

IBM Enhanced SSA 4-Port Adapter

SC23-1782-00

User's Guide and Reference

Note

Before using this information and the product it supports, be sure to read the general information under "Product Warranties and Notices" included with your system unit.

First Edition (April 1996)

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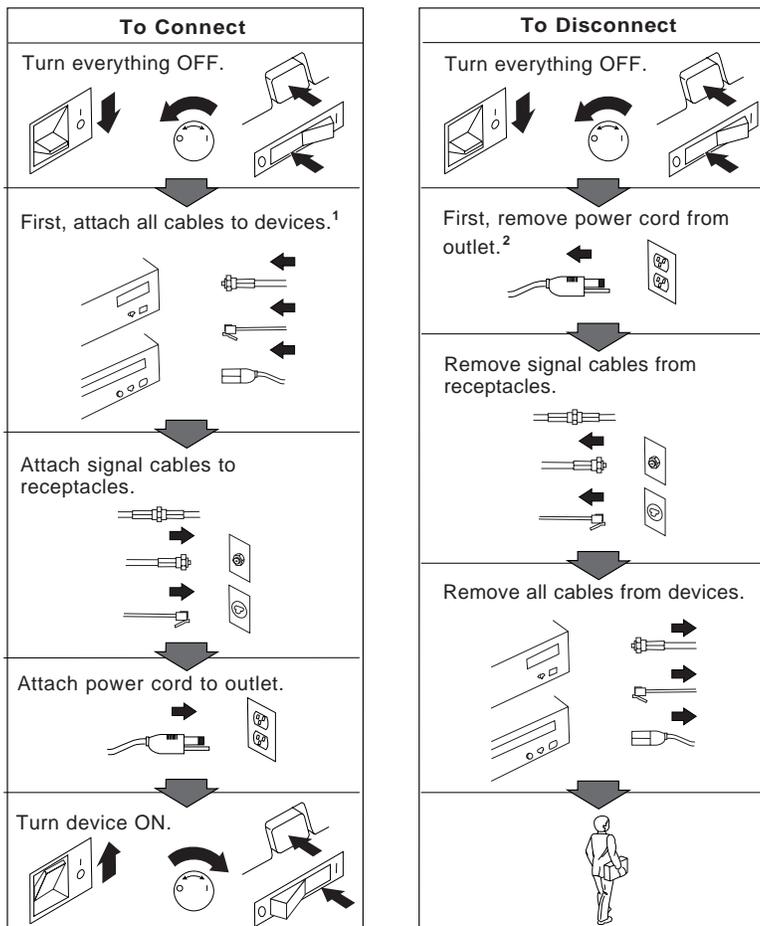
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Safety Information



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.

About This Book

This book (when used with your system unit documentation) can be used as a User's Guide and Reference for your IBM Enhanced 4-Port Adapter. It provides needed information for software device drivers. This book also addresses verifying that installation and configuration were successfully completed.

ISO 9000

ISO 9000 registered quality systems were used in the development and manufacturing of this product.

Related Publications

This book refers to the following publications:

- The documentation that came with your computer
- *SSA 4-Port Adapter and Enhanced 4-Port Adapter: Technical Reference*, S31H-8612.

Chapter 1. Introduction to the IBM Enhanced SSA 4-Port Adapter

The IBM Enhanced SSA 4-Port Adapter is a Micro Channel bus-master adapter that serves as the interface between systems using the Micro Channel architecture and devices using the Serial Storage Architecture (SSA).

This chapter describes the Enhanced SSA 4-Port Adapter (feature code 6216, type 4-G).

Description of Adapter Cards

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

- 1** Connector B2
- 2** Green light
- 3** Connector B1
- 4** Connector A2

- 5** Green light
- 6** Connector A1
- 7** Type-number label

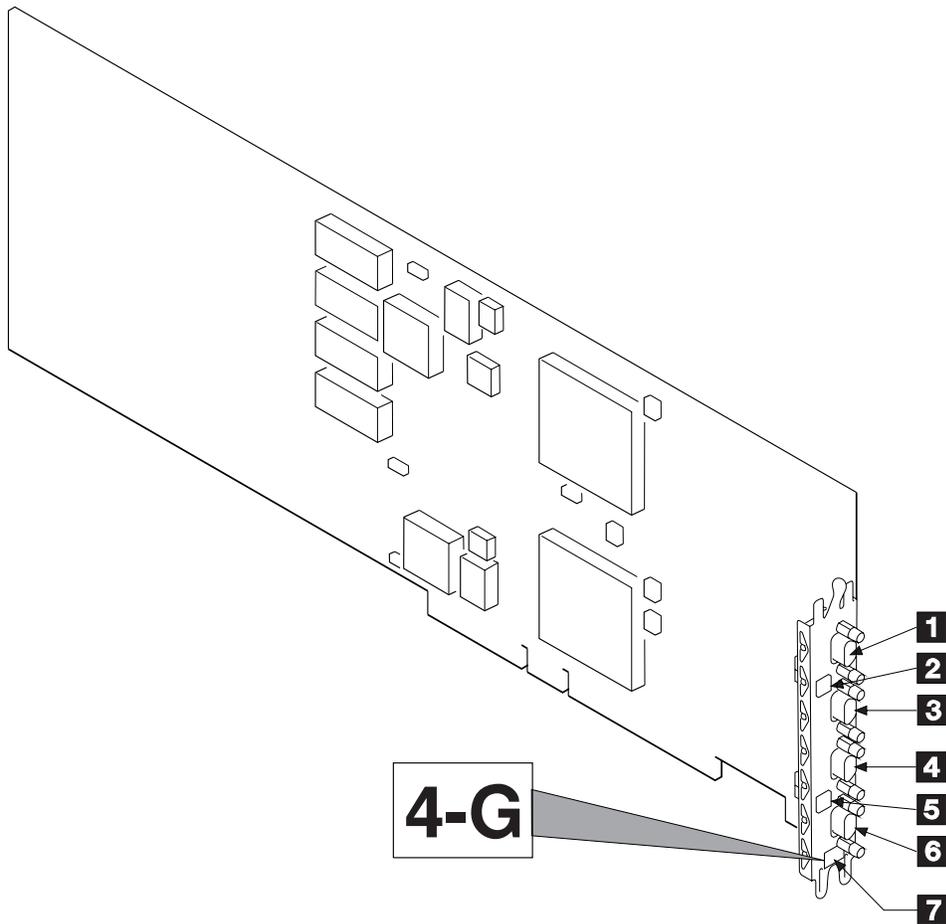


Figure 1-1. IBM Enhanced SSA 4-Port Adapter (Feature Code 6216, Part Number 40H5707)

The adapter provides 4 SSA ports for the attachment of storage devices such as hard disk drives. Each port operates at 20MBs full-duplex using point-to-point copper cables up to 25 meters long. SSA retains the SCSI-2 commands, queuing model, status, and sense bytes; it is an industry-standard interface.

The Enhanced SSA 4-Port Adapter can be used in configurations of up to 8 initiators.

Each of the two pairs of SSA ports can attach up to 48 dual-port devices in a closed loop. These features support fault-tolerant applications. This adapter supports up to eight-way initiator configurations.

The adapter has a Micro Channel interface. I/O transactions are transferred between the host system and the adapter using control blocks and full-duplex delivery pipes in shared memory. The adapter is capable of streaming data transfers at 40 or 80MBs on the Micro Channel.

The adapter and its subsystem handle SCSI commands, status, and sense. The adapter also deals with the SSA protocols, and it recovers link errors and some disk errors internally.

The device drivers and adapter communicate with each other by means of a logical client-server network called the Independent Packet Network (IPN). IPN provides a consistent application programming interface (API) independent of the environment. This produces a software environment that allows new functions to be added as easily as additional servers or filters.

The performance of the adapter takes full advantage of the SSA links. A single adapter can support at least 200 overlapped I/O requests by queuing the commands in the attached devices. The adapter overhead for an I/O operation is typically less than 125 microseconds. The adapter can execute up to 3000 short read/write operations per second, depending on the attached devices. The maximum bandwidth for data transfers is 40MBs, depending on the capabilities of the system bus.

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

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

Port Addresses

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

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

Rules for SSA Loops

Note: In greater than 2 initiator environment, all SSA adapters must be type 4-G enhanced SSA adapter.

For SSA loops that include SSA 4-Port Adapters or Enhanced SSA 4-Port Adapters, the following rules apply:

- Each SSA loop must be connected to a valid pair of connectors on the SSA adapter (that is, either connectors A1 and A2, or connectors B1 and B2).
- Only one of the two pairs of connectors on an adapter can be connected in a particular SSA loop.
- A maximum of 48 devices can be connected in a particular SSA loop.
- A maximum of eight adapter-connector pairs can be connected in a particular SSA loop if all the adapters are Enhanced SSA 4-Port Adapters (type 4-G).

A maximum of two adapter-connector pairs can be connected in a particular loop if at least one adapter is an SSA 4-Port Adapter (type 4-D).

- A maximum of two SSA adapters, that are connected in a particular SSA loop, can be installed in a single host system unit.

Microcode Maintenance

Updates to microcode are loaded into the using system from diskettes. If the level of the microcode stored in the using system is higher than the level of the microcode installed on the SSA adapter, or the disk drives attached to it, the higher-level microcode is automatically downloaded to the adapter and disk drives when the using system runs the device configuration method.

For some problems, the service request number (SRN) might ask you to check the microcode package ID before you exchange any field-replaceable units (FRUs). You can get the package ID for the adapter in two ways:

- On the command line, enter the following command:

```
lsattr -E -l adapter -a ucode
```

where **adapter** is the ID of the adapter that you want to check; for example, ssa0.

An example of a response to this command is:

```
ucode 8F97.01.nn Name of adapter code download False
```

where nn is the adapter code package ID.

- Use the Display or Change Configuration or Vital Product Data (VPD) service aid to display the VPD for the adapter. The first two characters of the ROS Level field contain the adapter code package ID.

To determine the ID of the microcode package being used on a disk drive, use the Display or Change Configuration or Vital Product Data (VPD) service aid to display the VPD for the disk drive. The first two characters of the ROS Level field contain the ID of the microcode package for the disk drive.

Note: During the configuration of the complete system, all the VPD files in the system are updated *before* any microcode is downloaded from the using system to the SSA subsystem. If the using system later downloads a new level of microcode to the subsystem, the VPD files in the system for the adapter or disk drive will not show the ID of the new microcode package until the next time the configuration manager (**cfgmgr**) is run.

Vital Product Data (VPD)

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

Abbreviations used in this section are:

DRAM	Dynamic random-access memory
FRU	Field-replaceable unit
RAM	Random-access memory
ROM	Read-only memory
ROS	Read-only storage
SSA	Serial storage architecture

SSA Adapter VPD

The information contained in the VPD includes:

Part number	Adapter card FRU part number
Serial number	Adapter card serial number
Engineering change level	Adapter card engineering change level
Manufacturing location	Manufacturer and plant code
ROS level & ID	Version of ROS code loaded on the adapter
Loadable microcode level	Version of loadable code needed for the satisfactory operation of this card
Device driver level	Minimum level of device driver needed for this level of card
Description of function	SSA Adapter
Device specific (Z0)	If the adapter contains additional DRAM modules, Z0 indicates the total DRAM size in megabytes
Device specific (Z1)	If the adapter contains a pluggable fast-write cache module, Z1 indicates the cache size in megabytes.

Adapter Power-On Self-Tests (POSTs)

Power-on self-tests (POSTs) are resident in the SSA adapter. The tests are POST-1 and POST-2.

POST-1 tests all the function necessary to enable the adapter to communicate with the Micro Channel. POST-1 can fail for either of two reasons:

- A hardware error has been detected. In such instances, the POST code enters a tight loop, and does not put the identification of the SSA adapter into the Programmable Option Select (POS) registers. If this error occurs, the SSA adapter must be exchanged for a new one.
- The flash EPROM has a check sum that is not valid. This error can be caused if the power fails while microcode is being downloaded. In such instances, the POST checks all the hardware needed to download the microcode. If all the hardware is correct, the POST sets the ROS Level to zero, puts the identification of the SSA adapter into POS 0-1, and puts error data into the adapter status register.

To recover from this type of error, microcode must be downloaded to the SSA adapter. If the using system can have an initial program load (IPL) without the adapter, the configuration code detects the down-level ROS code and downloads the latest level of code. The configuration code then uses Control Register bit 7 to reset the adapter and restart POST-1. If this failure makes the using system unable to have an IPL, the adapter code can be downloaded by the standalone diagnostics.

If no error is detected during POST-1, the identification of the SSA adapter is put into the POS registers, and POST-2 is started.

POST-2 tests the remaining hardware on the SSA adapter card and tests the other FRUs attached to the adapter. If this test fails, an error code is saved and sent to the using-system error log when the error logger becomes available. An internal health check continues to send the error code at regular intervals.

Chapter 2. SSA Configurations

This chapter introduces SSA subsystems, describes how SSA loops should be configured, and how SSA devices are known by the system programs.

SSA Subsystems

Serial Storage Architecture (SSA) is an industry-standard interface that provides high-performance fault-tolerant attachment of I/O storage devices. In SSA subsystems, transmissions to several destinations are multiplexed; the effective bandwidth is further increased by spatial reuse of the individual links.

Commands are forwarded automatically from device to device along a loop until the target device is reached. Multiple commands can be travelling around the loop simultaneously. SSA retains the SCSI-2 commands, queuing model, and status and sense bytes.

SSA Loops and Links

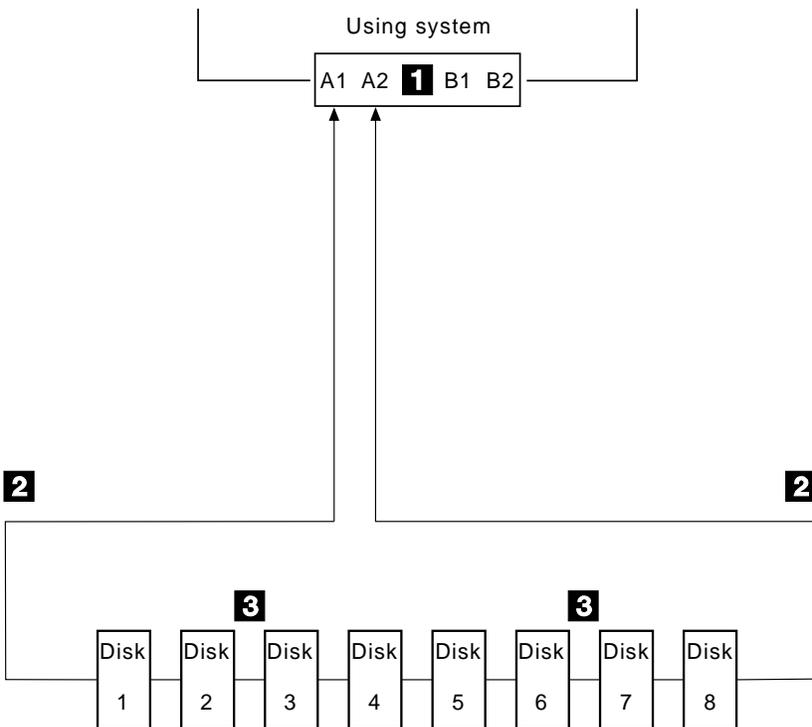
In the simplest SSA configuration, SSA devices are connected through two or more SSA links to an SSA adapter located in a using system. The devices, SSA links, and SSA adapter are configured in loops. Each loop provides a data path that starts at one connector of the SSA adapter and passes through a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

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

Loops and Data Paths

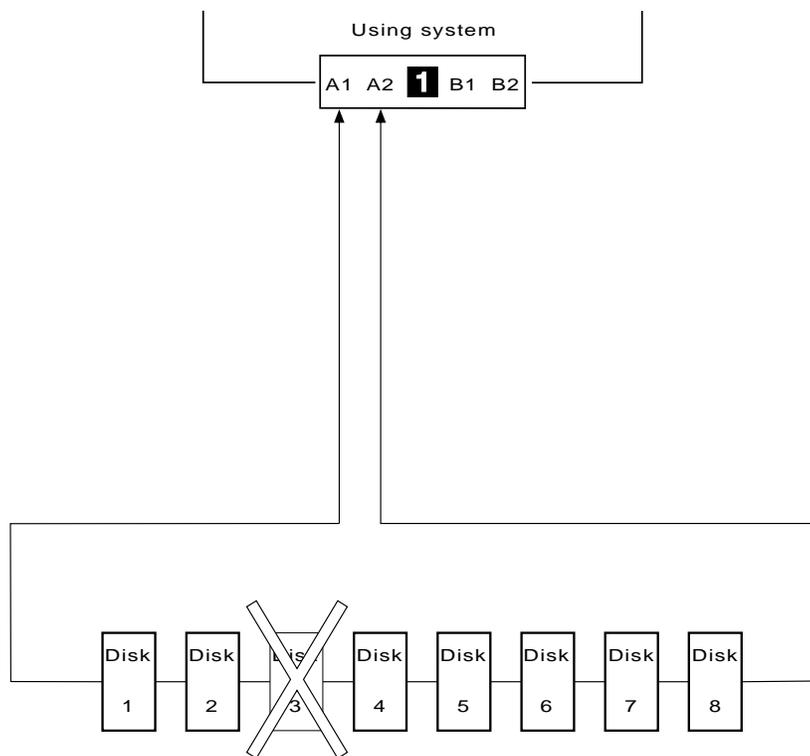
All devices that are attached to an SSA adapter card **1** are connected through SSA links **2**. The SSA links are configured as loops. Data and commands to a particular device pass through all other devices on the link between the adapter and the target device.

Data can travel in either direction around a loop. The adapter can, therefore, get access to the devices **3** (disk drives in this example) through two data paths. The using system cannot detect which data path is being used.



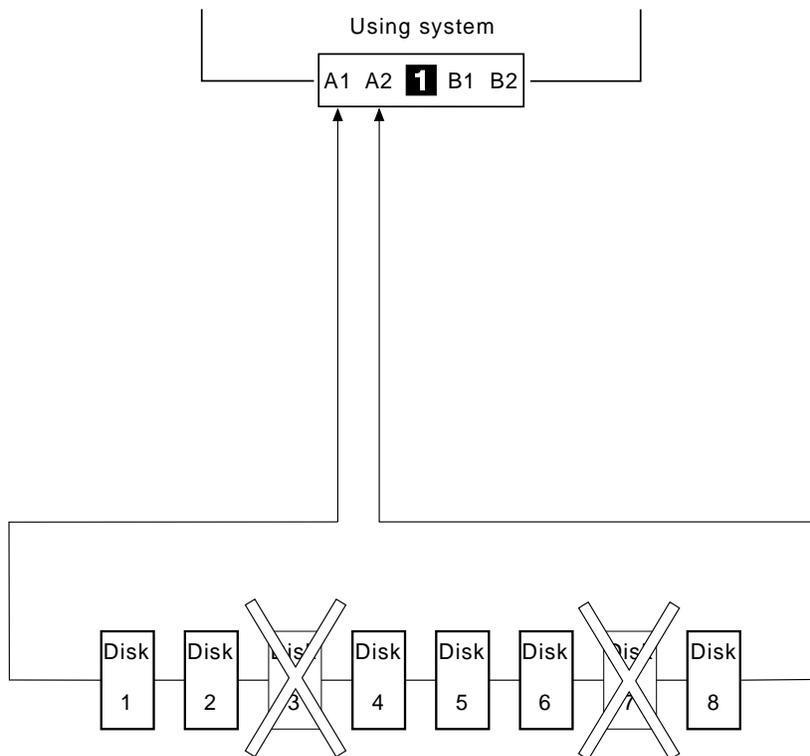
If a disk drive fails, or is turned off, the loop is broken, and one of the data paths to a particular disk drive is no longer available. The disk drives on the remains of the loop continue to work, but an error is reported to the system.

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



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

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



Examples of Configuration for 7133

Pages 2-6 through 2-13 describe the recommended configurations for SSA subsystems. This configuration is shown as a sample to aid in cabling your SSA subsystems. The configurations shown are the simplest and easiest to use. If performance or availability are particularly important to you, more complex cabling may provide a better solution. Consult your marketing representative who has more details on this.

Important: When you connect the SSA cables to a 7133 unit, always connect them as specified in the diagrams; this enables operators and service representatives to identify disk drives more easily.

SSA Cables

This section gives details of the adapter and cables shown in the diagrams that follow. The feature number to use when ordering the cables depends on the model and whether you are ordering the 7133 alone or as part of a system.

Important: All of the feature codes listed for the SSA Copper Cables (items **2**, **3**, and **4** in the following table) are feature codes of machine type 7133.

Item	Description	Part	Feature	Length
1	Enhanced SSA 4-Port Adapter	40H5707	6216 (feature of RS/6000)	
2	SSA Copper Cable	07H8985 32H1465 88G6404 32H1466 88G6406	5010 5025 5050 5100 5250	1.0 m (3.3 ft) 2.5 m (8.2 ft) 5.0 m (16.4 ft) 10 m (32.8 ft) 25 m (82.0 ft)
3 see notes	SSA Copper Cable	31H7960 07H8985 32H1465 88G6404	5006 5010 5025 5050	0.6 m (1.9 ft) 1.0 m (3.3 ft) 2.5 m (8.2 ft) 5.0 m (16.4 ft)
4	SSA Copper Cable	07H9163	5002	0.18 m (0.6 ft)

Notes:

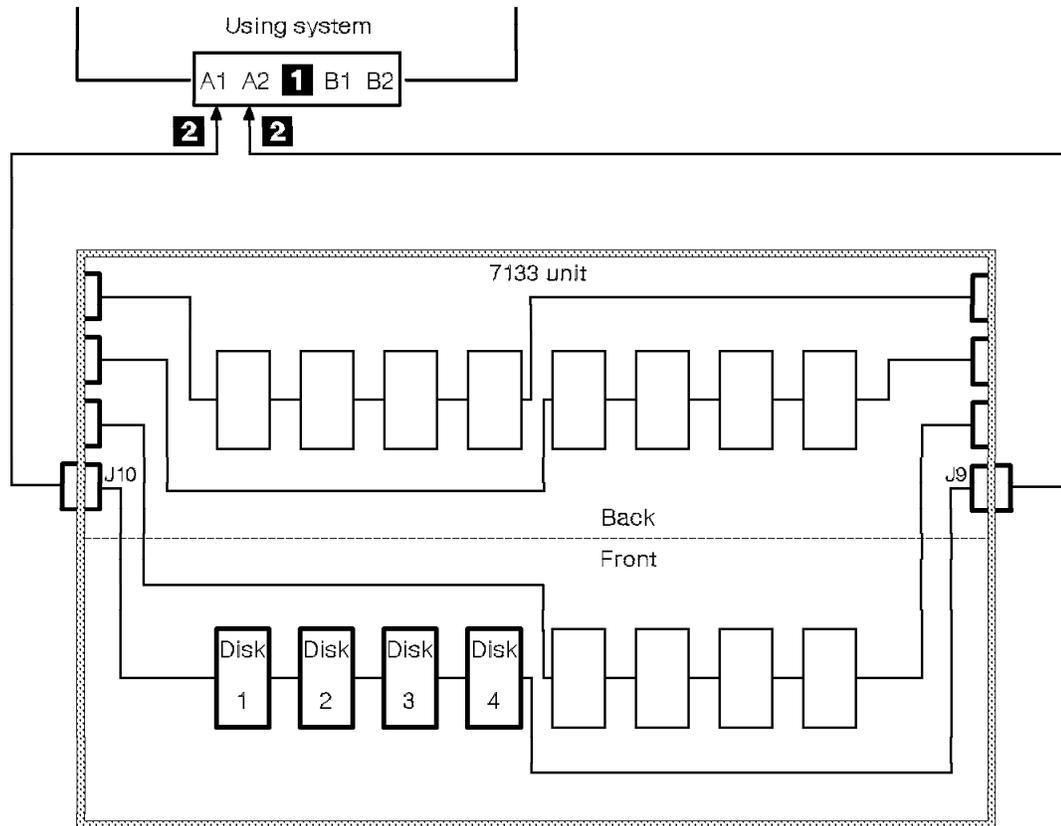
1. For a **Model 010**, do not use a cable of length 0.6 meters between connectors on the same 7133 unit (items **3** in the diagrams) because the cable gets in the way when you install or remove a disk drive module or fan-and-power-supply assembly at the back of the 7133 unit or a neighboring unit.
2. For a **Model 500**, always use a cable of length 0.6 meters or 0.18 meters between connectors on the same 7133 unit (items **3** in the diagrams).

For more information about the SSA cables delivered with the 7133 Model 010, refer to the *7133 Model 010 Installation Guide*.

Simple Configurations

A 7133 unit that is in base configuration includes four disk-drive modules. These modules are installed in the four left-hand positions at the front of the 7133 unit. The other 12 disk-drive positions contain dummy disk-drive modules. The disk-drive modules are linked in groups of four. Each group of four modules is linked to two external SSA connectors.

In the simplest configuration, the SSA loop is completed by connecting these two SSA connectors to one of the two pairs of connectors on an SSA adapter card in the using system:



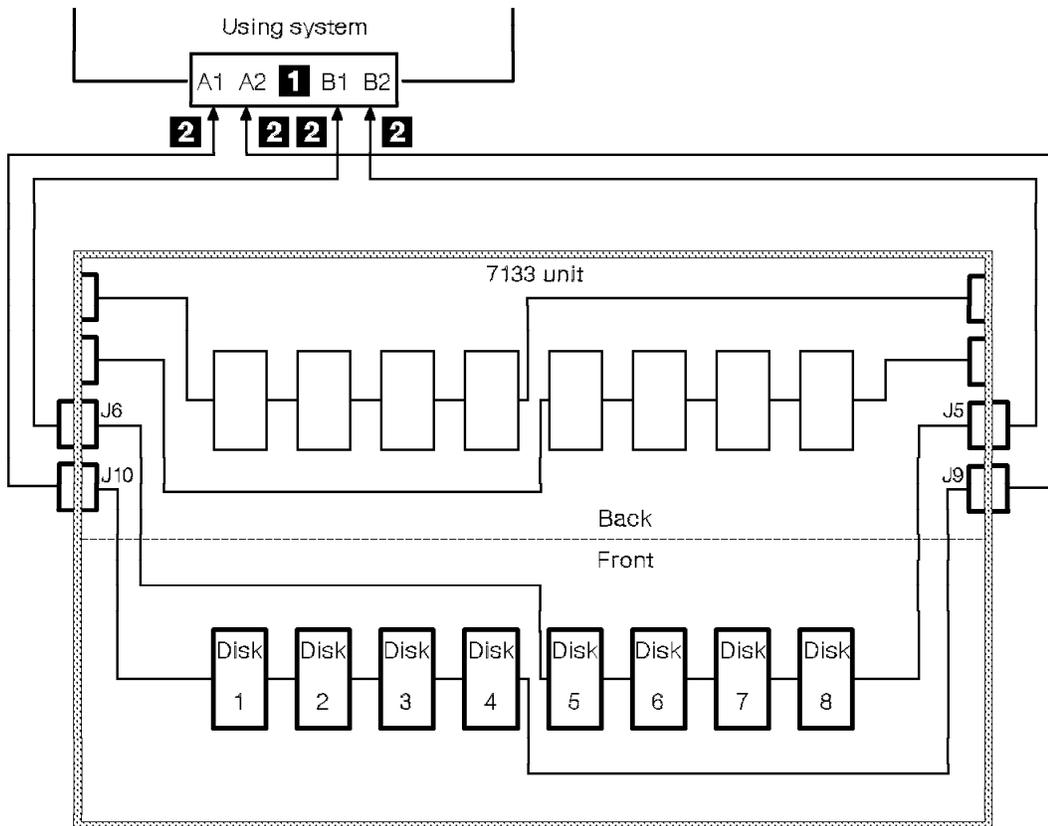
With this configuration:

- The two fan-and-power-supply assemblies in the 7133 unit provide redundant power and cooling to the disk-drives.
- There is no performance advantage to be gained by moving the disk drives to other positions and connecting them in more than one loop. If moved to other positions, the disk-drives might no longer have the benefit of redundant power and cooling.

The cables are described on page 2-5.

Larger Configurations

Four more disk-drive modules can be added to the base configuration in a single loop; but for a balanced subsystem, it is recommended that the two groups of four disk-drive modules are connected to separate pairs of connectors on the adapter card in two loops:



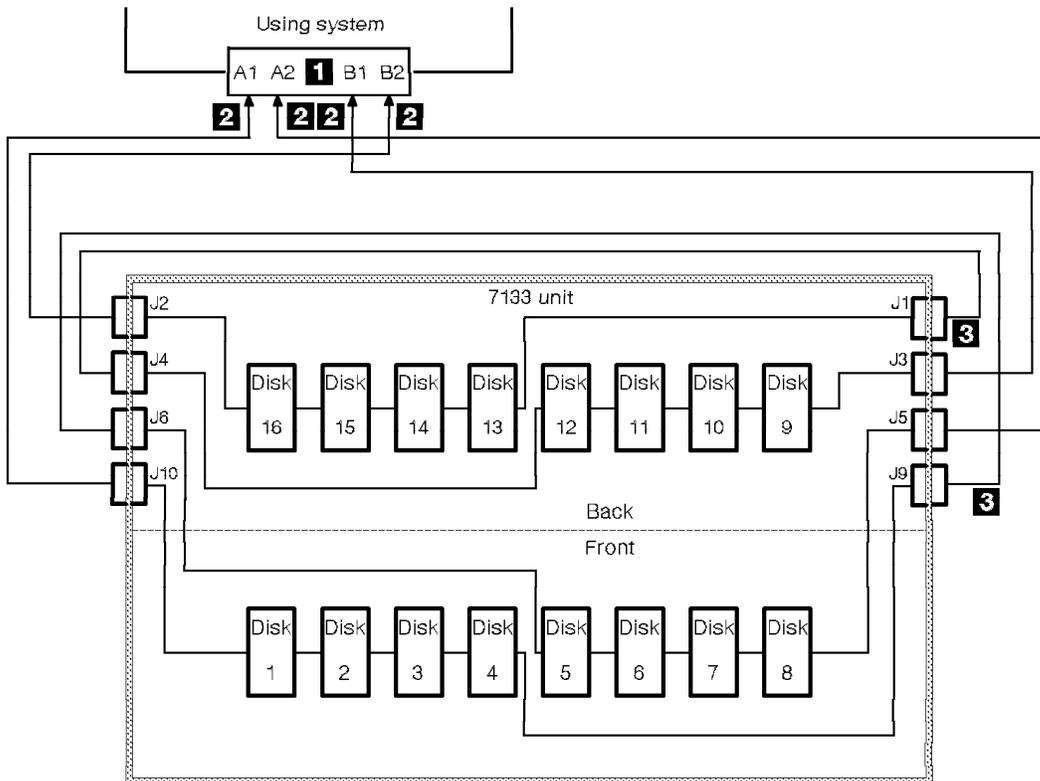
There is no performance advantage to be gained by moving the disk drives to other positions and connecting them in more than two loops using an additional adapter.

For this, and all larger configurations, to have redundant power and cooling for all disk-drives, you must install the third fan-and-power-supply assembly in the 7133 unit.

The cables are described on page 2-5.

Largest Configurations with One 7133 Unit

All 16 disk-drive modules in a full 7133 unit can be connected in a single loop; but for a balanced subsystem, it is recommended that two groups of eight disk-drive modules are connected to separate pairs of connectors on the adapter card in two loops:



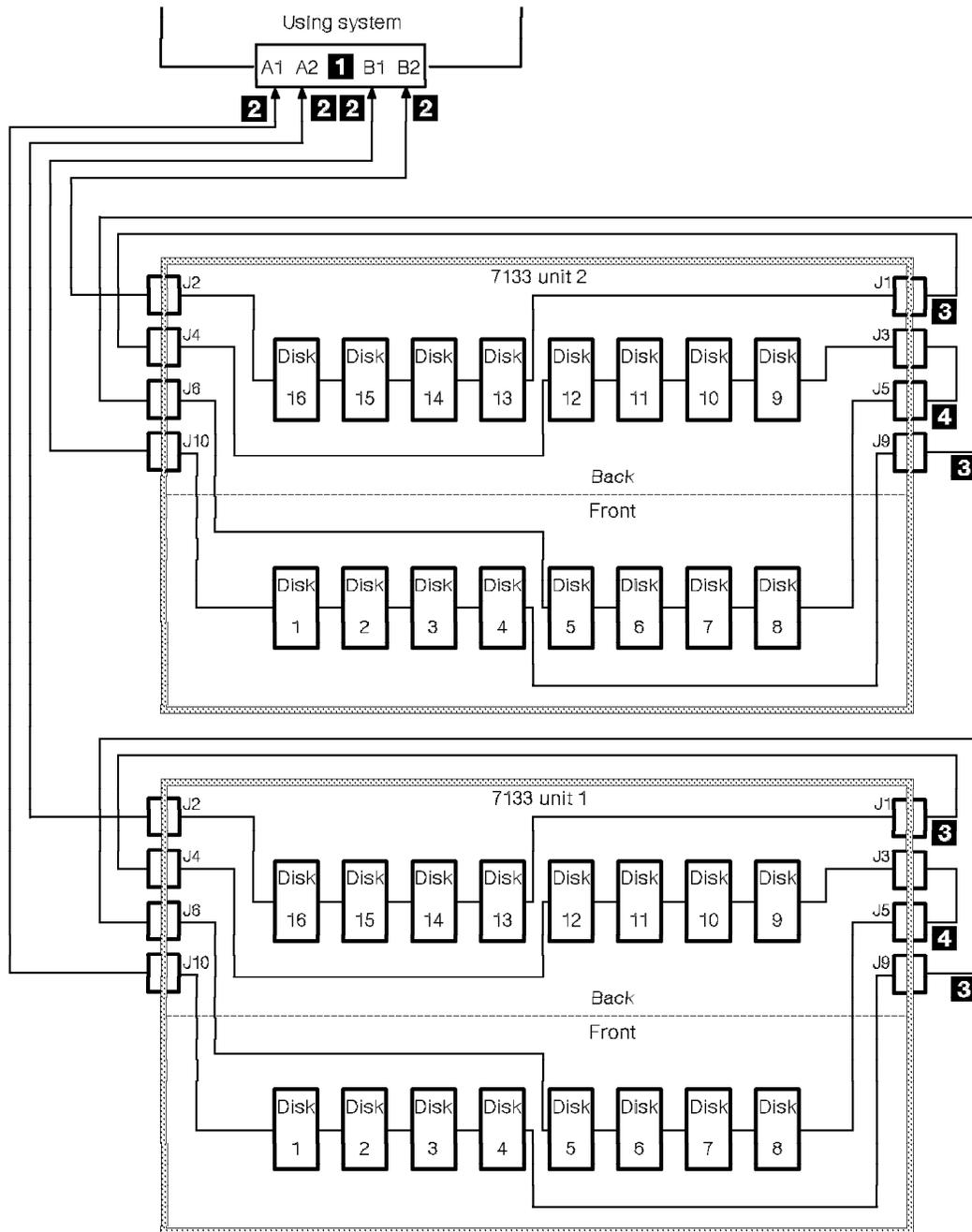
There is no performance advantage to be gained by connecting the disk drives in more than two loops.

For this configuration, you must install the third fan-and-power-supply assembly in the 7133 unit.

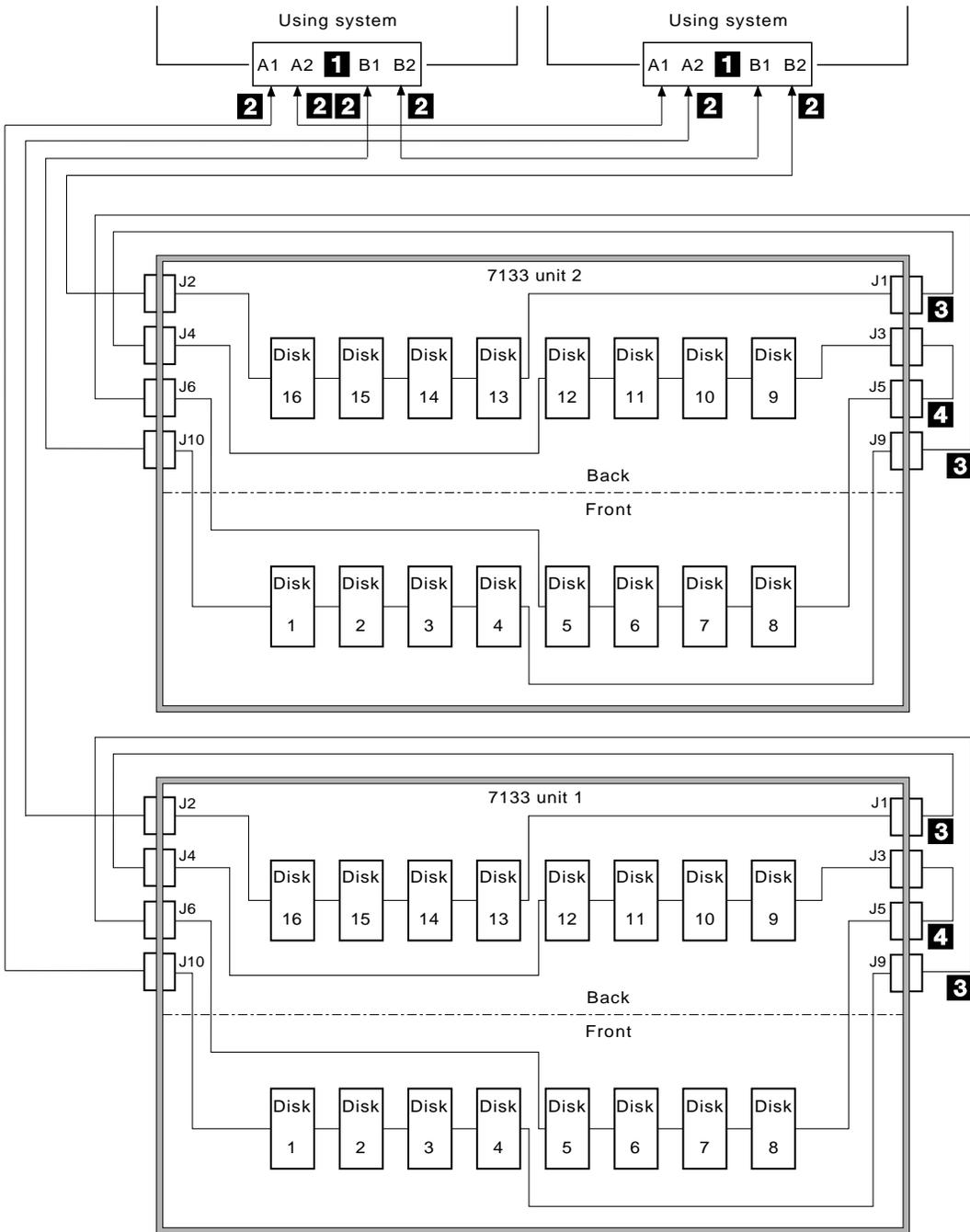
The cables are described on page 2-5.

Multiple-Unit Configurations

An SSA subsystem can include disk-drives that are installed in more than one 7133 unit. They can also be attached to more than one SSA adapter. They all could be connected in a single SSA loop, but for better performance and better serviceability, it is recommended that the disk-drives are connected to separate pairs of connectors on the adapter card in two loops:



For a higher-availability configuration, a second SSA adapter is included in the loops. The diagram shows the simplest cabling; more complex cabling may be required to maximize the performance of the subsystem.



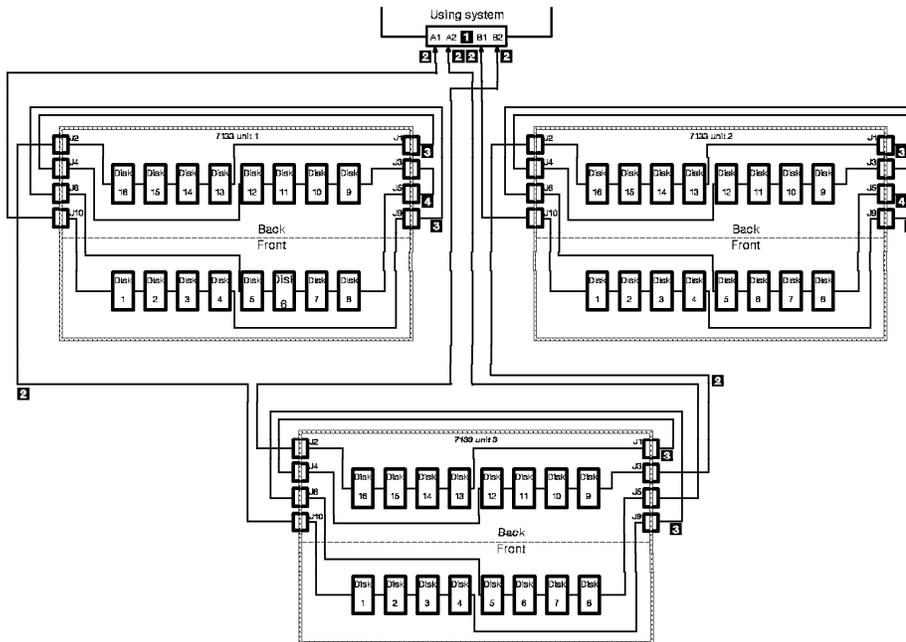
Note: The cables shown in the previous diagram are described on page 2-5.

Maximum Configurations

In larger subsystems, unless the workload of the system has special requirements, optimum performance is obtained by connecting the drives in equal numbers on the loops available. You can connect up to 48 disk-drive modules in one SSA loop, and up to 96 disk-drives to one adapter.

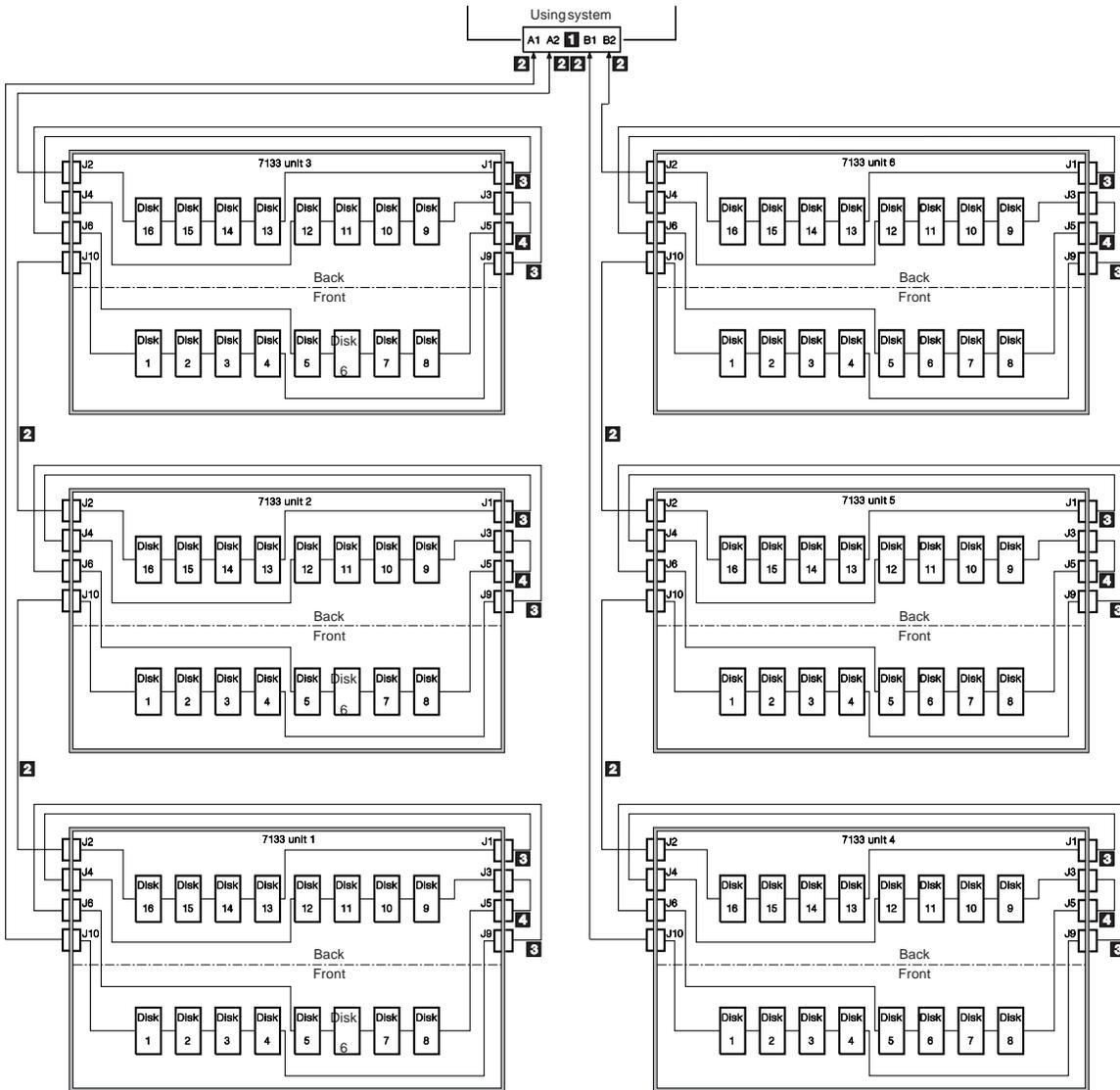
Here are two examples:

- 48 disk-drives, in three 7133 units, connected to a single adapter card:



The cables are described on page 2-5.

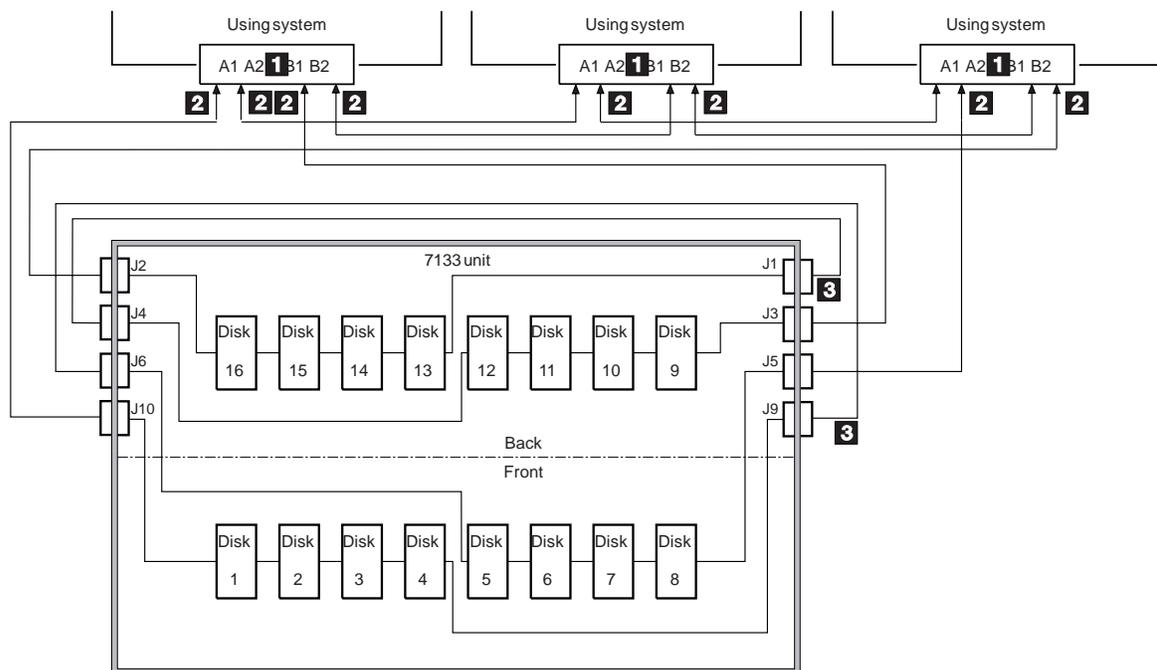
- 96 disk-drives, in six 7133 units, connected to a single adapter card:



The cables are described on page 2-5.

Eight Initiators

With Enhanced SSA 4-Port Adapters (type 4-G), eight adapter connectors can be connected.



Configuring Devices on an SSA Loop

If the SSA loops are configured with two or more SSA adapters in a loop and those adapters are installed in two or more using systems, it may be necessary to take special steps to ensure successful configuration of the systems following power-on.

These steps may be necessary because an SSA adapter, which is in a using system that is powered down, causes a break in the SSA loop. Having more than one break in the SSA loop can cause some using systems to be isolated from some disks.

The systems can be successfully configured by using either of the following two procedures:

- Once all the systems which contain adapters connected to the SSA loop have been powered on, do the following on each system.
 1. Run the **cfgmgr** command to configure all the SSA disks.

2. Manually **varyon** the volume groups and mount the filesystems as required.
- Set the Key Mode switch of each using system to Secure mode, then boot each system. When all the operator panels display 200, set the key to the Normal mode and continue the boot process.

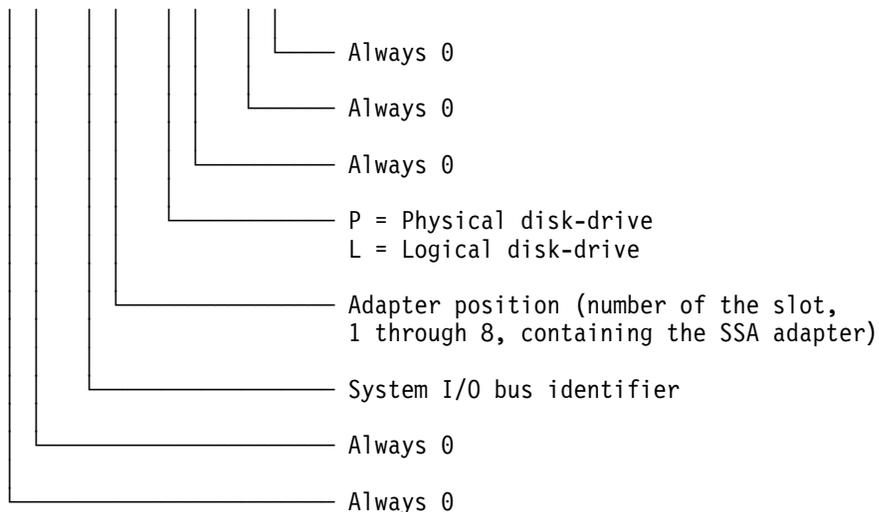
Addressing SSA Devices

This section describes how SSA adapters and devices are known to the using system programs.

Location Code Format

Location codes identify the locations of adapters and devices in the using system and its attached subsystems and devices. These codes are displayed when the diagnostic programs isolate a problem. For information about the location codes used by the using system, see the *Operator Guide* for the using system.

A B - C D - E F - G H



The location code shows only the position of the SSA adapter in the using system and the type of device that is attached. The location of the device within the SSA loop must be found by use of a service aid. The service aids use the device's IEEE-standard 16-digit unique ID.

Pdisks, Hdisks, and Disk Drive Identification

The *physical* disk drives (**pdisks**) in an SSA subsystem can be configured as logical units (LUNs). A LUN is also known as an **hdisk**, and can consist of one or more physical disk drives. An hdisk in an SSA subsystem might, therefore, consist of one pdisk or several pdisks.

The configuration software allocates an identification (hdisk and pdisk number) to each disk-drive during the configuration of the SSA link. The disk drives do not have fixed physical addresses.

The numeric identifiers of pdisks, hdisks, and the disk-drive slots are not related to each other. For example, pdisk1 is not necessarily installed in slot 1 of the physical unit in which it is installed.

The configuration software first recognizes the disk drive by its machine-readable serial number. The serial number of the disk drive is also displayed by the service aids. The service aids show the number as the last eight digits of the IEEE SSA Unique ID.

Service actions are always related to physical disk drives. For this reason, errors that occur on SSA disk drives are always logged against the physical disk drive (pdisk).

If a disk drive that has been formatted on a machine of a particular type (for example, a Personal System/2) is later installed into a using system that is of a different type (for example, a RISC System/6000), that disk drive is configured only as a pdisk during the configuration of the using system.

Adapter Functions

The principal functions of the Enhanced SSA 4-Port Adapter are:

- The adapter performs a power-on self-test (POST) to verify correct operation of the hardware.
- The adapter configures the SSA network. It can act as the master node if required.
- When interrupted by the host processor, the adapter fetches Independent Packet Network (IPN) transactions by Direct Memory Access (DMA) from host memory.
- The adapter translates each transaction into SCSI commands and issues them to the addressed device over a serial link. A pass-through mode is also provided to allow any SCSI command to be issued.

- When requested by a device, the adapter fetches write data from host memory by DMA and transmits it to the device. Similarly the adapter receives read data from the device and stores it in host memory by DMA.
- The adapter receives SCSI status from the device. If there is an error, the adapter issues a SCSI Request Sense command to the device. It may then attempt to recover the error. In all cases, the adapter interrupts the host processor to present the result of the transaction.

Supported Standards

The Enhanced SSA 4-Port Adapter implements the standards described in the following documents:

- Micro Channel Architecture portion of the *IBM Personal System/2 Hardware Technical Reference*, first edition, October 1990, part number 84F8933.
- *Serial Storage Architecture, SSA-PH (Transport Layer)*, X3T10.1 989D, working draft, revision 3, January 5, 1995.
- *Serial Storage Architecture, SSA-SCSI (SCSI-2 Mapping)*, X3T10.1 94-060, revision 04, February 27, 1995.
- *Small Computer System Interface - 2 (SCSI-2)*, X3.131.199X, Revision 10h.

Introduction to the Independent Packet Network (IPN)

The device drivers and adapter communicate with each other by means of a logical client-server network called Independent Packet Network (IPN).

IPN is a logical network of **services**. A client can access a service by specifying its address in the IPN network, without being concerned where the service is physically located. In IPN terminology, the client is a **master** and the service is a **slave**.

The unit of work in IPN is a **transaction**. The routing layer of IPN establishes a connection between the master and slave for the duration of each transaction. A master may queue multiple transactions in the same slave. However, the slave can execute the transactions in any order it chooses and even execute several transactions concurrently.

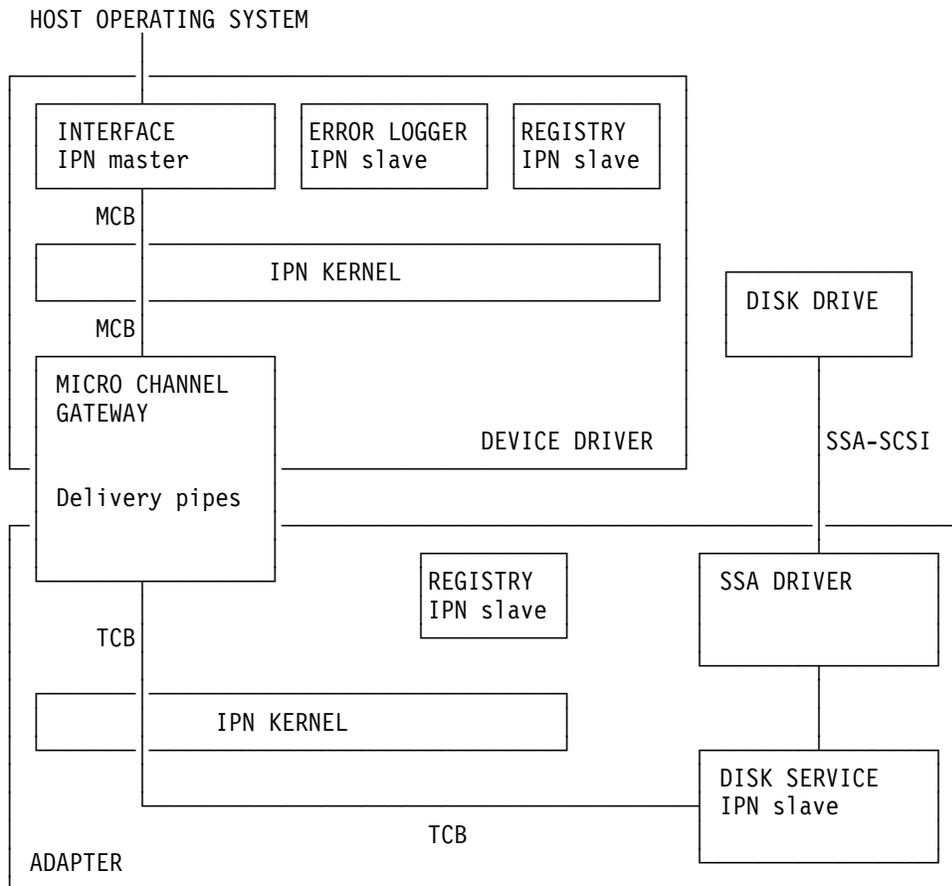
An IPN **node** is a hardware unit that runs the IPN kernel, a host system or the adapter are examples of nodes. In addition to network routing, the IPN kernel also performs such tasks as scheduling, memory management, and timer functions.

The adapter provides a **disk service** to give basic read/write access to each attached disk-drive. Additional services can be added, such as a fast-write service or a Redundant Array of Independent Disks (RAID) service.

The host device driver is an IPN master and also provides an **error logger**, which is a service for logging subsystem errors.

Every IPN node also contains a **registry** service. The registry keeps a list of all services running on its node and all other nodes that are directly accessible through a gateway on that node. The registry also forwards errors detected by the services running on its node to the error logger.

IPN spans the device driver and the adapter. IPN uses a **gateway** to cross a physical interface such as the Micro Channel. The gateway is transparent to the master and slave, and it incorporates the specific features of the physical interface. IPN can be extended to other adapters and controllers on the SSA network. (Disk drives implement SSA-SCSI rather than IPN protocols.)



The Enhanced SSA 4-Port Adapter contains a Micro Channel gateway, a disk service, a registry service, an SSA driver and the IPN kernel, as shown in figure above. A typical transaction to read data from a disk-drive would be processed as follows:

1. The device driver contains a master process that generates IPN transactions. The master calls the host IPN kernel with a pointer to a **master control block (MCB)** for the transaction. The MCB is addressed to the disk service.
2. The host IPN kernel calls the Micro Channel gateway with a pointer to the MCB.
3. The host side of the Micro Channel gateway creates a gateway transaction control block (GTCB) in host memory. This is a form of the transaction control block (TCB) that is optimized for the gateway function.

The Micro Channel gateway writes a pointer to the GTCB into the adapter incoming **delivery pipe**. This is a circular queue in adapter memory. The hardware automatically raises an interrupt to the adapter when the host writes to the delivery pipe.

4. The adapter side of the Micro Channel gateway fetches the GTCB by DMA. The gateway then creates a TCB in the adapter address space. A TCB is a subset of an MCB. Finally, the gateway calls the adapter IPN kernel to submit the TCB.
5. IPN calls the disk service for the addressed device with a pointer to the TCB.
6. The disk service generates the appropriate SCSI read command and passes it to the SSA driver.
7. The SSA driver issues the SCSI command to the disk-drive using the SSA protocol.
8. When the disk drive offers the requested data, the SSA driver transfers the data directly to the Micro Channel gateway.
9. When the drive returns good-completion status, the disk service calls IPN with the result of the TCB.
10. IPN calls the adapter side of the Micro Channel gateway. The gateway puts a pointer to the GTCB into the adapter outgoing delivery pipe. (The pipe is located in host memory.) The pointer is tagged to indicate that the GTCB has been completed. Then the gateway interrupts the host processor.
11. The host side of the Micro Channel gateway fetches the pointer and calls IPN.
12. IPN calls the master process with the result of the original MCB. (The call may be deferred.)

Chapter 3. SSA Service Aids

SSA service aids reside in the using system. They help you to service SSA subsystems. This section describes those service aids, and tells how to use them.

Attention: Do not run the service aids from more than one using system at a time. Otherwise, unexpected results might occur.

The SSA service aids are:

- | | |
|------------------------------------|---|
| Set Service Mode: | This service aid enables you to determine the location of a particular disk drive on the SSA loop, and to remove that disk drive from the loop. |
| Link Verification: | This service aid tells you the operational status of the links forming an SSA loop. |
| Configuration Verification: | This service aid lets you determine the relationship between physical and logical disk drives. |
| Format Disk: | This service aid formats an SSA disk drive. |
| Certify Disk: | This service aid verifies that all the data on a disk drive can be read correctly. |

Before you use the service aids, ensure that you are familiar with the principles of SSA loops and physical disk drives (pdisks). If you are not familiar with these principles, first read Chapter 2 on page 2-1.

The Identify Function

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

The Identify function can be accessed from any of the service aids.

Instructions displayed by the service aids tell you when you can select the Identify function.

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

Note: You cannot use the Identify function on a device that has a 'Reserved' status.

Starting the SSA Service Aids

To start the SSA service aids:

- 1** Start the using-system diagnostics (see the *Common Diagnostics Information* manual), and go to the DIAGNOSTIC OPERATING INSTRUCTIONS.
Note: If you are running standalone diagnostics from diskette or from CD-ROM, see "Installing SSA Extensions to Standalone Diagnostics" on page 4-1.
- 2** Follow the instructions to select FUNCTION SELECTION.
- 3** Select SERVICE AIDS from the Function Select menu.

4 Select SSA SERVICE AIDS from the Service Aids menu.

The SSA Service Aids menu is displayed.

```
SSA SERVICE AIDS                                     802380
Move cursor onto selection, then press Enter.

      Set Service Mode
      Link Verification
      Configuration Verification
      Format Disk
      Certify Disk

F3=Cancel      F10=Exit
```

Note: In some configurations of the using-system console:

Esc and **0** = Exit

Esc and **3** = Cancel

In such configurations, however, the displayed instructions for the function keys remain the same as those shown in the screen above.

5 Select the service aid that you require, then go to the relevant instructions in this chapter:

“Set Service Mode Service Aid” on page 3-4

“Link Verification Service Aid” on page 3-10

“Configuration Verification Service Aid” on page 3-14

“Format Disk Service Aid” on page 3-17

“Certify Disk Service Aid” on page 3-19.

Set Service Mode Service Aid

The Set Service Mode service aid enables you to determine the location of a particular disk drive, and to remove that disk drive from the unit in which it is installed. It causes the Check light of that disk drive to come on for identification, and stops all SSA loop activity through the disk drive. It also causes the Subsystem Check light (if present) of the unit containing the selected disk drive to come on. Only one disk drive at a time can be in Service Mode.

Before using this service aid, you must make the selected disk drive unavailable to the using system; otherwise, an error occurs.

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

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

If you leave the Set Service Mode service aid, Service Mode is reset.

To use the Set Service Mode service aid:

- 1 Select Set Service Mode from the SSA Service Aids menu (see “Starting the SSA Service Aids” on page 3-2). A list of physical disk drives (pdisks) is displayed:

```
SSA SERVICE AIDS                                     802380

SET SERVICE MODE                                     802381
Move cursor onto selection, then press Enter.

[ TOP ]
pdisk0  11111111  00-04-P      2 GB SSA C Physical Disk Drive
pdisk1  22222222  00-04-P      2 GB SSA C Physical Disk Drive
pdisk2  33333333  00-04-P      2 GB SSA C Physical Disk Drive
pdisk3  44444444  00-04-P      2 GB SSA C Physical Disk Drive
pdisk4  55555555  00-04-P      2 GB SSA C Physical Disk Drive
pdisk5  66666666  00-04-P      2 GB SSA C Physical Disk Drive
pdisk6  77777777  00-04-P      2 GB SSA C Physical Disk Drive
pdisk7  88888888  00-04-P      2 GB SSA C Physical Disk Drive
pdisk8  99999999  00-04-P      2 GB SSA C Physical Disk Drive

[ BOTTOM ]
F3=Cancel      F10=Exit
```

The columns of information displayed on the screen are defined as follows:

pdisk0 through pdisk8	Physical disk drive resource identifiers.
11111111 through 99999999	Serial numbers of the physical disk drives. The actual serial number of a disk drive disk drive is shown on a label on the disk drive.
00-04-P	See "Location Code Format" on page 2-16.
2 GB SSA C Physical Disk Drive	Descriptions of the disk drives.

- 2** Select the pdisk that you want to identify or put into Service Mode (for example, pdisk3). The following display appears with details of the disk drive that you have just selected:

SSA SERVICE AIDS	802380
------------------	--------

SET SERVICE MODE	802381
------------------	--------

SET SERVICE MODE	802382
pdisk3 44444444 00-04-P 2 GB SSA C Physical Disk Drive	
Move cursor onto selection, then press Enter.	
+ Set or Reset Identify. Select this option to set or reset the Identify indicator on the disk drive.	
> Set or Reset Service Mode. Select this option to set or reset Service Mode on the disk drive.	
F3=Cancel F10=Exit	

- 3** Select Service Mode or the Identify function. (For this example, assume that you have selected Service Mode.) The list of pdisks is displayed again, and the disk drive that you selected is marked by a >, which shows that the disk drive is in Service Mode.

```

SSA SERVICE AIDS                                     802380

SET SERVICE MODE                                     802381

SET SERVICE MODE                                     802382

SET SERVICE MODE                                     802381
Move cursor onto selection, then press Enter.

[ TOP ]
pdisk0  11111111  00-04-P      2 GB SSA C Physical Disk Drive
pdisk1  22222222  00-04-P      2 GB SSA C Physical Disk Drive
pdisk2  33333333  00-04-P      2 GB SSA C Physical Disk Drive
> pdisk3  44444444  00-04-P      2 GB SSA C Physical Disk Drive
pdisk4  55555555  00-04-P      2 GB SSA C Physical Disk Drive
pdisk5  66666666  00-04-P      2 GB SSA C Physical Disk Drive
pdisk6  77777777  00-04-P      2 GB SSA C Physical Disk Drive
pdisk7  88888888  00-04-P      2 GB SSA C Physical Disk Drive
pdisk8  99999999  00-04-P      2 GB SSA C Physical Disk Drive

[ BOTTOM ]
F3=Cancel      F10=Exit

```

Notes:

- a. You can select only one disk drive at time.
- b. If you select Service Mode, and the selected disk drive is not in a closed loop or at the end of a string (see Chapter 2 on page 2-1), your selection fails and an error message is displayed. Use the Link Verification service aid to identify any open-link problems before trying to reselect Service Mode.
- c. If you select Service Mode, and a file system is mounted on the selected disk drive, your selection fails. Use the Configuration Verification service aid to determine which hdisk must have its file system unmounted before you can select Service Mode.

- d. If the Check light of the disk drive that you have put into Service Mode does not come on, and you are not sure of the location of that disk drive, use the Identify function to help you find it (see “The Identify Function” on page 3-1).

4 Select a second disk drive if required (for example, pdisk5). The following display appears again:

```
SSA SERVICE AIDS                                802380

SET SERVICE MODE                                802381

SET SERVICE MODE                                802382

SET SERVICE MODE                                802381

SET SERVICE MODE                                802382
> pdisk5   66666666   00-04-P   2 GB SSA C Physical Disk Drive

Move cursor onto selection, then press Enter.

+ Set or Reset Identify.
  Select this option to set or reset the Identify indicator
  on the disk drive.
> Set or Reset Service Mode.
  Select this option to set or reset Service Mode
  on the disk drive.

F3=Cancel      F10=Exit
```

- 5** Select Service Mode or the Identify function. If the original disk drive is to remain in Service Mode, you can select only the Identify function now. (Only one disk drive at a time can be in Service Mode.) The list of pdisks appears again. The pdisk that is in Identify Mode is identified by a +.

```

SSA SERVICE AIDS                                     802380

SET SERVICE MODE                                     802381

SET SERVICE MODE                                     802382

SET SERVICE MODE                                     802381

SET SERVICE MODE                                     802382

SET SERVICE MODE                                     802381
Move cursor onto selection, then press Enter.

[ TOP ]

pdisk0  11111111  00-04-P  2 GB SSA C Physical Disk Drive
pdisk1  22222222  00-04-P  2 GB SSA C Physical Disk Drive
pdisk2  33333333  00-04-P  2 GB SSA C Physical Disk Drive
> pdisk3  44444444  00-04-P  2 GB SSA C Physical Disk Drive
pdisk4  55555555  00-04-P  2 GB SSA C Physical Disk Drive
+ pdisk5  66666666  00-04-P  2 GB SSA C Physical Disk Drive
pdisk6  77777777  00-04-P  2 GB SSA C Physical Disk Drive
pdisk7  88888888  00-04-P  2 GB SSA C Physical Disk Drive
pdisk8  99999999  00-04-P  2 GB SSA C Physical Disk Drive

[ BOTTOM ]
F3=Cancel      F10=Exit

```

- 6** Identify other disk drives in the same way, if required.

Link Verification Service Aid

The Link Verification service aid helps you determine:

- Where an SSA loop has been broken
- The status of the disk drives on that SSA loop
- The location of a power or cooling fault that has been detected by the disk drives on that SSA loop.

To use the Link Verification service aid:

- 1** Select Link Verification from the SSA Service Aids menu (see “Starting the SSA Service Aids” on page 3-2). The Link Verification adapter menu is displayed:

```
SSA SERVICE AIDS                                802380

LINK VERIFICATION                                802385
Move cursor onto selection, then press Enter.

 ssa0   00-03   SSA Adapter
 ssa1   00-05   SSA Adapter
 ssa2   00-06   SSA Adapter
 ssa3   00-07   SSA Adapter

F3=Cancel      F10=Exit
```

- 2** Select the adapter that you want to test.

The columns of information displayed on the screen are defined as follows:

ssa0 through ssa3

Adapter resource identifiers.

00-03 through 00-07

Adapter location codes. These codes specify the location of the SSA adapter in the using system.

SSA Adapter

Descriptions of the adapters.

- 3** When you have selected an adapter, a list is displayed showing the status of all the disk drives attached to the adapter:

```
SSA SERVICE AIDS                                802380

LINK VERIFICATION                                802385

LINK VERIFICATION                                802386
SSA Link Verification for:
  ssa1  00-05  SSA Adapter

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port      Status
          A1  A2  B1  B2
[TOP]
pdisk0    11111111    0  7              Good
pdisk1    22222222    1  6              Good
pdisk2    33333333    2  5              Good
pdisk3    44444444    3  4              Good
pdisk4    55555555    4  3              Good
pdisk5    66666666    5  2              Good
pdisk6    77777777    6  1              Good
pdisk7    88888888    7  0              Good
pdisk8    99999999          0 10             Good
pdisk9    nnnnnnnn          1  9             Good
[MORE]

F3=Cancel      F10=Exit
```

The columns of information displayed on the screen are defined as follows:

pdisk0 through pdisk9	Physical disk drive resource identifiers.
11111111 through 99999999	Serial numbers of the physical disk drives. The actual serial number of a disk drive is shown on a label on the disk drive.
A1 A2 B1 B2	Adapter connector number.
Status	Statuses are:
	Good Disk drive is working correctly.
	Failed Disk drive has failed.
	Power Disk drive has detected a loss of redundant power or cooling.
	Reserved Disk drive is used by another using system.

SSA links must be configured in a loop around which data can travel in either direction. The loop is broken if a cable fails or is removed, or if a disk drive fails. Because each disk drive on the loop can be accessed from either direction, the broken loop does not prevent access to any data, unless that data is on the failed disk drive. If the loop is broken between two disk drives, the Ready lights on those disk drives flash to show that only one SSA path is active. Also, the Link Verification service aid shows that only one path is available to each disk drive on the broken loop.

You can find the physical location of any disk drive on the loop by using the Identify function (see "The Identify Function" on page 3-1).

Notes:

- a. In the lists of physical disk drives (pdisks) that are displayed by the service aids, you might see:
 - ?????** These question marks show where an SSA loop is broken. No information is available about any devices that are beyond this point.
 - ******* These asterisks indicate an unconfigured device. That device might be:
 - Another SSA adapter either in the same using system or in a different using system
 - An SSA device that is in the SSA network, but whose type is not known. Such a condition can occur if, for

example, devices are added to the network, but **cfgmgr** is not run to configure those devices into the using system.

For example:

```
LINK VERIFICATION 802386
SSA Link Verification for:
  ssa1  00-05  SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port      Status
          A1  A2  B1  B2
[TOP]
pdisk0    11111111    0                  Good
pdisk1    22222222    1                  Good
?????
pdisk3    44444444          4                  Good
pdisk4    55555555          3                  Good
pdisk5    66666666          2                  Good
pdisk6    77777777          1                  Good
pdisk7    88888888          0                  Good
pdisk8    99999999          0  3                Good
pdisk9   10000000          1  2                Good
[MORE]

F3=Cancel      F10=Exit
```

Note that the missing disk drive (pdisk2) is represented by a line of question marks.

- b. If you have just made changes to, or have just turned on, the unit in which the disk drive is installed, you might need to wait up to 30 seconds before detailed information about the SSA network becomes available to the service aids.

4 When you have solved a problem, press **F3 (Esc and 3** on some consoles) to leave the display, then press Enter to reselect it. The display now shows the new status of the SSA links.

“Using the Service Aids for SSA-Link Problem Determination” on page 3-22 provides more examples of link problems and how to use this service aid to solve them.

Configuration Verification Service Aid

The Configuration Verification service aid enables you to determine the relationship between SSA logical units (hdisks) and SSA physical disk drives (pdisks). It also displays the connection information and operational status of the disk drive.

Notes:

1. User applications communicate with the hdisks; error data is logged against the pdisks.
2. If a disk drive that has been formatted on a machine of a particular type (for example, a Personal System/2) is later installed into a using system that is of a different type (for example, a RISC System/6000), that disk drive is configured only as a pdisk during the configuration of the using system.

In such an instance, use the Format service aid to reformat the disk drive, then run the **cfgmgr** command to correct the condition.

To use the Configuration Verification service aid:

- 1 Select Configuration Verification from the SSA Service Aids menu (see "Starting the SSA Service Aids" on page 3-2). A list of pdisks and hdisks is displayed:

```
SSA SERVICE AIDS                                802380

CONFIGURATION VERIFICATION                      802390
Move cursor onto selection, then press Enter.

[ TOP ]
pdisk0  22222222  00-03-P   2 GB SSA C Physical Disk Drive
pdisk1  33333333  00-05-P   2 GB SSA C Physical Disk Drive
pdisk2  44444444  00-07-P   2 GB SSA C Physical Disk Drive
hdisk3  22222222  00-03-L   SSA Logical Disk Drive
hdisk4  33333333  00-05-L   SSA Logical Disk Drive
hdisk5  44444444  00-07-L   SSA Logical Disk Drive

[ BOTTOM ]
F3=Cancel      F10=Exit
```

2 Select the hdisk or pdisk that you want to verify.

3 If you select an hdisk, a list of pdisks is displayed:

```
SSA SERVICE AIDS 802380

CONFIGURATION VERIFICATION 802390

CONFIGURATION VERIFICATION 802391
  hdisk3  22222222  00-03-L  SSA Logical Disk Drive
To set or reset Identify, move cursor onto selection, then press enter.
Physical  Serial#  Adapter  Port  SSA_Addr  Status
[TOP]
pdisk0    22222222  00-02    A1     5         Good
           00-02    A2     5         Good
           00-03    A1    10         Good
           00-03    A2     0         Good

[BOTTOM]
F3=Cancel  F10=Exit
```

If you select a pdisk, a list of hdisks is displayed:

```
SSA SERVICE AIDS 802380

CONFIGURATION VERIFICATION 802390
```

```
CONFIGURATION VERIFICATION                                802392
pdisk0  22222222  00-03-P  2 GB SSA C Physical Disk Drive

Move cursor onto selection, then press Enter.

hdisk3  22222222  00-03-L  SSA Logical Disk Drive

[BOTTOM]
F3=Cancel      F10=Exit
```

Note: If you select the hdisk from this screen, the hdisk configuration is displayed.

Format Disk Service Aid

The Format Disk service aid formats SSA disk drives.

Attention: Formatting a disk drive destroys all the data on that disk drive. Use this procedure only when instructed to do so by the service procedures.

To use the Format Disk service aid:

- 1 Select Format Disk from the SSA Service Aids menu (see “Starting the SSA Service Aids” on page 3-2). A list of pdisks is displayed:

```
SSA SERVICE AIDS                                     802380

FORMAT DISK                                           802395
Move cursor onto selection, then press Enter.

[TOP]
pdisk0  11111111  00-04-P      2 GB SSA C Physical Disk Drive
pdisk1  22222222  00-04-P      2 GB SSA C Physical Disk Drive
pdisk2  33333333  00-04-P      2 GB SSA C Physical Disk Drive
pdisk3  44444444  00-04-P      2 GB SSA C Physical Disk Drive
pdisk4  55555555  00-04-P      2 GB SSA C Physical Disk Drive
pdisk5  66666666  00-04-P      2 GB SSA C Physical Disk Drive
pdisk6  77777777  00-04-P      2 GB SSA C Physical Disk Drive
pdisk7  88888888  00-04-P      2 GB SSA C Physical Disk Drive
pdisk8  99999999  00-04-P      2 GB SSA C Physical Disk Drive

[BOTTOM]
F3=Cancel      F10=Exit
```

- 2 Select the pdisk that you want to format. The following instructions are displayed:

SSA SERVICE AIDS	802380
------------------	--------

FORMAT DISK	802395
-------------	--------

FORMAT DISK	802396
pdisk1 22222222 00-04-P 2 GB SSA C Physical Disk Drive	
Set or Reset Identify. Select this option to set or reset the Identify indicator on the disk drive.	
Format. Select this option only if you are sure that you have selected the correct disk drive. FORMATTING DESTROYS ALL DATA ON THE DISK DRIVE.	
F3=Cancel	F10=Exit

- 3 If you are not sure of the identification (pdisk number) of the disk drive that you want to format, use the Identify function to get a positive physical identification of the disk drive (see "The Identify Function" on page 3-1). You can further ensure that you have selected the correct disk drive by verifying that the serial number on the front of the disk drive is the same as the serial number displayed on the screen.
- 4 When you are sure that you have selected the correct disk drive, select Format.

Certify Disk Service Aid

The Certify Disk service aid verifies that all the data on a disk drive can be read correctly. Other maintenance procedures tell you when you need to run this service aid.

To use the Certify Disk service aid:

- 1 Select Certify Disk from the SSA Service Aids menu (see “Starting the SSA Service Aids” on page 3-2). A list of pdisks is displayed:

```
SSA SERVICE AIDS                                     802380

CERTIFY DISK                                         802404
Move cursor onto selection, then press Enter.

[TOP]
pdisk0  11111111  00-04-P      2 GB SSA C Physical Disk Drive
pdisk1  22222222  00-04-P      2 GB SSA C Physical Disk Drive
pdisk2  33333333  00-04-P      2 GB SSA C Physical Disk Drive
pdisk3  44444444  00-04-P      2 GB SSA C Physical Disk Drive
pdisk4  55555555  00-04-P      2 GB SSA C Physical Disk Drive
pdisk5  66666666  00-04-P      2 GB SSA C Physical Disk Drive
pdisk6  77777777  00-04-P      2 GB SSA C Physical Disk Drive
pdisk7  88888888  00-04-P      2 GB SSA C Physical Disk Drive
pdisk8  99999999  00-04-P      2 GB SSA C Physical Disk Drive

[BOTTOM]
F3=Cancel      F10=Exit
```

- 2 Select the pdisk that you want to certify. The following instructions are displayed:

SSA SERVICE AIDS	802380
------------------	--------

CERTIFY DISK	802404
--------------	--------

CERTIFY DISK	802405
pdisk1 22222222 00-04-P 2 GB SSA C Physical Disk Drive	
Move cursor onto selection, then press Enter.	
Set or Reset Identify. Select this option to set or reset the Identify indicator on the disk drive.	
Certify. Select this option to start the Certify operation.	
F3=Cancel	F10=Exit

- 3 If you are not sure of the identification (pdisk number) of the disk drive that you want to certify, use the Identify function to get a positive physical identification of the disk drive (see "The Identify Function" on page 3-1). You can further ensure that you have selected the correct disk drive by verifying that the serial number on the front of the disk drive is the same as the serial number displayed on the screen.
- 4 When you are sure that you have selected the correct disk drive, select Certify.

Service Aid Error Codes

If the SSA service aids detect an unrecoverable error, and are unable to continue, one of the following error codes might occur.

SSA01 Not enough using-system memory is available for this service aid to continue. Take one of the actions described here:

- This problem might be caused by a failed application program. Ask the user to end any failed application program, then try to run the service aid again.
- Run diagnostics in Problem Determination mode to the system unit. If you find any problems, solve them, then try to run the service aid again.
- Close down and reboot the using system, then try to run the service aid again.
- Run diagnostics from diskette or CD-ROM to isolate the problem. If you do not find a problem, the operating system might have failed.

SSA02 An unknown error has occurred. Take one of the actions described here:

- Run diagnostics in Problem Determination mode to the system unit. If you find any problems, solve them, then try to run the service aid again.
- If diagnostics fail, or if the same problem occurs when you try the service aid again, run diagnostics from diskette or CD-ROM to isolate the problem. If you do not find a problem, the operating system might have failed.

SSA03 The service aid was unable to open an hdisk. This problem might have occurred because a disk drive has failed or has been removed from the system. Take the actions described here:

1. Use the Configuration Verification service aid (see “Configuration Verification Service Aid” on page 3-14) to determine the location code of the SSA adapter to which the hdisk is attached. (For example, if the location code of the hdisk is 00-03-L, the location code of the SSA adapter is 00-03.)
2. Run the Link Verification service aid (see “Link Verification Service Aid” on page 3-10) to the SSA adapter.
3. If a link failure is indicated by the service aid, go to “MAP: 2320 SSA Link” on page 5-2.

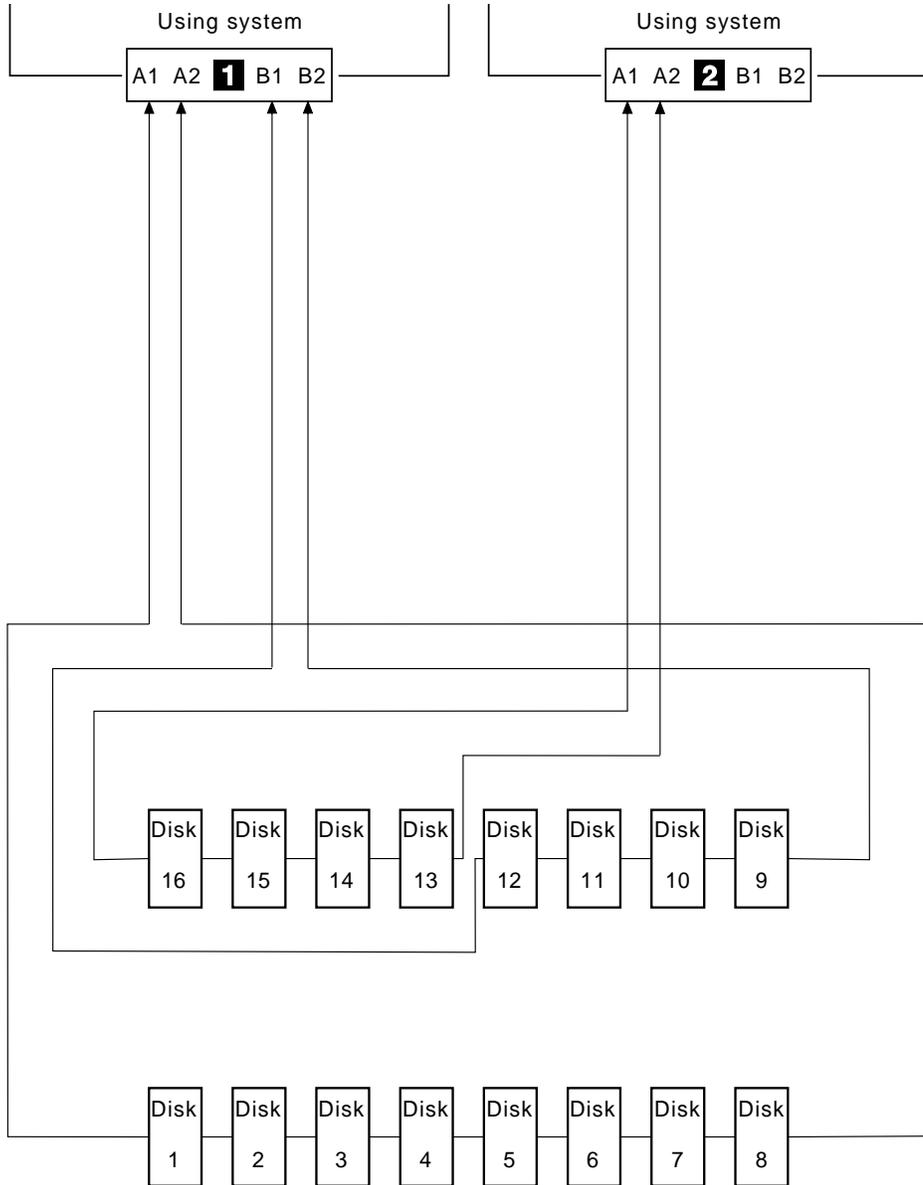
4. If no link failures are indicated, run diagnostics in System Verification mode to each pdisk that is attached to the SSA adapter.

Using the Service Aids for SSA-Link Problem Determination

If you have a problem with an SSA loop, use the Link Verification service aid (see “Link Verification Service Aid” on page 3-10). The following examples show various loops and the associated information that is displayed by the Link Verification service aid.

Example 1. Normal Loops

In the diagram, disk drives 1 through 8 are connected to connectors A1 and A2 of the SSA adapter **1**. Disk drives 9 through 12 are connected to connectors B1 and B2 of the same SSA adapter. Disk drives 13 through 16 are connected to connectors A1 and A2 of a different SSA adapter **2**.



For this example, the Link Verification service aid displays the following information:

```
LINK VERIFICATION 802386
SSA Link Verification for:
  ssa1  00-05  SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port          Status
          A1  A2  B1  B2
[TOP]
pdisk0   nnnnnnnn    0  7                    Good
pdisk1   nnnnnnnn    1  6                    Good
pdisk2   nnnnnnnn    2  5                    Good
pdisk3   nnnnnnnn    3  4                    Good
pdisk4   nnnnnnnn    4  3                    Good
pdisk5   nnnnnnnn    5  2                    Good
pdisk6   nnnnnnnn    6  1                    Good
pdisk7   nnnnnnnn    7  0                    Good
pdisk8   nnnnnnnn          0  3                    Good
pdisk9   nnnnnnnn          1  2                    Good
[MORE]

F3=Cancel      F10=Exit
```

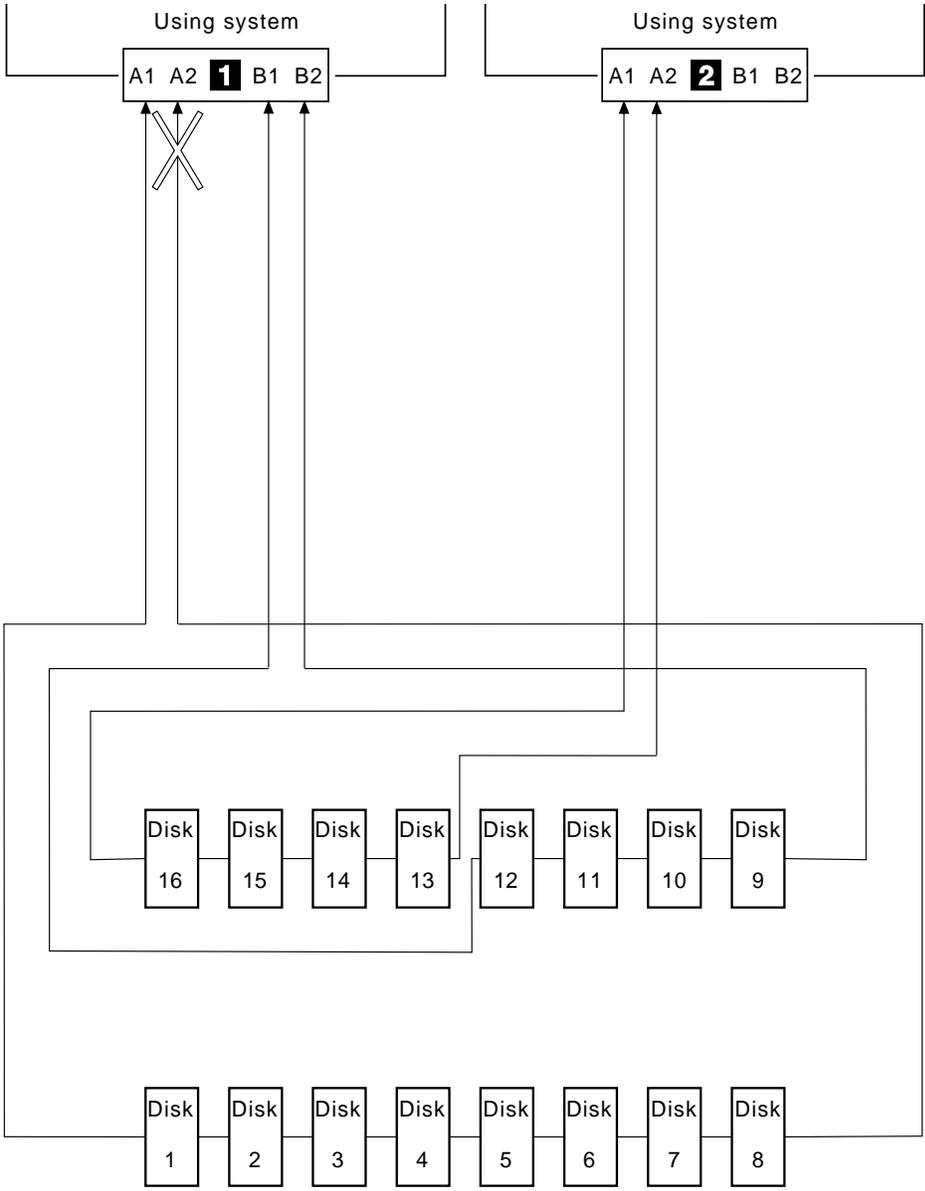
Note: Scroll the display to see all the connected disk drives.

Example 2. Broken Loop (Cable Removed)

Each disk drive normally communicates with the adapter through one data path. Because data can pass around the loop in either direction, the adapter automatically reconfigures the loop to enable communication to continue to each disk drive if the loop becomes broken.

In the diagram, disk drives 1 through 8 should be connected to connectors A1 and A2 of the SSA adapter **1**, but the loop is broken because the SSA cable has been disconnected from connector A2. Disk drives 9 through 12 are connected to connectors B1 and B2 of the same SSA adapter. Disk drives 13 through 16 are connected to connectors A1 and A2 of a different SSA adapter **2**.

Although the broken loop is reported as an error, all the disk drives can still communicate with the using system. Disk drives 1 through 8 can communicate through connector A1 of the SSA adapter **1**. Disk drives 9 through 12 can communicate through connectors B1 and B2 of the same SSA adapter (normal loop); disk drives 13 through 16 can communicate through connectors A1 and A2 of the SSA adapter **2**.



For this example, the Link Verification service aid displays the following information:

```

LINK VERIFICATION 802386
SSA Link Verification for:
  ssa1  00-05  SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port              Status
                                     A1  A2  B1  B2
[TOP]
pdisk0    nnnnnnnn      0                               Good
pdisk1    nnnnnnnn      1                               Good
pdisk2    nnnnnnnn      2                               Good
pdisk3    nnnnnnnn      3                               Good
pdisk4    nnnnnnnn      4                               Good
pdisk5    nnnnnnnn      5                               Good
pdisk6    nnnnnnnn      6                               Good
pdisk7    nnnnnnnn      7                               Good
pdisk8    nnnnnnnn      0   3                           Good
pdisk9    nnnnnnnn      1   2                           Good
[MORE]

F3=Cancel      F10=Exit

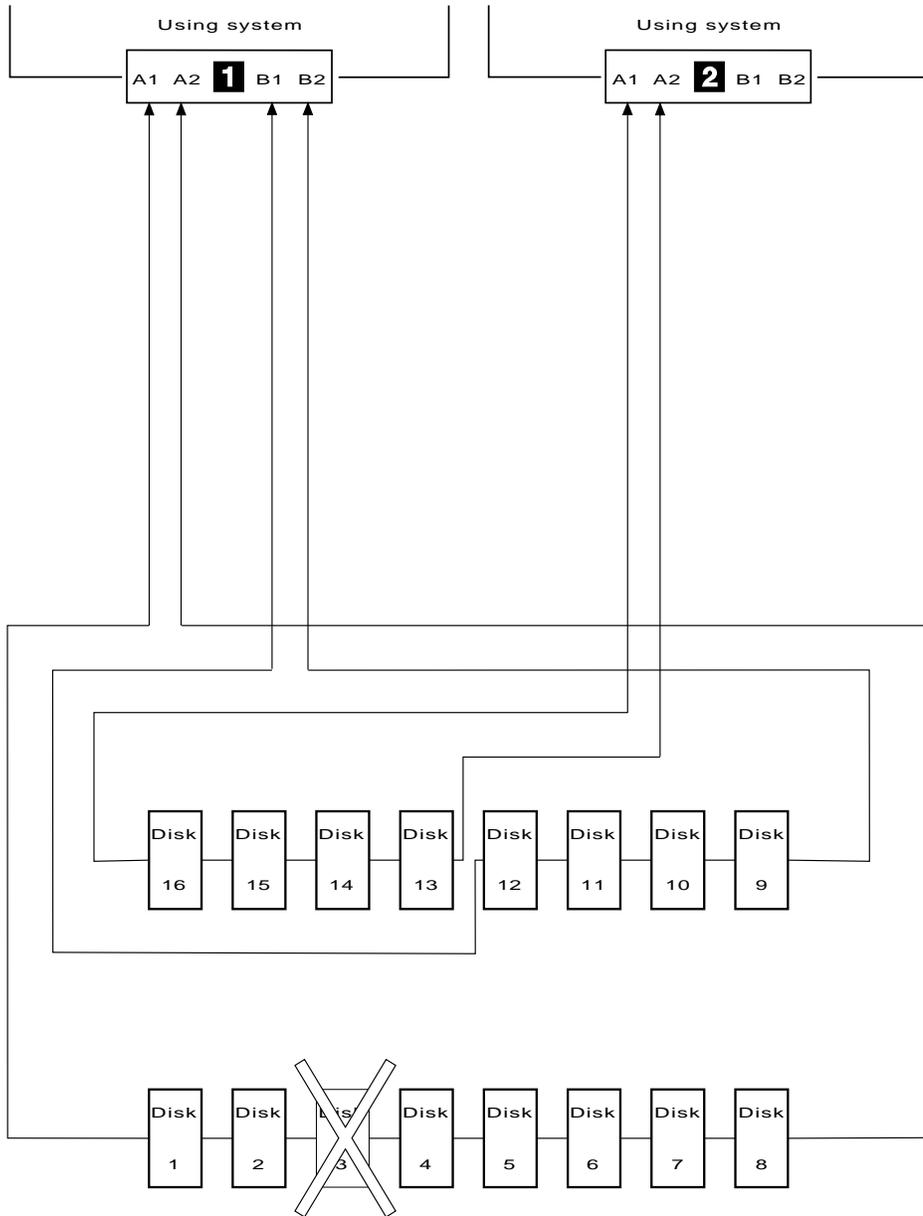
```

Note that the column for adapter connector A2 shows no connections.

Example 3. Broken Loop (Disk Drive Removed)

In the diagram, disk drives 1 through 8 are connected to connectors A1 and A2 of the SSA adapter **1**, but the loop is broken because disk drive number 3 has been removed. Disk drives 9 through 12 are connected to connectors B1 and B2 of the same SSA adapter. Disk drives 13 through 16 are connected to connectors A1 and A2 of a different SSA adapter **2**.

Although the missing disk drive is reported as an error, all the remaining disk drives can still communicate with the using system. Disk drives 1 and 2 can communicate through connector A1 of the SSA adapter **1**. Disk drives 4 through 8 can communicate through connector A2 of the SSA adapter. Disk drives 9 through 12 can communicate through connectors B1 and B2 of the same SSA adapter (normal loop); disk drives 13 through 16 can communicate through connectors A1 and A2 of the SSA adapter **2**.



For this example, the Link Verification service aid displays the following information:

```
LINK VERIFICATION 802386
SSA Link Verification for:
  ssa1  00-05  SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port      Status
          A1  A2  B1  B2
[TOP]
pdisk0   nnnnnnnn    0                Good
pdisk1   nnnnnnnn    1                Good
?????
pdisk3   nnnnnnnn    4                Good
pdisk4   nnnnnnnn    3                Good
pdisk5   nnnnnnnn    2                Good
pdisk6   nnnnnnnn    1                Good
pdisk7   nnnnnnnn    0                Good
pdisk8   nnnnnnnn          0  3            Good
pdisk9   nnnnnnnn          1  2            Good
[MORE]

F3=Cancel      F10=Exit
```

Note that the missing disk drive (pdisk2) is represented by a line of question marks.

Finding the Physical Location of a Device

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

Finding the Device When Service Aids Are Available

To help you find the correct physical disk drive, the SSA service aids include an Identify function. This function, when selected, causes the Check light of the selected disk drive to flash. It also causes the Subsystem Check light (if present) of the unit containing the selected disk drive to flash.

Some devices, (for example, adapters) do not have Check lights. To find such a device, you can either use the Identify function to identify devices that are next to the SSA adapter on the SSA link, or use the procedure described in "Finding the Device When No Service Aids Are Available."

Finding the Device When No Service Aids Are Available

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

The range of port (P) values depends on the adapter; these are defined in the *Adapters, Devices, and Cables* manual.

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

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

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

Chapter 4. SSA Problem Determination Procedures

SSA problem determination procedures are provided by power-on self-tests (POSTs), service request numbers (SRNs), and maintenance analysis procedures (MAPs). Some of these procedures use the system service aids that are described in Chapter 3 on page 3-1.

Installing SSA Extensions to Standalone Diagnostics

Attention: This section is relevant only if the using system has AIX Version 3.2.5 installed. AIX Versions 4.1.3 and above already contain the SSA extensions to standalone diagnostics.

Diagnostics and service aids for the SSA subsystem are not included in level 2.4.3 of the standalone diagnostic package. These additional diagnostics and service aids (SSA extensions) are supplied on a supplemental diagnostic diskette. To install the SSA extensions:

1. Using the stand-alone diagnostic diskettes or the CD-ROM, start the using-system diagnostics. (See the *Common Diagnostics Information* manual for instructions.)

The FUNCTION SELECTION menu is displayed.

2. Select DIAGNOSTIC ROUTINES

The DIAGNOSTIC MODE SELECTION menu is displayed.

3. Select SYSTEM VERIFICATION.

The DIAGNOSTIC SELECTION menu is displayed.

4. Select READ ANOTHER DIAGNOSTIC DISKETTE.

5. Insert the supplemental diskette into the diskette drive.

6. Press **Enter**.

The SSA extensions to the standalone diagnostics are installed and the SSA devices configured.

7. Press the Cancel-function key to go to the DIAGNOSTIC OPERATING INSTRUCTIONS menu.

Note: The identification of the Cancel-function key is displayed on the screen.

8. Press **Enter** to go to the FUNCTION SELECTION menu.

9. Select the function that you need (diagnostics or service aids).

Service Request Numbers (SRNs)

Service request numbers (SRNs) are generated by the system error-log analysis, system configuration code, diagnostics, and customer problem-determination procedures. SRNs help you to identify the cause of a problem, the failing field-replaceable units (FRUs), and the service actions that might be needed to solve the problem.

The SRN Table

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

SRN	The service reference number.
FRU List	The FRU or FRUs that might be causing the problem.
%	How likely it is (by percentage) that the FRU is causing the problem.
Problem	A description of the problem and the action you must take.

Abbreviations used in the table are:

DMA	Direct memory access
FRU	Field-replaceable unit
IOCC	Input/output channel controller
PAA	P = Adapter port number AA = SSA address (see also "Finding the Device When No Service Aids Are Available" on page 3-31)
POS	Programmable option select (POS registers)
POST	Power-On Self-Test

Using the SRN Table

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

1. Locate the SRN in the table. If you cannot find the SRN, you have a problem with the diagnostics, the microcode, or the documentation. Call your support center for assistance.
2. Read carefully the "Action" you must do for the problem. *Do not exchange adapters unless you are instructed to do so.*
3. Normally exchange only one adapter at a time. Always use instructions provided with the system unit when exchanging adapters. After each

adapter is exchanged, go to “MAP: 2410 SSA – Repair Verification” on page 5-18 to verify the repair.

Software and Microcode Errors

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

1. Make a note of the contents of the error log for the device that has the problem.
2. Go to the using-system service aids and select Display Vital Product Data to display the VPD of the failing system. Make a note of the VPD for all the SSA adapters and disk drives.
3. Report the problem to your support center. The center can tell you whether you have a known problem, and can, if necessary, provide you with a correction for the software or microcode.

SRN	FRU List	%	Problem
20PAA	Device (unit <i>Installation and Service Guide</i>). SSA adapter card (using-system <i>Installation and Service Guide</i>). External SSA cables Internal SSA connections (unit <i>Installation and Service Guide</i>).	45 45 6 4	Description: An open SSA link has been detected. Action: Run the Link Verification service aid to isolate the failure (see "Link Verification Service Aid" on page 3-10). If the SSA service aids are not available, go to the service information for the unit in which the device is installed.
21PAA to 29PAA	Device (unit <i>Installation and Service Guide</i>). SSA adapter card (using-system <i>Installation and Service Guide</i>). External SSA cables Internal SSA connections (unit <i>Installation and Service Guide</i>).	45 45 6 4	Description: An SSA 'Threshold exceeded' link error has been detected. Action: Go to "MAP: 2323 SSA – Intermittent Link Error" on page 5-13.
2A002	Device (unit <i>Installation and Service Guide</i>). SSA adapter card (using-system <i>Installation and Service Guide</i>).	50 50	Description: Async code 02 has been received. Probably, a software error has occurred. Action: Go to "Software and Microcode Errors" on page 4-3 before exchanging any FRUs.
2A003	Device (unit <i>Installation and Service Guide</i>). SSA adapter card (using-system <i>Installation and Service Guide</i>).	50 50	Description: Async code 03 has been received. Probably, a software error has occurred. Action: Go to "Software and Microcode Errors" on page 4-3 before exchanging any FRUs.
2A004	Device (unit <i>Installation and Service Guide</i>). SSA adapter card (using-system <i>Installation and Service Guide</i>).	50 50	Description: Async code 04 has been received. Probably, a software error has occurred. Action: Go to "Software and Microcode Errors" on page 4-3 before exchanging any FRUs.
2FFFF	None	–	Description: An async code that is not valid has been received. Action: Go to "Software and Microcode Errors" on page 4-3.
40000	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: The SSA adapter card has failed. Action: Exchange the FRU for a new FRU.

SRN	FRU List	%	Problem
43PAA	Device (unit <i>Installation and Service Guide</i>). SSA adapter card (using-system <i>Installation and Service Guide</i>).	90 10	<p>Description: An SSA device on the link is preventing the completion of the loop configuration.</p> <p>Action: If the SSA service aids are available, run the Link Verification service aid (see "Link Verification Service Aid" on page 3-10) to determine which device is preventing configuration. (That device is the one beyond the last-configured device on an open SSA loop.)</p> <p>If the SSA service aids are not available, note the value of PAA in this SRN, and go to "Finding the Physical Location of a Device" on page 3-31.</p>
44PAA	Device (unit <i>Installation and Service Guide</i>).	100	<p>Description: A device has a 'Failed' status.</p> <p>Action: If the SSA service aids are available, run the Link Verification service aid (see "Link Verification Service Aid" on page 3-10) to find the failing device. Before you exchange the failing device, run diagnostics in System Verification mode to that device to determine the cause of the problem.</p> <p>If the SSA service aids are not available, note the value of PAA in this SRN, and go to "Finding the Physical Location of a Device" on page 3-31. Exchange the failing FRU for a new FRU.</p>

SRN	FRU List	%	Problem
45PAA	Device (unit <i>Installation and Service Guide</i>). External SSA cables Internal SSA connections (unit <i>Installation and Service Guide</i>).	40 40 20	<p>Description: The SSA adapter has detected an open SSA loop. This problem is caused either by a device that is failing, or by a device that has been turned off from another using system on the same SSA loop. (That using system has itself been turned off.)</p> <p>Action: If the SSA service aids are available, run the Link Verification service aid (see "Link Verification Service Aid" on page 3-10) to determine which device is preventing configuration. (That device is the one beyond the last-configured device on an open SSA loop.)</p> <p>If the SSA service aids are not available, note the value of PAA in this SRN, and go to "Finding the Physical Location of a Device" on page 3-31.</p>
48000	None	–	<p>Description: The SSA adapter has detected a link configuration that is not valid.</p> <p>Action: See "SSA Loop Configurations that Are Not Valid" on page 4-9.</p>
50000	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	<p>Description: The SSA adapter failed to respond to the device driver.</p> <p>Action: Exchange the FRU for a new FRU.</p>
50001	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	<p>Description: A data parity error has occurred.</p> <p>Action: Exchange the FRU for a new FRU.</p>
50002	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	<p>Description: An SSA adapter DMA error has occurred.</p> <p>Action: Exchange the FRU for a new FRU.</p>
50004	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	<p>Description: Channel check.</p> <p>Action: Exchange the FRU for a new FRU.</p>
50005	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	<p>Description: A software error has occurred.</p> <p>Action: Go to "Software and Microcode Errors" on page 4-3 before exchanging the FRU.</p>

SRN	FRU List	%	Problem
50006	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: A channel check has occurred. Action: Exchange the FRU for a new FRU.
50007	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: The IOCC detected an internal error. Action: Exchange the FRU for a new FRU.
50008	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: Unable to read or write the POS registers. Action: Exchange the FRU for a new FRU.
50010	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: An SSA adapter or device drive protocol error has occurred. Action: Go to "Software and Microcode Errors" on page 4-3 before exchanging the FRU.
50012	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: The SSA adapter microcode has hung. Action: Run diagnostics in System Verification mode to the SSA adapter. If the diagnostics fail, exchange the FRU for a new FRU. If the diagnostics do not fail, go to "Software and Microcode Errors" on page 4-3 before exchanging the FRU.
50100	None	–	Description: An attempt was made to log an error against a pdisk that is not available to the using system. Action: This problem has occurred for one of the following reasons: <ul style="list-style-type: none"> • A user has deleted a pdisk from the system configuration. In such an instance, the hdisk that is related to the pdisk continues to operate normally. If the disk drive module tries to log an error, however, this SRN (50100) is produced. Give the cfgmgr command to return the pdisk to the system configuration. • A device has tried to log an error during system configuration. To find the failing device, run diagnostics to the devices that are connected to this SSA adapter.

SRN	FRU List	%	Problem
60000	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: The SSA adapter is missing from the expected configuration. Action: Verify that the SSA adapter card is installed in the expected slot of the using system. If it is in the expected slot, exchange the FRU for a new FRU. If it is not in the expected slot, give the diag -a command, and answer the questions that are displayed.
60240	None	–	Description: A configuration problem has occurred. Action: A device cannot be configured, for some unknown reason. Go to the START MAP for the unit in which the device is installed. If no problem is found, go to “Software and Microcode Errors” on page 4-3.
7XXXX	None	–	Description: An SSA device is missing from the expected configuration of the SSA loop. Action: Go to the service information for the unit in which the missing unit should be installed. Note: In this SRN, an X represents a digit 0 through F.
D4000	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: The diagnostics cannot configure the SSA adapter. Action: Exchange the FRU for a new FRU.
D4100	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: The diagnostics cannot open the SSA adapter. Action: Exchange the FRU for a new FRU.
D4300	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: The diagnostics have detected an SSA adapter POST failure. Action: Exchange the FRU for a new FRU.

SRN	FRU List	%	Problem
D44XX	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: The diagnostics have detected that the SSA adapter has corrupted the microcode, but cannot download a new version of the microcode. Action: Exchange the FRU for a new FRU. Note: In this SRN, an X represents a digit 0 through F.
DFFFF	SSA adapter card (using-system <i>Installation and Service Guide</i>).	100	Description: A command or parameter that has been sent or received is not valid. This problem is caused either by the SSA adapter, or by an error in the microcode. Action: Go to "Software and Microcode Errors" on page 4-3 before exchanging the FRU.

SSA Loop Configurations that Are Not Valid

Note: This section is related to SRN 48000.

SRN 48000 shows that the SSA loop contains more devices or adapters than are allowed. The maximum numbers allowed depend on the adapter; the *Adapters, Devices, and Cables Manual* contains these details for each adapter.

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

1. Turn off the using system.
2. Review the configuration that you are trying to make, and determine why that configuration is not valid.
3. Correct your configuration by reconfiguring the SSA cables or by removing the excess devices or adapters from the loop.
4. Turn on the using system.

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

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

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

2. Review the configuration that you are trying to make, and determine why that configuration is not valid.
3. Correct your configuration by reconfiguring the SSA cables or by removing the excess devices or adapters from the loop.

Chapter 5. SSA Maintenance Analysis Procedures (MAPs)

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

The following MAPs are discussed in this chapter:

How to Use these MAPs

Attention: Unless the using system needs to be turned off for some other reason, *do not turn off the using system when servicing an SSA loop*. Unit power cables and external SSA cables that connect the devices to the using system can be disconnected while that system is running.

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

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

MAP: 2320 SSA Link

This MAP helps you to isolate FRUs that are causing an SSA loop problem between a device and the SSA adapter, or between two devices. If you are not familiar with SSA loops, read the section Chapter 2 on page 2-1 before using this MAP. Chapter 2 explains SSA links, strings, and loops.

Attention: Unless the using system needs to be turned off for some other reason, *do not turn off the using system when servicing the SSA loop.* Unit power cables and external SSA cables that connect the devices to the using system can be disconnected while that system is running.

Step 1

(From steps 4 on page 5-3 and 10 on page 5-11; and from the START MAPs for units in which SSA devices are installed.)

Are the system service aids available?

- NO** Go to step 2.
 - YES** Go to step 5 on page 5-3.
-

Step 2

(From step 1)

Does any device have its Ready light off or flashing (two seconds on, two seconds off)?

- NO** Go to step 3 on page 5-3.
- YES** Go to the service information for the unit that contains the disk drive.

Step 3

(From step 2 on page 5-2)

Observe the lights on the SSA adapters in the using systems.

Does any SSA adapter have either, or both, of its lights off or flashing?

NO No trouble found.

YES Go to step 4.

Step 4

(From step 3)

Is the SSA adapter in a different using system from the one that reported the original fault?

NO In the sequence shown, exchange the following FRUs for new FRUs. Ensure that for *each* FRU exchange, you go to “MAP: 2410 SSA – Repair Verification” on page 5-18 to verify the repair.

1. If present, the external SSA cables that are attached to the connectors on each side of the light that is flashing (or off) on the SSA adapter.
2. The devices at the other end of these external SSA cables (see the service information for the unit that contains the device).
3. The adapter whose light is off or flashing (see the *Installation and Service Guide* for the using system).

YES Go to the using system that contains the SSA adapter, and return to step 1 of this MAP.

Step 5

(From step 1 on page 5-2)

Run the Link Verification service aid (see “Link Verification Service Aid” on page 3-10), and select the appropriate SSA adapter from the displayed Link Verification adapter menu.

If the service aid detects pdisks for the adapter you have selected, a list of pdisks is displayed. The diagram shows an example list:

```
LINK VERIFICATION 802386
SSA Link Verification for:
  ssa1 00-05 SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#  Adapter Port  Status
          A1  A2  B1  B2
[TOP]
pdisk0   nnnnnnnn   0  7           Good
pdisk1   nnnnnnnn   1  6           Good
pdisk2   nnnnnnnn   2  5           Good
pdisk3   nnnnnnnn   3  4           Good
pdisk4   nnnnnnnn   4  3           Good
pdisk5   nnnnnnnn   5  2           Good
pdisk6   nnnnnnnn   6  1           Good
pdisk7   nnnnnnnn   7  0           Good
pdisk8   nnnnnnnn           0  3           Good
pdisk9   nnnnnnnn           1  2           Good
]MORE[

F3=Cancel      F10=Exit
```

If the service aid cannot detect any pdisks, a message is displayed.

```
LINK VERIFICATION                                802385
Move cursor onto selection, then press Enter.
LINK VERIFICATION                                80238
Move cursor onto selection, then press <Enter>.

ssa0      00-02  SSA Adapter
          +-----+
          |
          | No pdisks are in the 'Available' state.
          |
          | If you are running the diagnostics in Concurrent
          | Mode run 'cfgmgr' to ensure that all pdisks are
          | configured before selecting this option.
          |
          | If pdisks cannot be configured then go to the
          | START page in the SSA Subsystem Service Guide.
          |
          | F3=Cancel      F10=Exit      Enter
          +-----+
F3=Cancel
```

Are any pdisks listed for the selected SSA adapter?

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

- No physical disks are connected to this SSA adapter:
 1. Ensure that the external SSA cables are correctly connected to the units in which the devices are installed and to the SSA adapter.
 2. Go to “MAP: 2410 SSA – Repair Verification” on page 5-18 to verify the repair.
- All the disk drives are turned off. Go to the START MAP for the unit in which the SSA devices are installed.
- The SSA adapter is failing:
 1. Exchange the SSA adapter for a new one (see the using-system *Installation and Service Guide*).
 2. Go to “MAP: 2410 SSA – Repair Verification” on page 5-18 to verify the repair.

YES Go to step 6.

Step 6

(From step 5 on page 5-3)

Observe the Status column on the screen. If the status of any pdisk is 'Power', that pdisk has detected a loss of redundant power or cooling. In the example shown here, pdisk4 has detected such a loss.

```

LINK VERIFICATION                                     802386
SSA Link Verification for:
  ssa1  00-05  SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical   Serial#       Adapter Port
                                     A1  A2  B1  B2
[TOP]
pdisk0    nnnnnnnn    0  7
pdisk1    nnnnnnnn    1  6
pdisk2    nnnnnnnn    2  5
pdisk3    nnnnnnnn    3  4
pdisk4    nnnnnnnn    4  3
pdisk5    nnnnnnnn    5  2
pdisk6    nnnnnnnn    6  1
pdisk7    nnnnnnnn    7  0
pdisk8    nnnnnnnn          0  3
pdisk9    nnnnnnnn          1  2
[MORE]

F3=Cancel      F10=Exit
  
```

Does one of the pdisks have a 'Power' status?

NO Go to step 7 on page 5-8.

YES Go to the START MAP for the unit in which the SSA device is installed.

Step 7

(from step 6 on page 5-6)

Observe the Status column on the screen. If the status of any pdisk is 'Failed', that pdisk is failing. In the example shown here, pdisk4 is failing.

```
LINK VERIFICATION 802386
SSA Link Verification for:
  ssa1  00-05  SSA ADAPTER
To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port      Status
          A1  A2  B1  B2
[TOP]
pdisk0    nnnnnnnn    0  7                Good
pdisk1    nnnnnnnn    1  6                Good
pdisk2    nnnnnnnn    2  5                Good
pdisk3    nnnnnnnn    3  4                Good
pdisk4    nnnnnnnn    4  3                Failed
pdisk5    nnnnnnnn    5  2                Good
pdisk6    nnnnnnnn    6  1                Good
pdisk7    nnnnnnnn    7  0                Good
pdisk8    nnnnnnnn           0  3                Good
pdisk9    nnnnnnnn           1  2                Good
[MORE]

F3=Cancel      F10=Exit
```

Is one of the pdisks failing?

NO Go to step 8 on page 5-9.

- YES**
1. Use the Identify function (as instructed on the screen) to find the failing pdisk. See "Finding the Physical Location of a Device" on page 3-31 if you need more information about finding the disk drive.
 2. Exchange the disk drive for a new one.
 3. Go to "MAP: 2410 SSA – Repair Verification" on page 5-18 to verify the repair.

Step 8

(From step 7 on page 5-8)

Observe the list of pdisks the screen. A row of question marks (?????) shows that a link in one of the loops is broken. If two rows of question marks are displayed, two links are broken, one in each loop. In the example shown here, pdisk2 is missing.

```
LINK VERIFICATION 802386
SSA Link Verification for:
  ssa1  00-05  SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port      Status
          A1  A2  B1  B2
[TOP]
pdisk0    nnnnnnnn      0                Good
pdisk1    nnnnnnnn      1                Good
?????
pdisk3    nnnnnnnn      4                Good
pdisk4    nnnnnnnn      3                Good
pdisk5    nnnnnnnn      2                Good
pdisk6    nnnnnnnn      1                Good
pdisk7    nnnnnnnn      0                Good
pdisk8    nnnnnnnn      0  3            Good
pdisk9    nnnnnnnn      1  2            Good
[MORE]

F3=Cancel      F10=Exit
```

Is a link broken between two pdisks?

NO Go to step 9 on page 5-10.

- YES**
1. Use the Identify function (as instructed on the screen) to find the pdisks that are on each side of the broken link. See "Finding the Physical Location of a Device" on page 3-31 if you need more information about finding the disk drive.
 2. Go to the service information for the unit that contains the device.

Step 9

(From step 8 on page 5-9)

Observe the list of pdisks the screen. A row of question marks (?????) shows where a configured pdisk is not present for a particular SSA address. A row of asterisks (*****) shows an unconfigured device.

```
LINK VERIFICATION 802386
SSA Link Verification for:
  ssa1  00-05  SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#  Adapter Port  Status
          A1  A2  B1  B2
[TOP]
pdisk0    nnnnnnnn    0                Good
pdisk1    nnnnnnnn    1                Good
pdisk2    nnnnnnnn    2                Good
pdisk3    nnnnnnnn    3                Good
?????
*****
pdisk5    nnnnnnnn    3                Good
pdisk6    nnnnnnnn    2                Good
pdisk7    nnnnnnnn    1                Good
pdisk8    nnnnnnnn    0                Good
pdisk9    nnnnnnnn    0  3            Good
          nnnnnnnn    1  2            Good
[MORE]

F3=Cancel      F10=Exit
```

Is a link broken between a pdisk and an unconfigured device?

NO Go to step 10 on page 5-11.

- YES**
1. Use the Identify function (as instructed on the screen) to find the pdisk that is next to the broken link.
 2. Find the unconfigured device by following the cable.
 3. In the sequence shown, exchange the following FRUs for new FRUs. Ensure that for *each* FRU exchange, you go to “MAP: 2410 SSA – Repair Verification” on page 5-18 to verify the repair.
 - a. Device (see the service information for the unit that contains the device).
 - b. The appropriate external SSA cable.
 - c. Unconfigured device.

Step 10

(From step 9 on page 5-10)

Observe the adapter port columns on the screen. In the example, the column that represents the A2 connector of the SSA adapter is blank. The link is therefore broken between connector A2 and the pdisks.

```

LINK VERIFICATION                                     802386
SSA Link Verification for:
  ssa1 00-05 SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port
                                     A1  A2  B1  B2
                                     Status
[TOP]
pdisk0    nnnnnnnn      0
pdisk1    nnnnnnnn      1
pdisk2    nnnnnnnn      2
pdisk3    nnnnnnnn      3
pdisk4    nnnnnnnn      4
pdisk5    nnnnnnnn      5
pdisk6    nnnnnnnn      6
pdisk7    nnnnnnnn      7
?????
pdisk8    nnnnnnnn      0  3
pdisk9    nnnnnnnn      1  2
[MORE]

F3=Cancel      F10=Exit
  
```

Is the link broken between the selected SSA adapter and a pdisk?

- NO** The link is broken between two unconfigured devices.
1. Find one of the unconfigured devices (probably an SSA adapter), which can be identified by its flashing light.
 2. To further isolate the problem, run the service aids on the using system in which that device is installed.
 3. Go to step 1 on page 5-2 of this MAP.
- YES** In the sequence shown, exchange the following FRUs for new FRUs. Ensure that for *each* FRU exchange, you go to "MAP: 2410 SSA – Repair Verification" on page 5-18 to verify the repair.
- At the using-system:
1. The appropriate external SSA cable.
 2. At the unit to which the external SSA cable is attached:
 - a. Disk drives, dummy disk drives, or similar parts (see the service information for the unit that contains the disk drives, dummy disk drives, or similar parts)
 - b. Signal card or similar part.
 3. The SSA adapter (see the using-system *Installation and Service Guide*).

MAP: 2323 SSA – Intermittent Link Error

This MAP helps you to isolate FRUs that are causing an intermittent SSA link problem. You are here because you have an SRN from the series 21000 through 29000.

If you are not familiar with the SSA link, read the section Chapter 2 on page 2-1 before using this MAP. Chapter 2 explains SSA links, strings, and loops.

Attention: Unless the using system needs to be turned off for some other reason, *do not turn off the using system when servicing an SSA loop.* Power cables and external SSA cables can be disconnected while that system is running.

Step 1

- a. Run the Link Verification service aid to the SSA adapter for which this error has been logged (see “Link Verification Service Aid” on page 3-10). A list of pdisks, similar to the example given here, is displayed.

```
LINK VERIFICATION                                     802386
SSA Link Verification for:
  ssa0  00-04  SSA ADAPTER
To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port
                                     A1  A2  B1  B2      Status
[TOP]
pdisk1    5AEA8089    0   3          Good
pdisk2    5AEA0035    1   2          Good
pdisk3    5AEA1001    2   1          Good
pdisk4    5AEA1720    3   0          Good

[BOTTOM]
F3=Cancel      F10=Exit
```

Note: On the Link Verification screen, each adapter port is identified by the number of its related connector on the adapter card:

- Adapter port 0 is identified as A1
- Adapter port 1 is identified as A2
- Adapter port 2 is identified as B1
- Adapter port 3 is identified as B2.

SRNs 21000 through 29000 include the adapter port number (0–3).

- b. Go to step 2 on page 5-15.

Step 2

(from step 1 on page 5-13)

- a. Observe the SRN that sent you to this MAP. It is in the series 21PAA through 29PAA (where P is the number of the SSA adapter port, and AA is the SSA address of the device).

Note the value of PAA in the SRN. For example:

If the SRN is 24002, PAA = 002.

If the SRN is 24104, PAA = 104.

- b. Observe the Link Verification screen, and identify the physical device that is represented by PAA in the SRN.

Note: If the SSA address (AA) in the SRN is higher than the highest SSA address that is displayed for the adapter port (P), that address is the address of the SSA adapter.

Read through the following examples if you need help in identifying the device.

Example 1

If the SRN is 24002, the device is connected to adapter port 0 (shown as A1 on the screen), and has an SSA address of 02 (shown as 2 on the screen). In the example screen, that device is pdisk3.

```

LINK VERIFICATION                                     802386

SSA Link Verification for:
ssa0 00-04 SSA ADAPTER

To set or reset Identify, move cursor onto selection, then press Enter.

Physical  Serial#      Adapter Port
                                     A1 A2 B1 B2                               Status
[TOP]
pdisk1   5AEA8089      0  3                               Good
pdisk2   5AEA0035      1  2                               Good
pdisk3   5AEA1001      2  1                               Good
pdisk4   5AEA1720      3  0                               Good

[BOTTOM]
F3=Cancel      F10=Exit

```

Example 2

If the SRN is 24104, the device (in theory) is connected to adapter port 1 (shown as A2 on the screen). The device, however, has an SSA address of 04. That address is higher than the highest address that is displayed for adapter port 1. The device is, therefore, the SSA adapter.

- c. Go to step 3 on page 5-17.

Step 3

(from step 2 on page 5-15)

The problem is in the SSA link between the device that you identified in step 2 and the device that is on the same adapter port (P), but whose SSA address has a value of 1 less than AA ($AA - 1$).

For example, in step 3, SRN 24002 identified pdisk3. The SSA address of pdisk3 is 02; the address ($AA - 1$) of the other device on the link is, therefore, 01. SSA address 01 is the address of pdisk2. SRN 24002 indicates, therefore, that link errors have been detected between pdisk2 and pdisk3.

Similarly, SRN 24104 identified the SSA adapter. The SSA address of the adapter is 04. The address of the other device is, therefore, 03. SSA address 03 is the address of pdisk1. SRN 24104 indicates, therefore, that link errors have been detected between adapter port A2 and pdisk1.

Exchange, in the sequence shown, the following FRUs for new FRUs. Ensure that for *each* FRU exchange, you go to “MAP: 2410 SSA – Repair Verification” on page 5-18 to verify the repair.

1. One of the two devices that are identified by the SRN.
2. The other of the two devices.
3. The internal SSA connections of the unit or units in which the devices are installed.
4. The external SSA cable.

MAP: 2410 SSA – Repair Verification

This MAP helps you to verify a repair after a FRU has been exchanged for a new one.

Attention: Unless the using system needs to be turned off for some other reason, *do not turn off the using system when servicing an SSA link or a unit in which SSA devices are installed.* Unit power cables and external SSA cables that connect devices to the using system can be disconnected while that system is running.

Step 1

(from steps 4, 5, 7, 9, and 10, in “MAP: 2320 SSA Link”;
step 3 in “MAP: 2323 SSA – Intermittent Link Error”)

Before you arrived at this MAP, you exchanged one or more FRUs for new FRUs. Some of those FRUs have Power lights (for example, disk drive modules and fan-and-power-supply assemblies). Check whether all those Power lights are on.

Do all the FRUs you have exchanged have their Power lights on (where applicable)?

- NO**
1. Exchange, for a new one, the FRU whose Power light is off.
 2. Go to step 2 on page 5-19.
- YES** Go to step 2 on page 5-19.

Step 2

(from step 1 on page 5-18)

Are all Check lights off?

- NO** Go to the START MAP for the unit in which the device with its check light on is installed.
- YES** 1. Run diagnostics, in System Verification mode, to the device that reported the problem.

Notes:

- a. Do not run Advanced Diagnostics; otherwise, errors are logged on other using systems that share the same loop.
- b. If you have just exchanged a disk drive module or an SSA adapter, you might need to run `cfgmgr` to restore the device to the system configuration.

If the original problem was not reported by a device, run diagnostics to each SSA adapter in the using system.

2. Run the Product Topology service aid (a non-SSA system service aid).

Note: If you do not run this service aid, the diagnostics might create an SRN for a problem that has already been solved.

Chapter 6. SSA Enhanced 4-Port Adapter and Subsystems: Technical Reference

SSA Subsystem Overview

Device Drivers

There are two types of device drivers used to support an SSA subsystem: the SSA adapter device driver which deals with the SSA adapter and SSA head device drivers which deal with devices attached to the SSA adapter. The SSA disk device driver is an example of an SSA head device driver.

Responsibilities of the SSA Disk Device Driver

The SSA disk device driver supports SSA disks connected to an SSA adapter. It provides the following:

- Standard block I/O to SSA logical disks represented as hdisks.
- Character mode I/O to SSA logical disks represented as rdisks.
- Error reporting from SSA physical disks represented as pdisks.
- Diagnostics and service interface to SSA physical disks represented as pdisks
- Re-issue of commands in the event of an adapter reset.

Responsibilities of the SSA Adapter Device Driver

The SSA adapter device driver provides a consistent interface to all SSA head device drivers, of which the SSA disk device driver is an example.

The SSA adapter device driver presents commands destined for SSA devices to the relevant adapter, detects their completion, and communicates this back to the originator of the command.

SSA Adapter Device Driver / Head Device Driver Interface

The SSA head device driver communicates with the SSA adapter device driver using the following sequence:

1. Opens the required instance of the SSA adapter device driver using the **fp_open** kernel service.
2. Calls the **fp_ioctl** kernel service to issue the **SSA_GET_ENTRY_POINT** operation to the opened adapter.

3. Calls the function **SSA_IPNDirective** whose address was returned by the **ioctl** operation. All communication with the SSA device is carried out using these calls to **SSA_IPNDirective**.
4. Closes the adapter using the **fp_close** kernel service.

Trace Formatting

The SSA adapter device driver and the SSA disk device driver can both make entries in the kernel trace buffer. The hook ID for the SSA adapter device driver is 45A. The hook ID for the SSA disk device driver is 45B. For information on how to use the kernel trace feature, refer to the **trace** command for the kernel debug program.

SSA Adapter Device Driver

Purpose

Supports the SSA adapter.

Syntax

```
#include /usr/include/sys/ssa.h
```

```
#include /usr/include/sys/devinfo.h
```

Description

The `/dev/ssan` special file provides an interface to allow SSA device drivers to access SSA devices. It manages the adapter resources so that multiple SSA device drivers can access devices on the same SSA adapter simultaneously. SSA adapters are accessed through the special files `/dev/ssa0`, `/dev/ssa1`, ..., `/dev/ssan`.

Configuring Devices

All of the SSA adapters connected to the system will normally be configured automatically during the system boot sequence.

SSA Adapter ODM Attributes

The SSA adapter has a number of attributes which can be displayed using the `lsattr` command:

ucode Holds the filename of the microcode package file supplying the version of adapter microcode currently loaded in an SSA adapter.

bus_intr_level Holds the value of bus interrupt level to be used by the SSA adapter device driver for this adapter.

dma_lvl Holds the value of DMA arbitration level to be used by the SSA adapter device driver for this adapter.

bus_io_addr Holds the value of bus I/O base address of the adapter's registers to be used by the SSA adapter device driver for this adapter.

dma_bus_mem Holds the value of bus I/O base address of the adapter's DMA address to be used by the SSA adapter device driver for this adapter.

dbmw Holds the size of the DMA area to be used by the SSA adapter device driver for this adapter. The value of this attribute may be changed using the **chdev** command. The default value is a compromise between allowing the adapter a large enough DMA area so that it can perform efficiently and allowing other adapters sufficient DMA area to be configured. The default value is appropriate for normal use. A larger DMA area might improve performance if a SSA device is attached to the system which required large quantities of outstanding I/O in order to achieve the best performance.

bus_mem_start Holds the value of the bus-memory start address to be used by the SSA adapter device driver for this adapter.

intr_priority Holds the value of interrupt priority to be used by the SSA adapter device driver for this adapter.

daemon Specifies whether or not to start the SSA adapter daemon. If the attribute is set to TRUE then the daemon will be started when the adapter is configured. The daemon holds the adapter device driver open even if it is not in use by the operating system.

This allows the adapter device driver to reset the adapter card if the software running on it should experience an unrecoverable problem. It also allows the adapter device driver to log errors against the adapter.

This is useful if the adapter is part of an SSA loop which is being used by another adapter since in this case an adapter failure would impact the availability of the SSA loop. The value of this attribute can be changed using the **chdev** command.

Device-Dependent Subroutines

The SSA adapter device driver supports only the **open**, **close** and **ioctl** subroutines. The **read** and **write** subroutines are not supported.

open and close Subroutines

The **open** subroutine is intended primarily for use by the diagnostic commands and utilities.

The SSA adapter device driver is opened by means of the **open** or **openx** subroutine call. If the **openx** subroutine call is used, the *ext* parameter is not used and should be set to 0.

Summary of SSA Error Conditions

If an **open** or **ioctl** subroutine issued to a SSA adapter fails, the subroutine will return -1 and the global variable **errno** will be set to a value from the file **/usr/include/sys/errno.h**.

Possible **errno** values for the SSA adapter device driver are:

EINVAL	Indicates an unknown ioctl was attempted or the parameters supplied were invalid.
EIO	Indicates that an I/O error occurred.
ENOMEM	Indicates that the command could not be completed due to insufficient real memory or insufficient paging space.
ENXIO	Indicates that the requested device does not exist.

Managing Dumps

The SSA adapter device driver is a target for the system dump facility.

The **DUMPQUERY** option returns a minimum transfer size of 0 bytes and a maximum transfer size equal to the DMA area size for the SSA adapter divided by 4.

To be processed, calls to the SSA adapter device driver **DUMPWRITE** option should use the *arg* parameter as a pointer to the **SSA_loreq_t** structure. Using this interface, commands supported by the adapter can be run on a previously started (opened) target device. The *uiop* parameter is ignored by the SSA adapter device driver.

Note: Only the **SsaMCB.MCB_Result** field of the **SSA_loreq_t** structure is set at completion of the **DUMPWRITE**. Error logging is, of necessity, not supported during the dump.

Successful completion of the **dddump** entry point is indicated by a 0. If unsuccessful, the entry point returns one of the following:

EINVAL	Indicates that the adapter device driver was passed a request that was not valid, such as attempting a DUMPSTART option before successfully executing a DUMPINIT option.
EIO	Indicates that the adapter device driver was unable to complete the command due to a lack of required resources or due to an I/O error.
ETIMEDOUT	Indicates that the adapter did not respond with status before the passed command time-out value expired.

Files

/dev/ssa0, /dev/ssa1, ..., /dev/ssan

Provide an interface to allow SSA head device drivers to access SSA devices or adapters.

IOCINFO (Device Information) SSA Adapter Device Driver ioctl Operation

Purpose

Returns a structure defined in the `/usr/include/sys/devinfo.h` file.

Description

The **IOCINFO** **ioctl** operation returns a structure defined in the `/usr/include/sys/devinfo.h` header file. The caller supplies the address to an area of type `struct devinfo` in the *arg* parameter to the **IOCINFO** operation. The `device-type` field for this component is **DD_BUS**; the `subtype` is **DS_SDA**.

The **IOCINFO** operation is defined for all device drivers that use the **ioctl** subroutine, as follows:

The operation returns a **devinfo** structure. The caller supplies the address of this structure in the argument to the **IOCINFO** operation. The device type in this structure is **DD_BUS**, and the subtype is **DS_SDA**. The `flags` field is set to **DF_FIXED**.

Files

`/dev/ssa0, /dev/ssa1, ..., /dev/ssan`

SSA_TRANSACTION SSA Adapter Device Driver ioctl Operation

Purpose

Sends an SSA transaction to an SSA adapter.

Description

The **SSA_Transaction** operation allows the caller to issue an IPN (Independent Packet Network) transaction to a selected SSA adapter. IPN is the language used to communicate with the SSA adapter and is documented in the *SSA Adapter Technical Reference*. The caller must be root or have an effective user ID of root to issue this operation.

The *arg* parameter for the **SSA_Transaction** operation specifies the address of a **SSA_TransactionParms_t** structure. This structure is defined in the **/usr/include/sys/ssa.h** file.

The **SSA_Transaction** operation uses the following fields of the **SSA_TransactionParms_t** structure:

DestinationNode

Contains the target node for the transaction.

DestinationService

Contains the target service on that node.

MajorNumber Major number of the transaction.

MinorNumber Minor number of the transaction.

DirectiveStatusByte

Contains the directive status byte for the transaction. This contains a value defined in **/usr/include/ipn/ipndef.h**. A non-zero value indicates an error.

TransactionResult

Contains the IPN result word returned by IPN for the transaction. This contains values defined in **/usr/include/ipn/ipntra.h**. A non zero value indicates an error.

ParameterDDR Set by the caller to indicate the buffer for parameter data.

TransmitDDR Set by the caller to indicate the buffer for transmit data.

ReceiveDDR Set by the caller to indicate the buffer for received data.

StatusDDR Set by the caller to indicate the buffer for status data.

TimeOutPeriod Number of seconds after which the transaction will be considered as having failed. A value of 0 indicates no time limit. Note that if an operation takes longer to complete than the specified timeout the adapter will be reset in order to purge the command.

WARNING: This is a very low level interface designed for use only by configuration methods and diagnostics software. Use of this interface may result in system hangs, system crashes, system corruption or undetected data loss.

Return Values

When completed successfully, this operation returns a value of 0. Otherwise, a value of -1 is returned and the errno global variable is set to one of the following values:

EIO	Indicates an unrecoverable I/O error.
ENXIO	Indicates an unknown device.
EINVAL	Indicates an unknown command. Indicates a bad buffer type.
EACCESS	Indicates user does not have root privilege.
ENOMEM	Indicates insufficient memory.
ENOSPC	Indicates insufficient file blocks.
EFAULT	Indicates bad user address.

Files

/dev/ssa0, /dev/ssa1, ..., /dev/ssan

SSA_GET_ENTRY_POINT SSA Adapter Device Driver ioctl Operation

Purpose

The **SSA_GET_ENTRY_POINT** operation allows another kernel extension, typically a SSA head device driver, to ascertain the direct call entry point for the SSA adapter device driver. This is the entry point through which the head device driver communicates with the adapter device driver. The address supplied is valid only as long as the calling kernel extension holds an open file descriptor for the SSA adapter device driver. This operation is not valid for a user process.

Description

The *arg* parameter specifies the address of a **SSA_GetEntryPointParms_t** structure in kernel address space. The **SSA_GetEntryPointParms_t** structure is defined in **/usr/include/sys/ssa.h**.

On completion of the operation, the fields within the **SSA_GetEntryPointParms_t** structure are modified as follows:

EntryPoint Address of the direct call entry point for the SSA adapter device driver which is used to submit operations from a head device driver.

InterruptPriority
The off level interrupt priority at which the calling kernel extension will be called back for completion of commands started by calling the direct call entry point.

Return Values

When completed successfully, this operation returns a value of 0. Otherwise, a value of -1 is returned and the **errno** global variable is set to the following value:

EINVAL Indicates that the caller was not in kernel mode.

Files

/dev/ssa0, /dev/ssa1, ..., /dev/ssan

SSA Adapter Device Driver Direct Call Entry Point

Purpose

This direct call entry point allows another kernel extension to send transactions to the SSA adapter device driver. This is not valid for a user process. On completion the caller will be notified by an off level interrupt. See **SSA_GET_ENTRY_POINT** SSA adapter ioctl operation.

Description

The entry point address is the address returned in *EntryPoint* by the **SSA_GET_ENTRY_POINT** ioctl operation. The function takes a single parameter of type **SSA_loreq_t** which is defined in */usr/include/sys/ssa.h*.

The fields of the **SSA_loreq_t** structure are used as follows:

SsaDPB	An array of size SSA_DPB_SIZE which is used by the SSA adapter device driver and should be initialized to all NULLs.
SsaNotify	The address of the function in the SSA head device driver which the SSA adapter device driver will call when the directive has completed.
u0	This is the transaction to be executed. Valid transactions are described in the <i>SSA Adapter Technical Reference</i> .

Return Values

This function does not return errors. The success or failure of the directive can be established by examining the directive status byte and transaction result fields which are set up in the SSA MCB. For details, see *SSA Adapter Technical Reference*.

ssadisk SSA Disk Device Driver

Purpose

Supports Serial Storage Architecture (SSA) disk drives.

Syntax

```
#include <sys/devinfo.h>
#include <sys/ssa.h>
#include <sys/ssadisk.h>
```

Configuration Issues

SSA Logical Disks and SSA Physical Disks

Serial Storage Architecture (SSA) disk drives are represented in AIX as SSA logical disks (**hdisk0**, **hdisk1**.....**hdiskN**) and SSA physical disks (**pdisk0**,**pdisk1**.....**pdiskN**). SSA logical disks represent the logical properties of the disk drive and can have volume groups and filesystems mounted upon them. SSA physical disks represent the physical properties of the disk drive. One SSA physical disk (pdisk) and one SSA logical disk (hdisk) is configured for each SSA disk drive connected to the system. SSA physical disks have the following properties:

- Configured as **pdisk0**, **pdisk1**.....**pdiskn**
- Have errors logged against them in the system error log.
- Support a character special file (**/dev/pdisk0 /dev/pdisk1..../dev/pdiskn**).
- Support the **ioctl** subroutine for servicing and diagnostics functions.
- Will not accept **read** or **write** subroutine calls for the character special file.

SSA logical disks have the following properties:

- Configured as **hdisk0**, **hdisk1**.....**hdiskn**
- Support a character special file (**/dev/rhdisk0, /dev/rhdisk1..../dev/rhdiskn**)
- Support a block special file (**/dev/hdisk0, /dev/hdisk1..../dev/hdiskn**)
- Support the **ioctl** subroutine call for nonservice and diagnostics functions only.
- Will accept the **read** and **write** subroutine call to the special files.
- Can be members of volume groups and have filesystems mounted upon them.

Multiple Adapters

SSA subsystems allow a disk drive to be controlled by up to 2 adapters in each host system they are attached to. This provides 2 paths to each disk drive connected to the adapters and allows the SSA subsystem to survive an adapter failure. If such a failure occurs, the SSA disk device driver will switch to the alternate adapter, if there is one, without returning an error to any working application.

Each time the SSA disks are configured, the SSA disk device driver is informed which path or paths are available to each disk drive and which adapter is to be used as the primary path. By default, primary paths to disk drives are shared equally among the adapters to balance the load. This static load balancing is performed once, when the devices are configured for the first time. The user may modify the primary path using the **chdev** command.

Because of the dynamic nature of the relationship between SSA adapters and disk drives, SSA pdisks and hdisks are not children of an adapter but of a SSA router, **ssar**. This does not represent any actual hardware. **ssar** exists merely to be the parent device for the SSA logical disks and SSA physical disks.

Note: When the SSA disk device driver switches from using one adapter to using the other adapter to communicate with a disk it issues a command which breaks any SSA-SCSI reserve condition which may exist on that disk. If there are multiple host CPUs connected to the SSA disks, SSA-SCSI reserve should therefore not be used as the sole method for controlling access to the SSA disks. Fencing has been provided as an alternative method for controlling access to disks in a multi host environment.

Configuring SSA Disk Drive Devices

SSA disk drives are represented in AIX as SSA logical disks (**hdisk0**, **hdisk1.....hdiskn**) and SSA physical disks (**pdisk0,pdisk1.....pdiskn**). The properties of each are described in the SSA Subsystem Overview.

Normally, all the disk drives connected to the system will be configured automatically by the system boot process and the user will need to take no action to configure them.

Since some SSA devices may be connected to the SSA network while the system is running without taking the system off line it may be necessary to configure SSA disks after the boot process has completed. In this case the devices should be configured by running the configuration manager with the **cfgmgr** command.

An exception is to configure a specific device with a specific name. This can be achieved using the **mkdev** command.

In order to use **mkdev** to configure a SSA physical disk, it will be necessary to specify the following information.

Parent ssar
Class pdisk
Subclass ssar
Type These can be listed using the entering `lsdev -P -c pdisk -s ssar`.

ConnectionLocation

15-character unique identifier of the disk drive.

If the disk drive has already been defined, the unique identity can be determined using the **lsdev** command as follows:

1. Enter `lsdev -Ccpdisk -r connwhere`.
2. Select the 15-character unique identifier for which characters 5 to 12 match those on the front of the disk drive.

Otherwise the 15-character unique identifier can be constructed from the 12-character SSA UID on the label on the side of the disk drive suffixed by the 3 characters "00D".

In order to use **mkdev** to configure a SSA logical disk it will be necessary to specify the following information:

Parent ssar
Class disk
Subclass ssar
Type hdisk

ConnectionLocation

15-character unique identifier of the disk drive.

If the disk drive has already been defined, the unique identity can be determined using the **lsdev** command as follows:

1. Run the command `lsdev -Ccdisk -r connwhere`.
2. Select the 15-character unique identifier for which characters 5 to 12 match those on the front of the disk drive.

Otherwise the 15-character unique identifier can be constructed from the 12-character SSA UID on the label on the side of the disk drive suffixed by the 3 characters "00D".

Device Attributes

SSA logical disks and SSA physical disks and the ssar router have a number of attributes which can be displayed using the **lsattr** command.

Attributes of the SSA Router, **ssar**

node_number

This must be set on systems which are using SSA fencing or the SSA Disk Concurrent Mode of Operation Interface.

Both of these features of the SSA disk device driver are used only in configurations which have more than one host system connected to the same SSA disk drives. In configurations where only one host system is connected to the SSA disk drives this attribute has no effect.

For configurations using SSA Fencing or the SSA Disk Concurrent Mode of Operation Interface this attribute should be set to a different value on each host in the configuration.

Note: After this attribute has been modified it is necessary to reboot the system for it to take effect.

Attributes Common to SSA Logical and SSA Physical Disks

adapter_a Specifies the name of one adapter connected to the device or **none** if no adapter is currently connected as adapter_a.

adapter_b Specifies the name of one adapter connected to the device or **none** if no adapter is currently connected as adapter_b.

primary_adapter

Specifies whether adapter_a or adapter_b is to be the primary adapter for this device.

This attribute may be modified using the **chdev** command to one of the values adapter_a, adapter_b or **assign**. If the value is set to **assign**, static load balancing will be performed when this device is made available and the system will set the value to either adapter_a or adapter_b.

connwhere_shad

Holds a copy of the value of the *connwhere* parameter for this disk drive. SSA disks drives cannot be identified by the location field given by **lsdev**. This is because they are connected in a loop and do not have hardware-selectable addresses like SCSI devices. The only means of identification of SSA devices is their serial number and this is written in the connwhere field of the CuDv entry for the device. Providing this **connwhere_shad**

attribute, which shadows the *connwhere* value, means the user can display the *connwhere* value for an SSA device for a pdisk or hdisk.

- pvid** Holds the ODM copy of the PVID for this disk drive for an hdisk.
- queue_depth** Specifies the maximum number of commands the SSA disk device driver dispatches for a single disk drive for an hdisk. This attribute can be modified using the **chdev** command. The default value is appropriate for normal operating conditions.
- reserve_lock** Specifies whether the SSA disk device driver locks the device with a reservation when it is opened for an hdisk.

Device-Dependent Subroutines

Typical physical volume operations are implemented using the **open**, **read**, **write**, and **close** subroutines.

open, read, write and close Subroutines

The **open** subroutine is intended primarily for use by the diagnostic commands and utilities. Appropriate authority is required for execution. If an attempt is made to run the **open** subroutine without the proper authority, the subroutine returns a value of -1 and sets the **errno** global variable to a value of **EPERM**.

The *ext* parameter passed to the **openx** subroutine selects the operation to be used for the target device. The **/usr/include/sys/ssadisk.h** file defines possible values for the *ext* parameter.

The *ext* parameter can contain any combination of the following flag values logically ORed together:

SSADISK_PRIMARY

Opens the device using the primary adapter as the path to the device. As a result of hardware errors the device driver may automatically switch to the secondary path if one exists. This can be prevented by additionally specifying the **SSADISK_NOSWITCH** flag.

This flag is supported for both SSA logical disks and SSA physical disk drives. This flag cannot be specified together with **SSADISK_SECONDARY**.

SSADISK_SECONDARY

Opens the device using the secondary adapter as the path to the device. As a result of hardware errors the device driver may automatically switch to the primary path if one exists. This can

be prevented by additionally specifying the **SSADISK_NOSWITCH** flag.

This flag is supported for both SSA logical disks and SSA physical disk drives. This flag is supported for both SSA logical disks and SSA physical disk drives. This flag cannot be specified together with **SSADISK_PRIMARY**.

SSADISK_NOSWITCH

If more than one adapter provides a path to the device, the device driver normally switches from one adapter to the other as part of its error recovery. This flag prevents this from happening.

This flag is supported for both SSA logical disks and SSA physical disk drives.

SSADISK_FORCED_OPEN

Forces the open regardless of whether another initiator has the device reserved. If another initiator has the device reserved, the reservation is broken. In other respects, the **open** operation runs normally.

This flag is supported only for SSA logical disks. This flag cannot be specified together with **SSADISK_FENCEMODE**.

SSADISK_RETAIN_RESERVATION

Retains the reservation of the device after a **close** operation by not issuing the release. This flag prevents other initiators from using the device unless they break the host machine's reservation.

Note: this does not cause the device to be explicitly reserved during the close if it was not reserved while it was open.

This flag is supported only for SSA logical disk drives. This flag cannot be specified together with **SSADISK_FENCEMODE**.

SSADISK_NO_RESERVE

Prevents the reservation of a device during an **openx** subroutine call to that device. This operation is provided so a device can be controlled by two processors that synchronize their activity by their own software means.

This flag overrides the setting of the attribute `reserve_lock` if the value of the attribute is yes. This flag is supported only for SSA logical disk drives. This flag cannot be specified together with **SSADISK_FENCEMODE**

SSADISK_SERVICEMODE

Opens the physical disk in service mode. This wraps the SSA links either size of the indicated physical disk allowing it to be removed from the loop for service without causing errors on the loops.

This flag is supported only for SSA physical disk drives. This flag cannot be specified together with **SSADISK_SCSIMODE**.

SSADISK_SCSIMODE

Opens an SSA physical disk in SCSI passthrough mode. This allows **SSADISK_IOCTL_SCSI** ioctls to be issued to the physical disk.

This flag is supported only for SSA physical disk drives. This flag cannot be specified together with **SSADISK_SERVICEMODE**.

SSADISK_NORETRY

Opens an SSA physical disk in no-retry mode.

When a physical disk has been opened in this mode, commands will not be retried if there is an error. This flag is supported only for SSA physical disk drives.

SSADISK_FENCEMODE

Opens an SSA logical disk drive in fence mode. The open succeeds even if the host is fenced out from access to the disk drive. Only ioctls can be issued to the device while it is open in this mode. Any attempt to read from or write to a device opened in this mode will be rejected with an error.

This flag is supported only for SSA logical disk drives. This flag cannot be specified together with **SSADISK_NO_RESERVE**, **SSADISK_FORCED_OPEN**, or **SSADISK_RETAIN_RESERVATION**.

"SSA Options to the openx Subroutine" in *AIX Version 4.1 Kernel Extensions and Device Support Programming Concepts* gives more specific information on the open operations.

readx and writex Subroutines

The **readx** and **writex** subroutines provide additional parameters affecting the raw data transfer. These subroutines pass the *ext* parameter, which specifies request options. The options are constructed by logically ORing zero or more of the following values:

HWRELOC	Indicates a request for hardware relocation (safe relocation only).
UNSAFEREL	Indicates a request for unsafe hardware relocation.
WRITEV	Indicates a request for write verification.

Error Conditions

Possible **errno** values for **ioctl**, **open**, **read**, and **write** subroutines when using the **scdisk** device driver include:

EBUSY	Indicates one of the following circumstances: <ul style="list-style-type: none"> • An attempt was made to open an SSA physical device which is already opened by another process. • The target device is reserved by another initiator.
EFAULT	Indicates an illegal user address.
EINVAL	Indicates one of the following circumstances: <ul style="list-style-type: none"> • The read or write subroutine supplied an <i>nbyte</i> parameter that is not an even multiple of the block size. • The data buffer length exceeded the maximum defined in the devinfo structure for an ioctl subroutine operation. • The openext subroutine supplied an unsupported combination of extension flags. • An unsupported ioctl subroutine operation was attempted. • An attempt was made to configure a device that is still open. • An illegal configuration command has been given. • The data buffer length exceeded the maximum defined for a strategy operation.
EIO	Indicates one of the following circumstances: <ul style="list-style-type: none"> • The target device cannot be located or is not responding. • The target device has indicated an unrecovered hardware error.
ESOFT	Indicates that the target device has reported a recoverable media error.
EMEDIA	Indicates that the target device has encountered an unrecovered media error.

- ENODEV** Indicates one of the following circumstances:
- An attempt was made to access an undefined device.
 - An attempt was made to close an undefined device.
- ENOTREADY** Indicates that an attempt was made to open a SSA physical device in service mode while a SSA logical device which uses it was in use.
- ENXIO** Indicates one of the following circumstances:
- The **ioctl** subroutine supplied an invalid parameter.
 - The **openext** subroutine supplied extension flags which selected a non-existent or non-functional adapter path.
 - A **read** or **write** operation was attempted beyond the end of the fixed disk drive.
- EPERM** Indicates the attempted subroutine requires appropriate authority.
- ENOCONNECT**
- Indicates that the host has been fenced out from access to this device.
- ENOMEM** Indicates that the system has insufficient real memory or insufficient paging space to complete the operation.
- ENOLCK** Indicates that an attempt was made to open a device in service mode which is in an SSA network which is not a loop.

Special Files

The **ssadisk** device driver uses raw and block special files in performing its functions.

Warning: Data corruption, loss of data, or loss of system integrity (system crash) will occur if devices supporting paging, logical volumes, or mounted file systems are accessed using block special files. Block special files are provided for logical volumes and disk devices and are solely for system use in managing file systems, paging devices, and logical volumes. These files should not be used for other purposes.

The special files used by the **ssadisk** device driver include the following (listed by type of device):

- SSA logical disk drives:

/dev/hdisk0, /dev/hdisk1, ..., /dev/hdiskn

Provide an interface to allow SSA device drivers block I/O access to logical SSA disk drives.

/dev/rhdisk0, /dev/rhdisk1, ..., /dev/rhdiskn

Provide an interface to allow SSA device drivers character access (raw I/O access and control functions) to logical SSA disk drives.

- SSA physical disk drives:

/dev/pdisk0, /dev/pdisk1, ..., /dev/pdiskn

Provide an interface to allow SSA device drivers character access (control functions only) to physical SSA disks drives.

Note: The prefix **r** on a special file name indicates the drive is accessed as a raw device rather than a block device. Performing raw I/O with an SSA logical disk requires that all data transfers be in multiples of the device block size. Also, all **lseek** subroutines that are made to the raw device driver must result in a file pointer value that is a multiple of the device block size.

IOCINFO (Device Information) SSA Disk Device Driver ioctl Operation

Purpose

Returns a structure defined in the `/usr/include/sys/devinfo.h` file.

Description

The **IOCINFO** operation returns a structure defined in the `/usr/include/sys/devinfo.h` header file. The caller supplies the address to an area of type `struct devinfo` in the *arg* parameter to the **IOCINFO** operation. The `device-type` field for this component is **DD_SCDISK**; the subtype is **DS_PV**. The information returned includes the block size in bytes and the total number of blocks on the disk drive.

Files

/dev/pdisk0, /dev/pdisk1, ..., /dev/pdisk n

Provide an interface to allow SSA device drivers to access SSA physical disks drives.

/dev/pdisk0, /dev/pdisk1, ..., /dev/pdisk n

Provide an interface to allow SSA device drivers to access SSA logical disks drives.

SSADISK_ISAL_CMD (ISAL Command) SSA Disk Device Driver ioctl Operation

Purpose

Provides a means to send Independent Network Storage Access Language (ISAL) commands to an SSA physical or logical disk drive. ISAL comprises a set of commands which allow a program to control and access a storage device. The ISAL command set is described in the *SSA Adapter Technical Reference*.

Description

The **SSADISK_ISAL_CMD** operation allows the caller to issue an ISAL command to a selected logical or physical disk drive. The caller must be root or have an effective user ID of root to issue this ioctl.

The following ISAL commands (minor function codes), defined in `/usr/include/ipn/ipnsal.h` may be issued:

FN_ISAL_Read	FN_ISALWrite
FN_ISAL_Format	FN_ISAL_Progress
FN_ISAL_Lock	FN_ISAL_Unlock
FN_ISAL_Test	FN_ISAL_SCSI
FN_ISAL_Download	FN_ISAL_Fence

Note: Some of these commands are not valid for one or other of SSA hdisks or SSA pdisks. This is not checked by the device driver but by the adapter card. If the caller attempts to send a command to a device for which it is not valid, the result returned by the adapter will be non-zero. The exception to this is that the device driver will reject with **EINVAL** any attempt to send a **FN_ISAL_Fence** command to a SSA physical disk.

Note: The **FN_ISAL_SCSI** command is rejected by the adapter with a non-zero result if it is sent to a device that has not been opened with the **SSADISK_SCSIMODE** extension parameter.

The *arg* parameter for the **SSADISK_ISAL_CMD** ioctl is the address of an **ssadisk_ioctl_parms** structure. This structure is defined in the `/usr/include/sys/ssadisk.h` file.

The **SSADISK_ISAL_CMD** ioctl uses the following fields of the **ssadisk_ioctl_parms** structure:

<code>dsb</code>	Contains the directive status byte returned for the command. This contains a value from <code>/usr/include/ipn/ipndef.h</code> . A nonzero value indicates an error.
<code>result</code>	Contains the Independent Packet Network (IPN) result word returned by IPN for the command. This contains values from <code>/usr/include/ipn/ipntra.h</code> . A non-zero value indicates an error.
<code>u0.isal.parameter_descriptor</code>	Set by the caller to indicate the buffer for parameter data.
<code>u0.isal.transmit_descriptor</code>	Set by the caller to indicate the buffer for transmit data.
<code>u0.isal.receive_descriptor</code>	Set by the caller to indicate the buffer for received data.
<code>u0.isal.status_descriptor</code>	Set by the caller to indicate the buffer for status data.
<code>u0.isal.minor_function</code>	Set by the caller to one of the ISAL commands defined in <code>/usr/include/ipn/ipnsal.h</code> and listed above.

Note: Structures are provided in `/usr/include/ipn/ipnsal.h` that can be used to format the contents of the parameter buffer for the various commands. In all cases, the handle which is located in the first four bytes of the parameter buffer will be overwritten by the device driver with the correct handle for the device.

Return Values

If the command was successfully sent to the adapter card this operation returns a value of 0. Otherwise, a value of -1 is returned and the `errno` global variable set to one of the following values:

EIO	Indicates an unrecoverable I/O error.
EINVAL	Indicates either that the caller has specified an ISAL command that is not in the list of supported ISAL commands, or that the caller has attempted to send an FN_ISAL_FENCE command to an SSA physical disk.
EPERM	Indicates that caller did not have an effective user ID (EUID) of 0.
ENOMEM	Indicates that the device driver was unable to allocate or pin enough memory to complete the operation.

If the return code is 0, the result field of the `ssadisk_ioctl_parms` structure is valid. This indicates whether the adapter was able to process the command successfully.

Files

/dev/pdisk0, /dev/pdisk1, ..., /dev/pdiskn

Provide an interface to allow SSA device drivers to access SSA physical disk drives.

/dev/hdisk0, /dev/hdisk1, ..., /dev/hdiskn

Provide an interface to allow SSA device drivers to access SSA logical disk drives.

SSADISK_ISALMgr_CMD (ISAL Manager Command) SSA Disk Device Driver ioctl Operation

Purpose

Provides a means to send Independent Network Storage Access Language (ISAL) Manager commands to an SSA physical or logical disk drive. ISAL comprises a set of commands which allow a program to control and access a storage device. The ISAL command set is described in the *SSA Adapter Technical Reference*.

Description

The **SSADISK_ISALMgr_CMD** operation allows the caller to issue an ISAL command to a selected logical or physical disk. The caller must be root or have an effective user ID of root to issue this ioctl.

The following ISAL commands (minor function codes), defined in `/usr/include/ipn/ipnsal.h` can be issued:

FN_ISALMgr_Inquiry FN_ISALMgr_HardwareInquiry

FN_ISALMgr_GetPhysicalResourceIDs FN_ISALMgrVPDInquiry

FN_ISALMgr_Characteristics FN_ISALMgr_Statistics

FN_ISALMgr_FlashIndicator

The *arg* parameter for the **SSADISK_ISALMgr_CMD** ioctl is the address of an **ssadisk_ioctl_parms** structure. This structure is defined in the `/usr/include/sys/ssadisk.h` file.

The **SSADISK_ISALMgr_CMD** ioctl uses the following fields of the **ssadisk_ioctl_parms** structure:

- `dsb` Contains the directive status byte returned for the command. This contains a value from `/usr/include/ipn/ipnndef.h`. A non zero value indicates an error.
- `result` Contains the IPN result word returned by IPN for the command. This contains values from `/usr/include/ipn/ipntra.h`. A non zero value indicates an error.
- `u0.isal.parameter_descriptor`
 Set by the caller to indicate the buffer for parameter data.
- `u0.isal.transmit_descriptor`
 Set by the caller to indicate the buffer for transmit data.

`u0.isal.receive_descriptor`
Set by the caller to indicate the buffer for received data.

`u0.isal.status_descriptor`
Set by the caller to indicate the buffer for status data.

`u0.isal.minor_function`
Set by the caller to one of the ISAL Manager Commands defined in `/usr/include/ipn/ipnsal.h` and listed above.

Note: Structures are provided in `/usr/include/ipn/ipnsal.h` this can be used to format the contents of the parameter buffer for the various commands. In all cases, the resource ID which is located in the first four bytes of the parameter buffer will be overwritten by the device driver with the correct Resource ID for the device.

Return Values

If the command was successfully sent to the adapter card, this operation returns a value of 0. Otherwise, a value of -1 is returned and the `errno` global variable set to one of the following values:

EIO Indicates an unrecoverable I/O error.

EINVAL Indicates that the caller has specified an ISAL manager command that is not in the list of supported ISAL manager commands above.

EPERM Indicates that caller did not have an effective user ID (EUID) of 0.

ENOMEM Indicates that the device driver was unable to allocate or pin enough memory to complete the operation.

If the return code is 0, the result field of the `ssadisk_ioctl_parms` structure is valid. This indicates whether the adapter was able to process the command successfully.

Files

`/dev/pdisk0, /dev/pdisk1, ..., /dev/pdiskn`
Provide an interface to allow SSA device drivers to access physical SSA disks.

`/dev/hdisk0, /dev/hdisk1, ..., /dev/hdiskn`
Provide an interface to allow SSA device drivers to access logical SSA disks.

SSADISK_SCSI_CMD (SCSI Command) SSA Disk Device Driver ioctl Operation

Purpose

Provides a means to send SSA-SCSI Serial Storage Architecture - Small Computer Systems Interface (SSA-SCSI) commands to an SSA physical disk drive that has been opened with the **SSADISK_SCSIMODE** extension flag.

Description

The **SSADISK_SCSI_CMD** operation allows the caller to issue an SSA-SCSI command to a selected physical disk. The caller must be root or have an effective user ID of root to issue this ioctl.

The *arg* parameter for the **SSADISK_ISALMgr_CMD** operation is the address of an **ssadisk_ioctl_parms** structure. This structure is defined in the **/usr/include/sys/ssadisk.h** file.

The **SSADISK_SCSI_CMD** operation uses the following fields of the **ssadisk_ioctl_parms** structure:

- | | |
|--------------------------------------|---|
| <code>dsb</code> | Contains the directive status byte returned for the command. This contains value from /usr/include/ipn/ipndef.h . A non zero value indicates an error. |
| <code>result</code> | Contains the IPN result word returned by IPN for the command. This contains values from /usr/include/ipn/ipntra.h . A non zero value indicates an error. |
| <code>u0.scsi.data_descriptor</code> | Set by the caller to describe the buffer for any data transferred by the scsi command. If no data is transferred then the length of the buffer should be set to 0. |
| <code>u0.scsi.direction</code> | Set by the caller to indicate the direction of the transfer. Valid values are:

SSADISK_SCSI_DIRECTION_NONE
No data transfer is involved for the command.

SSADISK_SCSI_DIRECTION_READ
Data is transferred from the subsystem into host memory. |

SSADISK_SCSI_DIRECTION_WRITE

Data is transferred from host memory into the subsystem.

- `u0.scsi.identifier` Identifies the SSA-SCSI logical unit number to which the command should be sent. The format of this field is as defined for SSA_SCSI (bit 7=1 identifies the Target routine, bits 6-0 identify the Logical Unit routine).
- `u0.scsi.cdb` Set by the caller to define the SCSI Command Descriptor Block (CDB) for the command.
- `u0.scsi.cdb_length` Set by the caller to indicate the length of the CDB.
- `u0.scsi.scsi_status` Contains the SCSI status returned for the command.

The device driver has no knowledge of the contents of the CDB, simply passing it on to the hardware. The user should consult the relevant hardware documentation to determine what CDBs are valid for a particular SSA physical disk.

Return Values

If the command was successfully sent to the adapter card then this operation returns a value of 0. Otherwise, a value of -1 is returned and the **errno** global variable set to one of the following values:

- EIO** Indicates either an unrecoverable I/O error or that the SCSI command was not recognised as valid by the hardware.
- EINVAL** The `u0.scsi.cdb_length` field in the `ssadisk_ioctl_parms` structure was set to an invalid length or the `u0.scsi.direction` field in the `ssadisk_ioctl_parms` structure was set to an invalid value.
- EPERM** Indicates that caller did not have an effective user ID (EUID) of 0.
- ENOMEM** Indicates that the device driver was unable to allocate or pin enough memory to complete the operation.

If the return code is 0, the result field of the **ssadisk_ioctl_parms** structure is valid. This indicates whether the adapter was able to process the command successfully.

Files

/dev/pdisk0, /dev/pdisk1, ..., /dev/pdiskn

Provide an interface to allow SSA device drivers to access physical SSA disks.

/dev/hdisk0, /dev/hdisk1, ..., /dev/hdiskn

Provide an interface to allow SSA device drivers to access logical SSA disks.

SSADISK_LIST_PDISKS SSA Disk Device Driver ioctl Operation

Purpose

Provides a means to determine which SSA physical disk drives make up a SSA logical disk drive.

Description

The **SSADISK_LIST_PDISKS** operation can be issued by any user to a SSA logical disk (hdisk). It returns a list of the SSA physical disks (pdisks) which make up the specified logical disk drive.

The *arg* parameter for the **SSADISK_LIST_PDISKS** operation is the address of an **ssadisk_ioctl_parms** structure. This structure is defined in the **/usr/include/sys/ssadisk.h** file.

The **SSADISK_LIST_PDISKS** operation uses the following fields of the **ssadisk_ioctl_parms** structure:

- `u0.list_pdisks.name_array`
Pointer to array of **ssadisk_name_desc_t** structures in the caller's memory. It is this array which is filled in with the names of the hdisks on return from the ioctl.
- `u0.list_pdisks.name_array_elements`
Set by the caller to indicate the number of elements in the array pointed at by the `u0.list_pdisks.name_array` parameter.
- `u0.list_pdisks.name_count`
On return from the ioctl, this indicates the number of names in the name array pointed at by `u0.list_pdisks.name_array`.
- `u0.list_pdisks.resource_count`
On return from the ioctl this indicates the number of physical disk drives which make up the logical disk drive. This may be less than `u0.list_pdisks.name_count` if not enough elements were allocated in the name array in the user's memory to hold all the pdisk names, or one or more of the physical disks which make up the logical disk have not been configured as AIX physical disk drives.

Return Values

If the command was successfully sent to the adapter card, this operation returns a value of 0. Otherwise, a value of -1 is returned and the **errno** global variable set to one of the following values:

- EIO** Indicates an unrecoverable I/O error.
- ENOMEM** Indicates that the device driver was unable to allocate or pin enough memory to complete the operation.

Files

- /dev/pdisk0, /dev/pdisk1, ..., /dev/pdisk n**
Provide an interface to allow SSA device drivers to access SSA physical disks.
- /dev/hdisk0, /dev/hdisk1, ..., /dev/hdisk n**
Provide an interface to allow SSA device drivers to access SSA logical disks.

SSA Disk Concurrent Mode of Operation Interface

The SSA subsystem supports the ability to broadcast one-byte message codes from one host to all other hosts connected to the same disk drive. This message-passing capability can be used to synchronize access to the disk drive. The operating system has a concurrent mode interface to use this hardware functionality.

The concurrent mode of operation requires that a top kernel extension runs on all hosts sharing a disk drive. The top kernel extensions communicate with each other via the SSA subsystem using the concurrent mode interface of the SSA disk device driver. This interface allows a top kernel extension to send and receive messages between hosts.

The concurrent mode interface consists of an entry point in both the SSA disk device driver and the top kernel extension. Two ioctls register and unregister the top kernel extension with the SSA disk device driver. The SSA Disk Device Driver's entry point provides the means to send messages as well as lock, unlock, and test disk drive. The top kernel extension entry point processes interrupts, including receiving messages from other hosts.

Note: In order for the concurrent mode interface to work, the **node_number** attribute of the ssar router must be set to a different, non zero, value on each of the hosts sharing a disk drive. After the **node_number** has been assigned. The host must be rebooted for it to take effect.

Device Driver Entry Point

The SSA disk device driver concurrent mode entry point sends commands from the top kernel extension for a specified SSA Disk. The top kernel extension calls this entry point directly. The **DD_CONC_REGISTER** ioctl operation registers entry points.

This entry point function takes one argument, which is a pointer to a **conc_cmd** structure, that is defined in the **/usr/include/sys/ddconc.h** file. The **conc_cmd** structures must be allocated by the top kernel extension. The concurrent mode command operation is specified by the **cmd_op** field in the **conc_cmd** structure and can have the following values. For each operation, the **devno** field of the **conc_cmd** structure specifies the appropriate SSA disk drive.

DD_CONC_SEND_REFRESH

Broadcasts the one-byte message code specified by the message field of the **conc_cmd** structure. The code is sent to all hosts connected to the SSA disk drive.

DD_CONC_LOCK

Locks the specified SSA disk drive for this host only. No other hosts will be able to modify data on the disk drive.

DD_CONC_UNLOCK

Unlocks the SSA disk drive. Other hosts can lock and modify data on the disk drive.

DD_CONC_TEST

Issues a test disk command to verify that the SSA disk drive is still accessible to this host.

The concurrent mode entry point returns a value of **EINVAL** if any of the following are true:

- The top kernel extension did not perform a **DD_CONC_REGISTER** operation.
- The **conc_cmd** pointer is null.
- The devno field in the **conc_cmd** structure is invalid.
- The cmd_op field in the **conc_cmd** structure is not one of the four valid values previously listed.

If the concurrent mode entry point accepts the **conc_cmd** structure, the entry point returns a value of 0. If the SSA disk device driver does not have resources to issue the command, the driver queues the command until resources are available. The concurrent commands queued in the SSA disk device driver are issued before any read or write operations queued by the driver's strategy entry point.

The completion status of the concurrent mode commands are returned to the top kernel extension's concurrent mode interrupt handler entry point.

Top Kernel Extension Entry Point

The top kernel extension must have a concurrent mode command interrupt handler entry point, which is called directly from the SSA disk device driver's interrupt handler. This function can take four arguments: the **conc_cmd** pointer, and the cmd_op, message_code, and devno fields. The **conc_cmd** pointer points to a **conc_cmd** structure. These arguments must be of the same type specified by the conc_intr_addr function pointer field in the **dd_conc_register** structure.

The following valid concurrent mode commands are defined in the **/usr/include/sys/ddcon.h** file. For each, the devno field specifies the appropriate SSA disk drive.

DD_CONC_SEND_REFRESH

Indicates the **DD_CONC_SEND_REFRESH** device driver entry point completed. The error field in the **conc_cmd** structure contains the return code necessary for the completion of this command. The possible values are defined in the **/usr/include/sys/errno.h** file. The **conc_cmd** pointer argument to the top kernel extension's special interrupt handler entry point is non-null. The **cmd_op**, **message_code**, and **devno** fields are 0.

DD_CONC_LOCK

Indicates the **DD_CONC_SEND_LOCK** device driver entry point completed. The error field in the **conc_cmd** structure contains the return code necessary for the completion of this command. The possible values are defined in the **/usr/include/sys/errno.h** file. The **conc_cmd** pointer argument to the top kernel extension's special interrupt handler entry point is non-null. The **cmd_op**, **message_code**, and **devno** fields are zero.

DD_CONC_UNLOCK

Indicates the **DD_CONC_UNLOCK** device driver entry point completed. The error field in the **conc_cmd** structure contains the return code necessary for the completion of this command. The possible values are defined in the **/usr/include/sys/errno.h** file. The **conc_cmd** pointer argument to the top kernel extension's special interrupt handler entry point is non-null. The **cmd_op**, **message_code**, and **devno** fields are zero.

DD_CONC_TEST

Indicates the **DD_CONC_TEST** device driver entry point completed. The error field in the **conc_cmd** structure contains the return code necessary for the completion of this command. The possible values are defined in the **/usr/include/sys/errno.h** file. The **conc_cmd** pointer argument to the top kernel extension's special interrupt handler entry point is non-null. The **cmd_op**, **message_code**, and **devno** fields are zero.

DD_CONC_RECV_REFRESH

Indicates a message with **message_code** was received for the SSA disk drive specified by the **devno** argument. The **conc_cmd** argument is null for this operation.

DD_CONC_RESET

Indicates the SSA disk drive specified by the **devno** argument was reset, and all pending messages or commands have been flushed. The argument **conc_cmd** is null for this operation.

- The concurrent command interrupt handler routine must have a short path length because it runs on the SSA disk device driver interrupt level. If substantial command processing is needed, then this routine should schedule an off-level interrupt to its own off-level interrupt handler.
- The top kernel extension must have an interrupt priority no higher than the SSA disk device driver's interrupt priority.
- The concurrent command interrupt handler routine might need to disable interrupts at INTCLASS0 if it is expected to use concurrent mode on SSA disk drive and some disks of different types. The other type of disk needs its own device driver to support the concurrent mode.
- A kernel extension that uses the **DD_CONC_REGISTER** ioctl must issue a **DD_CONC_UNREGISTER** ioctl before closing the SSA disk drive.

SSA Disk Fencing

SSA disk fencing is a facility which is provided in the SSA subsystem to allow multiple hosts to control access to a common set of disks.

Using the fencing commands provided by the hardware it is possible to exclude individual hosts from accessing a particular disk. The access list for different disks are independent of one another.

Fencing is essentially a function provided by the hardware and manipulated using the hardware commands, but the device driver does have some involvement.

The SSA disk device driver supports fencing by allowing the **FN_ISAL_FENCE** command, which is defined in the *SSA Adapter Technical Reference*, to be issued to SSA logical disks using the **SSADISK_ISALCMD ioctl** operation.

In order to use fencing, the **node_number** attribute of the **ssar** router must be set to a different value on each host which is participating in fencing. Note that after setting **node_number** the host must be rebooted for the new value to take effect.

By default, the value of **node_number** is 0. This value has particular significance because it is not possible to exclude a host with node number 0 from access to the disk. Thus if a disk is moved from a machine which has been using fencing to a machine which is not involved in fencing, the new machine will be able to communicate with the disk.

If a host attempts to open a disk from which it has been denied access using the **open** subroutine, the return code will be -1 and the global variable **errno** will be set to the value **ENOCONNECT**. Likewise, if an application already has a SSA logical disk open but since the open, it has been fenced out then calls to the read or write subroutine will fail, with **errno** set to **ENOCONNECT**.

The hardware fencing commands provide for a facility, to forcibly break through a fence. This command can be issued using the **SSADISK_ISALCMD ioctl** operation but it is necessary first to open the disk. A disk from which the host has been excluded can be opened by using the **openx** subroutine and specifying the **SSADISK_FENCEMODE** extension flag as described in the section on SSA disk device driver device-dependent subroutines. While open in this mode, no read or write operations will be permitted.

If a host has been excluded from access to a disk using fencing but that disk is also reserved to another host the reservation takes precedence. The return code from the **open** subroutine will be -1 and the global variable **errno** will be

set to **EBUSY**. If the host attempts to break through the reservation by passing the ext parameter **SSADISK_FORCED_OPEN** to the **openx** subroutine, the reservation will be broken but the open will fail with **errno** set to **ENOCNNECT**. In order to break through the fence, the SSA logical disk must be opened in **SSADISK_FENCEMODE** and the **SSADISK_ISALCMD** ioctl operation used to issue the appropriate hardware command to break the fence condition.

Appendix A. Communications Statements

The following statement applies to this product. The statement for other products intended for use with this product appears 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 harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Neither the provider nor the manufacturer are responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

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

European Union (EU) Statement

This product is in conformity with the protection requirements of EU Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. The manufacturer cannot 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 supplied by third parties. Consult with your dealer or sales representative for details on your specific hardware.

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.

International Electrotechnical Commission (IEC) Statement

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

United Kingdom Telecommunications Safety Requirements

This equipment is manufactured to the International Safety Standard EN60950 and as such is approved in the UK under the General Approval Number NS/G/1234/J/100003 for indirect connection to the public telecommunication network.

The network adapter interfaces housed within this equipment are approved separately, each one having its own independent approval number. These interface adapters, supplied by the manufacturer, do not use or contain excessive voltages. An excessive voltage is one which exceeds 70.7 V peak ac or 120 V dc. They interface with this equipment using Safe Extra Low Voltages only. In order to maintain the separate (independent) approval of the manufacturer's adapters, it is essential that other optional cards, not supplied by the manufacturer, do not use main voltages or any other excessive voltages. Seek advice from a competent engineer before installing other adapters not supplied by the manufacturer.

Avis de conformité aux normes du ministère des Communications du Canada

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

Canadian Department of Communications Compliance Statement

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

VCCI Statement

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。

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

This equipment is in the Class 1 category (information equipment to be used in commercial and/or industrial areas) and conforms to the standards set by the Voluntary Control Council For Interference by Data Processing Equipment and Electronic Office Machines aimed at preventing radio interference in commercial and/or industrial areas.

Consequently, when used in a residential area or in an adjacent area thereto, radio interference may be caused to radios and TV receivers, etc.

Read the instructions for correct handling. VCCI-1.

Radio Protection for Germany

Dieses Gerät ist berechtigt in Übereinstimmung mit dem deutschen EMVG vom 9.Nov.92 das EG-Konformitätszeichen zu führen.

Der Aufsteller der Konformitätserklärung ist die IBM Germany.

Dieses Gerät erfüllt die Bedingungen der EN 55022 Klasse A. Für diese 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.

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