



IBM SerialRAID Adapter

Installation and User's Guide

SA33-3283-00



IBM SerialRAID Adapter

SA33-3283-00

Installation and User's Guide

Note!

Before using this information and the product it supports, be sure to read the general information under “Notices” on page X-6.

First Edition (November 1998)

The following paragraph does not apply to any country where such provisions are inconsistent with local law:
THIS PUBLICATION IS PRINTED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions; therefore, this statement may not apply to you.

This publication could contain technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication.

It is possible that this publication may contain reference to, or information about, products (machines and programs), programming, or services that are not announced in your country. Such references or information must not be construed to mean that such products, programming, or services will be offered in your country. Any reference to a licensed program in this publication is not intended to state or imply that you can use only the licensed program indicated. You can use any functionally equivalent program instead.

© **Copyright International Business Machines Corporation 1995, 1998. All rights reserved.**

Note to U.S. Government Users — Documentation related to restricted rights — Use, duplication, or disclosure is subject to restrictions set forth in the GSA ADP Schedule Contract.

Contents

Safety Information	ix
About This Book	xi
What You Need To Know	xi
How This Book Is Organized	xi
Related Publications	xii
Numbering Convention	xii
Chapter 1. Introducing the IBM SerialRAID Adapter	1-1
Serial Storage Architecture	1-1
SSA Loops and Links	1-1
Rules for SSA Loops	1-5
Dual-Host Configuration	1-5
The Configuration Utilities	1-6
The RSM Configurator	1-6
The DOS Configurator	1-6
Adapter Configuration Capabilities	1-7
Resource Types	1-7
Ownership and Usage Type	1-7
Hardware Characteristics	1-10
RAID	1-12
RAID Levels	1-12
Support for RAID 5 Arrays	1-12
Hot Spare Resources	1-14
The Fast Write Feature	1-15
Operating System Software	1-16
Chapter 2. Installing an IBM SerialRAID Adapter	2-1
Before Installing the Adapter	2-1
Connecting the Disk Drives	2-2
Installing the Adapter Card	2-2
Selecting the Boot Device	2-3
Installing Windows NT To Boot From An SSA Device	2-4
Installing the SSA Device Drivers and Utility Programs	2-5
Chapter 3. Configuring SSA Resources Using the DOS Configurator	3-1
The SSA Configuration Programs	3-1
General Configuration Process	3-2
Types of Adapter Supported By the Configuration Utilities	3-3
Running the DOS Configurator	3-4
The Adapter List	3-5
Converting a New Resource Into a Free Resource	3-7
Managing Arrays	3-9
Managing Fast Write Resources	3-15
Managing System Resources	3-17

Adding a Resource to the System Resources List	3-19
Managing Rejected Resources	3-21
Deleting Resources	3-22
Managing Non-Volatile RAM	3-23
Chapter 4. Performing Other Configuration Tasks	4-1
Creating a Hot Spare	4-1
Viewing the Physical Configuration	4-3
Viewing Resources and Their Attributes	4-5
Attributes of Disk Resources	4-8
Attributes of Fast Write Resources	4-9
Attributes of RAID 5 Array Resources	4-10
Changing Array Attributes	4-11
Viewing and Changing Disk Access Modes	4-12
Exchanging a Component of An Array	4-13
Deleting an Array from the System Resources List	4-16
Destroying An Array	4-17
Chapter 5. Configuring SSA Resources Using the RSM Configurator	5-1
Installing the RSM Configurator	5-4
Using the RSM Configurator	5-5
Chapter 6. Dealing with Disk Problems and Array Problems	6-1
Basic Problems	6-1
Using the Event Logger	6-2
Changing Failed Array Components	6-3
Chapter 7. Getting the Latest Information	7-1
Appendix A. Resource Numbers	A-1
Glossary	X-1
Product Warranty and Notices	X-3
Statement of Limited Warranty	X-3
Production Status	X-3
The IBM Warranty	X-3
Warranty Service	X-4
Extent of Warranty	X-4
Limitation of Liability	X-5
Notices	X-6
Trademarks	X-6
Communications Statements	X-7
Federal Communications Commission (FCC) Statement	X-7
VCCI Statement	X-8
International Electrotechnical Commission (IEC) Statement	X-8
Avis de conformité aux normes de l'Industrie Canada	X-8
Industry Canada Compliance Statement	X-8

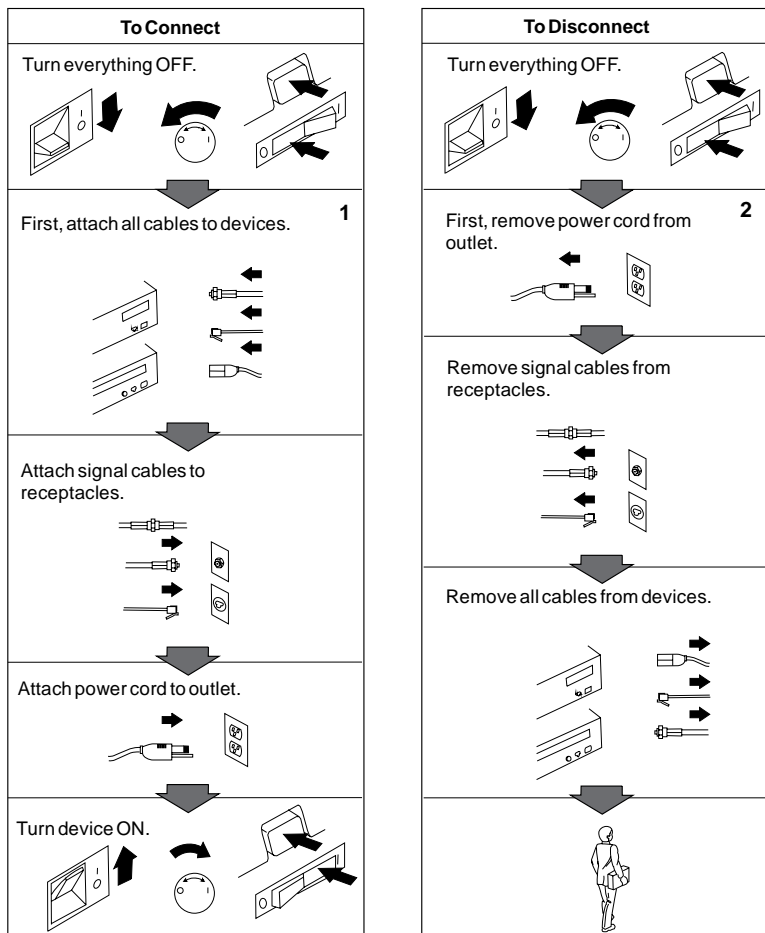
United Kingdom Telecommunications Requirements	X-8
EC Council Directive	X-8
Radio Protection for Germany	X-9
Index	X-11

Safety Information



DANGER:

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



1 In the U.K., by law, the telephone cable must be connected after the power cord.

2 In the U.K., by law, the power cord must be disconnected after the telephone line cable.

CAUTION:

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

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

Dispose of the battery according to local regulations.

A module on the IBM SerialRAID Adapter card contains a lithium battery.

About This Book

This book is intended for a network administrator—that is, the individual responsible for configuring, maintaining, managing, and troubleshooting a PC server or network.

It includes information about installing and using the IBM SerialRAID Adapter, discusses disk-array technology, and describes the use of the supplied configuration programs to define how the IBM SerialRAID Adapter works with mass storage devices.

What You Need To Know

This book assumes that you are familiar with the following procedures and topics:

- Installing adapter cards in PC servers.
- Installing Windows NT 4.0 on the servers that will host the IBM SerialRAID Adapters.
- Installing software (in particular, device drivers) for Windows NT 4.0.
- Setting up and using a browser to access pages on a remote TCP/IP host.
- Hardware details of the servers that will host the IBM SerialRAID Adapters.
- Technical details of the disk drives and disk enclosures to be attached to the IBM SerialRAID Adapters.

How This Book Is Organized

Chapter 1, Introducing the IBM SerialRAID Adapter, describes the adapter, what is provided with it, and the environments in which it works.

Chapter 2, Installing an IBM SerialRAID Adapter, describes how to install the adapter and its associated software.

Chapter 3, Configuring SSA Resources Using the DOS Configurator, describes how to use the DOS Configurator provided with the adapter to configure arrays and other resources for use by the system.

Chapter 4, Performing Other Configuration Tasks, describes other functions of the DOS Configurator supplied with the adapter.

Chapter 5, Configuring SSA Resources Using the RSM Configurator, introduces the RSM Configurator, the browser-based tool for configuring and monitoring SSA adapters.

Chapter 6, Dealing with Disk Problems and Array Problems, describes what to do if you have trouble with an SSA subsystem.

Chapter 7, Getting the Latest Information, describes where you can get more information about the adapter and SSA subsystems.

Appendix A, Resource Numbers, describes resource numbers and how they are allocated.

Related Publications

Other manuals that you might find useful are:

- *IBM SerialRAID Adapter: Maintenance Information*, SY33-0193
- *IBM SerialRAID Adapter: Technical Reference*, SA33-3284.

Numbering Convention

In this book:

KB means 1 000 bytes.

MB means 1 000 000 bytes.

MB/ps means 'megabytes per second'.

GB means 1 000 000 000 bytes.

Chapter 1. Introducing the IBM SerialRAID Adapter

The IBM SerialRAID Adapter is a Peripheral Component Interconnect (PCI) bus-master adapter that serves as the interface between systems using the PCI architecture and devices using the Serial Storage Architecture (SSA). The IBM SerialRAID Adapter supports RAID 5 arrays and individual disk drives in SSA subsystems.

Serial Storage Architecture

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

In SSA subsystems, transmissions to several destinations are multiplexed; the effective bandwidth is further increased by spatial reuse¹ of the individual links. Commands are forwarded automatically from device to device 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.

SSA Loops and Links

In the simplest SSA configuration, SSA devices are connected through SSA links (SSA cables) to an SSA adapter that is located in the system unit. The SSA links form loops; each loop provides a data path that starts at one connector of the SSA adapter and passes through a link to the devices. The loop continues through the devices, then returns to a second connector on the SSA adapter.

The maximum permitted length for an external cable that connects two SSA nodes (for example, disk drives) is 25 meters (82 feet), or 2.4 km if fiber optic cables are used with the SSA Fibre Optic Extender.

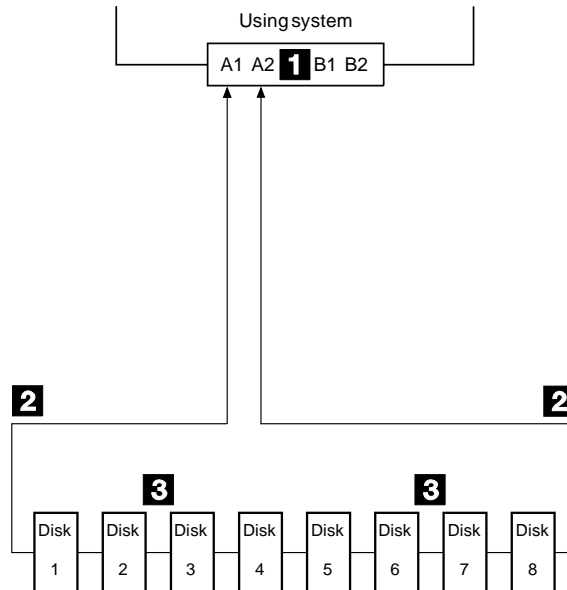
Details of the rules for configuring SSA loops are given in "Rules for SSA Loops" on page 1-5.

¹ i1.spatial reuse An SSA loop consists of separate SSA links between each node on a loop. One important characteristic of SSA is that different links can be used for different data transfers at the same time. One adapter can be sending data to one node whilst at the same time another adapter can be sending data to another node. This is termed 'spatial reuse'. The benefit is that the bandwidth that a single loop can sustain is the multiple of the number of different transfers that can take place concurrently due to spatial reuse.

Loops and Data Paths

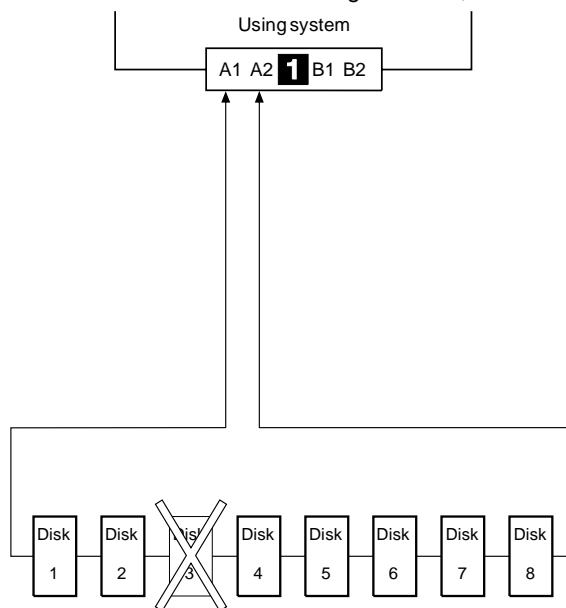
As illustrated in the following diagram, all devices that are attached to an SSA adapter card **1** are connected through SSA links **2**. Data and commands to a particular device pass through all other devices on the link between the adapter and the target device.

Data can travel in either direction round a loop. The adapter can, therefore, get access to the devices **3** through two data paths. The host cannot detect which data path is being used.



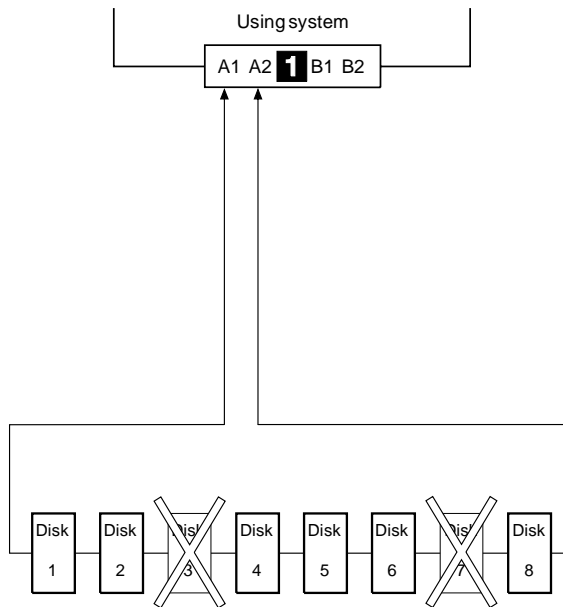
If a disk drive fails, or is turned off, the loop is broken, and one of the data paths to a particular disk drive is no longer available. The disk drives on what remains of the loop continue to work, but an error is reported to the system.

A *string* is a set of drives that can be reached through one end only of a loop. In the following diagram, disk drive number 3 has failed. Disk drives 1 and 2 can communicate with the system only through connector A1 of the SSA adapter. Disk drives 4 through 8 can communicate only through connector A2 of the SSA adapter. Disk drives 1 and 2 form a string of drives; disk drives 4 through 8 form another string.



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

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



Rules for SSA Loops

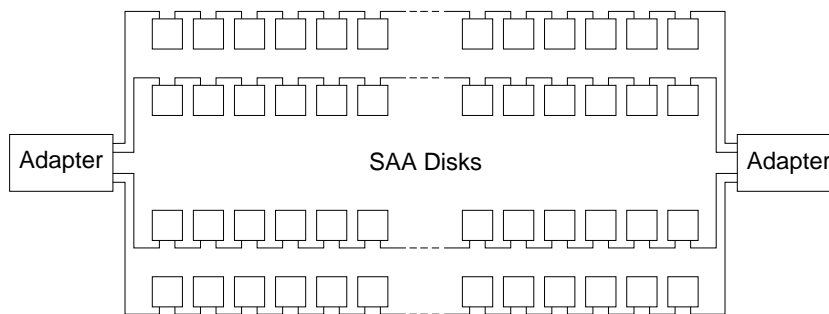
For SSA loops that include the IBM SerialRAID Adapter, the following rules apply:

- Each SSA loop must be connected to a valid pair of connectors on each SSA adapter (that is, either connectors A1 and A2, or connectors B1 and B2).
- Up to three adapters may be in each supported host. An IBM SerialRAID Adapter can support two SSA loops. A maximum of 48 devices can be connected in a particular SSA loop. Therefore each adapter can support up to 96 SSA devices.
- Up to two pairs of adapter connectors can be connected in a particular SSA loop.
- If there are two adapters in a particular SSA loop, they must both be IBM SerialRAID Adapters or IBM SSA RAID Cluster Adapters (that is, they cannot be mixed).
- If Fast Write resources are to be used, there can be no more than one adapter per loop.
- RAID 5 arrays created on earlier IBM RAID adapters will be recognized and will operate normally on the IBM SerialRAID Adapter. However, note that:
 - After you port such an array to the IBM SerialRAID Adapter, it cannot be ported back to an earlier type of adapter.
 - Arrays created on the IBM SerialRAID Adapter cannot be ported to earlier RAID adapters. They will not be recognized.
- Two adapters in a loop cannot be in the same host.

Dual-Host Configuration

For sharing data storage among hosts, two IBM SerialRAID Adapters can be connected in the same loop, but in different hosts. This arrangement is known as a *dual-host operation*.

The following diagram shows two IBM SerialRAID Adapters in two loops:



The Configuration Utilities

The adapter is supplied with two configuration tools, the Remote Systems Management Configurator (the RSM Configurator), and the DOS Configurator. Use the DOS Configurator for initial configuration tasks described in this chapter, and use the Remote Systems Management Configurator for subsequent day-to-day work. Where you want to install Windows NT on an SSA resource (a disk or an array), you must use the DOS Configurator to define the SSA device as a system resource.

Apart from differences in the user interface, the DOS Configurator and the RSM Configurator provide broadly similar functions, except that the DOS Configurator does not provide error logging.

Chapter 3, Configuring SSA Resources Using the DOS Configurator, and Chapter 4, Performing Other Configuration Tasks, are about using the facilities of the DOS Configurator.

The RSM Configurator

The RSM Configurator is a browser-based SSA configurator. Two versions are available for Windows NT Server 4.0:

- A stand-alone Windows NT service (Stand-Alone version)
- A Web extension for TME10 Netfinity (Netfinity version).

Both versions enable you to configure remote and local SSA subsystems, and offer all the functions of the DOS Configurator and some new functions, such as:

- Logical, physical and explorer views of the SSA subsystem
- A facility for online checking of the firmware level and the level of the RSM Configurator itself.

The **setup** program on diskette 1 of the SSA Remote Systems Management can be used to install either the Stand-Alone version or the SSA Netfinity Web extension .

For more details of the RSM Configurator, see Chapter 5, Configuring SSA Resources Using the RSM Configurator.

The DOS Configurator

The DOS Configurator is a DOS program that can be used to configure adapters and their disk resources. It is intended to be used for initial configuration or for performing other low-level operations. For day-to-day configuration maintenance tasks, use the RSM Configurator.

Adapters installed in the local server are visible to the configurator together with adapters that exist in the same SSA loops as those adapters. Thus, it is possible to configure adapters in servers other than the one in which it is running.

The DOS Configurator must be used to configure disk and array resources if it is intended to install the operating system on an SSA device. The RSM Configurator can then be used as the main configuration tool.

The DOS Configurator is supplied on a DOS bootable diskette. It must be run from DOS as supplied on the diskette, not from an NT DOS session.

Adapter Configuration Capabilities

If Windows NT is to be installed on an SSA disk or array to be managed by the adapter, suitable disk drives must first be configured as SSA resources. The IBM SerialRAID Adapter is supplied with a DOS Configurator for this purpose.

For configuration and maintenance of SSA subsystems from within Windows NT, a browser-based tool, the Remote Systems Management Configurator² is supplied, together with a dedicated SSA Event Logger. The Event Logger runs as a service in Windows NT and can forward SSA events to other system management tools.

For more information about the configuration tools, see “The Configuration Utilities” on page 1-6.

Resource Types

The configuration software packaged with the adapter enables configuration of **resources**³ that manage the data flow between the operating system and SSA devices attached to the adapter.

IBM SerialRAID Adapter supports creation and configuration of the following types of resource:

- Disk
- RAID 5
- Fast Write
- NVRAM

Ownership and Usage Type

Resources can be configured in ownership hierarchies; that is, resources can be formed from other appropriate resources. For example, a RAID 5 resource is typically formed from a number of disk resources. In such hierarchies, each type of resource handles input/output to 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

² In the rest of this book, the Remote Systems Management Configurator is referred to as the RSM Configurator.

³ Throughout this book, and in the configuration programs, ‘resource’ means “something to which input/output may be performed”. A resource may be a disk, or an adapter function, such as RAID or Fast Write. The adapter function typically works by providing resources, that use or are formed from other resources. For example, the RAID 5 function of SSA adapters provide RAID 5 array resources, using the XOR hardware in the adapter, and by making use of disk resources.

distributing the data among the disk resources that form it. A disk 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 supported by the IBM SerialRAID Adapter and configuration programs are:

- | | |
|------------------|--|
| New | <p>The resource is new from the manufacturer, has previously been used in an AIX environment, is a component of a RAID type not supported by this adapter, or a low-level SSA format has been performed on the disk. Such resources must be placed in the Free resources list before they can be configured for use in SSA subsystems. However, care should be taken before re-configuring a New resource: ensure that the resource does not contain data from an AIX system that is still required.</p> <p>In the RSM Configurator, these are shown as System (AIX) resources.</p> |
| Free | <p>The resource currently has no defined usage, and can be used in the formation of other resources or can be added to the System resources list.</p> <p>To change the usage of a resource, it must first be placed into the Free resources list.</p> |
| System | <p>The resource has been placed in the System resources list, and can be directly accessed by the operating system.</p> <p>The operating system can address only those resources that belong in the system usage class.</p> <p>In the RSM Configurator, these are shown as System (PC) resources.</p> |
| Hot Spare | <p>The resource may automatically become a component of an array that has been configured to use Hot Spares, if a component of the array fails or becomes unavailable.</p> |
| Rejected | <p>A Rejected Resource is that one has been a component of an array resource, but is no longer a component. An array rejects a component if the component fails or is found to contain corrupt data. If an array rejects a component, replaces it with a Hot Spare, and the original component becomes available again, the component will be a treated as a Rejected resource.⁴</p> |

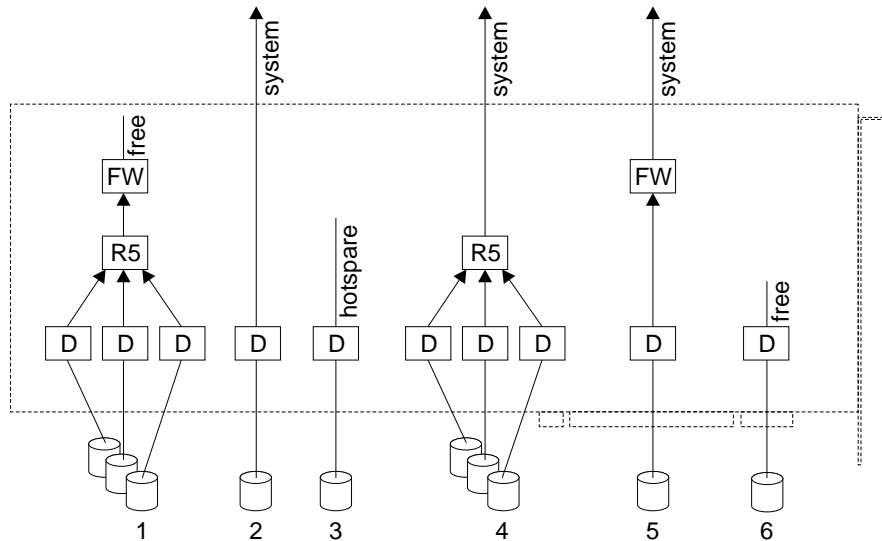
The configuration programs supplied with the adapter enable you to manage resources by maintaining a list of each usage type.

⁴ The presence of a rejected disk resource does not necessarily indicate a faulty disk drive. The resource may have been rejected by the RAID management software for a variety of reasons. The configuration programs provide diagnostic routines that can be used to obtain more information about Rejected resources.

In addition, the configuration utility can be used to create, modify, and delete array and Fast Write resources. For example, 5 disk resources could be made into a single RAID 5 resource.

For details of how to manage the lists, see Chapter 3, Configuring SSA Resources Using the DOS Configurator.

The sample configuration shown in the following diagram illustrates the principles of the logical interface provided by the adapter.



In the diagram:

- Boxes marked 'D' are disk resources.
- Boxes marked 'R5' are RAID 5 resources.
- Boxes marked 'FW' are Fast Write resources.
- The arrow heads indicate ownership of the resources.

Note the following points about this sample configuration ('system' means the operating system, Windows NT 4.0.):

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.

This resource could be added to the system resources list. The system would then be entitled to perform input/output operations to the Fast Write resource, which would handle input/output to the RAID 5 resource, which would in turn handle input/output to the individual disk resources of which it is formed. The Fast Write resource is in the Free resources list, but the resources of which it is formed are not.

A Fast Write resource can be formed of one resource only.

2. The adapter has one disk resource defined for use by the system.

The system 'owns' this disk resource, and is entitled to perform input/output to this resource.

This resource could be returned to the Free resources list.

3. The adapter has one disk resource defined as a Hot Spare.

This resource is not owned; however, it is a candidate for automatic use by any suitably configured array in the same loop as the Hot Spare resource. If it is used by an array, it then becomes a component of that array.

This resource could be returned to the Free resources list. However, it is the only Hot Spare available; therefore, if any of the arrays are configured to use a Hot Spare, and this resource were returned to the Free resources list, the adapter would generate and log an error message for each such array at regular intervals.

4. The adapter has one RAID 5 resource defined for use by the system.

The system 'owns' this RAID 5 resource, and is entitled to perform input/output to this resource. The RAID 5 resource handles input/output to the individual disk resources of which it is formed.

This resource could be returned to the Free resources list; but note that the disk resources of which it is formed would not be free.

5. The adapter has one disk resource defined for use by the system via Fast Write.

The system owns the Fast Write resource, and is entitled to perform input/output to it. The Fast Write resource in turn manages input/output operations to the disk resource associated with it.

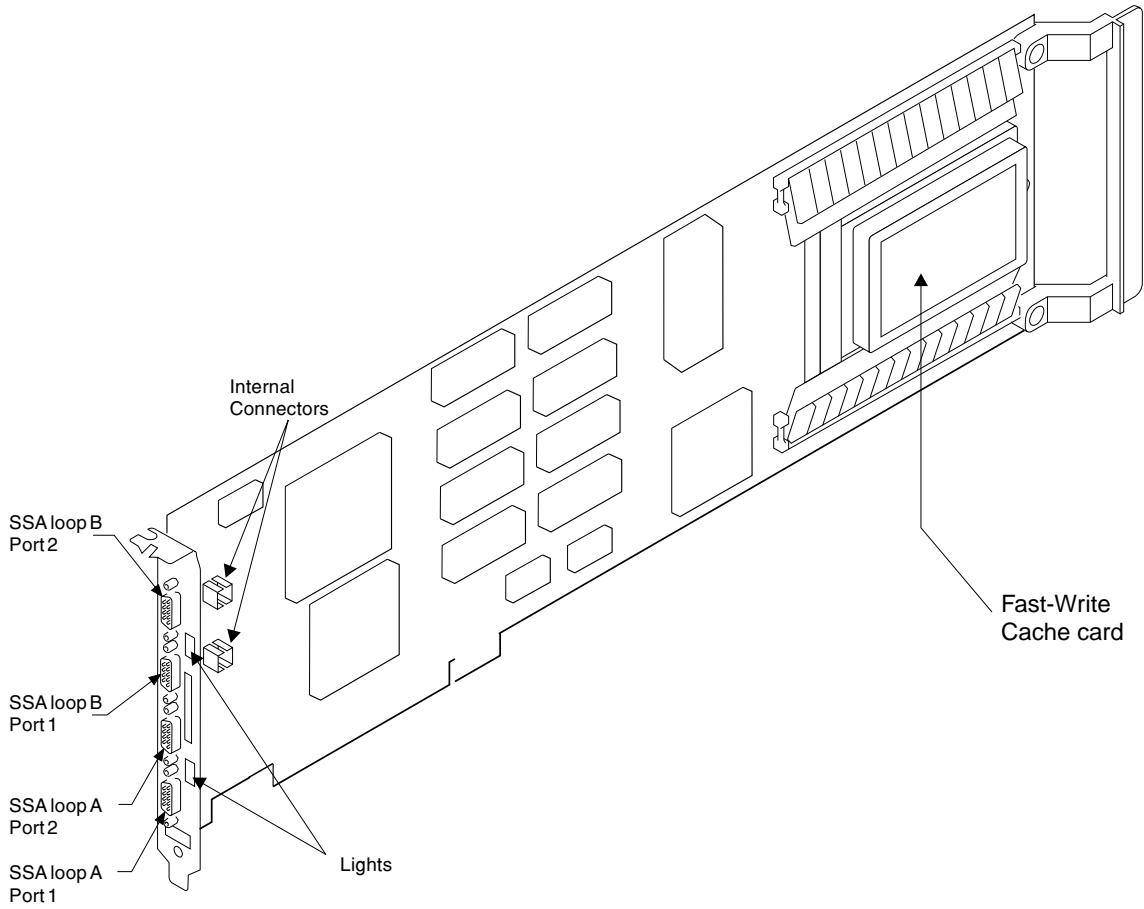
6. The adapter has one disk resource in the Free resources list. This resource could be added to the system resources list or to the Hot Spares list, or it could be made into a component of an array.

All resources can be configured as Fast Write (but note the restrictions stated on page 1-15).

Hardware Characteristics

The adapter provides four SSA ports for the attachment of storage devices. Each port operates up to an instantaneous maximum of 20 MB/ps⁵ full duplex. Thus the bandwidth of an SSA loop is potentially 80 MB/ps.

⁵ MB/ps is megabytes per second.



On the adapter card, there is a light next to the pair of SSA connectors (port 1 and port 2) for each SSA loop.

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

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

RAID

RAID (redundant array of independent disks) is a technology for grouping several hard disk drives into an *array* that is defined as a single logical disk drive. With certain types of RAID, this grouping technique increases data availability; if one disk fails, the system continues to run, with no operator intervention required. The failed disk can be replaced without turning off the server (*hot swapping*).

The IBM SerialRAID Adapter provides RAID functions within the interface between the server and its disk drives. Disk drives connected to the adapter can be configured as **components** of a RAID 5 array, as Hot Spares for possible future use in an array, or as individual drives.

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

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

The IBM SerialRAID Adapter provides RAID 5 facilities and also access to individual SSA disk drives that are not configured as components of an array.

RAID Levels

RAID 0 is also known as *striping*. A RAID 0 array provides a large bandwidth for processing large data files.

RAID 1 is also known as *mirroring* or *dual copy*. This provides the highest assurance of data availability, but the storage capacity is only half the total capacity of its components.

RAID 5 provides redundancy with good performance for reading large or small data files. Data can be reconstructed if one component fails. However, because of the processing time taken to update parity during write operations (see Note on parity on page 1-13), write performance with RAID 5 is not as good as with other RAID options.

Support for RAID 5 Arrays

Although this book is about the IBM SerialRAID Adapter, which supports RAID 5 and no other level of RAID, the configuration programs supplied with this adapter also support other adapter types. The contents of the menus and windows reflect the type of the adapter you have selected from the adapter list presented by the programs.

If you select an adapter other than an IBM SerialRAID Adapter, the menus are automatically adjusted to contain items that are particular to that adapter type and not

to the IBM SerialRAID Adapter. For example, if you select an adapter that supports RAID 1 arrays, the menus and windows allow you to manage RAID 1 arrays and not RAID 5 arrays.

The illustrations and instructions in this book assume configuration for an adapter that supports RAID 5 arrays.

An array is a single resource made up of individual disk resources. The IBM SerialRAID Adapter supports RAID arrays at level 5 (RAID 5 arrays).

An array has a resource number, and is treated by the operating system as a single large capacity disk with built-in redundancy and other optimized storage and retrieval characteristics.

A RAID 5 array can be configured to use Hot Spares (see “Hot Spare Resources” on page 1-14).

The array consists of three 3 through 16 disk resources (components). The components of the array (and any prospective Hot Spares that are intended to be used by it) must be on the same SSA loop.

The server’s operating system can be installed on a suitably configured array and the operating system booted from that array.

A RAID 5 array controlled by an IBM SerialRAID Adapter can be configured to use the adapter’s Fast Write function. “Managing Arrays” on page 3-9 describes how to use the DOS Configurator set up and maintain RAID 5 arrays for use with IBM SerialRAID Adapters.

Note on parity

RAID 5 arrays implement data striping and provide redundancy (protection against drive failures) by storing *parity* information. For an array with N components there is one parity strip for every $N-1$ data strips. The parity strip is calculated by performing an exclusive or' of the data in all of the associated data strips. The parity and associated data strips are always stored on different components of the array so that in the event of a drive failure which prevents a data strip being read the parity and remaining data strips can still be read from the other components. Using the parity and other data strips the data on the bad drive can be reconstructed by performing an exclusive or' of the parity with the remaining data strips.

Every time data is written to a RAID 5 array, a data strip and the corresponding parity strip must be updated. If all the parity in an array was stored on one drive this would mean that every write operation would require to write data to the parity drive and consequently performance would be limited by the speed at which the parity data can be written. To avoid this potential bottleneck RAID 5 arrays distribute parity strips across different components of the array.

Hot Spare Resources

Suitable disk resources can be configured as Hot Spares.

In a suitably configured array (one that has the Hot Spare Enabled attribute set), if one of its components fails, a Hot Spare (if available) is used automatically in place of the defective disk. The Hot Spare becomes a component of the array, and the array management software on the adapter rebuilds the Hot Spare to contain the data that was on the defective disk.

To be useable by an array, the Hot Spare, the array components, and the defective disk it may replace must all be on the same loop.

If an array loses a component, the first suitable Hot Spare on the same SSA loop as the array itself is used to replace the defective component.

For each array, provide a suitable Hot Spare. A prospective Hot Spare must have at least the same data capacity as the smallest component of any array that may use it. Ideally, it should be large enough to match the size of the largest component of any array that may use it. If the Hot Spare Exact attribute is set in the configuration of the array, then if the Hot Spare is over 10% larger than the disk it replaces it is not used. This is to prevent relatively large disk drives being used to replace smaller disks.

“Creating a Hot Spare” on page 4-1 describes how to use the DOS Configurator to configure a disk resource as a Hot Spare.

“Changing Failed Array Components” on page 6-3 discusses how to deal with situations where a Hot Spare has been automatically exchanged with a defective array component.

If a component of an array fails and there is no Hot Spare available, the array goes into one of the following 'states':

- | | |
|-----------------|--|
| Good | The array is online and it can be read from and written to. All the components of the array are present. No data rebuilding is outstanding. The array is fully protected against the loss of one component. |
| Exposed | <p>One component is missing from the array. When the array is read, data can be reconstructed for the missing component. The first write operation causes the array to enter the degraded state.</p> <p>If a suitable Hot Spare is available, the Hot Spare replaces the missing component and the array enters the rebuilding state after an interval.</p> |
| Degraded | <p>One component is missing and a write operation has been received for the array. Read and write operations to the array are supported.</p> <p>If a suitable Hot Spare is available when the array enters the degraded state, the Hot Spare replaces the missing component and the array enters the rebuilding state.</p> |

	The missing component is permanently excluded from the array.
Rebuilding	The array is online and it can be read from and written to. All components of the array are present but data is being rebuilt on one of the components.
Offline	An array is in this state when one of the following conditions exists: <ul style="list-style-type: none"> • Two or more components of the array are missing or have failed. • The rebuilding of a replacement component is not complete when another original component fails.

The Fast Write Feature

Resources controlled by the IBM SerialRAID Adapter can be configured as Fast Write resources. Fast Write resources use the adapter's Fast Write Feature.

The Fast Write Feature allows the adapter to return completion status for write commands earlier than it could otherwise, by caching write data in its battery-backed static random access memory (BBSRAM, which is non-volatile memory). Status is returned as soon as data has been stored in static RAM, which takes considerably less time than writing to disk. The adapter later writes data from static RAM to disk, a process known as de-staging. Data is de-staged automatically depending on operating conditions.

Fast Write improves response time (the time from a command being issued by the host to status for the command being received by the host). However, due to the additional work that Fast Write imposes on the adapter, overall throughput may be diminished under heavy load.

Fast Write gives the greatest improvement when applied to RAID 5 arrays because it can combine write data into transactions that are optimized for handling by the RAID management software on the adapter. Specifically, this creates a greater proportion of high-speed transactions to the array. This means the RAID management software has less work to do, because it need not read data from its component components to calculate parity. (It is saved parity data which enables RAID firmware to reconstruct data from a missing component of the array.)

Arrays and disk resources can use the Fast Write function of the IBM SerialRAID Adapter.

A dual-host system can accommodate RAID 5 resources and disk resources, but not Fast Write resources. A single-host system can accommodate single disk resources, RAID 5 resources, and Fast Write resources.

"Managing Fast Write Resources" on page 3-15 describes how to use the DOS Configurator to configure Fast Write resources.

Operating System Software

The IBM SerialRAID Adapter, its firmware, and the software supplied with it provide for the attachment of SSA devices to servers running Microsoft Windows NT 4.0 Server Standard Edition or Microsoft Windows NT 4.0 Server Enterprise Edition. The Enterprise Edition includes Microsoft Cluster Server Release 1, which provides clustering of servers and applications if failover capability is required for dual-host systems.

Chapter 2. Installing an IBM SerialRAID Adapter

This chapter describes how to install the IBM SerialRAID Adapter and the Windows NT device drivers and utilities required for use with the adapter.

Before Installing the Adapter

The IBM SerialRAID Adapter package contains:

- The *IBM SerialRAID Adapter Installation and Users Guide* (this book).
- The *IBM SerialRAID Adapter Maintenance Information*.
- One IBM SerialRAID Adapter—the 'adapter'.
- One diskette, labeled IBM SerialRAID Adapter DOS Configurator and Utilities—the 'DOS Configurator diskette'.
- One diskette, labeled IBM SerialRAID Adapter Windows NT Device Drivers and Utilities—the 'Windows NT diskette'. This diskette includes the IBM SSA Event Logger.
- Two diskettes, labeled IBM SerialRAID Adapter Remote Systems Management. These diskettes include the RSM Configurator and related information pages.

The procedures described in this chapter require the supplied IBM SerialRAID Adapter, the DOS Configurator diskette, and the Windows NT diskette. You will also need:

- The documentation that came with the server
- Operations guides for the SSA subsystems (enclosures and drives) you will be attaching to the adapters
- A small flat-blade screwdriver.

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

Contact the supplier if any parts are missing or damaged.

The general installation procedure is:

1. Plan the topology of your SSA subsystems, depending on your data storage and requirements. This topic is outside the scope of this book.
2. Install the IBM SerialRAID Adapters and connect them to disk drives and disk enclosures.
3. Install the SSA device drivers on the servers. These are Windows NT drivers.

The steps you follow depend on whether you already have Windows NT installed on the servers.

If not, you may want to install Windows NT on SSA drives or arrays. To do this, you must, for each server:

- a. Run the DOS Configurator to set up an SSA device (disk drive or RAID 5 array) that the Windows NT Install program can use. Using the DOS Configurator, you can set up more than one SSA device, but for the sake of simplicity, set up one device at this stage.¹
- b. Install the SSA device drivers for Windows NT.
- c. Install Windows NT on the SSA boot device.

If you already have Windows NT installed on the server, you need only perform step 3b.

Connecting the Disk Drives

The IBM SerialRAID Adapter has two pairs of SSA ports. Each pair can attach up to 48 dual-port devices (drives) in a closed loop or string. Up to two IBM SerialRAID Adapters can be included in a loop.

“SSA Loops and Links” on page 1-1 provides a general description of SSA loops and some rules for cabling valid configurations.

To connect the cables:

1. Connect the cables from the devices to the appropriate pair of connectors on the adapter card.
2. Tighten the retaining screws on the SSA cable connectors fully clockwise to ensure that a good ground connection is made.

Installing the Adapter Card

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

To install the adapter card, refer to the documentation that came with the PC server. The *User's Handbook* for the server describes how to install an adapter. Perform the steps described in that book, ensuring that you perform the actions relating to opening the static-protective package correctly.

When choosing a slot for the IBM SerialRAID Adapter, take note of the following restrictions and recommendations:

- For best performance, IBM SerialRAID Adapters in the same host should be on the same bus. Refer to the system documentation to determine the optimum placement of adapters in slots.
- If you want to boot from an SSA resource, install the SSA adapter in a PCI slot with a higher priority than the slots used by any SCSI adapters. If this is not

¹ If you set up more than one SSA resource in the System resources list, remember that Windows NT will boot from the first suitable resource managed by the adapter in the highest priority slot in the host.

possible, disable the CBIOS for the other storage adapters in the system. "Installing Windows NT To Boot From An SSA Device" on page 2-4 describes other actions you must perform to boot from an SSA resource.

- In some server units, the IBM SerialRAID Adapter card might be too large or the wrong shape to fit into some slot positions. If it helps, remove the blue handle on the IBM SerialRAID Adapter card by removing the screws that attach it to the adapter card.
- The manufacturers or suppliers of some server units might have recommendations on which slots to use for disk-drive adapters. For details of this refer to the documentation that is supplied with the server unit. You can find more information about SSA adapters and particular servers at the addresses given in Chapter 7, Getting the Latest Information.

Selecting the Boot Device

If any IBM SerialRAID Adapters are installed in a server, you must specify at startup whether you want Windows NT to boot from a resource controlled by an IBM SerialRAID Adapter. In particular, you need to do this when you are preparing to install Windows NT on an SSA resource, as described under "Installing Windows NT To Boot From An SSA Device" on page 2-4. To do this:

1. Turn power on to the system unit and to the devices.
2. **If you are NOT going to boot from an SSA resource:**
 - a. Ensure that the CBIOS for the IBM SerialRAID Adapter is disabled. To do this, if the message
CBIOS is currently enabled
appears during the boot process, press Tab while the message is visible.
 - b. Enable the CBIOS for the adapter that controls the device from which the server will boot (for instructions on how to do this, refer to the information for the adapter).
3. **If you are going to boot from an SSA resource:**
 - a. Ensure that the CBIOS for the IBM SerialRAID Adapter is enabled. To do this, if the message
CBIOS is currently disabled
appears during the boot process, press Tab while the message is visible.
 - b. Before running the Windows NT Install program, run the DOS Configurator (supplied on the bootable PC-DOS Configurator and Utilities diskette supplied with the adapter). Using the options in the DOS Configurator:
 - 1) Remove the resource from the New resources list; this will cause it to be added to the Free resources list. It can then be added to the System resources list in the order required. Chapter 3, Configuring SSA Resources Using the DOS Configurator describes how to do this.

- 2) For operation in a dual-host environment, set the disk drive access mode of any disk drives you intend to contain a Boot or System partition to Private to the adapter in the the server in which you will run the Windows NT Install program. "Viewing and Changing Disk Access Modes" on page 4-12 describes how to do this.
- c. If you have a problem when attempting to boot from an SSA resource, refer to "Basic Problems" on page 6-1.

Installing Windows NT To Boot From An SSA Device

When installing the SSA device drivers on a particular server, you may be faced with one of the following situations:

1. Windows NT is already installed on the server on a non-SSA device. Proceed to install the SSA device drivers, as described under "Installing the SSA Device Drivers and Utility Programs" on page 2-5.
2. Windows NT is not yet installed on the server, and you want to install it to boot from a non-SSA device. Install Windows NT as normal, then proceed to install the SSA device drivers, as described under "Installing the SSA Device Drivers and Utility Programs" on page 2-5.
3. Windows NT is not yet installed in the server, and you plan to install Windows NT to boot from an SSA resource (a RAID 5 array or a single drive attached to an IBM SerialRAID Adapter). This section addresses the third case, and describes how to install Windows NT to boot from an SSA resource, and assumes that an IBM SerialRAID Adapter is installed and configured as described in "Installing the Adapter Card" on page 2-2. When you have performed the tasks described in this section, install the SSA device drivers as described under "Installing the SSA Device Drivers and Utility Programs" on page 2-5.

If you want to install Windows NT on a resource attached to the IBM SerialRAID Adapter you must first make the resource into a system resource using the DOS Configurator.

You can install Windows NT on an SSA disk resource or RAID 5 array, with or without Fast Write. The DOS Configurator enables you to create a RAID 5 array which must also be made a system resource if it is to be used for the installation of Windows NT.

To install Windows NT to boot from an SSA resource:

1. Boot DOS.
When the 'CBIOS is currently disabled' message is displayed, press Tab; this enables the CBIOS.
2. Run the DOS Configurator (issacfg.exe) provided on the PC-DOS Configurator and Utilities diskette.
3. Create a single system resource (either a disk resource or a RAID 5 array) from which Windows NT will boot. (The details of this procedure are given in Chapter 3, Configuring SSA Resources Using the DOS Configurator.)

Note: The resource must be placed in the System resources list. It may be an array, but cannot be a **component** of an array.

4. Start to install Windows NT as normal, from the Microsoft installation diskettes. When the Windows NT Install program prompts you to specify whether to search for mass storage devices, press S twice, to specify the type of devices. Select the 'Other (have disk)' option, and insert the Windows NT device drivers diskette.

Note: If you need to install other SCSI or IDE controllers, you can do so now, by selecting 'Additional controllers', using information that came with the controller or with the server.

5. Complete the installation of Windows NT.
6. When Windows NT has been installed, you **must** proceed as described in "Installing the SSA Device Drivers and Utility Programs."

Installing the SSA Device Drivers and Utility Programs

A README.TXT file on the Windows NT diskette provides detailed instructions for installing the SSA device drivers and the associated utility programs (including the Windows Event Logger) on a server that already has Windows NT installed.

After installing the device drivers, you typically will want to configure further disk and array resources. You can use either the RSM Configurator or the DOS Configurator to perform further configuration tasks relating to your SSA subsystems. Chapter 3, Configuring SSA Resources Using the DOS Configurator describes how to do this using the DOS Configurator.

To run the DOS Configurator, shut down Windows NT and boot DOS from the DOS Configurator diskette.

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

You should now install SSA Remote Systems Management either as a Windows NT service or a Netfinity extension, run **setup.exe** on the SSA Remote Systems Management diskette 1.

When you have installed these systems and the device drivers, reboot the system. The following section describes how to ensure that Windows NT boots from the required SSA disk drive.

Chapter 3. Configuring SSA Resources Using the DOS Configurator

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

This chapter describes how to use the DOS Configurator to configure arrays and other resources. For information about using the Remote Systems Management Configurator, see Chapter 5, Configuring SSA Resources Using the RSM Configurator.

Note: If, after configuration, a system resource is not visible through Windows NT Disk Administrator, restart the server.

It is assumed that adapters have been installed and disk drives have been connected as described on page "Installing the Adapter Card" on page 2-2.

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

Note: The drive letters assigned to resources are a result of the combination of resource numbering and the partitioning of the resources.

The SSA Configuration Programs

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

Function	Summary
Array management	An array may be created or deleted, or an existing array configuration viewed/modified.
Management of 'new' resources	Lists all the New, System (AIX), or Preconfigured resources. These can be moved to the Free resources list. Note: <ul style="list-style-type: none">• A 'Preconfigured' resource is a component of a type of RAID (or Fast Write resource) not supported by this adapter; for example, a RAID 5 component disk attached to a IBM SSA RAID Cluster adapter.• In the RSM Configurator, new disk resources are shown as System (AIX).
Management of Free resources	Identify and optionally use resources which are not currently being used for any purpose.

Function	Summary
Management of system resources	<p>Maintain a list of resources that are visible to the operating system. This list is sorted in order of resource number.</p> <p>Resources can be added to this list. Candidates for adding are those resources in the Free list. Resources can be deleted (removed) from this list, and they become Free as a result.</p> <p>On adapters that support it, privacy information can be set for System resources.</p>
Configuration of Rejected Resources	<p>If a RAID array discovers a component resource that is corrupt, unusable in some way, or has been superseded by a Hot Spare, it changes the status of the component to Rejected. Such resources can be tested and put back into the pool of Free resources, then re-used. For details, see "Managing Rejected Resources" on page 3-21.</p>
Configuring Hot Spares	<p>These can be used with any array that supports redundancy (that is, RAID 1 and RAID 5). If an array is configured to use Hot Spares and a component fails, then the adapter will use a Hot Spare (if available) to replace the failed component.</p>
Managing NVRAM	<p>Non-volatile 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 non-volatile RAM. If it identifies records which indicate that some parity is out of date (probably due to a write operation being interrupted for some reason) then the adapter will begin a process to repair the parity across the whole array.</p> <p>If an array is removed from the system by any unusual method, this causes a 'dormant' entry in the adapter's NVRAM. Dormant entries can be inspected and deleted using the DOS Configurator and the RSM Configurator.</p>
Concurrent Diagnostics	<p>Run a level of diagnostics which enables the SSA subsystem to function without degradation of performance.</p>
Non-concurrent Diagnostics	<p>Run a detailed diagnostic that involves stopping I/O to the SSA disk resources (requires the system to be quiescent).</p>
Viewing the SSA Configuration	<p>Displays the list of SSA devices attached to each SSA port of the selected adapter. The position of a resource in the list represents its physical position within the SSA loop.</p>
Event Logging	<p>The RSM Configurator enables the Event Log to be analyzed. You can also specify the types of events to be logged.</p>

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. Free resources can optionally be made into RAID and or Fast Write resources, which themselves start life as Free resources.
3. Some Free resources can optionally be designated as Hot Spare resources, to protect against failure of array components.
4. Free resources can be made visible to the operating system by adding them to the System resources list. A system reboot may be necessary to make the System resources visible to the operating system.

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

Types of Adapter Supported By the Configuration Utilities

The IBM SerialRAID Adapter is one of the adapters supported by the configuration tools.

The IBM SSA RAID Adapter supports RAID 0, RAID 1, and RAID 5 resources, and individual disk resources. It is a single initiator adapter, in that only one such adapter may be in an SSA network.

The IBM SSA RAID Cluster Adapter supports RAID 1 resources, and individual disk resources. It is a dual initiator adapter, in that up to two such adapters may be in any SSA network. The adapter operates using a Primary/Secondary failover scheme, whereby one adapter provides protection against the failure of the other¹.

The IBM SerialRAID Adapter (the main subject of this book) supports RAID 5 resources, Fast Write resources, and individual disk resources. Up to two such adapters are supported in any SSA network (dual-host operation). If an SSA network contains a Fast Write resource, this network can only have a single adapter.

The Fast Write function can provide a performance boost for certain workloads by completing a write command as soon as the data enters the adapter's non-volatile memory, without waiting for it to be written to the associated disk or array resource.

Adapters that support more than one adapter per SSA network (that is, IBM SSA RAID Cluster adapter, or IBM SerialRAID Adapter) support the concept of privacy, in which a System resource may be made invisible to all but one specific adapter. This enables different computers to boot their operating system from private resources in a shared SSA network.

The IBM SSA RAID Cluster adapter does not support the Privacy designation of RAID 1 arrays. All RAID 1 arrays are Public.

Different types of SSA adapter cannot be mixed in the same SSA network; that is, IBM SSA RAID Cluster adapter and IBM SerialRAID Adapter cannot be mixed.

When you configure the disk drives in an SSA subsystem, the configuration information is written on the disks themselves. Each disk or other configured device carries information about its usage, that is, whether it is:

- 'Free' (not owned)
- Part of a RAID array

1

If failover is required for IBM SerialRAID Adapters in a dual-host system, use the facilities of Microsoft Cluster Server.

- A Hot Spare resource
- Used by the system (and if so, at what position in the resources list).

System resources are presented by the adapter's CBIOS code to the system BIOS in the order in which they appear in the System resources list. Device drivers also present 'System Resources' to the operating system in this same order.

The actions that you must perform are:

1. Accept any 'new' disk drives as disk resources into the subsystem (see "Converting a New Resource Into a Free Resource" on page 3-7)
2. Configure arrays, if required (see "Managing Arrays" on page 3-9)
3. Add the arrays or individual disk resources into the System resources list (see "Managing System Resources" on page 3-17).

The following sections describe the details of these actions, using the DOS Configurator. For information about using the RSM Configurator, see Chapter 5, Configuring SSA Resources Using the RSM Configurator.

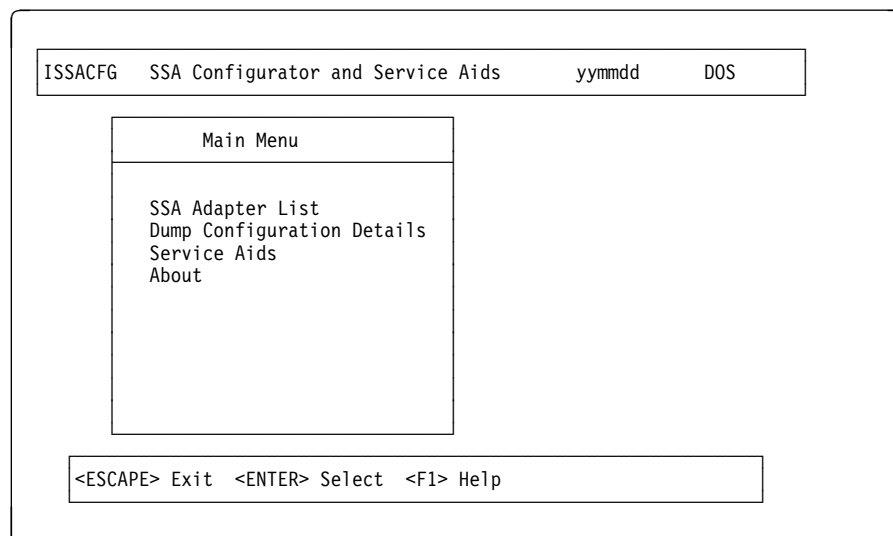
Running the DOS Configurator

To use the DOS Configurator, shut down Windows NT (if it is running) and reboot the server from the DOS Configurator diskette. To run the DOS Configurator, execute the following program from the DOS command prompt:

ISSACFG.EXE

Note: This program does not run in a DOS session under Windows NT.

The SSA Main Menu screen is displayed:



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 press Enter) to select that item.

To move to the previous menu, press Esc.

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

Note: The **Service Aids** command on the Main Menu displays a help panel which contains introductory information about the disk service aids. The disk service aids can be accessed via the **Disk Service Aids** command on the Adapter List menu. The service aids can be used to:

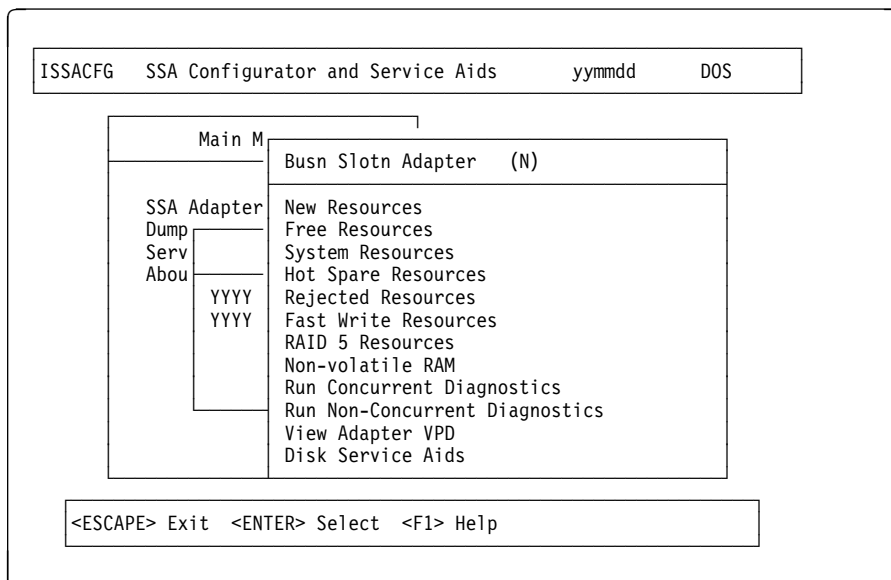
- Set and reset service mode for disks
- Format disks
- Certify disks
- Perform diagnostics on disks.

These are maintenance tasks which are more fully described in the *Maintenance Information* book.

The Adapter List

The Adapter List menu in the DOS Configurator provides access to adapters currently visible to the configurator, and to resources controlled by the adapters. The adapters return information to the configuration program about the resources they control, and their current usage.

When you select an adapter to work with, the Adapter Resources menu appears:



The following is a brief explanation of the items on this menu.

A New resource is one that has not been used previously by the type of system in which it is now installed. For example, in the context of PC servers, a new disk could have arrived directly from the factory, or have been used previously in an AIX system. To be useable in the current system, a New disk must be added into the Free resources list.

A Free resource is one that is not currently put to any *use*. The other uses of resources are System, Hot Spare, and Rejected.

Resources can be added to or removed from these use types by selecting the menu item of the corresponding name. When a resource is added to one of these lists, it moves from the Free list. When a resource is removed from one of these lists, it goes back the Free list.

Types of resources, such as Fast Write resources and RAID 5 arrays can be listed by selecting the menu of the corresponding name. Arrays (and new Fast Write Resources) can be created by adding to this list. Existing resources can be modified, or deleted from list.

Therefore, you can list resources based upon their current use, or based upon what they actually are (disk, array, and so on). The System Resources list shows disk drives, arrays, disk drives with Fast Write, arrays with Fast Write, and so on. If you list RAID 5 arrays, you'll see RAID 5 arrays, some of which are System Resources, some of which are Free.

Non-volatile RAM is used to maintain a record of parity updates in progress on the array components. When the adapter first initializes, it examines the non-volatile RAM. If it identifies records which indicate that some parity is out of date (probably due to a write operation being interrupted for some reason) then the adapter will begin a process to repair the parity across the whole array.

Concurrent Diagnostics is a level of SSA subsystem diagnostics which can be run without having to stop I/O to the SSA disk drives.

Non-concurrent Diagnostics is a more detailed diagnostic that involves stopping I/O to all SSA disk and resetting the SSA adapters. This function requires that you confirm a quiescent system before proceeding.

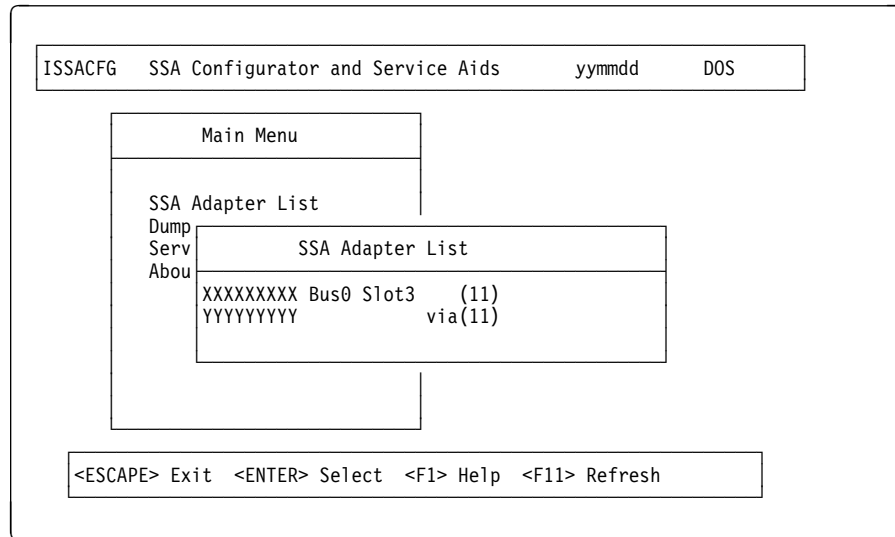
The adapter's Vital Product Data (VPD) can be examined, allowing you to check the level and type of firmware installed on the adapter.

Service Aids displays the list of SSA devices attached to each SSA port of the adapter card. The position of a resource in the list represents its physical position within 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**. A window opens containing a list of the SSA adapters.



This is 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.
- Operating Status (IBM SSA RAID Cluster adapter)** Whether it is the Primary.

Actions available on this screen are:

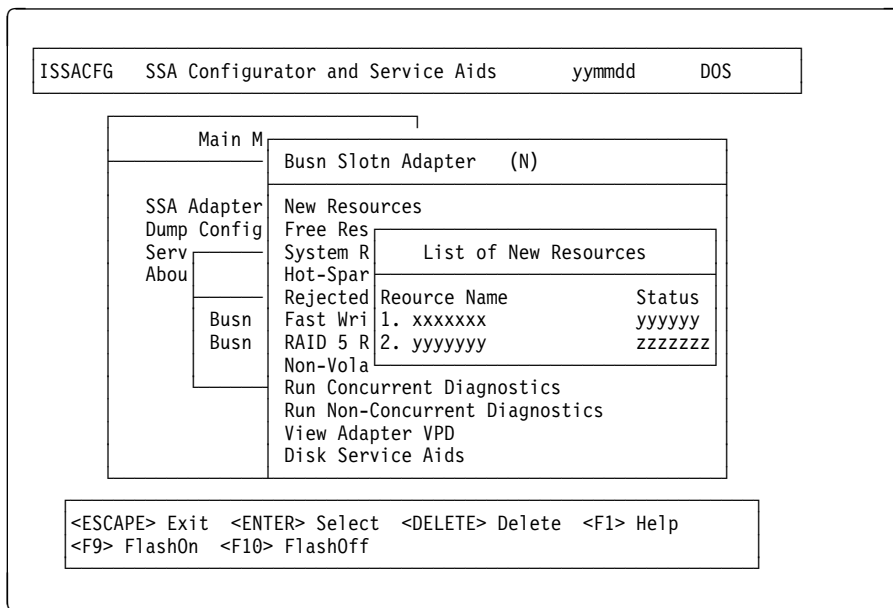
- Enter** Selects the adapter at the cursor position. After selection a menu of options is displayed.
- F2 (IBM SSA RAID Cluster adapter)** Set the highlighted adapter as Primary.
- F11** Refreshes the current menu screen.

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

2. In this list, press Enter to select one of the adapters which control the resources. The Adapter Resources menu appears.

3. Select **New Resources**.

A window opens containing a list of all the resources not previously used on this type of adapter:



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 not supported on this adapter, the word 'Preconfigured' is displayed at the end of the resource row.

The required resource can be selected using the cursor Up/Down keys.

The actions possible 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 and/or Fast Write resources.

F9 Identifies the resource by continuously flashing the check lights on the disk drives.

F10 Stops the check light flashing on the disk.

F11 Refreshes the current menu screen.

- In this list, for each disk drive that you want to configure into the SSA subsystem, highlight its name and press Delete. This moves the resource from the New

resources list and places it in the Free resources list. At the prompt, confirm the deletion.

You can return to the menu for this adapter by pressing Esc.

You can work with the Free resources list by selecting **Free Resources** from the Adapter Resources menu.

Resources that are in the Free resources list can be used to form arrays; "Managing Arrays" describes how to do this. Alternatively, disk resources can be accessed individually (see "Managing System Resources" on page 3-17).

Also, disk resources can be defined as Hot Spares. "Creating a Hot Spare" on page 4-1 describes how to do this.

Managing Arrays

An array is a composite resource, formed from other resources.

This section describes how to create arrays made from other resources in the SSA subsystem.

For details of how to delete an array from the System resources list, see "Deleting an Array from the System Resources List" on page 4-16.

For details of how to return all the components of an array to the free list, see "Destroying An Array" on page 4-17.

An array can be created and configured to use suitable available Hot Spares if one of its components fails. If you plan to configure any arrays to use Hot Spares, you define one or more Hot Spares. Refer to "Creating a Hot Spare" on page 4-1 for how to do this.

To create an array:

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

The SSA Adapter List window opens.

2. Select the adapter that will control the array, and press Enter.

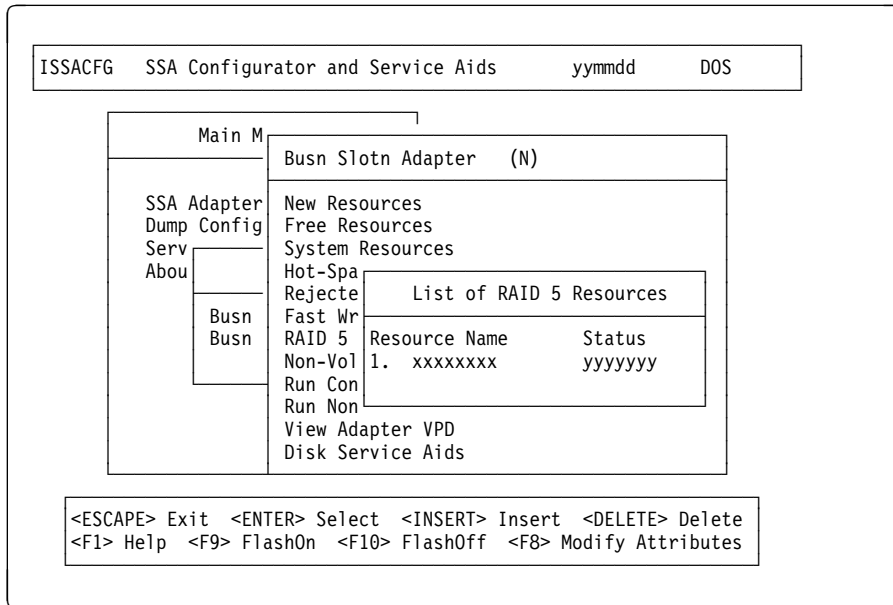
The resources that you define as components of the array must be connected in the same loop.

The Adapter Resources menu window opens:

3. Select **RAID 5 Resources**.

Note: The only level of RAID supported by the IBM SerialRAID Adapter is 5.

A list of RAID 5 arrays already controlled by this adapter appears in a new window (this list will be empty if no arrays have been configured):



The array name was supplied when the array was created.

The operational status of the array can be one of the following:

Online: Good:

All components are present and parity is up to date.

Online: Exposed

One component has been lost and a write operation has not been received since the component loss. Read data can be obtained from the other component. The missing component can be brought back and the array can then be returned to its state before the component was lost.

Online: Degraded

One component has been lost and a write operation has been received since the component loss. The missing component is Rejected from the array.

Online: Rebuilding

Data is being reconstructed from the other components of the array.

Offline

Typically, offline state is due to more than one component being missing, but there can be other causes. There will be entries in the event log from which the cause of the offline state can be determined.

An array can be selected by using the cursor Up/Down keys.

The actions possible 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 resource(s) are put back in the pool of Free Resources. |
| F8 | Enables modification of changeable resource attributes. |
| F9 | Identifies a resource by continuously flashing the check light(s) of all the disk drives which make up the resource. |
| F10 | Stops the check light(s) flashing on all the disk drives that make up the resource. |
| F11 | Refreshes the current menu screen. |

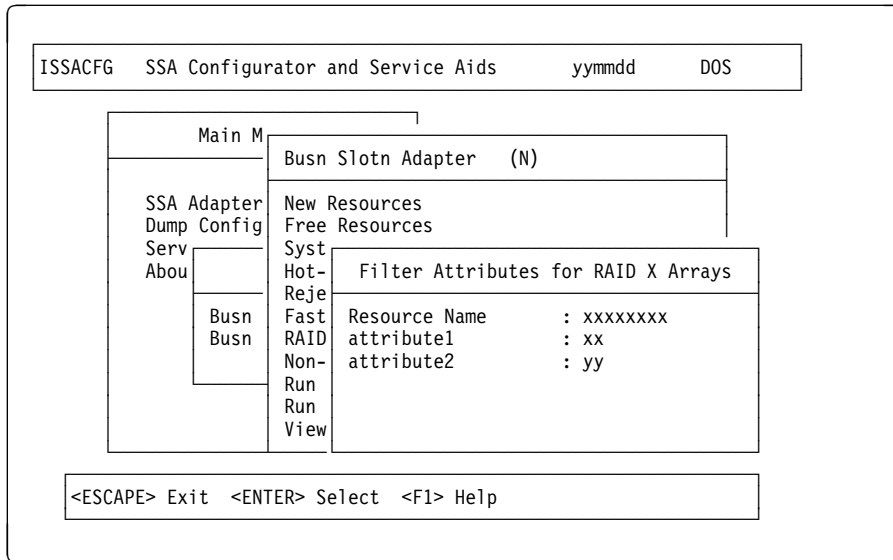
4. Press Insert.

A window opens showing the attributes for a RAID 5 array (for details of the attributes, see "Attributes of RAID 5 Array Resources" on page 4-10).

The actions possible are:

- | | |
|------------|---|
| F9 | Identifies a resource by continuously flashing check lights on the disk drives. An array is identified by continuously flashing the check light on all the components of the array. |
| F10 | Stops the check lights flashing. |
| F11 | Refreshes the current menu screen. |

To view or exchange individual components (if any), select "View Members" (using the cursor control keys) and press Enter.



Type a unique array name (of up to 14 alphanumeric characters) for the new array.

Note on resource names

1. When creating an array or other resource, a unique resource name must be supplied. Although strictly speaking the resource name needs only to be unique on a given adapter for a given resource type, you should supply a name that is unique across all machines in the organization.

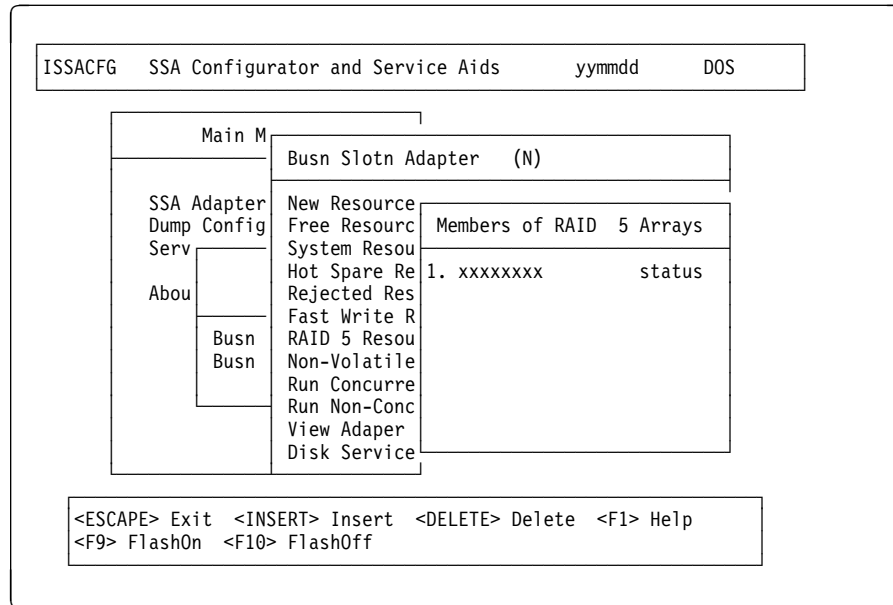
You can make names unique by including the machine name and date of installation in the name. For example, instead of naming a RAID 5 array 'Array1', a better name would be 557A4DBArray1, where 557A4DB is the network name or serial number of the machine containing the adapter that controls the array Array1.

2. The resource name of a disk resource is based on the drive's SSA Unique ID, which is fixed when the drive is manufactured.

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

Note: The DOS Configurator displays a default value for the Network ID field. When configuring for an IBM SerialRAID Adapter, ensure that this value is either 0 (loop A) or 1 (loop B). The configuration programs do not allow disk drives from more than one loop to be selected as components of an array. Therefore, the Network ID field must be the same for all resources in an array.

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



This screen lists each component of the RAID 5 array, giving their Resource Name, and whether they are present within the array (status).

The presence can be on of the following:

Present This array component is detected, by the adapter, as being 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) Array component is present, but needs rebuilding.

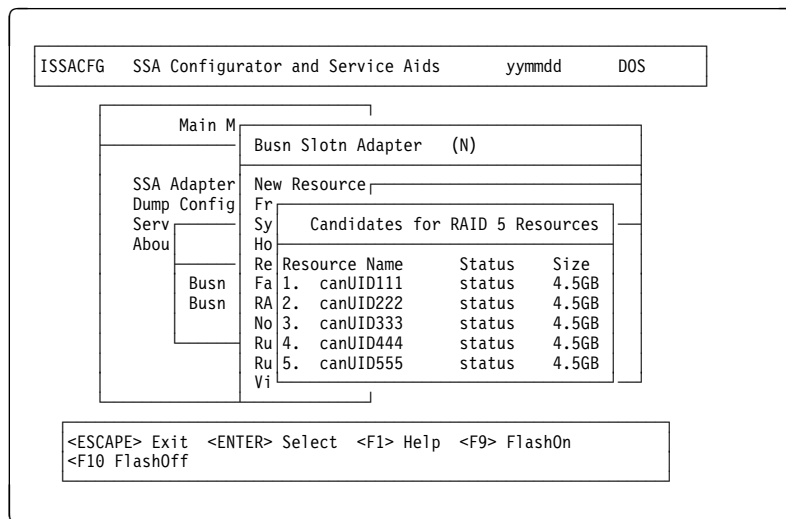
Not present This array component is NOT detected by the adapter as being available for use by the array

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

Not present (DeConfigured) The array deconfigured this component from the array, perhaps due to failure of the component.

Notes:

- a. A RAID 5 array must consist of 3 through 16 components. The DOS Configurator enforces this requirement.
 - b. To delete a component of the array, select the component and press Delete. The component goes into the Free resources list.
 - c. You can also delete the entire array and return it (though not its components) to the free list (see “Deleting an Array from the System Resources List” on page 4-16).
 - d. You can also destroy the array and return all its components to the free list (for details, see “Destroying An Array” on page 4-17).
5. 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:



Notes:

- a. The candidate list is a filtered list of resources that are suitable for making an array with the previously specified attributes. The list is compiled from data returned by the selected adapter.
- b. Not all unused disk drives may be eligible for use in a RAID 5 array.
- c. If any arrays are configured to use Hot Spares, make sure there is a suitable Hot Spare available. If you want an array to use Hot Spares you must configure it to do so, by setting the Hot Spare Enabled attribute, and, optionally, the Hot Spare Exact attribute.

The configuration programs do not perform any validation in this respect; that is, they allow you to configure an array to use Hot Spares even if there are no Hot Spares defined.

- d. If you define an array so that it does not use Hot Spares, you risk a situation in which a component of the array may fail and leave the array in a vulnerable state until manual intervention.
 - e. An array can be a Free resource, but if so it is not a suitable candidate for becoming a component of another array.
6. Select the resource 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 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.
7. When you have selected all the disk drives required, create the array by pressing Esc and following the prompt to confirm the creation of the array.

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 3-17 describes how to add resources to the System resources list.

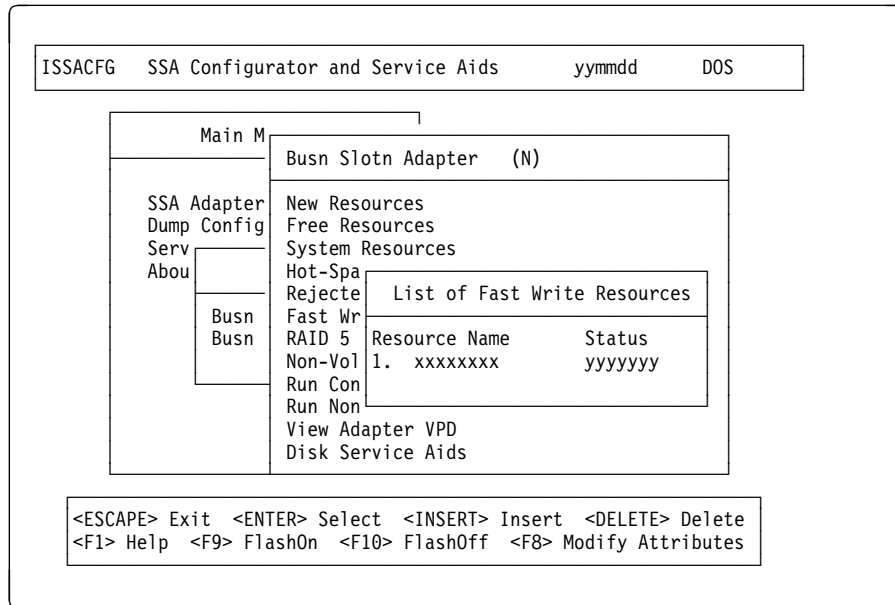
Managing Fast Write Resources

A Fast Write resource is formed from another resource.

This section describes how to create a Fast Write resource from other resources in the SSA subsystem.

To create a Fast Write resource:

1. From the SSA Main menu screen, select **SSA Adapter List**.
The SSA Adapter list window opens.
2. Select the adapter containing the resource that is to form the Fast Write resource.
Note: Only IBM SerialRAID Adapters support Fast Write resources.
3. Select Fast Write Resources



This screen identifies each Fast Write resource with its name and current status. The name was supplied when the Fast Write resource was created.

The actions possible are:

Insert

Delete Delete the resource from the adapter's resources list.

F8 Modify appropriate attributes of the Fast Write resource.

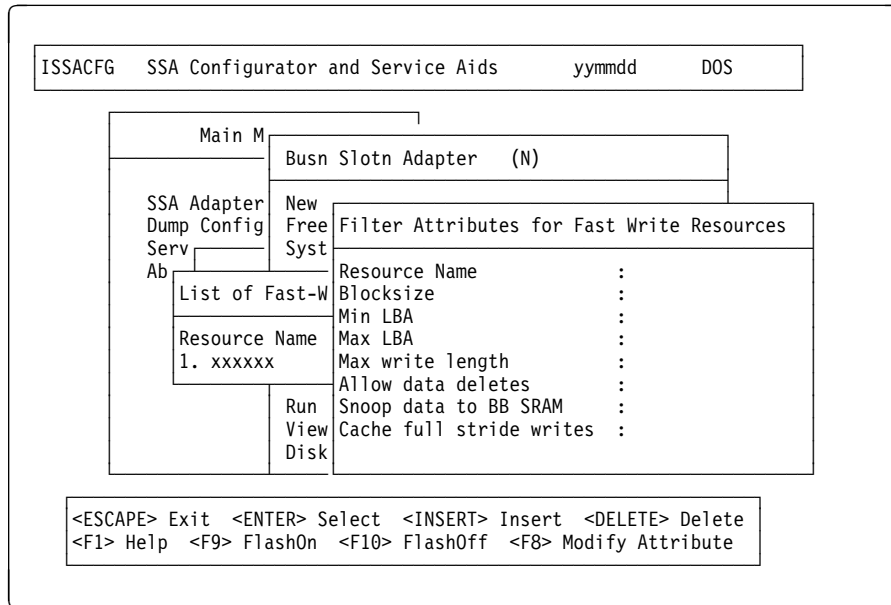
F9 Identifies the associated disk by continuously flashing its check light. An array is identified by continuously flashing the check light on all the components of the array.

F10 Stops the check light flashing on the disk associated with the Fast Write resource.

F11 Refreshes the current menu screen.

View Members A Fast Write resource has only one component.

4. Press Insert. The Filter Attributes for Fast Write Resources screen appears. For details of the attributes, see "Attributes of Fast Write Resources" on page 4-9.



5. Supply a unique name for the new Fast Write resource, and other attributes of the resource that will form the Fast Write resource. For details of the attributes of Fast Write resources, see “Attributes of Fast Write Resources” on page 4-9.
6. Press Enter to display a list of candidate resources that meet the filter criteria.
7. Select the required candidate resource and press Enter.

Managing System Resources

To enable the system to perform input/output operations to a resource, the resource must be placed in the System resources list.

When a resource has been placed in the System resources list of one host in a dual-host system, the resource is automatically in the System resources list of the other host. However, this is not true if the resource is defined as private to one host.

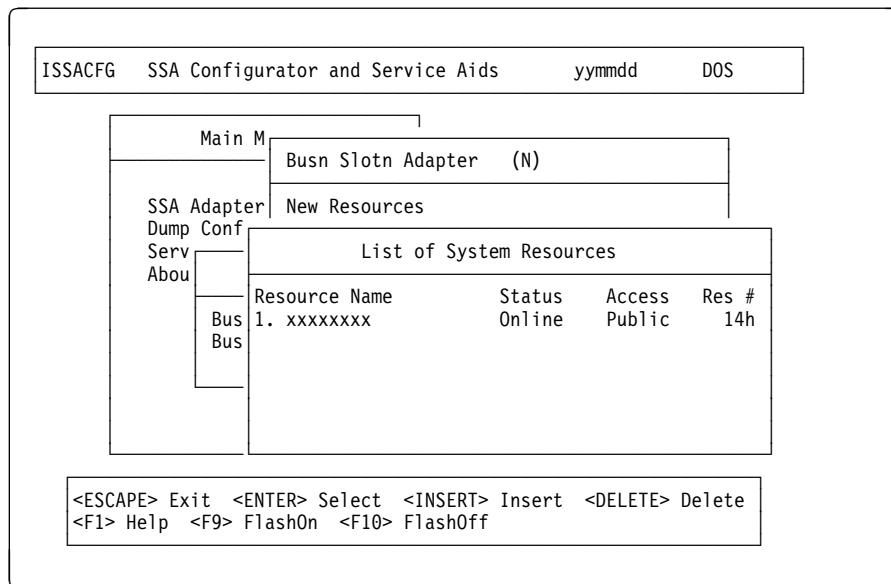
To make a resource into a System resource, from the menu screen for this adapter select **System Resources**. A list, initially blank, of the system resources is displayed.

Each resource is listed with its resource name, the status of the resource and the resource number.

Status can be one of the following:

Online Resource available

Offline Resource 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 order of the resources in the list is the order in which they are presented to the operating system.

Note

If you are setting up an SSA resource on which Windows NT will be installed:

- The resource must be at the top of the System resources list of the first SSA adapter found by the operating system at boot time (that is, the SSA adapter installed in the slot with the highest priority within the system).
- The access mode of the disk drive must be *local* to the system that you are booting (“Viewing and Changing Disk Access Modes” on page 4-12 describes disk drive access modes and how to set them).

For other details of the requirements for booting from an SSA disk drive, refer to the README.TXT file on the Windows NT diskette.

At the position in the list that you choose for the new resource, there must be a large enough gap in the sequence of resource numbers.

Possible actions for the selected system resource are:

- | | |
|---------------|--|
| Enter | Displays further information about the resource |
| Insert | Adds a resource from the Free resources list into the position immediately before the selected resource in the list. For more details, see "Adding a Resource to the System Resources List." |
| Delete | Removes the selected resource from the System resources list, and puts it in the Free resources list.

You might need to do this if you want to re-order 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 only usable via the selected adapter. Operating system boot resources should be made private. |
| F8 | No Access - Prevent the selected resource being used by any adapter. |
| F9 | Identifies a disk by continuously flashing its check light. An array is identified by continuously flashing the check lights on all the components of the array. |
| F10 | Stops the check light(s) flashing on the resource. |
| F11 | Refreshes the current menu screen. |

The Public/Private/No Access privacy designations only apply to adapters which 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 and the IBM SerialRAID Adapter.

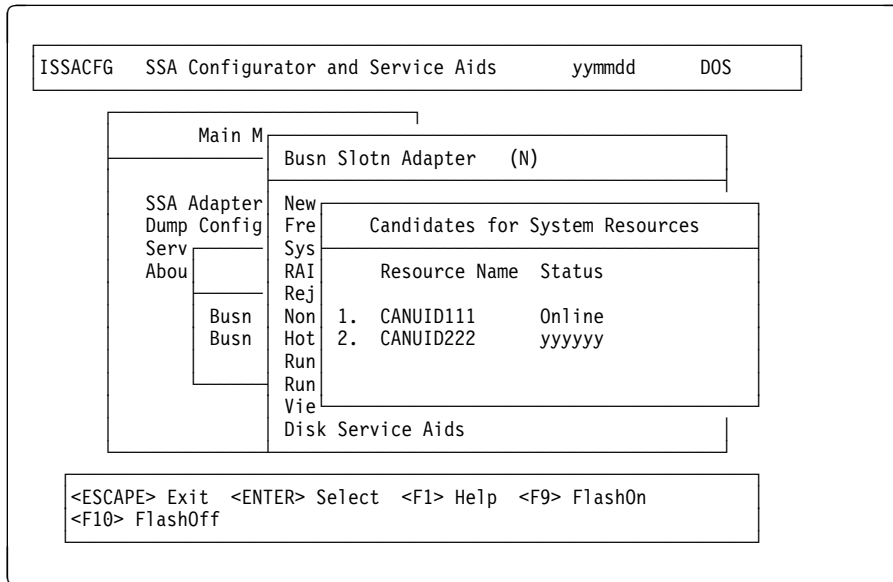
Adding a Resource to the System Resources List

1. On the System resources list, press Insert.

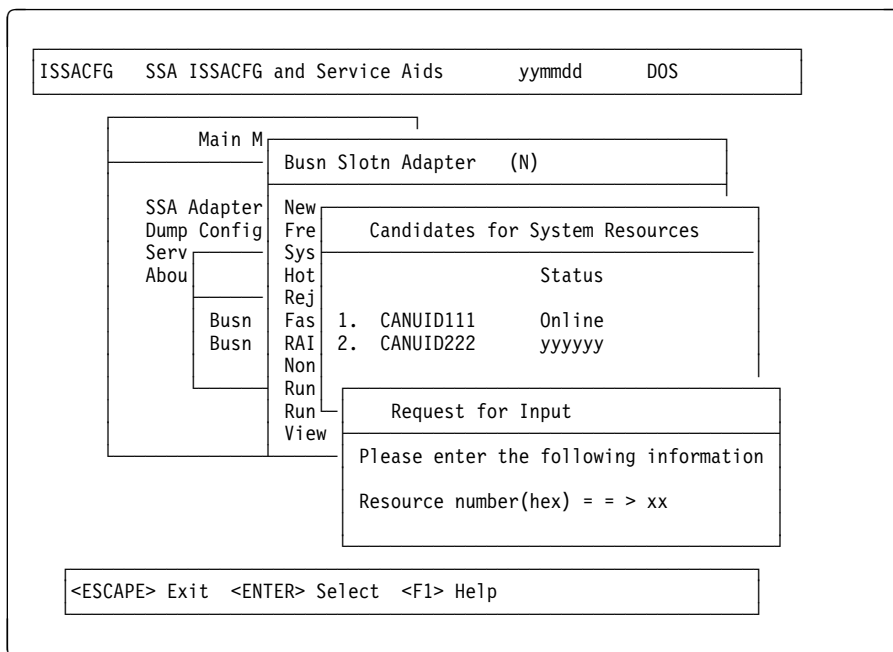
To add a resource to the list, highlight the name of a resource already in the list and press Insert. The new resource will be added immediately above this one if there is a suitable gap in the numbering.

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:



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



The resource number assigned for the new resource is shown.

You can enter a specific resource number or accept the default number. You change the resource number by overtyping it. (Appendix A, "Resource Numbers" on page A-1 describes resource numbers and how they are allocated.)

3. Press Enter.

The List of System Resources window reappears, showing the new resource just added, 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 to be added to the list.
5. Reboot the system to configure the new resources into the system.
6. Use facilities in the operating system (for example, FDISK in DOS, or Disk Administrator in Windows NT) to assign logical partitions and drive letters to the new resources.

Managing Rejected Resources

To re-use a Rejected resource:

1. Select **Rejected Resources** from the Adapter Resources menu.

Each Rejected resource is listed with its resource name, and its current status.

Note: Use the Certify function in the Disk Service Aids to make sure the rejected resource was not rejected because of a hardware problem before deciding to re-use it.

2. Select a specific Rejected resource using the Up/Down keys, then perform one of the following actions:

Enter	Displays more information about the array.
Delete	Deletes the selected Rejected Resource from the Rejected Resource list. The resource enters the Free resources list.
F9	Identifies the resource by continuously flashing its check light(s).
F10	Stops the check light(s) flashing on the resource.
F11	Refreshes the current menu screen.

Deleting Resources

The action taken when you delete a resource depends on:

- The type of the resource
- Its current usage
- The menu command used.

For example, you may want to delete a System disk resource that is configured as Fast Write. If you use the Fast Write menu to delete the disk resource, this will *also* mean that the disk resource is no longer a System resource, with unpredictable consequences for any data in the Fast Write cache. The recommended procedure is:

1. Use Delete on the System resources menu to delete the disk resource from the System resources list and return it to the Free resources list.
2. Use Delete on the Fast Write resources menu to remove the Fast Write function from the disk resource.

The following is a guide to dealing with other scenarios where you may want to delete resources.

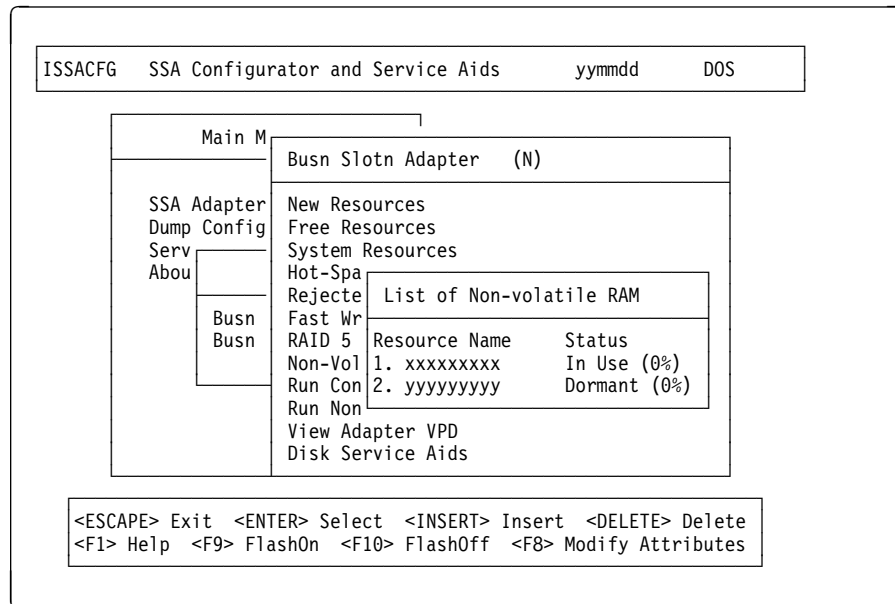
Resource to be deleted	What to do
System RAID 5	<ol style="list-style-type: none">1. Use Delete on the System resources menu to delete the RAID 5 resource from the System resources list.2. Use Delete on the RAID 5 resources menu to destroy the array and return its components to the Free resources list.
Fast Write RAID 5	<ol style="list-style-type: none">1. Use Delete on the Fast Write resources menu to remove the Fast Write function from the RAID 5 resource.2. Use Delete on the RAID 5 resources menu to destroy the array and return its components to the Free resources list.
System Fast Write RAID 5	<ol style="list-style-type: none">1. Use Delete on the System resources menu to remove the array from the System resources list, and return the array to the Free resources list.2. Use Delete on the Fast Write resources menu to remove the Fast Write function from the RAID 5 resource.3. Use Delete on the RAID 5 resources menu to destroy the array and return its components to the Free resources list.
Fast Write disk	Use Delete on the Fast Write resources menu to remove the Fast Write function from the disk resource.
System disk	Use Delete on the System resources menu to return the disk resource to the Free resources list.
Hot Spare	Use Delete on the Hot Spare resources list to return the Hot Spare to the Free resources list.

Important! When you delete a Fast Write resource (RAID 5 array or single disk resource) from the System resources list, any data in the Fast Write cache is de-staged to the destination disk drives. Therefore, when you want to move the disk drives that make up a Fast Write RAID 5 array from one adapter to another, delete the array from the System resources list (if it is a System resource) *before* you move the physical drives. This ensures that data for the disks is de-staged from the adapter's Fast Write cache to the disk drives before you move them.

Managing Non-Volatile RAM

Non-Volatile RAM (NVRAM) is used by the adapter's array management software to store information about parity updates for arrays. To delete dormant NVRAM entries (see page 3-2) and free them for subsequent re-use:

1. Select **Non-Volatile RAM** from the Adapter resources menu. The following menu appears.



Each item on the menu is an NVRAM entry. The Resource Name is that of the array that has the entry assigned to it. The status is either:

- In Use
- Dormant.

Note: The percentage shown is the proportion of the entry that is currently being used for I/O. A dormant entry always shows a percentage figure of zero. An entry shown as In Use shows a non-zero percentage figure to indicate that the entry is currently being used by the array.

2. Select the dormant entry to be deleted and press Delete. If you select an entry that is In Use and press Delete, this generates an error.

Chapter 4. Performing Other Configuration Tasks

This chapter describes the following common uses of the DOS Configurator.

- Defining a Hot Spare (this page)
- Viewing the physical configuration (see page 4-3)
- Viewing resources and their attributes (see page 4-5)
- Changing array attributes (see page 4-11)
- Viewing and changing disk resource access modes (see page 4-12)
- Exchanging a component of an array (see page 4-13)
- Deleting an array (see page 4-16).

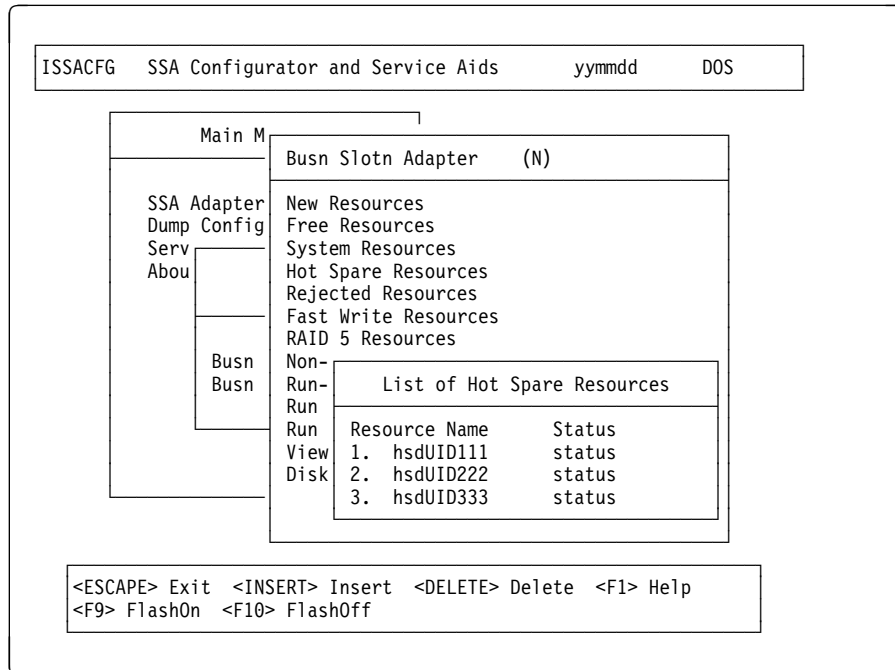
Note: If, after a configuration, a resource is not visible through Windows NT Disk Administrator, restart the server.

Creating a Hot Spare

A Hot Spare is a resource that the system can automatically use in place of a defective array component. A resource that is currently in the Free resources list can be made a Hot Spare, but it must be on the same loop as any array that may use it. To define a resource as a Hot Spare:

1. From the Main Menu screen, select **SSA Adapter List**.
2. The SSA Adapter List window opens:
3. Select the adapter to which the resource that is to be the Hot Spare is attached. The Hot Spare can be used only by arrays defined on that adapter. The Adapter Resources menu window opens.
4. Select **Hot Spare Resources**. A list of the Hot Spares controlled by the adapter is displayed.

Note: The list might not contain any Hot Spares.



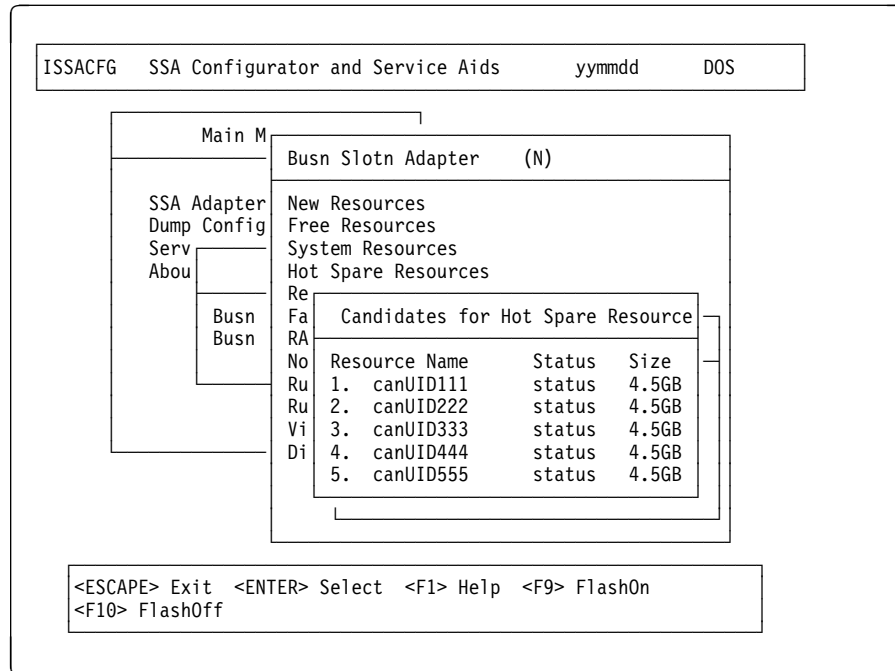
Each Hot Spare resource is listed with its Resource Name and the status (**Online** or **Offline**) of the resource.

A Hot Spare can be used with any array that supports redundancy (that is, RAID 1 and RAID 5).

5. Select the required resource by using the cursor Up/Down keys. The actions possible for the selected resource are:

- Enter** Displays more information about the resource.
- Insert** Creates a Hot Spare resource from the Free resources list and places it in the list. Another screen presents the list of resources that are candidates for a Hot Spare. Select the required resource by using the Cursor Up and Cursor Down keys and pressing Enter.
- Delete** Removes the selected resource from being a Hot Spare and puts it in the Free resources list.
- F9** Identifies a disk by continuously flashing its check light. An array is identified by continuously flashing the check light on all the components of the array.
- F10** Stops the check light flashing on the resource.
- F11** Refreshes the current menu screen.

- Press Insert to add a new entry to the list of Hot Spares. A list of candidate resources is displayed:



- Highlight the entry that is to be added to the list of Hot Spares. The physical drive must be on the same loop as the array it is intended for.

(You can identify the physical drive by putting the cursor on its Resource Name in this list and pressing F9. This causes a light on the disk drive to flash. To stop the light flashing, Press F10.)

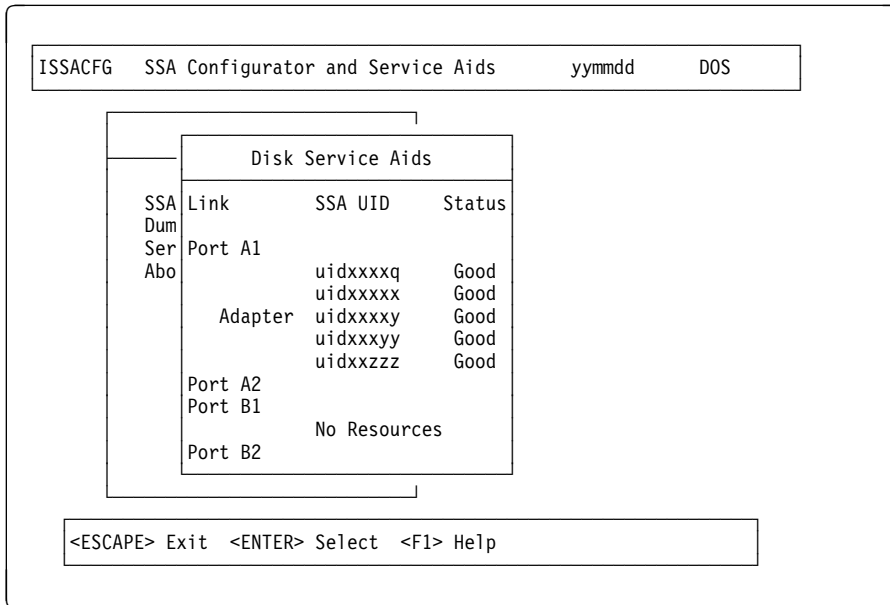
- Press Enter to define this resource as a Hot Spare.

The previous window is displayed with the new Hot Spare added to the list.

Viewing the Physical Configuration

The physical view of SSA subsystems can be useful for detecting any breaks in the links and for determining where other adapters are located in the network.

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



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

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

Viewing Resources and Their Attributes

From the SSA Main Menu, select SSA Adapter List, the adapter, and any resource list, for example the System resources list. The following window opens:

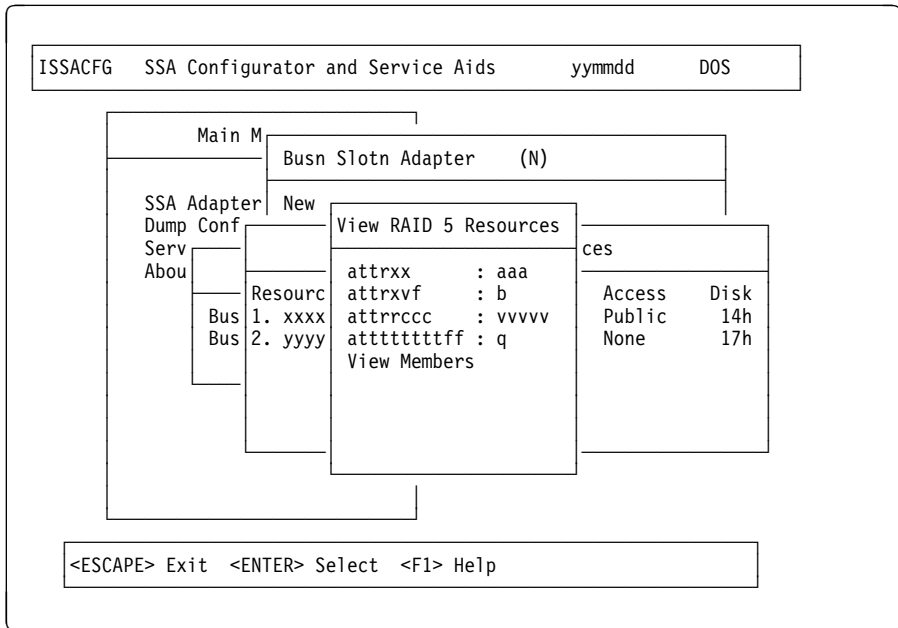
The screenshot shows a multi-level menu structure. At the top is a header box: ISSACFG SSA Configurator and Service Aids yymmdd DOS. Below it is a 'Main M' menu with options: Busn Slotn Adapter (N), SSA Adapter, Dump Conf, Serv, and Abou. The 'SSA Adapter' option is selected, leading to a 'New Resources' window. Within this window, the 'List of System Resources' window is open, displaying a table of resources. Below the table is a legend for function keys.

Resource Name	Status	Access	Res #
1. xxxxxxxx	Online	Private	14h
2. yyyyyyyy	Online	Public	17h

<ESCAPE> Exit <ENTER> Select <INSERT> Insert <DELETE> Delete
<F1> Help <F6> Public <F7> Private <F8> NoAccess
<F9> FlashOn <F10> FlashOff

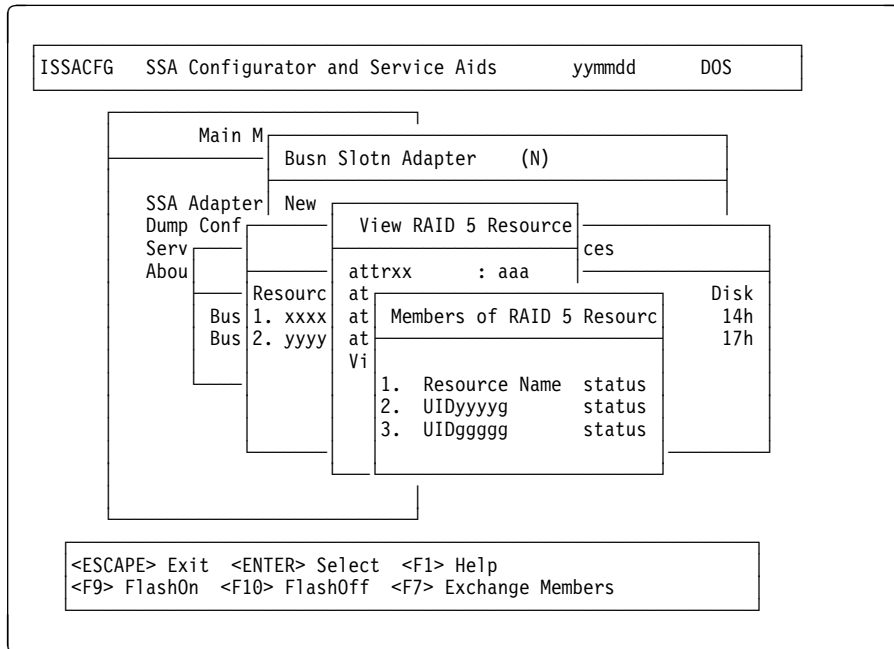
Select the resource you want to view.

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

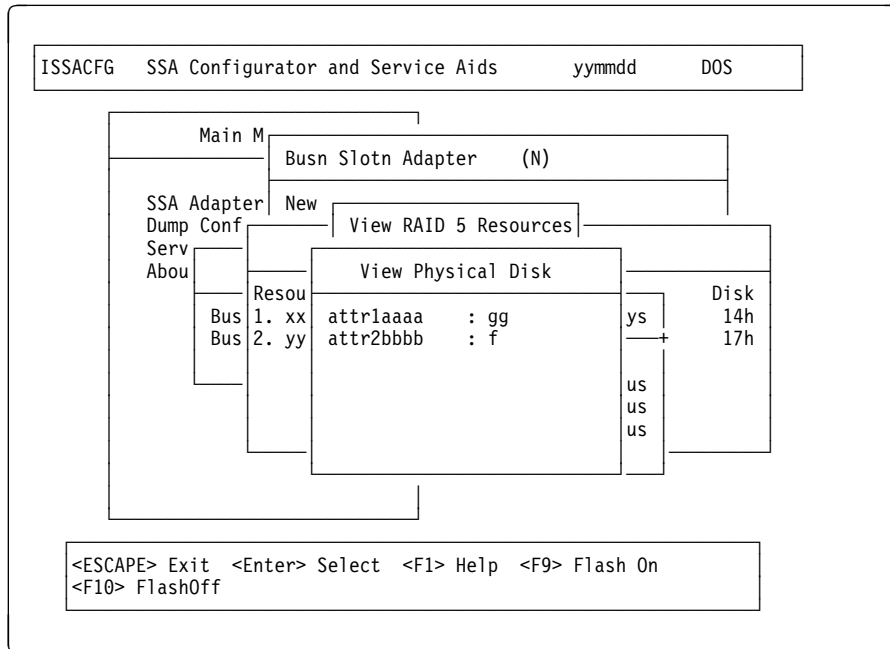


For further details of the attributes, see “Changing Array Attributes” on page 4-11.

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



If you select an item from this list, a new window opens showing the attributes of that component. For a description of the attributes of individual disk resources, see "Attributes of Disk Resources" on page 4-8.



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

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

Attributes of Disk Resources

Attributes of disk resources are:

Resource Name

The resource name is based on the SSA unique ID of the drive.

Status

Either **Online** or **Offline**.

Capacity

The capacity of this particular disk.

Blocksize

Data block size.

Drive Serial Number

The serial number of this disk drive.

Resource Number

The resource number is used by the operating system to address the disk.

Vendor ID

Disk manufacturer (for example, IBM OEM).

Product ID An ASCII field, where the first four characters define the product type; for example:

DFHC for IBM Ultrastar XP
DCHC for IBM Ultrastar 2XP
DGHC for IBM Ultrastar 3XP.

Revision Level IBM Product only. Indicates the revision level of the disk microcode.

Date of Manufacture

IBM Product only. Indicates the date on which the disk drive was manufactured in <yy><mm><dd> format.

Servo Microcode

IBM Product only. Indicates the level of servo microcode which is installed on the disk drive.

Attributes of Fast Write Resources

The attributes of a Fast Write resource are:

Resource Name

The resource name of the Fast Write resource.

Status

The status can be one of the following:

Online: Good: Component is present.

Offline: Wrong Cache:

Out of sync, data not in this card.

Inaccessible Cannot get to the cache.

Data Loss Unrecoverable error, cannot determine failing disk or LBA on the disk.

No. of Members

A Fast Write resource has only one component.

Capacity

Total capacity of this resource

Blocksize

Data block size, that is, 512

Min LBA

LBAs between the Min and Max LBA values

Max LBA

may be cached in the non-volatile Fast Write cache module.

Max write length

Writes larger than the given number of blocks are not cached.

Allow data deletes

If there is yet-to-be-written data in the non-volatile fast write cache module, attempts to delete the Fast Write resource will fail. Enabling this flag overrides this safety feature and allows the deletion to occur.

Snoop data to BB SRAM

Normally set to '1', meaning data is to be transferred to battery backed non-volatile memory, thus avoiding data loss upon power failure. If set to '0' data is only transferred into volatile adapter memory, and is lost upon power failure.

Cache full stride writes

If set to '1', the Fast Write resource caches 'full stride writes'.

Attributes of RAID 5 Array Resources

Attributes of RAID 5 arrays are:

Number of components

The number of components that make up this array.

Capacity

Total capacity of this array.

Blocksize

Data block size, that is, 512.

Strip Size

The number of data blocks stored on one component of an array before switching to another component for the following sequential data. The strip size can be 8, 16, 32, 64, or 128 blocks.

Stretch size

The number of strips that are written to each drive before the parity is moved to another component. Rotating the parity every N strips, rather than every strip, improves performance during rebuild. (N=4 by default.)

Hot Spare Enabled

When enabled (set to 1), the array can use an available Hot Spare if it moves to a Degraded state.

To enable an array to automatically use a Hot Spare:

- Ensure a suitable Hot Spare is available.
- Enable the array to use Hot Spares by setting either the Hot Spare Enabled attribute, and, if required, the Hot Spare Exact attribute.

Hot Spare Exact

When disabled (set to 0), the array can use a Hot Spare disk of any size equal to or greater than the smallest component of the array. When enabled (set to 1), only disk drives that are no more than 10% bigger can be used.

Unbuilt Parity Strips

Indicates the number of parity strips which have yet to be rebuilt.

Unbuilt Data Strips

If a component of an array has been replaced then this information field will indicate the number of strips on this component which still require to be reconstructed as part of the rebuild process.

Invalid Array Strips

The number of strips which cannot be read. This field should normally indicate 0.

Network ID

Indicates upon which SSA loop (0=A, 1=B) the components of the array are connected.

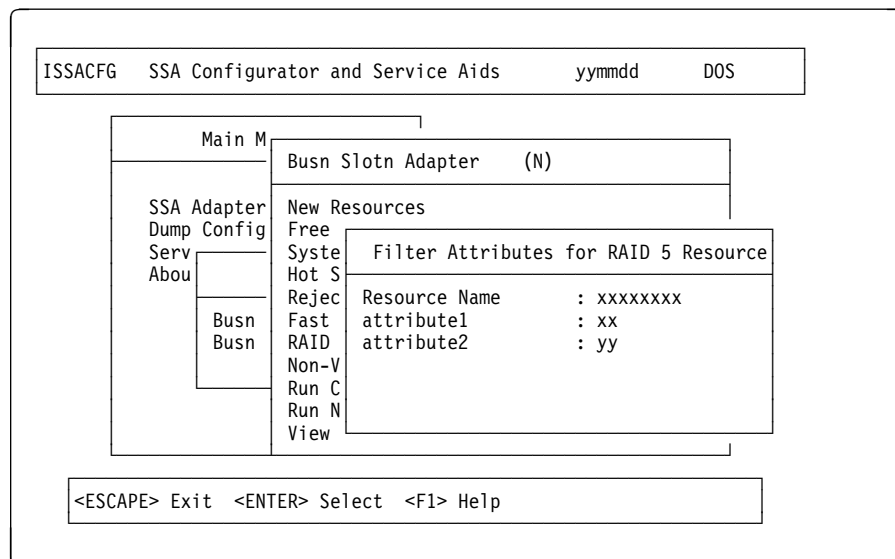
The IBM SerialRAID Adapter requires that all components of a RAID array are on the same SSA network, and this adapter reports a Network ID. Earlier adapters allow components to be split across loops, and won't show the Network ID field.

Having all components on the same SSA loop is required so that the adapter can operate correctly where two adapters access the same array.

Changing Array Attributes

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

1. From the SSA Main Menu, select **SSA Adapter List**. The SSA Adapter List window opens:
2. Select the adapter that controls the array. The Adapter Resources menu window opens.
3. Select **RAID 5 Resources**. A list of all the RAID 5 resources controlled by the adapter appears in a new window. The list includes arrays in the Free resources list **and** arrays in the System resources list.
4. Highlight the array whose attributes you want to change, and press F8. A window opens showing the attributes for the array selected:



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

5. Press Enter to set each attribute in turn.

Viewing and Changing Disk Access Modes

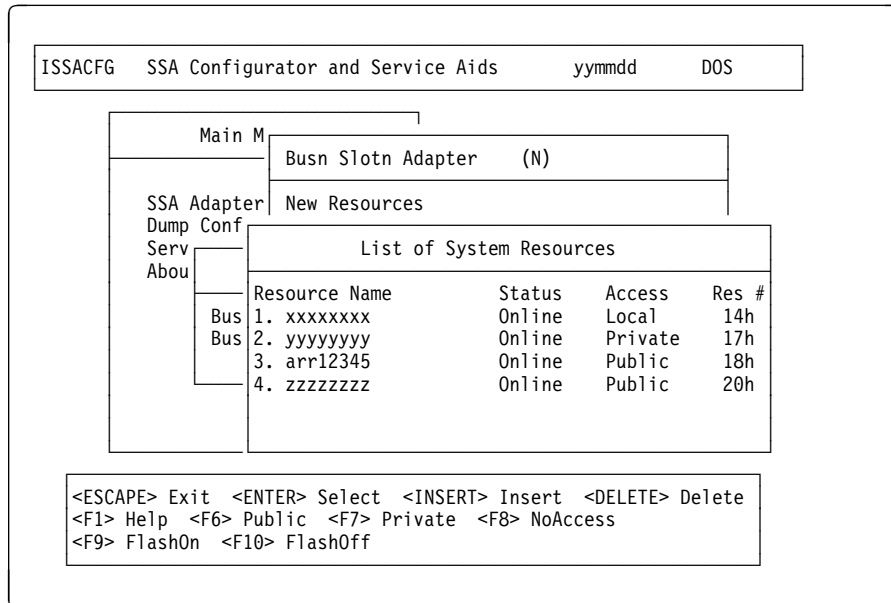
An individual system resource has one of four access modes:

Public	The disk drive can be accessed through both adapters in the cluster.
Local	The disk drive can be accessed only through the adapter that you have selected from the SSA Adapter List menu. Note: If you want to boot from an SSA disk, the access mode of the boot disk must be Local when you view the resources through the adapter that is installed in the system that you want to boot.
Private	The disk drive cannot be accessed through the adapter that you have selected from the SSA Adapter List menu. The disk drive can be accessed only through the other adapter in the cluster.
No Access	The disk drive cannot be accessed through either adapter in the cluster.

The default access mode is Public.

To view and change the access modes of individual system disk resources:

1. From the SSA Main Menu, select **SSA Adapter List**,
2. Select the adapter through which you want to view the resources
3. Select **System Resources**. A window like the following opens:



In this example, resource 1 is a disk resource that can be accessed only by the adapter that you selected in step 2 on page 4-12. Resource 2 is a disk resource that can be accessed only by the other adapter in the same cluster. Resource 3 is an array and resource 4 is a disk, both of which can be accessed by either adapter.

To change the access mode of a disk resource, highlight it in the list and press F6, F7, or F8 as appropriate. Pressing F7 To change the access mode to Local, when viewed through the current adapter of a dual-host system; it appears as Private when viewed through the other adapter.

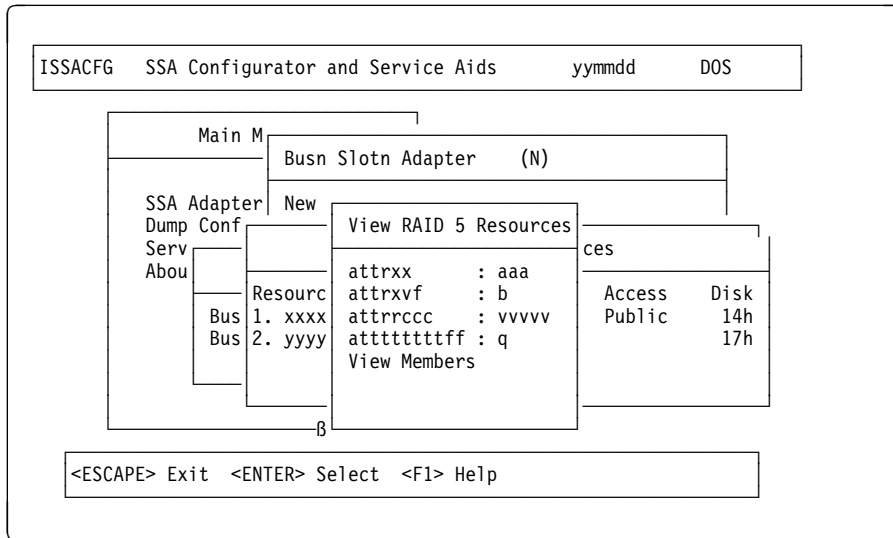
You must use this facility if you want to boot from an SSA resource. When you view the resource through the adapter that is installed in the system that you want to boot, the access mode of the boot disk must be Local.

Exchanging a Component of An Array

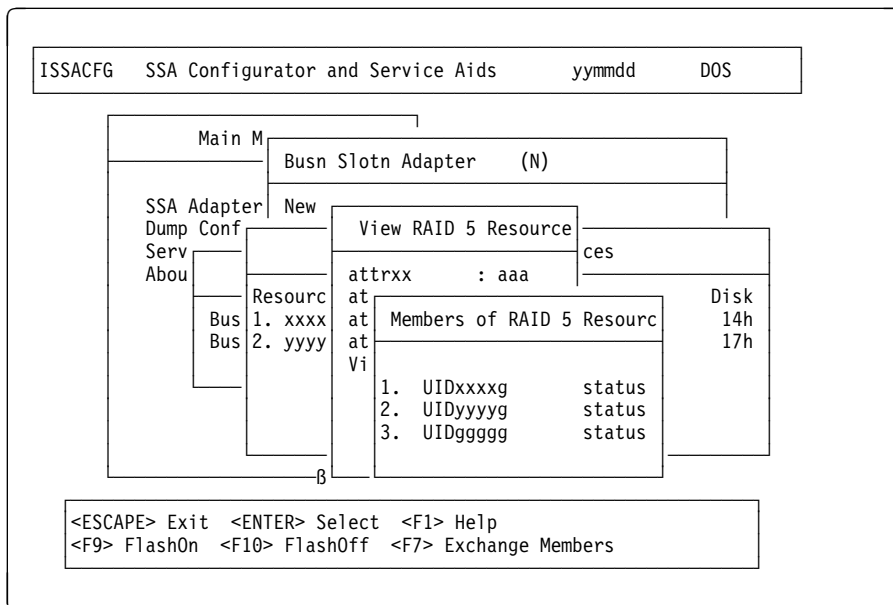
Exchanging a component of an array means altering the definition of the array so that one resource is replaced in the definition by another resource. The physical positions of the resources are not affected.

To replace a component of an array by another resource:

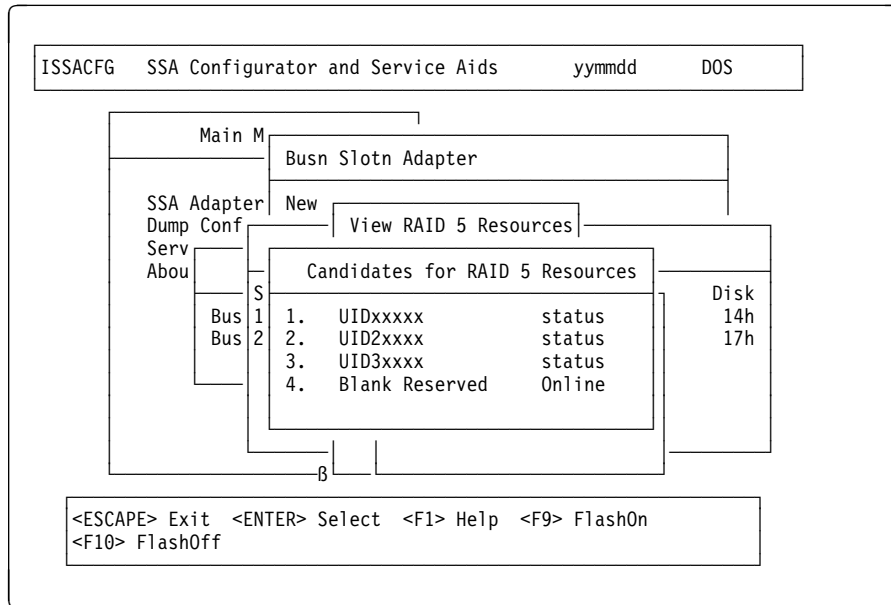
1. From the SSA Main Menu, select SSA Adapter List, then the adapter that controls the array. Select, from any appropriate resources list (for example, the System resources list), the array in which you want to exchange a component. A window opens showing the attributes of the array:



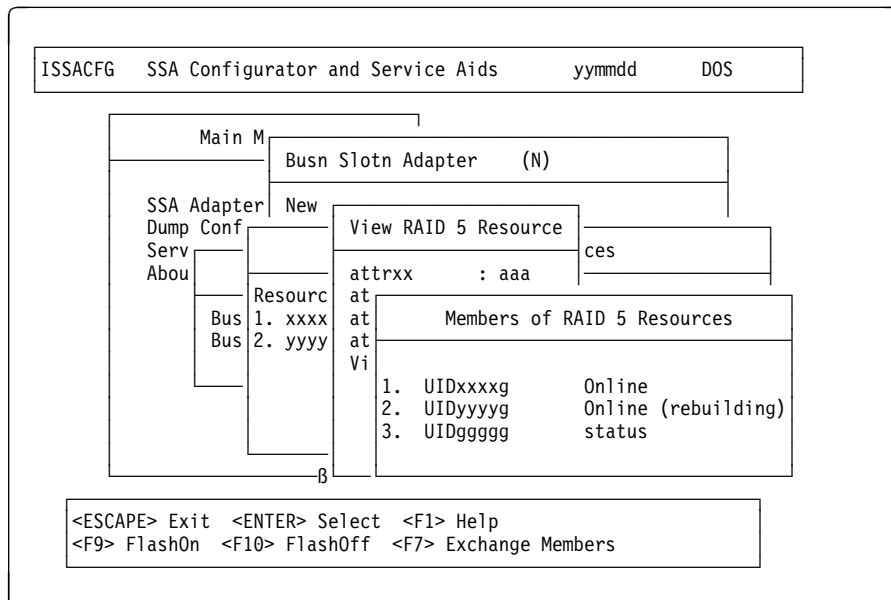
- Use the arrow keys to scroll to the last item in the list, **View Members**, and press Enter. A window opens showing a list of the components of the array:



- Select the component that you want to exchange and press F7. A window opens showing the free, resources (on the appropriate loop) that are candidates for exchange:



- Select from this list the resource that you want to become the new component of the array. The window closes. The previous window now shows the new component, with the status 'Rebuilding' while the adapter rebuilds the data onto the resource from the rest of the array.



The old component is returned to the Free resources list.

Deleting an Array from the System Resources List

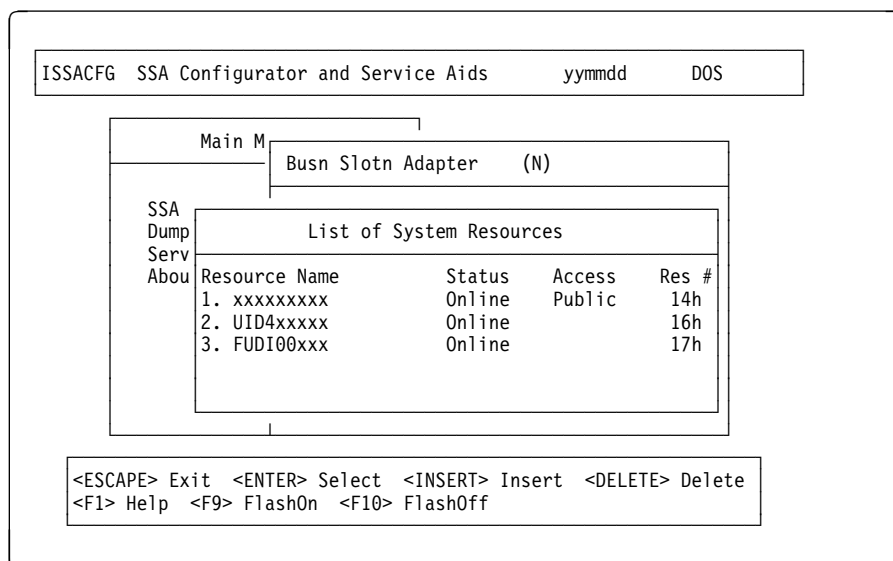
When you delete an array from the System resources list, the array resource is no longer known to the operating system.

Note: *Deleting* an array from the System resources list merely returns the array to the Free resources list (it does not destroy the array). You can *destroy* the array by deleting it from the list of RAID 5 resources, and returning its components to the Free resources list. See “Destroying An Array” on page 4-17 for details.

Important. Before deleting an array, delete from the operating system any partition definitions on the array resource. Otherwise old invalid partition data in the operating system can cause unexpected results.

To delete an array from the System resources list:

1. From the Main Menu, select **SSA Adapter List** and an adapter that controls the array. The Adapter resources menu window opens.
2. Select **System Resources**. A window opens showing the list of all resources currently defined to the system:



3. Highlight the entry for the array that you want to delete from the System resources list, make a note of its array name, press Delete, and confirm the deletion at the prompt.

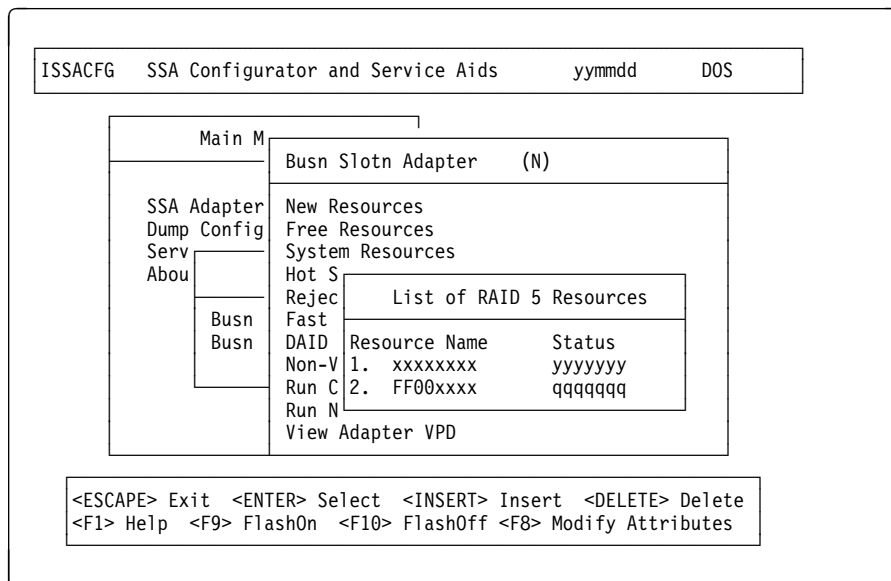
The Adapter resources menu window reopens.

Destroying An Array

To destroy an array (that is, return its components to the Free resources list):

1. Select **RAID 5 Resources** from the Adapter resources menu. You can scroll the contents of the window by using the arrow keys. A list of the RAID 5 arrays controlled by this adapter appears in a new window.

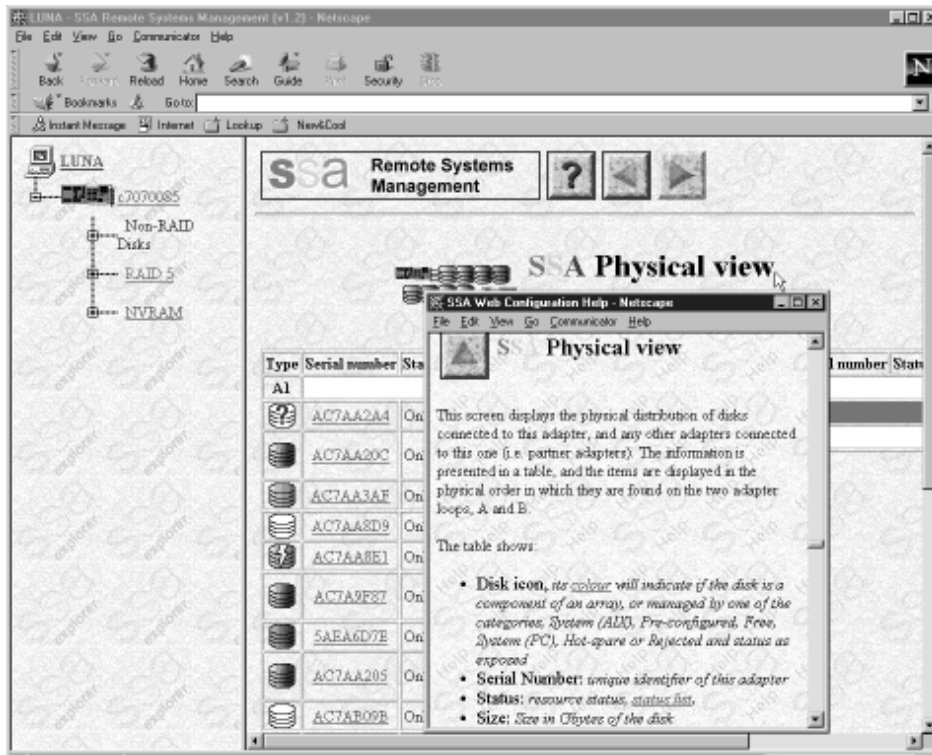
The list includes arrays in the Free resources list **and** arrays in the System resources list.



2. Put the cursor against the array to be deleted, press Delete, and confirm the deletion at the prompt. The components of the array are returned to the Free resources list.
3. Shutdown and reboot Windows NT.

Chapter 5. Configuring SSA Resources Using the RSM Configurator

The RSM Configurator is a browser-based tool for configuration of SSA adapters and devices. It enables you to configure SSA devices attached to any IBM SSA RAID adapter that is running the SSA Remote Systems Management Service, locally or remotely, via any of the supported browsers.



SSA Remote Systems Management requires Microsoft NT Server 4.0 (Standard or Enterprise Edition), with networking installed on the server containing the adapter and devices to be configured.

Two versions of the RSM Configurator are supplied :

Stand-Alone version

This version runs as a Windows NT service.

Netfinity version

This version runs as a TME10 Netfinity Web Extension.

To use the Stand-Alone version, TCP/IP networking must be installed. To use the Netfinity version, TME10 Netfinity version 5.0 or 5.1 with Web Manager Services must

be installed and enabled. To use the Stand-Alone version, the target server must be accessible via a TCP/IP connection.

To target the local server, use the server's name or its IP address. If you have installed TCP/IP on a non-networked machine, you can access SSA Remote Systems Management on that machine via the TCP/IP loopback address **127.0.0.1**.

The Netfinity version uses the same network protocols as Netfinity.

Both versions require one of the following browsers:

- Microsoft Internet Explorer 4.0x
- Netscape Navigator 3.xx, or Netscape Communicator 4.0x

The installation diskettes contain a README file for each version, with names as follows:

readmenf.txt For Netfinity

readmesa.txt For the Stand-Alone version.

When installed, the Stand-Alone version runs as the Windows NT service 'SSA Remote System Management', and can be started and stopped by selecting Services in the Control Panel.

The RSM Configurator can be used to perform all the functions of the DOS Configurator.

- Changing failed disk drives
- Defining Hot Spares
- Viewing the logical and physical configuration
- Viewing resources and their attributes
- Changing array attributes
- Viewing and changing disk drive access modes
- Exchanging a component of an array
- Deleting an array

In addition, the following facilities are provided:

Event logging and analysis

Checking the error log and getting help with individual service request numbers (SRNs)

'Check level' function

To download updates of the adapter microcode, disk microcode, the RSM Configurator software, and the Event Logger, as appropriate.

This function does not install the code on the host server; it downloads to a local disk. For more details of how to install the

microcode, see the README file in the \issa directory, or consult the *Maintenance Information* book.

Context-sensitive help

Provides help with the items and functions available on the current page.

Remote configuration

Configuring 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 | At this level, the user can run the RSM Configurator but cannot perform any updates. |
| Config | At this level, 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 Sockets Layer) to implement its security features.

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 used by the Event Logger.
- The type of errors to be reported by error log analysis in the RSM Configurator.

The event log control file (evntctrl.txt) resides in the directory into which the event log has been installed.

SSA event forwarding

The Netfinity version additionally can be configured to route events to the Netfinity Alert Manager. For details, see the relevant section of the file **readmenf.txt** on the installation diskettes.

Specialized views

These are the Logical, Physical, System, and Enclosures views.

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

The Physical view shows resources listed in physical order, 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 System view shows all 'system (PC)' resources (arrays and individual disk drives) in resource number order.

The Enclosures view shows, for 7133 Models D40 and T40 Serial Disk Systems, any enclosures and their individual components (for example, controllers, bypass cards, fans, power supply units), and enables configuration of these individual components. For details, consult the information provided with the enclosure.

Checking the error log and getting help with individual SRNs

When viewing the Event Log via the Analysis page, clicking on a service request number provides access to help information about the SRN.

For details of the SRNs, see the *Maintenance Information* book.

Installing the RSM Configurator

Both versions of the RSM Configurator are supplied on the two diskettes provided with the adapter. To install the RSM Configurator:

1. Study the README file for the version of the RSM Configurator you will be installing.

This file is also presented at the end of the installation process; for the Stand-Alone version, you should pay particular attention to the section about security.

2. Run the setup program, and select the version (either Stand-Alone version or Netfinity version) when prompted.

Both versions of the RSM Configurator (and updates to them) can also be downloaded as a single self-extracting executable 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 diskettes.

Using the RSM Configurator

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

The Stand-Alone version defaults to use port 511 on the target server. For information about changing the port number for the Stand-Alone version, see the 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, Physical, and Enclosures views. 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.



Figure 5-1. The RSM Configurator

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

The areas (see Figure 5-1) of the dual-pane view are:

1 The Explorer.

The Explorer view is a hierarchical tree view showing the adapters, and the devices attached to the adapters. Clicking on an item in the Explorer view expands the item in that view (if appropriate) and also displays. In the right-hand pane, logical or physical details of an item are displayed when a resource name or resource type is selected.

2 Navigation area.

The RSM banner returns you to the Adapter List page. The Help button displays the help information for the RSM Configurator, relevant to the current page.

The Back button, when active, returns to the previously visited page.

3 Details and forms section for the current resource or adapter. This section also reflects the results of any actions initiated by pressing any of the buttons in the

Actions section. Any messages (information, errors, or warnings) are displayed in an area at the top of this section.

'Check Code level' is a link to the IBM SSA Customer Support home page.

4 The Actions section dynamically changes to reflect the contents of the current page.

The color of certain items in the RSM Configurator indicates the use of the relevant resource, as follows:

White	The resource is a Preconfigured resource, or a System (AIX) resource (that is, in the DOS Configurator, it appears in the New resources list).
Blue	The resource is a Free resource.
Green	The resource is a System (PC) resource: the resource is available to the operating system (that is, in the DOS Configurator, it appears in the System resources list).
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 (disk icon)	The disk resource is visible to the current adapter, but is not controlled by it.

A tutorial guide to the RSM Configurator covering its uses and containing a number of sample configurations, is supplied. To view this guide, open your browser at:

`http://<machine_name>:511/tutorial.htm`

or

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

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

A set of help pages is also included, covering topics such as update facilities and using 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/ssaindex.htm`

You can also access this index page by clicking Start-->SSA Tools.

Chapter 6. Dealing with Disk Problems and Array Problems

This chapter:

- Provides general guidance on solving basic problems with SSA subsystem.
- Describes how to get detailed information about errors and other events on the adapter and the disk drives attached to it.
- Describes the actions you must perform with the adapter utility programs when changing a disk drive.

Basic Problems

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

- Is CMOS setup required to enable PCI bus parameters?
- Is the adapter installed in a bus-master PCI slot?
- Are all the cables connected correctly?
- Does the configuration follow the SSA rules for this adapter?

If the system cannot access the SSA resources, check the following:

- Is power turned on to the disk drives?
- Has the configuration utility been run for all the required disk drives, and do they appear in the System resources list?
- Are the disk drives connected in a valid loop or string? "Rules for SSA Loops" on page 1-5 describes the rules for SSA loops.
- Is the light next to the adapter-loop ports on, showing that both ports (if you have two loops or strings) are operational?

If the system fails to boot from an SSA device, ensure that:

- There is **not** an IDE disk drive installed
- There is **not** another SCSI adapter with BIOS enabled installed in a higher-priority PCI slot than the SSA adapter
- The CBIOS of the adapter is enabled
- The SSA device drivers are loaded before any SCSI device drivers. If you need further assistance with this task, consult your IBM Service Representative.
- The resource number of the resource containing the partition from which you are trying to boot has not changed.

Using the Event Logger

The RSM Configurator (not the DOS Configurator) provides event logging. The Event Logger is supplied with the IBM SerialRAID Adapter, and runs as a service in Windows NT. Its service name is 'PC SSA Event Logger'. It can be started and stopped using the Service Manager in Windows NT. It reports events related to the operation of devices managed by the adapter in the local server.

To view the information collected by the Event Logger, use the facilities in the RSM Configurator.

The SSA Event Logger uses a binary file to store the events received from the adapters. The file wraps after a specified number 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 and can be modified by the user of the RSM Configurator.

Instructions for tailoring the control file are contained in a comment header at the beginning of the control file itself.

Note: After a modification of the SSA Event Logger control file, the Event Logger must reload the control file to make the changes effective. This can be achieved by stopping the SSA Event Logger and re-starting it. To start and stop the SSA Event Logger service, click Control Panel-->Services-->PC SSA Event Logger.

When changes have been made using the RSM Configurator, the SSA Event Logger reloads its control file automatically.

Each event that the SSA Event Logger can receive is associated with a template (number) and a threshold. For an event to be logged, it has to occur at least as many times as specified by the threshold to be considered as an error and be presented in the analysis view.

The contents of the Event Log file can be dumped, as part of problem determination. A dump of the log file contains all the events received and more information than is visible using the analyze function in the RSM Configurator. The dump is a textual representation of the contents of the SSA Event Logger binary log file. It contains almost all the information in the SSA Event Logger binary file, in the following format:

```
Date and time:  date/time
SSA unique ID:  adapter S/N or disk S/N
Error type:     'Aapter' or 'Disk'
Template:       Textual representation of a number, the template
SRN:
Flag:          'Current' or 'Fixed'
```

For disk drives, the entry also contains the sense data, 36 bytes on hexadecimal format over four lines. For adapters and for array errors, it may contain the resource name of the array's

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

Changing Failed Array Components

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

uidxxxx Not Present

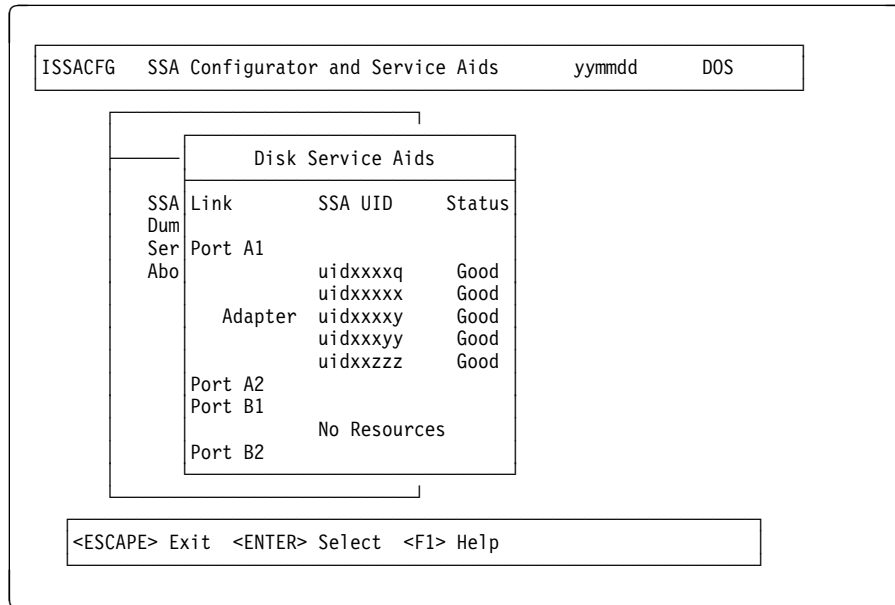
To exchange a failed drive, use the following general procedure (more details are presented later in this section):

1. Place the disk drive in service mode
2. Replace the defective disk drive with a replacement disk drive
3. Remove service mode from the replacement disk drive
4. Reposition the replacement disk in the array

Use the DOS Configurator to change the disk drive using the following procedure. The RSM Configurator can also be used instead of DOS Configurator.

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

A list of physical disk drives is displayed:



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

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

2. You can identify a disk drive by highlighting its entry in this list and pressing F9. This causes the Check light on the disk drive to flash (if it is not on already) and a + symbol appears beside the entry in the list. Pressing F10 stops the light flashing.
3. Highlight the entry for the disk drive that you are going to replace and press F4. This puts that disk drive into service mode; the Check light on the disk drive comes on (it might be on already) and a + symbol appears beside the entry in the list. Only one disk can be in service mode at a time.
4. Replace the physical disk drive. The *User's Handbook* for the unit containing the disk drive describes how to do this.
5. Highlight the entry for the disk drive that you have just replaced and press F4. This removes that disk drive from service mode.
6. Press Esc to return to the Main Menu. (Leaving the Service Aids window automatically removes any disk drive from service mode.) Add the replacement disk drive to the array by exchanging the old entry with the entry for the replacement disk drive, using the procedure described in "Exchanging a Component of An Array" on page 4-13.

If the disk drive that failed was a component of an array for which a suitable Hot Spare was available, the Hot Spare will have been exchanged automatically with the faulty disk drive. You can either:

- Define the replacement disk drive as a Hot Spare, using the procedure described in “Creating a Hot Spare” on page 4-1, or
- Wait until the array has been rebuilt by the array management software, then exchange the replacement disk drive with the previous Hot Spare, using the procedure described in “Exchanging a Component of An Array” on page 4-13.

Note: The previous Hot Spare remains a component of the array, although you can redefine it as a Hot Spare.

Chapter 7. Getting the Latest Information

For the latest device drivers, firmware, 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 detailed maintenance information on the adapter and its subsystem, refer to the *IBM SerialRAID Adapter: Maintenance Information* manual, SY33-0193.

For detailed information on the operation of the adapter, refer to the *IBM SerialRAID Adapter: Technical Reference* manual, SA33-3284.

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 & Support or new CBIOS flashes) specifically about PC Servers, refer to:

<http://www.pcco.ibm.com>

Appendix A. Resource Numbers

A resource number is assigned to a resource when it is added to the System resources list.

The number assigned is related to the position in the System Resource List at which the resource is attached. The configurators provide an option that allows the user 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 the disk 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 order in which mass storage devices are processed by the operating system at boot time, and any resultant drive lettering, depends on:

- The priority order of mass storage devices in PCI slots in the server. The priority order of devices varies depending on the make and model of the server.
- The order of the resources in the SSA System resources list. Resources with lower resource numbers get presented first.
- The partitioning information that the operating system holds concerning the mass storage devices.

For more information about these aspects of server configuration, and IBM SerialRAID Adapter configuration, consult the technical information for the server, or see your Service Representative.

Glossary

ANSI. American National Standards Institute

BBSRAM. Battery-backed static random access memory

CBIOS.

CMOS. Complementary metal oxide semiconductor

DRAM. Dynamic random access memory

failover. An arrangement that enables one host/adaptor combination to take over the management of resources attached to a failed host/adaptor combination.

firmware. Software (programs or data) that has been written onto read-only memory (ROM)

Hot Spare. A resource that is reserved for automatic use as a component of an array if one of the array's components fails.

Hot swapping. The ability to add and remove devices to a computer while the computer is running and have the operating system automatically recognize the change.

IDE. Integrated Drive Electronics. An interface for mass storage devices, in which the controller is integrated into the disk or CD-ROM drive.

LBA. Logical block address (sector number on a disk).

LUN. Logical Unit Number

New resource. A resource that either:

- Is new from the manufacturer
- Has previously been used in an AIX environment
- Is a component of a RAID type not supported by the adaptor currently selected in the configurator
- Has had a low-level SSA format performed on it.

NVRAM. Non-volatile random access memory

Parity. In an array that has redundancy, information stored in the array to enable data to be rebuilt if any of the components fail.

PCI. Peripheral Component Interconnect

Preconfigured resource. A component of a type of RAID (or a Fast Write resource) that is not supported by the adaptor currently selected in one of the configuration programs.

RAID. Redundant Array of Independent (or Inexpensive) Disks, a category of disk drives that employ two or more drives in combination for fault tolerance and performance.

resource. A disk drive or other SSA device that is to be accessed individually, or an array. More generally, any entity to which input/output may be performed.

RSM. Remote Systems Management

SCSI. Small Computer Systems Interface

service mode. A maintenance aid that logically bypasses a disk in a loop without breaking the logical links in the loop.

SRN. Service Request Number

SSA. Serial Storage Architecture

Spatial reuse. A characteristic of SSA whereby different links on a loop can be used for different data transfers at the same time. One adaptor can be sending data to one node whilst at the same time another adaptor can be sending data to another node.

System resource. A disk or array that is recognized by the operating system during the boot process.

URL. Universal Resource Locator.

VPD. Vital Product Data

Product Warranty and Notices

International Business Machines Corporation

Armonk, New York, 10504

Statement of Limited Warranty

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

Machine: IBM SerialRAID Adapter

Warranty Period*: One year

**Elements and accessories are warranted for three months. Contact your place of purchase for warranty service information.*

IBM Options installed with the system carry the same warranty as the system. IBM Options installed after the installation carry the balance of the system warranty or one year, whichever is greater.

Production Status

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

The IBM Warranty

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

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

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

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

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

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

Warranty Service

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

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

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

It is your responsibility to:

1. obtain authorization from the owner (for example, your lessor) to have IBM or your reseller service a Machine that you do not own;
2. where applicable, before service is provided —
 - a. follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provide,
 - b. secure all programs, data, and funds contained in a Machine,
 - c. inform IBM or your reseller of changes in a Machine's location, and
 - d. for a Machine with exchange service, remove all features, parts, options, alterations, and attachments not under warranty service. Also, the Machine must be free of any legal obligations or restrictions that prevent its exchange; and
3. be responsible for loss of, or damage to, a Machine in transit when you are responsible for the transportation charges.

Extent of Warranty

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

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

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

In Canada, warranties include both warranties and conditions.

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

Limitation of Liability

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

1. bodily injury (including death), and damage to real property and tangible personal property; and
2. the amount of any other actual loss or damage, up to the greater of \$100,000 or the charge for the Machine that is the subject of the claim.

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

1. third-party claims against you for losses or damages (other than those under the first item listed above);
2. loss of, or damage to, your records or data; or
3. economic consequential damages (including lost profits or savings) or incidental damages, even if IBM is informed of their possibility.

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

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

Notices

References in this book to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Subject to IBM's valid intellectual property or other legally protectable rights, any functionally equivalent product, program, or service may be used instead of the IBM product, program, or service. The evaluation and verification of operation in conjunction with other products, except those expressly designated by IBM, are the responsibility of the user.

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

IBM may have patents or pending patent applications covering subject matter in this document. The furnishing of this document does not give you any license to these patents. You can send license enquiries, in writing, to the IBM Director of Licensing, IBM Corporation, 500 Columbus Avenue, Thornwood, New York 10594, U.S.A.

Trademarks

The following term is a trademark of IBM Corporation in the United States or other countries or both:

IBM

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

Other company, product, or service names may be trademarks or service marks of others.

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

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

Properly shielded and grounded cables and connectors (part numbers 07H9163, 07H8985, 32H1465, 88G6404, 32H1466, or 88G6406, or their equivalents) must be used in order to meet FCC emission limits. Neither the provider nor the manufacturer is responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

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

電波障害自主規制 届出装置の記述

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

VCCI Statement

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

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

International Electrotechnical Commission (IEC) Statement

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

Avis de conformité aux normes de l'Industrie Canada

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

Industry Canada Compliance Statement

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

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.

EC Council Directive

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

- Council Directive 73/23/EEC on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.
- Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility.

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

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

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

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

Radio Protection for Germany

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

Der Aussteller der Konformitätserklärung ist die IBM Germany.

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

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

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

Hinweis:

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

Index

Special Characters

- 'CBIOS is currently disabled' message 2-3
 - booting from SSA disk drive 2-4
 - installing 2-4, 2-5
 - Windows NT on SSA device 2-4
- 'CBIOS is currently enabled' message 2-3

A

- access control 5-3
 - control file 5-3
 - SSA event forwarding 5-3
- access failure checks 6-1
- access modes, disk 4-12
- adapter hardware
 - ports 1-10
- Adapter List menu 3-5
- adapter types 3-3
- array
 - configuring 3-1
 - failure 1-14
 - good 1-14
 - Hot Spare 1-14
 - Hot Spare Exact attribute 1-14
 - recommendations 1-14
 - resources 1-14
 - states 1-14
- attributes of disk resources 4-8
- attributes of Fast Write resources 4-9
- attributes of RAID 5 resources 4-10

B

- bandwidth 1-10
 - lights 1-11
- boot device, selecting 2-3
 - installing on SSA disk drive 2-3
- boot failure checks 6-1
- broken loop 1-2

C

- cable length 1-1
- cables, connecting 2-2
 - IBM SerialRAID Adapter 2-2

- cables, connecting (*continued*)
 - installing 2-2
- changing array attributes 4-11
- changing failed component 6-3
- check level function 5-2
- check light 6-4
- clustering 1-16
- component 1-12
- configuration tools 1-6
- configuration, physical 4-3
- configurator functions 3-1
 - dormant 3-2
 - general process 3-2
- configuring
 - disk arrays 3-1
 - SSA subsystems 3-1
- connectors 1-3
 - loops, rules for 1-5

D

- degraded state 1-14
 - rebuilding 1-15
- deleting an array 4-16
- destroying an array 3-14, 4-17
 - destroying 4-17
 - versions 5-1
- device drivers
 - installation 2-1
- disk 4-8
- disk access modes 4-12
- disk arrays
 - configuring 3-1
- disk drive indicator light 6-4
- disk drives
 - connecting 2-2
 - converting into free resource 3-7
 - numbers
 - setting 3-21
 - ports 2-2
 - preconfigured 3-8
 - rejected 3-21
- disk resource, attributes 4-8
- DOS Configurator
 - configuration capabilities 1-7
- DOS Configurator, running 3-4

- dual-host 1-5
- dual-host operation 1-16, 3-3
- dumping event log file 6-2
 - changing 6-3

E

- enclosures view 5-3
- event logging and analysis 5-2
- exchanging array component 4-13
 - array 4-16
 - deleting 4-16
 - exchanging 4-13
 - exchanging component 4-13
 - rebuilding 4-15
- exposed state 1-14
 - degraded 1-14

F

- failed component, changing 6-3
- failover. 1-16, 3-3
- Fast Write 4-9
- Fast Write resource, attributes 4-9
- flashing check light on disk drive 6-4

G

- good state 1-14
 - exposed 1-14

H

- hardware characteristics
- Hot Spare 3-14
 - adding to System Resources list 3-17
 - Fast Write 3-15
 - installing Windows NT on SSA 3-18
 - managing 3-15
 - status 3-18
- hots spare 3-9
 - naming 3-12
 - status 3-10

I

- indicator light on disk drive 6-4
- information
 - more 7-1

- installation
- Internet Explorer 5-2

L

- labels, unique ID 1-11
- links 1-1
- logical view 5-3
 - installing 5-4
 - RSM Configurator 5-4
- loop bandwidth 1-10
- loops 1-1
- LUN A-1
 - order presented to operating system A-1

M

- mirroring 1-12

N

- Netscape Navigator 5-2
- network ID 3-12
 - presence 3-13

O

- offline state 1-15
 - benefits 1-15
- operating system

P

- paths, data (SSA link) 1-2
- PCI slots 2-2
- physical configuration 4-3
- physical view 5-3
- port indicator lights 1-11
- port numbers 5-5
- preconfigured resource 3-8
 - creating 3-9
- presence of array component 3-13
 - array 3-14
 - component 3-14
 - deleting 3-14
 - destroying 3-14
- privacy 3-3
- problem solving
 - basic 6-1
 - control file 6-2

problem solving (*continued*)
dumping log file 6-2
task name on Windows NT 6-2
using Event Logger 6-2

R

RAID 5 4-10
changing attributes 4-11
Hot Spare Enabled attribute 4-10
Hot Spare Exact attribute 4-10
RAID 5 resource, attributes 4-10
RAID levels 1-12
readme files 3-18, 5-2, 5-3, 5-4, 5-5
rebuilding state 1-15
offline 1-15
redundancy 1-12
rejected resource 3-21
creating 4-1
deleting 3-22
deleting dormant 3-23
in use 3-23
resources 3-22
resource numbers A-1
resource type 1-9
Fast Write 1-9
RAID 5 1-9
resource types 1-7
RSM Configurator
rules for SSA loops 1-5
running the DOS Configurator 3-4

S

sample configuration 1-9
security and access control 5-3
SSA Fibre Optic Extender 1-1
data paths and loops 1-2
loops and data paths 1-2
SSA ports 2-2
SSA unique ID label 1-11
component 1-12
introduction 1-12
string 1-3
striping 1-12
system view 5-3

T

TCP/IP domain name 5-5
help pages 5-7
item colors 5-7
screen areas 5-6
tutorial 5-7
types of adapter 3-3
utilities 3-3

U

unique ID labels 1-11
unique resource name 3-12
usage type 1-7
Free 1-8
Hot Spare 1-8
New 1-8
Rejected 1-8
System 1-8
System (AIX) 1-8
System (PC) 1-8
utility programs, installing 2-5
control file 2-5
device drivers 2-5
installing 2-5
utility programs 2-5

V

viewing physical configuration 4-3
attributes 4-5
viewing attributes 4-5

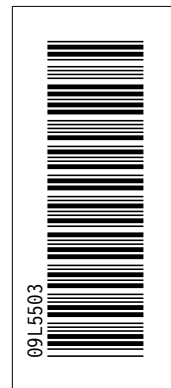
Author's note

Index under development...



Part Number: 09L5503

Printed in the U.S.A.



Screen Definitions

<u>id</u>	<u>File</u>	<u>Page</u>	<u>References</u>
UNLST	H0G81SET	1	

Figures

<u>id</u>	<u>File</u>	<u>Page</u>	<u>References</u>
FRAMES1	H0G81WEB	5-6	5-1 5-6

Headings

<u>id</u>	<u>File</u>	<u>Page</u>	<u>References</u>
INT	H0G81INT	1-1	Chapter 1, Introducing the IBM SerialRAID Adapter xi
SSAINT	H0G81INT	1-1	Serial Storage Architecture
SERLIN	H0G81INT	1-1	SSA Loops and Links 2-2
RULES	H0G81INT	1-5	Rules for SSA Loops 1-1, 6-1
CLEXMP	H0G81INT	1-5	Dual-Host Configuration
CFGS	H0G81INT	1-6	The Configuration Utilities 1-7
RSMCFG	H0G81INT	1-6	The RSM Configurator
RESTYP	H0G81INT	1-7	Resource Types
USGTYP	H0G81INT	1-7	Ownership and Usage Type
HARDCH	H0G81INT	1-10	Hardware Characteristics
R5ARR	H0G81INT	1-12	RAID Levels
HSDD	H0G81INT	1-14	Hot Spare Resources 1-13
FWFINT	H0G81INT	1-15	The Fast Write Feature
INS	H0G81INS	2-1	Chapter 2, Installing an IBM SerialRAID Adapter xi
INSTCRD	H0G81INS	2-2	Installing the Adapter Card 2-4, 3-1
BTDEV	H0G81INS	2-3	Selecting the Boot Device
OSINS	H0G81INS		

		2-4	Installing Windows NT To Boot From An SSA Device 2-3, 2-3
OSON	H0G81INS	2-5	Installing the SSA Device Drivers and Utility Programs 2-4, 2-4, 2-4, 2-5
CFG	H0G81CFG	3-1	Chapter 3, Configuring SSA Resources Using the DOS Configurator xi, 1-6, 1-9, 2-3, 2-4, 2-5
CFGPRG	H0G81CFG	3-1	The SSA Configuration Programs
ADTYPES	H0G81CFG	3-3	Types of Adapter Supported By the Configuration Utilities
ADLIST	H0G81CFG	3-5	The Adapter List
ACCPT	H0G81CFG	3-7	Converting a New Resource Into a Free Resource 3-4
CREARR	H0G81CFG	3-9	Managing Arrays 1-13, 3-4, 3-9
FWCONF	H0G81CFG	3-15	Managing Fast Write Resources 1-15
CONF2	H0G81CFG	3-17	Managing System Resources 3-4, 3-9, 3-15
SYSADD	H0G81CFG	3-19	Adding a Resource to the System Resources List 3-19
REJUSE	H0G81CFG	3-21	Managing Rejected Resources 3-2
RESDEL	H0G81CFG	3-22	Deleting Resources
NVRAM	H0G81CFG	3-23	Managing Non-Volatile RAM
PER	H0G81PER	4-1	Chapter 4, Performing Other Configuration Tasks xi, 1-6
DEFHS	H0G81PER	4-1	Creating a Hot Spare 1-14, 3-9, 3-9, 6-5
VPHYS	H0G81PER	4-3	Viewing the Physical Configuration 4-1
VEWRES	H0G81PER	4-5	Viewing Resources and Their Attributes 4-1
DSKATTR	H0G81PER	4-8	Attributes of Disk Resources 4-7
FWATTR	H0G81PER	4-9	Attributes of Fast Write Resources 3-16, 3-17
ARRATTR	H0G81PER	4-10	Attributes of RAID 5 Array Resources 3-11
CHATTR	H0G81PER	4-11	Changing Array Attributes 4-1, 4-6
ACMODE	H0G81PER	4-12	Viewing and Changing Disk Access Modes 2-4, 3-18, 4-1
EXCH	H0G81PER	4-13	Exchanging a Component of An Array

			4-1, 6-4, 6-5
DELARR	H0G81PER	4-16	Deleting an Array from the System Resources List 3-9, 3-14, 4-1
DESTARR	H0G81PER	4-17	Destroying An Array 3-9, 3-14, 4-16
RSM	H0G81WEB	5-1	Chapter 5, Configuring SSA Resources Using the RSM Configurator xi, 1-6, 3-1, 3-4
RSMINS	H0G81WEB	5-4	Installing the RSM Configurator
URSM	H0G81WEB	5-5	Using the RSM Configurator
PRO	H0G81PRO	6-1	Chapter 6, Dealing with Disk Problems and Array Problems xi
BASPRO	H0G81PRO	6-1	Basic Problems 2-4
ARPRO	H0G81PRO	6-2	Using the Event Logger
CHARRY	H0G81PRO	6-3	Changing Failed Array Components 1-14
HLP	H0G81HLP	7-1	Chapter 7, Getting the Latest Information xi, 2-3
RESNO	H0G81DNO	A-1	Appendix A, Resource Numbers xii, 3-21
NOTICES	H0G81WAR	X-3	Product Warranty and Notices
NOTP	H0G81WAR	X-6	Notices ii
TMPG	H0G81WAR	X-6	Trademarks

List Items

<u>id</u>	<u>File</u>	<u>Page</u>	<u>References</u>
NTINST	H0G81INS	2-2	3b 2-2
OSNOT	H0G81INS	2-4	1
FREE1	H0G81CFG	3-8	3
ARLIST	H0G81CFG	3-9	3
BILD	H0G81CFG	3-15	7
LSEL	H0G81PER	4-12	2 4-13
NOTNUM	H0G81PER	4-16	1

Revisions

<u>id</u>	<u>File</u>	<u>Page</u>	<u>References</u>
LG3	H0G81SET	1	
LGH	H0G81SET	1	1-6, 1-7, 3-5, 3-6

Spots

<u>id</u>	<u>File</u>	<u>Page</u>	<u>References</u>
PARNOT	H0G81INT	1-13	Note on parity 1-12
FWREST	H0G81INT	1-15	(no text) 1-10
NVSPOT	H0G81CFG	3-2	(no text) 3-23
ARRATTS	H0G81CFG	3-10	(no text)
TMPG	H0G81WAR	X-6	(no text)

Processing Options

Runtime values:

Document fileid	H0G81MST SCRIPT
Document type	USERDOC
Document style	IBMXGGD
Profile	EDFPRF40
Service Level	0030
SCRIPT/VS Release	4.0.0
Date	98.10.21
Time	11:32:09
Device	PSA
Number of Passes	4
Index	YES
SYSVAR X	YES

Formatting values used:

Annotation	NO
Cross reference listing	YES
Cross reference head prefix only	NO
Dialog	LABEL
Duplex	YES
DVCF conditions file	(none)
DVCF value 1	(none)
DVCF value 2	(none)
DVCF value 3	(none)
DVCF value 4	(none)
DVCF value 5	(none)
DVCF value 6	(none)

DVCF value 7	(none)
DVCF value 8	(none)
DVCF value 9	(none)
Explode	NO
Figure list on new page	YES
Figure/table number separation	YES
Folio-by-chapter	YES
Head 0 body text	(none)
Head 1 body text	Chapter
Head 1 appendix text	Appendix
Hyphenation	NO
Justification	NO
Language	ENGL
Keyboard	395
Layout	OFF
Leader dots	YES
Master index	(none)
Partial TOC (maximum level)	(none)
Partial TOC (new page after)	INLINE
Print example id's	NO
Print cross reference page numbers	YES
Process value	(none)
Punctuation move characters	,
Read cross-reference file	(none)
Running heading/footering rule	NONE
Show index entries	NO
Table of Contents (maximum level)	3
Table list on new page	YES
Title page (draft) alignment	CENTER
Write cross-reference file	(none)

Imbed Trace

Page 0	H0G81SET
Page i	H0G81FNT
Page ii	H0G81EDN
Page vii	H0G81SAF
Page x	H0G81PRF
Page xii	H0G81INT
Page 1-16	H0G81INS
Page 2-5	H0G81CFG
Page 3-23	H0G81PER
Page 4-17	H0G81WEB
Page 5-7	H0G81PRO
Page 6-5	H0G81HLP
Page 7-2	H0G81DNO
Page A-2	H0G81GLO
Page X-1	H0G81WAR

DSMBEG323I STARTING PASS 2 OF 4.

DSMBEG323I STARTING PASS 3 OF 4.

DSMBEG323I STARTING PASS 4 OF 4.

+++EDF014E Missing term for I2 entry. (Page 1-1 File: H0G81INT)

DSMMOM397I '.EDFINDX2' WAS IMBEDDED AT LINE 37 OF 'H0G81INT'

DSMMOM397I 'H0G81INT' WAS IMBEDDED AT LINE 51 OF 'H0G81MST'

+++EDF014E Missing term for I2 entry. (Page 1-1 File: H0G81INT)

DSMMOM397I '.EDFINDX2' WAS IMBEDDED AT LINE 67 OF 'H0G81INT'

DSMMOM397I 'H0G81INT' WAS IMBEDDED AT LINE 51 OF 'H0G81MST'

+++EDF014E Missing term for I2 entry. (Page 1-1 File: H0G81INT)

DSMMOM397I '.EDFINDX2' WAS IMBEDDED AT LINE 68 OF 'H0G81INT'

DSMMOM397I 'H0G81INT' WAS IMBEDDED AT LINE 51 OF 'H0G81MST'