

Compaq StorageWorks

Application Note Enterprise/Modular Storage RAID Array FC-AL HA Configurations for IBM AIX EK-SMA38-AN.B01

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Enterprise/Modular Storage RAID Array FC-AL HA Configurations for IBM AIX

Application Note

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Enterprise Network Storage Architecture (ENSA)

Compaq StorageWorks Enterprise/Modular Storage RAID Array (RA/MA8000 and ESA/EMA12000 Fibre Channel) 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

The Enterprise/Modular Storage RAID Array Fibre Channel 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 using Fibre Channel Arbitrated Loop (FC-AL) technology.

The RA/MA8000 Fibre Channel is a mid-range storage system available in a pedestal enclosure for departmental use in the office. It can also be installed in server racks for data centers. An easy-to-deploy, flexible solution for open systems, the RA/MA8000 currently supports up to 1.3 TB of storage with the use of 18GB disks.

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

These storage systems incorporate the latest in RAID technology providing RAID levels 0, 1, 0+1, adaptive 3/5, and non-RAID disks. The Compaq 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 Enterprise/Modular Storage RAID Array Fibre Channel 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 Enterprise/Modular Storage RAID Array Fibre Channel Storage Systems:

Table 1 Configuration Reference Material

Document Title	Order Number
Release Notes, HSG80 Array Controller Solution Software for IBM AIX	AA-RJ24E-TE
HSG80 ACS Solution Software Version 8.6 for IBM AIX Installation and Configuration Guide	AA-RJ25D-TE
HSG80 Array Controller ACS V8.6 CLI Reference Guide	EK-G80CL-RA.A01
HSG80 Array Controller ACS Version 8.6 Maintenance and Service Guide	EK-G80MS-SA.A01
Compaq StorageWorks Command Console V2.3 User Guide	AA-RFA2H-TE
Compaq StorageWorks Warranty Terms and Conditions	EK-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 Fibre Channel IBM AIX configurations based on the configuration maximums listed below. For configurations not shown here, the configuration maximums should be used to determine the viability of a proposed configuration. Exceeding the maximum will create unsupported configurations. Additional information specific to a particular configuration is provided by section.

Configuration Maximums

The HSG80 controller configuration maximums include:

- Maximum 32 visible LUNs - Cambex HBA
128 visible LUNs - IBM HBA
- Maximum 200 assignable unit numbers, 64 LUNs Max
- 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 32 Connections
- Maximum 9 Characters per Connection Name

The AIX Operating System:

- Maximum 512GB file system per LUN
- Maximum 16 LUNs per Fibre Channel Target - Cambex HBA
64 LUNs per Target - IBM HBA

The Fibre Channel loop configuration maximums include:

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

For Transparent Failover Mode (used exclusively in these configurations):

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

Assumptions

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

General Configuration Notes

- All single controller storage configurations can be upgraded to dual controller configurations.
- 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.”
 - NOTE: This application note describes Transparent Failover Mode configurations 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 RA/MA8000 or ESA/EMA12000 Fibre Channel Solution Software V8.6 for the IBM AIX operating system.
- All configurations use 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.
- 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. IBM AIX requires changes to default ALPAs.
 - In configurations with two Storage Systems, this document uses the convention of:
 - For first Storage System; ALPA D5 for Port 1 and ALPA D6 for Port 2
 - For second Storage System: ALPA D3 for Port 1 and ALPA D4 for Port 2
- All configurations require the connection name operating system parameter to be set to "WINNT". (CLI: SET *connection-name* OPERATING_SYSTEM = WINNT)
 - NOTE: Although a selection for operating system IBM exists, this setting may cause problems during controller failover. Use the WINNT setting for IBM AIX.
- By default the HSG80 Command Console LUN (CCL) is enabled. This may be disabled. (CLI: SET *controller* NOCOMMAND_CONSOLE_LUN)
 - NOTE: The HSG80 controllers support a range of 200 unit numbers. In Transparent Failover Mode, the units D0-D99 are assigned to Port 1 and units D100 - D199 are assigned to Port 2.
- For configurations with more than one server on the same loop:

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

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

- ❑ Disable/Clear all current access_paths
(CLI: SET *unit-number* DISABLE_ACCESS_PATH = ALL)
- ❑ Set a specific Host access (through the connection name)
(CLI: SET *unit-number* ENABLE_ACCESS_PATH = *connection-name*)
- For 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.
- For two storage system (4 controller) configurations with more than one controller host port on the same loop, set the ALPA for each controller host port in the second enclosure to a different LOOP_HARD address (CLI: SET *controller* PORT_1_AL_PA = *xy*)
- Record the Fibre Channel HBA Worldwide Identification (WWID) address. Some HBAs display the WWID on the HBA itself.
- 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. By default, new connection names are automatically added to the controller connection name table as !NEWCON*nn* (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 Fibre Channel 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.).
- Each active controller host port on a loop presents one SCSI Target ID with up to sixty-four (64) LUNs to each Fibre Channel HBA on the same loop. LUNs (logical units) can consist of single disks (JBOD), a storage set of multiple disks or a partition (up to 64), configured for a specific RAID level of 0, 0 + 1, or 3/5.
- There are two points of view when speaking of fibre channel connections:
 - ❑ The first view 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 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, you have the flexibility of using all connections. That is, if you define all the targets in the server's configuration file and map these targets to all available connections you will have a complete use of the available connections. On the other hand, if you wish to restrict access from the server point of view, you 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, you choose not to use them.

In the configurations of this application note, you use the server's point of view to limit access to certain targets. This means you have unused connections. This also means that when implementing a configuration, you only need to identify the connections that you are using, not all of them. Thus, the naming of connections is done for only those connections that are active in the specific configuration. 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 Enterprise/Modular Storage RAID Array Fibre Channel IBM AIX configurations that are described in this document.

Table 2 Typical RA/MA8000 / ESA/EMA12000 FC-AL IBM AIX Configurations - Index

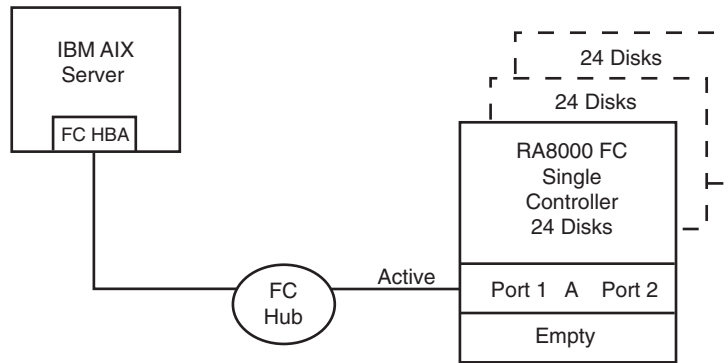
Configuration #	Description	Page
1	One Server, Single Controller	8
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Configuration Parts Lists

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

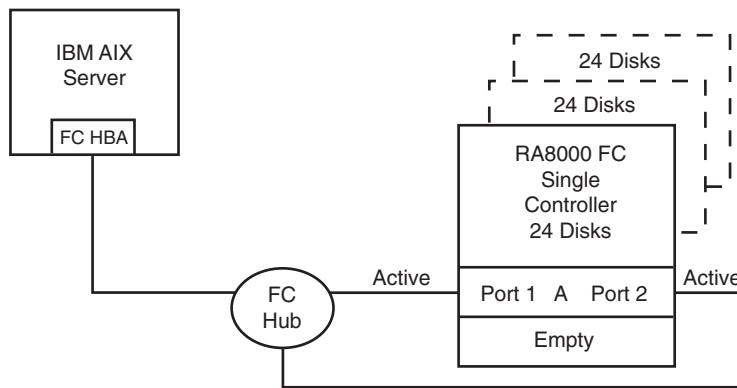
The single controller configuration (Figure 1) is an entry-level RA/MA8000 Fibre Channel or ESA/EMA12000 that can be expanded to accommodate additional storage capacity or performance needs as required. The configuration consists of an RA/MA8000 or ESA/EMA12000 storage enclosure with a single HSG80 array 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).



SHR-1623

Figure 1. Configuration 1

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.



SHR-1624

Figure 2. Configuration 1 with Double LUN Capacity

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

Figure 1 Description

In this configuration, 1 logical connection is available with up to 128 LUNs (IBM) or 16 LUNs (Cambex). 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 = D5

TOPOLOGY = LOOP_HARD

Figure 2 Description

In this configuration, 2 logical connections are available with up to 128 LUNs (IBM) or 32 LUNs (Cambex). 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 = D5

TOPOLOGY = LOOP_HARD

Verify/Set the following for Port 2:

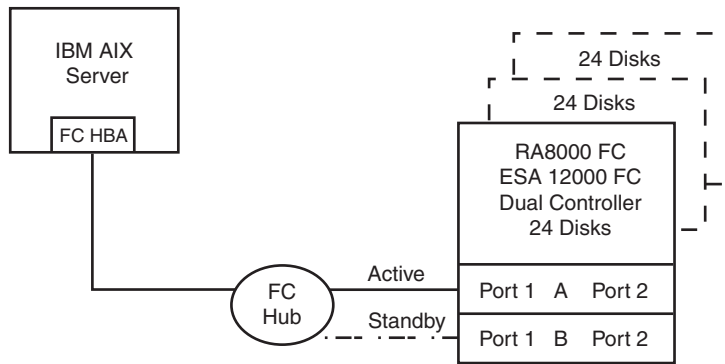
AL_PA = D6

TOPOLOGY = LOOP_HARD

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 RA/MA8000 Fibre Channel or ESA/EMA12000 storage enclosure with two HSG80 array controllers on a single loop. In normal operation Controller A provides the active path for all storage sets 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.

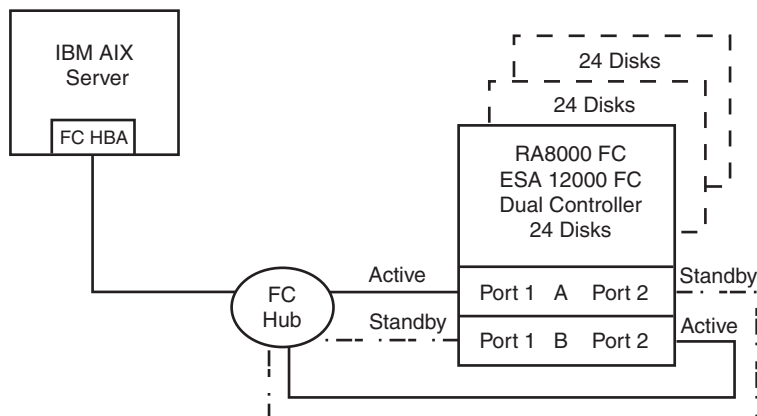
In Figure 3, a single controller host port, Port 1 is active providing up to 64 LUNs (IBM) or 16 LUNs (Cambex) across up to 24 disks. An additional 48 disks can be added using two expansion enclosures. Additional servers can be added to this configuration as required using the existing hub (refer to Configuration 6).



SHR-1625

Figure 3. Configuration 2

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.



SHR-1626

Figure 4. Configuration 2 with Increased Performance and Double LUN Capacity

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

Figure 3 Description

In this configuration, up to 128 LUNs (IBM) 32 LUNs (Cambex) 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 = D5

TOPOLOGY = LOOP_HARD

Figure 4 Description

In this configuration, 2 logical connections are available with up to 128 LUNs (IBM) or 32 LUNs (Cambex). 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 = D5

TOPOLOGY = LOOP_HARD

Verify/Set the following for Port 2

AL_PA = D6

TOPOLOGY = LOOP_HARD

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 RA/MA8000 pedestal enclosures or a single ESA/EMA12000 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).

STORAGE ENCLOSURE 1

STORAGE ENCLOSURE 2

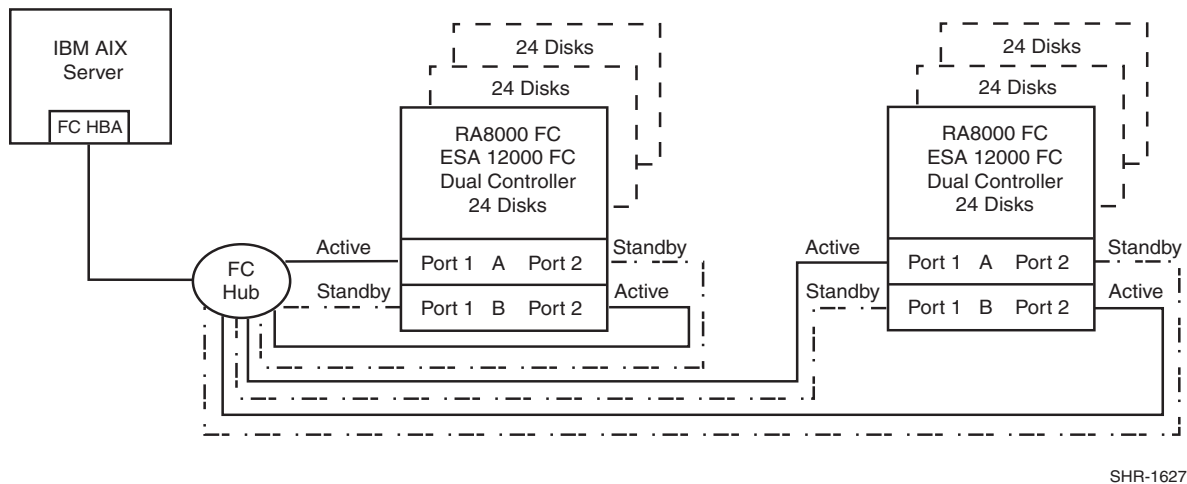


Figure 5. Configuration 3

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 = D5

TOPOLOGY = LOOP_HARD

Verify/Set the following for Port 2

Port 2 units D100 – D115

AL_PA = D6

TOPOLOGY = LOOP_HARD

Storage Enclosure 2 (Figure 5)

Verify/Set the following for Port 1

Port 1 units D0 – D15

AL_PA = D3

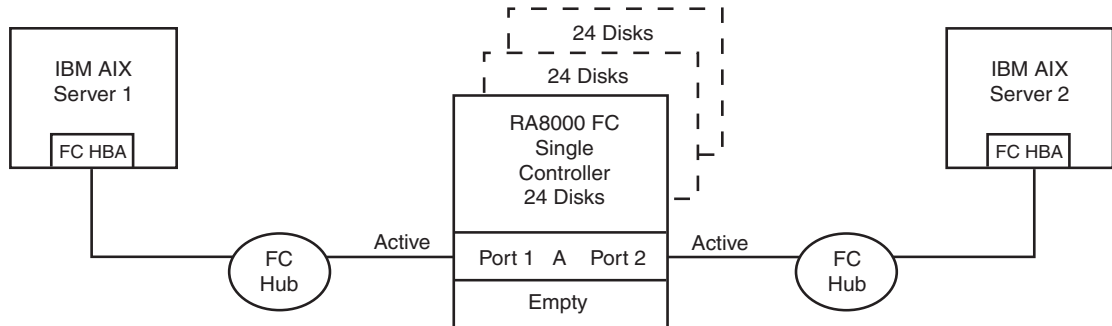
```

    TOPOLOGY = LOOP_HARD
Verify/Set the following for Port 2
    Port 2 units D100 – D115
    AL_PA = D4
    TOPOLOGY = LOOP_HARD

```

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

Configuration four (Figure 6) uses 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 uses two separate fibre channel loops. Additional servers can be added to this configuration as required using the existing hubs (refer to Configuration 8).



SHR-1628

Figure 6. Configuration 4

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 D00 – D15
    AL_PA = D5
    TOPOLOGY = LOOP_HARD
Verify/Set the following for Port 2:

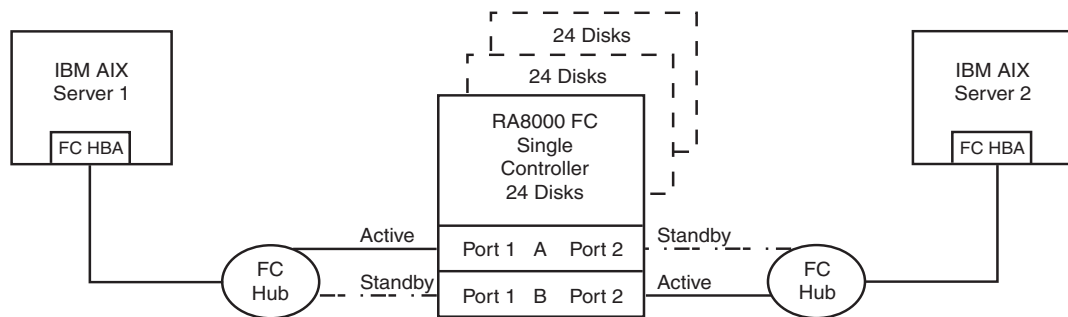
```

Port 2 units D100 – D115
 AL_PA = D6
 TOPOLOGY = LOOP_HARD

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

Configuration 5 (Figure 7) uses 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 uses 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 storage sets assigned to Server 1 through Port 1. Controller B provides the active path for all storage sets 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).



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Figure 7. Configuration 5

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 = D5

TOPOLOGY = LOOP_HARD

Verify/Set the following for Port 2:

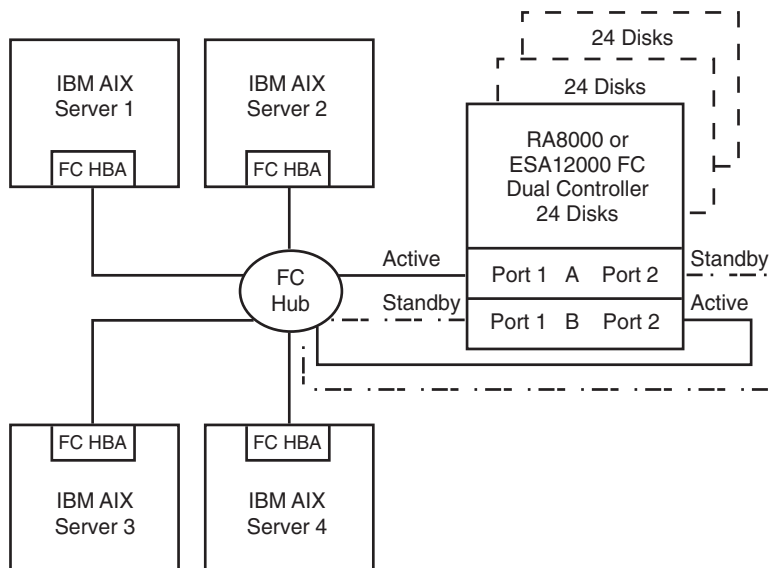
Port 2 units D100 – D115

AL_PA = D6

TOPOLOGY = LOOP_HARD

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

Configuration 6 (Figure 8) builds on Configurations 2 and 5 using 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.



SHR-1630

Figure 8. Configuration 6

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 = D5

TOPOLOGY = LOOP_HARD

Verify/Set the following for Port 2:

Port 2 units D100-D131 (Two Servers, 16 LUNs each)

AL_PA = D6

TOPOLOGY = LOOP_HARD

- For clarity, explicitly rename your connection names for the servers. Note that there are 8 logical connections available but you 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 SERVER1P1UNIT_OFFSET = 0(default)

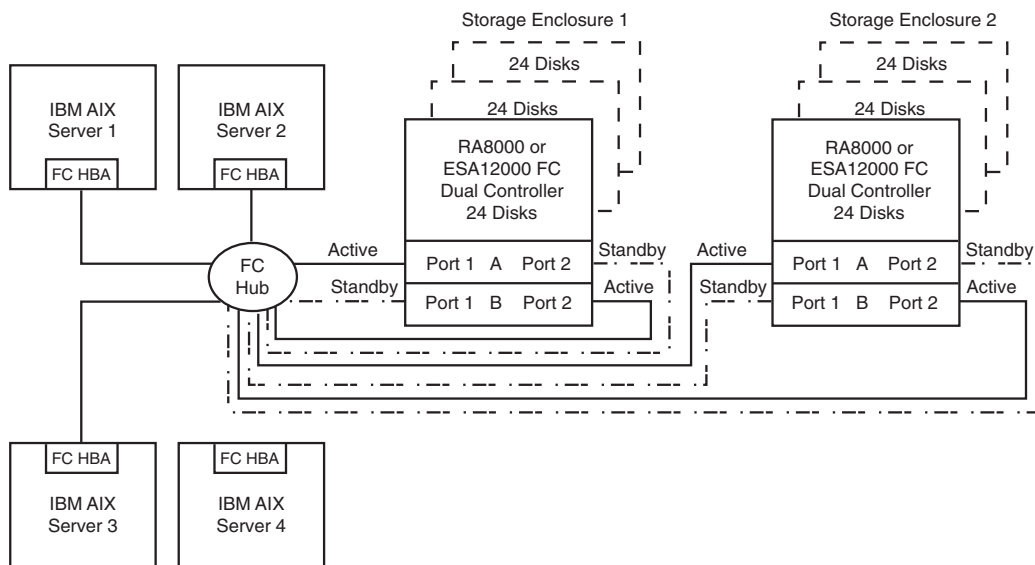
SET SERVER2P1UNIT_OFFSET = 16

SET SERVER3P2UNIT_OFFSET = 100(default)

SET SERVER4P2UNIT_OFFSET = 116

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 using 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.



SHR-1631

Figure 9. Configuration 7

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 in this example, Compaq has 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 = D5

TOPOLOGY = LOOP_HARD

Verify/Set the following for Port 2:

Port 2 units D100-D131 (Two Servers, 16 LUNs each)

AL_PA = D6

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 SERVER1P1UNIT_OFFSET = 0

SET SERVER1P2UNIT_OFFSET = 100

SET SERVER2P1UNIT_OFFSET = 16

SET SERVER2P2UNIT_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 = D3

TOPOLOGY = LOOP_HARD

Verify/Set the following for Port 2

Port 2 units D100-D131

AL_PA = D4

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 SERVER3P1UNIT_OFFSET = 0
SET SERVER3P2UNIT_OFFSET = 100
SET SERVER4P1UNIT_OFFSET = 16
SET SERVER4P2UNIT_OFFSET = 116
    
```

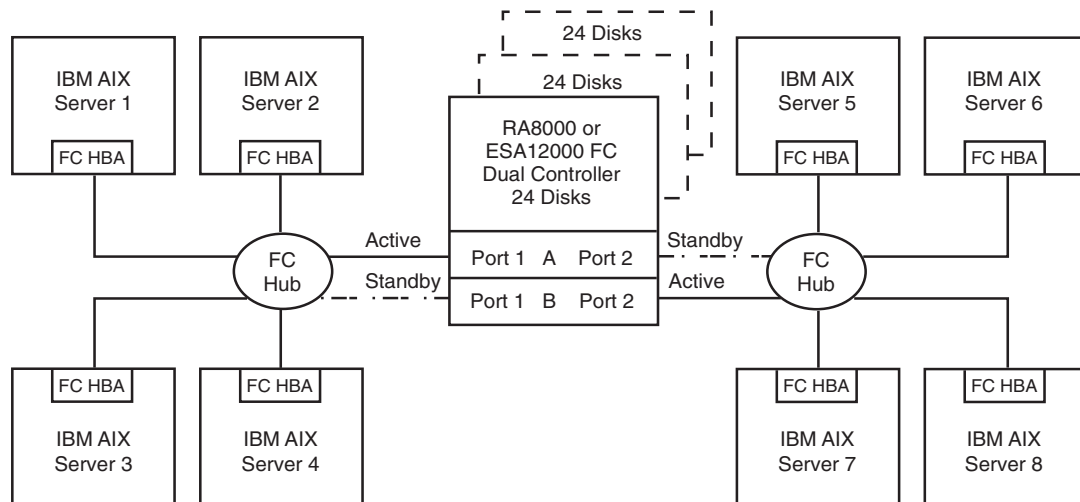
Table 3 provides an alternate setup of Configuration 7, where servers access both storage enclosures using 16 connections.

Table 3 Configuration 7 Alternate Set Up

Node/HW	Storage Enclosure 1	Storage Enclosure 2	Servers 1 .. 4
ALPAs	D5, D6	D3, D4	HBA WWID
Targets	65, 64, 10, 9	63, 62, 12, 11	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 using 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.



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Figure 10. Configuration 8

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 = D5

TOPOLOGY = LOOP_HARD

Verify/Set the following for Port 2:

Port 2 units D100-D163(4 servers, 16 LUNs each)

AL_PA = D6

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 SERVER1P1UNIT_OFFSET = 0

SET SERVER2P1UNIT_OFFSET = 16

SET SERVER3P1UNIT_OFFSET = 32

SET SERVER4P1UNIT_OFFSET = 48

SET SERVER5P2UNIT_OFFSET = 0

SET SERVER6P2UNIT_OFFSET = 16

SET SERVER7P2UNIT_OFFSET = 32

SET SERVER8P2UNIT_OFFSET = 48

Configuration Parts Lists

Configuration 1 Parts List

The following parts list is for one IBM with AIX V4.2 or V4.3.

Table 4 Configuration Parts List

Compaq Part #	Description	Quantity
	Enterprise/Modular Storage RAID Array FC Solution Software V8.6 for IBM AIX	1
	ACS V8.6 Controller Software	1

Table 4 Configuration Parts List (Continued)

Compaq Part #	Description	Quantity
149841-B21	Cambex Fibre Channel Host Bus Adapter IBM Fibre Channel Host Bus Adapter	Choose 1
380550-B21 (Blue) 380550-B22 (Opal) 380660-B21	RA/MA8000 Pedestal w/single HSG80 RA/MA8000 Pedestal w/single HSG80 RA/MA8000 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 2 nd 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 2 nd 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**Table 5 Configuration 1 Optional Components**

Compaq Part #	Description	Quantity
380570-B21 (Blue) 380570-B22 (Opal) 380568-B21	Pedestal Expansion with additional 24 slots Pedestal Expansion with additional 24 slots Rackable Expansion with additional 24 slots	Up to 2
380563-B21	Expansion Cable Kit	1 per Expansion
See Table 4.	Additional Disk Drives	Up to 48

Configuration 2 Parts List

The following table contains the parts list for one IBM with AIX V4.2 or V4.3.

Table 6 Configuration 2 Parts List		
Compaq Part #	Description	Quantity
	Enterprise/Modular Storage RAID Array FC Solution Software V8.6 for IBM AIX	1
	ACS V8.6 Controller Software	2
	Cambex Fibre Channel Host Bus Adapter IBM SBUS Fibre Channel Host Bus Adapter (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)	RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Rackable w/dual HSG80 ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 50HZ ESA/EMA12000 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 2 nd 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 2 nd 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

Table 7 Configuration 2 Optional Components

Compaq Part #	Description	Quantity
380570-B21 (Blue) 380570-B22 (Opal) 380568-B21	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots	Up to 2 OR Choose 1
380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 50HZ ESA/EMA12000 Expansion 48 Slot 50HZ	
380563-B21	Expansion Cable Kit	1 per Expansion
See Table 6.	Additional Disk Drives	Up to 48

Configuration 3 Parts List

The following table contains the parts list for one IBM with AIX V4.2 or V 4.3.

Table 8 Configuration 3 Parts List

Compaq Part #	Description	Quantity
	Enterprise/Modular Storage RAID Array FC Solution Software V8.6 for IBM AIX	2
	ACS V8.6 Controller Software	4
380575-001 123503-001	SWSA4-SB SBus Fibre Channel Host Bus Adapter (32bit) DS-SWSA4-SC SBus Fibre Channel Host Bus Adapter (64bit)	Choose 1
	Cambex Fibre Channel Host Bus Adapter IBM Fibre Channel Host Bus Adapter	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)	RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Rackable w/dual HSG80 ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 50HZ ESA/EMA12000 w/dual HSG80 48 Slot 50HZ OR ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 50HZ ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 50HZ	Choose 2 OR Choose 1

Table 8 Configuration 3 Parts List (Continued)

Compaq Part #	Description	Quantity
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-B2 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 3 Optional Components**Table 9 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 ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 50HZ ESA/EMA12000 Expansion 48 Slot 50HZ	Up to 4 OR Choose 1 OR Choose 2
380563-B21	Expansion Cable Kit	1 per Expansion
See Table 8.	Additional Disk Drives	Up to 96

Configuration 4 Parts List

The following table contains the parts list for two IBM Servers with AIX V4.2 or V4.3.

Table 10 Configuration 4 Parts List

Compaq Part #	Description	Quantity
	Enterprise/Modular Storage RAID Array FC Solution Software V8.6 for IBM AIX	1
	ACS V8.6 Controller Software	1

Table 10 Configuration 4 Parts List (Continued)

Compaq Part #	Description	Quantity
	Cambex Fibre Channel Host Bus Adapter IBM Fibre Channel Host Bus Adapter	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)	RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Rackable w/dual HSG80 ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 50HZ ESA/EMA12000 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**Table 11 Configuration 4 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 ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 50HZ ESA/EMA12000 Expansion 48 Slot 50HZ	Up to 2 OR Choose 1
380563-B21	Expansion Cable Kit	1 per Expansion
See Table 10.	Additional Disk Drives	Up to 48

Configuration 5 Parts List

The following table contains the parts list for two IBM Servers with AIX V4.2 or V4.3.

Table 12 Configuration 5 Parts List

Compaq Part #	Description	Quantity
	Enterprise/Modular Storage RAID Array FC Solution Software V8.6 for IBM AIX	1
	ACS V8.6 Controller Software	2
	Cambex Fibre Channel Host Bus Adapter IBM Fibre Channel Host Bus Adapter	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)	RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Rackable w/dual HSG80 ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 50HZ ESA/EMA12000 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

Table 13 Configuration 5 Optional Components

Compaq Part #	Description	Quantity
380570-B21 (Blue) 380570-B22 (Opal) 380568-B21	Pedestal Expansion 24 slots Pedestal Expansion 24 slots Rackable Expansion 24 slots	Up to 2 OR Choose 1
380640-001 (Blue) 380640-002 (Opal) 380650-B21 (Blue) 380650-B22 (Opal)	ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 50HZ ESA/EMA12000 Expansion 48 Slot 50HZ	
380563-B21	Expansion Cable Kit	1 per Expansion
See above	Additional Disk Drives	Up to 48

Configuration 6 Parts List

The following table contains the parts list for four IBM Servers with AIX V4.2 or V4.3.

Table 14 Configuration 6 Parts List

Compaq Part #	Description	Quantity
	Enterprise/Modular Storage RAID Array FC Solution Software V8.6 for IBM AIX	1
	ACS V8.6 Controller Software	2
	Cambex Fibre Channel Host Bus Adapter IBM Fibre Channel Host Bus Adapter	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)	RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Pedestal w/dual HSG80 RA/MA8000 Rackable w/dual HSG80 ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 60HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 24 Slot 50HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 60HZ ESA/EMA12000 w/dual HSG80 48 Slot 50HZ ESA/EMA12000 w/dual HSG80 48 Slot 50HZ	Choose 1
295573-B22	FC Optical Hub, 12-Port (no GBICs)	1
380561-B21	FC Optical GBIC	8

Table 14 Configuration 6 Parts List (Continued)

234457-B21	FC 2 Meter Optical Cable	Choose 8
234457-B22	FC 5 Meter Optical Cable	
234457-B23	FC 15 Meter Optical Cable	
234457-B24	FC 30 Meter Optical Cable	
234457-B25	FC 50 Meter Optical Cable	
380691-B21	4GB UW 7200 RPM Disk	Choose up to 24 (48 for ESA 48 slot)
380595-B21	9GB UW 7200 RPM Disk	
380588-B21	9GB UW 10000 RPM Disk	
380694-B21	18GB UW 7200 RPM Disk	
380589-B21	18GB UW 10000 RPM Disk	

Configuration 6 Optional Components**Table 15 Configuration 6 Optional Components**

Compaq Part #	Description	Quantity
380570-B21 (Blue)	Pedestal Expansion 24 slots	Up to 2 OR Choose 1
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	
380563-B21	Expansion Cable Kit	1 per Expansion
See Table 14.	Additional Disk Drives	Up to 48

Configuration 7 Parts List

The following table contains the parts list for four IBM Servers with AIX V4.2 or V4.3.

Table 16 Configuration 7 Parts List

Compaq Part #	Description	Quantity
	Enterprise/Modular Storage RAID Array FC Solution Software V8.6 for IBM AIX	2
	ACS V8.6 Controller Software	4
	Cambex Fibre Channel Host Bus Adapter IBM Fibre Channel Host Bus Adapter	4

Table 16 Configuration 7 Parts List (Continued)

Compaq Part #	Description	Quantity
380550-B21 (Blue)	RA/MA8000 Pedestal w/dual HSG80	Choose 2
380550-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	
OR	OR	
380620-001 (Blue)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 60HZ	
380620-002 (Opal)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 60HZ	
380630-B21 (Blue)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 50HZ	
380630-B22 (Opal)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 50HZ	
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)

Configuration 7 Optional Components

Table 17 Configuration 7 Optional Components

Compaq Part #	Description	Quantity
380570-B21 (Blue)	Pedestal Expansion 24 slots	Up to 4 OR Choose 1 OR Choose 2
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	
380563-B21	Expansion Cable Kit	1 per Expansion
See Table 16.	Additional Disk Drives	Up to 96

Configuration 8 Parts List

The following table contains the parts list for eight IBM Servers with AIX V4.2 or V4.3.

Table 18 Configuration 5 Parts List

Compaq Part #	Description	Quantity
	Enterprise/Modular Storage RAID Array FC Solution Software V8.6 for IBM AIX	1
	ACS V8.6 Controller Software	2
	Cambex Fibre Channel Host Bus Adapter IBM Fibre Channel Host Bus Adapter	8
380550-B21 (Blue)	RA/MA8000 Pedestal w/dual HSG80	Choose 1
380550-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	
242795-B21	FC Optical Hub, 7-Port (no GBICs)	Choose 2
295573-B22	FC Optical Hub, 12-Port (no GBICs)	
380561-B21	FC Optical GBIC	12

Table 18 Configuration 5 Parts List (Continued)

Compaq Part #	Description	Quantity
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**Table 19 Configuration 8 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 ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 60HZ ESA/EMA12000 Expansion 48 Slot 50HZ ESA/EMA12000 Expansion 48 Slot 50HZ	Up to 2 OR Choose 1
380563-B21	Expansion Cable Kit	1 per Expansion
See Table 18.	Additional Disk Drives	Up to 48

Appendix A - Arbitrated Loop Physical Addresses (ALPAs)

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

alpha (hex)	Targ (hex)	Targ (dec)	alpha (hex)	Targ (hex)	Targ (dec)
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

	00	7E	126
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Controller ALPAs

Lowest to Highest Priority

alpha (hex)	Targ (hex)	Targ (dec)	alpha (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

alpa (hex)	Targ (hex)	Targ (dec)	alpa (hex)	Targ (hex)	Targ (dec)
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