

Compaq SANworks

Application Note FC-SW High Availability Configurations for IBM AIX

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FC-SW High Availability Configurations for IBM AIX

Application Note

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Terms Specific to this Application Note

Compaq StorageWorks RAID Array and Enterprise Storage Systems

SANworks Secure Path 2.0 for IBM AIX supports the following Compaq StorageWorks RAID Arrays and Enterprise Storage Array storage systems:

- RA8000/ESA12000
- MA8000/EMA12000
- MA6000

Since more than one storage system is supported, the term *RAID Array storage systems* is used to indicate information applicable to all storage systems.

HSGx0

SANworks Secure Path 2.0 for IBM AIX supports both the HSG80 and the HSG60 controllers. As more than one controller is supported, HSGx0 is used to indicate information applicable to both controllers.

HSGx0 Host Port 2

The HSG80/HSG60 controller Host Port 2 is not currently supported and not used in any of the configurations specified in this document.

Command Line Interpreter

The prompt CLI> is also used to indicate a command to the Command Line Interpreter (CLI).

For example, where the prompt may be:

HSG80>

or

HSG60>

you will see

CLI>

Secure Path 2.0 for IBM AIX Transparent Failover/Multiple-Bus Failover

Transparent failover is an essential part of the StorageWorks Enterprise and RAID Array storage systems feature set. However, Secure Path 2.0 for IBM AIX uses multiple-bus failover topology only.

Introduction

This application note serves as a guide to some High-Availability Fibre Channel Switch (FC-SW) configurations for the following Compaq StorageWorks RAID Arrays and Enterprise Storage Array systems:

- RA8000/ESA12000
- MA8000/EMA12000
- MA6000

The storage systems listed above are used in conjunction with the IBM RS/6000 family of servers running AIX versions 4.3.3, 4.3.2 and 4.2.1.

Clearly, there are many levels of complexity in dealing with servers in light of performance, usage and load as well as the nature and configuration of Fibre Channel switches, and most importantly, the actual configuration of the storage sets that are used by the servers. Each installation or site may have needs that are beyond the scope of this application note, and to that end, we recommend contacting your local Compaq Services representative for on-site consultation.

Visit Our Web Site for the Latest Information

Compaq is continually making additions to its StorageWorks solutions product line. Please check the Compaq web site for more information on the complete line of Fibre Channel storage products, product certification, technical information, updates, and documentation. This information can be accessed at:

www.compaq.com/products/storageworks

Enterprise Network Storage Architecture (ENSA)

Compaq StorageWorks RAID Array storage systems are the latest in fully integrated Fibre Channel RAID storage solutions. These products provide the key initial steps in delivering on Compaq's ENSA vision. ENSA addresses the issues that customers expect to face now and in the future. The products address today's issues including: economical capacity growth, data protection, high availability, increased distance, multi-vendor platform support, and investment protection by being the base for building the ENSA vision.

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StorageWorks RAID Product Overview

The RAID Array storage systems are based on a common architecture and offer customers centralized management, high availability, exceptional performance and scalability in open systems environments. These products provide a Fibre Channel storage solution with industry leading Storage Area Network (SAN) support utilizing both Fibre Channel Switch (FC-SW) and Fibre Channel Arbitrated Loop (FC-AL) topology and technology.

- The RA8000 FC is a mid-range storage system available in a pedestal enclosure for departmental use in the office. It can also be installed in server racks for small data centers. An easy-to-deploy, flexible solution for open systems, the RA8000 supports up to 2.6 TB of storage with two expansion cabinets using a total of 72 disks, each with a capacity of 36GB.
- The ESA12000 FC, designed for the data center, is available in three easy-to-order building blocks, each optimized for specific, high-capacity customer requirements. The ESA12000 FC offers unprecedented levels of storage, scaling in performance and capacity as user requirements increase.
- The MA8000/EMA12000 transitions the RA8000/ESA12000 storage solutions to the new StorageWorks packaging. MA8000/EMA12000 supports the same features as the existing RA8000/ESA12000 including heterogeneous server and operating system platforms; StorageWorks HSG80 Fibre Channel controllers; SANworks data and storage management software and maximum single system configuration of up to 72 drives. The maximum system configuration requires only one cabinet due to the new modular controller (Model 2200) and drive enclosures (Models 4200 and 4300). The new packaging increases the system modularity and footprint economy without requiring changes to the existing SAN infrastructure or the HSG80.
- The Modular Array 6000 (MA6000) is the low-priced member of the MA8000 and EMA12000 product set. As a set member, it is easy and inexpensive to start small and grow the system to full Enterprise capabilities as needs grow. The MA6000 supports the HSG60 RAID Array controller and uses Controller Array Software (ACS) Version 8.5L.

These storage systems incorporate the latest in RAID technology providing RAID levels 0, 1, 0+1, adaptive 3/5, and non-RAID (JBOD) disks. Compaq's implementation of RAID capability assures that data availability will be maintained despite hardware failure. Features such as read ahead cache and mirrored write back cache improve or minimize the affect on performance while preserving data availability and high availability support.

The RAID Array storage systems Solution Software for IBM AIX kits contain the necessary operating system specific software and documentation needed to install, configure, and monitor your storage system. All platform kits include the StorageWorks Command Console (SWCC) for storage management operations including configuring, status inquiry and notification facilities. Additionally, SWCC provides a graphical interface, simplifying the most complex of storage management operations.

IMPORTANT: Secure Path 2.0 for IBM AIX does not currently support Fibre Channel Arbitrated Loop configurations.

StorageWorks RAID Product Details

The RAID Array and Enterprise storage systems controller and ACS versions are shown as follows:

Controller	ACS Version
HSG80	Version 8.5F
HSG60	Version 8.5L

The ACS software is designed to support multiple platforms providing features including: dual controller operation, two controller failover modes – Transparent and Multiple-Bus, mirrored write back cache, read ahead cache, RAID implementation, disk mirroring, and disk partitioning capabilities. In addition, ACS manages host interconnect and protocol services to provide data for event notification and status as displayed by SWCC.

The HSG80 controller has two FC host ports providing up to a total of nearly 200 MB per second of available bandwidth. Disk drives are connected to the controller through 6 UltraSCSI channels providing up to 40 MB per second per channel of available bandwidth. Servers can use multiple host bus adapters (HBAs) to multiple RAID Array storage systems for unlimited storage capacity.

The HSG60 controller has two FC host ports providing up to a total of nearly 80 MB per second of available bandwidth. Disk drives are connected to the controller through 2 UltraSCSI channels providing up to 40 Mbytes per second per channel of available bandwidth. Servers can use multiple host bus adapters (HBAs) to multiple RAID Array storage systems for unlimited storage capacity.

The Command Console client is available on Windows NT/2000. A Storage Window for the HSG80/HSG60 controller supports the ACS and offers integration with Compaq's Insight Manager (CIM). Insight Manager can receive SNMP traps from the Command Console Agent and Insight Manager services can directly launch SWCC for notification or configuring operations.

StorageWorks Secure Path Version 2.0 High Availability Application Options for IBM AIX

StorageWorks Secure Path is a high availability software product providing continuous data access for Compaq StorageWorks RAID Array and Enterprise storage products configured on IBM AIX. Redundant hardware, advanced RAID technology and automated failover capability are used to enhance data availability. Secure Path effectively eliminates controllers, interconnect hardware and host bus adapters as single points of failure in the storage configuration.

The key to Secure Path's functionality is the capability of HSGx0 controllers to operate in the active/active Multiple-bus failover mode. This failover mode allows each controller to be configured on its own bus and to process I/O independently under normal operation. Available storage units may be "preferred" to one or the other of the two controllers which determines which controller path is used for access at system boot time. During runtime, storage units may be moved between paths at anytime using the Secure Path Status and Management Utility (cbxfesm).

Controllers in Multiple-bus failover mode monitor each other and automatically failover storage units from the failed member of a controller pair. The Secure Path software detects the failure of I/O operations to complete on a failed path and automatically re-routes all traffic to the surviving path. Controller and path failover is completed seamlessly, without process disruption or data loss.

The Secure Path management utility provides continuous monitoring capability and identifies failed paths and failed-over storage units. To facilitate static load balancing, storage units can be moved between paths using the Secure Path Status and Management Utility (cbxfesm).

The integration of Secure Path and StorageWorks RAID Array Fibre Channel technology provides the maximum level of fault-tolerance, data availability, and performance required for critical environments.

High Availability Configuration Information

This section provides information about the following topics:

- Reference Documentation
- Configuration Guidelines (Maximums, Assumptions, and General Notes)

Reference Documentation

Table 1 lists related documents supporting RA8000/ESA12000, MA8000/EMA12000 and MA6000 Fibre Channel Storage Systems.

Table 1 Reference Documentation

Topic	Document Title	Order Number
Secure Path		
<i>Secure Path User Guide</i>	<i>Compaq SANworks Secure Path Version 2.0 for IBM AIX Installation and Reference Guide</i>	<i>AA-RLTOA-TE</i>
<i>Secure Path Release Notes</i>	<i>Compaq SANworks Secure Path Version 2.0 for IBM AIX Release Notes</i>	<i>AA-RLT2A-TE</i>
<i>FC-SW High Availability Configurations for IBM AIX Application Note</i>	<i>FC-SW High Availability Configurations for IBM AIX</i>	<i>AA-RN98A-TE (This document)</i>
HSG80		
<i>Solution Software Kit Overview</i>	<i>RA8000/ESA12000 and MA8000/EMA12000 HSG80 Array Controller StorageWorks Solution Software Kit Overview</i>	<i>EK-SOLSR-AA.B01</i>
<i>Solution Software HSG80 Release Notes</i>	<i>Compaq StorageWorks RA8000/ESA12000 and MA8000/EMA12000 HSG80 Solution Software V8.5c for IBM AIX Release Notes</i>	<i>AA-RJ24D-TE</i>
<i>SWCC User Guide</i>	<i>Compaq StorageWorks Command Console V2.3 User Guide</i>	<i>AA-RFA2G-TE</i>
<i>Modula Configuration Guide</i>	<i>Modula Array Configuration Guide</i>	<i>EK-MACON-CA.A01</i>
<i>CLI Reference Manual</i>	<i>HSG80 Array Controller ACS Version 8.5 CLI Reference Manual</i>	<i>EK-HSG85-RG.A01</i>
<i>Maintenance and Service Guide</i>	<i>HSG80 Array Controller ACS Version 8.5 Maintenance and Service Guide</i>	<i>EK-HSG84-SV.C01</i>
<i>Registration</i>	<i>RA7000/8000, ESA10000/12000 and MA8000/EMA12000</i>	<i>EK-RAESA-RC.D01</i>
<i>Installation Guide</i>	<i>Compaq StorageWorks HSG60/HSG80 Array Controller ACS Version 8.5c Solution Software for IBM AIX Installation and Configuration Guide</i>	<i>AA-RNJ8A-TE</i>

Table 1 Reference Documentation

Topic	Document Title	Order Number
<i>StorageWorks Warranty Package</i>	<i>Warranty Terms and Conditions</i>	<i>EK-HSXS-WC.C01</i>
	<i>Warranty Terms and Conditions Addendum</i>	<i>3R-Q178A-3V.B01, 158199-021</i>
HSG60		
<i>Solution Software Kit Overview</i>	<i>MA6000 HSG60 Array Controller Solution Software Kit Overview</i>	<i>AA-RMBDA-TE</i>
<i>Configuration Guide</i>	<i>Modular Array Configuration Guide</i>	<i>EK-MACON-CA.B01</i>
<i>SWCC User Guide</i>	<i>Compaq StorageWorks Command Console V2.3 for MA6000 User guide</i>	<i>AA-RMBCA-TE</i>
<i>CLI Reference Guide</i>	<i>HSG60/HSG80 Array Controller ACS Version 8.5 CLI Reference Guide</i>	<i>EK-HSG85-RG.B01</i>
<i>Service Guide</i>	<i>HSG60/HSG80 Array Controller ACS Version 8.5 Maintenance and Service Guide</i>	<i>EK-HSG84-SV.D01</i>
<i>Registration</i>	<i>MA6000, RA7000/8000, ESA10000/12000 and MA8000/EMA12000</i>	<i>EK-RAESA-RC.E01</i>
<i>StorageWorks Warranty Package</i>	<i>Warranty Terms and Conditions</i>	<i>EK-HSXS-WC.C01</i>
	<i>Warranty Terms and Conditions Addendum</i>	<i>3R-Q178A-3V.B01, 158199-021</i>
<i>Installation Guide</i>	<i>Compaq StorageWorks HSG60/HSG80 Array Controller ACS Version 8.5c Solution Software for IBM AIX Installation and Configuration Guide</i>	<i>AA-RNJ8A-TE</i>

General Configuration Guidelines

Fibre Channel storage technology offers more configuration flexibility than parallel SCSI storage. This application note describes typical Compaq StorageWorks RAID Array And FC IBM AIX configurations based on the configuration maximums listed below. For configurations not shown here, the configuration maximums should be used to determine the viability of a proposed configuration. Exceeding the maximums will create unsupported configurations. Additional information specific to a particular configuration is provided by section.

Configuration Maximums

The HSG80 Controller

- Maximum 128 visible LUNS/200 assignable unit numbers; 127 visible LUNs if the Command Console LUN is enabled
- Maximum 512 GB LUN Capacity
- Maximum 72 physical devices
- Maximum 20 RAID-5 Storage sets
- Maximum 30 (RAID-5 and RAID-1) Storage sets
- Maximum 45 (RAID-5 and RAID-1 and RAID-0) Storage sets
- Maximum 8 partitions of a Storage set or individual disk
- Maximum 6 members of a Mirror set
- Maximum 14 members per RAID-5 Storage set
- Maximum 24 members per Stripe set
- Maximum 48 physical devices per Striped-Mirror set

The HSG60 Controller

- Maximum 128 visible LUNS/200 assignable unit numbers; 127 visible LUNs if the Command Console LUN is enabled
- Maximum 512 GB LUN capacity
- Maximum 24 physical devices
- Maximum 8 RAID-5 Storage sets
- Maximum 8 partitions of a storage set or individual disk
- Maximum 6 physical devices per RAID 1 (mirror set)
- Maximum 14 members per RAID-5 Storage set
- Maximum 24 members per RAID 0 (Stripe set)
- Maximum 24 physical devices per Striped-Mirror set

IMPORTANT: The IBM AIX driver has a limitation of 16 LUNs per FC Target.

The IBM AIX Operating System

- Maximum 1 TB file system per LUN
- Maximum 16 LUNs per FC Target
- Only two active host ports per controller pair

The Fibre Channel Switch

- Maximum 500 meters per optical cable segment, 50 micron, multi-mode or 175 meters per optical cable segment, 62.5 micron, multi-mode.
- Maximum 1 kilometer distance between Server and Storage.

Assumptions

This application note assumes familiarity with configuring RAID storage systems, specifically the use of the Command Line Interface (CLI) as well as experience and use of the IBM AIX operating system. Additionally, an understanding of Fibre Channel terminology and concepts is assumed.

NOTE: Table 1 of this document lists the various documents related to the HSG80 and HSG60 Controllers and the configuration of the Compaq StorageWorks RAID Array and Enterprise systems. Refer to the documents for more detailed help on a specific topic.

General Configuration Notes

1. All single controller storage configurations can be upgraded to dual controller configurations. All High Availability configurations discussed in this document require dual controller configurations.
2. Controller pairs must be configured for Multiple-bus Failover Mode.

IMPORTANT: Converting from Transparent Failover Mode to Multiple-bus Transparent Failover mode is documented in Appendix A.

3. All configuration diagrams show a frontal view of the storage system.
 - a. Controller Host Port 1 is the left port; Controller Host Port 2 is the right port.
 - b. Controller A is the top controller; Controller B is the bottom controller.
4. Host Port 2 is not used for any of the configurations in this document.
5. All configurations require Solution Software V8.5c for the IBM AIX operating system.
6. Each storage system can be configured using the Storage Works Command Console (SWCC) or the Command Line Interface (CLI) configured through either the HSGx0 controller maintenance serial port or a TCP/IP interface.
7. All configurations **require** Array Controller Software (ACS) V8.5F for HSG80 or ACS V8.5L for the HSG60 for the FC-SW topology. This is software support at the controller level.
8. All configurations **require** Compaq SANworks Secure Path Version 2.0 for the IBM AIX operating system.
9. All configurations utilize short wavelength lasers and multi-mode fibre channel optical cables.
10. All configurations **require** the Connection Name *Operating System* parameter set to "WINNT".
(CLI: "SET *connection-name* OPERATING_SYSTEM = WNNT")
11. By default the HSGx0 Command Console LUN (CCL) is enabled. This may be disabled.
(CLI: "SET *controller* NOCOMMAND_CONSOLE_LUN")
12. For configurations with more than one server on the same fabric:

Use the SET *connection-name Unit_Offset* value to set the range of unit numbers to be visible from each Server (CLI: “SET *connection-name* UNIT_OFFSET = n”) This will provide a first level of access control from Server to Storage.

To define a second level of access control from Server to Storage, it is highly recommended to define a specific combination of Storage Unit and Host by enabling an ACCESS_PATH. The steps are:

- ❑ Disable/Clear all current access_paths
(CLI: “SET *unit-number* DISABLE_ACCESS_PATH = ALL”)
- ❑ Set a specific Host access (through the connection name)
(CLI: “SET *unit-number* ENABLE_ACCESS_PATH = *connection-name*”)

13. Record the FC HBA Worldwide Identification (WWID) address. To do this run the AIX command:

```
#lscfg -vl scsi2
```

where scsi2 is the HBA you wish to view.

14. Use the recorded WWID to identify the connection name displayed from the CLI at the controller using the CLI: “SHOW CONNECTIONS” command.

15. Rename connection names. When the RAID controller detects a path from a HBA to a controller port, it creates a connection and connection names are automatically added to the controller connection name table as “!NEWCONnn” (where nn is a number from 0 to 99). Currently, the total number of connections is 64. Once a connection is identified using the FC HBA WWID, rename the connection to a name meaningful to the specific configuration. (CLI: “RENAME *old-name new-name*”. Connection names may contain nine (9) characters). In some cases, host name and port value may suffice (i.e., WESTP1, WESTP2, EASTP1, EASTP2, etc.).

16. Each active controller host port on a fabric presents one SCSI Target ID with up to sixty-four (64) LUNs to each FC HBA pair on the same fabric. LUNs (logical units) can consist of single disks (JBOD), a storage set of multiple disks or a partition (up to 64), configured for a specific RAID level of 0, 0 + 1, or 3/5.

17. Thinking About Connections

The second view of connections is from the controller side. On a fabric, the controller knows about each host-adapter combination (HAC) that it can communicate with. The controller creates one connection on each active controller port for each HAC. Thus, if there are four servers on a fabric, each with a fibre channel adapter, the controller will create four connections for the servers for each active controller port. If there is one active port, the controller will establish 4 connections. If there are two active ports, the controller will create 8 connections.

NOTE: The CLI provides the ability to delete a connection. This deletion is good ONLY until the controller reinitializes. When a controller reboots, it rebuilds its connection table for all HACs that it can see.

High Availability Configuration Topologies and Modes

This section provides a detailed description of the eight most common FC IBM AIX high availability configurations, as follows:

- One Server, Secure Path V2.0, Multiple-Bus Failover, One Storage Enclosure
- Up to Four Servers, Secure Path V2.0, Multiple-Bus Failover, One Shared Storage Enclosure

- Up to Four Servers, Secure Path V2.0, Multiple-Bus Failover, Two Shared Storage Enclosures
- One Server, Secure Path V2.0, Multiple-Bus Failover, Four Shared Storage Enclosures
- One Server, Secure Path 2.0, Multiple-Bus Failover, Four Host Bus Adapters, Eight Shared Storage Enclosures

NOTE: All configurations have one or more HSGx0 Storage Systems with dual-controllers bound in Multiple-bus Failover Mode.

HA Configuration 1

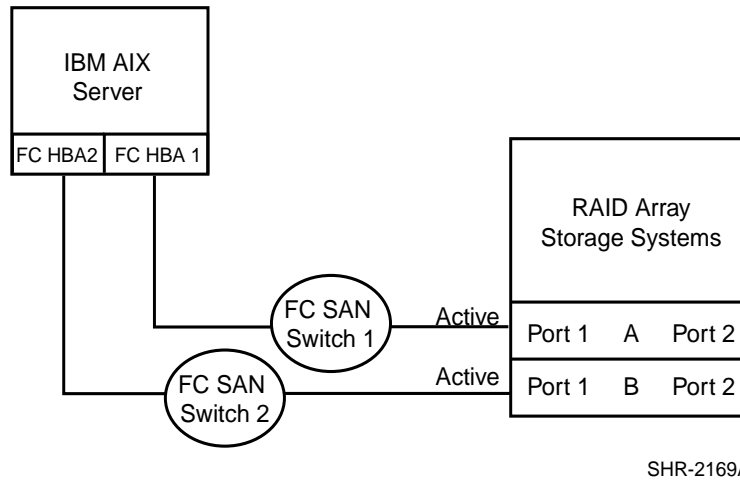


Figure 1. One Server, Secure Path and One Storage Enclosure

HA Configuration 1 Notes

- Two independent Fibre Channel Switched paths
- RAID Array Storage System Solution SoftwareV8.5c for IBM AIX
- Secure Path V2.0 for IBM AIX application software installed
- Dual HSGx0 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 16 LUNs with 2 active controller host ports. Port 1 presents units D0 – D15; Port 2 is not used.
- Set the Unit Preferred Path. Use the Preferred Path unit parameter to assign units to specific controllers. Units should be distributed equally across controllers for load balancing.

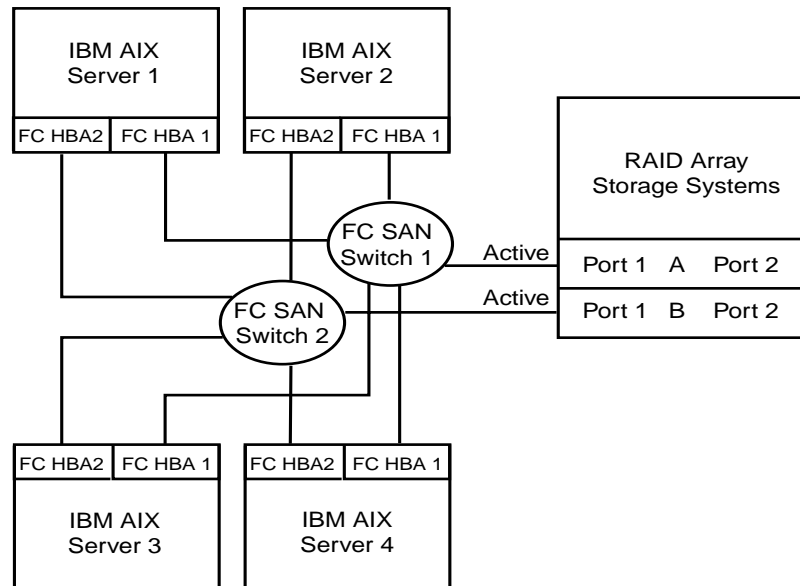
Suggested Controller Unit Number Assignment:

Prefer units D0 – D7 to Controller A

Prefer units D8 – D15 to Controller B

- In this configuration two logical connections are available.
- Rename the connection names. For example, use SERV1P1A, SERV1P1B

HA Configuration 2



SHR-2170A

Figure 2. Four Servers, Secure Path, Multiple-Bus Failover, Shared Storage Enclosure

HA Configuration 2 (Figure 2) builds on Configuration 1 providing storage for up to four separate (non-cooperating) servers on two independent Fibre Channel switched paths. The four servers share the storage enclosure in that each server has exclusive access to its own set of LUNs. This is made possible by the setting of explicit “connection name access” at the unit level and using connection name “unit offsets” to give each server an accessible range of unit numbers. Additional levels of access control are necessary for this configuration because all servers are sharing the two Fibre Channel switched paths. The configuration uses two separate paths to the storage from each server. In the event of a failure of any component within the access path – HBA, cables, SAN switch, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path.

Figure 2 HA Configuration 2**HA Configuration 2 Notes**

- Two independent Fibre Channel Switched paths
- Shared storage enclosure
- RAID Array Storage System Solution Software V8.5c for IBM AIX
- Secure Path V2.0 for IBM AIX application software installed
- Dual HSGx0 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 64 LUNs, 16 available to each server with 2 active controller host ports.
- Set the Unit Preferred Path. Use the Preferred Path unit parameter to distribute units equally across controllers/ports for load balancing
 - Prefer units D0-D7 to Controller A
 - Prefer units D8-D15 to Controller B
 - Prefer units D16 – D23 to Controller A
 - Prefer units D24 – D31 to Controller B
 - Prefer units D32 – D39 to Controller A
 - Prefer units D40 – D47 to Controller B
 - Prefer units D48 – D55 to Controller A
 - Prefer units D56 – D63 to Controller B
- In this configuration 8 logical connections are available
- Rename the connection names. For example use SRV1A1P1A, SRV1A2P1B, SRV2A1P1A, SRV2A2P1B, SRV3A1P1A, SRV3A2P1B, SRV4A1P1A, SRV4A2P1B
- Set exclusive unit access for each unit to specific server connection names, i.e., for unit D0 ENABLE = SRV1A1P1A, SRV1A2P1B, for unit D16 ENABLE = SRV2A1P1A, SRV2A2P1B.
- If you are using SWCC to create units, by default units are enabled on all known connection names. You must explicitly disable connection names enabled for units to prevent access.
- Set the connection name unit offset values for each connection as shown below.

Note: The suggested unit numbering and connection parameters results in the units being distributed equally across servers and controller host ports, as follows:

Server 1: Port 1 units D0 – D15

Connection names, unit offset values: SRV1A1P1A, 0. SRV1A2P1B, 0

Server 2: Port 1 units D16 – D31

Connection names, unit offset values: SRV2A1P1A, 16. SRV2A2P1B, 16

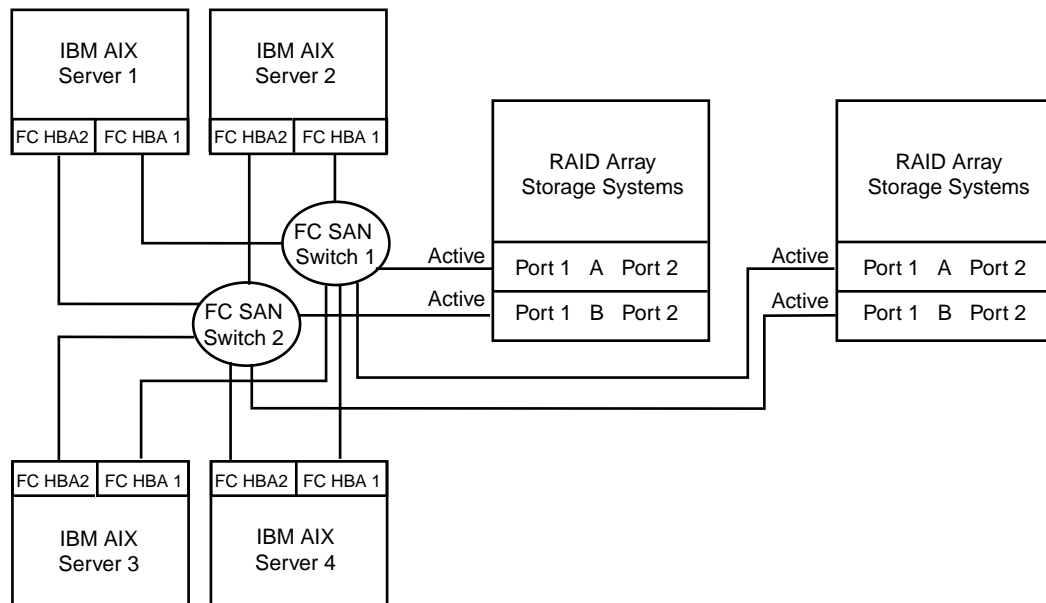
Server 3: Port 1 units D32 – D47

Connection names, unit offset values: SRV3A1P1A, 32. SRV3A2P1B, 32

Server 4: Port 1 units D48 – D63

Connection names, unit offset values: SRV4A1P1A, 48. SRV4A2P1B, 48

HA Configuration 3



SHR-2171A

Figure 3. Four Servers, Secure Path, Multiple-Bus Failover, Two Shared Storage Enclosures

HA Configuration 3 (Figure 3) builds on Configuration 2 by adding storage capacity using a second enclosure and second pair of controllers. The second pair of controllers are connected to two fibre channel loops providing redundant paths for up to four separate (non-cooperating) servers. The four servers share both storage enclosures in that each server has exclusive access to its own LUNs in each enclosure through the use of mutually exclusive LUN numbering, explicit unit host access, and the use of connection unit offsets. Additional levels of access control are necessary for this configuration because all servers are sharing the two fibre channel loops. The configuration utilizes two separate paths to the storage from each server. In the event of a failure of any component within the access path – HBA, cables, switch, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path.

Figure 3 HA Configuration 3

HA Configuration 3 Notes

- Two independent Fibre Channel Switched paths
- Shared storage enclosure
- RAID Array Storage System Solution Software V8.5c for IBM AIX
- Secure Path V2.0 for IBM AIX application software installed
- Dual HSGx0 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment

- Up to 32 LUNs available to each server with 4 active controller host ports. Refer to Configuration 2 for a suggested way to define the units that distributes them equally across servers/host ports. Unit configurations and numbering can be identical for each storage enclosure, as each server will see each active controller host port as a unique target ID with a unique set of LUNs.
- For each storage enclosure (controller pair), set the Unit Preferred Path. Use the Preferred Path unit parameter to distribute units equally across controllers/ports for load balancing.

For Example:

Prefer units D0 – D7 to Controller A
 Prefer units D8 – D15 to Controller B
 Prefer units D16 – D23 to Controller A
 Prefer units D24 – D31 to Controller B
 Prefer units D32 – D39 to Controller A
 Prefer units D40 – D47 to Controller B
 Prefer units D48 – D55 to Controller A
 Prefer units D56 – D63 to Controller B

- In this configuration 16 logical connections are available, 8 in each enclosure
- For each storage enclosure (controller pair), rename the connection names, i.e., SRV1A1P1A, SRV1A2P1B, SRV2A1P1A, SRV2A2P1B, SRV3A1P1A, SRV3A2P1B, SRV4A1P1A, SRV4A2P1B
- Set exclusive unit access for each unit to specific server connection names, i.e., for unit D0 ENABLE = SRV1A1P1A, SRV1A2P1B, for unit D32 ENABLE = SRV2A1P1A, SRV2A2P1B. If you are using SWCC to create units, by default units are enabled on all known connection names. You must explicitly disable connection names enabled for units to prevent access.
- Set the connection name unit offset values for each connection as shown below:

Note: The suggested unit numbering and connection parameters results in the units being distributed equally across servers and controller host ports, as follows:

Server 1: Port 1 units D0 – D15
 Connection names, unit offset values: SRV1A1P1A, 0. SRV1A2P1B, 0
 Server 2: Port 1 units D16 – D31
 Connection names, unit offset values: SRV2A1P1A,16. SRV2A2P1B, 16
 Server 3: Port 1 units D32 – D47
 Connection names, unit offset values: SRV3A1P1A, 32. SRV3A2P1B, 32
 Server 4: Port 1 units D48 – D63
 Connection names, unit offset values: SRV4A1P1A, 48. SRV4A2P1B, 48

HA Configuration 4

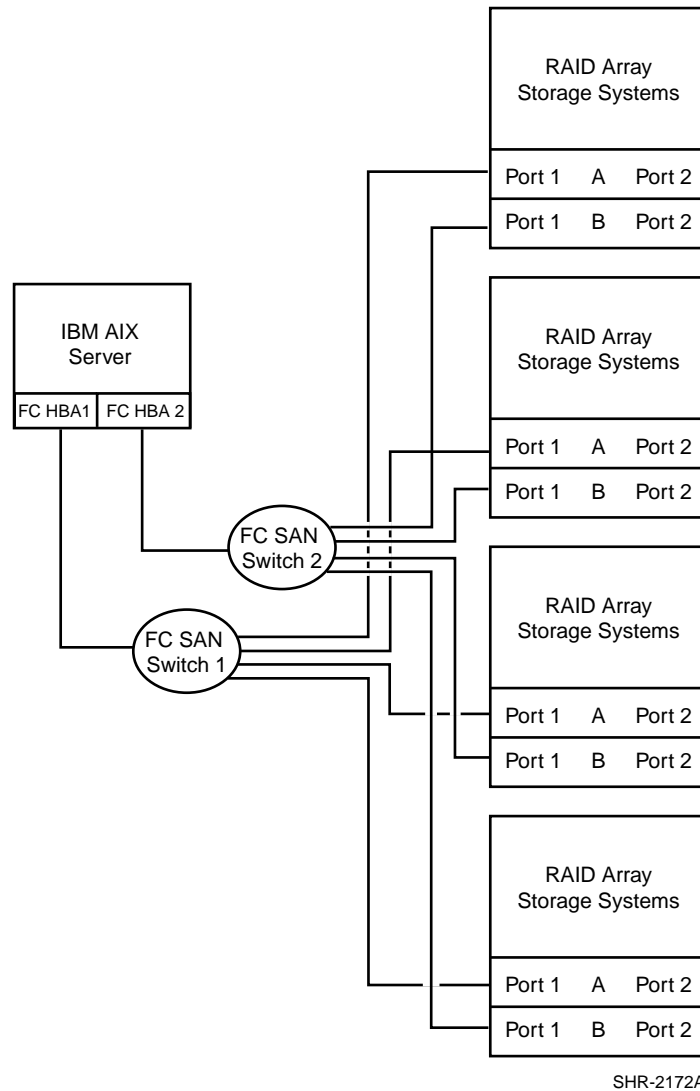
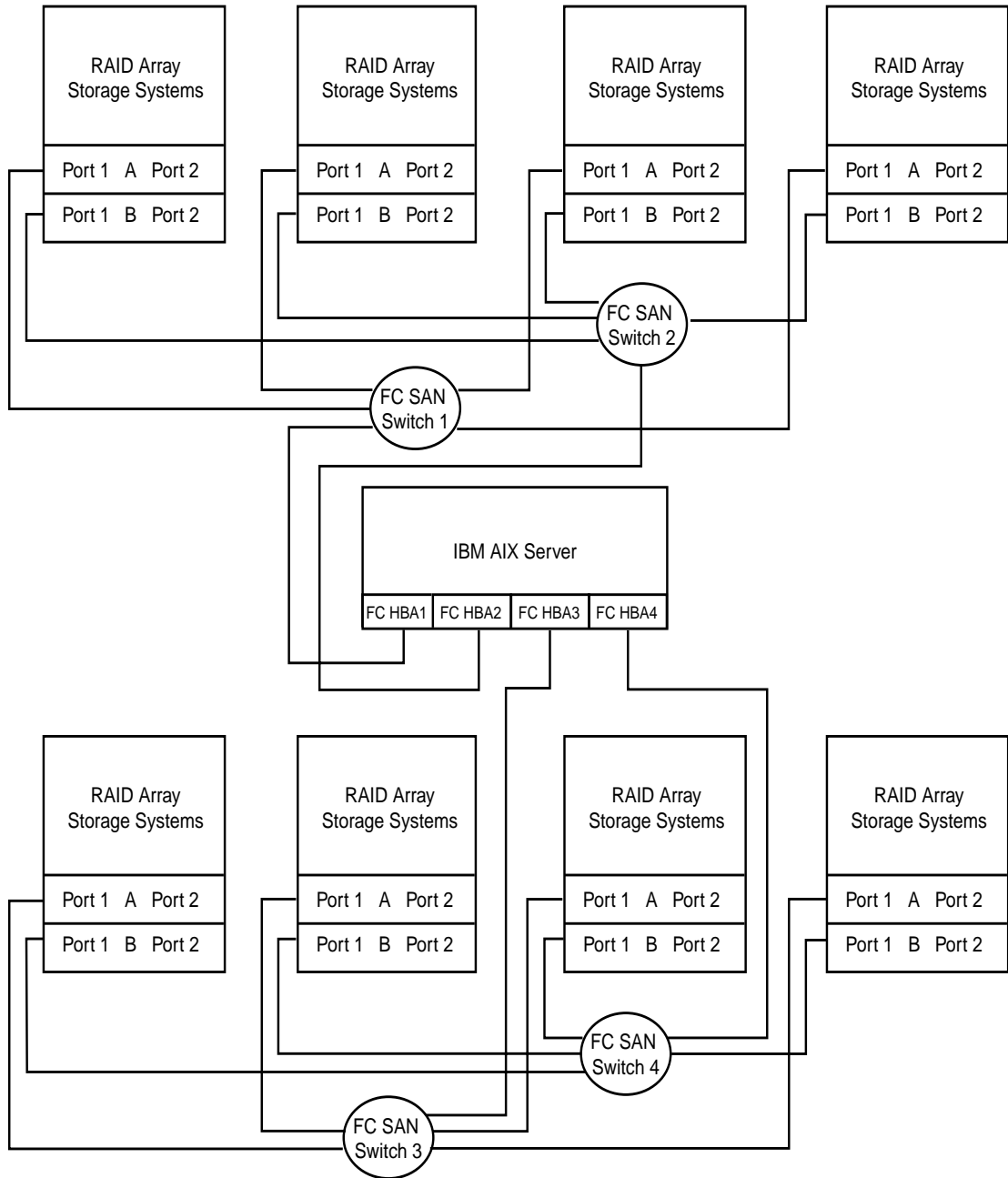


Figure 4. One Server, Secure Path, Multiple-Bus Failover, Four Shared Storage Enclosures,

- Two independent Fibre Channel switched paths
- Shared storage enclosure
- RAID Array Storage System Solution Software V8.5c for IBM AIX
- Secure Path V2.0 for IBM AIX application software installed
- Dual HSGx0 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 64 LUNs, 16 available to each RAID array with 2 active controller host ports.
- Up to 500 meters per cable segment

- For each storage enclosure (controller pair), set the Unit Preferred Path. Use the Preferred Path unit parameter to distribute units equally across controllers/ports for load balancing. *Example:*
 Prefer units D0 – D7 to Controller A
 Prefer units D8 – D15 to Controller B

HA Configuration 5



SHR-2173A

Figure 5. One Server, Secure Path, Multiple-Bus Failover, Eight Shared Storage Enclosures

- Two independent Fibre Channel Switched paths
- Shared storage enclosure
- Enterprise and RAID Array Storage Systems Solution Software V8.5 for IBM AIX
- Secure Path V2.0 for IBM AIX application software installed
- Dual HSGx0 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 128 LUNs, 16 available to each RAID Array with 2 active controller host ports.
- For each storage enclosure (controller pair), set the Unit Preferred Path. Use the Preferred Path unit parameter to distribute units equally across controllers/ports for load balancing. *Example:*
 Prefer units D0 – D7 to Controller A
 Prefer units D8 – D15 to Controller B

High Availability Parts List

- IBM AIX running versions 4.3.3, 4.3.2 and 4.2.1.
- Quantities assumed as needed for a specific configuration.

Table 2 High Availability Parts List

Compaq Part Number	Description
Software	
165978-B21	IBM AIX 8.5c Solution software for HSG80 (QB-65RAK-MA)
192213-B21	IBM AIX 8.5c Solution Software for HSG60 (QB-6J4AK-SA)
128697-B21	ACS V8.5F Array Controller Software (QB-6BUAA-SA)
180319-B21	ACS V8.5L Array Controller Software (QB-6FTAA-SA)
231495-B21	Secure Path 2.0 for IBM AIX (QB-6GOAA-SA)
Host Bus Adapters	
197819-B21	IBM-AIX Fibre Channel Adapter (DS-SWIA1-PD)
RA8000/ESA12000	
380560-B21 (Blue)	RA8000 Pedestal w/dual HSG80 (DS-SWXRA-MA)
380560-B22 (Opal)	RA8000 Pedestal w/dual HSG80 (DS-SWXRA-MF)
380660-B21	RA8000 Rackable w/dual HSG80 (DS-SWXRA-MD)
380580-001 (Blue)	ESA12000 w/dual HSG80 24 Slot 60HZ (DS-SWXES-KA)
380580-002 (Opal)	ESA12000 w/dual HSG80 24 Slot 60HZ (DS-SWXES-SA)
380590-B21 (Blue)	ESA12000 w/dual HSG80 24 Slot 50HZ (DS-SWXES-KB)
380590-B22 (Opal)	ESA12000 w/dual HSG80 24 Slot 50HZ (DS-SWXES-SB)
380600-001 (Blue)	ESA12000 w/dual HSG80 48 Slot 60HZ (DS-SWXES-HA)
380600-002 (Opal)	ESA12000 w/dual HSG80 48 Slot 60HZ (DS-SWXES-QA)
380610-B21 (Blue)	ESA12000 w/dual HSG80 48 Slot 50HZ (DS-SWXES-HB)

Table 2 High Availability Parts List

Compaq Part Number	Description
RA8000/ESA12000 Con't	
380610-B22 (Opal)	ESA12000 w/dual HSG80 48 Slot 50HZ (DS-SWXES-QB)
380620-001 (Blue)	ESA12000 w/2pairs/dual HSG80 48 Slot 60 HZ (DS-SWXES-JA)
380620-002 (Opal)	ESA12000 w/2 pairs/dual HSG80 48 Slot 60 HZ (DS-SWXES-RA)
380630-B21 (Blue)	ESA12000 w/2 pairs/dual HSG80 48 Slot 50 HZ (DS-SWXES-JB)
380630-B22 (Opal)	ESA12000 w/2 pairs/dual HSG80 48 Slot 50 HZ (DS-SWXES-RB)
380570-B21 (Blue)	Pedestal Expansion 24 slots (DS-SWXRA-HB)
380570-B22 (Opal)	Pedestal Expansion 24 slots (DS-SWXRA-MG)
380568-B21	Rackable Expansion 24 slots (DS-SWXRA-MR)
380640-001 (Blue)	ESA12000 Expansion 48 Slot 60HZ (DS-SWXES-LA)
380640-002 (Opal)	ESA12000 Expansion 48 Slot 60HZ (DS-SWXES-TA)
380650-B21 (Blue)	ESA12000 Expansion 48 Slot 50HZ (DS-SWXES-LB)
380650-B22 (Opal)	ESA12000 Expansion 48 Slot 50HZ (DS-SWXES-TB)
MA8000/EMA12000	
176622-B21	HSG80 Controller w/256 MB Cache (DS-HSG80-BK)
175992-B21 (Opal)	MA8000 - 1 Controller enclosure, 3 Dual Bus 14-bay drive enclosures, 22U Modular Storage Cabinet (60 HZ) DS-SWXEB-CA
175992-B22 (Opal)	MA8000 - 1 Controller enclosure, 3 Dual Bus 14-bay drive enclosures, 22U Modular Storage Cabinet (50 HZ) DS-SWXEB-CB
175990-B21 (Opal)	EMA12000 D14 - 3 Controller enclosures, 9 Dual Bus 14-bay drive enclosures, 42U Modular Storage Cabinet (60 HZ) DS-SWXEB-AA
175990-B22 (Opal)	EMA12000 D14 - 3 Controller enclosures, 9 Dual Bus 14-bay drive enclosures, 42U Modular Storage Cabinet (50 HZ) DS-SWXEB-AB
175994-B21 (Opal)	EMA12000 S10 - 1 Controller enclosure, 6 Single Bus 10-bay drive enclosures, 42U Modular Storage Cabinet (60 HZ) DS-SWXEB-EA
175994-B22 (Opal)	EMA12000 S10 - 1 Controller enclosure, 6 Single Bus 10-bay drive enclosures, 42U Modular Storage Cabinet (50 HZ) DS-SWXEB-EB
175991-B21 (Opal)	EMA12000 S14 - 1 Controller enclosure, 6 single bus 14-bay drive enclosures, 36U Modular Storage Cabinet (60 HZ) DS-SWXEB-DA
175991-B22 (Opal)	EMA12000 S14 - 1 Controller enclosure, 6 single bus 14-bay drive enclosures, 36U Modular Storage Cabinet (50 HZ) DS-SWXEB-DB
175993-B21(Blue)	1 Controller enclosure, 3 dual bus 14-bay drive enclosures, 41U Modular Storage Cabinet (60 HZ)
175993-B22(Blue)	1 Controller enclosure, 3 dual bus 14-bay drive enclosures, 41U Modular Storage Cabinet (50 HZ)
380673-B21	64 MB Cache Upgrade for HSX80 (DS-HSDIM-AB)
380674-B21	256 MB Cache upgrade for HSX80 (DS-HSDIM-AC)
135823-B21	Model 2200 ECB (DS-SE2C5-CB)
MA6000	
174134-B21	HSG60 Controller w/256 MB Cache (DS-HSG60-BJ)

Table 2 High Availability Parts List

Compaq Part Number	Description
MA6000 Con't	
187738-B21	MA6000 D14 - M2 Controller Shelf, HSG60 Controller with 256 MB cache, 1 14-bay drive enclosure: dual bus, dual power (DS-SWXRA-NA)
187739-B21	MA6000 D14 - M2 Controller Shelf, HSG60 Controller with 256 MB cache, 2 14-bay drive enclosure: dual bus, dual power (DS-SWXRA-NB)
380674-B21	256 MB Cache upgrade for HSX80 (DS-HSDIM-AC)
135823-B21	Model 2200 ECB (DS-SE2C5-CB)
FC SAN Switches	
300591-B21	Compaq 8-Port (DS-DSGGA-AA)
300591-B22	Compaq 8-Port (DS-DSGGA-AC)
158222-B21	Compaq 8-Port DS-DSGGB-AA)
158223-B21	Compaq 8-Port (DS-DSGGB-AB)
176219-B21	Compaq 8-Port (DS-DSGGC-AA)
380578-B21	Compaq 16-Port (DS-DSGGA-AB)
380578-B22	Compaq 16-Port (DS-DSGGA-AD)
158224-B21	Compaq 16-Port (DS-DSGGB-BA)
158225-B21	Compaq 16-Port (DS-DSGGB-BA)
212776-B21	Compaq 16-Port (DS-DSGGC-AB)
FC Switch Firmware	
	DS-DSGGA-XX - V1.6d ¹
	DS-DSGGB-XX -V2.0.3a
	DS-DSGGC-XX -V2.1.7
GBICs, Cables and Disk Drives	
380561-B21	FC Optical GBIC (DS-DXGGA-SA)
234457-B21	FC 2 Meter Optical Cable (BNGBX-02)
234457-B22	FC 5 Meter Optical Cable (BNGBX-05)
234457-B23	FC 15 Meter Optical Cable (BNGBX-15)
234457-B24	FC 30 Meter Optical Cable (BNGBX-30)
234457-B25	FC 50 Meter Optical Cable (BNGBX-50)
380691-B21	4GB UW 7200 RPM Disk (DS-RZ1CF-VW)
380595-B21	9 GB UW 7200 RPM Disk (DS-RZ1DF-VW)
380694-B21	18 GB UW 7200 RPM Disk (DS-RZ1EF-VW)
380588-B21	9 GB UW 10000 RPM Disk (DS-RZ1DD-VW)
380589-B21	18 GB UW 10000 RPM Disk (DS-RZ1ED-VW)
147599-001	36 GB UW 7200 RPM Disk (DS-RZ1FB-VW)
159138-001	36 GB UW 10000 RPM Disk (DS-RZ1FC-VW)
123065-B22	9GB Hard Disk Drive 7200 RPM 1" (3R-A0525-AA)
388144-B22	18 GB Hard Disk Drive 7200 RPM 1"(3R-A0527-AA)
128418-B22	18 GB Hard Disk Drive 10K RPM (3R-A0561-AA)

Table 2 High Availability Parts List

Compaq Part Number	Description
GBICs, Cables and Disk Drives Con't	
328939-B22	9 GB Hard Disk Drive 10K RPM (3R-A0526-AA)
176496-B22	36 GB Hard Disk Drive 10K RPM (3R-A0919-AA)
176494-B21	72.8 GB Disk Drive (3R-A1491-AA)

¹If the DS-DSGGA-XX switch does not have the supported firmware, follow the directions contained on the CD-ROM for the IBM AIX Secure Path Version 2.0 release located in <mount directory>/firmware/README.

Appendix A

Controller Failover Transitions

Introduction

This appendix provides the procedures for setting dual-redundant HSG80 controllers from one failover mode to another. Controllers can exist in one of the following failover modes: Transparent Failover (TF), Multiple-Bus Failover (MBF) and Nofailover (NF).

The controller failover state changes, discussed in the following sections, are:

- a. From Transparent Failover to NoFailover Mode
- b. From Transparent Failover to Multiple-bus Failover Mode
- c. From Multiple-bus Failover to Nofailover and then to Transparent Failover Mode

To change the failover state of a controller, connect a serial line to the top controller. This will be referenced as THIS_CONTROLLER. The second controller will be referenced as the OTHER_CONTROLLER. All commands directed to the RAID storage system (i.e., those preceded by HSG80> prompt in the following sections), must be issued through this serial connection to the top controller.

Verifying the current state of the controllers is achieved by entering:

```
CLI> SHOW THIS_CONTROLLER
```

The display from the SHOW command has a number of sections. The information required for changing a controller failover state is located in the first section, under the “Controller:” heading. A sample display for Transparent Failover is shown below, and the failover state is identified with an arrow, “->” preceding the text of note.

Example:

```
Controller:
HSG80 ZG83502145 Software V85F-0, Hardware E03
NODE_ID          = 5000-1FE1-0000-3350
ALLOCATION_CLASS  = 0
SCSI_VERSION     = SCSI-2
-> Configured for dual-redundancy with ZG80200290
->      In dual-redundant configuration
```

When a controller state is changed using the procedures described in one of the next sections, the display will be refreshed to verify that the change has completed successfully.

Changing from Transparent Failover to No Failover Mode

1. At the CLI> prompt, enter:

```
CLI> SET NOFAILOVER
```

This action will cause the OTHER_CONTROLLER to shutdown.

2. At the CLI> prompt, enter:

```
CLI> SHOW THIS_CONTROLLER
```

From the resulting display, verify that the controller state has changed to no failover.

Example:

Controller:

```
HSG80 ZG83502145 Software V85F-0, Hardware E03
NODE_ID           = 5000-1FE1-0000-3350
ALLOCATION_CLASS   = 0
SCSI_VERSION      = SCSI-2
-> Not Configured for dual-redundancy
```

3. Restart the OTHER_CONTROLLER by pressing the RESET button on the OTHER_CONTROLLER.

IMPORTANT: The “other” controller will shut down and you must restart it manually. Momentarily depress the reset button on the front panel of the controller. Wait for two minutes for the controller to reboot before proceeding. If you are using a RA8000/ESA12000 Storage System, the OTHER_CONTROLLER sounds an alarm when it detects the second controller, which is not bound in any failover mode. All controllers will notify you that they are not bound in a failover mode. You can silence the alarm and disregard the message about misconfigured controllers.

4. To verify the change in controller state, enter:

```
CLI> SHOW THIS_CONTROLLER
```

Example:

Controller:

```
HSG80 ZG83502145 Software V85F-0, Hardware E03
NODE_ID           = 5000-1FE1-0000-3350
ALLOCATION_CLASS   = 0
SCSI_VERSION      = SCSI-2
-> Not Configured for dual-redundancy
->Controller misconfigured -- other controller present
```

Changing from Transparent Failover to Multi-bus Failover Mode

Whether there are defined UNITS or not for the RAID system, the following steps will implement Transparent Failover to Multi-bus Failover:

1. At the CLI> prompt, enter:

```
CLI> SET NOFAILOVER
```

This action will cause the OTHER_CONTROLLER to shutdown.

2. At the CLI> prompt, enter:

```
CLI> SHOW THIS_CONTROLLER
```

From the resulting display, verify that the controller state has changed to no failover.

Example:

```

Controller:
    HSG80 ZG83502145 Software V85F-0, Hardware E03
    NODE_ID           = 5000-1FE1-0000-3350
    ALLOCATION_CLASS   = 0
    SCSI_VERSION      = SCSI-2
    -> Not Configured for dual-redundancy

```

- Restart the OTHER_CONTROLLER by pressing the RESET button on the OTHER_CONTROLLER.

IMPORTANT: The “other” controller will shut down and you must restart it manually. Momentarily depress the reset button on the front panel of the controller. Wait for two minutes for the controller to reboot before proceeding. If you are using a RA8000/ESA12000 Storage System, the OTHER_CONTROLLER sounds an alarm when it detects the second controller, which is not bound in any failover mode. All controllers will notify you that they are not bound in a failover mode. You can silence the alarm and disregard the message about misconfigured controllers.

Example:

```

Controller:
    HSG80 ZG83502145 Software V85F-0, Hardware E03
    NODE_ID           = 5000-1FE1-0000-3350
    ALLOCATION_CLASS   = 0
    SCSI_VERSION      = SCSI-2
    -> Not Configured for dual-redundancy
        Controller misconfigured -- other controller present

```

- When the OTHER_CONTROLLER is on-line, enter the following command to put the controllers into Multi-bus Failover mode:

```
CLI> SET MULTIBUS_FAILOVER COPY=THIS
```

This action will copy all unit and connection information to the OTHER_CONTROLLER and restart both controllers.

After both controllers have restarted, the controller pair will be bound in Multi-bus Failover mode with consistent views of all the RAID system information.

- Verify that the controllers are now in Multi-bus failover. Enter:

```
CLI> SHOW THIS_CONTROLLER
```

Example:

```

Controller:
    HSG80 ZG83502145 Software V85F-0, Hardware E03
    NODE_ID           = 5000-1FE1-0000-3350
    ALLOCATION_CLASS   = 0
    SCSI_VERSION      = SCSI-2
    -> Configured for MULTIBUS_FAILOVER with ZG80200290
    -> In dual-redundant configuration

```

- If the RAID system had connections prior to making this transition, display the connections examine their “offset value” (last column), using this command:

```
CLI> SHOW CONNECTIONS
```

NOTE: In Transparent Failover mode, the controller, by default, assigns an offset value of 0 to the left hand port and an offset value of 100 to the right hand port. In Multi-bus Failover mode, the controller assigns an offset value of 0 to all ports, unless existing connections have non-zero offset values.

IMPORTANT: HSGx0 controller port 2 is not used in any of the configurations in this document.

NOTE: Secure Path software requires connections to be reset to zero (0) so that both paths will be able to access the entire set of UNITS on the RAID system. To reset the connections to zero, enter:

```
CLI> SET CONNECTION connection_name UNIT_OFFSET=0
```

Repeat for each connection.

Changing from Multibus Failover Mode to Nofailover and then to Transparent Failover Mode

1. It is advised that the Dn values and associated information as well as the storage set information be recorded for later use.

2. Inspect the “Connections:” display for connections on the storage system. Enter:

```
CLI> SHOW CONNECTIONS
```

Delete all connections by entering the following command for each connection found:

```
CLI> DELETE connection_name (Repeat for each connection).
```

NOTE: The connections will be regenerated later.

3. If there are units (Dn) on the storage system, they must be deleted. This is due to the inconsistencies incorporated in the volumes' WWID in different failover modes.

```
CLI> SHOW UNITS
```

```
CLI> DELETE Dn (for each Dn)
```

NOTE: The UNITS will be restored after the controller state is changed. It is advised that the Dn values and associated information as well as the storage set information be recorded for later use. The controller state change will not affect the data on the storage sets.

4. If the controllers are currently in a failover mode, enter:

```
CLI> SET NOFAILOVER
```

This action will cause the OTHER_CONTROLLER to shutdown.

Verify the current state of the controller by entering:

```
CLI> SHOW THIS_CONTROLLER
```

Example:

```
Controller:
    HSG80 ZG83502145 Software V85F-0, Hardware E03
    NODE_ID          = 5000-1FE1-0000-3350
    ALLOCATION_CLASS  = 0
    SCSI_VERSION     = SCSI-2
    -> Not Configured for dual-redundancy
```

5. Restart the OTHER_CONTROLLER by pressing the RESET button on the OTHER_CONTROLLER

IMPORTANT: The “other” controller will shut down and you must restart it manually. Momentarily depress the reset button on the front panel of the controller. Wait for two minutes for the controller to reboot before proceeding. If you are using a RA8000/ESA12000 Storage System, the OTHER_CONTROLLER sounds an alarm when it detects the second controller, which is not bound in any failover mode. All controllers will notify you that they are not bound in a failover mode. You can silence the alarm and disregard the message about misconfigured controllers.

CLI> SHOW THIS_CONTROLLER

Example:

```
Controller:
    HSG80 ZG83502145 Software V85F-0, Hardware E03
    NODE_ID           = 5000-1FE1-0000-3350
    ALLOCATION_CLASS   = 0
    SCSI_VERSION      = SCSI-2
    -> Not Configured for dual-redundancy
    -> Controller misconfigured -- other controller present
```

When the OTHER_CONTROLLER is available, enter:

CLI> SET FAILOVER COPY=THIS

This action will copy all unit and configuration information to the OTHER_CONTROLLER restart it. When restarted, the controller pair will be bound in Transparent Failover mode.

Verify the controller state change by entering:

CLI> SHOW THIS_CONTROLLER

Example:

```
Controller:
    HSG80 ZG83502145 Software V85F-0, Hardware E03
    NODE_ID           = 5000-1FE1-0000-3350
    ALLOCATION_CLASS   = 0
    SCSI_VERSION      = SCSI-2
    -> Configured for dual-redundancy with ZG80200290
    -> In dual-redundant configuration
```

Restore the UNIT to storage set mapping that was recorded earlier. Enter:

CLI> ADD UNIT Dn storage_set_name

CAUTION: Do not initialize the units. This action will destroy data on the storageset(s).

Restart both controllers to reacquire connections. Enter:

CLI> RESTART OTHER_CONTROLLER

CLI> RESTART THIS_CONTROLLER

An alternative method to reestablish the connections is to reboot the server(s).