

Compaq StorageWorks

Application Note Enterprise/Modular Storage RAID Array FC-AL Configurations for Tru64 UNIX AA-RPHLA-TE

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Enterprise/Modular Storage RAID Array FC-AL Configurations for Tru64 UNIX

Application Note

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Enterprise Network Storage Architecture (ENSA)

Compaq Enterprise/Modular Storage RAID Array (RA/MA8000 and ESA/EMA12000 FC) 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 is 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 AlphaServer family of servers running Tru64 UNIX V5.1.

NOTE: This application note describes FC-AL configurations for Tru64 UNIX V5.1 using HSG80 multiple-bus failover mode. (Tru64 UNIX V5.1 also supports transparent failover mode with FC-AL, but multiple-bus failover is recommended and is shown in the configuration examples presented in this document.)

There are many levels of complexity when dealing with servers including: 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, contact your local Compaq Services representative for onsite consultation.

The RA/MA8000 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 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 FC, 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 FC 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 supports 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 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 (HBAs) to multiple RA/MA8000 FC systems for unlimited storage capacity.

The Enterprise/Modular Storage RAID Array 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.

The Enterprise/Modular Storage RAID Array 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 Enterprise/Modular Storage RAID Array 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 FC 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 NT/2000. A Storage Window for the HSG80 controller supports the Array Controller Software (ACS) V8.6 and offers integration with the Compaq Insight Manager (CIM). The CIM can receive SNMP traps from the Command Console Agent and Insight Manager services can directly launch SWCC for notification or configuring operations.

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 Release Notes, RA/MA8000 and ESA/EMA12000 HSG80 Solution Software V8.6 for Tru64 UNIX	AA-RFATF-TE
HSG80 ACS Solution Software Version 8.6 for Tru64 UNIX Installation and Configuration Guide	AA-RFAUD-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 V2.4 User Guide	AA-RFA2H-TE
Compaq StorageWorks Warranty Terms and Conditions	EK-HSXS-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 FC Tru64 UNIX 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

The HSG80 controller maximums include:

- Maximum 128 visible LUNS
- 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
- Maximum 9 characters per Connection Name

The Fibre Channel Loop maximums include:

- 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

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 Tru64 UNIX operating system. Additionally, an understanding of Fibre Channel terminology and concepts is assumed.

NOTE: Table 1 lists the documents related to the HSG80 Controller and the configuration of the Enterprise/Modular Storage RAID Array systems. Refer to these documents for more detailed help about 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 can be configured for either Dual Redundant Failover Mode *or* Multiple-bus Failover Mode.

IMPORTANT: This Application Note describes configurations using Multiple-Bus Failover.

- The KGPSA-CA host bus adapter is required for arbitrated loop configurations. (The older KGPSA-BC adapter supports fabric mode only.)
- 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 FC Solution Software V8.6 for the Tru64 UNIX operating system.
- All configurations utilize 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 be set to “Tru64_UNIX”. (CLI: SET *connection-name* OPERATING_SYSTEM = Tru64_UNIX)
- 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 Multiple-Bus Failover Mode, all 200 unit numbers may be visible to all ports.
- For configurations with more than one server on the same loop 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 FC HBA Worldwide Identification (WWID) address. For Tru64, the WWID is displayed when a host system boots and the Fibre Channel driver starts. The HBA addresses are found in the */var/adm/messages* file. The format is *nnnn-nnnn-nnnn-nnnn*. This WWID should be recorded.
- The FC HBA WWID can also be determined by using the *wwidmgr* utility at the Alpha SRM Console.
- 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 HBA 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 96. After a connection is identified using the Fibre Channel 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 (that is, WESTP1, WESTP2, EASTP1, EASTP2, and so forth.).
- Each active controller host port on a loop presents one SCSI Target ID with up to 64 logical units (LUNs) to each FC HBA on the same loop. LUNs can consist of single disks (JBOD), a storage set of multiple disks or a partition, configured for a specific RAID level of 0, 0 + 1, or 3/5.
- Set the KGPSA-CA HBA to loop mode. Use the *wwidmgr* command at the Alpha SRM console to set the HBA to loop. For example:


```
wwidmgr -set adapter -item 0 - topo loop
```

 Verify using the following command:


```
wwidmgr -show adapter
```

 After the next reinitialization, the topology will be loop. For example:


```
>>> init
```
- Compaq recommends setting HSG80's in SCSI-3 mode (but it is not required).

High Availability Configuration Topologies and Modes

This section provides a description of four example Enterprise/Modular Storage RAID Array FC Tru64 UNIX configurations.

Table 2 Typical FC-AL Tru64 UNIX V5.1 Configurations - Index

Configuration #	Description	Page
1	One Server, one HSG80 pair	8
2	Two Servers, one HSG80 pair	9
3	Two Servers, two HSG80 pairs	10
4	Two Servers, two HSG80 pairs, dual HBAs	11

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

Configuration 1 - One Server, One HSG80 Pair

Configuration 1 (Figure 1) represents an entry-level Enterprise/Modular Storage RAID Array configuration that can be expanded to support additional storage capacity or performance needs as required. The configuration consists of a single Enterprise/Modular Storage RAID Array enclosure with two HSG80 array controllers configured in Multiple-Bus Failover mode. The initial configuration supports up to 24 disks. Support for an additional 48 disks can be added using two expansion enclosures.

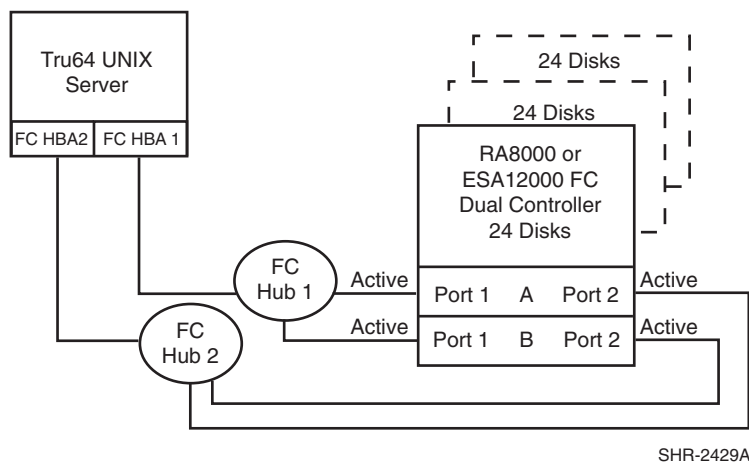


Figure 1. Configuration 1

Configuration 1 Notes

- Two Fibre Channel loops
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for Tru64 UNIX 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.
- Set the Unit Preferred Path. Use the Preferred Path unit parameter to assign units to specific controllers. Units should be distributed equally across controllers.
- Rename the connection names, that is, SERV1P1A, SERV1P1B.
- Dual HBA's set to loop mode.

Configuration 2 - Two Servers, One HSG80 Pair

Configuration 2 (Figure 2) provides dual redundant controllers configured in multiple-bus failover node. The configuration consists of a single Enterprise/Modular Storage RAID Array storage enclosure with two HSG80 array controllers connected to two servers in a TruCluster configuration.

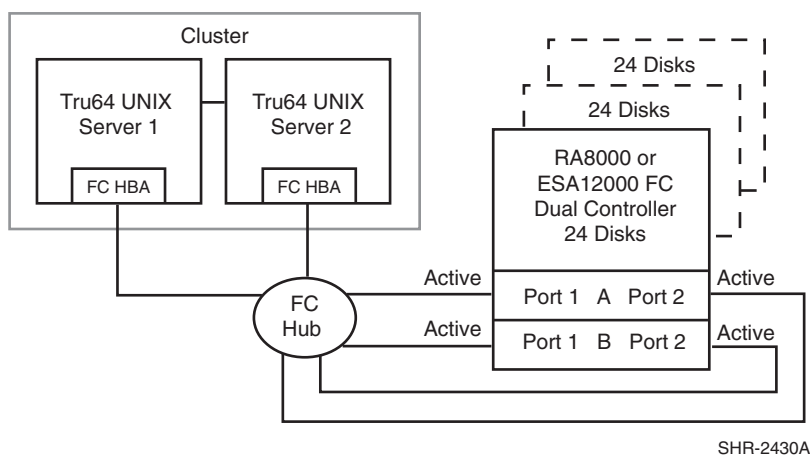


Figure 2. Configuration 2

Configuration 2 Notes

- Single Fibre Channel loop
- Dual HSG80 controllers configured in Multiple-Bus Failover Mode
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for Tru64 UNIX
- TruCluster software installed
- Up to 500 meters per cable segment
- Up to 72 disks with 2 optional expansion cabinets
- Rename the connection names, that is, SERVER1P1, SERVER1P2

Configuration 3 - Two Servers, Two HSG80 Pairs

Configuration 3 (Figure 3) demonstrates the use of two HSG80 storage systems connected to a two node TruCluster configuration using Fibre Channel Arbitrated Loop (FC-AL) using two seven port hubs.

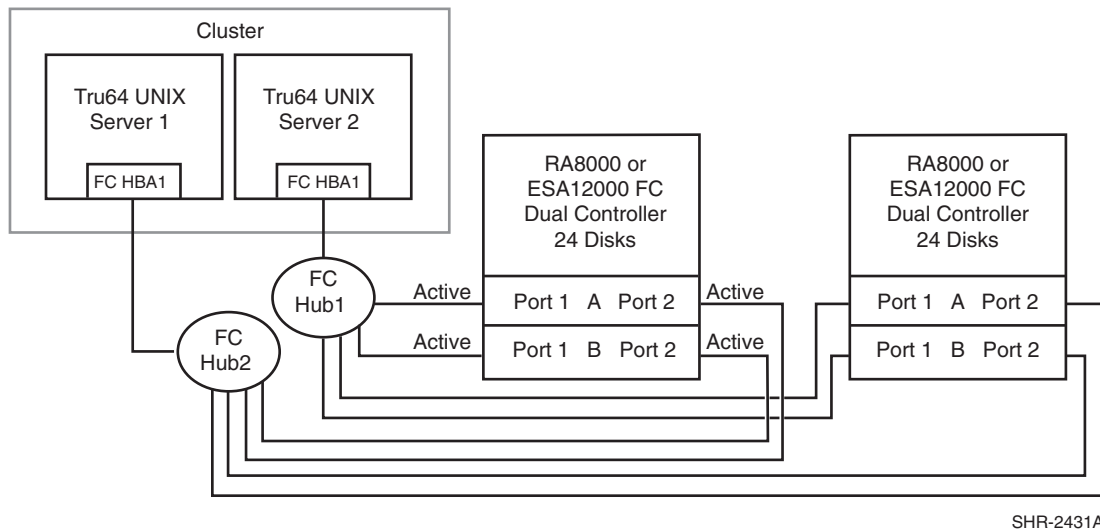


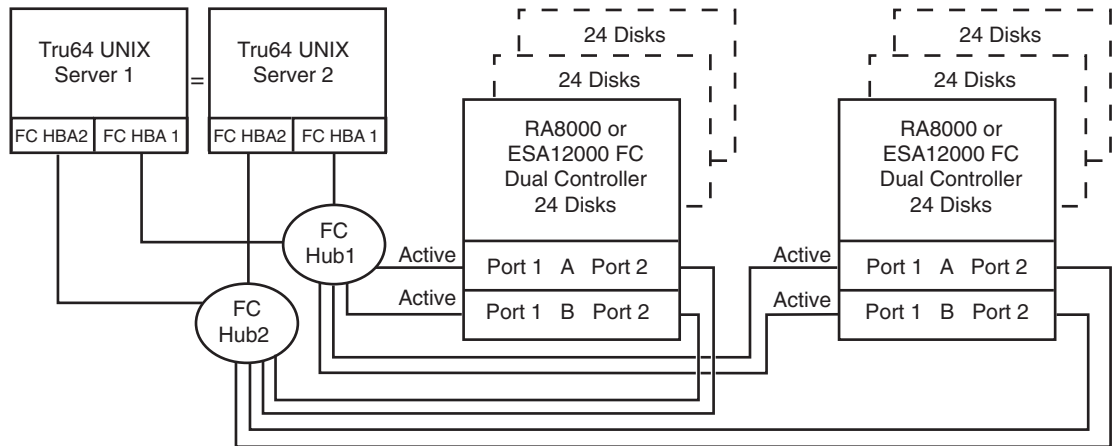
Figure 3. Configuration 3

Configuration 3 Notes

- Two Fibre Channel loops.
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for Tru64 UNIX installed.
- TruCluster configuration.
- 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 per HSG80 pair.
- Set the Unit Preferred Path. Use the Preferred Path unit parameter to assign units to specific controllers. Units should be distributed equally across controllers.
- Rename the connection names, that is, SERV1P1A, SERV1P1B, SERV2P1A, SERV2P1B.
- One HBA per host set to loop mode.
- One memory channel cluster connection.

Configuration 4 - Two Servers, Two HSG80 Pairs, Dual HBA's

Configuration 4 (Figure 4) builds on configurations 3 by using dual HBA's in the hosts, dual memory channel cluster connections and dual FC-AL hubs in a TruCluster configuration



SHR-2432A

Figure 4. Configuration 4

Configuration 4 Notes

- Two Fibre Channel loops.
- Two shared storage enclosures.
- Enterprise/Modular Storage RAID Array HSG80 Solution Software V8.6 for Tru64 UNIX installed.
- TruCluster configuration.
- 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.
- 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 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

- For each storage enclosure (controller pair), rename the connection names, that is, SRV1A1P1A, SRV1A2P1B, SRV2A1P1A, SRV2A2P1B, SRV3A1P1A, SRV3A2P1B, SRV4A1P1A, SRV4A4P1B.
- 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, etc.
- Two HBA's per host, set to loop mode.
- Two memory channel cluster connections.

Parts List

- Alpha Servers running Tru64 UNIX V5.1.
- Quantities assumed as needed for a specific configuration.

Table 3 Parts List

Compaq Part #	Description
222320-B21	RA/MA8000 and ESA/EMA12000 FC Solution Software V8.6 for Tru64 UNIX (QB-65RAB-SC)
128697-B21	ACS V8.6 Controller Software (QB-6BUAA-SA)
168794-B21	FC HBA (KGPSA-CA)
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	FC Optical Hub 7-Port (DS-SWXHB-07)
380561-B21	FC Optical GBIC (DS-DXGGA-SA)

Table 3 Parts List (Continued)

Compaq Part #	Description
234457-B21	FC 2 Meter Optical Cable (BNGBX-02)
234457-B22	FC 5 Meter Optical Cable -05
234457-B23	FC 15 Meter Optical Cable -15
234457-B24	FC 30 Meter Optical Cable -30
234457-B25	FC 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 following controller failover state changes are discussed in this appendix:

- Transparent Failover to NoFailover Mode
- Transparent Failover to Multiple-bus Failover Node
- 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 (that is, 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.

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 HSG80> prompt, enter:

```
HSG80> SET NOFAILOVER
```

This action will cause the OTHER_CONTROLLER to shutdown.

2. At the HSG80> prompt, enter:

```
HSG80> 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.

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 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:

- At the HSG80> prompt, enter:

HSG80> SET NOFAILOVER

This action will cause the OTHER_CONTROLLER to shutdown.

- At the HSG80> prompt, enter:

HSG80> 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.

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 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:

```
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.

- Verify that the controllers are now in Multi-bus failover by entering the following command:

```
HSG80> 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 and examine their “offset value” (last column), by entering the following 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.

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:

```
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
```

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.

2. 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 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.

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 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

4. 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.

5. Verify the controller state change by entering:

HSG80> 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

6. 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).

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 (ALPA)

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

ALPA (hex)	Targ (hex)	Targ (dec)	ALPA (hex)	Targ (hex)	Targ (dec)
45	5D	93	04	7B	123
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

ALPA (hex)	Targ(hex)	Targ (dec)	ALPA (hex)	Targ(hex)	Targ (dec)
C7	15	21	82	36	54
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

