RA8000/ESA12000
FC-AL Configurations
for Sun Solaris

COMPAQ
STORAGEWORKS

Application Note
EK-FCALS-AA. A01

Introduction

This application note serves as a guide to the most common Fibre Channel Arbitrated Loop (FC-AL) configurations for Compaq StorageWorks RAID Array 8000 (RA8000 FC) and Enterprise Storage Array 12000 (ESA12000 FC) storage system(s) in conjunction with the Sun family of servers running the Solaris 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 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.

Visit Our Web Site for the Latest Information

Compaq is continually making additions to its storage 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:

http://www.compaq.com/storageworks

NOTE

This application note describes RA8000/ESA12000 FC-AL standard configurations. For FC-AL High Availability configurations, utilizing Veritas FirstWatch software for Sun Solaris, please reference the FC-AL High Availability Configurations for Sun Solaris – Application Note (EK-FCALH-AA).

Enterprise Network Storage Architecture (ENSA)

Compaq StorageWorks RA8000 FC and ESA12000 FC products are the latest in fully integrated Fibre Channel RAID storage solutions.

These storage products provide the key initial step in delivering 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 being the base for building the ENSA vision.

Product Overview

The RA8000 FC and ESA12000 FC 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 Fibre Channel Arbitrated Loop (FC-AL) 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 data centers. An easy-to-deploy, flexible solution for open systems, the RA8000 currently supports up to 1.3 TB of storage with the use of 18GB disks.

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.

These storage systems incorporate the latest in RAID technology providing RAID levels 0, 1, 0+1, adaptive 3/5, and non-RAID 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 performance while preserving data and high availability support.

Platform kits are components of software and documentation created for each specific operating system that can be used with the Compaq StorageWorks RAID arrays. Platform kits exist for the SUN (Solaris) operating system, Hewlett-Packard (HP-UX) operating system, and so on.

The RA8000/ESA12000 FC platform 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, the SWCC provides a graphical user interface (GUI), simplifying the most complex of storage management operations.

Configuration References

Table 1 lists the documents that provide further information on the configuration of RA8000 and ESA12000 Fibre Channel Storage Systems:

Table 1 Configuration Reference Material

Topic	Document Title	Order Number
RA8000/ESA12000 High Availability FC-AL Configurations Application Note	*RA8000/ESA12000 FC-AL High Availability Configurations for Sun Solaris*	*EK-FCALH-AA*
Sun Solaris HSG80 Array Controller	*Release Notes, HSG80 Array Controller (ACS V8.3) for Sun Solaris*	*AA–RFBPB–TE*
Quick Setup Guide	*RAID Array 8000/ESA12000 Fibre Channel Storage Subsystem for Sun Solaris*	*AA–RFBNA–TE*
Sun Solaris RA8000/ESA12000 Installation	*RA8000/ESA12000 HSG80 Solution Software V8.3 for Sun Solaris Reference Guide*	*AA–RFAQA–TE*
HSG80 Array Controller Configuration	*HSG80 Array Controller ACS Version 8.3 Configuration and CLI Reference Guide*	*EK-HSG80-RG*
HSG80 Array Controller Maintenance	*HSG80 Array Controller ACS Version 8.3 Maintenance and Service Guide*	*EK–HSG80-SV*
StorageWorks Command Console	*Command Console V2.1 (HSG80) for RAID Array 8000/ESA12000, User's Guide*	*AA–RFA2A–TE*
Warranty Information	*DIGITAL StorageWorks Warranty Terms and Conditions*	*EK-HSXSW-WC*
HSG80 Array Controller Parts	*HSG80 Array Controller Illustrated Parts Map*	*EK-HSG80-MP or 355217-001*

General Configuration Guidelines

Fibre Channel storage technology offers more configuration flexibility than parallel SCSI storage. This application note describes typical RA8000/ESA12000 FC Sun Solaris 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

1. Maximum   128 visible LUNS (64 per port)

2. Maximum   200 assignable unit numbers

3. Maximum   72 physical devices

4. Maximum   20 RAID-5 StorageSets

5. Maximum   30 (RAID-5 and RAID-1) StorageSets

6. Maximum   45 (RAID-5 and RAID-1 and RAID-0) StorageSets

7. Maximum   8 partitions of a StorageSet or individual disk

8. Maximum   6 members of a MirrorSet

9. Maximum   14 members per RAID-5 StorageSet

10. Maximum   24 members per StripeSet

11. Maximum   48 physical devices per Striped-MirrorSet

12. Maximum   32 Connections

13. Maximum   9 Characters per Connection Name

The Solaris Operating System

1. Maximum   256GB file system per LUN (Solaris Versions: 2.5.1, 2.6)

2. Maximum   64 LUNs per FC Target

3. Patches   Refer to *RA8000/ESA12000 HSG80 Solution Software V8.3 for Sun Solaris Reference Guide* (AA-RFAQA-TE) for required patch levels.

The Fibre Channel Loop

1. Maximum   500 meters per optical cable segment, 50 micron, multi-mode.
                175 meters per optical cable segment, 62.5 micron, multi-mode.

2. Maximum   1 kilometer distance between Server and Storage.

3. Maximum   4 Fibre Channel Host Based Adapters per loop.

    For Transparent Failover Mode (**Used Exclusively in these Configurations**)

4. Maximum   4 Servers on a single FC-AL Loop with …
    Maximum   2 Storage Systems with …
    Maximum   4 Controllers with 2 Active controller ports per controller pair.

5. Maximum   8 Servers on two FC-AL Loops with …
    Maximum   1 Storage System per Loop with…
    Maximum   2 Controllers with 2 Active controller ports.

Assumptions

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

Document References

Table 1 of this document lists the various documents related to the HSG80 Controller and the configuration of the RA8000/ESA12000 RAID Arrays. Refer to the documents contained therein for more detailed help on a specific topic.

General Configuration Notes

1. All single controller storage configurations can be upgraded to dual controller configurations.

2. Controller pairs can 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*"*.

   This application note describes Transparent Failover Mode configurations only.

3. 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.

4. 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.

5. All configurations **require** Array Controller Software (ACS) V8.3 for the FC-AL topology. This is software support at the controller level.

   All configurations **require** RA8000/ESA12000 FC Solution Software V8.3 for the Sun Solaris operating system. Solution Software V8.3A supports the 32-bit FC host bus adapter. Solution Software V8.3B supports both the 32-bit and 64-bit FC host bus adapters.

6. All configurations utilize short wavelength lasers and multi-mode fibre channel optical cables. They do not include Fibre Channel Switch technology or single-mode optical cables and long wavelength laser technology. Additionally, cascading fibre channel hubs are not supported in these configurations.

7. 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 A 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   **1**[st]   ALPA 71 for Port 1 and ALPA 72 for Port 2
                                     2nd   ALPA 73 for Port 1 and ALPA 74 for Port 2

8. All configurations **require** the Connection Name *Operating System* parameter set to "SUN". (CLI: "SET *connection-name* OPERATING_SYSTEM = SUN")

9. By default the HSG80 Command Console LUN (CCL) is enabled. This may be disabled.
   (CLI: "SET *controller* NOCOMMAND_CONSOLE_LUN")

> **UNIT NUMBERS**
>
> 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.
>
> Solaris supports up to 64 LUNs per target. The RAID platform kit installation defines 16 LUNs per target considered more than sufficient for general use. These LUNs are defined in the file: `/kernel/drv/sd.conf`
>
> In this document, examples show a range of unit values as D0-D15 and D100-D115 to map to the default set of LUNs.

10. 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*")

11. For single controller configurations with two active controller host ports on the same loop, use the *connection-name Unit_Offset* value to set the range of unit numbers to be visible from controller host port 2.

12. 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")

13. Record the FC HBA Worldwide Identification (WWID) address. Some HBAs display the WWID on the HBA itself. For Solaris, the WWID is displayed when a host system boots and the Fibre Channel driver attaches to the adapter. The format is nnnn-nnnn-nnnn-nnnn. This WWID should be recorded.

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. By default, new connection names are automatically added to the controller connection name table as "!NEWCONnn" (where nn is a number from 1 to 32). The controller adds a connection when a path to an adapter from each active controller host port is detected. Once you have identified each connection using the FC HBA WWID, rename the connection names 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 loop presents one SCSI Target ID with up to sixty-four (64) LUNs to each FC HBA on the same loop. LUNs (logical units) can consist of single disks (JBOD), a storageset of multiple disks or a partition (up to 64), configured for a specific RAID level of 0, 0 + 1, or 3/5.

17. In the configurations there are verification/setup steps on the Sun Server that involve the ALPAs. These can be set/reset with a shell script provided in /opt/steam/bin (assuming that /opt was the base directory area for the HSG80 platform kit installation). Note that when constructing the Target list, you will be entering **decimal values**. A complete table of decimal to hex values is provided in Appendix A and the required set are shown in each configuration.

18. **Thinking About Connections.** There are two points of view when speaking of fibre channel connections.

   • The first view of connections is taken 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.

Configuration Descriptions

Table 2 lists the most common RA8000/ESA12000 FC Sun Solaris configurations and the pages of this document where a description of capacities and configuration notes are provided.

Table 2 Typical RA8000 / ESA12000 FC-AL Sun Solaris Configurations - Index

Configuration #	Description	Pages
1	One Server, Single Controller	10 - 11
2	One Server, Dual Controller Transparent Failover	12 - 14
3	One Server, Two Dual Controller Pairs Transparent Failover	15- 16
4	Two Servers, Single Controller, Shared Storage Enclosure	17 -18
5	Two Servers, Dual Controller Transparent Failover, Shared Storage Enclosure	19 - 20
6	Up to Four Servers, Dual Controller Transparent Failover, Shared Storage Enclosure	21 - 23
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8	Up to Eight Servers, Dual Controller Transparent Failover, Shared Storage Enclosure	28 - 30

Configuration Parts Lists

A list of parts for each specific configuration is provided at the end of this document following the configuration descriptions. Verify that you have all the required parts before beginning the installation.

Configuration 1 - One Server, Single Controller

The single controller configuration (**Figure 1**) is an entry-level RA8000 FC or ESA12000 that can be expanded to accommodate additional storage capacity or performance needs as required. The configuration consists of an RA8000 or ESA12000 storage enclosure with a single HSG80 array controller on a single fibre channel loop. 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. Additional servers can be added to this configuration as required using the existing hub (refer to Configuration 6).

Figure 1 Configuration 1
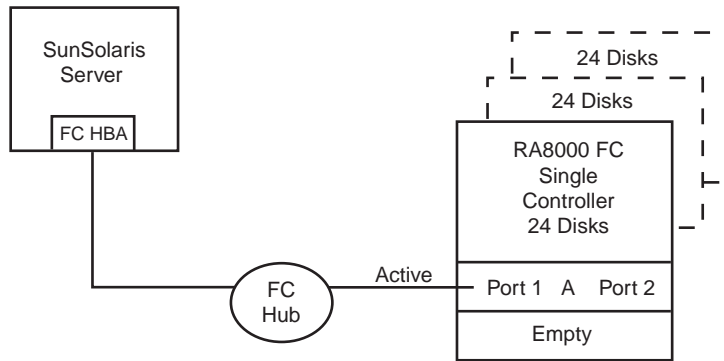
SHR-1484

LUN capacity can be doubled by adding a third fibre channel cable from the hub to Port 2 of the controller, resulting in the configuration shown in Figure 2.

Figure 2 Configuration 1 with Double LUN Capacity

SHR-1485

Configuration 1 Notes

- Single Fibre Channel Loop
- Single HSG80 controller; controller failover is not available.
- Up to 500 meters per 50-micron cable segment
- Up to 72 disks with 2 optional expansion enclosures

First Diagram (Figure 1)

In this configuration, 1 logical connection is available with up to 64 LUNs. This Host-Hub-Storage configuration is developed in later configurations. Suggested controller unit number assignment: Port 1, units D0 – D15.

Storage Enclosure

- Verify/Set the following for Port 1:

  AL_PA = 71
  TOPOLOGY = LOOP_HARD

Sun Server

Note that in this configuration, using Port 1 will allow access to 64 units and the Controller will allow access to units D0 - D99 only.

- Verify/Set the following:

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters*, and then Option 1, *View Adapters*. In the View screen, verify that the default ALPAs 64, 65 exist.

  If they do not, Select Option 4, *Modify an Adapter* and modify the adapter for the *fca and/or fcaw* driver. Modify the list to reflect Targets 64, 65. Target to ALPA mapping shown below.

Target	ALPA
64	72
65	71

Reboot the server to load the new setting.

Second Diagram (Figure 2)

In this configuration, 2 logical connections are available with up to 128 LUNs.
Suggested controller unit numbers: Port 1, units D0 – D15; Port 2, units D100 – D115.

Storage Enclosure

- Verify/Set the following for Port 1:

  AL_PA = 71
  TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2:

  AL_PA = 72
  TOPOLOGY = LOOP_HARD

Sun Server

Same values as the first configuration diagram. In this configuration, we will access both ports, access both ALPAs and use the second connection.

Configuration 2 - One Server, Dual Controller Transparent Failover

This two-controller configuration (**Figure 3**) provides dual redundant controllers configured in Transparent Failover mode. The configuration consists of an RA8000 FC or ESA12000 storage enclosure with two HSG80 array controllers on a single loop. In normal operation Controller A provides the active path for all storagesets to the server through Port 1. A second controller, Controller B is a hot standby. Controller B will automatically become active in the event of a failure in Controller A. All units being accessed through Port 1 of Controller A will become accessible through Port 1 of Controller B. In **Figure 3**, 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. Additional servers can be added to this configuration as required using the existing hub (refer to Configuration 6).
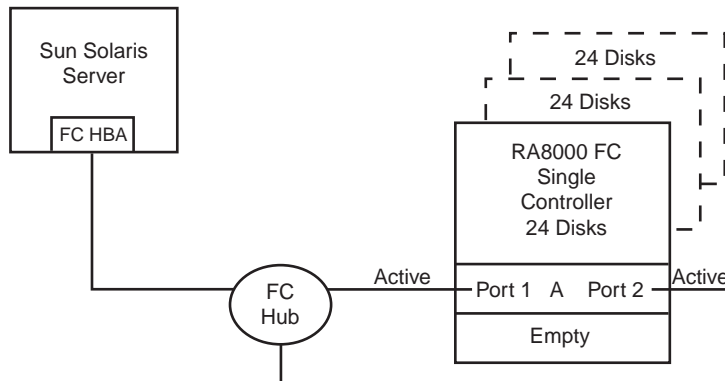
Figure 3 Configuration 2
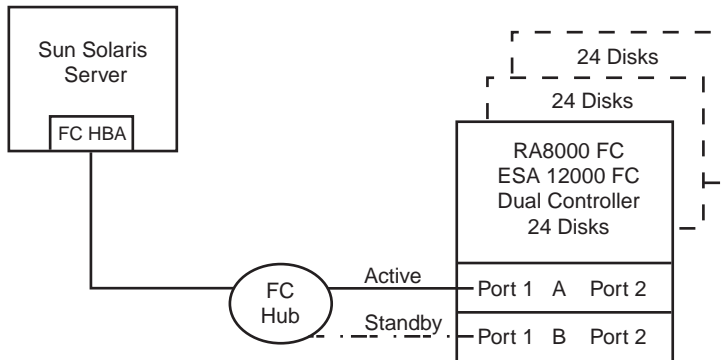
SHR-1486

Utilization of the second controller, Controller B, as an active controller to increase performance and double LUN capacity can be accomplished without sacrificing redundancy. Two 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 4**. This configuration provides full controller redundancy in the event either controller fails. During failover, the surviving controller will transition the standby port to the active state providing access to all units for the server.

Figure 4 Configuration 2 with Increased Performance and Double LUN Capacity
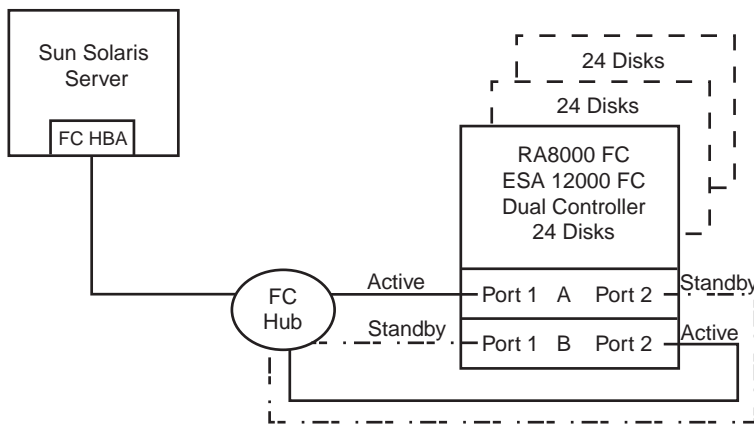
SHR-1487

Configuration 2 Notes

- Single Fibre Channel Loop
- Dual HSG80 controllers configured in Transparent Failover Mode
- Up to 500 meters per 50-micron cable segment
- Up to 72 disks with 2 optional expansion enclosures
- 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

First Diagram (Figure 3)

In this configuration, up to 64 LUNs are supported with 1 active controller host port.
Suggested controller unit numbers: Port 1, units D0 – D15

Storage Enclosure

- Verify/Set the following for Port 1

  AL_PA = 71
  TOPOLOGY = LOOP_HARD

Sun Server

- Verify/Set the following:

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters*, and then Option 1, *View Adapters*. In the View screen, verify that only Target 65 exists.

  If it does not, Select Option 4, *Modify an Adapter*, and modify the adapter for the ***fca and/or fcaw*** driver. Modify the list to reflect Target 65 only. Target to ALPA mapping shown below.

Target	ALPA
65	71

  Reboot the server to load the new setting.

Second Diagram (Figure 4)

In this configuration, 2 logical connections are available with up to 128 LUNs. Suggested controller unit numbers: Port 1, units D0 – D15; Port 2, units D100 – D115

Storage Enclosure

- Verify/Set the following for Port 1

  AL_PA = 71
  TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2

  AL_PA = 72
  TOPOLOGY = LOOP_HARD

Sun Server

- Verify/Set the following:

Change directory to /opt/steam/bin and invoke **config.sh**

```
# cd /opt/steam/bin; ./config.sh
```

Select Option 20, *Add/Change Adapters,* and then Option 1, *View Adapters*. In the View screen, verify that Targets 64, 65 exist.

If they do not, Select Option 4, *Modify an Adapter*, and modify the adapter for the *fca and/or fcaw* driver. Modify the list to reflect Targets 64 and 65. Target to ALPA mapping shown below.

Target	ALPA
64	72
65	71

Reboot the server to load the new settings.

Configuration 3 - One Server, Two Dual Controller Pairs Transparent Failover

Configuration 3 (**Figure 5**) is a two dual-controller configuration with two dual-redundant controller pairs using two RA8000 pedestal enclosures or a single ESA12000 enclosure. The controllers are configured in Transparent Failover Mode providing controller redundancy in each storage enclosure. This configuration takes advantage of the high capacity of a single fibre channel loop allowing for expansion of storage capacity without the addition of another hub. As with Configuration 2, full controller redundancy and two controller capacity is provided in both storage enclosures. In this configuration four active controller ports provide up to 256 LUNs across up to 48 disks. An additional 96 disks can be added using four expansion enclosures. Additional servers can be added to this configuration as required using the existing hub (refer to Configuration 7).

Figure 5 Configuration 3
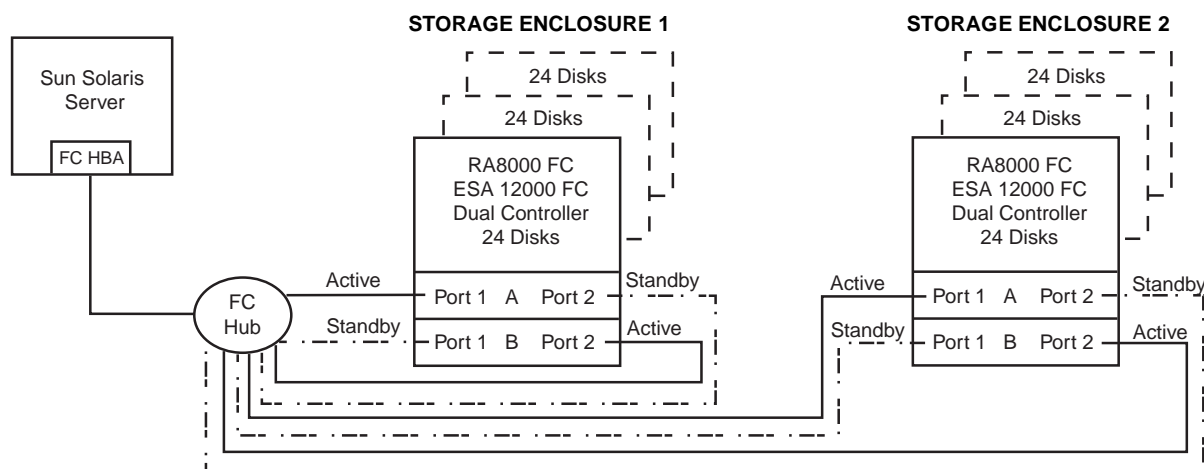
SHR-1488

Configuration 3 Notes

- Single Fibre Channel Loop
- Two Dual HSG80 controller pairs configured in Transparent Failover Mode
- Up to 500 meters per 50-micron cable segment
- Up to 144 disks with 4 optional expansion enclosures
- In this configuration, 4 logical connections are available. There are 2 per storage enclosure with up to 128 LUNs each.
- By default, setting the controller pairs 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

Storage Enclosure 1 (Figure 5)

- Verify/Set the following for Port 1
   Port 1 units D0 – D15
   AL_PA = 71
   TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2
   Port 2 units D100 – D115
   AL_PA = 72
   TOPOLOGY = LOOP_HARD

Storage Enclosure 2 (Figure 5)

- Verify/Set the following for Port 1
  Port 1 units D0 – D15
  AL_PA = 73

  TOPOLOGY = LOOP_HARD
- Verify/Set the following for Port 2
  Port 2 units D100 – D115
  AL_PA = 74
  TOPOLOGY = LOOP_HARD

Sun Server

- Verify/Set the following:

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that the Targets 62, 63, 64, 65 exist.

  If they do not, Select Option 4, *Modify an Adapter* and modify the adapter for the *fca and/or fcaw* driver. By default, you will see Targets 64, 65. Modify the list to reflect Targets 62, 63, 64, 65. Target to ALPA mapping shown below.

Target	ALPA
62	74
63	73
64	72
65	71

Reboot the server to load the new settings.

Configuration 4 – Two Servers, Single Controller, Shared Storage Enclosure

Configuration four (**Figure 6**) utilizes the second controller host port to provide storage to a second separate (non-cooperating) server. The two servers share the storage enclosure in that each server has exclusive access to its own LUNs through the use of mutually exclusive LUN numbering and Target identification. This configuration utilizes two separate fibre channel loops. Additional servers can be added to this configuration as required using the existing hubs (refer to Configuration 8).

Figure 6 Configuration 4
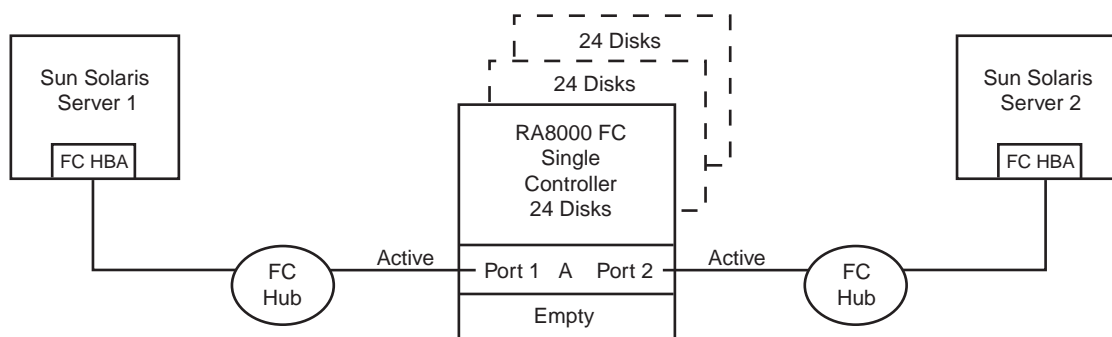
SHR-1489

Configuration 4 Notes

- Two Fibre Channel Loops
- Shared storage enclosure
- Single HSG80 controller, controller failover is not available
- Up to 500 meters per 50-micron cable segment
- Up to 72 disks with 2 optional expansion enclosures
- Up to 128 LUNs total, 64 available to each server with 2 active controller host ports.

Storage Enclosure

- Verify/Set the following for Port 1:

  Port 1 units D0-D15
  AL_PA = 71
  TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2:

  Port 2 units D100-D115
  AL_PA = 72
  TOPOLOGY = LOOP_HARD

Sun Server 1

- Verify/Set the following:

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that Target 65 exists.

  If it does not*,* Select Option 4, *Modify an Adapter,* and modify the adapter for the *fca and/or fcaw* driver. By default, you will see Targets 64, 65. Modify the list to reflect Target 65 only. Target to ALPA mapping shown below.

Target	ALPA
65	71

  <u>*Reboot the server to load the new settings.*</u>

Sun Server 2

- Verify/Set the following:

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that only Target 64 exists.

  If it does not, Select Option 4, *Modify an Adapter*, and modify the adapter for the *fca and/or fcaw* driver. By default, you will see Targets 64, 65. Modify the list to reflect Target 64 only. Target to ALPA mapping shown below.

Target	ALPA
64	72

  <u>*Reboot the server to load the new settings.*</u>

Configuration 5 – Two Servers, Dual Controller Transparent Failover, Shared Storage Enclosure

Configuration 5 (**Figure 7**) utilizes a dual controller pair to provide storage and controller redundancy to a second, separate (non-cooperating) server. The two servers share the storage enclosure in that each server has exclusive access to its own LUNs through the use of mutually exclusive LUN and Target numbering. This configuration utilizes two separate fibre channel loops. Each server has access to its own dedicated controller. In the event of a controller failover, the surviving controller will continue to provide full access to units of both servers.

In normal operation Controller A provides the active path for all storagesets assigned to Server 1 through Port 1. Controller B provides the active path for all storagesets assigned to Server 2 through Port 2. Each server also has a dedicated standby port in the event that there is a controller failover. Additional servers can be added to this configuration as required using the existing hubs (refer to Configuration 8).

Figure 7 Configuration 5
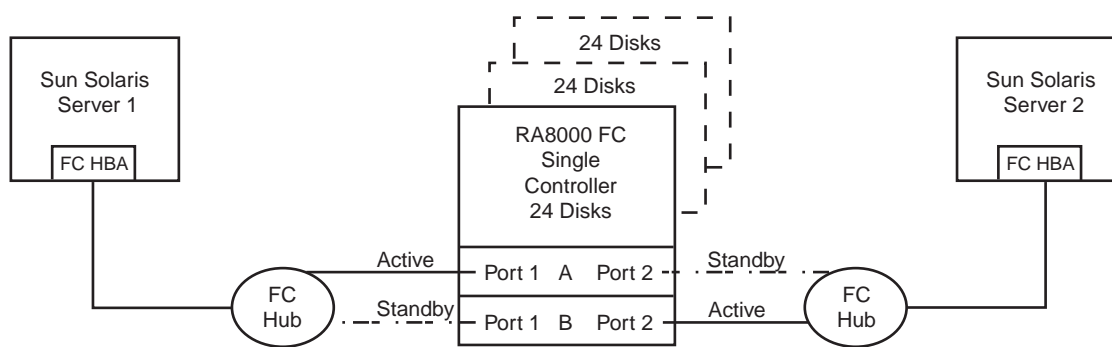
SHR-1490

Configuration 5 Notes

- Two Fibre Channel Loops
- Shared storage enclosure
- Dual HSG80 controllers configured in Transparent Failover Mode
- Up to 500 meters per 50-micron cable segment
- Up to 72 disks with 2 optional expansion enclosures
- Up to 128 LUNs total, 64 available to each server with 2 active controller host ports.
- 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

Storage Enclosure

- Verify/Set the following for Port 1:

  Port 1 units D0-D15
  AL_PA = 71
  TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2:

  Port 2 units D100-D115
  AL_PA = 72
  TOPOLOGY = LOOP_HARD

Sun Server 1

- Verify/Set the following:

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that only Target 65 exists.

  If it does not, Select Option 4, *Modify an Adapter* and modify the adapter for the ***fca and/or fcaw*** driver. By default, you will see Targets 64, 65. Modify the list to reflect Target 65 only. Target to ALPA mapping shown below.

Target	ALPA
65	71

Reboot the server to load the new setting.

Sun Server 2

- Verify/Set the following:
  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that only Target 64 exists.

  If it does not, Select Option 4, *Modify an Adapter* and modify the adapter for the ***fca and/or fcaw*** driver. By default, you will see Targets 64, 65. Modify the list to reflect Target 64 only. Target to ALPA mapping shown below.

Target	ALPA
64	72

Reboot the server to load the new setting.

Configuration 6 – Up to Four Servers, Dual Controller Transparent Failover, Shared Storage Enclosure

Configuration 6 (**Figure 8**) builds on Configurations 2 and 5 utilizing a dual controller pair on a single loop to provide storage and controller redundancy for up to four separate (non-cooperating) servers. 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 setting explicit *connection-name* unit_offsets to give each server an accessible range of unit numbers. As with all dual controller configurations, controller failover and performance benefits are inherent.

Figure 8 Configuration 6
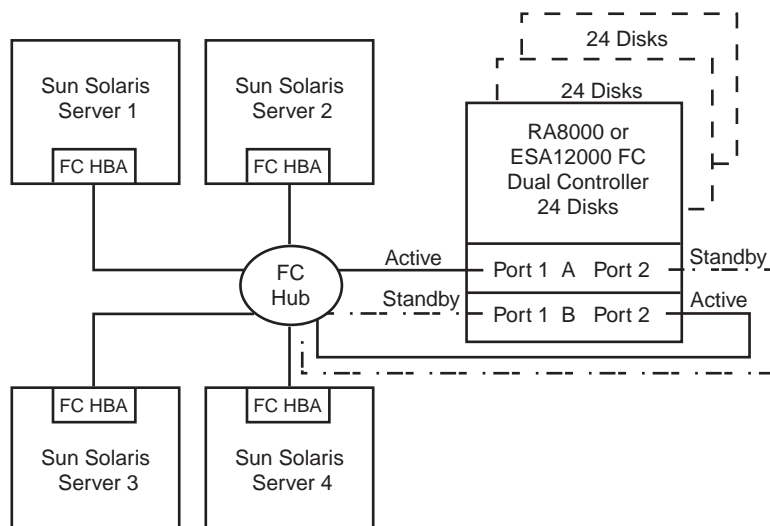
SHR-1491

Configuration 6 Notes

- Single Fibre Channel Loop
- Shared storage enclosure
- Dual HSG80 controllers configured in Transparent Failover Mode
- Up to 500 meters per 50-micron cable segment
- Up to 72 disks with 2 optional expansion enclosures
- Up to 256 LUNs total, 64 available to each server with 2 active controller host ports
- In this configuration, 8 logical connections are available, 2 to each server
- 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 unit offset values to 0 for Port 1 and 100 for Port 2.
- In the following setup, two servers have access to units D0-D99 and two servers have access to units D100-D199. Using unit offsets, each server has a unique set of targets.

Storage Enclosure

- Verify/Set the following for Port 1:

  Port 1 units D0-D31   (Two Servers, 16 LUNs each)
  AL_PA = 71
  TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2:

  Port 2 units D100-D131   (Two Servers, 16 Luns Each)
  AL_PA = 72
  TOPOLOGY = LOOP_HARD

- For clarity, we explicitly rename our connection names for the servers. Note that there are 8 logical connections available but we will use only one per Server.

- The naming convention chosen will help identify and maintain the configuration(s).

  For Example:

      SERVER1P1   (Server 1, Controller Port 1)
      SERVER2P1   (Server 2, Controller Port 1)
      SERVER3P2   (Server 3, Controller Port 2)
      SERVER4P2   (Server 4, Controller Port 2)

      SERVER1P2   (Unused Connection)
      SERVER2P2   (Unused Connection)
      SERVER3P1   (Unused Connection)
      SERVER4P1   (Unused Connection)

- For each Server, SET/VERIFY the connection name unit offset values.

  For Example:

      SET SERVER1P1   UNIT_OFFSET =   0   (default)
      SET SERVER2P1   UNIT_OFFSET = 16
      SET SERVER3P2   UNIT_OFFSET = 100   (default)
      SET SERVER4P2   UNIT_OFFSET = 116

Sun Server 1; Sun Server 2

- Verify/Set the following for each server :

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that only Target 65 exists.

  If it does not, Select Option 4, *Modify an Adapter* and modify the adapter for the ***fca and/or fcaw*** driver. By default, you will see Targets 64, 65. Modify the list to reflect Target 65 only. Target to ALPA mapping shown below.

Target	ALPA
65	71

  Reboot the servers to load the new settings.

Sun Server 3; Sun Server 4

- Verify/Set the following for each Server :

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that Target 64 exists.

  If it does not, Select Option 4, *Modify the Adapter* and modify the adapter for the ***fca and/or fcaw*** driver. By default, you will see Targets 64, 65. Modify the list to reflect Target 64 only. Target to ALPA mapping shown below.

Target	ALPA
64	72

  Reboot the servers to load the new settings.

Configuration 7 – Up to Four Servers, Two Dual Controller Pairs Transparent Failover, Shared Storage Enclosure

Configuration 7 (**Figure 9**) builds on Configurations 3 and 6 utilizing two dual controller pairs on a single loop to provide storage and controller redundancy for up to four, separate (non-cooperating) servers. The four servers share the storage enclosures in that each server has exclusive access to its own set of LUNs within each enclosure. This is made possible by the setting of connection-name unit offsets to give each server an accessible range of unit numbers. The addition of a second controller pair doubles the disk and LUN capacity available to the four servers.

Figure 9 Configuration 7
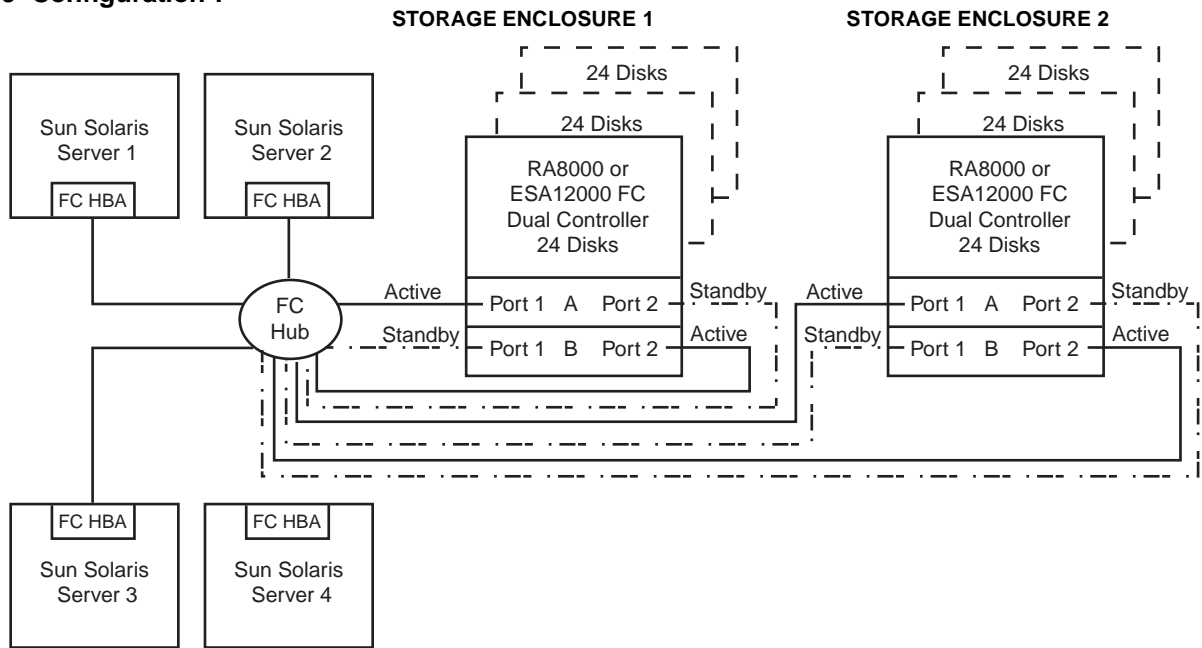
SHR-1492

Configuration 7 Notes

- Single Fibre Channel Loop
- Shared storage enclosure
- Two Dual HSG80 controller pairs configured in Transparent Failover Mode
- Up to 500 meters per 50-micron cable segment
- Up to 144 disks with 4 optional expansion enclosures
- Up to 512 LUNs, 128 available to each server with 4 active controller host ports
- In this configuration, 16 connections exist. A server may have 4 connections but we have chosen to configure each server to access only 2 each. An alternate configuration, shown at the end of this section, uses the complete 16 connections.

- By default, setting the controller pairs in Transparent Failover Mode will 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.

- Configuration 7 is an extension of Configuration 6. We will modify the server configurations so that pairs of servers have the same Targets. LUN numbering is identical for each enclosure but when viewed from each Server the LUNs are assigned under different Target IDs.

Storage Enclosure 1

- Verify/Set the following for Port 1:

  Port 1 units D0-D31 (Two Servers, 16 LUNs each)
  AL_PA = 71
  TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2:

  Port 2 units D100-D131   (Two Servers, 16 LUNs each)
  AL_PA = 72
  TOPOLOGY = LOOP_HARD

- For clarity, we explicitly rename our connection names for the servers. The naming convention chosen will help identify and maintain the configuration(s).

  For Example:

  SERVER1P1   (Server 1, Controller Port 1)
  SERVER1P2   (Server 1, Controller Port 2)
  SERVER2P1   (Server 2, Controller Port 1)
  SERVER2P2   (Server 2, Controller Port 2)

  (Unused Connections)
  SERVER3P1, P2
  SERVER4P1, P2

- For each Server, SET/VERIFY the connection name unit offset values.

  For Example:

  SET SERVER1P1   UNIT_OFFSET = 0
  SET SERVER1P2   UNIT_OFFSET = 100
  SET SERVER2P1   UNIT_OFFSET = 16
  SET SERVER2P2   UNIT_OFFSET = 116

Storage Enclosure 2 (Note unique values for these ALPAs)

- Verify/Set the following for Port 1

  Port 1 units D0-D31
  AL_PA = 73
  TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2

  Port 2 units D100-D131
  AL_PA = 74
  TOPOLOGY = LOOP_HARD

- For clarity, we explicitly rename our connection names for the servers. The naming convention chosen will help identify and maintain the configuration(s).

  For Example:

  SERVER3P1   (Server 3, Controller Port 1)
  SERVER3P2   (Server 3, Controller Port 2)
  SERVER4P1   (Server 4, Controller Port 1)
  SERVER4P2   (Server 4, Controller Port 2)

  (Unused Connections)
  SERVER1P1, P2
  SERVER2P1, P2

- For each Server, SET/VERIFY the connection name unit offset values.

  For Example:

SET SERVER3P1	UNIT_OFFSET = 0
SET SERVER3P2	UNIT_OFFSET = 100
SET SERVER4P1	UNIT_OFFSET = 16
SET SERVER4P2	UNIT_OFFSET = 116

Sun Server 1; Sun Server 2

- Verify/Set the following for each server :

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that only Targets 64, 65 exist.

  If they do not, Select Option 4, *Modify an Adapter* and modify the adapter for the *fca and/or fcaw* driver. By default, you will see Targets 64, 65. If not, Modify the list to reflect Targets 64, 65 only. Target to ALPA mapping shown below.

Target	ALPA
64	72
65	71

  Reboot the servers to load the new settings.

Sun Server 3; Sun Server 4

- Verify/Set the following for each server :

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that only Targets 62, 63 exist.

  If they do not, Select Option 4, *Modify an Adapter* and modify the adapter for the *fca and/or fcaw* driver. By default, you will see Targets 64, 65. Modify the list to reflect Targets 63, 62 only. Target to ALPA mapping shown below.

Target	ALPA
62	74
63	73

  Reboot the servers to load the new settings.

Table 3 provides an alternate setup of Configuration 7, where servers access both storage enclosures using 16 connections.

Table 3 Configuration 7 Alternate Set-up

Node/HW	Storage Enclosure 1	Storage Enclosure 2	Servers 1 .. 4
ALPAs	71, 72	73, 74	HBA WWID
Targets	65, 64	63, 62	62, 63, 64, 65
Connections	Servers 1 .. 4	Servers 1 .. 4	Both Storage Enclosures
Unit Offsets	P1: D0- D63 (4 * 16) P2: D100- D163 Server 1 P1 Offset 0 Server 2 P1 Offset 16 Server 3 P1 Offset 32 Server 4 P1 Offset 48 Server 1 P2 Offset 100 Server 2 P2 Offset 116 Server 3 P2 Offset 132 Server 4 P2 Offset 148	P1: D0- D63 (4 * 16) P2: D100-D163 Server 1 P1 Offset 0 Server 2 P1 Offset 16 Server 3 P1 Offset 32 Server 4 P1 Offset 48 Server 1 P2 Offset 100 Server 2 P2 Offset 116 Server 3 P2 Offset 132 Server 4 P2 Offset 148	

Configuration 8 – Up to Eight Servers, Dual Controller Transparent Failover, Shared Storage Enclosure

Configuration 8 (**Figure 10**) builds on Configurations 5 and 6 utilizing a dual controller pair on two fibre channel loops to provide storage and controller redundancy to two groups of up to four, separate (non-cooperating) servers. The eight 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 *connection-name* unit offsets to give each server an accessible range of unit numbers.

Figure 10 Configuration 8
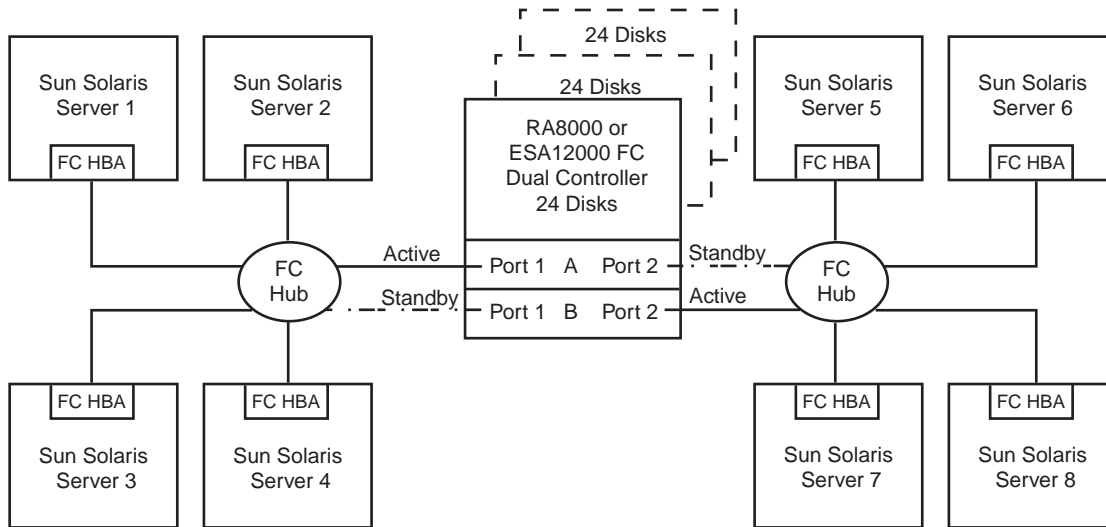
SHR-1493

Configuration 8 Notes

- Two Fibre Channel Loops
- Shared storage enclosure
- Dual HSG80 controllers configured in Transparent Failover Mode
- Up to 500 meters per 50-micron cable segment
- Up to 72 disks with 2 optional expansion enclosures
- Up to 512 LUNs 64 available to each server with 2 active controller host ports
- In this configuration, 8 connections are available, 1 to each server.
- 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 unit offset values to 0 for Port 1 and 100 for Port 2.

Storage Enclosure

- Verify/Set the following for Port 1:

  Port 1 units D0-D63   (4 servers, 16 LUNs each)
  AL_PA = 71
  TOPOLOGY = LOOP_HARD

- Verify/Set the following for Port 2:

  Port 2 units D100-D163   (4 servers, 16 LUNs each)
  AL_PA = 72
  TOPOLOGY = LOOP_HARD

- For clarity, we explicitly rename our connection names for the servers. The naming convention chosen will help identify and maintain the configuration(s).

  For Example:

  SERVER1P1   (Server 1, Controller Port 1)
  SERVER2P1   (Server 2, Controller Port 1)
  SERVER3P1   (Server 3, Controller Port 1)
  SERVER4P1   (Server 4, Controller Port 1)

  SERVER5P2   (Server 5, Controller Port 2)
  SERVER6P2   (Server 6, Controller Port 2)
  SERVER7P2   (Server 7, Controller Port 2)
  SERVER8P2   (Server 8, Controller Port 2)

- For each Server, Verify/Set the connection name unit offset values.

  For Example:

  SET SERVER1P1   UNIT_OFFSET = 0
  SET SERVER2P1   UNIT_OFFSET = 16
  SET SERVER3P1   UNIT_OFFSET = 32
  SET SERVER4P1   UNIT_OFFSET = 48

  SET SERVER5P2   UNIT_OFFSET = 0
  SET SERVER6P2   UNIT_OFFSET = 16
  SET SERVER7P2   UNIT_OFFSET = 32
  SET SERVER8P2   UNIT_OFFSET = 48

Sun Server 1; Sun Server 2; Sun Server 3; Sun Server 4

- Verify/Set the following for each server :

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that only Target 65 exists.

  If it does not, Select Option 4, *Modify an Adapter* and modify the adapter for the *fca and/or fcaw* driver. By default, you will see Targets 64, 65. Modify the list to reflect Target 65 only. Target to ALPA mapping shown below.

Target	ALPA
65	71

  Reboot the servers to load the new settings.

Sun Server 5; Sun Server 6; Sun Server 7; Sun Server 8

- Verify/Set the following for each server :

  Change directory to /opt/steam/bin and invoke **config.sh**

  ```
  # cd /opt/steam/bin; ./config.sh
  ```

  Select Option 20, *Add/Change Adapters* and then Option 1, *View Adapters*. In the View screen, verify that only Target 64 exists.

  If it does not, Select Option 4, *Modify an Adapter* and modify the adapter for the ***fca and/or fcaw*** driver. By default, you will see Targets 64, 65. Modify the list to reflect Target 64 only. Target to ALPA mapping shown below.

Target	ALPA
64	72

<u>Reboot the servers to load the new settings.</u>

Configuration 1 Parts List

- One Sun Server with Solaris Version 2.5.1 or 2.6

Compaq Part #	Description	Quantity
380554-001	RA8000/ESA12000 FC Solution Software V8.3 for Sun Solaris	1
380577-001	ACS V8.3 FC-AL Controller SW	1
380575-001 123503-001	SBUS FC HBA (32bit) SBUS FC HBA (64bit)	Choose 1
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21	RA8000 Pedestal w/single HSG80 RA8000 Pedestal w/single HSG80 RA8000 Rackable w/single HSG80	Choose 1
242795-B21 295573-B22	FC Optical Hub, 7-Port (no GBICs) FC Optical Hub, 12-Port (no GBICs)	Choose 1
380561-B21	FC Optical GBIC	2 3 for 2nd Port
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	FC 2 Meter Optical Cable FC 5 Meter Optical Cable FC 15 Meter Optical Cable FC 30 Meter Optical Cable FC 50 Meter Optical Cable	Choose 2 Add 1 for 2nd Port
380691-B21 380595-B21 380588-B21 380694-B21 380589-B21	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 7200 RPM Disk 18GB UW 10000 RPM Disk	Choose up to 24 (48 for ESA 48 slot)

Configuration 1 Optional Components

380570-B21 (Blue) 380570-B22 (Opal) 380568-B21	Pedestal Expansion w/add'l 24 slots Pedestal Expansion w/add'l 24 slots Rackable Expansion w/add'l 24 slots	Up to 2
380563-B21	Expansion Cable Kit	1 per Expansion
See Above	Additional Disks Drives	Up to 48

Configuration 2 Parts List

- One Sun Server with Solaris Version 2.5.1 or 2.6

Compaq Part #	Description	Quantity
380554-001	RA8000/ESA12000 FC Solution Software V8.3 for Sun Solaris	1
380577-001	ACS V8.3 FC-AL Controller SW	2
380575-001 123503-001	SBUS FC HBA (32bit) SBUS FC HBA (64bit)	Choose 1
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21 380580-001 (Blue) 380580-002 (Opal) 380590-B21 (Blue) 380590-B22 (Opal) 380600-001 (Blue) 380600-002 (Opal) 380610-B21 (Blue) 380610-B22 (Opal)	RA8000 Pedestal w/dual HSG80 RA8000 Pedestal w/dual HSG80 RA8000 Rackable w/dual HSG80 ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 50HZ	Choose 1
242795-B21 295573-B22	FC Optical Hub, 7-Port (no GBICs) FC Optical Hub, 12-Port (no GBICs)	Choose 1
380561-B21	FC Optical GBIC	3, 5 for 2nd Port
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	FC 2 Meter Optical Cable FC 5 Meter Optical Cable FC 15 Meter Optical Cable FC 30 Meter Optical Cable FC 50 Meter Optical Cable	Choose 3 Choose 3 for 2nd Port
380691-B21 380595-B21 380588-B21 380694-B21 380589-B21	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 7200 RPM Disk 18GB UW 10000 RPM Disk	Choose up to 24 (48 for ESA 48 slot)

Configuration 2 Optional Components

380570-B21 (Blue) 380570-B22 (Opal) 380568-B21 380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 50HZ ESA12000 Expansion 48 Slot 50HZ	Up to 2 OR Choose 1
380563-B21	Expansion Cable Kit	1 per Expansion
See above	Additional Disks Drives	Up to 48

Configuration 3 Parts List

- One Sun Server with Solaris Version 2.5.1 or 2.6

Compaq Part #	Description	Quantity
380554-001	RA8000/ESA12000 FC Solution Software V8.3 for Sun Solaris	2
380577-001	ACS V8.3 FC-AL Controller SW	4
380575-001 123503-001	SBUS FC HBA (32bit SBUS FC HBA (64bit)	Choose 1
380575-001 123503-001	SWSA4-SB SBUS FC HBA (32bit) DS-SWSA4-SC SBUS FC HBA (64bit)	Choose 1
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21 380580-001 (Blue) 380580-002 (Opal) 380590-B21 (Blue) 380590-B22 (Opal) 380600-001 (Blue) 380600-002 (Opal) 380610-B21 (Blue) 380610-B22 (Opal) OR 380620-001 (Blue) 380620-002 (Opal) 380630-B21 (Blue) 380630-B22 (Opal)	RA8000 Pedestal w/dual HSG80 RA8000 Pedestal w/dual HSG80 RA8000 Rackable w/dual HSG80 ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 50HZ OR ESA12000 w/2 pairs/dual HSG80 48 Slot 60HZ ESA12000 w/2 pairs/dual HSG80 48 Slot 60HZ ESA12000 w/2 pairs/dual HSG80 48 Slot 50HZ ESA12000 w/2 pairs/dual HSG80 48 Slot 50HZ	Choose 2 OR Choose 1
295573-B22	FC Optical Hub, 12-Port (no GBICs)	1
380561-B21	FC Optical GBIC	9
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	FC 2 Meter Optical Cable FC 5 Meter Optical Cable FC 15 Meter Optical Cable FC 30 Meter Optical Cable FC 50 Meter Optical Cable	Choose 9
380691-B21 380595-B21 380588-B21 380694-B21 380589-B21	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 7200 RPM Disk 18GB UW 10000 RPM Disk	Choose up to 24 (48 for ESA 48 slot)

(Optional Components listed on next page)

Configuration 3 Optional Components

Compaq Part #	Description	Quantity
380570-B21 (Blue) 380570-B22 (Opal) 380568-B21 380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 50HZ ESA12000 Expansion 48 Slot 50HZ	Up to 4 OR Choose 1 OR Choose 2
380563-B21	Expansion Cable Kit	1 per Expansion
See above	Additional Disks Drives	Up to 96

Configuration 4 Parts List

- Two Sun Servers with Solaris Version 2.5.1 or 2.6

Compaq Part #	Description	Quantity
380554-001	RA8000/ESA12000 FC Solution Software V8.3 for Sun Solaris	1
380577-001	ACS V8.3 FC-AL Controller SW	1
380575-001 123503-001	SBUS FC HBA (32bit) SBUS FC HBA (64bit)	2
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21 380580-001 (Blue) 380580-002 (Opal) 380590-B21 (Blue) 380590-B22 (Opal) 380600-001 (Blue) 380600-002 (Opal) 380610-B21 (Blue) 380610-B22 (Opal)	RA8000 Pedestal w/dual HSG80 RA8000 Pedestal w/dual HSG80 RA8000 Rackable w/dual HSG80 ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 50HZ	Choose 1
242795-B21 295573-B22	FC Optical Hub, 7-Port (no GBICs) FC Optical Hub, 12-Port (no GBICs)	Choose 2
380561-B21	FC Optical GBIC	4
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	FC 2 Meter Optical Cable FC 5 Meter Optical Cable FC 15 Meter Optical Cable FC 30 Meter Optical Cable FC 50 Meter Optical Cable	Choose 4
380691-B21 380595-B21 380588-B21 380694-B21 380589-B21	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 7200 RPM Disk 18GB UW 10000 RPM Disk	Choose up to 24 (48 for ESA 48 slot)

Configuration 4 Optional Components

380570-B21 (Blue) 380570-B22 (Opal) 380568-B21 380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 50HZ ESA12000 Expansion 48 Slot 50HZ	Up to 2 OR Choose 1
380563-B21	Expansion Cable Kit	1 per Expansion
See above	Additional Disks Drives	Up to 48

Configuration 5 Parts List

- Two Sun Servers with Solaris Version 2.5.1 or 2.6

Compaq Part #	Description	Quantity
380554-001	RA8000/ESA12000 FC Solution Software V8.3 for Sun Solaris	1
380577-001	ACS V8.3 FC-AL Controller SW	2
380575-001 123503-001	SBUS FC HBA (32bit) SBUS FC HBA (64bit)	2
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21 380580-001 (Blue) 380580-002 (Opal) 380590-B21 (Blue) 380590-B22 (Opal) 380600-001 (Blue) 380600-002 (Opal) 380610-B21 (Blue) 380610-B22 (Opal)	RA8000 Pedestal w/dual HSG80 RA8000 Pedestal w/dual HSG80 RA8000 Rackable w/dual HSG80 ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 50HZ	Choose 1
242795-B21 295573-B22	FC Optical Hub, 7-Port (no GBICs) FC Optical Hub, 12-Port (no GBICs)	Choose 2
380561-B21	FC Optical GBIC	6
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	FC 2 Meter Optical Cable FC 5 Meter Optical Cable FC 15 Meter Optical Cable FC 30 Meter Optical Cable FC 50 Meter Optical Cable	Choose 6
380691-B21 380595-B21 380588-B21 380694-B21 380589-B21	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 7200 RPM Disk 18GB UW 10000 RPM Disk	Choose up to 24 (48 for ESA 48 slot)

Configuration 5 Optional Components

380570-B21 (Blue) 380570-B22 (Opal) 380568-B21 380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 50HZ ESA12000 Expansion 48 Slot 50HZ	Up to 2 OR Choose 1
380563-B21	Expansion Cable Kit	1 per Expansion
See above	Additional Disks Drives	Up to 48

Configuration 6 Parts List

- Four Sun Servers with Solaris Version 2.5.1 or 2.6

Compaq Part #	Description	Quantity
380554-001	RA8000/ESA12000 FC Solution Software V8.3 for Sun Solaris	1
380577-001	ACS V8.3 FC-AL Controller SW	2
380575-001 123503-001	SBUS FC HBA (32bit) SBUS FC HBA (64bit)	4
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21 380580-001 (Blue) 380580-002 (Opal) 380590-B21 (Blue) 380590-B22 (Opal) 380600-001 (Blue) 380600-002 (Opal) 380610-B21 (Blue) 380610-B22 (Opal)	RA8000 Pedestal w/dual HSG80 RA8000 Pedestal w/dual HSG80 RA8000 Rackable w/dual HSG80 ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 50HZ	Choose 1
295573-B22	FC Optical Hub, 12-Port (no GBICs)	1
380561-B21	FC Optical GBIC	8
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	FC 2 Meter Optical Cable FC 5 Meter Optical Cable FC 15 Meter Optical Cable FC 30 Meter Optical Cable FC 50 Meter Optical Cable	Choose 8
380691-B21 380595-B21 380588-B21 380694-B21 380589-B21	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 7200 RPM Disk 18GB UW 10000 RPM Disk	Choose up to 24 (48 for ESA 48 slot)

Configuration 6 Optional Components

380570-B21 (Blue) 380570-B22 (Opal) 380568-B21 380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 50HZ ESA12000 Expansion 48 Slot 50HZ	Up to 2 OR Choose 1
380563-B21	Expansion Cable Kit	1 per Expansion
See above	Additional Disks Drives	Up to 48

Configuration 7 Parts List

- Four Sun Servers with Solaris Version 2.5.1 or 2.6

Compaq Part #	Description	Quantity
380554-001	RA8000/ESA12000 FC Solution Software V8.3 for Sun Solaris	2
380577-001	ACS V8.3 FC-AL Controller SW	4
380575-001 123503-001	SBUS FC HBA (32bit) SBUS FC HBA (64bit)	4
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21 380580-001 (Blue) 380580-002 (Opal) 380590-B21 (Blue) 380590-B22 (Opal) 380600-001 (Blue) 380600-002 (Opal) 380610-B21 (Blue) 380610-B22 (Opal) OR 380620-001 (Blue) 380620-002 (Opal) 380630-B21 (Blue) 380630-B22 (Opal)	RA8000 Pedestal w/dual HSG80 RA8000 Pedestal w/dual HSG80 RA8000 Rackable w/dual HSG80 ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 50HZ OR ESA12000 w/2 pairs/dual HSG80 48 Slot 60HZ ESA12000 w/2 pairs/dual HSG80 48 Slot 60HZ ESA12000 w/2 pairs/dual HSG80 48 Slot 50HZ ESA12000 w/2 pairs/dual HSG80 48 Slot 50HZ	Choose 2 OR Choose 1
295573-B22	FC Optical Hub, 12-Port (no GBICs)	1
380561-B21	FC Optical GBIC	12
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	FC 2 Meter Optical Cable FC 5 Meter Optical Cable FC 15 Meter Optical Cable FC 30 Meter Optical Cable FC 50 Meter Optical Cable	Choose 12
380691-B21 380595-B21 380588-B21 380694-B21 380589-B21	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 7200 RPM Disk 18GB UW 10000 RPM Disk	Choose up to 24 (48 for ESA 48 slot)

(Optional Components listed on next page)

Configuration 7 Optional Components

Compaq Part #	Description	Quantity
380570-B21 (Blue) 380570-B22 (Opal) 380568-B21 380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 50HZ ESA12000 Expansion 48 Slot 50HZ	Up to 4 OR Choose 1 OR Choose 2
380563-B21	Expansion Cable Kit	1 per Expansion
See above	Additional Disks Drives	Up to 96

Configuration 8 Parts List

- Eight Sun Servers with Solaris Version 2.5.1 or 2.6

Compaq Part #	Description	Quantity
380554-001	RA8000/ESA12000 FC Solution Software V8.3 for Sun Solaris	1
380577-001	ACS V8.3 FC-AL Controller SW	2
380575-001 123503-001	SBUS FC HBA (32bit) SC SBUS FC HBA (64bit)	8
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21 380580-001 (Blue) 380580-002 (Opal) 380590-B21 (Blue) 380590-B22 (Opal) 380600-001 (Blue) 380600-002 (Opal) 380610-B21 (Blue) 380610-B22 (Opal)	RA8000 Pedestal w/dual HSG80 RA8000 Pedestal w/dual HSG80 RA8000 Rackable w/dual HSG80 ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 60HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 24 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 60HZ ESA12000 w/dual HSG80 48 Slot 50HZ ESA12000 w/dual HSG80 48 Slot 50HZ	Choose 1
242795-B21 295573-B22	FC Optical Hub, 7-Port (no GBICs) FC Optical Hub, 12-Port (no GBICs)	Choose 2
380561-B21	FC Optical GBIC	12
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	FC 2 Meter Optical Cable FC 5 Meter Optical Cable FC 15 Meter Optical Cable FC 30 Meter Optical Cable FC 50 Meter Optical Cable	Choose 12
380691-B21 380595-B21 380588-B21 380694-B21 380589-B21	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 7200 RPM Disk 18GB UW 10000 RPM Disk	Choose up to 24 (48 for ESA 48 slot)

Configuration 8 Optional Components

380570-B21 (Blue) 380570-B22 (Opal) 380568-B21 380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 60HZ ESA12000 Expansion 48 Slot 50HZ ESA12000 Expansion 48 Slot 50HZ	Up to 2 OR Choose 1
380563-B21	Expansion Cable Kit	1 per Expansion
See above	Additional Disks Drives	Up to 48

Appendix A - ALPAs
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
43	5E	94	02	7C	124
3C	5F	95	01	7D	125

Reserved for FL_PORT

				Targ (hex)	Targ (dec)
			00	7E	126

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
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*