting executable file, or as a zip file, from:

http://www.hursley.ibm.com/ssa/rsm/

For further important details of the installation process, see the relevant README file on the installation CD-ROM.

Starting the RSM Configurator

To configure or monitor a server, the appropriate version of the RSM configurator must be running on the target server.

The NT stand-alone version and the NetWare version default to use port 511 on the target server. For information about changing the port number for the NT stand-alone version and the NetWare version, see the appropriate README file.

The Netfinity version defaults to use port 411 (or whatever port number you assign to Netfinity). Therefore, to access the target machine, open the browser at one of the following URLs:

http://<*machine name*>:511/ssa (Stand-Alone version)
or
http://<*machine name*>:411/ssa (Netfinity version)

where *machine name* is the TCP/IP domain name of the server.

The RSM configurator presents an explorer-style view in the left-hand pane. The right-hand pane displays all configuration pages, and the **Logical View**, **Physical View**, and **Enclosure View**. To switch off the dual-pane view and show just the contents of the right-hand pane, start the browser at one of the following URLs:

```
http://<machine name>:511/ssa?pageid=0
http://<machine name>:411/ssa?pageid=0
```

where *machine name* is the TCP/IP domain name of the server. This action displays the Adapter list page.

Using the RSM Configurator

Figure 17. The RSM Configurator

The window title of the browser indicates the version of the RSM configurator.

Figure 17 shows the areas of the three-pane window, which are:

- **Common Navigation Frame** **1** .

  The Common Navigation Frame area contains four buttons, each of which takes you to views that you can access also from any other RSM configurator view. That is, you do not need to select an adapter or resource before you can select the view that you want.

  - The **SSA Tools Menu** button opens a new browser window that displays a several links. The first link is to the RSM configurator. Other links are to associated pages that include the RSM help, the RSM tutorial, and the SRN list (which is a specific part of the RSM help).

  - The **System View** button displays, in the **Configuration Frame**, a list of all the existing System(PC) resources and the drive letters by which the server operating system recognizes them.

  - The **Event Logger** button displays, in the **Configuration Frame**, the **Event Logger View** . It also displays, in the **Actions Area**, buttons such as those that allow you to observe, analyze, and clear the SSA event log.

– The **Security** button displays, in the **Configuration Frame**, the **Security View**. It also displays, in the **Actions Area**, buttons such as those that allow you to add, modify, or delete security records.

Note: The **Navigation Area** **2** , the **Information Area** **3** , the **Configuration Area** **4** , and the **Actions Area** **5** are of variable size. The combination of the these areas is known as the **Configuration Frame**.

- **Navigation Area** **2** .

  The **Navigation Area** displays a row of buttons on the right-hand side of the Remote Systems Management title. (The Remote Systems Management title returns you to the **Adapter List**.) If any button is grayed out, it cannot be used on this page. From left to right, the buttons are:

  – The **Help** button, which displays, in a separate browser window, help information that is related to the displayed page.

  – The **Logical View**, **Physical View**, and **Enclosure View** buttons respectively, each of which displays the corresponding specific view of all the resources that are connected to the selected adapter. These buttons are enabled when an adapter has been selected.

  – The **Back** button, which returns to the previously visited page.

- **Information Area** **3** .

  The **Information Area** contains reports of user errors, warnings, and (after some actions) important information. These messages appear only once. For example, if you are in a **Resource View**, and select a function to make the indicator light flash on the resource, a message appears to notify you that the action was successful. If you then move elsewhere, the message disappears. It does not appear again, although the light might still be flashing on the resource. The Information area also shows the results of actions. Any messages (information, warnings or errors) that result from actions are displayed at the top of this area.

- **Configuration Area** **4** .

  The **Configuration Area** area displays resource lists and views as selected, and input forms for configuration actions.

  "Check Code level" on the **Adapter View** is a link to the IBM SSA Customer Support home page.

- **Actions Area** **5** .

  The **Actions Area** contains buttons for actions that are related to the existing view. The set of buttons that is displayed changes with each different view and with each status and use of the resources that are in the existing view. (For example, when the **Configuration Area** shows the **Disk View** of a free disk drive, the **Attach** button is displayed. This button allows you to make the disk drive a system resource. The **Detach** button is not displayed. When the **Attach** button is clicked, however, and the resource usage type has changed from Free to System, the **Detach** button is displayed, and the **Attach** button is no longer displayed.)

- **Explorer Frame** **6** .

  The **Explorer Frame** displays a hierarchical tree that shows the adapters, and the devices that are connected to those adapters. The root of the tree is an icon that is at the top of the tree. This icon represents the PC system. You can use the tree in the following ways:

  – Click on the root icon to refresh the Explorer tree display.
  – Click on the system name link (next to the icon) to return to the **Adapter List View** in the **Configuration Area**.
  – Click on a + symbol at a branch of the tree to expand that branch by one level of detail. The + symbol changes to a – symbol. Click on this – symbol to collapse that branch of the tree down to one line.
  – Click on an adapter serial number to see the **Adapter View** for that adapter in the **Configuration Area**.
  – Click on a link such as a RAID type name to see a list of arrays of that type in the **Configuration Area**.
  – Click on the name of a particular resource (array or disk drive) to see the **Array View** or **Disk View** for that resource in the **Configuration Area**.

The color of icons and table entries in the RSM configurator indicates the use of the related resource, as follows:

White   The resource is a preconfigured resource, or a system (AIX) resource.

Blue   The resource is a free resource.

Green   The resource is a system (PC) resource. The resource is available to the operating system.

Yellow   The resource is a hot-spare resource.

Red   The resource is a rejected resource.

Purple   The resource is a component of an array.

Gray   The resource is visible to the current adapter, but is not controlled by it.

Black   The resource is offline.

Getting Good Results from the RSM Configurator

This section provides hints to help you to get good results when you use the RSM configurator.

Navigation

To return the RSM configurator to the Adapter List (that is, the view that you see when you start the configurator), click on the system name link in the Explorer Frame.

Note: Netscape returns you to the Adapter List also if you resize the browser window.

From the Adapter List, you have three methods to reach the **Array View** for a given array resource or the **Disk View** for a given disk drive resource. You can use:

- The **Explorer Frame**
- The **Navigation Area** and **Logical View**
- The **Navigation Area** and **Physical View**

Using the Explorer Frame

1. Click on + for the required adapter (if visible) to show the resource type branches.
2. Click on + for the resource type to show the names of resources of that type.
3. Click on the name (for an array) or serial number (for a disk drive) of the required resource. The required view is displayed.

Using the Navigation Area and Logical View

1. In the Adapter list (in the **Configuration Area**), click on the serial number of the required adapter. The **Adapter View** for the adapter is displayed in the **Configuration Area**.
2. In the **Navigation** area, click on the **Logical View** button.
3. In the **Logical View** that is now displayed in the **Configuration Area**, click on the name of the type of resource. The list of resources of that type is displayed in the **Configuration Area**.
4. In the list that is now displayed, click on the name (for an array) or serial number (for a disk drive). The required view is displayed.

Using the Navigation Area and Physical View

1. Use either of the other two methods to select the required adapter.
2. In the Navigation area, click on the **Physical View** button.
3. In the **Physical View** that is now displayed, click on the serial number of a disk drive or the name of an array. The **Disk View** or **Array View** for the selected resource is displayed.

   Note: For a disk resource, the **Certify** button (and, for a free disk resource, the **Format** button) are displayed in the Actions area only if you reach the **Disk view** from the **Physical View**.

If a problem occurs with a power supply or a cooling fan in an enclosure, SSA disk drives report the problem to the adapter. The word "Power" appears in the **Disk View** for the disk drive and in the **Physical View** for the adapter.

The problem can occur for several reasons. If the enclosure has its own controller, you can obtain more details from the **Enclosure View** as follows:

1. Select the required adapter by one of the methods described in "Navigation" on page 77.
2. In the Navigation area, click on the **Enclosure View** button. The **Configuration Area** now shows the Enclosure list. Note that the list cell that shows the name of each enclosure that is reporting problems has a darker background.
3. In the **Configuration Area**, click on the name of the enclosure that contains the disk drive or drives that are reporting a problem.
4. Observe the resulting **Enclosure View**. It displays a table with icons that represent the physical contents of the enclosure. The table cell that shows a power supply assembly or a cooling fan assembly has a darker background if one of those components has failed.
5. If a power supply assembly or a cooling fan assembly has not caused the problem, observe the cells that represent disk drive slots. If any slot does not contain either a disk drive or a dummy disk drive, the cell for that slot is marked "Empty" in the table.

   An empty slot causes two problems:

   • The SSA link is broken.

   • The correct cooling airflow is not fully effective, and the enclosure might overheat.

   If you find an empty slot, you must install either a working disk drive or a dummy disk drive module.

   Note: On any enclosure that does not have a controller that can respond to more specific queries, all problems such as missing disk drives are reported to the RSM configurator as spare power supply failures. In a enclosure that has no controller, therefore, the RSM configurator displays the word "Power" on the **Physical View** and **Disk View** of each disk drive that has a problem to report, because it has assumed that a failed power supply or cooling fan has caused the problem.

Finding More Information

A tutorial guide to the RSM configurator is supplied. This guide describes how you can use the configurator, and contains some sample configurations. To observe the guide, open your browser at:

`http://<machine name>:511/tutorial.htm`

or

`http://<machine name>:411/help/tutorial.htm`

where *machine name* is the TCP/IP domain name of the server.

A set of help pages is also included. These pages contain topics such as update facilities and how to use SSA command line tools. To access the RSM configurator, the tutorial, and the help pages, open your browser at the index page:

```
http://<machine name>:511/ssaindex.htm
```

or

```
http://<machine name>:411/help/ssaindex.htm.
```

You can also access this index page if you select **Start**, then **Programs**, then **SSA Tools**.

Chapter 8. Multiple-Domain Array Management

This chapter describes how to configure and manage a system in which the computing and disk drive resources are split between two or more domains, so that the system can continue to operate if one domain is lost.

Configuration of RAID-1 and RAID-10 Arrays

RAID-1 and RAID-10 arrays hold data on mirrored pairs of disk drives; that is, the two disk drives of a particular pair contain the same data. If either disk drive fails, the data is still available. This characteristic of these array types allows the mirrored copies of the data to be held on disk drives that are in different domains. For example, the disk drives can be in different disk subsystems, or on different domains. If one domain loses power, the array continues to operate because one copy of the data is still available.

The RAID manager ensures that the two copies of the data are synchronized. It is possible for an array to become split in half, and for the adapters to become unable to communicate with each other. The design of the system must include precautions, therefore, that prevent both using systems from continuing to operate on the half of the array that each system can access. Such a condition causes the data on each mirrored pair to be inconsistent. The RAID manager allows only one half of the array to remain available. This action prevents two using systems writing different data to the separate halves of the array.

The Split Array Resolution flag determines whether the primary or secondary side of the array can operate when some of the configuration disks are not available. Normally, the Split Array Resolution flag is set to **Primary**. When the Split Array Resolution flag is set to **Primary** and the secondary configuration disk can be accessed, but no primary configuration disk drive can be accessed by an adapter, the array goes into the Offline state to that adapter.

When the Split Array Resolution flag is set to **Secondary** and the secondary configuration disk drive can be detected, access to the array is permitted. If the Split Array Resolution flag is set to **Secondary**, and the secondary configuration disk cannot be detected, the array goes into the Offline state.

The Split Array Resolution flag affects initialization of the array:

- If an array appears with the Split Array Resolution flag set to **Secondary**, only member disk drives from the secondary half of the array are accepted. If member disk drives from the primary half of the array appear, they are exchanged into the array and a rebuilding process begins. These actions are logged for each primary disk drive. If all the member disk drives for the primary half of the array appear, and they are rebuilding, or they have completed rebuilding, the Split Array Resolution flag is set to **Primary**.
- If, in a RAID-10 array, the first two primary disk drives and the first secondary disk drive are all in separate power domains, you can configure that array so that it can always continue to operate after a power failure of a single power domain. After the

loss of any power domain in this configuration, a using system continues to detect
either all the primary configuration disk drives, or one primary and one secondary
configuration disk drive, and continues to access the array without the need to set
the Split Array Resolution flag.

Operation after a Loss of Member Disks

An array goes into the Offline state if, after any component failure or change in
configuration, it becomes possible for the disk drives of mirrored pairs each to receive
different data from different systems. Under such conditions, the disk drives of a
mirrored pair might no longer contain matching data; that is, they are not synchronized.

An array can continue to operate although one of the following conditions might exist:
- The number of managing adapters is increased or decreased when all the primary
  and secondary configuration disk drives are working.
- A primary disk drive is missing, cannot be read, or cannot be written, but the other
  primary and secondary disk drives are working.
- The secondary configuration disk drive is missing, cannot be read, or cannot be
  written, but both primary configuration disk drives are working
- Both primary configuration disk drives are missing, but the secondary configuration
  disk drive is working, and all the adapters in the management list can be detected.
  The adapter microcode automatically sets the Split Array Resolution flag to
  Secondary.
- Both primary disk drives can be detected, but they cannot be read or written and the
  secondary configuration disk drive is working. The adapter microcode automatically
  sets the Split Array Resolution flag to **Secondary**.

The array goes into the Offline state for the following errors or reconfiguration:
- Both primary configuration disks are missing and fewer than all the managing
  adapters on the list are visible. The Split Array Resolution flag needs to be set to
  Secondary before operations to the array can continue.
- The secondary disk drives are missing and all the managing adapters are missing.
- The primary side of the array initializes, read or write operations are performed on
  the array, and, on the primary configuration disk drives, the Split Array Resolution
  flag is set to **Primary**. Later, the secondary configuration disk drive appears. Its Split
  Array Resolution flag is set to **Secondary**. Under these conditions, both the primary
  side and the secondary side might have been written independently, and the data
  might not be consistent on the mirrored pair members. You must determine whether
  the correct data is on the primary side or on the secondary side. Then you must
  reinitialize by changing the value of the Split Array Resolution flag on the side that
  does not have the correct data.

The HotSpareSplits parameter can be used to control whether hot-spare disk drives are
introduced when exactly half the member disk drives of an array are missing. In a
multiple-domain array configuration when one domain loses access to the other, it might
be desirable that hot-spare disk drives are *not* introduced while half the disks are no
longer visible. When the HotSpareSplits flag is set to **off** and all the secondary disks

and the other adapter are not visible, hot-spare disk drives are not introduced. If the Split Array Resolution flag has been set to **Secondary** (secondary disks only are being used) and the HotSpareSplits flag is set to **off**, hot-spare disk drives are not introduced when all the primary disks and the other adapter are not visible.

Three types of array management problems can cause an array to be in the Offline state to the using system:

- One half of the array is not present.
- The adapter is not known to the remaining half of the array.
- The split and join procedure was not performed correctly.

This section describes those problems, gives examples of possible causes, and recommends recovery actions.

One Half of the Array Is Not Present

This condition produces SRN 48750.

This type of problem can be caused by:

- Disk drive failure
- Power failure in the using system
- Communication problems between two systems on the SSA network

Dual-Host System with Only One System Switched On

Figure 18 shows a dual-host system that has just been switched on. The system contains a RAID-1 array, but the primary disk drive is missing because system 1 in not switched on. The array remains in the Offline state on both systems until either of the following occurs:

- The primary disk drive becomes available.
- The Split Array Resolution flag is set to **Secondary**.
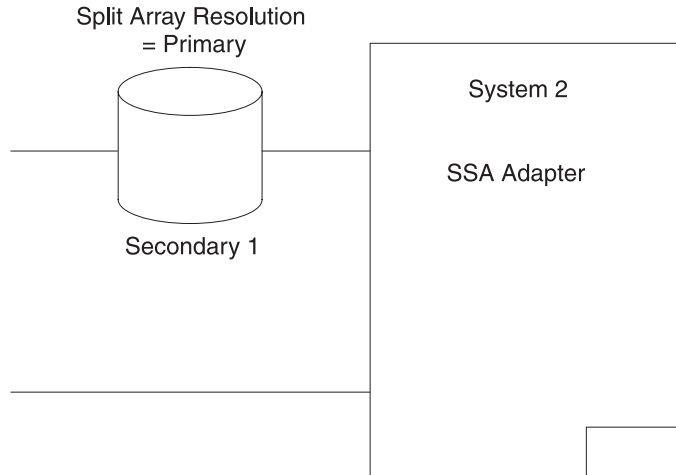
Figure 18. Dual-Host System with Only One System Switched On

Split Systems

The system can become split because communications have failed between the two systems.

System 1 Split from System 2: Figure 19 shows system 1 split from system 2.

```
            Split Array Resolution   Split Array Resolution
                  = Primary                = Primary

System 1                                              System 2

SSA Adapter                                           SSA Adapter

                  Primary 1              Secondary 1




                  Primary 2              Secondary 2
```
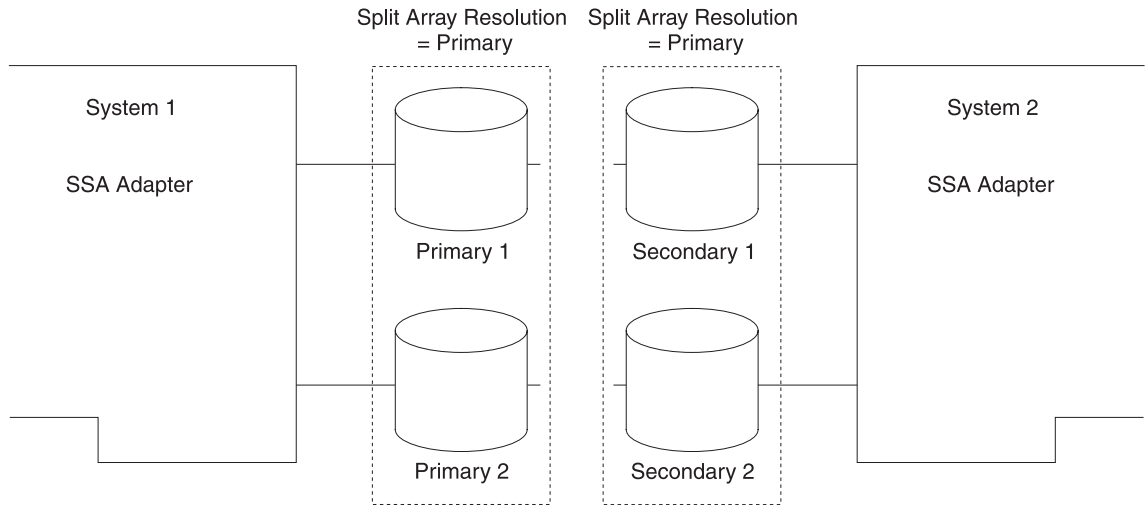
Figure 19. System 1 Split from System 2

On system 1, the array is in the Exposed or the Degraded state. On system 2, the array is in the Offline state, and SRN 48750 is generated. The array remains in the Offline state on system 2 until:

- The two systems are reconnected.
- The Split Array Resolution flag is set to **Secondary**.

  Attention: You must set the Split Array Resolution flag to **Secondary** for ***both*** halves of the array if you need access from system 2. This action ensures that write operations can be performed only on the secondary half of the array. If data had been allowed to be written to both halves of the array, the data would become unsynchronized. If the two halves are later reconnected, and the Split Array Resolution flag is set differently on the primary and secondary side, the array enters the Offline state to both systems.

Normal Reconnection: When the systems are reconnected, the secondary disk
drives are resynchronized with the primary disk drives, as shown in Figure 20.
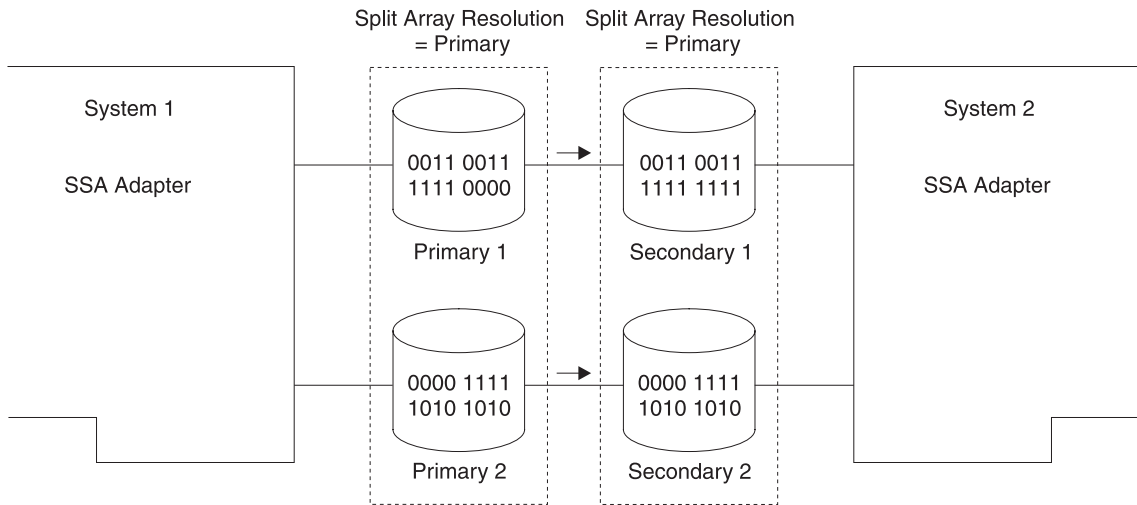
Figure 20. Reconnection of a Split Array

The array enters the Good state for both systems.

Failure of a Primary Disk Drive in a Dual-Host System: Figure 21 shows a dual-host system in which the primary disk drive of a RAID-1 array has failed.

Split Array Resolution
= Primary

System 1

SSA Adapter

System 2

SSA Adapter

Primary 1   Secondary 1
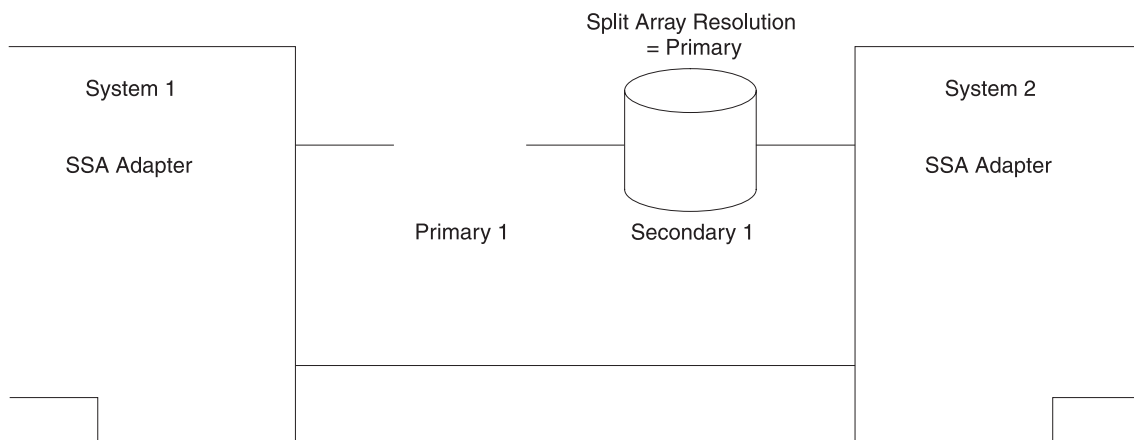
Figure 21. RAID-1 Disk Drive Failure

Because both adapters can still detect the secondary disk drive of the array, the Split Array Resolution flag is automatically set to **Secondary**, and I/O operations continue. The array is in the Exposed or Degraded state. When the primary disk drive is reconnected, it is resynchronized from the secondary disk drive, and the Split Array Resolution flag is automatically set to **Primary**.

RAID-1 Failure of a Host System and a Primary Disk Drive: Figure 22 shows
system 2 disconnected from system 1. The array is in the Offline state. If you set the
Split Array Resolution flag to **Secondary**, the array goes into the Good state.
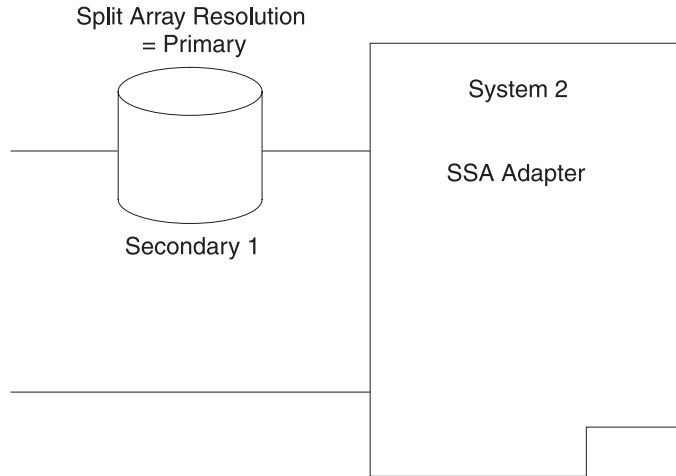
Figure 22. RAID-1 Failure of a Host System and a Primary Disk Drive

RAID-10 Failure of a Host System and a Primary Disk Drive: Figure 23 shows
system 2 disconnected from system 1. The array is in the Offline state. If you set the
Split Array Resolution flag to **Secondary**, the array goes into the Good state.
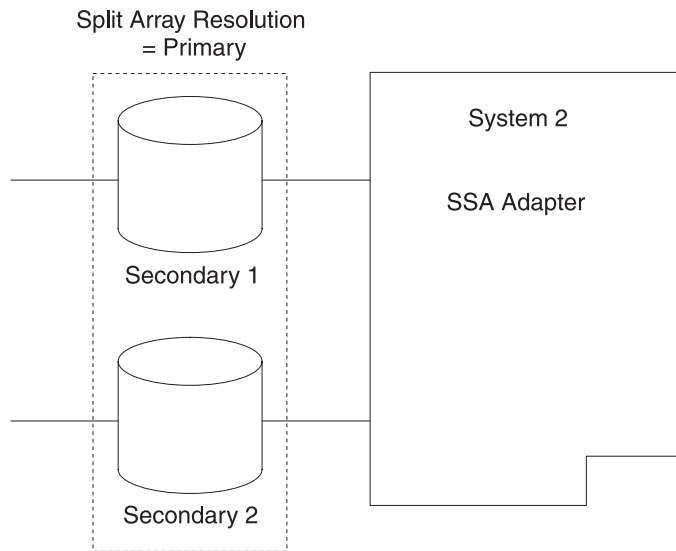
Figure 23. RAID-10 Failure of a Host System and a Primary Disk Drive

Array is Offline because Adapter Is Not Known to the Remaining Half of the Array

When this condition exists, the host system generates SRN 48755.

To maintain data consistency, SSA RAID-1 and RAID-10 arrays keep a record of the adapters to which they are connected. If exactly one half of the array is connected to a different adapter, the array remains in the Offline state unless you take specific action to make the array available.

This type of problem can be caused by:
- Incorrect reconfiguration of an array
- Simultaneous failure of an SSA adapter and a disk drive

Failure of an Adapter and a Disk Drive

In Figure 24, an SSA adapter and a disk drive have failed. When a new adapter is installed, the array remains in the Offline state until the state of the Split Array Resolution flag is changed back to **Primary**.
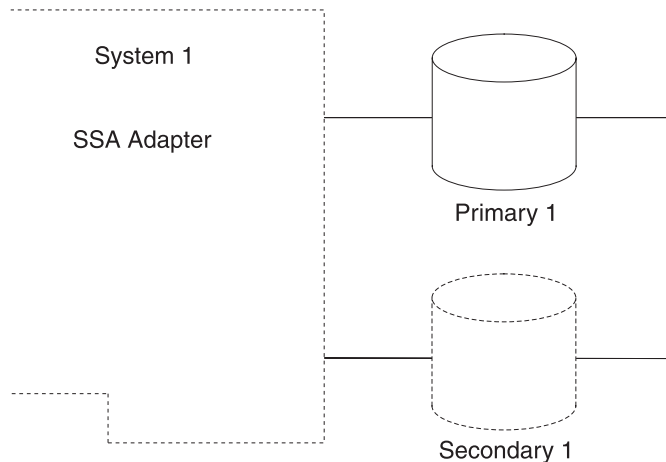
Figure 24. Failure of an Adapter and a Disk Drive

Moving an Array between Systems

In Figure 25, exactly half of a RAID-10 array is being moved from its original connections (adapter A and adapter B) to a new configuration where it is connected to adapter C and adapter D.
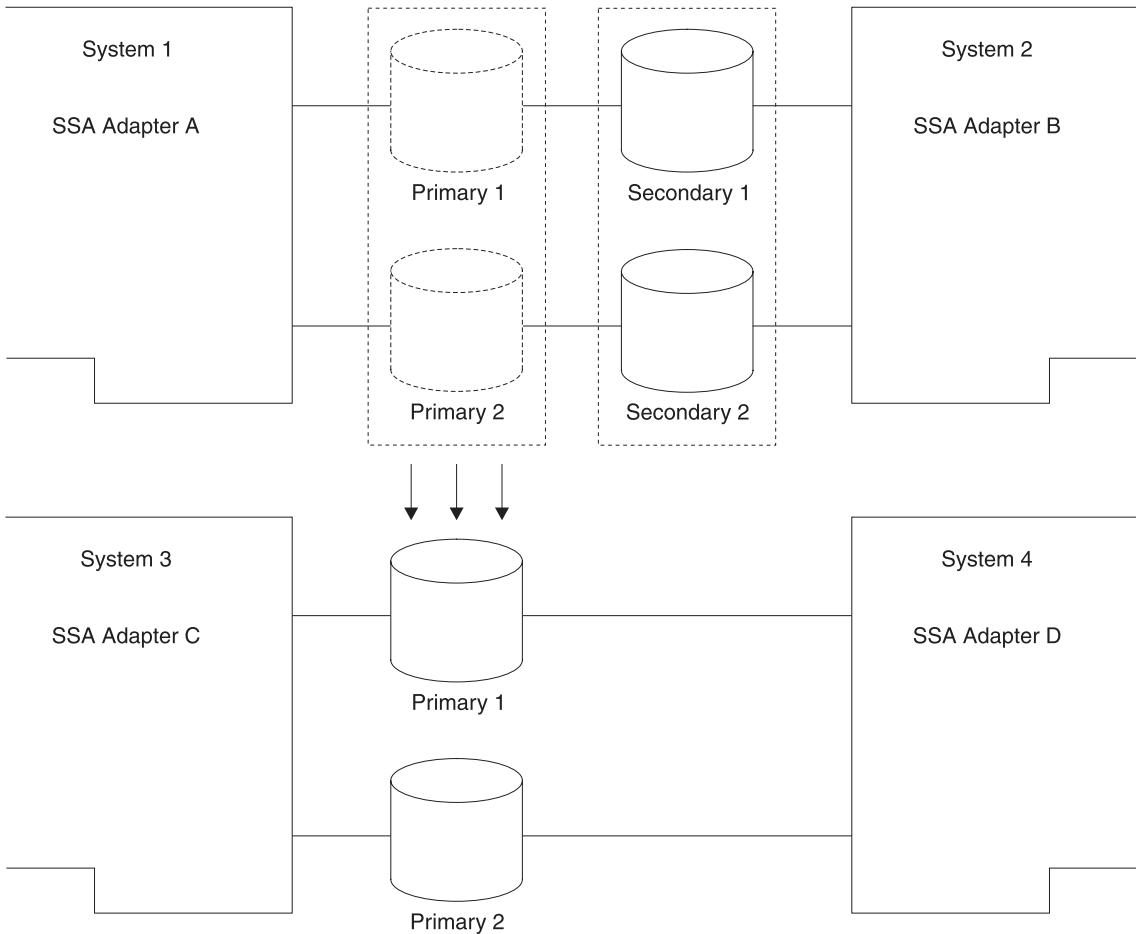
Figure 25. Moving a RAID-10 Array

Under these conditions:

- The half of the array that is still connected to adapter A and adapter B is in the Exposed state.
- The half of the array that is connected to adapter C and adapter D is in the Offline state. System 3 and system 4 generate SRN 48755.

You can solve this problem if you do one of the following:

- Return the primary half of the array to its original adapters.
- Move the secondary half of the array to the new adapters.

- Change the state of the Split Array Resolution flag on the new adapters.

  Attention: This method helps you to recover the system from severe errors. Use this method only if the other half of the array has failed completely, and will never be used again.

Array is Offline because the Split and Join Procedure Was Not Performed Correctly

When this condition occurs, the host system generates SRN 48760.

The condition can be caused if a RAID-1 or a RAID-10 array has been split exactly in half, and a separate write operation has been performed to each half of the array.

This problem can occur in a dual-host configuration if:

- Only one adapter can be detected on the SSA loop, you change the state of the Split Array Resolution flag, and a separate write operation is performed to each half of the array.
- Both adapters can be detected on the SSA loop, but one half of the RAID array cannot be detected, and the following sequence of events occurs:

  1. A write operation is performed.
  2. The half of the array that could originally be detected can no longer be detected.
  3. The half of the array that could not originally be detected can now be detected, and data is written to it.
  4. The half of the array that could originally be detected can now be detected again.

The problem can also occur in a single-host system if only one half of the RAID array can be detected, and the following sequence of events occurs:

1. A write operation is performed.
2. The half of the array that could not originally be detected can now be detected.
3. The half of the array that could originally be detected can no longer be detected, and data is written to it.
4. The half of the array that could originally be detected can now be detected again.

RAID-10 Array Split

Figure 26 shows a RAID-10 array that has been split into halves.

Split Array Resolution Split Array Resolution
= Primary   = Primary

System 1

SSA Adapter

Primary 1

Primary 2

Secondary 1

Secondary 2

System 2

SSA Adapter
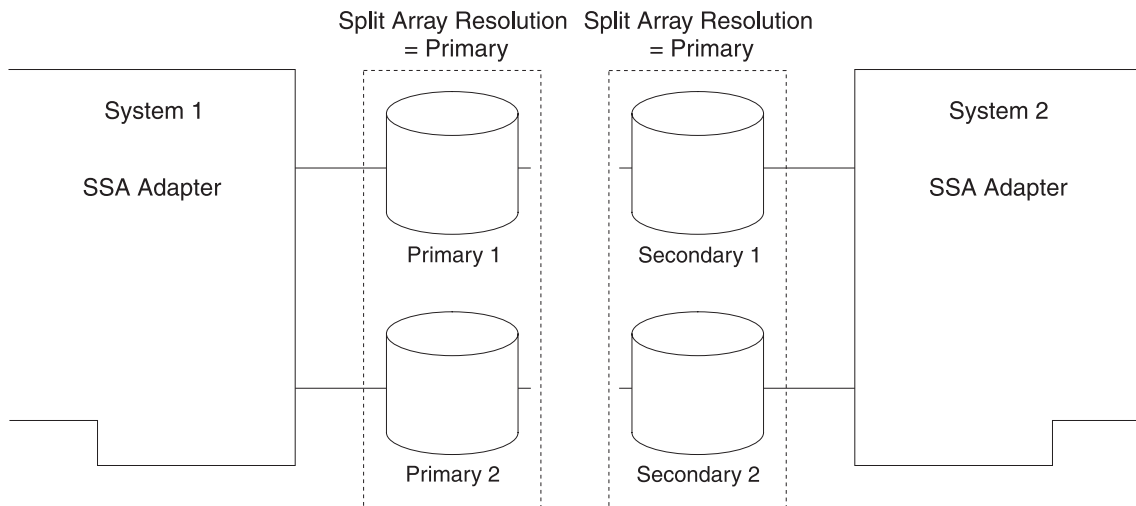
Figure 26. Forcing Access on a RAID-10 Array

The Split Array Resolution flag has been set to **Secondary** to permit I/O operations to be performed on the secondary half of the array. Only user actions can set this condition. Separate write operations can be performed to each half of the array. If these write operations are performed, however, the two halves of the array must not be reconnected.

RAID-10 Array with Unsynchronized Data

Figure 27 shows a RAID-10 array whose halves have been reconnected.
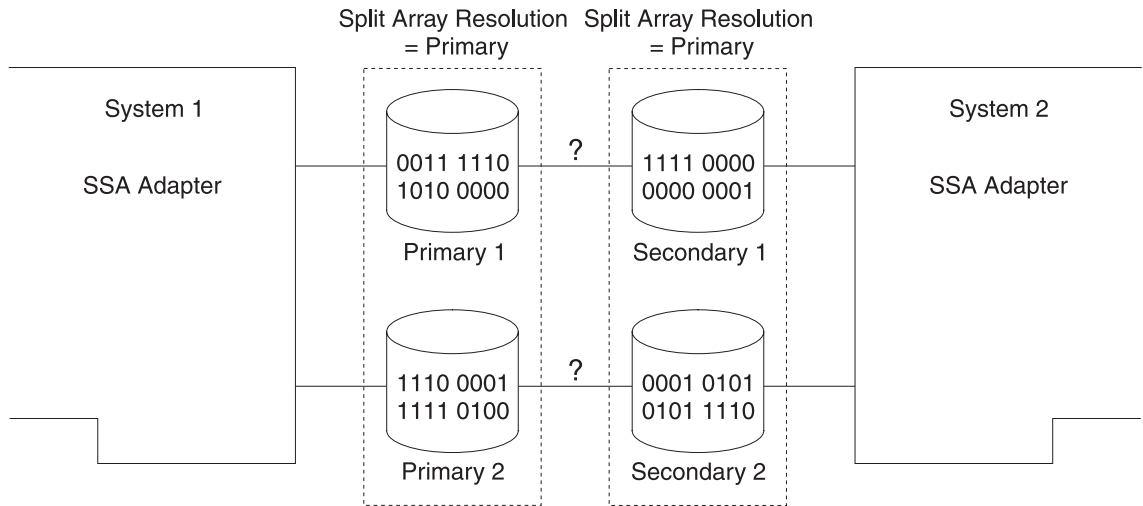
Figure 27. Reconnecting an Unsynchronized Array

Each half of the array contains different data, but no indication is given to which data is valid. Under these conditions, the array is in the Offline state, and both systems generate SRN 48760.

Chapter 9. Using The Fast-Write Cache Functions

This chapter describes how to configure the fast-write cache function, and to solve any fast-write problems that might occur during fast-write operations.

Fast-Write Cache Card Battery

The fast-write cache card receives its power from a rechargeable battery. This battery can maintain data in the write cache for seven days after power has been removed from the adapter card. When an adapter is connected to the power, the fast-write cache card performs a fast-charge operation on the battery. This fast-charge operation lasts from 5 to 60 minutes, as determined by the charge state of the battery. During the fast-charge operation, you can enable, and get access to, fast-write disk drives. The fast-write function, however, remains inactive until the battery is fully charged.

Note: If you run diagnostics to an adapter that contains a fast-write cache card whose battery is on a fast-charge operation, SRN 42529 is generated.

The fast-write cache card keeps a record of the age of its battery. When the battery approaches the age at which it might not be able to maintain the data in the fast-write cache for seven days, an error is logged. This error recommends that the battery be exchanged for a new one. At this time, the fast-write cache continues to work normally. If the battery is not exchanged inside approximately three months from the time of the error, the fast-write cache is disabled and a new error is logged. This error indicates that the fast-write cache is no longer active.

Enabling the Fast-Write Cache Function for a Disk Drive or an Array

Important Notes:

1. Only free resources can be enabled for the fast-write function.
2. When a non-fast-write attached resource is detached, made into a free resource, enabled for fast-write operations, then reattached, Windows NT assigns a new resource number to that resource. If you want to use the original resource number, shut down, then restart, the system.

To enable the fast-write function:

1. Start the RSM configurator.
2. Select **Logical View**.
3. From the **Logical View**, select the resource (disk drive or array) that you want to make into a fast-write resource. That resource must be a free resource.

   The **Resource View** is displayed.
4. Click on the **Create FW** button to display the fast-write options.

   Note: The **Create FW** button is available only if the resource has a usage of "Free", and the existing SSA loop configuration supports fast-write resources.

5. Change the options if required (see Help for details).

6. Select **OK**. The resource is now enabled for the fast-write function.

Disabling the Fast-Write Function from a Disk Drive or an Array

Important Notes:

1. Only free resources can be disabled from the fast-write function.

2. When a fast-write attached resource is detached, then reattached as a non-fast-write resource, Windows NT assigns a new access letter to that resource. If you want to cancel the new letter, shutdown, then restart, the system.

3. It is recommended that you disable the fast-write function before you delete an array resource.

To disable the fast-write function:

1. Start the RSM configurator.

2. Select **Logical View**.

3. From the **Logical View**, select the fast-write resource (disk drive or array) that you want to disable. If the resource is a system PC resource, you must first detach it.

   The **Resource View** is displayed.

4. Click on the **Delete FW** button to disable the fast-write function.

The resource is now disabled from the fast-write function.

Chapter 10. SSA Event Logs

This chapter describes:

- Event logging (summary)
- The SSA Event Logger software
- Working with the SSA Event Log using RSM
- The contents of the event log file
- Health checks
- Event log management
- Event log analysis
- How to solve simple problems with your SSA subsystem
- How to get detailed information about errors and other events that have occurred on the adapter and on the disk drives that are attached to it
- The actions you must perform with the adapter utility programs while you are changing a disk drive

This information explains the meaning of the error log data to help you to further analyze the error log

Event Logging Summary

Hardware errors can be detected by an SSA disk drive, an SSA Adapter, or the SSA device driver. The SSA adapter performs error recovery for disk drive errors; the SSA device driver performs error recovery for the SSA adapter. When a problem is detected that needs to be logged, all the relevant data is sent to the event logging service in the device driver. The event logging service then sends the data to the system error logger.

SSA errors are logged asynchronously; that is, independently of any system input or output activity. For example, if an SSA cable is unexpectedly disconnected, an Open Serial Link error is logged immediately. The SSA subsystem does not wait for a read or write command before it logs the error.

Sometimes, on the SSA network, the SSA adapter and SSA disk drives detect errors that were possibly caused by activities elsewhere on the network. (Such activities might be the rebooting of another system unit, a system upgrade, or maintenance.) These events do not need any service action, and should not cause any problem unless the automatic event log analysis determines that the event is critical.

Because SSA subsystems are designed for high availability, most subsystem errors do not cause input and output operations to fail. Some errors, therefore, might not be obvious to the user. To ensure that the user knows about such errors, a health check is run to the adapter each hour. When an SSA adapter receives a health check, it logs any active errors and conditions that it knows exist on the SSA subsystem.

Additional event logging functions are controlled by settings in the Event Control file. You can find details of these settings in the help file that is on the Control File page of the RSM configurator.

The SSA Event Logger Software

The SSA Event Logger is supplied with the Advanced SerialRAID/X Adapter. When running, the logger is managed by the adapter that is in the local server.

Under Windows NT, the SSA Event Logger runs as a service; its service name is PC SSA Event Logger. You can use the Service Manager in Windows NT to start and stop the event logger. Under Novell NetWare, the SSA Event Logger runs as a NetWare loadable module (NLM). You can load and unload it in the same way as you do any other NLM.

The RSM configurator provides access to the SSA Event Logger. You can use RSM to see the information that is collected by the event logger. The information can be presented as a simple dump, or it can be analyzed into error types and filtered through occurrence thresholds. These thresholds specify how many times a particular type of error must occur before it is presented in the analysis.

Working with the Event Log

To work with the event log, go to the **Common Configuration Frame**, and click on the **SSA Event Logger** button. The **Event Logger View** is displayed. This view includes the version number of the logger that you are using, and the **Check ELog Version** button, which you can use to determine whether you are using the latest available version of the event logger software. The buttons in the action area provide access to the available facilities:

Refresh   Refreshes the information in the browser window.

Stop   Stops the event logger service or process.

Clear   Deletes the whole contents of the event log file.

Analyse   If the event log file is not empty, displays a filtered summary of the existing logged errors.

View   If the event log file is not empty, displays a dump of the contents of the event log file, as a plain text listing.

Ctrl file   Displays, and allows you to edit, the settings that are in the SSA Event Logger Control File.

It is recommended that you always use the **Analyse** button for problem determination because this action will indicate whether a service action is required.

Contents of the Event Log File

The SSA Event Logger uses a binary file to store the events that are received from the adapters. The file wraps after a specified number of entries. Details of this file (for example, its path name and maximum size, and the types of events to be recorded) are specified in the SSA Event Logger Control File.

Each error that the SSA Event Logger can receive is associated with a template and a threshold.

Using the **View** option, you can display details of all the events that have been logged. The **View** option provides more detailed information than the **Analyse** option does. That information is in the following format:

```
Date and time: <Date in format DD-MM-YYYY and time in format HH:MM:SS>
SSA unique ID: <Adapter or disk serial number or enclosure name>
Error type:    'Adapter' or 'Disk' or 'Enclosure'
Template:      <Name of the template>
SRN:           <Service Request Number in format nnnnn>
Flag:          'Current' or 'Fixed'
```

For example:

```
Date and time: 22-09-1999    20:39:26
SSA unique ID: S9072103
Error type:    Adapter
Template:      SSA_DETECTED_ERROR
SRN:           301C0
Flag:          Current
```

For disk drive errors, the entry also contains the sense data, which consists of 36 bytes in hexadecimal format over four lines. For adapter errors, the entry contains the unique ID of the adapter. For array errors, the entry contains the resource name of the array. For enclosure errors, the entry contains the name of the enclosure.

For example:

```
Date and time: 27-09-1999    10:41:50
SSA unique ID: ESRA
Error type:    Enclosure
Template:      SSA_ENCL_ERR1
SRN:           80211
Flag:          Current
               08 02 11 02 00 00 00 00 AC
               14 00 77 00 53 39 30 37 32
               31 30 33 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00
```

Health Checks

A periodic health check checks for SSA subsystem problems that do not cause input or output errors, but cause some loss or redundancy or functionality. It reports such errors each hour until the problem is solved.

This health check sends a command to the adapter. The command causes the adapter to write a new event log entry for each problems that it detects, although those problems might not be causing any failure in the user's applications. Such problems include:

- Adapter hardware faults
- Adapter configuration problems
- RAID array problems
- Fast-write cache problems
- Open serial link conditions
- Link configuration faults
- Disk drives that are returning Check status to an inquiry command
- Redundant power failures in SSA enclosures

Attention: The users of the server do not see many of the problems that might occur on arrays. RAID-1, RAID-5, and RAID-10 functions continue to provide service to the users although a component of an array might have failed. Unless that failure is detected and corrected, however, a second failure in that array could cause the whole array to become unavailable. It is therefore very important that you use the RSM configurator to check the adapter error log regularly. A good idea is to include such a check in the startup procedure for the operating system.

Event Log Management

Summary

If an error is permanent, it is reported each time that the health check is run. If an error is intermittent, it is logged each time that it occurs. Because a particular error need be logged only a defined number of times for the automatic error log analysis to determine that service activity is needed, the device driver stops the repeated logging of the same error. If error logging were not managed in this way, a repeated error could fill the error log and hide other errors that other components in the system might have logged by other components in the system. If error logging management is active for one type of error, however, a different type of error can still be sent to the error log. All types of error are, therefore, logged.

Error logging management is performed for the error types that are shown in Table 1 on page 102. If one of these error types is permanent on a particular device, it is reported each time that the health check is run. The SSA adapter sends the resulting error-log entries to the device driver. The device driver error logger permits these error-log entries to be sent on to the error log until the number of entries for that error reaches a

predetermined *threshold value*. After that value is reached, no more entries of that type are made for that device until the first error has been in the log for at least six hours.

The example in Figure 28 shows an open-link error occurring. This type of error has a logging threshold value of three. The error is logged when the link is first broken (in this example, at about 04:30). The error is then logged each hour as a result of the heath check.

04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00

Adapter sends
LINK_OPEN error
to device driver

SSA Error Logger

Device driver
logs LINK_OPEN
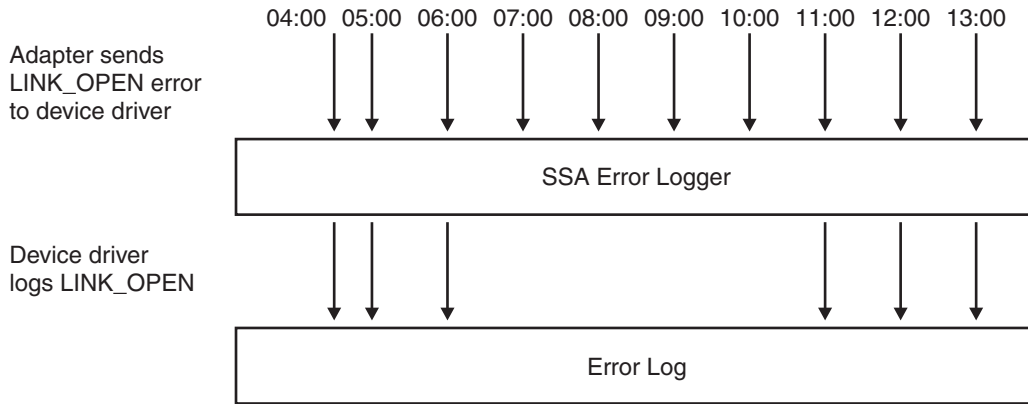
Error Log

Figure 28. Example of an Open Link Error

The example also shows that, during any six hour period, no more than three errors of this type are sent to the error log. If other types of error occur for this device, or errors occur for another device, they are sent immediately to the error log. The actual threshold values that are used for any given error type are regularly reviewed, and might change with any new version of the device driver. They always permit, however, enough errors to be logged to ensure that the error log analysis produces an SRN when any service action is required.

Event Log Analysis

Error log analysis determines whether the data that is in the error log indicates that a service action is needed. The analysis uses the detailed data that is logged with each error. If a service action is needed, an SRN is produced. This SRN provides an entry point into the maintenance procedures that are given either in this book or in the *Service Guide* for the SSA subsystem. (See "Service Request Numbers (SRNs)" on page 133 for more information about SRNs.)

You can run error log analysis from the Event Logger page of the RSM configurator.

Understanding Logged Events

SSA error logs are grouped into types of event. Each type of event is assigned to an error record template. The template specifies the text that appears when the event log is displayed. It also specifies the priority that is applied to each error type when the cause of a problem is determined. Table 1 shows the error record templates and their descriptions.

Table 1. Error Record Templates

Error Record Template	Error Description
DISK_ERR1	An unrecovered media error has been detected. The problem will be solved automatically when data is next written to the failing block. If you are using RAID-5, no application has failed. If you are not using RAID-5, an application might have had a media error. Run error log analysis to determine whether the disk drive has become unreliable and should be exchanged for a new one.
DISK_ERR4	A recovered media error has been detected. An occasional recovered media error is not serious. Multiple media errors per day on one disk drive, however, might indicate that the disk drive is failing. Run error log analysis to determine whether the disk drive should be exchanged for a new one.
SSA_ARRAY_ERROR	A RAID array failure has been detected, and the array is not fully operational. Usually, the data on the array is safe, but ensure that you follow the service procedures exactly so that you do not lose any data.
SSA_CACHE_ERROR	These errors indicate that the fast-write cache has detected a problem. Usually, the problem has been caused by user or service actions, such as moving a Fast-Write Cache Option card from one adapter to another, or moving a disk drive between adapters before the data in the cache card has been synchronized with the data on the disk drive. Take care when moving cache cards, or adapters that contain cache cards, because they might contain data that needs to be synchronized. Always follow the service procedures for the SRN carefully to ensure that you do not lose any data.
SSA_CACHE_BATTERY	This error recommends that the battery of the fast-write cache card be exchanged for a new one.
SSA_DEGRADED_ERROR	An error or condition has occurred that might cause some of the SSA functions to be unavailable or to be working with reduced performance.
SSA_DETECTED_ERROR	Errors of this type are logged by the adapter when a device failure has been reported via SSA asynchronous messages. Because the system name of the device, or devices, that are sending these messages is not known, the error is logged against the adapter. The SRN indicates the service procedures to be performed.

Table 1. Error Record Templates (continued)

Error Record Template	Error Description
SSA_DEVICE_ERROR	This error can be logged against the adapter or disk drive resource.
	When the error is logged against a disk drive, it indicates that the adapter has detected a failure on the disk drive. It is possible, however, that the failure was detected because the disk drive was unavailable for a short period. Run the error log analysis to determine whether the disk drive should be exchanged for a new one.
	When the error is logged against the adapter, it indicates that the adapter has received a report of a status that is not valid. The adapter cannot, however, determine which disk drive sent the bad data. Run diagnostics to all SSA disk drives. If no failure is found, the log might have been caused by a link error.
SSA_DISK_ERR1	An SSA disk drive has received a command or parameter that is not valid. This error might be caused by:
• A software error in the adapter
• A software error in the disk drive
• A hardware error
SSA_DISK_ERR2	The disk drive has performed an internal error recovery operation. No action is needed.
SSA_DISK_ERR3	The disk drive has performed internal media maintenance. No action is needed.
SSA_DISK_ERR4	One of the following has occurred:
• The disk drive has had an unrecovered hardware error.
• The disk drive has had a hardware error that is now recovered, but the disk drive is reporting that it might be going to fail.
SSA_ENCL_ERR1	A hardware error has occurred in the enclosure.
SSA_ENCL_ERR2	A temperature problem has occurred in the enclosure.
SSA_HDW_ERROR	A hardware failure has occurred. Run diagnostics to determine which FRUs to exchange for new FRUs.
SSA_HDW_RECOVERED	A hardware error has occurred that has been recovered by the error recovery procedures. Run error log analysis to determine whether a FRU needs to be exchanged for a new FRU.
SSA_LINK_ERROR	Link errors might be detected by any node in the SSA loop. The adapter is notified of these errors. It performs any necessary error recovery, and logs the error. Link errors are normally associated with some other failure on the SSA loop. Link errors might be logged when other devices on the loop are switched on or off, or when cables or devices are disconnected during service activity. Intermittent link errors are not serious. If many link errors occur, however, one of the SSA links might be going to fail. Run error log analysis to determine whether any repair action is needed.

Table 1. Error Record Templates (continued)

Error Record Template	Error Description
SSA_LINK_OPEN	SSA devices are normally configured in a closed loop. The loop consists of a series of links, each link connecting two SSA devices. A device can be an adapter card or a disk drive. If this loop becomes broken, the alternative signal path round the loop is automatically used. A link might be broken if: • A device is removed from the loop • A device on the loop is reset or switched off, or it fails • An SSA cable is removed, or it fails Each SSA device has a Ready light that indicates the operational status of the SSA loop to which that device is connected. The light is permanently on when the device can communicate with the two SSA devices that are logically next to it on the SSA loop. The light flashes if the device can communicate with only one of those two devices. The light is off if the device cannot communicate with either of the two SSA devices. Usually, an SSA device is present at each side of the point where the SSA loop is broken. Each of those devices has its Ready light flashing.
SSA_SETUP_ERROR	A user procedure has not been performed correctly. Use the SRN to determine the procedure that has caused the problem.
SSA_SOFTWARE_ERROR	The software has detected an unexpected condition. If you have just installed the SSA subsystem, ensure that the latest versions of microcode and software have been installed.

Solving Simple Disk Array 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 switched on to the disk drives?

• Has the configuration utility been run for all the required disk drives, and do those disk drives appear in the list of system resources?

• Are the disk drives connected in a valid loop? "Rules for SSA Loops" on page 14 describes the rules for SSA loops.

• On the adapter, is the green light on for the pair of adapter ports, showing that both ports are operational?

If you need to exchange a failing component, see "Exchanging an Array Disk Drive" on page 110.

Part 2. Maintenance Information

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Chapter 11. SSA Adapter Information

For a description of the SSA adapter, port addresses, and the rules for SSA loops, see Chapter 1. Introducing SSA and the IBM Advanced SerialRAID/X Adapter.

Microcode Maintenance

For some problems, the service request number (SRN) might ask you to check the microcode package ID before you exchange any field-replaceable units (FRUs). To check the microcode package ID:

1. Start the RSM configurator.

   If necessary, ask the user how to access the RSM configurator, or get the URL from the README file that is supplied with the adapter.

2. The Adapter List is displayed.

3. Select the required adapter. The **Adapter View** page for the selected adapter is displayed.

4. Find the **ROS level** (a typical level is 5900).

5. Check also the **Loadable Microcode Level** (a typical value is 05).

   If the microcode is not at the correct level, get the latest microcode from the SSA Customer Support Homepage, which is at:

   http://www.hursley.ibm.com/ssa/pcserver/

Adapter Microcode Maintenance

Instructions on how to download microcode are contained a README.TXT file that is on the CD-ROM that is supplied with the adapter. See also the *IBM Advanced SerialRAID/X Adapter: Installation Guide*.

Disk Drive Microcode Maintenance

Instructions on how to download microcode are contained a README.TXT file that is on the CD-ROM that is supplied with the adapter. See also the *IBM Advanced SerialRAID/X Adapter: Installation Guide*.

Vital Product Data (VPD) for the SSA Adapter

The vital product data (VPD) for the SSA adapter can be displayed by using the using-system service aids. This section shows the types of information that are contained in the VPD.

Product Number	Dem_6.11
FRU Part Number	Dem_6.11
Serial Number	c7070085
Eng. Change Level	1M_Demon
Manf. Location	IBM053
ROS Level	1600
Loadable Microcode Level	05
Device Driver Level	00
Desc. Function	SSA_ADAPTER
DRAM Size	DRAM=032
Fast Write Cache Size	CACHE=1
Adapter ID	0000000000062954

Adapter Power-On Self-Tests (POSTs)

Power-on self-tests (POSTs) are resident in the SSA adapter. These tests ensure that the adapter does not run the functional code until the hardware that uses the code has been tested. The hardware consists of only the adapter card and any memory modules and fast-write cache modules that are connected to the adapter. Some POST failures cause the adapter to become unavailable to the system unit. Other POST failures allow the adapter to be available, although some function might not be enabled. The particular tests that are run are related to the type of SSA adapter that is being used. If a POST fails and prevents the adapter from becoming available, exchange the adapter card for a new one. If a POST fails, but does not prevent the adapter from becoming available, an error is logged. That error indicates which FRUs must be exchanged for new FRUs.

Chapter 12. Removal and Replacement Procedures

This chapter describes how to remove and replace:

- Disk drives
- The Advanced SerialRAID/X Adapter
- The SDRAM module of the adapter
- The fast-write cache card of the adapter
- The battery assembly of the fast-write cache card

Exchanging Disk Drives

When a maintenance procedure requires you to replace a faulty disk drive with a new one, first check whether the disk drive to be removed is a member of a RAID array.

- If the disk drive to be changed *is not* a member of an array, go to "Exchanging a Non-Array Disk Drive".
- If the disk drive to be changed *is* a member of an array, go to "Exchanging an Array Disk Drive" on page 110.

Exchanging a Non-Array Disk Drive

1. Start the RSM configurator and select the appropriate adapter from the Adapter List.
2. On the **Adapter View** page, select the **Physical View** .
3. On the **Physical View** page, select the disk drive that you want to exchange.
4. If the replacement disk drive is new, or has been previously used in an AIX machine, the system puts it onto the list of new resources. (The RSM configurator identifies such a disk drive as system (AIX).) You must convert that disk drive to a free resource before you can use it in your system.

   If the replacement disk drive has been previously formatted as a member of a RAID array in a different system, the system identifies it as a preconfigured disk drive. You must convert that disk drive to a free resource before you can use it in your system.
5. On the **Disk View** page, click on the **Service Mode** button at the bottom of the page to put the disk drive into service mode.

   If necessary use the Identify function to find the actual disk drive. Click on **FlashOn**: the Check light flashes on the selected disk drive. Click on **FlashOff** to remove the function.

   Note: The Check light is not switched off automatically when you leave the **Disk View** page. This allows the Identify function to be used on more than one disk drive at the same time. To turn the Check light off, return to **Disk View** page and select **FlashOff**.
6. You can now remove the faulty disk drive and insert the replacement disk drive.
7. To reset service mode on the new disk drive, return to the **Physical View** page, and click on the **Reset Service Mode** button at the bottom of the page.

If necessary, use the RSM configurator to convert the newly-installed disk drive into a free resource.

Exchanging an Array Disk Drive

This section describes how to logically remove a disk drive from an array, and replace it with a compatible free resource. You must use this procedure if a component disk drive of an array develops a permanent fault and no hot-spare disk drive is available. If this occurs, the failing disk drive is automatically deconfigured and moved to the Rejected list at the next write operation. In the array, the failing disk drive is replaced by Blank reserved. To restore the array to its full operational status you must replace the Blank reserved in the array with a suitable free resource.

Note: If a hot-spare disk drive was available when the array disk drive was failing, the hot-spare disk drive is automatically added to the array, and the failing disk drive is moved to the list of rejected disks. When this condition occurs, convert the rejected disk to a free resource, then change it as described in "Exchanging a Non-Array Disk Drive" on page 109. You can then reassign the new disk drive as a hot-spare disk drive to replace the one that was used.

This procedure is useful also if, for example, you need to exchange a disk drive that is giving many read and write errors, but has not been rejected from the array.

Note: If the disk drive that failed was a component of an array for which no hot-spare disk drive was available, the entry for the failed resource in the list of components of the array is replaced with:

```
uidxxxx      Not Present
```

To exchange a failed disk drive:

1. Start the RSM configurator.
2. If required, use the **Flash on** button to make the Check light flash on the failing disk drive (if it is not already flashing).
3. Before you can remove the disk drive, you must put it into service mode. Before you can put the disk drive into service mode, you must make that disk drive a free resource:
   - If the disk drive that you are removing is a component of an array:
     a. On the RSM configurator, select **Array View** .
     b. Select the component (disk drive) by serial number.
     c. Click on the **Comp.Exchange** button.
     d. Select a replacement disk drive or **Blank reserved**.
     e. Click on the **Exchange** button. The selected disk drive is now a free resource.
   - If the disk drive that you are removing is a rejected disk drive:
     a. On the RSM configurator, select **Logical View** .
     b. Select **Rejected Resources**.
     c. Select the component (disk drive) by serial number.

d. Click on the **Delete** button. The selected disk drive is now a free resource.

4. Select **Physical View** .

5. Select the disk drive that you want to put into service mode (its owner should be free).

6. Select **Disk View** .

7. Click on the **Service Mode** button.

   Note: Service mode is available only if you use the route through **Physical View** and **Disk View** .

8. The **Physical View** now displays Break where the failing disk drive was located. You can now exchange the failing disk drive (see the *Operator Guide*, or equivalent, for the unit that contains the disk drive.

9. When you have installed the replacement disk drive, select **Physical View** .

10. Click on the **Reset Service Mode** button to reset service mode on the replacement disk drive.

11. If required, use the **Comp.Exchange** button to add the new disk drive to the array.

12. If the disk drive that failed was a component of an array for which a suitable hot-spare disk drive was available, that hot-spare disk drive was exchanged automatically with the failed disk drive. You can either:

    • Define the replacement disk drive as a hot-spare disk drive.

    • Wait until the array has been rebuilt by the array management software, then exchange the replacement disk drive with the previous hot-spare disk drive.

Removing and Replacing an Advanced SerialRAID/X Adapter

Attention: The adapter assembly contains parts that are electrostatic-discharge (ESD) sensitive. Use the tools and procedures defined by your organization to protect such parts.

1. Shut down the operating system. Failure to shut the system down correctly may result in loss of data.

2. Remove power from the system.

3. Remove the adapter from the system unit (see the service information for the system unit).

4. If you are exchanging the adapter card for another, you must remove the SDRAM module and the fast-write cache card, and install them onto the new adapter card.

   Note: The fast-write cache card might contain customer data.

   • See "Removing an SDRAM Module of an Advanced SerialRAID/X Adapter" on page 113 to remove the SDRAM module.

   • See "Removing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 116 to remove the fast-write cache card.

5. If you are exchanging the adapter card for another, install the SDRAM module and the fast-write cache card from the original adapter card onto the replacement adapter card.

- See "Installing an SDRAM Module of an Advanced SerialRAID/X Adapter" on page 114 to install the SDRAM module.
- See "Installing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 118 to install the fast-write cache card.

6. Install the adapter into the system unit (see the service information for the system unit).

7. Switch on the power to the system.

8. Start up the system.

Removing an SDRAM Module of an Advanced SerialRAID/X Adapter

Attention: The adapter assembly contains parts that are electrostatic-discharge (ESD) sensitive. Use the tools and procedures defined by your organization to protect such parts.

1. If not already done, remove the adapter from the system unit (see "Removing and Replacing an Advanced SerialRAID/X Adapter" on page 111).

2. Refer to Figure 29.

3. Holding your thumbs against the connector **3** , open the clips **1** by pressing them in the directions shown by the arrows in the diagram. This action pulls the SDRAM module **2** out of the connector.

4. Remove the SDRAM module.
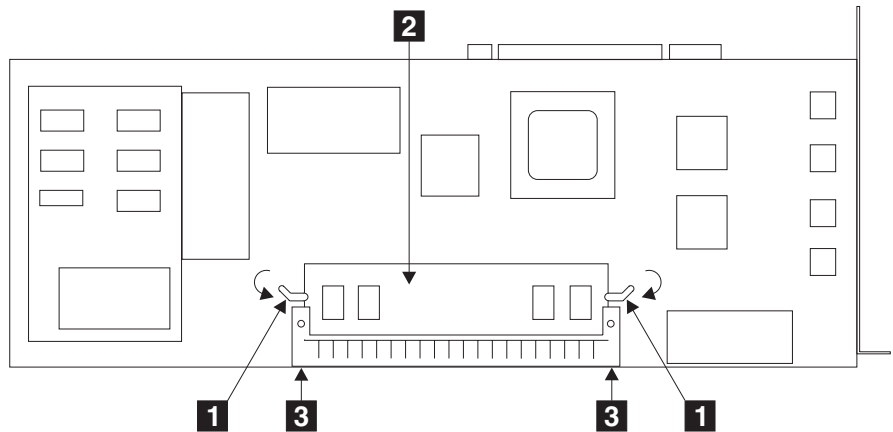
Figure 29. Removing the SDRAM Module

Installing an SDRAM Module of an Advanced SerialRAID/X Adapter

Attention:

- The adapter assembly contains parts that are electrostatic-discharge (ESD) sensitive. Use the tools and procedures defined by your organization to protect such parts.
- If you are exchanging a new SDRAM for a failed SDRAM, ensure that new SDRAM is the same size as the old SDRAM. Refer to the label on each SDRAM.

1. Refer to Figure 30.
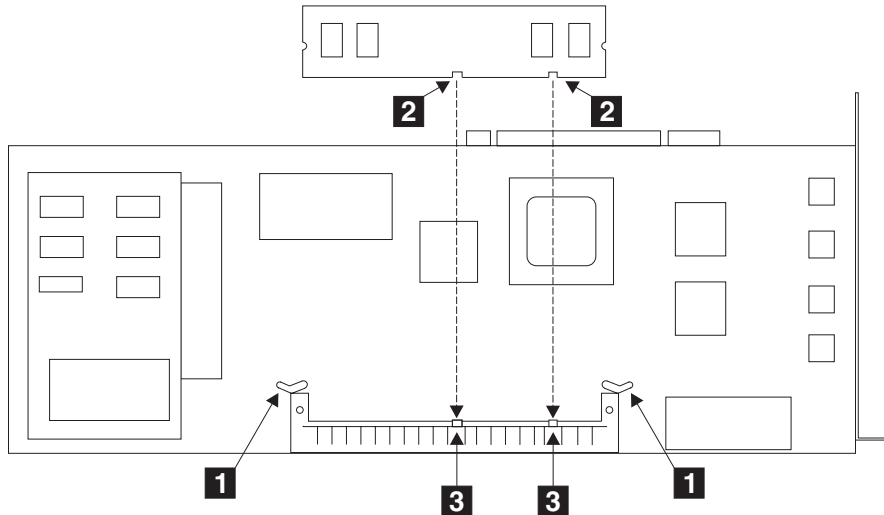
Figure 30. Checking the Clips, Slots and Guides

2. Ensure that the clips **1** are fully open.
3. Hold the SDRAM module so that its slots **2** align with the guides **3** of the connector.

4. Refer to Figure 31.
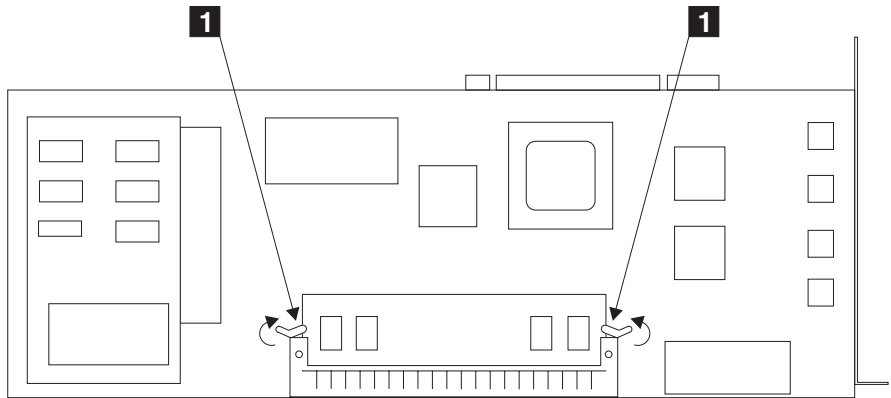
Figure 31. Installing the SDRAM Module

5. Carefully insert the SDRAM module into the connector.
6. Press strongly on the module until it is fully home.
7. Close the clips `1` by pivoting them in the directions shown by the arrows in the diagram. You hear a click when the clips are fully closed. If you cannot close the clips, the module is not fully home. Press the module fully home, then close the clips.
8. If appropriate, reinstall the adapter into the system unit (see the service information for the system unit).

Removing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter

Attention:

- The adapter assembly contains parts that are electrostatic-discharge (ESD) sensitive. Use the tools and procedures defined by your organization to protect such parts.
- The fast-write cache card might contain customer data.

1. If not already done, remove the adapter from the system unit (see "Removing and Replacing an Advanced SerialRAID/X Adapter" on page 111).
2. Place the adapter card, with its components downward, onto a nonconducting surface.
3. Refer to Figure 32.
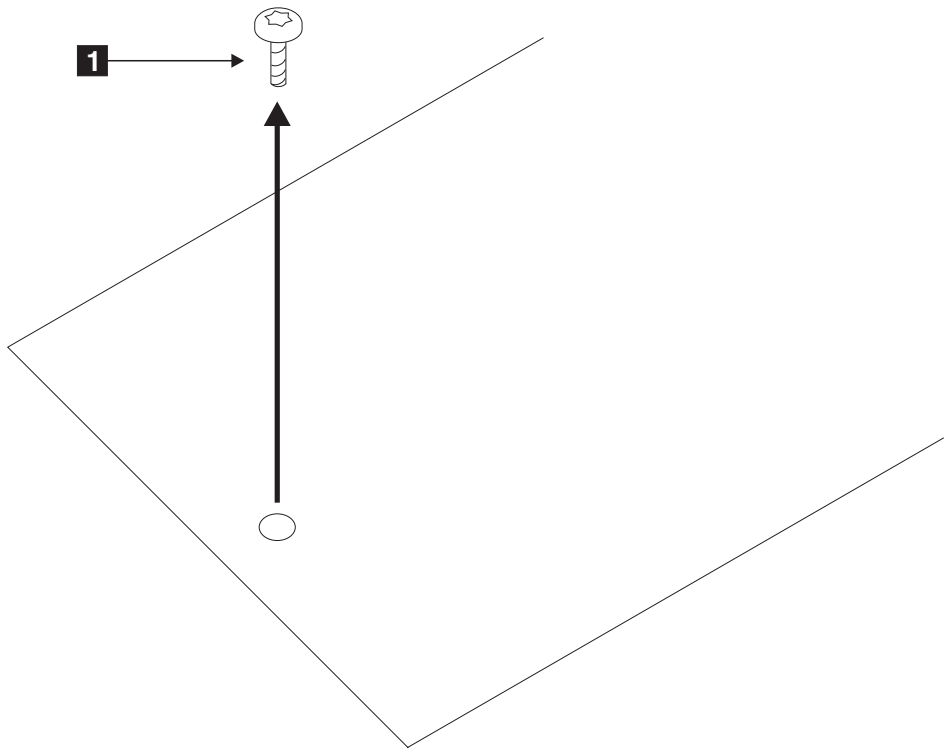
Figure 32. Removing the Mounting Screw from the Fast-Write Cache Card

4. Remove the mounting screw **1** . (The screw fastens the fast-write cache card in position.)

5. Refer to Figure 33.
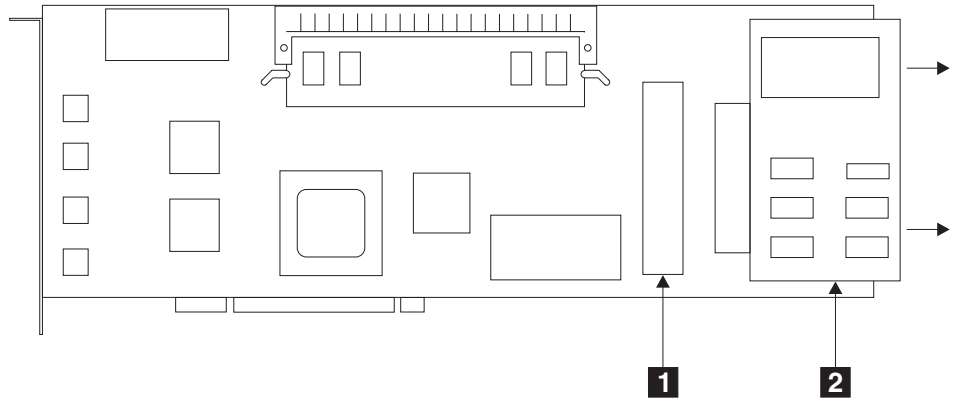
Figure 33. Removing the Fast-Write Cache Card

6. Invert the adapter card, so that its components are upward.
7. Carefully unplug the fast-write cache card **2** from the connector **1** .

Installing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter

Attention: The adapter card contains parts that are electrostatic-discharge (ESD) sensitive. Use the tools and procedures defined by your organization to protect such parts.

1. Place the adapter card, with its components upward, onto a nonconducting surface.
2. Refer to Figure 34.
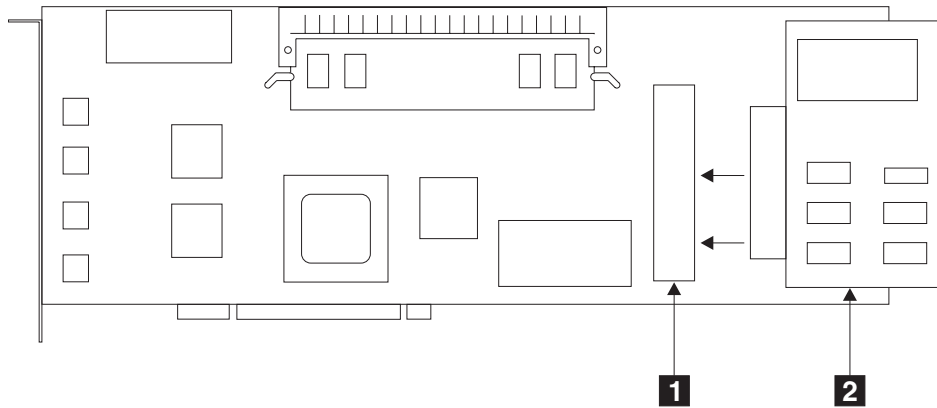
Figure 34. Installing the Fast Write Cache Card

3. Carefully plug the fast-write cache card **2** into the connector **1**. Ensure that you push the cache card fully home.
4. Invert the adapter card, so that its components are downward.

5. Refer to Figure 35.
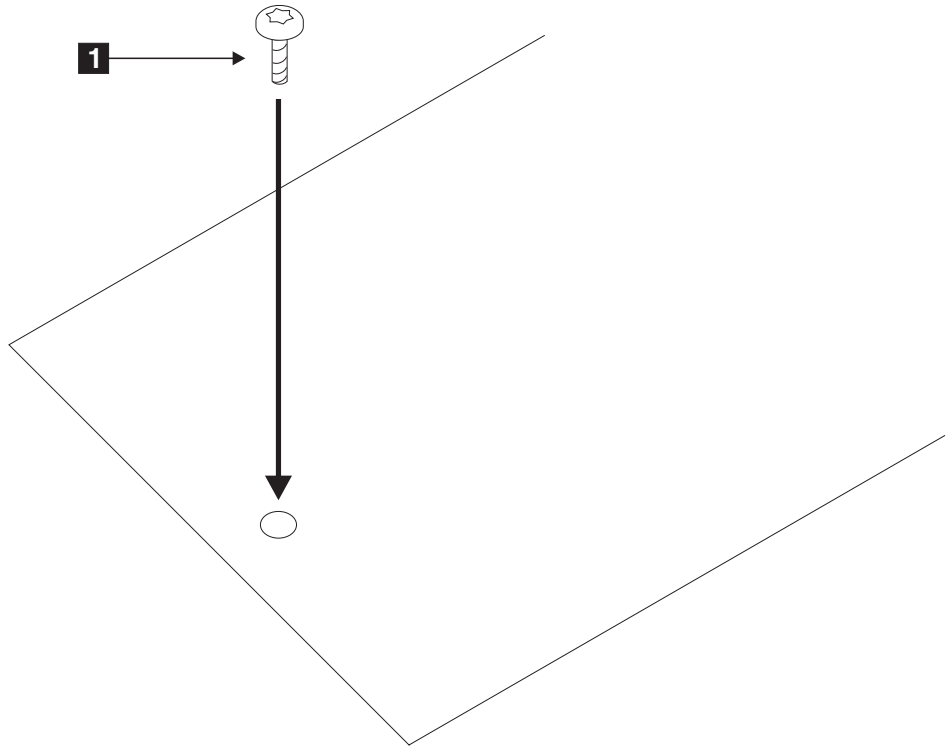
Figure 35. Installing the Mounting Screw of the Fast-Write Cache Card

6. Install the mounting screw **1** , and tighten it fully. (The screw is supplied with the fast-write cache card.)
7. If appropriate, reinstall the adapter into the system unit (see the service information for the system unit).

Removing the Battery Assembly from the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter

Attention:

- The adapter assembly contains parts that are electrostatic-discharge (ESD) sensitive. Use the tools and procedures defined by your organization to protect such parts.
- The Fast-Write Cache Option card might contain customer data.

1. If not already done, remove the adapter from the system unit (see "Removing and Replacing an Advanced SerialRAID/X Adapter" on page 111).
2. Remove the fast-write cache card (see "Removing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 116).
3. Refer to Figure 36.
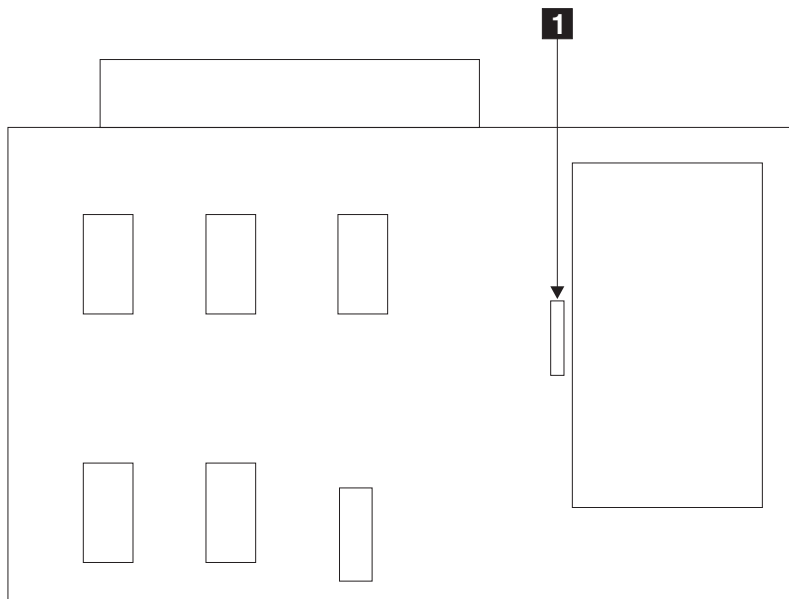
Figure 36. Releasing the Battery Assembly

4. **Attention:** The battery falls when it is released from the fast-write cache card.

   Hold the fast-write cache card approximately 10 mm (0.5 in.) above a work surface.
5. Press the clip **1** . The battery assembly falls through the hole in the fast-write cache card.

6. Refer to Figure 37.
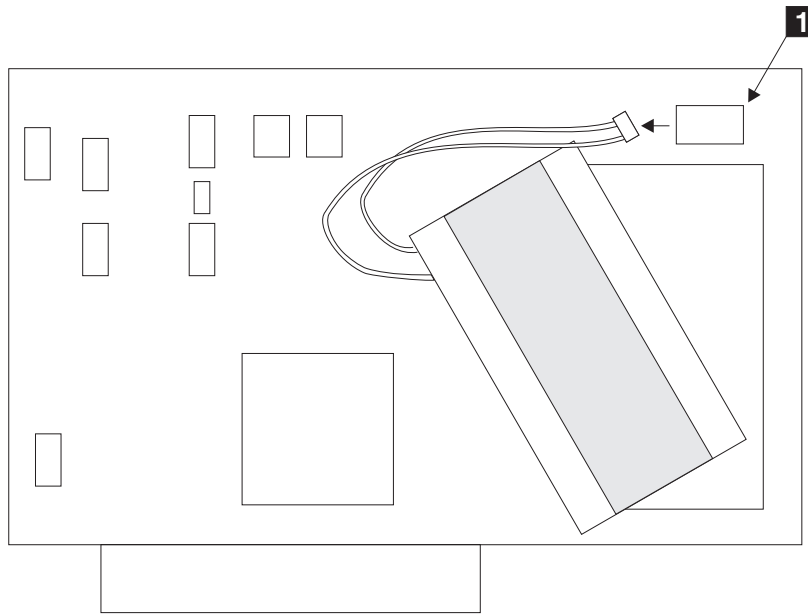
Figure 37. Disconnecting the Battery Assembly

7. Invert the fast-write cache card.
8. Carefully unplug the battery assembly from the connector **1** .

Installing a Battery Assembly into the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter

Attention:

- The adapter assembly contains parts that are electrostatic-discharge (ESD) sensitive. Use the tools and procedures defined by your organization to protect such parts.
- The fast-write cache card might contain customer data.

1. Refer to Figure 38.
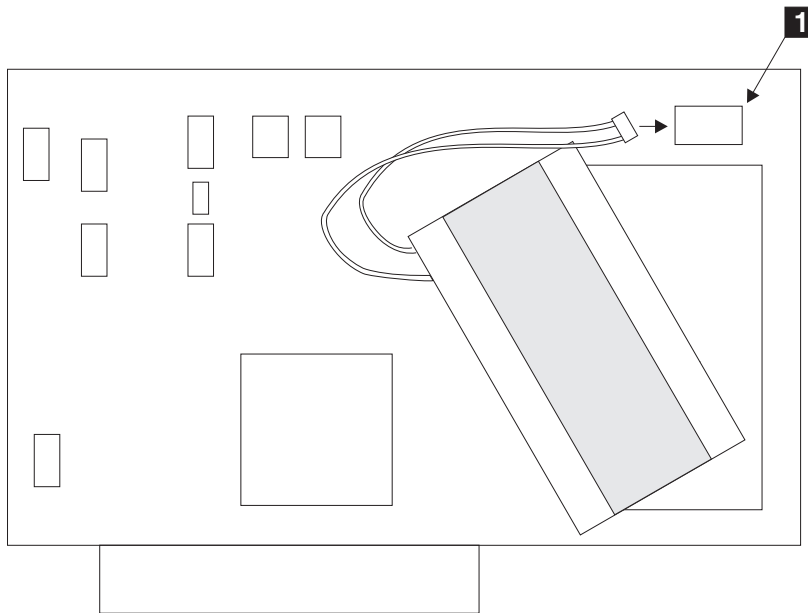
Figure 38. Connecting the Battery Assembly

2. Hold the fast-write cache card so that the battery-assembly connector **1** is upward.
3. Connect the battery assembly to the connector **1** .

4. Refer to Figure 39.
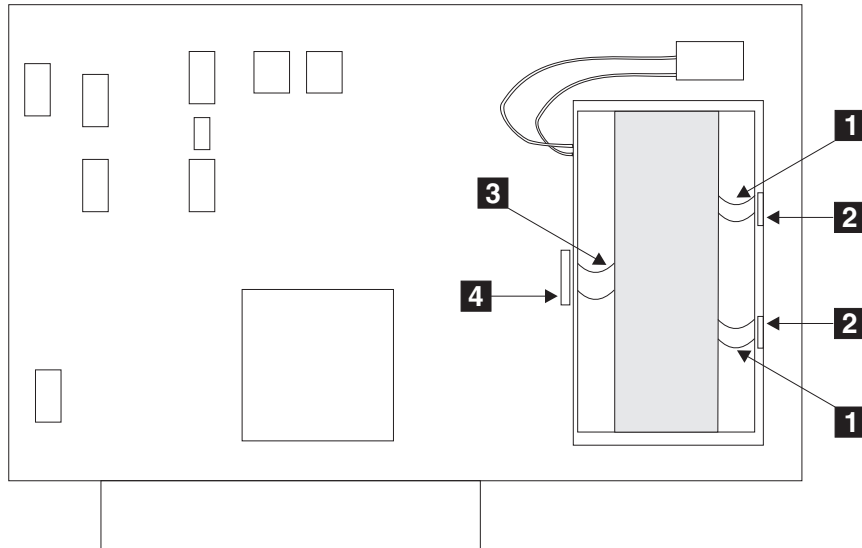
Figure 39. Installing the Battery Assembly

5. Locate the battery assembly so that the two lugs **1** are under the edges of the small slots **2** , and the clip **3** is over the larger slot **4** .
6. Carefully press the battery assembly downward until the clip latches under the edge of the slot.
7. Reinstall the fast-write cache card (see "Installing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 118).
8. If appropriate, reinstall the adapter into the system unit (see the service information for the system unit).

   Note: The battery on the fast-write cache card might be fully discharged. If it is, the diagnostics fail and generate SRN 42529 (see "Service Request Numbers (SRNs)" on page 133). While the battery is discharged, the adapter can be used; the fast-write cache, however, remains disabled until the battery is charged. The battery becomes fully charged approximately one hour after the adapter is connected to the power.

9. You must now reset the battery-age counter. To do this:
   a. Start the RSM configurator.
   b. From the Adapter list, select the adapter whose battery you have just exchanged.
   c. Select **Adapter View** .
   d. Click on the **Battery Counter Reset** button.

Part Numbers

- Advanced SerialRAID/X Adapter card without SDRAM module and without fast-write cache card: 09L2124
- 64 MB module: 09L2104
- Fast-write cache card: 09L2105
- Fast-write cache battery: 09L5609

Chapter 13. Using the SSA Service Aid Functions

The SSA service aid functions help you to service SSA systems. This section describes:
- The SSA service aid functions and how to use them
- Identify function and how to use it
- How to find the physical location of a device
- The Event/Error Log utility and how to use it.

SSA Service Aid Functions

The SSA service aid functions are provided in the RSM configurator. Details of the functions are in the help file. The functions are:

- **Set Service Mode:** This service aid function enables you to determine the location of a particular disk drive on the SSA loop, and to remove that disk drive from the loop.

- **Identify:** This service aid function enables you to determine the location of a particular disk drive that you want to identify.

- **Format Disk:** This service aid function formats an SSA disk drive.

- **Certify Disk:** This service aid function verifies that all the data on a disk drive can be read correctly.

Attention: Do not run the service aid functions from more than one system at a time; otherwise, unexpected results might occur.

Before you use the service aid functions, ensure that you are familiar with the principles of SSA loops. If you are not familiar with these principles, first read "Chapter 2. Introducing SSA Loops" on page 9.

Selecting SSA Service Aid Functions from the RSM Configurator

The service aids that are provided in the RSM configurator are available from the **Disk View** page. To get access to the **Disk View** page:

1. Start the RSM configurator. If you need help, do either of the following:
   - Ask the user how to set up access to the RSM configurator.
   - Go to the README file that is provided with the adapter, and find the URL for the RSM configurator.

   The Adapter List page is displayed.

2. Select the adapter whose connected disk drives you want to service. The **Adapter View** page for that adapter is displayed.

3. Select **Physical View**. Details of the disk drives that are connected to the selected adapter are displayed.

4. Select the disk drive that you want to service. The **Disk View** page is displayed.

   Note: If the disk drive that you want is not shown, that disk drive might be failing, or it might not be physically connected.

5. The **Disk View** page contains the buttons that start the service aid functions. Those buttons are:

   Flash on
   > Sets Identify on the selected disk drive. When Identify is set, the Check light of the disk drive flashes slowly.

   Flash off
   > Resets Identify on the selected disk drive.

   Certify Runs a write and read certify operation on the selected disk drive.

   Diagnostics
   > Runs diagnostics to the selected disk drive.

   Format Runs a format operation on the selected disk drive.

   > **Attention:** The Format operation destroys all data that is on the disk drive.
   >
   > Use the Format function only when the service procedures tell you to do so.
   >
   > **Note:** When the format operation has completed, the disk drive is shown on the **Disk View** page as a free disk drive for system use.

   Attach Configures a free disk drive for system use.

   Service mode
   > Sets service mode on the selected disk drive.

Set Service Mode Service Aid Function

A disk drive must be in service mode before it is removed from the SSA loop to be serviced. When service mode is set:

- The Check light of the disk drive comes on for identification.
- All SSA loop activity through the disk drive stops.
- The disk drive motor stops.
- The Check light (if present) of the enclosure that contains the selected disk drive comes on.
- The SSA loop is broken, and no communication to the disk drive is possible.

Only one disk drive at a time can be in service mode.

Before using this service aid, you must make the selected disk a free resource.

SSA devices can be maintained concurrently; that is, they can be removed, installed, and tested on an SSA loop while the other devices on the loop continue to work normally. If a disk drive has its Check light on, you can remove that disk drive from the SSA loop without taking any special actions.

If a disk drive does *not* have its Check light on, the SSA loop that passes through it might still be active, although the disk drive itself might not be working. You must put that disk drive into service mode before you remove it from the SSA loop.

If you are not sure of the identification of the disk drive that you want to format, use the Identify function (Flash) to get a positive physical identification of the disk drive. You can further ensure that you have selected the correct disk drive by verifying that the serial number on the disk drive is the same as the serial number that is displayed on the screen.

To reset service mode on the new disk drive, return to the **Physical View** page, and click on the **Reset Service Mode** button at the bottom of the page. If necessary, use the RSM configurator to convert the newly-installed disk drive into a free resource.

The Identify Function

This function enables you to determine the location of a particular disk drive that you want to identify, but do not want to remove. Identify causes the Check light of the disk drive to flash for identification (two seconds on, two seconds off), but has no effect on the normal operation of the disk drive. It also causes the Check light (if present) of the unit containing the selected disk drive to flash. You can use the Identify function on any number of disk drives at the same time.

In the RSM configurator, most of the displays that show disk drive information provide **Flash on** and **Flash off** buttons.

The service aids display the UIDs of the devices. By checking the UID on the serial-number label on the device, you can verify that the correct device has its Check light flashing.

Finding the Physical Location of a Device

The physical location of a device (for example, a disk drive or an Advanced SerialRAID/X Adapter) cannot be reported directly by the system because of the way in which the SSA interface works. The address of an SSA device is related to the position of that device on the SSA loop. The address can, therefore, change if the configuration is changed.

Finding the Device When Service Aids Are Available

When the service aids are available, use the Identify function to find the correct disk drive (see "The Identify Function" on page 127). If you want to find a device that does not have a Check light (for example, an adapter), you can either use the Identify function to identify devices that are next to the Advanced SerialRAID/X Adapter on the SSA link, or use the procedure described in "Finding the Device When No Service Aids Are Available".

Finding the Device When No Service Aids Are Available

When no service aids are available, you must find the device by using the port (P) and SSA-address (AA) values that are provided by some service request numbers (SRNs). Examples of these SRNs are 43PAA, 44PAA, and 45PAA.

The port (P) value can be a number 0 through 3. It indicates the port connector on the SSA adapter:

0 = Connector A1
1 = Connector A2
2 = Connector B1
3 = Connector B2

The AA value is the decimal SSA-address value. It indicates the position of the device that you are trying to find (counted *along* the SSA loop).

Use the port value to locate the relevant connector on the Advanced SerialRAID/X Adapter, then follow the SSA cable to the first *real* device. Include other adapters as real devices if they are in the same SSA link. Do not include dummy devices.

The first device that you reach represents SSA-address count 0. Continue to follow the SSA links from device to device, increasing the SSA-address count by 1 for each device, until you reach the device that is indicated in the SRN.

The Event/Error Logger

The adapter software includes an event/error logger. This logger is automatically loaded into the system during the installation of the adapter software, and afterward, at each power-on operation. It collects information about SSA errors, and tells you when an error occurs that needs a service action.

All errors are reported and logged in the event/error log files of cluster members.

The format in which the event/error logger reports errors is controlled by the file EVNCTRLF.TXT. Details of the settings and how to change them are in the RSM configurator. (See also "Event/Error Logger Functions".)

Selecting the Event/Error Logger

1. Start the RSM configurator. If you need help, do either of the following:

   - Ask the user how to set up access to the RSM configurator.
   - Go to the README file that is provided with the adapter, and find the URL for the RSM configurator.

   The Adapter List page is displayed.

2. Click on the **Event Logger** button. A list of available functions is displayed.
3. Select a function (see "Event/Error Logger Functions").

Event/Error Logger Functions

The event/error logger provides functions that allow you to use the logged information. These functions are:
- Timeout
- Analyze the SSA Event Log
- View the SSA Event Log
- Stop the SSA Event Log
- Start the SSA Event Log (if the event logger has stopped)
- Clear the SSA Event Log
- Modify the SSA Event Logger Control File

Timeout

This function enables you to set a longer time for the event logger to perform the analyze and view functions. A heavily-loaded system might cause a time out to occur if the time setting is too short.

Analyze the SSA Event Log

This function checks the log information that has been collected over the previous twenty-four hours, and displays information about errors that require service actions to be done.

Service Actions are indicated by service request numbers (SRNs). Click on the SRN to open the Help file, which lists the SRNs. See also "Service Request Numbers (SRNs)" on page 133.

Note: The Analyze the SSA Event Log function does not recommend a service action for every log entry. Not all log entries require a service action. In some conditions, some errors might be related to operational procedures. Such errors do not require service actions.

Attention: If you need to do any service actions, always go first to "MAP 2010: START" on page 163.

When you have solved a problem, you must flag all the errors that are related to that problem. Otherwise, the next time that you run the Analyze the SSA Event Log function, or diagnostics, another SRN might be created for the problem, which no longer exists.

Fix Procedure
Included in the Analyze the SSA Event Log function is a fix procedure. This procedure enables you to flag an error as "fixed". To flag a fixed error, check off the box that is next to the description of that error. Then click on the **Fix** button.

View the SSA Event Log

This function displays the contents of the event/error log. You can use the browser Save As function to save the data to a file if required.

Note: Not all log entries require a service action. In some conditions, some errors might be related to operational procedures. Such errors do not require service actions.

Stop the SSA Event Logger

This function ends the operations of the event/error logger.

Start the SSA Event Logger

This function starts the operations of the event/error logger.

Clear the SSA Event Log

This function clears the event/error log.

Modify the SSA Event/Error Logger Control File

This function displays the SSA event/error logger control file and allows it to be modified. The information displayed is:

Log Filename
> The name of the binary SSA event log file that stores all the SSA event data.

Log Size

Sets the maximum size that is allowed for the SSA binary event log file.

Netfinity Logging

Enables and disables the logging of events to the Netfinity event log. Each error that occurs starts an analysis of the SSA event log. If the result shows that a service action is needed, an entry is sent to the Netfinity event log.

System Logging List

A list of the error templates, each of which has a selection (select) flag. If you set the select flag for a particular error, that error is logged to the Windows NT Event Log and to the SSA Event Log. Each error template has five digit-positions into each of which you can enter a hexadecimal number. This number specifies an SRN or a range of SRNs. You can enter a ? to specify any possible value for a position.

Chapter 14. SSA Problem Determination Procedures

SSA problem determination procedures are provided by power-on self-tests (POSTs), service request numbers, and maintenance analysis procedures (MAPs). Some of these procedures use the service aid functions that are described in "Chapter 13. Using the SSA Service Aid Functions" on page 125.

Service Request Numbers (SRNs)

Service request numbers (SRNs) are generated by the event/error logging function and by the diagnostics. SRNs help you to identify the cause of a problem, the failing field-replaceable units (FRUs), and the service actions that might be needed to solve the problem.

Displaying SRNs

To see the SRNs:

1. Start the RSM Configurator.
2. From the Adapter List, select **Event/Error Logger**.
3. Select **Analyze the SSA Event Log**. The error log is analyzed, and all errors that need service action are displayed.
4. To return to the Adapter List at any time, select the SSA logo that is displayed at the top of the configurator page.

The SRN Table

The table in this section lists the SRNs and describes the actions you should do. The table columns are:

SRN	The service reference number.
Problem	A description of the problem and the action you must take.
Possible Causes	The condition or FRUs that might be causing the problem, and how likely it is (by percentage) that a particular FRU is causing the problem.

Abbreviations used in the table are:

DMA	Direct memory access.
FRU	Field-replaceable unit.
PAA	P = Adapter port number
	AA = SSA address (see also "Finding the Device When No Service Aids Are Available" on page 128).
PCI	Peripheral Component Interconnect.
POST	Power-On Self-Test.
SDRAM	Synchronous dynamic random-access memory.

Using the SRN Table

> **Note:** You should have been sent here from either diagnostics, or a START MAP. Do not start problem determination from the SRN table; always go to the START MAP for the unit in which the device is installed.

1. Locate the SRN in the table. **If you cannot find the SRN**, refer to the documentation for the subsystem or device. If you still cannot find the SRN, you have a problem with the diagnostics, the microcode, or the documentation. Call your support center for assistance.

2. Read carefully the "Action" you must do for the problem. *Do not exchange FRUs unless you are instructed to do so.*

3. Normally exchange only one FRU at a time. After each FRU is exchanged, go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

4. When exchanging an adapter, always use the instructions that are supplied with the system unit.

SRN	Problem	Possible Causes
1xxxx	Description: SRNs in this range are not adapter SRNs. Action: For SRNs in this range, see the documentation for your SSA enclosure or SSA subsystem.	Not applicable.
20PAA	Description: An open SSA link has been detected. Action: Use the **Physical View** of the RSM configurator to isolate the failure (see "Chapter 13. Using the SSA Service Aid Functions" on page 125). If the SSA service aids are not available, go to the service information for the unit in which the device is installed.	**Possible FRUs:** **Device (45%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (45%)**. **External SSA cables (6%)**. **Internal SSA connections (4%)** (enclosure service information).
21PAA to 29PAA	Description: An SSA 'Threshold exceeded' link error has been detected. Action: Go to "MAP 2323: SSA Intermittent Link Error" on page 166.	**Possible FRUs:** **Device (45%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (45%)**. **External SSA cables (6%)**. **Internal SSA connections (4%)** (enclosure service information).
2A002	Description: Async code 02 has been received. Probably, a software error has occurred. Action: Go to "Software and Microcode Errors" on page 160 before exchanging any FRUs.	**Possible FRUs:** **Device (50%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (50%)**
2A003	Description: Async code 03 has been received. Probably, a software error has occurred. Action: Go to "Software and Microcode Errors" on page 160 before exchanging any FRUs.	**Possible FRUs:** **Device (50%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (50%)**.
2A004	Description: Async code 04 has been received. Probably, a software error has occurred. Action: Go to "Software and Microcode Errors" on page 160 before exchanging any FRUs.	**Possible FRUs:** **Device (50%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (50%)**
2A005 to 2A206	Description: SRNs in this range are not adapter SRNs. Action: For SRNs in this range, see the documentation for your SSA enclosure or SSA subsystem.	Not applicable.

SRN	Problem	Possible Causes
2FFFF	Description: An async code that is not valid has been received. Action: Go to "Software and Microcode Errors" on page 160.	Software error.
300C0 301C0 31000	Description: SRNs in this range are not adapter SRNs. Action: For SRNs in this range, see the documentation for your SSA enclosure or SSA subsystem.	Not applicable.
303FE	Description: A disk drive microcode error has been detected. Action: Go to "Software and Microcode Errors" on page 160.	Software error. **Possible FRUs:** **Device (100%)** ("Exchanging Disk Drives" on page 109).
303FF	Description: An SCSI status that is not valid has been received. Action: Go to "Software and Microcode Errors" on page 160.	**Possible FRUs:** **Device (100%)** ("Exchanging Disk Drives" on page 109).
33PAA	Description: Excessive link reconfigurations have been detected. Action: Go to "MAP 2323: SSA Intermittent Link Error" on page 166.	**Possible FRUs:** **External SSA cables (30%)**. **Internal SSA connections (30%)** (enclosure service information). **Device (30%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (10%)**.
34000	Description: The adapter cannot initialize a device. This problem might be badly affecting the SSA loop. If the device was a member of a RAID array, you might not be able to list this disk drive by using the RAID facilities. Action: Exchange the FRUs for new FRUs.	**Possible FRUs:** **Device (90%)** ("Exchanging Disk Drives" on page 109). **External SSA cables (5%)** **Internal SSA connections (5%)** (enclosure service information)
40000	Description: The SSA adapter card has failed. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)**.

SRN	Problem	Possible Causes
40064	Description: A 64 MB SDRAM in the adapter card module has failed. Action: Exchange the FRUs for new FRUs.	**Possible FRUs:** **64 MB SDRAM module 0 (99%)** ("Removing an SDRAM Module of an Advanced SerialRAID/X Adapter" on page 113). **SSA adapter card (1%)**
42000	Description: Either no SDRAM module is present on the adapter card, or the POST cannot determine the size of the existing SDRAM module. Action: Install an SDRAM module of the correct size, or exchange the existing SDRAM module for a new one of the correct size.	**Possible FRUs:** **SDRAM module (90%)** ("Removing an SDRAM Module of an Advanced SerialRAID/X Adapter" on page 113). **SSA adapter card (10%)**.
42200	Description: Other adapters on the SSA loop are using levels of microcode that are not compatible. Action: Install the latest level of adapter microcode onto all the other adapters on this SSA loop.	User or service action.
42500	Description: The fast-write cache card has failed. Action: 1. Exchange the cache card for a new one. 2. Switch on power to the system unit. 3. If the original cache card contained data that was not moved to a disk drive, new error codes are produced. Run NonCDiagnostics to the adapter. If an SRN is produced, do the actions for that SRN.	**Possible FRUs:** **Fast-write cache card (98%)** ("Removing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 116). **SSA adapter card (2%)**
42510	Description: Not enough SDRAM available to run the fast-write cache operation. Action: 1. Start the RSM configurator. 2. Select the required adapter. 3. Note the DRAM size. 4. For fast-write operations, the size of the available SDRAM must be greater than the size of the fast-write cache. If you cannot determine the correct size of SDRAM to use, contact your support center.	User or service action.

SRN	Problem	Possible Causes

42515	Description: A fast-write disk is installed, but no fast-write cache card has been detected. The cache card is not installed correctly.
	
	Action:
	1. If you have not already done so, run NonCDiagnostics to the adapter. If a different SRN is generated, solve that problem first.
	2. Do the following actions as appropriate:
	  • If the cache card is not installed correctly, remove it from the adapter, then reinstall it correctly.
	  • If the cache card is installed correctly, it might have failed. Exchange, for new FRUs, the FRUs that are shown in the FRU list for this SRN.
		Possible FRUs:
		
		Fast-write cache card (90%) ("Removing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 116).
		
		SSA adapter card (10%)

42521	Description: A fast-write cache card has failed. Data has been written to the cache card, and cannot now be recovered. The disk drives that have lost the data cannot be identified. All unsynchronized fast-write disk drives that are connected to this adapter are offline.
	
	Action:
	1. Ask the customer to refer to "Disabling the Fast-Write Function from a Disk Drive or an Array" on page 96 to determine:
	  • Which disk drives are affected by this error
	  • How much data has been lost
	  • Which data recovery procedures can be done
	2. Ask the customer to disable the fast-write option for:
	  • Each device for which the fast-write option is offline
	  • All other devices that are connected to the failing adapter, and have the fast-write option enabled
	
	For instructions on how to disable the fast-write option, see "Disabling the Fast-Write Function from a Disk Drive or an Array" on page 96.
	3. If this error has occurred because the fast-write card has been switched off for more than seven days, or if the fast-write cache card battery has been disconnected, clear the contents of the fast-write cache:
	  a. Start the RSM configurator.
	  b. Select from the adapter list the adapter whose fast-write cache card has failed.
	  c. Select **Adapter View**.
	  d. Click on the **Format Cache** button.
	
	If the fast-write cache card has not been switched off, exchange it for a new one.
	4. Ask the customer to re-enable the fast-write option for the devices that are connected to the new fast-write cache card.
		Possible FRUs:
		
		Fast-write cache card (100%) ("Removing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 116).

SRN	Problem	Possible Causes
42523	Description: The fast-write cache card has a bad version number. Action: Install the correct adapter microcode for this cache card.	User or service action.

42524	Description: A fast-write disk drive (or drives) that does not contain synchronized data has been detected. The fast-write cache card, however, cannot be detected. The disk drive (or drives) is offline.
	
	Action:
	• If the fast-write cache card has been removed, reinstall it.
	• If the fast-write cache card has failed:
	  1. Ask the customer to disable the fast-write option for:
	    – Each device for which the fast-write option is offline
	    – All other devices that are connected to the failing adapter, and have the fast-write option enabled
	
	    For instructions on how to disable the fast-write option, see "Disabling the Fast-Write Function from a Disk Drive or an Array" on page 96.
	  2. Exchange the fast-write cache card for a new one.
	  3. Ask the customer to re-enable the fast-write option for the devices that are connected to the new fast-write cache card.
		Possible FRUs:
		
		Fast-write cache card (100%) ("Removing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 116).

SRN	Problem	Possible Causes

42525	Description: A fast-write logical disk contains unsynchronized data, but the fast-write cache card does not contain that data. One of the following conditions occurred:
	
	• The data was not synchronized on the old adapter before the disk drive was moved to this adapter.
	• The wrong fast-write cache card was installed onto this adapter.
	• The fast-write cache card lost the data because the battery failed.
	
	The failing disk drive is offline.
	
	Action:
	
	• If the disk drive has just been moved from another adapter, do either of the following actions:
	
	  – Return the disk drive to its original adapter.
	  – Move the original fast-write cache card to this adapter so that the data can be synchronized.
	
	• If the wrong fast-write cache card has been installed (for example, if the adapter has been exchanged, but the original fast-write cache card is still on the old adapter card), install the original fast-write cache card onto this adapter.
	
	• If the adapter card has been switched off for more than seven days, the battery is discharged and data has been lost. If the adapter card has been switched off for fewer than seven days, exchange the fast-write cache card for a new one, then do the following:
	
	1. Ask the customer to disable the fast-write option for:
	
	  – Each device for which the fast-write option is offline
	  – All other devices that are connected to the failing adapter and have the fast-write option enabled.
	
	  For instructions on how to disable the fast-write option, see "Disabling the Fast-Write Function from a Disk Drive or an Array" on page 96.
	
	2. If the fast-write option has been disabled for a RAID-5 array, that array can no longer be configured. Delete the RAID-5 array, then recreate it. For instructions on how to delete the array, see "Managing Arrays" on page 57.
	
	3. Ask the customer to re-enable the fast-write option for the devices that are connected to the fast-write cache card.
		Possible FRUs:
		
		Fast-Write Cache Option Card battery (100%) ("Removing the Battery Assembly from the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 120).

SRN	Problem	Possible Causes
42527	Description: A dormant fast-write cache entry exists. The fast-write cache contains unsynchronized data for a disk drive that is no longer available. Action: If possible, reconnect the disk drive to the adapter to enable the data to be synchronized. If you cannot reconnect the disk drive (for example, because the disk drive has failed), the user should delete the dormant fast-write cache entry (see "Disabling the Fast-Write Function from a Disk Drive or an Array" on page 96). Although the resource is no longer available, the RSM configurator still shows the resource. Go to the **Resource View** page of the RSM configurator, and select **Detach** or **Delete** as appropriate.	User or service action.

42528	Description: A fast-write disk drive has been detected that was previously unsynchronized, but has since been configured on a different adapter.
	
	Action: If this disk drive contains data that should be kept, return the disk drive to the adapter to which it was previously connected.
	
	If the disk drive does not contain data that should be kept:
	1. Physically remove the disk drive from the system configuration.
	2. Ask the user to delete all offline items:
	  a. Start the RSM configurator and go to the **Resource View**.
	  b. Select **Detach** or **Delete** as appropriate.
	  c. When the items have been deleted, reinstall the disk drive that you have just removed.
		User or service action.

42529	Description: The fast-write cache is inactive. The battery is in a fast-charge operation. It remains in the fast-charge operation for up to one hour after the adapter has been connected to the power. During this time, the fast-write function remains inactive. **(Inactive means that although fast-write disk drives can be enabled and accessed, they are not using the fast-write function.)** Action: If the using system has been switched on for less than one hour, wait for the battery to complete charging. If the using system has been switched on for more than one hour, run diagnostics to the adapter. If the same SRN is generated, exchange the FRU for a new FRU.	**Possible FRUs:** **Fast-write cache card battery (100%)** ("Removing the Battery Assembly from the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 120).
4252A	Description: The supply voltage to the fast-write cache card is low. The card has switched to self-refresh mode. Action: In the sequence shown, exchange the FRUs for new FRUs.	**Possible FRUs:** **Fast-write cache card (90%)** ("Removing the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 116). **SSA adapter card (10%)**.

SRN	Problem	Possible Causes
4252B	Description: The fast-write cache card battery has reached the end of its life. The fast-write cache is disabled. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **Fast-write cache card battery (100%)** ("Removing the Battery Assembly from the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 120).
4252C	Description: The fast-write cache card battery needs to be exchanged for a new one. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **Fast-write cache card battery (100%)** ("Removing the Battery Assembly from the Fast-Write Cache Card of an Advanced SerialRAID/X Adapter" on page 120).

42540	Description: Two-way fast-write for a disk drive is configured to operate only when both caches are available. One cache, however, is now not available.
	
	Action:
	1. If the using system that contains the partner adapter is switched off, switch it on.
	2. If the configuration has been changed, review the configuration rules, and restore a valid configuration.
	3. Run diagnostics on the partner adapter, and correct all problems. (The partner adapter is the other adapter on the SSA loop that includes the adapter that reported the problem.)
	4. If, while the other adapter is not available, the user wants to use the fast-write function on disk drives that are connected to this adapter, change the state of the disk drive **Bypass cache if one-way** attribute to **off**. To do this:
	  a. Start the RSM configurator.
	  b. Select **Modify Fast Write attributes**.
	  c. Change the state of the attribute.
		• Failure in another using system.
		• A user action has set **Bypass Cache if one-way** attribute to **off**.
		• Configuration change.

43PAA	Description: An SSA device on the link is preventing the completion of the loop configuration. Action: If the RSM configurator is available, use the **Physical View** to determine which device is preventing configuration. (That device is the one beyond the last-configured device on an open SSA loop.) If the SSA service aids are not available, note the value of PAA in this SRN, and go to "Finding the Physical Location of a Device" on page 128.	**Possible FRUs:** **Device (90%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (10%)**.

SRN	Problem	Possible Causes
44PAA	Description: An SSA device has a 'Failed' status. Action: If the RSM configurator is available, use the **Physical View** to find the failing device. If no device is listed with a status of "Failed", use the PAA part of the SRN to determine which device is failing. Before you exchange the failing device, run NonCDiagnostics to that device to determine the cause of the problem. If the RSM configurator is not available, note the value of PAA in this SRN, and go to "Finding the Physical Location of a Device" on page 128. Exchange the failing FRU for a new FRU.	**Possible FRUs:** **Device (100%)** ("Exchanging Disk Drives" on page 109).
45PAA	Description: The SSA adapter has detected an open SSA loop. Action: If the RSM configurator is available, use the **Physical View** to determine which part of the SSA loop is failing. If the RSM configurator is not available: 1. Note the value of PAA in this SRN, and go to "Finding the Physical Location of a Device" on page 128. 2. When you have found the physical location of the device, go to "MAP 2320: SSA Link" on page 164.	**Possible FRUs:** **Device (40%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (40%)** **External SSA cables, Fibre-Optic Extenders, fibre optic cables, or internal connections in the device enclosure (20%)** (enclosure service information).
46000	Description: An array is the Offline state because not enough disk drives are present in the array to maintain data availability. Action: If the RSM configurator is available, use the **Physical View** to find power faults or broken SSA links that might be causing this problem. If the SSA service aids are not available, or the problem remains, go to "MAP 2324: SSA RAID" on page 168 to isolate the problem.	• For RAID-0, at least one component disk drive of the array is missing. • For RAID-5, at least two component disk drives are missing. • For RAID-10, at least one mirrored pair of disk drives is missing. • Power problem. • System configuration problem.

SRN	Problem	Possible Causes
46500	Description: A member disk drive is missing from an array, or the original SSA adapter is not available. The array is in the Offline state. Action: • If the missing disk drive is still operational, reconnect it to the SSA loop. • If the original SSA adapter is operational, reconnect the offline array to that adapter. • If both the SSA adapter and the disk drive have failed, delete the array, then recreate it.	At least one disk drive missing from an array, and that array is not now connected to the SSA adapter that opened it. The array remains in the Offline state, because its data integrity cannot be verified. This problem might have occurred because: • An SSA adapter card **and** a disk drive both failed. • The using-system configuration was changed while an array was still open.
47000	Description: An attempt has been made to store in the SSA adapter the details of more than 32 arrays. Action: Use the RSM configurator to remove old array (entry dormant 0%) entries from the NVRAM resource list. This action creates more space for new entries. See "MAP 2324: SSA RAID" on page 168 for more details of this procedure.	User action.
47500	Description: Part of the array data might have been lost. Action: Go to "MAP 2324: SSA RAID" on page 168.	• An unreadable data sector existed on a disk drive when an array was created. • An unreadable data sector was detected during a rebuilding operation on an array. • The SSA adapter was reset during an attempt to recover a failed disk drive.
48000	Description: The SSA adapter has detected a link configuration that is not valid. Action: See "SSA Loop Configurations that Are Not Valid" on page 160.	SSA loop configuration problem.
48500	Description: The array filter has detected a link configuration that is not valid. Action: See "Rules for SSA Loops" on page 14, and correct the configuration.	SSA loop configuration problem.

SRN	Problem	Possible Causes
48600	Description: One component disk drive of an array is not on the SSA loop that contains the other component disk drives of the array. The array is in the Exposed state. All the component disk drives of an array must be on the same SSA loop. Action: 1. Start the RSM configurator. 2. Use the **Physical View** to locate all the components of the array. If necessary, use the Identify (FlashOn) function to identify the disk drives. 3. Move all the component disk drives to the same SSA loop.	SSA loop configuration problem.
48700	Description: Multiple component disk drives of an array are not on the SSA loop that contains the other component disk drives of the array. The array is in the Offline state. All the component disk drives of an array must be on the same SSA loop. Action: 1. Start the RSM configurator. 2. Use the **Physical View** to locate all the components of the array. If necessary, use the Identify (FlashOn) function to identify the disk drives. 3. Move all the component disk drives to the same SSA loop.	SSA loop configuration problem.

SRN	Problem	Possible Causes
48750	Description: An array is in the Offline state because the primary or the secondary half of the array is not present. Action: Switch on the power to the other half of the array, or repair the broken loop that is preventing access to the other disk drives. If the other half of the array has become permanently unavailable because an unrecoverable error has occurred, you can force access to the available half of the array. **Attention:** Do not force access to the available half of the array unless you are sure that *no* updates to the other (unavailable) half of the array will be performed. See "Chapter 8. Multiple-Domain Array Management" on page 81 before you perform this operation. To force access to the available half of the array, change the setting of the Split Array Resolution flag: 1. Start the RSM configurator. 2. Find the name of the array. To do this, either use the **Logical View** and the array list for the RAID type, or use the **Explorer View**. 3. Click on the **Modify Attribs** button to display the **Modify Array Attributes View**. 4. Change the setting of the Split Array Resolution flag. 5. If possible, change the setting of the Split Array Resolution flag on the unavailable half of the array. **Attention:** If the unavailable half of the array is reconnected to the available half before the setting of the Split Array Resolution flag has been changed, neither SSA adapter can get access to the array.	The adapter cannot get access the other adapter in the loop because one of the following conditions exists: • The SSA adapter can detect the secondary half of the array, but the Split Array Resolution flag is set to **Primary**. • The SSA adapter can detect the primary half of the array, but the Split Array Resolution flag is set to **Secondary**. This problem can be caused by a power failure on one half of the array, or by a broken SSA loop between the two halves of the array.

SRN	Problem	Possible Causes

48755	Description: One of the following conditions exists:
	
	• One member of a RAID-1 array has been detected, but the adapter is unknown to that array member.
	
	• All the primary, or all the secondary, disk drives of a RAID-10 array are present, but the adapter is unknown to the array.
	
	Action: If the problem has resulted from an unplanned change to the using-system configuration, return the using system to its original configuration.
	
	If the problem has resulted from the failure of an SSA adapter **and** the failure of half the members of an array, do the following actions to attach the array to the adapter:
	
	1. Start the RSM configurator.
	2. Select **Array View** for the array.
	3. Verify (confirm) from the component list that this is the array that has the problem.
	4. Click on the **Modify Attribs** button.
	5. On the **Modify Array Attributes View**, change the Split resolution flag.
	6. Click on the **Modify** button to confirm the change and to return to the **Array View**. The array becomes available, but remains in the Exposed state or in the Degraded state until the missing array members are added.
	7. Add the missing members of the array:
	  a. In the **Array View**, click on the serial number of a missing component.
	  b. In the resulting **Disk View**, click on the **Comp Exchange** button.
	  c. In the **Component Exchange View**, select a replacement component from the list of candidates. To select the replacement component, click on the radio button that is on the left-hand side of the that component.
	  d. Click on the **Exchange** button. You are returned to the **Array View** where you can check whether all missing components have been replaced
		• An SSA adapter **and** a disk drive have failed.
		• A RAID member disk drive is connected to another SSA adapter.
		• A split-site configuration has only one SSA adapter configured, and the adapter and all the primary, or secondary, disk drives fail.

48760	Description: An array is in the Offline state because the split/join procedure was not performed correctly. The data on the array is not constant. Action: See "Chapter 8. Multiple-Domain Array Management" on page 81 before you attempt to recover the array.	This problem can occur if a RAID-1 array or a RAID-10 array has been split exactly in half, and a write operation has been performed independently to both halves of the array.

SRN	Problem	Possible Causes
48800	Description: The Invalid-strip-table is full. Because of failures on multiple component disk drives of an array, at least 128 blocks of data are not accessible. Other data on the array might still be readable. Action: 1. Start the RSM configurator. 2. Use the **Array View** to identify the array that is failing. 3. Ask the customer to make a backup of all data that is still readable, and then to delete the failed array. 4. When the array has been deleted, run the following to each disk drive that was a member of the failed array: • NonCDiagnostics • The Certify function 5. If, in the previous step, you found any disk drive failures, correct those failures. 6. Tell the customer that the array can now be recreated.	**Possible FRUs:** **Device (100%)** ("Exchanging Disk Drives" on page 109).
48900	Description: An array is not available; multiple devices have failed. Action: Run diagnostics and the Certify function to all the disk drives that were used to create the array. If problems occur, correct those problems before you attempt to recreate the array.	None.
48950	Description: A disk drive has caused an array building operation to fail. Action: 1. Ask the user to make a backup of the data that is on this array. Some data might not be accessible. 2. Ask the user to delete the array. 3. Start the RSM configurator. 4. Select **Physical View**. 5. Select **Disk View**. 6. Run diagnostics to all disk drives that are listed as rejected (if any are listed). 7. Run the Certify function to disk drives that are listed as rejected. 8. Run the Certify function to all the disk drives that were components of the failed array. 9. If problems occur on any disk drive, exchange that disk drive for a new one. 10. Ask the user to recreate the array.	**Possible FRUs:** • **Device (100%)** ("Exchanging Disk Drives" on page 109)

SRN	Problem	Possible Causes
49000	Description: An 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. Action: • If the RSM configurator is available, select **Physical View** to find any failed disk drives, failed SSA links, or power failures that might have caused the problem. If you find any faults, go to the Start MAP (or equivalent) in the enclosure service information to isolate the problem, then go to 32 on page 182 of MAP 2324: SSA RAID to return the array to the Good state. • If the RSM configurator is not available, go to "MAP 2324: SSA RAID" on page 168 to isolate the problem.	• A RAID-5 array causes this SRN if a disk drive is not available to the array, and a write command is sent to the array. • A RAID-1 or RAID-10 array causes this error if the array has one or more degraded mirrors. A RAID-1 or RAID-10 mirror becomes degraded when one disk drive in the mirror pair is not available, and a write command is sent to the array.
49100	Description: An 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. Action: • If the RSM configurator is available, select **Physical View** to find any failed disk drives, failed SSA links, or power failures that might have caused the problem. If you find any faults, go to the Start MAP (or equivalent) in the enclosure service information to isolate the problem, then go to 32 on page 182 of MAP 2324: SSA RAID to return the array to the Good state. • If the RSM configurator is not available, go to "MAP 2324: SSA RAID" on page 168 to isolate the problem.	• A RAID-5 array causes this error code if a disk drive is not available to the array. • A RAID-1 or RAID-10 array causes this error if the array has one or more exposed mirrors. A RAID-1 or RAID-10 mirror becomes exposed when one disk drive in the mirror pair is not available to the array.

SRN	Problem	Possible Causes
49500	Description: No hot-spare disk drives are available for an array that is configured for hot-spare disk drives. Action: • If the RSM configurator is available, select **Physical View** to find any failed disk drives, failed SSA links, or power failures that might have caused the problem. If you find any faults, go to the Start MAP (or equivalent) in the enclosure service information to isolate the problem, then go to 32 on page 182 of MAP 2324: SSA RAID to return the array to the Good state. • If the RSM configurator is not available, go to "MAP 2324: SSA RAID" on page 168 to isolate the problem.	A RAID array is configured to use hot-spare disk drives, but no disk drive can be found that is configured as a hot-spare disk drive. This error code is used only when no hot-spare pools have been assigned. All arrays and hot-spare disk drives are in the default pool 0.

SRN	Problem	Possible Causes

49510	Description: Hot-spare configuration is not synchronized. This problem has occurred because the cabling has changed or because new hot-spare disk drives have been added to the SSA loop.
	
	Action:
	
	1. If the changes were not planned, restore the system to its original configuration.
	
	   If the changes were planned, go to step 2.
	
	2. Start the RSM configurator.
	
	3. Select the adapter that logged the error.
	
	4. Select the **Hot-Spare Pool List View**. To do this, click on the**Hot-Spare Pools** button, either on the expanded Explorer pane, or on the **Logical View** of the adapter resources.
	
	5. In the **Hot-Spare Pool List View** , click, in turn, on the Pool ID of each pool that has a status of **Inconsistent**.
	
	6. For each pool that has a status of **Inconsistent**, go to its **Hot-Spare Pool View**, and check whether the number of pool components matches the user's requirements.
	
	  • If the pool contains too few components, click on the **Add hot-spare** button, and select an additional spare disk drive.
	
	  • If the pool contains too many components, click on the serial number of a component that you want to delete, then, on the **Disk View** for that component, click on the **Delete** button.
	
	  • If the number of pool components matches the user's requirements:
	
	    a. Go to the **Hot-Spare Pool View**.
	
	    b. Check whether the Minimum Number of Hot-spares In Pool attribute matches user's requirements. If the attribute matches, Click on the **Confirm** button. If the attribute does not match, click on the **Modify Attribs** button and make the change. (This attribute number is normally one less than the number of hot-spare disk drives that are configured. It can, however, be a lower number.)
	
	7. Click on the **Refresh** button to update the view.
	
	8. If the Status of the hot-spare pool has changed to **Full**, the repair is complete.
	
	   If any other status value is displayed, run CDiagnostic, from the **Adapter View**, to all SSA Adapters to determine the new SRN.
		SSA loop configuration problem.

SRN	Problem	Possible Causes

49520 (Part 1)	Description: Hot-spare tuning has been lost.
	
	Action:
	1. Start the RSM configurator.
	2. Select the adapter that logged the error.
	3. Click on the icon that displays the **Logical View**.
	4. Scroll to the bottom of the page and check whether any Non-RAID Disks have a status of **Rejected**.
	5. Note how many rejected disk drives are listed, and note the serial number of each of those disk drives.
	6. Click on the icon at the top of the page, to select the **Physical View**.
	7. In the **Physical View**, refer to the serial numbers that you noted, and find each of the rejected disk drives. For each rejected disk drive, note its size in gigabytes (GB), the enclosure in which it is installed, and the slot in which it is installed (so you can find it more easily). Ensure that you find all the rejected disk drives.
	8. Get the number of new disk drives that you need to replace all the rejected disk drives.
	9. Go to each affected enclosure and replace each of the rejected disk drives with a new disk drive of the correct size.
	10. From the **Logical View** of the RSM configurator, scroll to Non-RAID Disks, and click on the System (AIX) heading to display a list of the new disk drives. (The system recognizes these disk drives as System (AIX) disk drives.)
	11. On the resulting Non-RAID Disks System (AIX) page, select **Delete all** to force all the new disks listed to free status.
	12. For each RAID array, select **Array View** and note the hot-spare pools to which components belong.
	13. If array components belong to the wrong pool click on the **Assign Hot-Spare Pool** button, and change the pool to return to the desired configuration.
	14. If any array components are missing although you have exchanged all the rejected disk drives, add the missing members of the array:
	   a. In the **Array View**, click on the serial number of a missing component.
	   b. In the resulting **Disk View**, click on the **Comp Exchange** button.
	   c. In the **Component Exchange View**, select a replacement component from the list of candidates. To do this, click on the radio button that is on the left-hand side of the component.
	   d. Click on the **Exchange** button. You are now returned to the **Array View** where you can check whether all missing components have been replaced.
	15. Go to Part 2 of this SRN.
		An array member has used a hot-spare disk drive from a pool other than its specified pool. If the hot-spare pools have been correctly configured, this error indicates that more than one disk drive might have failed.
		
		Possible FRUs:
		
		   Device (100%) ("Exchanging Disk Drives" on page 109).

SRN	Problem	Possible Causes
49520 (Part 2)	Description: Hot-spare tuning has been lost. **Note:** You have come here from Part 1 of this SRN. Action (continued from Part 1 of this SRN): 1. If the user has a record of how disk drives are assigned to the hot-spare pools, use that information to assign the hot-spare disk drives to the correct pools. If the user has no such record, see "Deciding how to Configure Hot-Spare Disk Drive Pools" on page 33 to determine the best hot-spare configuration, then go to step 2. 2. Change the configuration of the hot-spare pool. Either recreate the original configuration (that is, as it was before the rejected disk drives failed), or create a new configuration that matches the user's requirements. You might need to exchange components and add new disk drives to hot-spare pools as follows: a. Select the **Hot-Spare Pool List View**. To do this, click on the **Hot-Spare Pools** button either on the expanded Explorer pane, or on the **Logical View** of the adapter resources. b. In the **Hot-Spare Pool List View**, click, in turn, on the Pool ID of each pool that has a status of **Mixed**. c. For each selected pool, observe the Components associated list that is in the related **Hot-Spare Pool View**. Note the array name and the serial numbers of any disk drives that have a status of `wrong_pool`. d. In the **Array View** for each array that contains a component with a status of `wrong_pool`, select the component (click on its serial number). On the **Disk View**, click on the **Comp. Exchange** button. e. In the **Component Exchange View**, observe the list of available free disk drives. From the list, select a disk drive that is suitable for the array that you are correcting. (To be suitable, the disk drive must have the correct size and be in the required physical location.) Exchange the disk drive. f. In the **Component Exchange View**, ensure that each component has come from an enclosure that is in the required location. g. For each array, select **Array View**. Use the **Assign Hot-Spare Pool** button to ensure that each component is associated with the desired hot-spare pool. h. When each array is complete and correct, if any free disk drives remain, add hot-spare disk drives to hot-spare pools to complete the user's desired configuration.	An array member has used a hot-spare disk drive from a pool other than its specified pool. If the hot-spare pools have been correctly configured, this error indicates that more than one disk drive might have failed. **Possible FRUs:** **Device (100%)** ("Exchanging Disk Drives" on page 109).

SRN	Problem	Possible Causes
49530	Description: The number of disk drives that remain in a hot-spare pool is less than the specified number. Action: 1. Start the RSM configurator. 2. Select the adapter that logged the error. 3. Click on the icon that displays the **Logical View**. 4. Scroll to the bottom of the page and check whether any Non-RAID Disks have a status of **Rejected**. 5. Note how many rejected disk drives are listed, and note the serial number of each of those disk drives. 6. Click on the icon at the top of the page, to select the **Physical View**. 7. In the **Physical View**, refer to the serial numbers that you noted, and find each of the rejected disk drives. For each rejected disk drive, note its size in gigabytes (GB), the enclosure in which it is installed, and the slot in which it is installed (so you can find it more easily). Ensure that you find all the rejected disk drives. 8. Get the number of new disk drives that you need to replace all the rejected disk drives. 9. Go to each affected enclosure and replace each of the rejected disk drives with a new disk drive of the correct size. 10. From the **Logical View** of the RSM configurator, scroll to Non-RAID Disks, and click on the System (AIX) heading to display a list of the new disk drives. (The system recognizes these disk drives as System (AIX) disk drives.) 11. On the resulting Non-RAID Disks System (AIX) page, select **Delete all** to force all the new disks listed to free status. 12. In the **Hot-Spare Pool List View**, select in turn each pool and add hot-spare disk drives from the available new free disk drives	The number of hot-spare disk drives that are now in the assigned pool is less than the specified minimum number. **Possible FRUs:** **Device (100%)** ("Exchanging Disk Drives" on page 109).

SRN	Problem	Possible Causes

49540	Description: Adapters that do not provide support for hot-spare pools have been detected.
	
	Action: If the changes were **not** planned, restore the system to its original configuration.
	
	If the changes were planned, do only one of the following actions:
	• If the SSA adapter is an Advanced SerialRAID/X Adapter whose microcode does not support hot-spare pools, update the microcode to the latest level .
	• For adapters that cannot be updated to support hot-spare pools, change the SSA configuration to remove hot-spare pools:
	  1. Start the RSM configurator.
	  2. Select the adapter that does support hot-spare pools, and expand the tree in the Explorer pane to show the individual arrays and hot-spare pools.
	  3. For each array, select its **Array View**.
	  4. Select each component that does not belong to hot-spare pool 0.
	  5. From the **Disk View** for the component, assign the component to hot-spare pool 0.
	  6. **Assign Hot Spare Pool** button on the related **Array View**.
	  7. Expand the Explorer pane to show the individual hot-spare pools by name.
	  8. For each non-zero hot-spare pool, select its **Hot-Spare Pool View**, and click the **Delete** button to move to pool 0 all the hot-spare disk drives that are in the non-zero pool.
		Hot-spare disk drives have been assigned to pools other than pool 0, but other SSA adapters on the SSA loop are using versions of microcode that do not provide support for spare pools.
		
		This problem has occurred because the cabling has changed or because an SSA adapter that does not provide support for hot-spare pools has been added to the SSA loop.

49800	Description: A different adapter has been detected on each loop. Action: Go to "Rules for SSA Loops" on page 14 and observe the configuration rules for this adapter. Correct the configuration.	SSA loop configuration problem.
4A100	Description: The adapter cannot initialize a disk drive. The failing disk drive might, or might not, be configured on this system. Action: Run diagnostics to all disk drives. If the diagnostics fail, exchange the disk drive for a new disk drive. If the diagnostics do not detect a failing disk drive: 1. Start the RSM configurator. 2. Select **Physical View** to search for disk drives that are not configured. 3. Exchange, for new disk drives, all disk drives that are not configured.	**Possible FRUs:** **Device (100%)** ("Exchanging Disk Drives" on page 109).

SRN	Problem	Possible Causes

4BPAA	Description: A disk drive at PAA cannot be configured, because its UID cannot be read.
	
	Action:
	• If the RSM configurator is available:
	  1. Select **Physical View** to find the failing device.
	  2. Exchange the FRU for a new FRU.
	• If the RSM configurator is not available:
	  1. Note the value of PAA in this SRN, then go to "Finding the Physical Location of a Device" on page 128.
	  2. Exchange the FRU for a new FRU.
		Possible FRUs:
		
		Device (100%) ("Exchanging Disk Drives" on page 109).

50000	Description: The SSA adapter failed to respond to the device driver. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)**.
50001	Description: A data parity error has occurred. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)** (using-system *Installation and Service Guide*).
50002	Description: An SSA adapter DMA error has occurred. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)** (using-system *Installation and Service Guide*).
50007	Description: The IOCC detected an internal error. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)** (using-system *Installation and Service Guide*).
50008	Description: Unable to read or write the POS registers or PCI configuration space. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)** (using-system *Installation and Service Guide*).
50010	Description: An SSA adapter or device drive protocol error has occurred. Action: Go to "Software and Microcode Errors" on page 160 before exchanging the FRU.	**Possible FRUs:** **SSA adapter card (100%)** (using-system *Installation and Service Guide*).

SRN	Problem	Possible Causes
50012	Description: The SSA adapter microcode has hung. Action: Run NonCDiagnostics in System Verification mode to the SSA adapter. If the diagnostics fail, exchange the FRU for a new FRU. If the diagnostics do not fail, go to "Software and Microcode Errors" on page 160 before exchanging the FRU.	**Possible FRUs:** **SSA adapter card (100%)** (using-system *Installation and Service Guide*).
50013	Description: The SSA adapter card has failed. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)** (using-system *Installation and Service Guide*).
50411	Description: The SSA adapter has detected an SS_SIC_CLASS1 error. This error can be caused by an adapter hardware failure, or by excessive electrical interference on the SSA loop. Action: Exchange the FRUs for new FRUs in the given sequence.	**Possible FRUs:** **SSA adapter card (40%)**. **External SSA cables (30%)** **Device (30%)** ("Exchanging Disk Drives" on page 109).
50422	Description: The SSA adapter has detected an SS_TIMEOUT error. A transaction has exceeded its timeout. This problem can be caused by disk drive errors. Action: Run diagnostics to all the disk drives that are connected to the adapter. If you find any problems, solve those problems. If you do not find any problems, run NonCDiagnostics to the adapter. If the diagnostics run successfully, go to "Software and Microcode Errors" on page 160 before you exchange the adapter.	**Possible FRUs:** **SSA adapter card (70%)** **Device (30%)** ("Exchanging Disk Drives" on page 109).

SRN	Problem	Possible Causes
50425	Description: The SSA adapter has detected an SS_LINK_CONFIG_FAILED error. SSA devices cannot be configured because one device in the SSA loop is causing link responses that are not valid. Action: Isolate the failing device: 1. If only one SSA loop is connected to the adapter, go to step 2. If two SSA loops are connected to the adapter, disconnect one loop, and run CDiagnostics to the adapter, to determine which loop contains the failing device. Then go to step 2. 2. Disconnect the first device on the SSA loop that contains the failing device, and run CDiagnostics to the adapter. 3. If the diagnostics show that the failing device is still in the SSA loop, reconnect the device, and disconnect the next device in sequence. 4. Run the diagnostics again. 5. Repeat steps 3 and 4 until you isolate the failing device.	**Possible FRUs:** **Device (90%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (10%)** (using-system *Installation and Service Guide*).
504XX	Description: The SSA adapter microcode has hung. Action: Run NonCDiagnostics to the SSA adapter. If the diagnostics fail, exchange the FRU for a new FRU. If the diagnostics do not fail, go to "Software and Microcode Errors" on page 160.	**Possible FRUs:** **SSA adapter card (100%)**.
7XXXX	Description: An SSA device is missing from the expected configuration of the SSA loop. Action: Go to the service information for the enclosure in which the missing device should be installed. **Note:** In this SRN, an X represents a digit 0 through F.	An SSA enclosure diagnostic has detected a missing disk drive.
8XXXX	Description: SRNs in this range are used by the SSA enclosure (subsystem). Action: Go to the service information for your SSA enclosure. **Note:** In this SRN, an X represents a digit 0 through F.	Not applicable.
D0000 to D0FFF	Description: SRNs in this range are not adapter SRNs. Action: For SRNs in this range, see the documentation for your SSA enclosure or SSA subsystem.	Not applicable.
D4000	Description: The diagnostics cannot configure the SSA adapter. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)**.
D4100	Description: The diagnostics cannot open the SSA adapter. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)**.
D4300	Description: The diagnostics have detected an SSA adapter POST failure. Action: Exchange the FRU for a new FRU.	**Possible FRUs:** **SSA adapter card (100%)**.

SRN	Problem	Possible Causes
D44XX	Description: The diagnostics have detected that the SSA adapter has corrupted the microcode, but cannot download a new version of the microcode. Action: Exchange the FRU for a new FRU. **Note:** In this SRN, an X represents a digit 0 through F.	**Possible FRUs:** **SSA adapter card (100%)**.
D6FFF	Description: A high-speed SSA link is running at low speed. This error is logged when the health check runs the ssa_speed utility. This problem might have occurred for one of the following reasons: • The external SSA cable is a 20-MB-per-second cable (black). • Too many recovered link errors exist. Action: If the customer wants this particular link to run at low speed, you can prevent this error from being logged, as follows: 1. Start the RSM configurator. 2. Set the appropriate option in the event logger control file (EVNTCTRLF.TXT) to prevent the error from being logged. For more information, see the event logger Help in the RSM configurator.	**Possible FRUs:** **External SSA cables (30%)** **Internal connections in the device enclosure (30%)** (enclosure service information). **Device (30%)** ("Exchanging Disk Drives" on page 109). **SSA adapter card (10%)**.
DFFFF	**Note:** The description and action for this SRN are valid only if you have run diagnostics to the SSA adapter. If this SRN has occurred because you have run diagnostics to some other device, see the service information for that device. Description: A command or parameter that has been sent or received is not valid. This problem is caused either by the SSA adapter, or by an error in the microcode. Action: Go to "Software and Microcode Errors" on page 160 before exchanging the FRU.	**Possible FRUs:** **SSA adapter card (100%)**.
SSA01	Description: Not enough system memory is available for this service function to continue. Action: Take one of the actions described here: • This problem might be caused by a failed application program. Ask the user to end any failed application program, then try to run the service aid again. • Run diagnostics in Problem Determination mode to the system unit. If you find any problems, solve them, then try to run the service aid again. • Close down and reboot the using system, then try to run the service aid again. • Run diagnostics from diskette or CD-ROM to isolate the problem. If you do not find a problem, the operating system might have failed.	**None**

SRN	Problem	Possible Causes
SSA02	Description: An unknown error has occurred. Action: Take one of the actions described here: • Run diagnostics to the system unit. If you find any problems, solve them, then try to run the service aid again. • If diagnostics fail, or if the same problem occurs when you try the service aid again, run diagnostics from diskette or CD-ROM to isolate the problem. If you do not find a problem, the operating system might have failed.	None.
SSA03	Description: The RSM configurator was unable to access the selected disk drive. This problem might have occurred because a disk drive has failed or has been removed from the system.	None.

Software and Microcode Errors

Some SRNs indicate that a problem might have been caused by a software error or by a microcode error. If you have one of these SRNs, do the following actions:

1. Make a note of the contents of the error log for the device that has the problem.
2. Use the Dump Cfg function on the **Adapter View** of the RSM configurator to collect the subsystem configuration data.
3. Report the problem to your support center. The center can tell you whether you have a known problem, and can, if necessary, provide you with a correction for the software or microcode.

   If the support center has no known correction for the SRN, exchange, for new FRUs, the FRUs that are listed in the SRN.

SSA Loop Configurations that Are Not Valid

The SRNs that send you to this section indicate an SSA loop or configuration that is not valid. The description for your particular SRN might provide additional information. "Rules for SSA Loops" on page 14 shows how many devices and adapters can be contained in an SSA loop.

If the SRN occurred when you, or the customer, switched on the system:

1. Switch off the system.
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. Switch on the system.

Service Hint: Cables can easily become crossed. If you still have problems, disconnect all the cables from the SSA adapter, then reconnect them

one at a time. For each cable that you reconnect, start the RSM configurator and select **Physical View** to check whether the configuration is as you expect.

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.

SSA Maintenance Analysis Procedures (MAPs)

The maintenance analysis procedures (MAPs) describe how to analyze a failure that has occurred in an SSA loop.

How to Use the MAPs

Attention: Unless the system needs to be switched off for some other reason, *do not switch off the system when servicing an SSA loop*. Unit power cables and external SSA cables that connect the devices to the system can be disconnected while that system is running. If you do switch the system off, ensure that the system is shut down correctly. Failure to do this may result in loss of data.

- To isolate the FRUs, do the actions and answer the questions given in the MAPs.
- When instructed to exchange two or more FRUs in sequence:
    1. Exchange the first FRU in the list for a new one.
    2. Verify that the problem is solved. For some problems, verification means running the diagnostic programs.
    3. If the problem remains:
        a. Reinstall the original FRU.
        b. Exchange the next FRU in the list for a new one.
    4. Repeat steps 2 and 3 until either the problem is solved, or all the related FRUs have been exchanged.
    5. Do the next action indicated by the MAP.

Attention: Disk drives are fragile. Handle them with care, and keep them well away from strong magnetic fields.

MAP 2010: START

This MAP is the entry point to the MAPs for the SSA adapter. If you are not familiar with these MAPs, read "How to Use the MAPs" on page 162 first.

You might have been sent here because:
- The system problem determination procedures sent you here.
- Action from an SRN list sent you here.
- A problem occurred during the installation of a disk subsystem or a disk drive.
- Another MAP sent you here.
- A customer observed a problem that was not detected by the system problem determination procedures.

Attention: Unless the system unit needs to be switched off for some other reason, *do not switch off the system unit when servicing the SSA loop.* Unit power cables and external SSA cables that connect the devices to the system can be disconnected while that system is running. If you do switch the system off, ensure that the system is shut down correctly. Failure to do this may result in loss of data.

1.

   Do you have an SSA subsystem (5-character) SRN?

   NO   Go to step 2.

   YES   Go to "Service Request Numbers (SRNs)" on page 133.

2. (from step 1)
   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).
   b. Select the adapter from the SSA Adapter List.
   c. Select **CDiagnostics**.
   d. Go to step 3.

3. (from step 2)

   Did the diagnostics produce an SRN?

   NO   Go to "MAP 2410: SSA Repair Verification" on page 184.

   YES   Go to "Service Request Numbers (SRNs)" on page 133.

MAP 2320: SSA Link

This MAP helps you to isolate FRUs that are causing an SSA loop problem between a device and the SSA adapter, or between two devices. If you are not familiar with SSA loops, read the section "Chapter 2. Introducing SSA Loops" on page 9 before using this MAP. Chapter 2. Introducing SSA Loops explains SSA links, strings, and loops.

Attention: Unless the system unit needs to be switched off for some other reason, *do not switch off the system unit when servicing the SSA loop*. Unit power cables and external SSA cables that connect the devices to the system can be disconnected while that system is running. If you do switch the system off, ensure that the system is shut down correctly. Failure to do this may result in loss of data.

1.

    Are the system service aids available?

    NO   Go to step 2.

    YES   Go to step 3.

2. (from step 1)

    Are any Ready (link status) lights flashing on this SSA loop?

    NO

           a. Note the PAA (that is, the last three digits) of the SRN.

           b. Go to "Finding the Physical Location of a Device" on page 128.

    YES   Go to "SSA Link Errors" on page 186 to analyze the problem.

3. (from step 1)

    a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

    b. Select the required adapter from the SSA Adapter List.

    c. Select **Physical View**.

    Are any disk drives listed for the selected SSA adapter?

    NO   One of the following conditions exists. Take the action described.

           • No physical disks are connected to this SSA adapter:

               a. Ensure that the external SSA cables are correctly connected to the units in which the devices are installed and to the SSA adapter.

               b. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

           • All the disk drives are switched off. Go to the START MAP for the unit in which the SSA devices are installed.

           • The SSA adapter is failing:

               a. Exchange the SSA adapter for a new one.

               b. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

    YES   Go to step 4 on page 165.

4. (from step 3)

   Observe the Status column on the screen. If the status of any disk drive is 'Power', a loss of redundant power or cooling has been detected.

   Does one or more of the disk drives have a 'Power' status?

   NO   Go to step 5.

   YES   Go to the START MAP for the unit in which the SSA device is installed.

5. (from step 4)

   Observe the Status column on the screen. If the status of any disk drive is 'Failed', that disk drive is failing.

   Is one of the disk drives failing?

   NO   Go to step 6.

   YES

       a. Use the Identify (FlashOn) function to find the failing disk. See "Finding the Physical Location of a Device" on page 128 if you need more information about finding the disk drive.

       b. Exchange the disk drive for a new one (see "Exchanging Disk Drives" on page 109).

       c. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

6. (from step 5)

   Observe the list of disks on the screen. A red line with the text **Break** shows that a link in one of the loops is broken.

   Is a link broken?

   NO   No trouble found.

   YES

       a. Use the Identify (FlashOn) function to find the devices (disk drives or adapters) that are on each side of the broken link. See "Finding the Physical Location of a Device" on page 128 if you need more information about finding the device.

       b. Go to "SSA Link Errors" on page 186. The information that is provided there can help you solve the problem. If necessary, refer to the service information for the unit that contains the device.

MAP 2323: SSA Intermittent Link Error

This MAP helps you to isolate FRUs that are causing an intermittent SSA link problem. You are here because you have an SRN from the series 21xxx through 29xxx, or you have SRN 33xxx.

If you are not familiar with the SSA link, read the section "Chapter 2. Introducing SSA Loops" on page 9 before using this MAP. Chapter 2. Introducing SSA Loops explains SSA links, strings, and loops.

Attention: Unless the system unit needs to be switched off for some other reason, *do not switch off the system unit when servicing an SSA loop*. Power cables and external SSA cables can be disconnected while that system is running. If you do switch the system off, ensure that the system is shut down correctly. Failure to do this may result in loss of data.

1.
   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).
   b. Select the required adapter from the SSA Adapter List.
   c. Select **Physical View**.

      Note: On the **Physical View**, each adapter port is identified by the number of its related connector on the adapter card:
      - Adapter port 0 is identified as A1
      - Adapter port 1 is identified as A2
      - Adapter port 2 is identified as B1
      - Adapter port 3 is identified as B2

      SRNs 21xxx through 29xxx and 33xxx include the adapter port number (0–3).
   d. Go to step 2.
2. (from step 1)
   a. Observe the SRN that sent you to this MAP. The final three characters are in the format PAA, where P is the number of the SSA adapter port, and AA is the SSA address of the device.

      Note the value of PAA in the SRN. For example:
         If the SRN is 24002, PAA = 002.
         If the SRN is 24104, PAA = 104.
   b. Observe the screen, and identify the physical device that is represented by PAA in the SRN. This device is the first of the two devices that are connected by the failing link.

      If the SRN is in the series 21xxx through 29xxx, the second device of the two is located at PAA−1.

      If the SRN is 33xxx, the second device of the two is located at PAA+1.

Note: If the SSA address (AA) in the SRN is higher than the highest SSA address that is displayed for the adapter port (P), that address is the address of the SSA adapter.

   c. Go to step 3.

3. (from step 2)

   The problem is in the SSA link between the two devices that you identified in step 2 on page 166.

   Exchange, in the sequence shown, the following FRUs for new FRUs. Ensure that for *each* FRU exchange, you go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

   a. One of the two devices that are identified by the SRN (see "Exchanging Disk Drives" on page 109).

   b. The other of the two devices.

   c. The internal SSA connections of the unit or units in which the devices are installed.

   d. The external SSA cable.

MAP 2324: SSA RAID

This MAP helps you to solve problems that have occurred in SSA RAID arrays.

Attention: Unless the system unit needs to be switched off for some other reason, *do not switch off the system unit when servicing an SSA link or a unit in which SSA devices are installed*. Unit power cables and external SSA cables that connect devices to the system unit can be disconnected while that system is running. If you do switch the system off, ensure that the system is shut down correctly. Failure to do this may result in loss of data.

Before starting this MAP, ensure that all the disk drives are working correctly:
1. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).
2. Select the required adapter from the SSA Adapter List.
3. Select **Adapter View**.
4. Select **CDiagnostics** to identify any disk drive problems that have occurred.
5. Check the Status column to find any power problems, SSA link problems, and SSA disk drives that have a Failed status.
6. Correct all those problems before you start this procedure.

Attention: Some of the steps in this MAP need you to change the configuration of the array, or to change the use of an SSA disk drive. Do not do those steps unless you have the user's permission.

1. (from steps 3, 24, and 25)

   You have been sent to this step either from another step in this MAP, or because you have one of the following Service Request Numbers (SRNs):

   46000, 47000, 47500, 49000, 49100, 49500

   Do you have SRN 49500?

   NO

       a. Run CDiagnostics to the SSA adapters.
       b. Go to step 2.

   YES   No hot-spare disk drives are available.

       Go to step 21 on page 178.

2. (from step 1)

   Did the diagnostics produce SRN 46000, 47000, 47500, 49000, or 49100?

   NO   Go to step 3 on page 169.

   YES   Go to step 4 on page 169.

3. (from step 2)

   Do you have any other SRN?

   NO Go to step 22 on page 179.

   YES

       a. Solve the problems that caused the SRN.

       b. Return to step 1 on page 168.

4. (from step 2)

   Find your SRN in the following table, then do the appropriate actions.

   Note: If you still do not have any of these SRNs, you are in the wrong MAP.

SRN	Cause	Action
46000	An array is in the Offline state.	Go to step 5.
47000	You have more than the maximum number of arrays allowed.	Go to step 8 on page 171.
47500	A partial loss of data has occurred.	Go to step 9 on page 171.
49000	An array is in the Degraded state.	Go to step 13 on page 173.
49100	An array is in the Exposed state.	Go to step 17 on page 176.

5. (from step 4)

   An array is in the Offline state if it contains at least one component disk drive, but does not contain enough component disk drives to maintain data availability. When a RAID-0 array is in the Offline state, at least one component disk drive is missing. When a RAID-5 array is in the Offline state, at least two component disk drives are missing. Such a condition can occur if at least two disk drives in the array have failed, or are not available to the array at this time.

   Are any disk drives missing or without power, or have any disk drives been recabled (not necessarily by you)?

   NO Go to step 6 on page 170.

   YES Restore the original configuration:

       a. Start the RSM configurator, and select **Logical View**.

       b. Select either **RAID**, or **System (PC)** to display the resource list.

          The status of the array changes to Online (nondegraded) when the adapter can find all the component disk drives of the array.

       c. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

6. (from step 5)

   Either one or more disk drives have failed, or an array that is not complete has been connected to the SSA adapter.

   - If no disk drives have been added to this system, go to step 7.

   - If one or more disk drives have been added to this system, and those disk drives were previously components of an array on this system or on another system, *either:*

     – Install the missing array components to complete the array.

     or:

     – Do the following:

       a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

       b. Select **Array View** for your selected array.

       c. If the array is a fast-write array, click on the **Delete FW** button to delete the fast-write function.

       d. Click on the **Delete** button to delete the array. The component disk drives are now all free resources. **All the data that was on that array is now lost.**

       e. Locate and repair all failed disk drives, and make those disk drives available for the creation of a new array.

       f. Go to step 7.

7. (from step 6)

   The array data cannot be recovered. The following steps clear the error condition and change the disk drives to a usable state.

   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

   b. Select **Logical View**.

   c. Select **Rejected**.

   Are any disk drives listed?

   NO Ask the user to delete and recreate the array that is in the Offline state.

   YES

   a. Run NonCDiagnostics to all the disk drives that are listed as rejected.

   b. Run the Certify function to all the disk drives that are listed as rejected.

   c. If any problems occur, exchange the failed disk drives for new disk drives (see "Exchanging Disk Drives" on page 109).

   d. Go to step 32 on page 182 to add the disk drive to the group of disk drives that are available for use by the RAID manager.

   Note: A disk drive that is listed as rejected is not necessarily failing. For example, the array might have rejected the disk drive because a power problem, or an SSA link problem, caused that drive to become temporarily unavailable. Under such conditions,

the disk drive can be reused. You can check the error log for the previous few days to see if any errors have been logged against the rejected disk drive.

   e. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

8. (from step 4)

   An attempt has been made to create a new array, but the adapter already has the maximum number of arrays defined.

   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

   b. Select **NVRAM**.

   c. Select and delete any array names that are no longer used.

9. (from step 4)

   Attention: Part of the data that is on the array has been damaged and cannot be recovered. *Before* any other action is taken, the user must recover all the data that is not damaged, and create a backup of that data.

   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

   b. Select the required adapter from the SSA Adapter list.

   c. Select **Logical View**.

   d. Select the arrays, one at a time, and check whether any array has one or more invalid data strips.

   Does any array have one or more invalid data strips?

   NO Review the symptoms, then go to "MAP 2320: SSA Link" on page 164, and start the problem determination procedure again.

   YES

   a. Note the name of the failing array.

   b. Go to step 10 on page 172.

10. (from step 9)
    a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69), and select **Logical View**.
    b. Select **RAIDx**.
    c. Select the appropriate array to see the components.
    d. Select the failing disk drive, and note the Resource Names of the disk drives that are components of the array.
    e. Ask the user create a backup of all the data from this array. Some data might not be accessible.
    f. When the backup has been created, ask the user to delete the array.
    g. Run NonCDiagnostics to each of the disk drives that you noted previously.

    Do the diagnostics fail when they are run to a particular disk drive?

    NO   Go to step 11.

    YES

        a. Exchange the failing disk drive for a new one (see "Exchanging Disk Drives" on page 109).
        b. Go to step 32 on page 182 to add the disk drive to the group of disk drives that are available for use by the RAID manager.

11. (from step 10)
    Run the Certify function to each of the disk drives that you noted previously.
    Did the Certify function fail when it was run to a particular disk drive?

    NO

        a. Ask the user to recreate the array.
        b. Go to step 22 on page 179.

    YES

        a. Run the Format function to the disk drive.
        b. Run the Certify function again to the disk drive.
        c. Go to step 12 on page 173.

12. (from step 11)

   Did the Certify function fail again?

   NO

   > a. Ask the user to recreate the array.
   > b. Go to step 22 on page 179.

   YES

   > a. Exchange the failing disk drive for a new one (see "Exchanging Disk Drives" on page 109).
   > b. Go to step 32 on page 182 to add the disk drive to the group of disk drives that are available for use by the RAID manager.

13. (from step 4)

   An array is in the Degraded state if one component disk drive of the array is missing, and a write command has been sent to that array. When an array is in the Degraded state, its data is not protected.

   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69), and select **Logical View**.
   b. Select **Rejected**.

   Are any disk drives listed?

   NO   A disk drive has not been detected by the adapter. Go to step 15 on page 174.

   YES

   > a. Run NonCDiagnostics to all the disk drives that are listed as rejected.
   > b. Run the Certify function to all the disk drives that are listed as rejected.
   > c. If problems occur on any disk drive, go to step 14 on page 174. Otherwise, continue with this procedure.
   > d. Delete all the disk drives that are listed as rejected. This action changes those disk drives to free disk drives.
   >
   > > **Note:** A disk drive that is listed as rejected is not necessarily failing. For example, the array might have rejected the disk drive because a power problem, or an SSA link problem, caused that drive to become temporarily unavailable. Under such conditions, the disk drive can be reused. You can check the error log for the previous few days to see if any errors have been logged against the rejected disk drive.
   >
   > e. Select **Array View**.
   > f. Select **Blank Reserved**.
   > g. Click on the **Exchange Comp** button to list the candidate disk drives.
   > h. Select a candidate disk drive.
   > i. Click on the **Exchange** button to add this disk drive to the array. The array goes into the Online (Rebuilding) state.

Note: The array can be used during the rebuilding operation. Inform the user, however, that while the rebuilding operation is running, the data is not protected against another disk drive failure. The rebuilding operation runs more slowly if the array is being used.

When the rebuilding operation is complete, ask the user to run NonCDiagnostics to the SSA adapters, to ensure that the rebuilding operation has not found any more problems.

j. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

14. (from step 13)

a. Exchange the disk drive for a new drive (see "Exchanging Disk Drives" on page 109).

b. Go to step 32 on page 182 to add the disk drives to the group of disk drives that are available for use by the RAID manager.

Note: The array can be used during the rebuilding operation. Inform the user, however, that while the rebuilding operation is running, the data is not protected against another disk drive failure. The rebuilding operation runs more slowly if the array is being used.

When the rebuilding operation is complete, ask the user to run NonCDiagnostics to the SSA adapters, to ensure that the rebuilding operation has not found any more problems.

15. (from step 13)

Does the Physical View indicate an open loop?

NO Go to step 16 on page 175.

YES Go to "MAP 2320: SSA Link" on page 164.

16. (from step 15)

    Does any SSA disk drive have its Check light on?

    NO   The disk drive might have been removed from the subsystem.

        a. Reinstall the removed drive, or select a new disk drive for addition to the array.

        b. Delete all the disk drive that are listed as rejected. This action changes those disk drives to free disk drives.

        c. Select **Array View**.

        d. Select **Blank Reserved**.

        e. Click on the **Exchange Comp** button to list the candidate disk drives.

        f. Select a candidate disk drive.

        g. Click on the **Exchange** button to add this disk drive to the array. The array goes into the Online (Rebuilding) state.

    YES

        a. Exchange the failed disk drive for a new one (see "Exchanging Disk Drives" on page 109).

        b. Go to step 32 on page 182.

17. (from step 4)

A RAID-5 array is in the Exposed state when one member disk drive of the array is not available to the array. A RAID-1 or RAID-10 array is in the Exposed state when one or more mirrors are exposed. A mirror is exposed when one disk drive in the mirror pair is not available to the array.

If the missing disk drives are returned to the array, the array enters the Good state. No data rebuilding is necessary. If data is written to an array that is in the Exposed state, that data is not protected, and the array goes into the Degraded state (see "Chapter 3. RAID Functions and Array States" on page 23 for more information).

a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69), and select **Logical View**.

b. Select **Rejected**.

Are any disk drives listed?

NO   A disk drive has not been detected by the adapter. Go to step 19 on page 177.

YES

a. Run NonCDiagnostics to all the disk drives that are listed as rejected.

b. Run the Certify function to all the disk drives that are listed as rejected.

c. If problems occur on any disk drive, go to step 18 on page 177. Otherwise, continue with this procedure.

d. Delete all the disk drive that are listed as rejected. This action changes those disk drives to free disk drives.

e. Select **Array View**.

f. Select **Blank Reserved**.

g. Click on the **Exchange Comp** button to list the candidate disk drives.

h. Select a candidate disk drive.

i. Click on the **Exchange** button to add this disk drive to the array. The array goes into the Online (Rebuilding) state.

Note: The array can be used during the rebuilding operation. Inform the user, however, that while the rebuilding operation is running, the data is not protected against another disk drive failure. The rebuilding operation runs more slowly if the array is being used.

When the rebuilding operation is complete, ask the user to run diagnostics in System Verification mode to the SSA adapters, to ensure that the rebuilding operation has not found any more problems.

j. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

18. (from step 17)

    a. Exchange the disk drive for a new drive (see "Exchanging Disk Drives" on page 109).

    b. Go to step 32 on page 182 to add the disk drives to the group of disk drives that are available for use by the RAID manager.

> **Note:** A disk drive that is listed as rejected is not necessarily defective. For example, the array might have rejected the disk drive because a power problem, or an SSA link problem, caused that drive to become temporarily unavailable. Under such conditions, the disk drive can be reused. You can check the error log for the previous few days to see if any errors have been logged against the rejected disk drive.

19. (from step 17)

    Does the Physical View indicate an open loop?

    NO   Go to step 20.

    YES   Go to "MAP 2320: SSA Link" on page 164.

20. (from step 19)

    Does any SSA Disk drive have its Check light on?

    NO   The disk drive might have been removed from the subsystem.

        a. Reinstall the removed drive, or select a new disk drive for addition to the array.

        b. Delete all the disk drive that are listed as rejected. This action changes those disk drives to free disk drives.

        c. Select **Array View**.

        d. Select **Blank Reserved**.

        e. Click on the **Exchange Comp** button to list the candidate disk drives.

        f. Select a candidate disk drive.

        g. Click on the **Exchange** button to add this disk drive to the array. The array goes into the Online (Rebuilding) state.

        h. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

    YES

        a. Exchange the failed disk drive for a new one (see "Exchanging Disk Drives" on page 109).

        b. Go to step 32 on page 182.

21. (from step 1)

   No spare disk drives are available for an array that is configured for hot-spare disk drives.

   a. If the subsystem contains disk drives that have failed, repair those disk drives, or exchange them for new disk drives (see "Exchanging Disk Drives" on page 109).

   b. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

   c. From the SSA Adapter List, select the adapter against which SRN 49500 was logged.

   d. Select **Logical View**.

   e. Select **Hot-Spare**.

   f. Click on the **Create Hot-Spare** button, and try to make a hot-spare disk drive. (Use the default block size.)

   Are any candidate disk drives listed?

   NO   Review with the user the requirement for hot-spare disk drives. If the customer wants hot spare disk drives, one or more disk drives must have their use changed to **Hot-Spare Disk**.

   If the customer does not want hot-spare disk drives:

   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

   b. Select **Array View**.

   c. Click on the **Modify Attributes** button to display the array attributes.

   d. Change the **Enable Use of Hot-Spares** attribute to **No**.

   YES   The following conditions must be met to make a hot-spare disk drive available for use by an array:

   • The hot-spare disk drive and the array must be on the same SSA loop.

   • If the **spare_exact** parameter is set to **true**, the size of the hot-spare disk drive must be the same as the size of the smallest member disk drive in the array.

   • If the **spare_exact** parameter is set to **false**, the size of the hot-spare disk drive must be at least that of the smallest member disk in the array.

   a. Ensure that these conditions are met.

   b. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

22. (from step 2 in MAP 2410: SSA Repair Verification, and from steps 3, 11, and12 in this MAP)

> **RAID Checkout**
>
> You are now starting the RAID checkout procedure

a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).
b. Select **Logical View**.
c. Select **Rejected**.

Are any disk drives listed?

NO   Go to step 24 on page 180.

YES

    a. Run NonCDiagnostics to all the disk drives that are listed as rejected.
    b. Run the Certify function to all the rejected disk drives.
    c. Go to step 23 on page 180.

23. (from step 22)

   Is any disk drive failing?

   NO   Go to step 24.

   > **Note:** A disk drive that is listed as rejected is not necessarily defective. For example, the array might have rejected the disk drive because a power problem, or an SSA link problem, caused that drive to become temporarily unavailable. Under such conditions, the disk drive can be reused. You can check the error log for the previous few days to see if any errors have been logged against the rejected disk drive.

   YES

       a. Exchange the failing disk drive for a new one (see "Exchanging Disk Drives" on page 109).

       b. Go to step 32 on page 182 to add the disk drive to the group of disk drives that are available for use by the RAID manager.

24. (from steps 22 and 23)

   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

   b. Select the required adapter from the SSA Adapter List.

   c. Select each array type in turn.

   Are any arrays listed with a status other than Online (Non-Degraded) or Online (Rebuilding)?

   NO   Go to step 25.

   YES   Go to step 1 on page 168.

25. (from step 24)

   a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).

   b. Select **Logical View**.

   c. Select **RAIDx**. All the arrays of this type are shown.

   d. Select the arrays, one at a time, and check whether any array has one or more invalid data strips, one or more unbuilt parity strips, or one or more unbuilt data strips.

   Do any listed arrays have invalid data strips?

   NO   Go to step 26 on page 181.

   YES   Go to step 1 on page 168.

26. (from step 25)

    Do any RAID-5 arrays have Unbuilt Parity Strips or Unbuilt Data Strips?

    NO   Go to step 27.

    YES   The rebuilding operation is running or has stopped before completion.

            a. Note the number of unbuilt parity strips and unbuilt data strips.

            b. Click on the **Refresh** button.

            c. Again note the number of unbuilt parity strips and unbuilt data strips. If the numbers are lower than those that you noted earlier, the rebuilding operation is running. Wait for the rebuilding operation to complete before you continue. If the numbers have not changed, the rebuilding operation has stopped.

            d. If this is the first time you have been through this step while solving this particular problem, return to step 1 on page 168. Otherwise:

                1) Start the RSM configurator.

                2) Delete the array.

                3) Run the Certify function to each member disk drive.

                4) Recreate the array.

                5) Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.

27. (from step 25)

    Have disk drives been going into the rejected state with no other failure indications?

    NO   Go to step 28.

    YES   This problem can occur if an array is accessed before all the component disk drives are available.

            Ensure that the power system switches on power to all the disk drives before, or when, it switches on the power to the system unit.

28. (from step 27)

    Was SRN 46000 logged, but no error found, when CDiagnostics were run?

    NO   Go to step 29.

    YES   An array was in the Offline state, but is now available.

            Ensure that the power system switches on power to all the disk drives before, or when, it switches on the power to the system unit.

29. (from step 28)

    Was SRN 49100 logged, but no error found, when CDiagnostics were run?

    NO   Go to step 30 on page 182.

    YES   An array was in the Exposed state, but is now in the Good state.

            This problem might have occurred because a disk drive was temporarily removed from the system.

Ensure that the power system switches on power to all the disk drives before, or when, it switches on the power to the system unit.

30. (from step 29)
    a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).
    b. For each installed adapter:
       1) Select **Logical View**.
       2) Select **Hot-Spare Pools**.

    Are any pools listed with a status of "reduced"?

    NO   Go to step 31.

    YES The number of hot-spare disk drives that are in the pool is less than the number of hot-spare disk drives that were originally assigned to that pool.
             a. Either ask the customer which disk drives are to be assigned to which hot-spare pools, or see "Chapter 4. Hot-Spare Management" on page 33.
             b. Select a free disk drive or a hot-spare disk drive to add to the pool. If no free or hot-spare disk drives exist in the list, review the configuration with the customer, or see "Chapter 4. Hot-Spare Management" on page 33 for guidance.
             c. Go to step 31.

31. (from step 30)
    You have solved all the problems.
    a. Go to "MAP 2410: SSA Repair Verification" on page 184 to verify the repair.
    b. If you have previously created a backup, reload that data now.

32. (from steps 7, 10, 12, 14, 16, 18, 20, and 23)
    Has a failed disk drive been exchanged for a new disk drive?

    NO   If you have repaired a power or cabling fault that caused the disk drive to be missing from the system, the drive might now be in a rejected state. You must change that disk drive into a usable disk drive:
             a. Start the RSM configurator (see "Chapter 7. The RSM Configurator" on page 69).
             b. Select **Logical View**.
             c. Select **Rejected**.
             d. Delete the disk drive that has been restored to the system. This action changes the disk drive to a free resource.
             e. Ask the customer to choose how the disk drive is to be configured:
                - Hot-spare disk drive
                - Attached resource
                - Remain as a free resource.

YES If you exchanged the disk drive by using the procedure that is described in "Exchanging Disk Drives" on page 109, the new disk drive is identified as a new disk drive.

a. If required, use the RSM configurator to change the new disk drive to a free resource.

b. Ask the customer to choose how the disk drive is to be configured:

- Hot-spare disk drive
- Attached resource
- Remain as a free resource.

c. Go to step 30 on page 182.

MAP 2410: SSA Repair Verification

This MAP helps you to verify a repair after a FRU has been exchanged for a new one.

Attention: Unless the system unit needs to be switched off for some other reason, *do not switch off the system unit when servicing an SSA link or a unit in which SSA devices are installed*. Unit power cables and external SSA cables that connect devices to the system can be disconnected while that system is running. If you do switch the system off, ensure that the system is shut down correctly. Failure to do this may result in loss of data.

1. (from step 3 in MAP 2010: START; steps 3 and 5 in MAP 2320: SSA Link; step 3 in MAP 2323: SSA Intermittent Link Error; step 5 in MAP 2324: SSA RAID)

   Before you arrived at this MAP, you might have exchanged one or more FRUs for new FRUs. Some of those FRUs have Power lights (for example, disk drives). Check whether all those Power lights are on.

   Do all the FRUs that you have exchanged have their Power lights on (where applicable)?

   NO

       a. Exchange, for a new one, the FRU whose Power light is off.

       b. Go to step 2.

   YES   Go to step 2.

2. (from step 1)

   Are all Check lights off?

   NO   Go to the START MAP for the unit in which the device that has its Check light on is installed.

   YES

       a. Run CDiagnostics to the device that reported the problem.

           Notes:

           1) Do not run NonCDiagnostics; otherwise, errors are logged on other systems that share the same loop.

           2) If you have just exchanged a disk drive or an SSA adapter, you must use the configurator to restore the device to the system.

       b. If the original problem was not reported by a device, run diagnostics to each SSA adapter in the system unit.

       c. Do the problem fix procedure (see "Fix Procedure" on page 130).

           Note: If you do not run this function, the diagnostics might create an SRN for a problem that has already been solved.

       d. Go to step 3 on page 185.

3. (from step 2)

   Did the diagnostics produce an SRN?

   NO   You have solved the problem.

   YES

   - If the diagnostics have produced the same SRN, go to step 4.
   - If the diagnostics have produced a different SRN, go to "Service Request Numbers (SRNs)" on page 133.

4. (from step 3)

   Have you exchanged all the FRUs that were originally reported by the SRN?

   NO   Exchange the next FRU that the SRN has listed.

   YES

   a. Run NonCDiagnostics to all the adapters that are in this SSA loop.
   b. Run NonCDiagnostics to all the disk drives that are in this SSA loop.
   c. Run the Certify function to all the disk drives that are in this SSA loop.
   d. Correct all errors that are reported by the diagnostics.
   e. Do the problem fix procedure (see "Fix Procedure" on page 130).

      Note: If you do not run this function, the diagnostics might create an SRN for a problem that has already been solved.

   f. If your subsystem contains RAID arrays, go to the **RAID Checkout** at 22 on page 179 of MAP 2324: SSA RAID.

SSA Link Errors

SSA link errors can be caused if:

- Power is removed from an SSA device.
- An SSA device is failing.
- An SSA device is removed.
- A cable is disconnected.

Such errors might be indicated by:

- SRN 45PAA
- A flashing link status (Ready) light on the SSA device at each end of the failing link
- The indication of an open link by the Disk service aid

SSA Link Error Problem Determination

Instead of using the normal MAPs to solve a link error problem, you can refer directly to the link status lights to isolate the failing FRU. The descriptions given here show you how to do this.

In an SSA loop, SSA devices are connected through two or more SSA links to an SSA adapter. Each SSA link is the connection between two SSA nodes (devices or adapters); for example:

- Disk drive to disk drive
- Adapter to disk drive
- Adapter to adapter.

An SSA link can contain several parts. When doing problem determination, think of the link and all its parts as one complete item.

Here are some examples of SSA links. Each link contains more than one part.

Example 1

In Figure 40, the link is between two disk drives that are in the same subsystem. It has three parts.

SSA Subsystem

Disk Drive 1	Internal Connection	Disk Drive 2
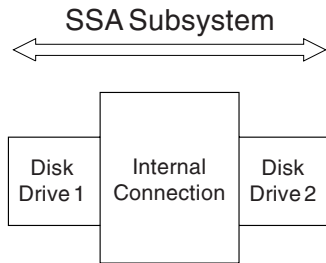
Figure 40. Three-Part Link in One Subsystem

Example 2

In Figure 41, the link is between two disk drives that are in the same subsystem. It has five parts.

SSA Subsystem

Disk Drive 1	Internal Connection	Dummy Disk Drive	Internal Connection	Disk Drive 2
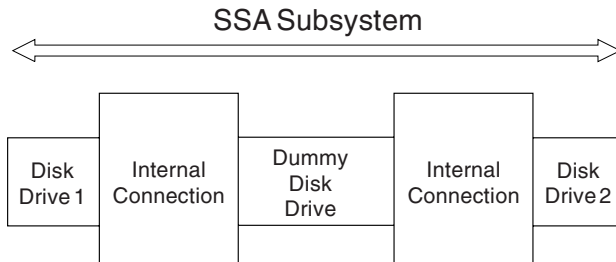
Figure 41. Five-Part Link in One Subsystem

Example 3

In Figure 42, the link is between two disk drives that are not in the same subsystem. It has seven parts.
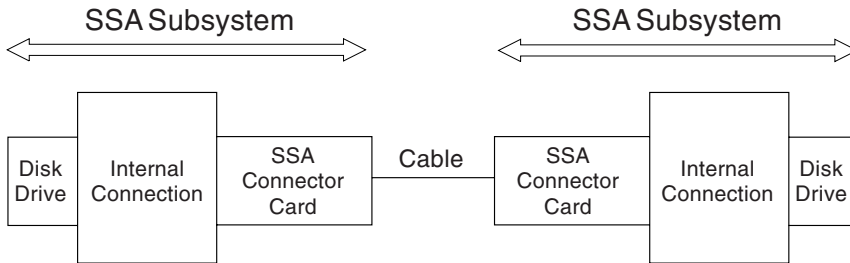
Figure 42. Seven-Part Link in Two Subsystems

Example 4

Figure 43, the link is between a disk drive and an SSA adapter. It has five parts.
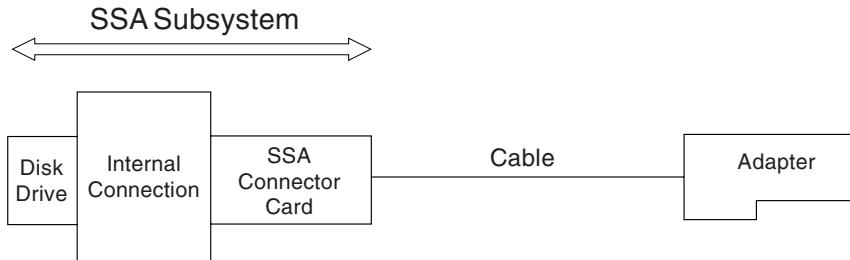
Figure 43. Five-Part Link between Disk Drive and Adapter

Example 5

In Figure 44, the link is between two SSA adapters. It has five parts. Note that it has fibre optic cables and optical connectors instead of normal SSA cables.
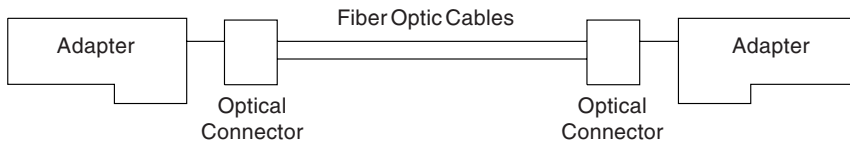
Figure 44. Five-Part Link between Two Adapters

Link Status (Ready) Lights

If a fault occurs that prevents the operation of a particular link, the link status lights of the various parts of the complete link show that the error has occurred.

You can find the failing link by looking for the flashing green status light at each end of the affected link. Some configurations might have other indicators along the link (for example, SSA connector cards) to help with FRU isolation.

The meanings of the disk drive and adapter lights are summarized here:

Status of Light	Meaning
Off	Both SSA links are inactive.
Permanently on	Both SSA links are active.
Slow flash (two seconds on, two seconds off)	Only one SSA link is active.

If your subsystem has other link status lights, see the subsystem service information for the subsystem for more details.

Open Loop

If the RSM configurator is available, you can use the **Physical View** to show that the SSA loop is broken. A red line and the text **Break** indicate a broken loop. The Ready lights flash on the devices that are on each side of the point where the loop is broken.

You can also use the Identify (FlashOn) function to show where the loop is broken. The Check light on the selected disk drive flashes. This action does not affect the customer's operations.

For more information about the service aids, see "Chapter 13. Using the SSA Service Aid Functions" on page 125.

Part 3. Appendixes

Appendix A. Resource Numbers

A resource number is assigned to a resource when that resource is added to the System Resource list. This number is related to the position in the System Resource list at which the resource is attached. The configurators provide an option that allows you to change the resource number to another number, if required. Valid numbers are 1 through 255.

Resource numbers are similar to the SCSI ID settings on SCSI disk drives. The system software uses the numbers to map the disk drives to a logical bus, target, and LUN ID.

The logical bus number to which a system resource is mapped is:

```
Resource number divided by 32
```

where 32 is the number of targets on each bus. Therefore, a resource number that is lower than 32 is in logical bus 0.

The target address is the remainder that results from dividing number by 32.

For example:

Disk Number	Mapping
2	Logical Bus 0 Target 2
32	Logical Bus 1 Target 0
37	Logical Bus 1 Target 5
65	Logical Bus 2 Target 1

The Logical Unit Number (LUN) is always set to 0.

For compatibility with Microsoft Cluster Server, the boot device (if it is an SSA disk resource) must be on a different logical bus from any shared disk drives.

The sequence in which the operating system processes mass storage devices at boot time, and any disk drive lettering that is produced as a result, is related to:

- The priority sequence of mass storage devices that are in PCI slots in the server. The priority sequence of devices varies with the type and model of the server.
- The sequence of the resources that are in the SSA System resources list. Resources with lower resource numbers are presented first.
- The partitioning information that the operating system holds about the mass storage devices.

For more information about these topics of server configuration, and adapter configuration, see the technical information for the server, or consult your service representative.

Appendix B. 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.

Federal Communications Commission (FCC) Statement

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 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.

Japanese Voluntary Control Council for Interference (VCCI) Statement

This product is a Class A Information Technology Equipment and conforms to the standards set by the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). In a domestic environment, this product might cause radio interference, in which event the user might be required to take adequate measures.

Korean Government Ministry of Communication (MOC) Statement

Please note that this device has been approved for business purposes with regard to electromagnetic interference. If you find that this device is not suitable for your use, you can exchange it for one that is approved for non-business purposes.

New Zealand Compliance Statement

This is a Class A product. In a domestic environment this product might cause radio interference, in which event the user might be required to take adequate measures

International Electrotechnical Commission (IEC) Statement

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

Avis de conformité à la réglementation d'Industrie Canada

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

Industry Canada Compliance Statement

This Class A digital apparatus complies with IECS-003.

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.

European Union (EU) Statement

This product is in conformity with the protection requirements of EU council directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. Neither the provider nor 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.

Radio Protection for Germany

Zulassungsbescheinigung laut Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) vom 30, August 1995.

Dieses Gerät ist berechtigt in Übereinstimmung mit dem deutschen EMVG das EG–Konformitätszeichen zu führen.

Der Aussteller der Konformitätserklärung ist die IBM Deutschland.

Informationen in Hinsicht EMVG Paragraph 3 Abs. (2):

Das Gerät erfüllt die Schutzanforderungen nach EN 50082-1 und EN 55022 Klasse A.

EN55022 Klasse A Geräte bedürfen folgender Hinweise:

Nach dem EMVG: "Geräte dürfen an Orten, für die sie nicht ausreichend entstört sind, nur mit besonderer Genehmigung des Bundesministeriums 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, Para.3, Abs.4). Dieses

Genehmigungsverfahren ist nach Paragraph 9 EMVG in Verbindung mit der entsprechenden Kostenverordnung (Amtsblatt 14/93) kostenpflichtig.

Nach der EN 55022: "Dies ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funkstörungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Massnahmen durchzuführen und dafür aufzukommen."

Anmerkung: Um die Einhaltung des EMVG sicherzustellen, sind die Geräte wie in den Handbüchern angegeben zu installieren und zu betreiben.

Taiwan Class A Compliance Statement

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

Glossary

This glossary explains terms and abbreviations that are used in the manual. The glossary contains terms and definitions from the *IBM Dictionary of Computing*, ZC20-1699.

If you do not find the term or abbreviation for which you are looking, try the index or refer to the *IBM Dictionary of Computing* at URL:

http://www.networking.ibm.com/nsg/nsgmain.htm

A

AIX. Advanced Interactive Executive.

AIX system disk. A disk drive that is owned by AIX; that is, it is not accessible to a PC server.

array. See *disk array*.

attribute. A named property of an entity; for example, the attributes of a RAID array include state, current use, and size of array.

B

boot. To prepare a computer system for operation by loading an operating system.

buffer. A routine or storage that is used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transferring data from one device to the other.

C

candidate disk. Disk drives that are available for use in an array.

component. The components of a RAID array are the member disk drives that are configured for that array.

contiguous. Touching or joining at a common edge or boundary; for example, an unbroken consecutive series of storage locations.

D

Degraded state. The state that a RAID array enters if, while in the Exposed state, it receives a write command. See also *Exposed state*.

device driver. (1) A file that contains the code needed to use an attached device. (2) A program that enables a computer to communicate with a specific peripheral device. (3) A collection of subroutines that control the interface between I/O device adapters and the processor.

DMA. Direct memory access.

domain. One half of a RAID-1 or RAID-10 array, that half containing a complete copy of the data that is stored in the array.

DOS. Disk operating system.

DRAM. Dynamic random-access memory.

E

EEPROM. Electrically erasable read-only memory.

Exposed state. The state that a RAID array enters if a member disk drive becomes missing (logically or physically) from that array.

F

Failed status. The disk drive is not working.

flag. A character that shows that a particular condition exists.

FRU. Field-replaceable unit.

G

GB. Gigabyte.

gigabyte (GB). 1000000000 bytes.

Good state. The state of a RAID array when all its member disk drives are present.

H

hot-spare disk drive. A spare disk drive that is automatically added to a RAID array to logically replace a member disk drive that has failed.

I

interface. Hardware, software, or both, that links systems, programs, or devices.

IOCC. Input/output channel controller.

IPN. Independent Packet Network.

ISAL. Independent Network Storage Access Language.

K

KB. Kilobyte.

kilobyte (KB). 1000 bytes.

L

LUN. Logical unit.

M

maintenance analysis procedure (MAP). A service procedure for isolating a problem.

MAP. See *maintenance analysis procedure*.

MB. Megabyte.

megabyte (MB). 1000000 bytes.

Member disk. A disk drive that is part of a RAID array.

microcode. One or more microinstructions used in a product as an alternative to hard-wired circuitry to implement functions of a processor or other system component.

mirrored pair. Two disk drives that contain the same data, and are referred to as one entity by the using system.

mirroring. The process of writing the same data to two disk drives at the same time. The two disk drives become a mirrored pair. The system can, therefore, continue to operate correctly when one of the mirrored disk drives fails.

N

node. In a network, a point at which one or more functional units connect channels or data circuits. For example, in an SSA subsystem, a disk drive or an adapter.

NVRAM. Nonvolatile random access memory.

O

Offline state. The state that a RAID array enters when two or more member disk drives become missing.

P

parameter. A variable that is given a constant value for a specified application.

PCI. Peripheral Component Interconnect.

physical disk. The actual hardware disk drive.

POST. Power-on self-test.

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

primary half. The term that distinguishes one half of a split array. The term "secondary half" distinguishes the other half of the split array (also known as primary domain).

R

RAID. Redundant array of independent disks.

RAID array. In RAID systems, a group of disks that is handled as one large disk by the operating system.

RAID manager. The software that manages the logical units of an array system.

Rebuilding state. The state that a RAID array enters after a missing member disk drive has been returned to the array or exchanged for a replacement disk drive. While the array is in this state, the data and parity are rebuilt on the returned or replacement disk drive.

Rejected disk. A failing disk drive that the array management software has removed from a RAID array.

router. A computer that determines the path of network traffic flow.

RSM. Remote Systems Management.

S

SCSI. Small computer system interface.

SDRAM. Synchronous dynamic random-access memory.

secondary half. The term that distinguishes one half of a split array. The term "primary half" distinguishes the other half of the split array (also known as secondary domain).

Serial Storage Architecture. An industry-standard interface that provides high-performance fault-tolerant attachment of I/O storage devices.

service request number. A number that helps you to identify the cause of a problem, the failing field-replaceable units (FRUs), and the service actions that might be needed to solve the problem. Service request numbers are generated by the system error-log analysis, system configuration code, and customer problem determination procedures.

SRN. Service request number.

SSA. Serial Storage Architecture.

SSA unique ID. The specific identifier for a particular SSA device. Each SSA device has a specific identifier that is not used by any other SSA device in the whole world.

stretch. A set of stripes that is used to perform a particular level of array management.

strip. The maximum amount of contiguous user data that is mapped to one component.

stripe. A set of strips (with their mirrors) that have corresponding LBAs on each component.

U

unrecoverable error. An error for which recovery is impossible without the use of recovery methods that are outside the normal computer programs.

V

vital product data (VPD). In the AIX operating system, information that uniquely defines system, hardware, software, and microcode elements of a processing system.

VPD. Vital product data.

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