

Compaq StorageWorks

Application Note Enterprise/Modular Storage RAID Array FC-AL Configurations for HP-UX AA-RPHKA-TE

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First Edition (June 2001)

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Enterprise Network Storage Architecture (ENSA)

Compaq Enterprise/Modular Storage RAID Array (RA/MA8000 and ESA/EMA12000) products are the latest in fully integrated Fibre Channel RAID storage solutions. These products provide the key initial step in delivering the Compaq's ENSA vision. ENSA addresses the issues that customers expect to face now and in the future. Both products address today's issues including: economical capacity growth, data protection, high availability, increased distance, multi-vendor platform support, and investment protection by serving as the base for building the ENSA vision.

Product Overview

This application note serves as a guide to some High-Availability Fibre Channel Arbitrated Loop (HA FC-AL) configurations for Compaq Enterprise/Modular Storage RAID Array system(s) in conjunction with the HP family of servers running the HP Operating System.

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 arbitrated loops and hubs, 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.

NOTE: This application note describes Enterprise/Modular Storage RAID Array High Availability Fibre Channel Arbitrated Loop configurations. For standard configurations refer to *HSG80 ACS Solution Software V 8.6 for HP-UX Installation and Configuration Guide (AA-RFBEG-TE)*.

The RA/MA8000 Fibre Channel 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 RA/MA8000 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 ESA/EMA12000 Fibre Channel, designed for the data center, is available in three easy-to-order building blocks, each optimized for specific, high-capacity customer requirements. The ESA/EMA12000 Fibre Channel offers unprecedented levels of storage, scaling in performance and capacity as user requirements increase.

StorageWorks RAID Product Details

The Enterprise/Modular Storage RAID Array systems use the Compaq HSG80 RAID controller running Array Controller Software (ACS) V8.6. 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 Fibre Channel host ports providing up to a total of nearly 200 Mbytes per second of available bandwidth. Disk drives are connected to the controller through 6 UltraSCSI channels providing up to 40 Mbytes per second per channel of available bandwidth. Servers can use multiple host bus adapters (host bus adapters) to multiple RA/MA8000 Fibre Channel systems for unlimited storage capacity.

The RA/MA8000 Fibre Channel is supplied in two basic building blocks, a pedestal style cabinet and what has been termed a “rackable” model. The pedestal is a self-contained desk height cabinet, it is available in Digital Classic Top Gun blue and in Compaq Opal. The rackable is shipped ready to be mounted in a 19” Compaq rack or a 19” cabinet/rack using an included universal RETMA/metric mounting kit.

RA/MA8000 Fibre Channel controllers come with 64 MB of cache. Cache options allow for 128 MB, 256 MB and 512MB of cache in each controller. ESA/EMA12000 Fibre Channel controllers come with 256 MB of cache. Cache options allow for 512MB of cache in each controller. Cache features include read ahead and mirrored write back cache for use in optimizing performance where redundant capabilities are required for high availability system configurations. In the rare event that a storage controller fails the mirrored data is immediately available to the remaining controller for continuing operation.

The RA/MA8000 Fibre Channel pedestals and rackables come in both single controller and in dual controller models to allow the customer to select the level of high availability required for his application. A single controller model can be upgraded to a dual controller model when warranted by the application.

High availability is supported by the use of redundancy and hot swappable components. The RA/MA8000 Fibre Channel disk enclosures include redundant cooling, and have 5 power supplies providing N+1 redundancy. Power can be upgraded to full redundancy with the addition of 3 more supplies and a 2nd power distribution unit for AC input redundancy. StorageWorks components are “hot” swappable including storage controllers when operating as a redundant pair.

The Enterprise/Modular Storage RAID Array Fibre Channel can be configured and monitored using the StorageWorks Command Console (SWCC). SWCC is included in the HSG80 Software Solutions Platform kit. Using this client/server tool, RAID sets can be configured locally or over a TCP/IP network. The client provides an easy to use graphical interface. It can be used to monitor the RAID storage systems and notify you of events by updating a video display, sending electronic mail or alerting via a pager. The Command Console Client includes applications (or Storage Windows) that communicate with the Command Console Agent software running on the server/host platform.

The Command Console client is available on Windows 95/98 and on Intel/Alpha platforms running Windows NT/2000. A Storage Window for the HSG80 controller supports the Array Controller Software (ACS) V8.6 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.

High Availability Application Options

This section discusses the following High Availability Application Options:

- PV Links for HP 10.20 and 11.0
- MC/Serviceguard

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 Enterprise/Modular Storage RAID Array Fibre Channel Storage Systems.

Table 1 Reference Documentation

Document Title	Order Number
Compaq StorageWorks RA/MA8000 and ESA/EMA12000 HSG80 Array Controller Solution Software V8.6F Kit	EK-SOLSR-AA
Compaq StorageWorks Release Notes, RA/MA8000 and ESA/EMA12000 HSG80 Solution Software V8.6 for HP-UX	AA-RFBDG-TE
HSG80 ACS Solution Software Version 8.6 for HP-UX Installation and Configuration Guide	AA-RFBEG-TE
HSG80 Array Controller ACS V8.6 CLI Reference Guide	EK-G80CL-RA.A01
HSG80 Array Controller ACS Version 8.6 Maintenance and Service Guide	EK-G80MS-SA.A01
Compaq StorageWorks Command Console V2.3 User Guide	AA-RFA2H-TE
Compaq StorageWorks Warranty Terms and Conditions	EK-HSXSU-WC.C01

General Configuration Guidelines

Fibre Channel storage technology offers more configuration flexibility than parallel SCSI storage. This application note describes typical Enterprise/Modular Storage RAID Array Fibre Channel HP-UX 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 maximum will create unsupported configurations. Additional information specific to a particular configuration is provided by section.

Configuration Maximums

Maximum configurations for the HSG80 Controller:

- Maximum 128 visible LUNS (64 per port)
- Maximum 200 assignable unit numbers
- Maximum 72 physical devices
- Maximum 20 RAID-5 StorageSets
- Maximum 30 (RAID-5 and RAID-1) StorageSets
- Maximum 45 (RAID-5 and RAID-1 and RAID-0) StorageSets
- Maximum 8 partitions of a StorageSet or individual disk
- Maximum 6 members of a MirrorSet
- Maximum 14 members per RAID-5 StorageSet
- Maximum 24 members per StripeSet

- Maximum 48 physical devices per Striped-MirrorSet
- Maximum 96 Connections for a dual-controller pair; refer to the *HSG80 ACS Solution Software Version 8.6 for HP-UX Installation and Configuration Guide* (AA-RFBEG-TE) for connection information.
- Maximum 9 Characters per Connection Name

Maximum configurations for the HP operating system:

- Maximum 256GB file system per LUN (HP-UX Versions: V10.20, or V11.0 32-bit mode only)
- Maximum 64 LUNs per Fibre Channel Target
- Patches refer to *HSG80 ACS Solution Software Version 8.6 for HP-UX Installation and Configuration Guide* (AA-RFBEG-TE) for required patch levels.

Maximum configurations for the Fibre Channel loop:

- Maximum 500 meters per optical cable segment, 50 micron, multi-mode.
175 meters per optical cable segment, 62.5 micron, multi-mode
- Maximum 1 kilometer distance between Server and Storage
- Maximum 4 Fibre Channel Host Based Adapters per loop

Maximum configurations for Transparent or Multi-Bus Failover Mode:

- Maximum 4 Servers on a single FC-AL Loop
- Maximum 2 Storage Systems
- Maximum 4 Controllers with 2 Active controller ports per controller pair
- Maximum 8 Servers on two FC-AL Loops
- Maximum 1 Storage System per Loop
- Maximum 2 Controllers with 2 Active controller ports

Assumptions

This application note assumes familiarity with configuring RAID storage system, specifically the use of the Command Line Interface (CLI) as well as experience and use of the HP-UX 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 Controller and the configuration of the Enterprise/Modular Storage RAID Array systems. Refer to the documents contained therein for more detailed help on a specific topic.

General Configuration Notes

- All single controller storage configurations can be upgraded to dual controller configurations. All High Availability configurations discussed in this document assume dual controller configurations.
- Controller pairs must be configured for either Dual Redundant Failover Mode *or* Multiple-bus Failover Mode. When controllers are in Dual Redundant Failover Mode, this is referred to as “Transparent Failover Mode”.

IMPORTANT: This Application Note describes configurations with either Transparent Failover or Multiple-Bus Failover. Converting from Transparent Failover Mode to Multiple-bus Transparent Failover mode (and vice-versa) is documented in Appendix A.

- All configuration diagrams show a frontal view of the storage system.
 - ❑ Controller Host Port 1 is the left port; Controller Host Port 2 is the right port.
 - ❑ Controller A is the top controller; Controller B is the bottom controller.
- Each storage system can be configured using the Storage Works Command Console (SWCC) or the Command Line Interface (CLI) configured through either the HSG80 controller maintenance serial port or a TCP/IP interface.
- All configurations **require** Array Controller Software (ACS) V8.6 for the FC-AL topology. This is software support at the controller level.
- All configurations require Enterprise/Modular Storage RAID Array Fibre Channel Solution Software V8.6 for the HP-UX operating system. This software supports both the 32-bit and 64-bit Fibre Channel host bus adapters.
- All configurations use short wavelength lasers and multi-mode fibre channel optical cables. They do not include Fibre Channel Switch technology nor single-mode optical cables and long wavelength laser technology. Additionally, cascading fibre channel hubs are not supported in these configurations.
- All configurations require Arbitrated Loop Physical Addresses (ALPAs). There is one ALPA for each device on a loop. Each ALPA is configured as LOOP_HARD and must be unique. (See Appendix B for Valid ALPA Addresses)
 - ❑ Controller Defaults: Host Port 1 has an ALPA of 71; Host Port 2 has an ALPA of 72.
 - ❑ In configurations with a two Storage Systems, this document uses the convention of:

Storage System 1st ALPA 71 for Port 1 and ALPA 72 for Port 2
2nd ALPA 73 for Port 1 and ALPA 74 for Port 2
- All configurations require the connection name *Operating System* parameter set to “HP”. (CLI: SET *connection-name* OPERATING_SYSTEM = HP)
- By default the HSG80 Command Console LUN (CCL) is enabled. This may be disabled. (CLI: SET *controller* NOCOMMAND_CONSOLE_LUN)

NOTE: The HSG80 controllers support a range of 200 unit numbers. In Transparent Failover Mode, the units D0-D99 are assigned to Port 1 and units D100 - D199 are assigned to Port 2. In Multiple-Bus Failover Mode, all 200 unit numbers may be visible to all ports. Connection offsets are used to restrict access/visibility.

HP supports up to 64 LUNs per target. The RAID platform kit installation defines 16 LUNs per target. This is considered more than sufficient for general use.
- For configurations with more than one server on the same loop:

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 possible 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*)
- For two storage system (4 controller) configurations with more than one controller host port on the same loop, set the ALPA for each controller host port in the second enclosure to a different LOOP_HARD address (CLI: SET *controller*PORT_1_AL_PA = *xy*)
- Record the Fibre Channel host bus adapter Worldwide Identification (WWID) address. Some host bus adapters display the WWID on the HBA itself. For HP, the WWID is displayed when a host system boots and the Fibre Channel driver attaches to the adapter. These HBA addresses will also be found in the `/var/adm/messages` file. The format is *nnnn-nnnn-nnnn-nnnn*. This WWID should be recorded.
- Use the recorded WWID to identify the connection name displayed from the CLI at the controller using the CLI: SHOW CONNECTIONS command.
- Rename connection names. When the RAID controller detects a path from a host bus adapter to a controller port, it creates a connection and connection names are automatically added to the controller connection name table as !NEWCON*nn* (where *nn* is a number from 0 to 99). Currently, the total number of connections is 64. Once a connection is identified using the Fibre Channel host bus adapter WWID, rename the connection to a name meaningful to the specific configuration. (CLI: RENAME *old-name new-name*. Connection names may contain nine characters). In some cases, host name and port value may suffice (i.e., WESTP1, WESTP2, EASTP1, EASTP2, etc.).
- Each active controller host port on a loop presents one SCSI Target ID with up to sixty-four (64) LUNs to each Fibre Channel host bus adapter on the same loop. 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.
- There are two points of view when referring to fibre channel connections.
 - ❑ The first view of connections is from the server side. The server has a configuration file that allows the operating system to identify targets and logical units used for I/O. The targets and logical units may be configured as desired within the maximum values for the operating system and restrictions of the fibre channel specifications. This means that while there may be 6 targets (ALPAs) on a fibre channel arbitrated-loop, the configuration file may/may not list all 6 targets. In short, a specific server may not look for or try to access a specific target.
 - ❑ The second view of connections is from the controller side. On a loop, 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 loop, 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.

By combining the server point of view and the controller point of view, we have the flexibility of using all connections. That is, if we define all the targets in the server's configuration file and map these targets to all available connections we will have a complete use of the available connections. On the other hand, if we wish to restrict access from the server point of view, we may edit the server configuration so that there are fewer targets than connections available, leaving unused connections. Those connections are still available but for reasons of load balancing or access control, we choose not to use them.

In the configurations of this application note, we use the server's point of view to limit access to certain targets. This means we have unused connections. This also means that when implementing a configuration, we only need to identify the connections that we are using, not all of them. Thus, the naming of connections is done for only those connections that are active in the specific configuration. We simply disregard the unused 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 devices that it can see.

High Availability Configuration Topologies and Modes

This section provides a detailed description of the eight most common Enterprise/Modular Storage RAID Array Fibre Channel HP-UX high availability configurations.

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NOTE: All configurations have one or more HSG80 Storage Systems with dual-controllers bound in either Transparent Failover or Multiple_bus Failover Mode.

HA Configuration 1 - Two Servers, MC/Serviceguard Cluster Server, Transparent Failover

HA Configuration 1 (Figure 1) provides dual redundant controllers configured in Transparent Failover mode. The configuration consists of a single Enterprise/Modular Storage RAID Array enclosure with two HSG80 array controllers connected to two servers running MC/Serviceguard Application software. In normal operation Controller A provides the active path for all storage sets to the server pair through Controller A, Port 1. A second controller, Controller B, is a hot standby. In the event of a failure in Controller A, Controller B will automatically become active. All units being accessed through Port 1 of Controller A will become accessible through Port 1 of Controller B. In the event of a server failure, MC/Serviceguard will transfer access to units through the surviving server. In the initial configuration a single controller host port (Port 1) is active providing up to 64 LUNs across up to 24 disks. An additional 48 disks can be added using two expansion enclosures.

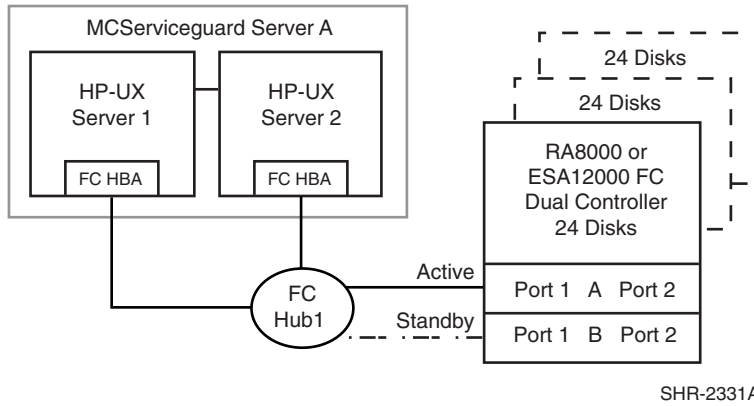


Figure 1. HA Configuration 1

With the addition of two fibre channel cables, Controller B, can become an active controller to increase performance and double LUN capacity. Two additional fibre channel cables, one connected to Controller A Port 2, and one connected to Controller B Port 2, result in the configuration shown in Figure 3. This configuration provides full controller redundancy in the event that Controller A or Controller B fails. In either failover scenario the surviving controller will transition a standby port to active providing access to all units in the MC/Serviceguard pair.

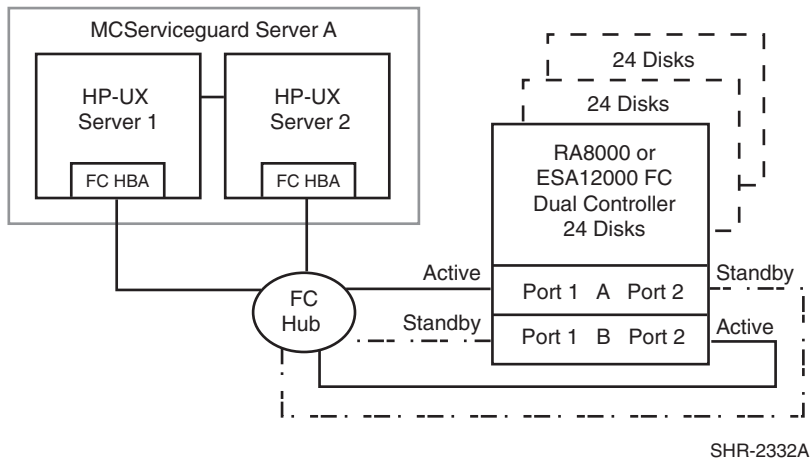


Figure 2. HA Configuration 1 with Increased Performance and Doubled LUN Capacity

HA Configuration 1 Notes

Figure 1 on page 10 shows the following configurations:

- Single Fibre Channel loop
- Dual HSG80 controllers configured in Transparent Failover Mode
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for HP-UX installed
- MC/Serviceguard application software installed
- Up to 500 meters per cable segment

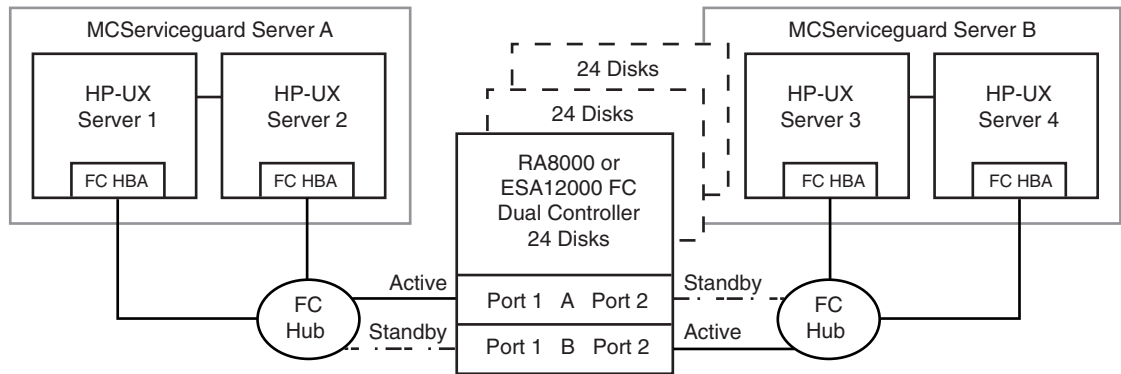
- Up to 72 disks with 2 optional expansion cabinets
- Up to 64 LUNs with 1 active controller host port.
- Suggested controller unit number assignment: Port 1 units D0 – D63. Two (2) logical connections are available
- Rename the connection names, i.e., SERVER1P1, SERVER1P2
- Run *SaveCfg* as required to account for the required LUNs

Figure 2 on page 10 shows the following configurations:

- Single Fibre Channel loop
- Dual HSG80 controllers configured in Transparent Failover Mode
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for HP-UX installed
- MC/Serviceguard application software installed
- Up to 500 meters per cable segment
- Up to 72 disks with 2 optional expansion cabinets
- Up to 128 LUNs with 2 active controller host ports. Suggested controller unit number assignment:
- Port 1 units D0 – D63, Port 2 units D100 – D163. (Four (4) logical connections are available).
- Utilization of controller host Port 2 requires two additional fibre channel cables
- Setting the controller pair in Transparent Failover mode will, by default automatically configure Port 1 and Port 2 of both controllers to the Active and Standby state indicated, and set unit offset values to 0 for Port 1 and 100 for Port 2
- Rename the connection names, i.e., SERVER1P1, SERVER1P2, SERVER2P1, SERVER2P2
- Run *SaveCfg* as required to account for the required LUNs

HA Configuration 2 - Four Servers, MC/Serviceguard, Transparent Failover, Shared Storage Enclosure

The dual-controller configuration (Figure 3 on page 12) uses two pairs of controller host ports to provide storage for a second server pair under MC/Serviceguard control. Each Server pair can be configured with up to 64 LUNs. The two MC/Serviceguards share the storage enclosure in that each cluster has exclusive access to its own LUNs through the use of mutually exclusive LUN numbering. The controllers are configured in Transparent Failover mode providing controller redundancy for both clusters. In the event of a controller failover, the surviving controller will continue to provide full access to units in both Veritas clusters. In the event of a server failure, MC/Serviceguard failover will be invoked to provide access to units through the surviving server. In this configuration two active controller ports provide up to 128 LUNs (64 per server pair) across up to 24 disks. An additional 48 disks can be added using two expansion enclosures to increase storage capacity.



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Figure 3. HA Configuration 2

HA Configuration 2 Notes

- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for HP-UX installed
- MC/Serviceguard application software for two server pairs installed
- Shared storage enclosure
- Two Fibre Channel loops
- Dual HSG80 controllers configured in Transparent Failover Mode
- Up to 500 meters per cable segment
- Up to 72 disks with 2 optional expansion enclosures
- Up to 128 LUNs total/64 per server pair with 2 active controller host ports.
- Suggested controller unit number assignment
Server pair A, Controller A Port 1 units D0 – D63.
Server pair B, Controller B Port 2 units D100 – D163
- By default, setting the controller pair in Transparent Failover mode will automatically configure Port 1 and Port 2 of both controllers to the Active and Standby state indicated, and set the unit offset values to 0 for Port 1 and 100 for Port 2
- In this configuration 4 logical connections are available
- Rename the connection names, i.e., SERVER1P1, SERVER2P1, SERVER3P2, SERVER4P2
- Run *SaveCfg* as required to account for the required LUNs

HA Configuration 3 - Two Servers, MC/Serviceguard, Multiple-Bus Failover

HA Configuration 3 (Figure 4 on page 13) combines the benefits of MC/Serviceguard pairing and controller redundancy to provide the highest level of availability. The configuration uses two separate physical paths to the storage. In the event of a failure of any component within the access path – Fibre Channel host bus adapter, cables, hub, or controller host port interface, all units on the failing path will become accessible through the alternate path. In the event of a server failure, MC/Serviceguard failover will be invoked to provide access to units through the surviving server.

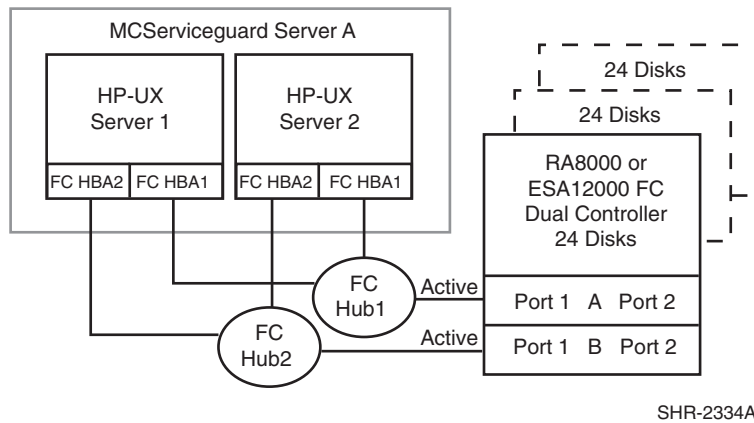


Figure 4. HA Configuration 3

HA Configuration 3 Notes

- Two Fibre Channel loops
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for HP-UX installed
- Dual HSG80 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 72 disks with 2 optional expansion cabinets
- Up to 64 LUNs with 2 active controller host ports.
- Suggested controller unit number assignment: Port 1 units D0 – D63
- 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.
For example:

Prefer units D0 – D31 to Controller A

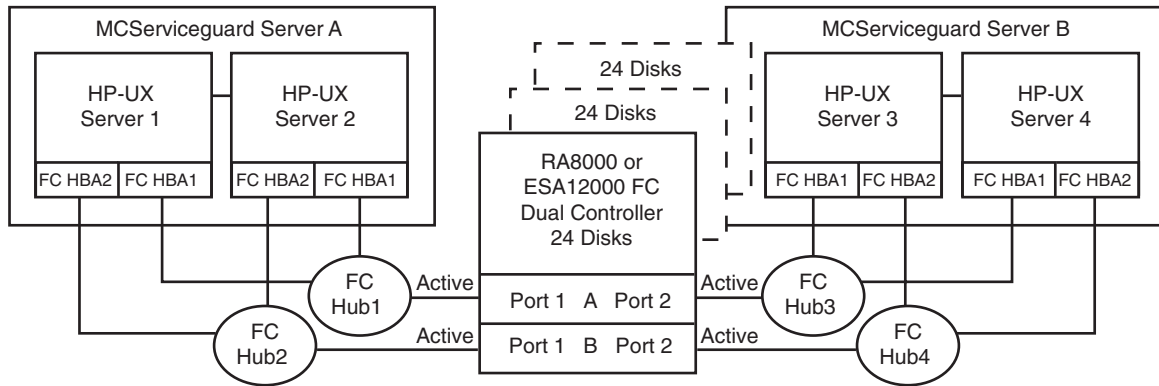
Prefer units D32 – D63 to Controller B

- In this configuration 4 logical connections are available
- Rename the connection names, i.e., SERV1P1A, SERV1P1B, SERV2P1A, SERV2P1B
- Run *SaveCfg* as required to account for the required LUNs

HA Configuration 4 - Four Servers, MC/Serviceguard, Multiple-Bus Failover, Two Independent Server Pairs, Shared Storage Enclosure

HA Configuration 4 (Figure 5 on page 14) builds on configurations 2 and 3, combining the benefits of MC/Serviceguard software, controller redundancy, and sharing of the storage enclosure. The configuration provides two independent server pairs with two separate physical paths to the storage through two pairs of controller host ports. In the event of a failure of any component within the access path – Fibre Channel host bus adapter, cables, hub, or controller host port interface, all units on the failing path will become accessible through the alternate path. In the event of a server failure, cluster failover will be invoked to provide access to units through the surviving server. Each MC/Serviceguard pair can be configured with up to 64 LUNs. The two server pairs share the storage enclosure as each

server pair has exclusive access to its own LUNs through the use of mutually exclusive LUN numbering. An additional 48 disks can be added using two expansion enclosures to increase storage capacity.



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Figure 5. HA Configuration 4

HA Configuration 4 Notes

- Four Fibre Channel loops
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for HP-UX installed
- MC/Serviceguard application software installed
- Dual HSG80 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 72 disks with 2 optional expansion cabinets
- Up to 128 LUNs total/64 server pair with 4 active controller host ports.
- Suggested controller unit number assignment:
 - Port 1 units D0 – D63,
 - Port 2 units D64 – D127
- Set the Unit Preferred Path. Use the Preferred Path unit parameter to distribute units equally across controllers for load balancing, as follows:
 - Prefer units D0 – D31 to Controller A
 - Prefer units D32 – D63 to Controller B
 - Prefer units D64 – D95 to Controller A
 - Prefer units D96 – D127 to Controller B
 (In this configuration 8 logical connections are available)
- Rename the connection names, i.e., SERV1P1A, SERV1P1B, SERV2P1A, SERV2P1B, SERV3P2A, SERV3P2B, SERV4P2A, SERV4P2B
- Set exclusive unit access for each unit to specific server connection names, i.e., for unit D0 ENABLE = SERV1P1A, SERV1P1B, SERV2P1A, SERV2P1B, for unit D32 ENABLE = SERV3P2A, SERV3P2B, SERV4P2A, SERV5P2B.
- 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 clusters/controller host ports as follows:

Server 1: Port 1 units D0 – D63

Connection names, unit offset values: SERV1P1A, 0. SERV1P1B, 0

Server 2: Port 1 units D0 – D63

Connection names, unit offset values: SERV2P1A, 0. SERV2P1B, 0

Server 3: Port 2 units D64 – D127

Connection names, unit offset values: SERV3P2A, 64. SERV3P2B, 64

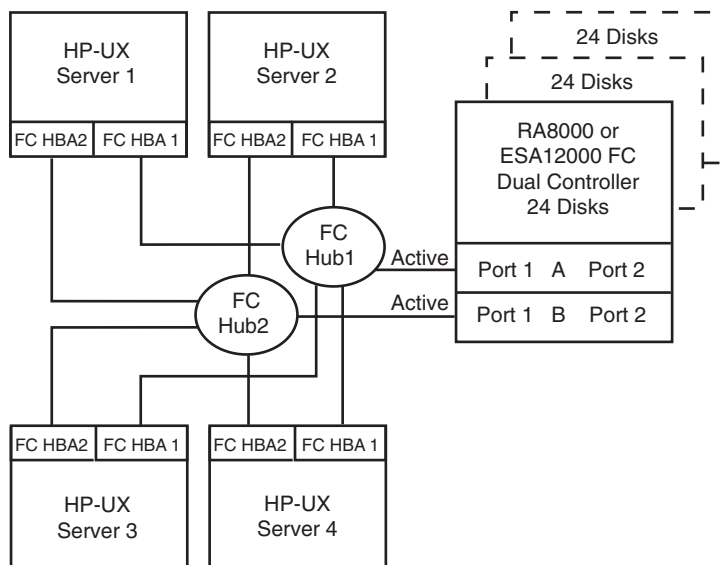
Server 4: Port 2 units D64 – D127

Connection names, unit offset values: SERV4P2A, 64. SERV4P2B, 64

- Run *SaveCfg* as required to account for the required LUNs.

HA Configuration 5 - Up to Four Servers, Multiple-Bus Failover, Shared Storage Enclosure

HA Configuration 5 (Figure 6 on page 15) provides storage for up to four separate (non-cooperating) servers on two fibre channel loops. 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 loops. 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 – host bus adapter, cables, hub, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path.



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Figure 6. HA Configuration 5

HA Configuration 5 Notes

- Two Fibre Channel loops
- Shared storage enclosure
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for HP-UX installed
- Dual HSG80 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 72 disks with 2 optional expansion cabinets
- Up to 128 LUNs, 32 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 – D15 to Controller A

Prefer units D16 – D31 to Controller B

Prefer units D32 – D47 to Controller A

Prefer units D48 – D63 to Controller B

Prefer units D64 – D79 to Controller A

Prefer units D80 – D95 to Controller B

Prefer units D96 – D111 to Controller A

Prefer units D112 – D127 to Controller B

- In this configuration 8 logical connections are available
- 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 – D31

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

Server 2: Port 1 units D32 – D63

Connection names, unit offset values: SRV2A1P1A, 32. SRV2A2P1B, 32

Server 3: Port 1 units D64 – D95

Connection names, unit offset values: SRV3A1P1A, 64. SRV3A2P1B, 64

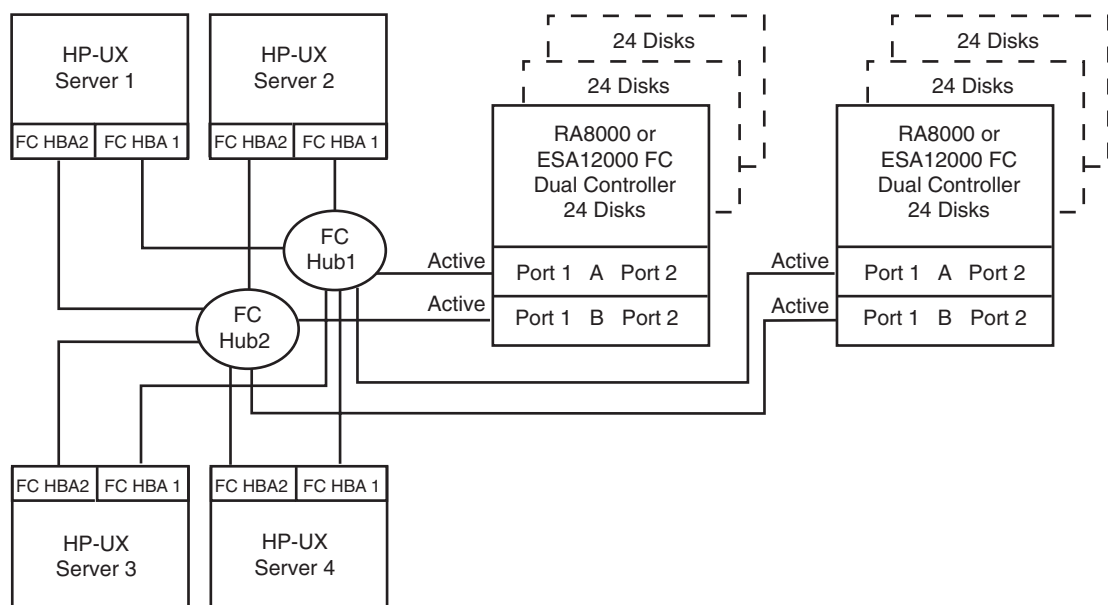
Server 4: Port 1 units D96 – D127

Connection names, unit offset values: SRV4A1P1A, 96. SRV4A2P1B, 96

- Run *SaveCfg* as required to account for the required LUNs.

HA Configuration 6 - Up to Four Servers, Multiple-Bus Failover, Two Shared Storage Enclosures

HA Configuration 6 (Figure 7 on page 17) builds on Configuration 5 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 uses two separate paths to the storage from each server. In the event of a failure of any component within the access path – host bus adapter, cables, hub, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path.



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Figure 7. HA Configuration 6

HA Configuration 6 Notes

- Two Fibre Channel loops
- Shared storage enclosure
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for HP-UX installed
- Two HSG80 controller pairs configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 144 disks with 4 optional expansion cabinets
- Up to 256 LUNs, 64 available to each server with 4 active controller host ports. Refer to Configuration 6 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 – D15 to Controller A

Prefer units D16 – D31 to Controller B

Prefer units D32 – D47 to Controller A

Prefer units D48 – D63 to Controller B

Prefer units D64 – D79 to Controller A

Prefer units D80 – D95 to Controller B

Prefer units D96 – D111 to Controller A

Prefer units D112 – D127 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, SRV4A4P1B
- 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.
- For the second enclosure set each controller host port ALPA to a different address than set on the first enclosure. Suggested settings: Enclosure 1 Port 1 = 71, Port 2 = 72. Enclosure 2 Port 1 = 73, Port 2 = 74
- Set the connection name unit offset values for each connection as shown below
- Suggested unit numbering and connection parameters would result in the units being distributed equally across enclosures and controller host ports as follows:

Storage Enclosure 1

- ALPA settings: Controller Host Port 1 = 71, Port 2 = 72
 - Server 1: Port 1 units D0 – D31
Connection names, unit offset values: SRV1A1P1A, 0. SRV1A2P1B, 0
 - Server 2: Port 1 units D32 – D63
Connection names, unit offset values: SRV2A1P1A, 32. SRV2A2P1B, 32
 - Server 3: Port 1 units D64 – D95
Connection names, unit offset values: SRV3A1P1A, 64. SRV3A2P1B, 64
 - Server 4: Port 1 units D96 – D127
Connection names, unit offset values: SRV4A1P1A, 96. SRV4A2P1B, 96

Storage Enclosure 2

- ALPA settings: Controller Host Port 1 = 73, Port 2 = 74
 - Server 1: Port 1 units D0 – D31
Connection names, unit offset values: SRV1A1P1A, 0. SRV1A2P1B, 0

Server 2: Port 1 units D32 – D63

Connection names, unit offset values: SRV2A1P1A, 32. SRV2A2P1B, 32

Server 3: Port 1 units D64 – D95

Connection names, unit offset values: SRV3A1P1A, 64. SRV3A2P1B, 64

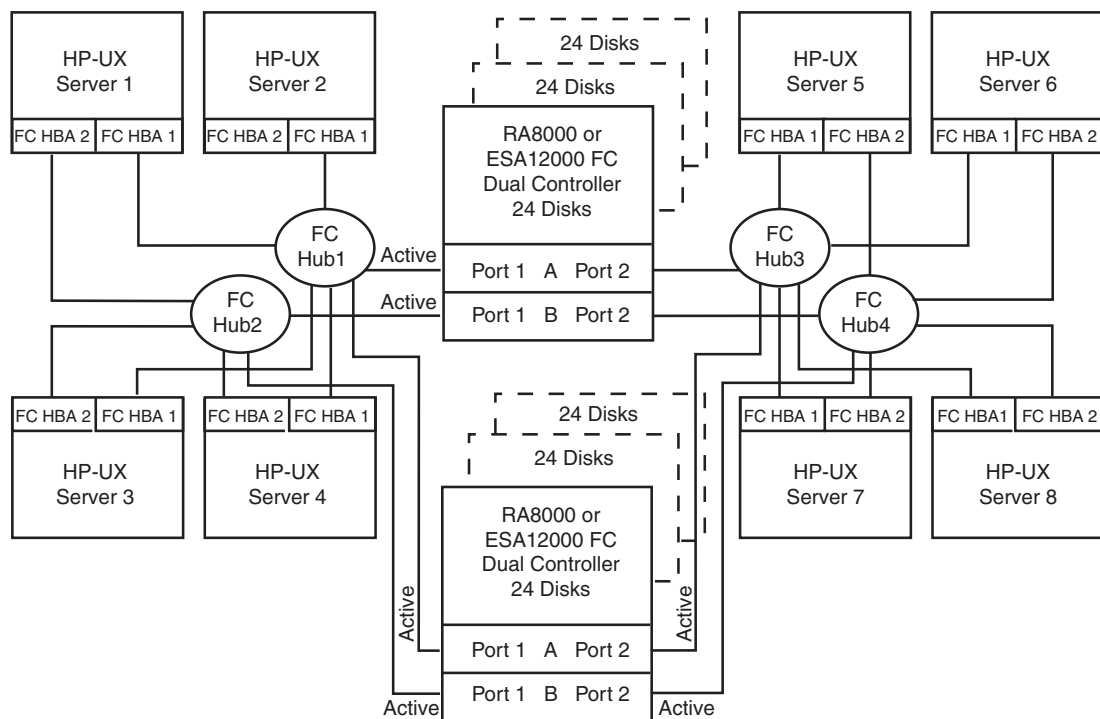
Server 4: Port 1 units D96 – D127

Connection names, unit offset values: SRV4A1P1A, 96. SRV4A2P1B, 96

- Run *SaveCfg* as required to account for the required LUNs

HA Configuration 7 - Up to Eight Servers, Multiple-Bus Failover, Two Shared Storage Enclosures

Configuration 7 (Figure 8 on page 19) builds on Configurations 5 and 6 using two dual controller pairs on four loops to provide storage path and controller redundancy for up to eight separate (non-cooperating) servers. The eight 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 each group of four servers is sharing two fibre channel loops. 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 – host bus adapter, cables, hub, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path.



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Figure 8. HA Configuration 7

HA Configuration 7 Notes

- Four Fibre Channel loops

- Shared Storage Enclosure
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for HP-UX installed

Two HSG80 controller pairs configured in Multiple-Bus Failover Mode

- Up to 500 meters per cable segment
- Up to 144 disks with 4 optional expansion cabinets
- Up to 128 LUNs, 32 available to each server with 8 active controller host ports. Refer to Configuration 6 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. 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
Prefer units D64 – D71 to Controller A
Prefer units D72 – D79 to Controller B
Prefer units D80 – D87 to Controller A
Prefer units D88 – D95 to Controller B
Prefer units D96 – D103 to Controller A
Prefer units D104 – D111 to Controller B
Prefer units D112 – D119 to Controller A
Prefer units D120 – D127 to Controller B

(In this configuration 32 logical connections are available, 16 in each enclosure).

- For each 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.
- For the second enclosure set each controller host port ALPA to a different address than set on the first enclosure. Suggested:
Enclosure 1 Port 1 = 71, Port 2 = 72.
Enclosure 2 Port 1 = 73, Port 2 = 74

- Set the connection name unit offset values at each enclosure for each connection as shown below. Suggested unit numbering and connection parameters would result in the units being distributed equally across enclosures and controller host ports as follows:

Enclosure 1: ALPA settings: Controller Host Port 1 = 71, Port 2 = 72

Enclosure 2: ALPA settings: Controller Host Port 1 = 73, Port 2 = 74

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

Server 5: Port 2 units D64 – D79

Connection names, unit offset values: SRV5A1P2A, 64. SRV5A2P2B, 64

Server 6: Port 2 units D80 – D95

Connection names, unit offset values: SRV6A1P2A, 80. SRV6A2P2B, 80

Server 7: Port 2 units D96 – D111

Connection names, unit offset values: SRV7A1P2A, 96. SRV7A2P2B, 96

Server 8: Port 2 units D112 – D127

Connection names, unit offset values: SRV8A1P2A, 112. SRV8A2P2B, 112

- Run *SaveCfg* as required to account for the required LUNs

High Availability Parts List

- HP Servers with HP V10.20 and V11.0 (32-bit mode).
- Quantities assumed as needed for a specific configuration.

Table 3 High Availability Parts List

Compaq Part #	Description
222325-B21	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for HP-UX (QB-65RAJ-SA)
128697-B21	ACS V8.6 Controller Software (QB-6BUAA-SA)
HP A3404A	FC-AL HSC Bus, K Class
HP A3591A	FC-AL HSC Bus, D Class
HP A3591B	FC-AL HSC Bus, D Class
HP A3636A	FC-AL HSC Bus, T Class
HP A3740A	FC-AL PCI, A, L, N, V Class
HP A5158A	FC-AL PCI, A, L, N, V Class
218409-B21	Compaq PCI FC Host Bus Adapter , HBA driver Version 2.5.8, Firmware Version N/A

Table 3 High Availability Parts List (Continued)

Compaq Part #	Description
380560-B21 (Blue)	RA/MA8000 Pedestal w/dual HSG80
380560-B22 (Opal)	RA/MA8000 Pedestal w/dual HSG80
380660-B21	RA/MA8000 Rackable w/dual HSG80
380580-001 (Blue)	ESA/EMA12000 w/dual HSG80 24 Slot 60HZ
380580-002 (Opal)	ESA/EMA12000 w/dual HSG80 24 Slot 60HZ
380590-B21 (Blue)	ESA/EMA12000 w/dual HSG80 24 Slot 50HZ
380590-B22 (Opal)	ESA/EMA12000 w/dual HSG80 24 Slot 50HZ
380600-001 (Blue)	ESA/EMA12000 w/dual HSG80 48 Slot 60HZ
380600-002 (Opal)	ESA/EMA12000 w/dual HSG80 48 Slot 60HZ
380610-B21 (Blue)	ESA/EMA12000 w/dual HSG80 48 Slot 50HZ
380610-B22 (Opal)	ESA/EMA12000 w/dual HSG80 48 Slot 50HZ
380620-001 (Blue)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 60 HZ
380620-002 (Opal)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 60 HZ
380630-001 (Blue)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 50 HZ
380630-002 (Opal)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 50 HZ
380570-B21 (Blue)	Pedestal Expansion 24 slots
380570-B22 (Opal)	Pedestal Expansion 24 slots
380568-B21	Rackable Expansion 24 slots
380640-001 (Blue)	ESA/EMA12000 Expansion 48 Slot 60HZ
380640-002 (Opal)	ESA/EMA12000 Expansion 48 Slot 60HZ
380650-B21 (Blue)	ESA/EMA12000 Expansion 48 Slot 50HZ
380650-B22 (Opal)	ESA/EMA12000 Expansion 48 Slot 50HZ
234453-001	Fibre Channel Optical Hub 7-Port (DS-SWXHB-07)
295573-B22 (DEC)	Fibre Channel Optical Hub 12-Port (DS-DHGGB-AA)
380561-B21	Fibre Channel Optical GBIC (DS-DXGGA-SA)
234457-B21	Fibre Channel 2 Meter Optical Cable (BNGBX-02)
234457-B22	Fibre Channel 5 Meter Optical Cable -05
234457-B23	Fibre Channel 15 Meter Optical Cable -15
234457-B24	Fibre Channel 30 Meter Optical Cable -30
234457-B25	Fibre Channel 50 Meter Optical Cable -50
380691-B21	4GB UW 7200 RPM Disk (DS-RZ1CF-VW)
380595-B21	9GB UW 7200 RPM Disk (DS-RZ1DF-VW)
380694-B21	18GB UW 7200 RPM Disk (DS-RZ1EF-VW)
380588-B21	9GB UW 10000 RPM Disk (DS-RZ1DD-VW)
380589-B21	18GB UW 10000 RPM Disk (DS-RZ1ED-VW)
147599-001	36GB UW 7200RPM Disk (DS-RZ1FB-VW)
159138-001	36GB UW 1000 RPM Disk (DS-RZ1FC-VW)

Appendix A: Controller Failover Transitions

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

The controller failover state changes, discussed in this appendix are:

- Transparent Failover to NoFailover Mode
- Transparent Failover to Multiple-bus Failover Mode
- Multiple-bus Failover to Nofailover and then to Transparent Failover Mode

NOTE:

- 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), must be issued through this serial connection to the top controller.

Verify the current state of the controllers by entering:

```
HSG80> 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.

For example:

```
Controller:
HSG80 ZG83502145 Software V86F-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 this appendix, the display will be refreshed to verify that the change has completed successfully.

Changing from Transparent Failover to No Failover Mode

1. Shutdown the OTHER_CONTROLLER by entering the following command:

```
HSG80> SET NOFAILOVER
```

2. Verify that the controller state has changed to no failover by entering the following command:

```
HSG80> SHOW THIS_CONTROLLER
```

Information, similar to the following, displays:

Controller:

HSG80 ZG83502145 Software V86F-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.

The OTHER_CONTROLLER will sound an alarm as it discovers the second controller but detects that it is not bound in a failover mode. The alarm (may be silenced) and the message about the controllers being misconfigured may be disregarded.

- To verify the change in controller state, enter:

HSG80> SHOW THIS_CONTROLLER

Example:

Controller:

HSG80 ZG83502145 Software V86F-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 procedure will implement Transparent Failover to Multi-bus Failover:

- Shutdown the OTHER_CONTROLLER by entering the following command:

HSG80> SET NOFAILOVER

- Verify that the controller state has changed to no failover by entering the following command:

HSG80> SHOW THIS_CONTROLLER

Information, similar to the following, displays:

Controller:

HSG80 ZG83502145 Software V86F-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.

The OTHER_CONTROLLER will sound an alarm as it discovers the second controller but knows that it is not bound in a failover mode. The alarm (may be silenced) and the message about the controllers being misconfigured may be disregarded.

Example:

Controller:

```
HSG80 ZG83502145 Software V86F-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

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

```
HSG80> 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.

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

```
HSG80> SHOW THIS_CONTROLLER
```

Example:

Controller:

```
HSG80 ZG83502145 Software V86F-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

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

```
HSG80> 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.

```
HSG80> 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. Inspect the “Connections:” display for connections on the storage system by entering the following command:

```
HSG80> SHOW CONNECTIONS
```

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

```
HSG80> DELETE connection_name (Repeat for each connection).
```

NOTE: The connections will be regenerated later.

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.

```
HSG80> SHOW UNITS
```

```
HSG80> 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.

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

```
HSG80> SET NOFAILOVER
```

This action will cause the OTHER_CONTROLLER to shutdown.

Verify the current state of the controller by entering:

```
HSG80> SHOW THIS_CONTROLLER
```

Example:

Controller:

```
HSG80 ZG83502145 Software V86F-0, Hardware E03
```

```
NODE_ID      = 5000-1FE1-0000-3350
```

```
ALLOCATION_CLASS = 0
```

```
SCSI_VERSION  = SCSI-2
```

```
-> Not Configured for dual-redundancy
```

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

The OTHER_CONTROLLER will sound an alarm as it discovers the second controller but knows that it is not bound in a failover mode. The alarm (may be silenced) and the message about the controllers being misconfigured may be disregarded.

Verify the current state of the controller by entering:

```
HSG80> SHOW THIS_CONTROLLER
```

Example:

Controller:

HSG80 ZG83502145 Software V86F-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

5. When the OTHER_CONTROLLER is available, enter:

HSG80> 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.

6. Verify the controller state change by entering:

HSG80> SHOW THIS_CONTROLLER

Example:

Controller:

HSG80 ZG83502145 Software V86F-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

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

HSG80> ADD UNIT Dn storage_set_name

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

8. Restart both controllers to reacquire connections. Enter:

HSG80> RESTART OTHER_CONTROLLER

HSG80> RESTART THIS_CONTROLLER

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

Appendix B: Arbitrated Loop Physical Addresses

Host/Server ALPAs. Lowest to Highest Priority

ALPA (hex)	Targ (hex)	Targ (dec)	ALPA (hex)	Targ (hex)	Targ (dec)
6E	42	66	3A	60	96
6D	43	67	39	61	97
6C	44	68	36	62	98
6B	45	69	35	63	99
6A	46	70	34	64	100
69	47	71	33	65	101
67	48	72	32	66	102
66	49	73	31	67	103
65	4A	74	2E	68	104
63	4B	75	2D	69	105
5C	4C	76	2C	6A	106
5A	4D	77	2B	6B	107
59	4E	78	2A	6C	108
56	4F	79	29	6D	109
55	50	80	27	6E	110
54	51	81	26	6F	111
53	52	82	25	70	112
52	53	83	23	71	113
51	54	84	1F	72	114
4E	55	85	1E	73	115
4D	56	86	1D	74	116
4C	57	87	1B	75	117
4B	58	88	18	76	118
4A	59	89	17	77	119
49	5A	90	10	78	120
47	5B	91	0F	79	121
46	5C	92	08	7A	122
45	5D	93	04	7B	123

ALPA (hex)	Targ (hex)	Targ (dec)	ALPA (hex)	Targ (hex)	Targ (dec)
43	5E	94	02	7C	124
3C	5F	95	01	7D	125

Reserved for FL_PORT

	00	7E	126
--	----	----	-----

HSG80 Controller ALPAs

Lowest to Highest Priority

ALPA (hex)	Targ (hex)	Targ (dec)	ALPA (hex)	Targ (hex)	Targ (dec)
EF	00	0	B1	21	33
E8	01	1	AE	22	34
E4	02	2	AD	23	35
E2	03	3	AC	24	36
E1	04	4	AB	25	37
E0	05	5	AA	26	38
DC	06	6	A9	27	39
DA	07	7	A7	28	40
D9	08	8	A6	29	41
D6	09	9	A5	2A	42
D5	0A	10	A3	2B	43
D4	0B	11	9F	2C	44
D3	0C	12	9E	2D	45
D2	0D	13	9D	2E	46
D1	0E	14	9B	2F	47
CE	0F	15	98	30	48
CD	10	16	97	31	49
CC	11	17	90	32	50
CB	12	18	8F	33	51
CA	13	19	88	34	52
C9	14	20	84	35	53
C7	15	21	82	36	54

ALPA (hex)	Targ (hex)	Targ (dec)	ALPA (hex)	Targ (hex)	Targ (dec)
C6	16	22	81	37	55
C5	17	23	80	38	56
C3	18	24	7C	39	57
BC	10	25	7A	3A	58
BA	1A	26	79	3B	59
B9	1B	27	76	3C	60
B6	1C	28	75	3D	61
B5	1D	29	74	3E	62
B4	1E	30	73	3F	63
B3	1F	31	72	40	64
B2	20	32	71	41	65