

Compaq StorageWorks

Application Note Enterprise/Modular Storage RAID Array FC-AL HA Configurations for Windows NT/Windows 2000 - Intel AA-RHOSE-TE

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First Edition (June 2001)

Part Number: AA-RHOSE-TE

Compaq Computer Corporation

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Printed in the U.S.A.

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Enterprise Network Storage Architecture (ENSA)

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

NOTE: This application note describes Enterprise/Modular Storage RAID Array FC-AL high availability configurations. For standard configurations refer to "RA/MA8000 and ESA/EMA12000 FC-AL Configurations for Windows NT/Windows 2000 – Intel".

Product Overview

The Enterprise/Modular Storage RAID Array Fibre Channel systems are based on a common architecture and offer customers centralized management, high availability, and 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 FC-AL (arbitrated loop) 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 small data centers. An easy-to-deploy, flexible solution for open systems, the RA/MA8000 supports up to 2.6 TB of storage.

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 or minimize the affect on performance while preserving data availability and supporting high availability.

The Enterprise/Modular Storage RAID Array 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. SWCC provides a user oriented graphical user interface (GUI) simplifying the most complex of storage management operations.

Microsoft Cluster Server (MSCS)

A Windows NT/Windows 2000 MSCS cluster enables two servers to share an Enterprise/Modular Storage RAID Array Fibre Channel system through a Fibre Channel bus. If a server failure should occur, the storage I/O is re-routed through to the functioning server. This process, called cluster failover, requires no resource downtime ensuring the high availability of data.

The Enterprise/Modular Storage RAID Array Fibre Channel systems are supported in four Windows NT/Windows 2000 MSCS cluster configurations. All of the cluster configurations provide full cluster failover capabilities through a fibre channel bus connected to both cluster servers.

In addition to cluster failover, the RAID array controllers can be configured in transparent failover mode to protect against the unlikely event of a single controller failure. This feature eliminates controllers as single points of failure and is invoked without the need for server intervention.

For the highest availability, two hardware paths between the cluster servers and the Enterprise/Modular Storage RAID Array Fibre Channel system can be configured using Compaq's Secure Path for Windows NT/Windows 2000. This configuration provides two separate physical paths between the servers and the storage.

Secure Path for Windows NT/ Windows 2000

Compaq SANworks Secure Path is a high availability software product providing continuous data access for Enterprise/Modular Storage RAID Array Fibre Channel products configured on Windows NT/ Windows 2000 platforms. Redundant hardware, advanced RAID technology and automated failover capability are used to enhance fault tolerance and availability. Secure Path effectively eliminates controllers, interconnect hardware and host bus adapters as single points of failure in the storage system.

Key to Secure Path's functionality is the capability of Enterprise/Modular Storage RAID Array Fibre Channel dual HSG80 controllers to operate in the active/active Multiple-Bus failover mode. This failover mode allows each controller to be configured on its own bus and to process I/O independently under normal operation. Available storage units are "preferred" to one or the other of the two controllers which determines which controller path is used for access at system boot time. During runtime, storage units may be moved between paths at anytime through use of the management utility.

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

The Secure Path management utility provides continuous monitoring capability and identifies failed paths and failed-over storage units. To facilitate static load balancing, storage units can be moved between paths using simple "drag-and-drop" operations.

The integration of Secure Path, Windows NT/Windows 2000 Clustering, and StorageWorks RAID Array Fibre Channel technology provides the maximum level of fault-tolerance, data availability, and performance required for mission-critical environments.

Performance Considerations

The performance of an application on a system that includes Enterprise/Modular Storage RAID Array Fibre Channel can be limited by many different components of the system. Some of the possible component limitations include the host CPU(s), memory size, the host bus adapter(s) (HBA), the fibre channel bus, the RAID controller, or the specific configuration of disks used behind the controller. The limiting factor can move to any of these components depending on the workload. Identifying the limits will assist in determining the best configuration for a given application.

Table 1 lists the upper limit performance specifications for the components of the Enterprise/Modular Storage RAID Array Fibre Channel systems based on testing using standard storage performance tests and methodologies. These numbers should be used to compare component level performance as a means to determine the best configuration from a performance perspective. User application tests may not necessarily reach these levels of performance as applications may perform additional levels of processing for each I/O. The controller specifications listed show both cache (no disk access) and media (with disk access) limitations.

To further aid in evaluating the performance aspects of specific configurations, additional information is included within each configuration section. The configurations are rated based on I/O performance (I/Os per second) - typical of small transfer applications such as databases and mail, and bandwidth performance (MBs per second) - typical of large transfer applications such as video and graphics. Note that other factors, such as connectivity needs, may require trade-offs be made such that performance is a secondary consideration.

Table 1 Performance Maximums of FC-AL Components

Transfer Size	IO/sec (small transfer sizes, random access)		MB/sec (large transfer sizes, sequential access)	
	Read	Write	Read	Write
Operation Type				
Fibre Channel Host Bus Adapter - KGPSA-BC (LP7000)	15,500	14,250	86	51
Fibre Channel Hub	25,000	25,000	100	100
Single HSG80 Controller (1 Active Port)	12,000 Cache 4,100 Media	9,000 Cache 4,000 Media	77 Cache 54 Media	50 Cache 44 Media
Single HSG80 Controller (2 Active Ports)	12,000 Cache 4,100 Media	9,000 Cache 4,000 Media	98 Cache 54 Media	100 Cache 47 Media
Dual HSG80 Controllers (2 Active/2 Standby Ports)	24,000 Cache 8,200 Media	18,000 Cache 8,000 Media	154 Cache 102 Media	101 Cache 88 Media
Dual HSG80 Controllers (4 Active Ports)	24,000 Cache 8,200 Media	18,000 Cache 8,000 Media	195 Cache 102 Media	178 Cache 88 Media

NOTE: Fibre Channel Hub performance limits are theoretical. Actual measured performance is lower due to limits unrelated to the hub.

Configuration References

The following table lists the documents that provide further information on the configuration of Enterprise/Modular Storage RAID Array Fibre Channel Systems:

Table 2 Configuration Reference Material

Document Title	Order Number
Enterprise/Modular Storage RAID Array FC-AL Configurations for Windows NT/Windows 2000 Application Note	AA-RH0RC-TE Available via the WEB
Release Notes, HSG80 Array Controller (ACS V8.6) for Windows NT Server - Intel	AA-RH0QF-TE or 387393-002
Release Notes, HSG80 Array Controller (ACS V8.3) for Windows NT Server - Intel	AA-RFA8A-TE
HSG80 ACS Solution Software Version 8.6 for Windows NT – Intel Installation and Configuration Guide	AA-RFA9F-TE
StorageWorks Secure Path for Windows NT Installation Guide	EK-WNTMP-MH.D01
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-HSXSW-WC

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 Windows NT/Windows 2000 configurations based on the configuration maximums listed. This document is not intended to describe all possible configurations. For configurations not shown here, the configuration maximums should be used to determine the viability of a proposed configuration. It is strongly recommended that you not exceed the maximums listed. The maximums and notes listed apply to all configurations, additional information specific to particular configurations is provided in each configuration section.

Configuration Maximums

- 500 meters per optical cable segment, 1 kilometer total distance between server and storage.
- The maximum number of Fibre Channel host bus adapters per server is 4 or the total allowed in the server if less than 4. When configuring more than one Fibre Channel host bus adapter in a single server, each must be connected to a different fibre channel hub (for example: different loop).
- Fibre channel hubs – Maximum of 4 non-cooperating servers per hub or 2 cooperating servers per hub (one Windows NT/Windows 2000 Cluster per hub). Non-cooperating (standalone) and cooperating (clustered) servers cannot be mixed on the same hub.
- The maximum number of active controller ports per host bus adapter is 4.
- Server maximums using Controller Transparent Failover Mode (assumes one Fibre Channel host bus adapter per server).
 - Up to 4 servers on a single Fibre Channel hub with up to 2 storage systems - using 4 controllers with 2 active and 2 standby controller host ports per controller pair
 - Up to 8 servers on two Fibre Channel hubs (4 servers per hub) with 1 storage system - using 2 controllers with 2 active and 2 standby controller host ports

- Maximums using Controller Multiple-Bus Failover Mode:
 - ❑ Up to 4 storage systems on four hubs – using 8 controllers with 4 active controller host ports per controller pair (refer to HA Configuration 5)
 - ❑ Up to 4 servers on two hubs with up to 2 storage systems – using 4 controllers with 4 active controller host ports per controller pair (refer to HA Configuration 8)
 - ❑ Up to 8 servers on four hubs with 2 storage systems – using 4 controllers with 4 active controller host ports per controller pair (refer to HA Configuration 9)
- Maximum storage capacity stated assumes 36 GB disks, increases in disk drive capacity will increase overall storage capacity for the same enclosure footprint.

General Configuration Notes

- Dual redundant controllers can be configured for Transparent Failover Mode or Multiple-Bus Failover Mode.
- All configuration diagrams show a front view of the storage system, Controller A is the top controller; Controller B is the bottom controller. Controller Host Port 1 is the left port; Host Port 2 is the right port.
- Each storage system can be configured using SWCC or the Command Line Interface (CLI) configured through either the HSG80 controller maintenance serial port or a TCP/IP interface .
- All configurations use Array Controller Software (ACS) V8.6 with all controller ports configured for FC-AL topology. Dual controllers must be configured with the same ACS version.
- All configurations shown use short wavelength lasers/multi-mode fibre channel optical cables in all cable segments.
- All configurations require the *Arbitrated Loop Physical Address* (ALPA) for each loop device be set to hard and be unique. Refer to the product documentation for a list of valid addresses.
- All configurations require the Connection Name *Operating System* parameter set to “WINNT”.
- By default the HSG80 Command Console LUN (CCL) is enabled. This must be disabled for Windows NT/Windows 2000 (using the CLI: SET controller NOCOMMAND_CONSOLE_LUN).
- For two (or more) enclosure configurations with more than one controller host port on the same hub, set the ALPA for each controller host port in the additional enclosure(s) to a different hard address (using the CLI: SET controller PORT_1_AL_PA = nn).
- All High Availability Multiple-Bus Failover configurations require Compaq Secure Path for Windows NT/Windows 2000. The minimum revision required is V3.0.
 - **NOTE:** Refer to the Secure Path documentation listed in Table 3 for specific installation procedures.
- For version 3.0 of Secure Path, one instance of the Secure Path Manager can manage multiple standalone servers or multiple clustered servers. Use more than one instance if you need to concurrently manage environments that include both standalone servers and clustered servers.
- All Secure Path configurations using 4 active controller ports connected to the same server or servers offer the flexibility to use the 4 active ports for either increased total LUN count, or increased path accessibility to a lower number of LUNs.

For Maximum LUN Count use distinct controller port unit offsets and access control on controller port 1 and controller port 2 to configure up to 16 LUNs total, 8 available through each pair of port paths. This means you can configure up to 8 LUNs on the two port 1 paths, and another 8 LUNs on the two port 2 paths. It is suggested that for units accessed through controller host port 1 you use unit number and offset values in the range of 0 – 99. For units accessed through controller host port 2,

use unit number and offset values in the range 100 – 199. For static controller load balancing individual LUNs should be distributed across each path of a port pair using the “Preferred Path” controller feature.

For maximum controller port PATH accessibility to the same set of LUNs, configure all 4 controller ports for access to the same 8 LUNs using the same unit offset on all 4 controller ports. In addition to the static controller load balancing feature, in this configuration you can enable dynamic port load distribution which distributes I/O load to each LUN across both ports on the same controller. The dynamic load distribution feature is available for non-clustered servers only.

- Distribute units equally across both controllers for proper static load balancing using the Unit Preferred Path parameter to assign units to a specific controller at initial boot.
- For two (or more) server Secure Path configurations, it is suggested that the first adapter in each server be connected to the first (same) fibre channel hub, the second two adapters to the second hub, and so forth. This is not required, however, it does aid in understanding logical to physical LUN and path mapping for maintenance purposes.
- Selective Storage Presentation (SSP) - For configurations with more than one server on the same hub accessing the same controller host port, or configurations with more than one active controller host port on the same hub.
 - Use the connection name Unit Offset value to set the range of unit numbers to be visible from each server (using the CLI: SET *connection-name* UNIT_OFFSET = *n*)
 - Use the Unit Connection Name parameter to allow exclusive access to units from each server (using the CLI: SET *unit-number* DISABLE_ACCESS_PATH = ALL ENABLE_ACCESS_PATH = *connection-name*)
 - Set the ALPA to a unique hard address for each Fibre Channel host bus adapter
- Record the Fibre Channel host bus adapter Worldwide ID (WWID) IEEE address shown on the back of each Fibre Channel host bus adapter prior to installing into a server.
- Use the recorded WWID to identify the connection name displayed from the CLI at the controller using the SHOW CONNECTIONS command.
- Rename connection names. By default new connection names are automatically added to the controller connection name table by the controllers when they detect a path to an adapter from each active controller host port. The default connection name assigned by the controllers will be !NEWCON*nn*, where *nn* is a number from 1 to 96 (ACS V8.6). After the controllers detect all paths, rename each connection name to be more meaningful to the configuration for example, SERVER1P1, SERVER1P2, and so forth. (connection names can be a maximum of 9 characters).
- Each active controller host port on a loop presents one SCSI Target ID with up to eight LUNS to each server (Fibre Channel host bus adapter) on the same loop. LUNs (logical units) can consist of single disks (JBOD), or a storage set of multiple disks or multiple partitions configured for a specific RAID level of 0, 1, 0 + 1, or 3/5.

Configuration Descriptions

Table 2 lists the most common Enterprise/Modular Storage RAID Array Fibre Channel Windows NT/Windows 2000 high availability configurations and the pages of this document where a description of capacities, configuration notes, performance considerations, are provided.

Table 3 Common Enterprise/Modular Storage RAID Array FC-AL Windows NT/Windows 2000 HA Configurations

High Availability Configuration #	Description	Page
1	One Server, Secure Path, Dual Controller Multiple-Bus Failover	9
2	Two Servers, MSCS, Dual Controller Transparent Failover	11
3	Four Servers, MSCS, Dual Controller Transparent Failover, Two Independent Clusters, Shared Storage Enclosure	13
4	Two Servers, MSCS, Secure Path, Dual Controller Multiple-Bus Failover	14
5	Two Servers, MSCS, Secure Path, Four Dual Controller Pairs Multiple-Bus Failover	15
6	Four Servers, MSCS, Secure Path, Dual Controller Multiple-Bus Failover, Two Independent Clusters, Shared Storage Enclosure	18
7	Up to Four Servers, Secure Path, Dual Controller Multiple-Bus Failover, Shared Storage Enclosure	20
8	Up to Four Servers, Secure Path, Two Dual Controller Pairs Multiple-Bus Failover, Shared Storage Enclosure	23
9	Up to Eight Servers, Secure Path, Two Dual Controller Pairs Multiple-Bus Failover, Shared Storage Enclosure	25

Configuration Parts Lists

A list of parts for each specific configuration is provided at the end of this document following the configuration descriptions.

HA Configuration 1 – One Server, Secure Path, Dual Controller Multiple-Bus Failover

HA Configuration 1 (Figure 1) represents an entry-level Enterprise/Modular Storage RAID Array high availability configuration that can be expanded to support additional storage capacity or performance needs as required. The configuration consists of a single Enterprise/Modular Storage RAID Array enclosure with two HSG80 array controllers configured in Multiple-Bus Failover mode. The configuration uses two separate paths (two fibre channel loops) to the storage. In the event of a failure of any component within the access path – host bus adapter, cables, hub, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path. The initial configuration provides up to 84 disks.

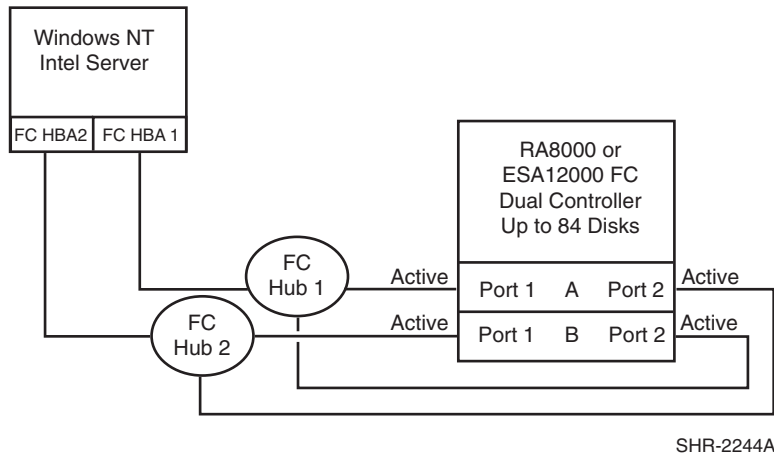


Figure 1. HA Configuration 1

HA Configuration 1 Notes

- Two Fibre Channel loops
- Uses Compaq Secure Path for Windows NT/Windows 2000 (minimum revision 3.0). Dynamic load distribution is available in this configuration when configured for maximum controller port paths
- One instance of Secure Path Manager can control all paths
- Dual HSG80 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 84 disks
- Depending on your specific application needs, configure either for maximum LUNs or for maximum controller port PATH accessibility
 - For Maximum LUN Count – Up to 16 LUNs with 4 active controller host ports. Suggested distinct controller port unit number and offset value assignment: Port 1 units D0 – D7, unit offset = 0, Port 2 units D100 – D107, unit offset = 100. Use the Preferred Path unit parameter to assign units to specific controllers for static load balancing. Prefer units D0 – D3, D100 – D103 to Controller A, prefer units D4 – D7, D104 – D107 to Controller B.
 - For Maximum Controller Port PATH Accessibility – Up to 8 LUNs with 4 active controller host ports and dynamic load distribution between two ports on the same controller. Suggested controller unit number and offset value assignment: All controller port connections use unit offset = 0 and have access to units D0 – D7. Use the Preferred Path unit parameter to assign units to specific controllers. Units should be distributed equally across controllers for static load balancing. Prefer units D0 – D3 to Controller A, prefer units D4 – D7 to Controller B. Enable dynamic load distribution.
- In this configuration 4 logical connections are available
- Rename the connection names, for example: SERVA1P1A, SERVA1P2B, SERVA2P1B, SERVA2P2A
- Set the same ALPA for each Fibre Channel host bus adapter. Suggested settings: HBA1 = 01, HBA2 = 01

HA Configuration 1 Performance Considerations

This configuration uses dual controllers with four active controller host ports. The overall limit is based on the two active host bus adapter limit of 31,000 I/O/sec and 172 MB/sec data rate. The primary advantage of this configuration is the ability to provide redundant independent paths to the storage. This is a general-purpose configuration that can be used for intensive I/O applications and very intensive bandwidth applications.

HA Configuration 2 – Two Servers, MSCS, Dual Controller Transparent Failover

HA Configuration 2 (Figure 2) provides dual redundant controllers configured in Transparent Failover mode. The configuration consists of a single Enterprise/Modular Storage RAID Array enclosure with two HSG80 array controllers connected to two servers running MSCS software. In normal operation Controller A provides the active path for all storagesets to the cluster through Controller A, Port 1. A second controller, Controller B, is a hot standby. In the event of a failure in Controller A, Controller B will automatically become active. All units being accessed through Port 1 of Controller A will become accessible through Port 1 of Controller B. In the event of a server failure, cluster failover will be invoked to provide access to units through the surviving server. In the initial configuration a single controller host port (Port 1) is active providing up to 8 LUNs across up to 84 disks. An additional 48 disks can be added using two expansion enclosures.

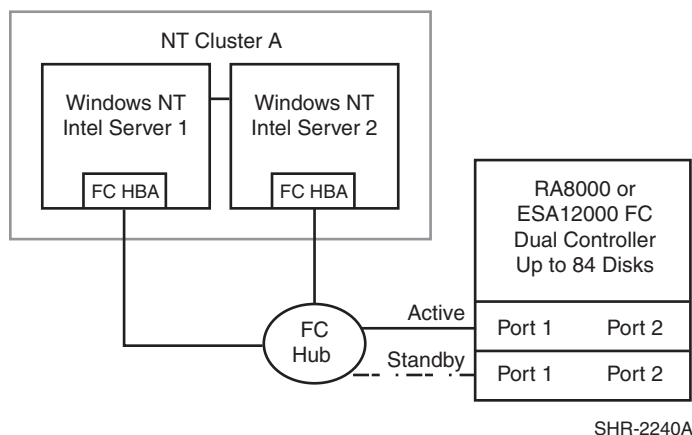


Figure 2. HA Configuration 2

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

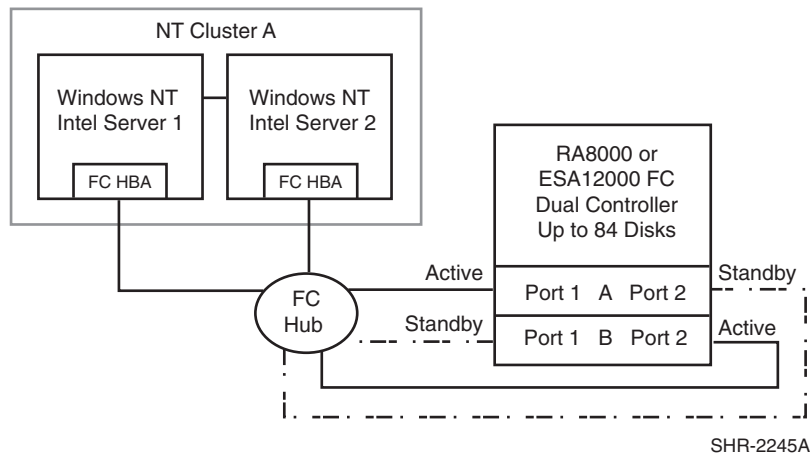


Figure 3. HA Configuration 2 with Increased Performance and Doubled LUN Capacity

HA Configuration 2 Notes

- Single Fibre Channel loop
- Dual HSG80 controllers configured in Transparent Failover Mode
- MSCS
- Up to 500 meters per cable segment
- Up to 84 disks
- Up to 8 LUNs with 1 active controller host port (Figure 2). Suggested controller unit number assignment: Port 1 units D0 – D7. In this configuration 2 logical connections are available
- Up to 16 LUNs with 2 active controller host ports (Figure 3). Suggested controller unit number assignment: Port 1 units D0 – D7, Port 2 units D100 – D107. In this configuration, 4 logical connections are available
- Utilization of Controller A Host Port 2, and Controller B Host Port 2, requires two additional fibre channel cables
- 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 Figure 2 configuration, two logical connections are available; in the Figure 3 configuration, four logical connections are available, rename the connection names, for example: SERVER1P1, SERVER1P2, SERVER2P1, SERVER2P2
- Set each Fibre Channel host bus adapter ALPA to a unique hexadecimal hard address. Suggested settings: Server 1 HBA = 01, Server 2 HBA = 02

HA Configuration 2 Performance Considerations

The configuration in Figure 2 uses a single active controller host port, resulting in a throughput limit of 12,000(cache)/4,100(media) I/O/sec, and a data rate limit of 77(cache)/54(media) MB/sec. Utilizing the second controller host port as shown in Figure 3, results in a performance increase up the dual controller two active port limit of 24,000 I/O/sec and a theoretical single loop of 100 MB/sec data rate.

This is a general-purpose configuration that can be used for typical I/O applications and typical bandwidth applications. Using the second controller will increase performance to allow for intensive I/O applications and moderately intensive bandwidth applications.

HA Configuration 3 – Four Servers, MSCS, Dual Controller Transparent Failover, Two Independent Clusters, Shared Storage Enclosure

This dual-controller configuration (Figure 4) uses the two pairs of controller host ports to provide storage for a second, independent Windows NT/Windows 2000 Cluster. Each Windows NT/Windows 2000 Cluster can be configured with up to 8 LUNs. The two clusters share the storage enclosure in that each cluster has exclusive access to its own LUNs through the use of mutually exclusive LUN numbering. The controllers are configured in Transparent Failover mode providing controller redundancy for both clusters. In the event of a controller failover, the surviving controller will continue to provide full access to units in both clusters. In the event of a server failure, cluster failover will be invoked to provide access to units through the surviving server. In this configuration two active controller ports provide up to 16 LUNs across up to 84 disks. An additional 48 disks can be added using two expansion enclosures to increase storage capacity.

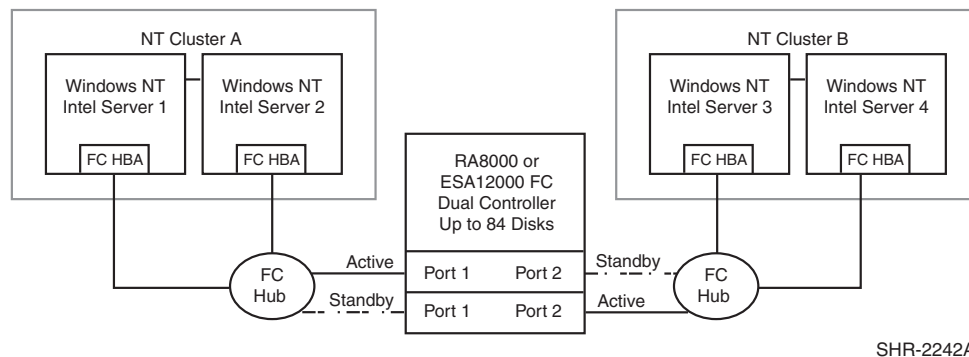


Figure 4. HA Configuration 3

HA Configuration 3 Notes

- Two MSCS clusters
- Shared storage enclosure
- Two Fibre Channel loops
- Dual HSG80 controllers configured in Transparent Failover Mode
- Up to 500 meters per cable segment
- Up to 84 disks with 2 optional expansion enclosures

- Up to 16 LUNs total/8 per cluster with 2 active controller host ports. Suggested controller unit number assignment: Cluster A, Controller A Port 1 units D0 – D7. Cluster B, Controller B Port 2 units D100 – D107
- By default, setting the controller pair in Transparent Failover mode will automatically configure Port 1 and Port 2 of both controllers to the Active and Standby state indicated, and set the unit offset values to 0 for Port 1 and 100 for Port 2
- In this configuration 4 logical connections are available, rename the connection names, for example: SERVER1P1, SERVER2P1, SERVER3P2, SERVER4P2
- Set exclusive access for each unit to specific server connection names. For example: for unit D0 ENABLE = SERVER1P1, SERVER2P1; for unit D100 ENABLE = SERVER3P2, SERVER4P2
- For each loop, set each Fibre Channel host bus adapter ALPA to a unique hexadecimal hard address. Suggested settings: Server 1 HBA = 01, Server 2 HBA = 02

HA Configuration 3 Performance Considerations

This configuration uses dual controllers with two active and two standby controller host ports. The overall limit is based on the dual controller, two active port limit of 24,000(cache)/8,200(media) I/O/sec and 154(cache)/102(media) MB/sec data rate. The primary advantage of this configuration is the ability to share the storage enclosure between two independent clusters without any performance degradation.

This is a general-purpose configuration that can be used for intensive I/O applications and very intensive bandwidth applications.

HA Configuration 4 – Two Servers, MSCS, Secure Path, Dual Controller Multiple-Bus Failover

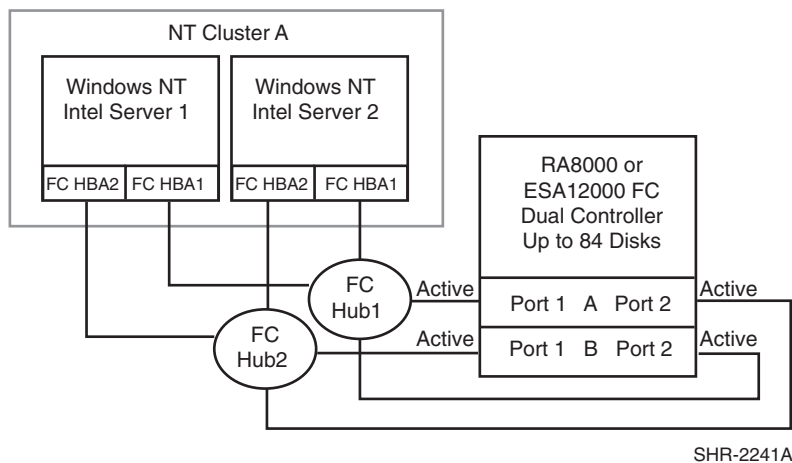


Figure 5. HA Configuration 4

HA Configuration 4 Notes

- Two Fibre Channel loops
- Uses Compaq Secure Path for Windows NT/Windows 2000 (minimum revision 3.0). Dynamic load distribution is not available in this configuration
- One instance of Secure Path Manager can control all paths
- Dual HSG80 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 84 disks
- Depending on your specific application needs, configure either for maximum LUNs or for maximum controller port paths.
 - For Maximum LUN Count – Up to 16 LUNs with 4 active controller host ports. Suggested distinct controller port unit number and offset value assignment: Port 1 units D0 – D7, unit offset = 0, Port 2 units D100 – D107, unit offset = 100. Use the Preferred Path unit parameter to assign units to specific controllers for static load balancing. Prefer units D0 – D3, D100 – D103 to Controller A, prefer units D4 – D7, D104 – D107 to Controller B.
 - For Maximum Controller Port PATH Accessibility – Up to 8 LUNs with 4 active controller host ports. Suggested controller unit number and offset value assignment: All controller port connections use unit offset = 0 and have access to units D0 – D7. Use the Preferred Path unit parameter to assign units to specific controllers. Units should be distributed equally across controllers for static load balancing. Prefer units D0 – D3 to Controller A, prefer units D4 – D7 to Controller B.
- In this configuration 8 logical connections are available, rename the connection names, for example: SRV1A1P1A, SRV1A2P1B, SRV1A1P2B, SRV1A2P2A, and so forth.
- In each server set the ALPA for each Fibre Channel host bus adapter to the same hexadecimal hard address, but unique on the loop. Suggested settings: Server 1 HBA1 = 01, HBA2 = 01, Server 2 HBA1 = 02, HBA2 = 02.

HA Configuration 4 Performance Considerations

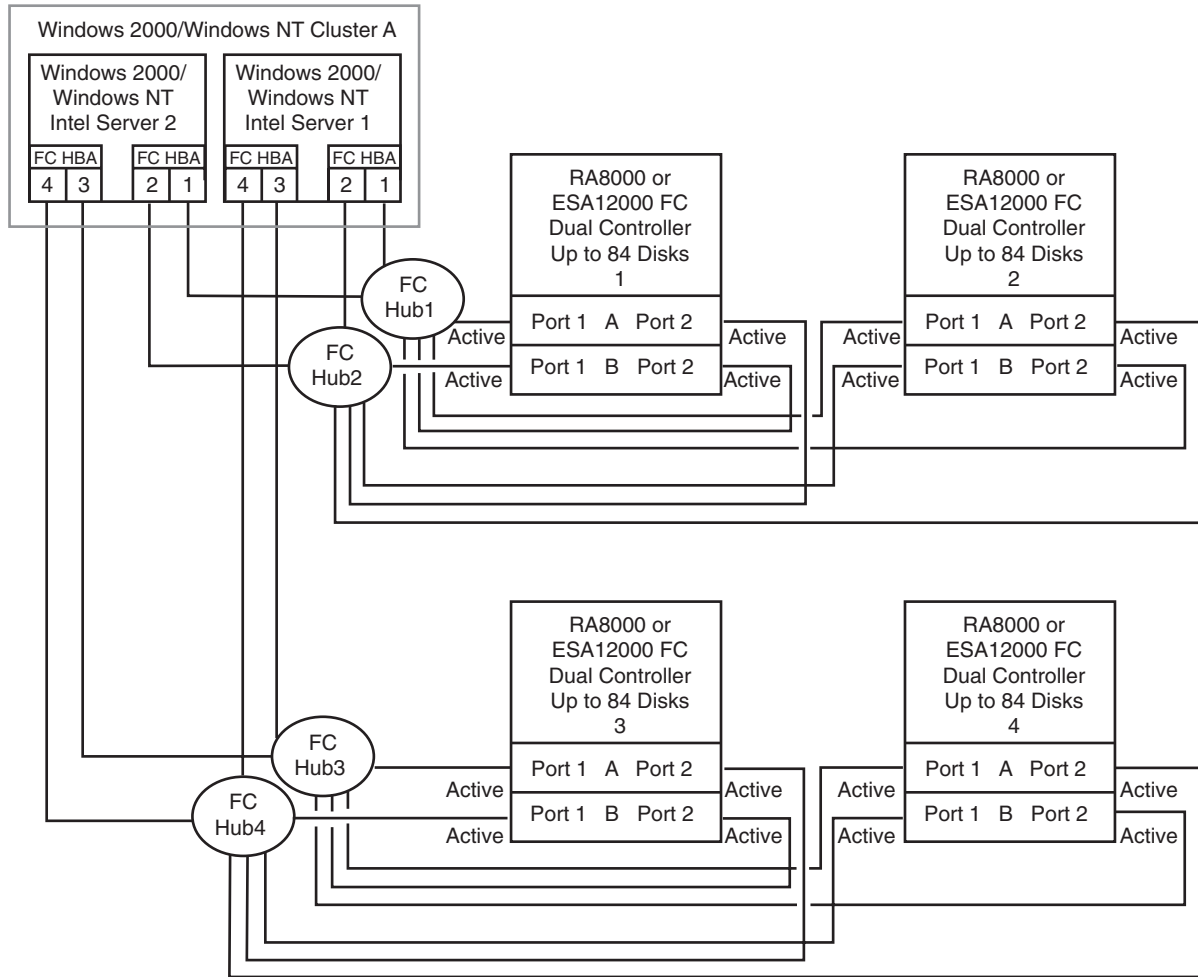
This configuration uses dual controllers with four active controller host ports. The overall limit is based on the dual controller, two active port limit of 24,000(cache)/8,200(media) I/O/sec and 195(cache)/102(media) MB/sec data rate. The primary advantage of this configuration is the ability to provide redundant independent paths to the storage and redundant servers.

This is a general-purpose configuration that can be used for intensive I/O applications and extremely intensive bandwidth applications.

HA Configuration 5 – Two Servers, MSCS, Secure Path, Four Dual Controller Pairs Multiple-Bus Failover

Configuration 5 (Figure 6) builds on Configuration 4 using four Fibre Channel host bus adapters in each cluster server connected to four dual controller pairs on four loops to provide storage path and controller redundancy with high storage capacity. The configuration uses two separate paths to each storage enclosure from each server in the cluster. In the event of a failure of any component within the access

path – host bus adapter, cables, hub, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path. In the event of a server failure, cluster failover will provide access to all storage from the surviving server.



SHR-2246A

Figure 6. HA Configuration 5

HA Configuration 5 Notes

- Four Fibre Channel loops
- Uses Compaq Secure Path for Windows NT/Windows 2000 (minimum revision 3.0). Dynamic load distribution is not available in this configuration
 - ❑ One instance of Secure Path Manager can control all paths
 - ❑ Four Dual HSG80 controller pairs configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 336 disks

- In this configuration 32 logical connections are available, 8 in each enclosure. For each enclosure (controller pair), rename the connection names as shown below
- In each server set the ALPA for each Fibre Channel host bus adapter to the same hexadecimal hard address, but unique on the loop. Suggested settings: Server 1 HBA1 = 01, HBA2 = 01, HBA3 = 01, HBA4 = 01 Server 2 HBA1 = 02, HBA2 = 02, HBA3 = 02, HBA4 = 02
- For the second controller enclosures, Enclosures 2 and 4, set each controller host port ALPA to a different address than set on the first enclosures, Enclosures 1 and 3:

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

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

Controller Enclosure 3: Controller Host Port 1 = 71, Port 2 = 72

Controller Enclosure 4: Controller Host Port 1 = 73, Port 2 = 74

- Depending on your specific application needs, configure either for maximum LUNs or for maximum controller port paths
 - For Maximum LUN Count – Up to 64 LUNs with 4 active controller host ports. The suggested unit numbering and connection parameters that result in the units being distributed equally across enclosures and controller host ports follow:

For all Controller Enclosures, Server 1 and Server 2 units:

Port 1 units D0 – D7, Port 2 units D100 – D107

Prefer units D0 – D3, D100 – D103 to Controller A

Prefer units D4 – D7, D104 – D107 to Controller B

For Controller Enclosures 1 and 2, connection names, unit offset values: SRV1A1P1A, 0. SRV1A2P1B, 0. SRV1A1P2B, 100. SRV1A2P2A, 100. SRV2A1P1A, 0. SRV2A2P1B, 0. SRV2A1P2B, 100. SRV2A2P2A, 100.

Set exclusive access for each unit to the appropriate connection names, for example:

D0 ENABLE = SRV1A1P1A, SRV1A2P1B, SRV2A1P1A, SRV2A2P1B

D100 ENABLE = SRV1A1P2B, SRV1A2P2A, SRV2A1P2B, SRV2A2P2A

For Controller Enclosures 3 and 4, connection names, unit offset values: SRV1A3P1A, 0. SRV1A4P1B, 0. SRV1A3P2B, 100. SRV1A4P2A, 100. SRV2A3P1A, 0. SRV2A4P1B, 0. SRV2A3P2B, 100. SRV2A4P2A, 100.

Set exclusive access for each unit to the appropriate connection names, for example:

D0 ENABLE = SRV1A3P1A, SRV1A4P1B, SRV2A3P1A, SRV2A4P1B

D100 ENABLE = SRV1A3P2B, SRV1A4P2A, SRV2A3P2B, SRV2A4P2A

- For Maximum Controller Port PATH Accessibility – Up to 32 LUNs when configured for maximum paths, the suggested unit numbering and connection parameters that result in 8 LUNs being accessible through 4 ports in each controller enclosure follow:

For all Controller Enclosures, Server 1 and Server 2 units D0 – D7

Prefer units D0 – D3 to Controller A

Prefer units D4 – D7 to Controller B

For Controller Enclosures 1 and 2, connection names, unit offset values: SRV1A1P1A, 0. SRV1A2P1B, 0. SRV1A1P2B, 0. SRV1A2P2A, 0. SRV2A1P1A, 0. SRV2A2P1B, 0. SRV2A1P2B, 0. SRV2A2P2A, 0.

Set exclusive access for each unit to the appropriate connection names, for example:

D0 ENABLE = SRV1A1P1A, SRV1A2P1B, SRV2A1P1A, SRV2A2P1B, SRV1A1P2B,
SRV1A2P2A, SRV2A1P2B, SRV2A2P2A

For Controller Enclosures 3 and 4, connection names, unit offset values: SRV1A3P1A, 0.
SRV1A4P1B, 0. SRV1A3P2B, 0. SRV1A4P2A, 0. SRV2A3P1A, 0. SRV2A4P1B, 0.
SRV2A3P2B, 0. SRV2A4P2A, 0.

Set exclusive access for each unit to the appropriate connection names, for example:

D0 ENABLE = SRV1A3P1A, SRV1A4P1B, SRV2A3P1A, SRV2A4P1B, SRV1A3P2B,
SRV1A4P2A, SRV2A3P2B, SRV2A4P2A

- Unit configurations and numbering can be identical for each storage enclosure, as each server will see each active controller host port as a unique target ID with a unique set of LUNs.

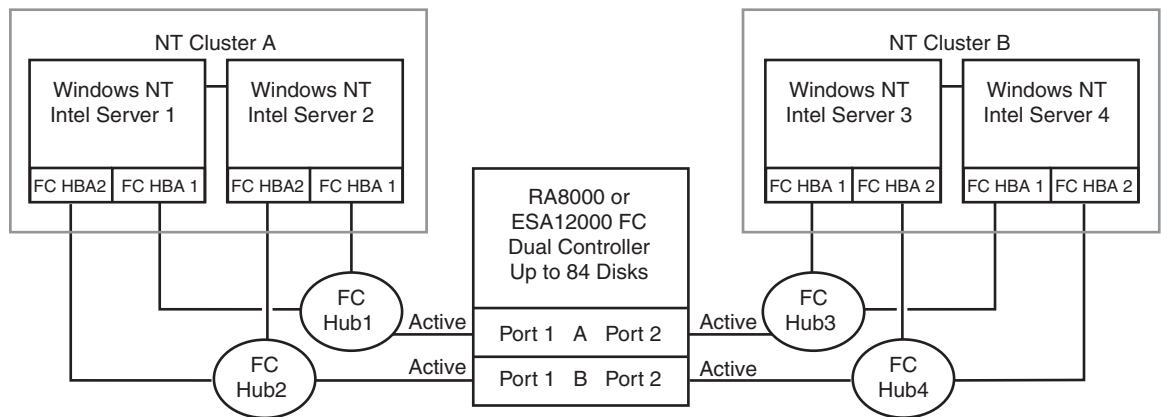
HA Configuration 5 Performance Considerations

This configuration uses 4 dual controller pairs with an overall aggregate limit based on a theoretical four-loop limit of 62,400 I/O/sec and 400 MB/sec data rate. The primary advantage of this configuration is the ability to connect up to four storage systems with redundant independent paths to the servers.

This is a high availability, high capacity configuration that can be used for extremely intensive I/O applications and extremely intensive bandwidth applications.

HA Configuration 6 – Four Servers, MSCS, Secure Path, Dual Controller Multiple-Bus Failover, Two Independent Clusters, Shared Storage Enclosure

HA Configuration 6 (Figure 7) builds on configurations 3 and 4, combining the benefits of MSCS clustering, Secure Path for Windows NT/Windows 2000 software, controller redundancy, and sharing of the storage enclosure. The configuration provides two independent clusters with two separate physical paths to the storage through two pairs of controller host ports. In the event of a failure of any component within the access path – Fibre Channel host bus adapter, cables, hub, or controller host port interface, all units on the failing path will become accessible through the alternate path. In the event of a server failure, cluster failover will be invoked to provide access to units through the surviving server. Each Windows NT/Windows 2000 Cluster can be configured with up to 8 LUNs. The two clusters share the storage enclosure in that each cluster has exclusive access to its own LUNs through the use of mutually exclusive LUN numbering. An additional 48 disks can be added using two expansion enclosures to increase storage capacity.



SHR-2243A

Figure 7. HA Configuration 6

HA Configuration 6 Notes

- Four Fibre Channel loops
- Uses Compaq Secure Path for Windows NT/Windows 2000 (minimum version 3.0). Dynamic load distribution is not available in this configuration
- One instance of Secure Path Manager can control all paths
- Dual HSG80 controllers configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 84 disks
- Up to 16 LUNs total/8 per Cluster with 4 active controller host ports. Suggested controller unit number and offset value assignment: Port 1 units D0 – D7, unit offset = 0, Port 2 units D100 – D107, unit offset 100
- Set the Unit Preferred Path. Use the Preferred Path unit parameter to distribute units equally across controllers for load balancing
 - Prefer units D0 – D3 to Controller A
 - Prefer units D4 – D7 to Controller B
 - Prefer units D100 – D103 to Controller A
 - Prefer units D104 – D107 to Controller B
- In this configuration 8 logical connections are available, rename the connection names, for example:
 - SERV1P1A, SERV1P1B, SERV2P1A, SERV2P1B
 - SERV3P2A, SERV3P2B, SERV4P2A, SERV4P2B
- Set exclusive unit access for each unit to specific server connection names. For example: for unit D0 ENABLE = SERV1P1A, SERVP1B, SERV2P1A, SERV2P1B; for unit D100 ENABLE = SERV3P2A, SERV3P2B, SERV4P2A, SERV5P2B
- Set the connection name unit offset values for each connection as shown below

- In each server set the ALPA for each Fibre Channel host bus adapter to the same hexadecimal hard address, but unique on the loop. Suggested settings: Server 1 HBA1 = 01, HBA2 = 01, Server 2 HBA1 = 02, HBA2 = 02, and so forth.
- Suggested unit numbering and connection parameters would result in the units being distributed equally across clusters/controller host ports as follows:

Server 1: Port 1 units D0 – D7

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

Server 2: Port 1 units D0 – D7

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

Server 3: Port 2 units D100 – D107

Connection names, unit offset values: SERV3P2A, 100. SERV3P2B, 100

Server 4: Port 2 units D100 – D107

Connection names, unit offset values: SERV4P2A, 100. SERV4P2B, 100

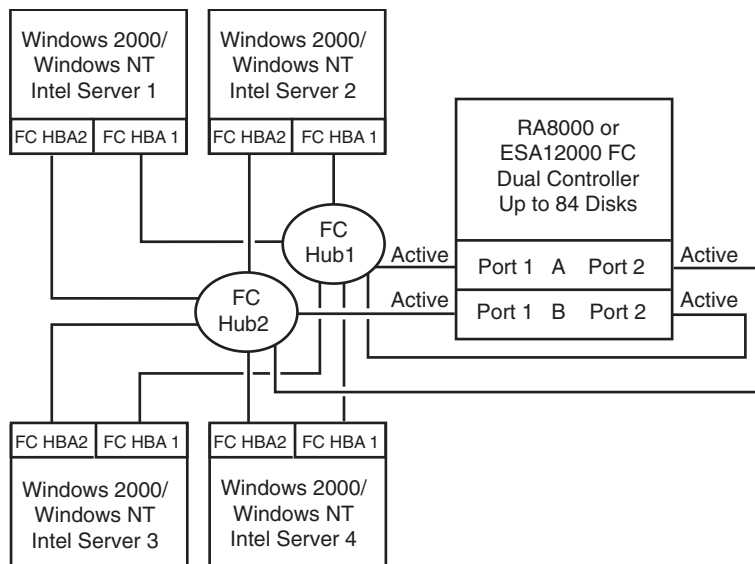
HA Configuration 6 Performance Considerations

This configuration uses dual controllers with four active controller host ports. The overall limit is based on the dual controller, four active port limit of 24,000(cache)/8,200(media) I/O/sec and 195(cache)/102(media) MB/sec data rate. The primary advantage of this configuration is the ability to share the storage enclosure to connect two independent clusters with redundant independent paths to the storage.

This is a general-purpose configuration that can be used for intensive I/O applications and extremely intensive bandwidth applications.

HA Configuration 7 – Up to Four Servers, Secure Path, Dual Controller Multiple-Bus Failover, Shared Storage Enclosure

HA Configuration 7 (Figure 8) builds on Configuration 1 providing storage for up to four separate (non-cooperating) servers on two fibre channel loops. The four servers share the storage enclosure in that each server has exclusive access to its own set of LUNs. This is made possible by the setting of explicit “connection name access” at the unit level and using connection name “unit offsets” to give each server an accessible range of unit numbers. Additional levels of access control are necessary for this configuration because all servers are sharing the two fibre channel loops. The configuration utilizes two separate paths to the storage from each server. In the event of a failure of any component within the access path – host bus adapters, cables, hub, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path.



SHR-2247A

Figure 8. HA Configuration 7

HA Configuration 7 Notes

- Two Fibre Channel loops
 - Shared storage enclosure
 - Uses Compaq Secure Path for Windows NT/Windows 2000 (minimum version 3.0). Dynamic load distribution is available in this configuration when configured for maximum controller port paths
 - One instance of Secure Path Manager can control all paths
 - Dual HSG80 controllers configured in Multiple-Bus Failover Mode
 - Up to 500 meters per cable segment
 - Up to 84 disks
 - In this configuration 16 logical connections are available
 - In each server, set the ALPA for each Fibre Channel host bus adapter to the same hexadecimal hard address, but unique on the loop suggested settings, Server 1 HBA1 = 01, HBA2 = 01, Server 2 HBA1 = 02, HBA2 = 02, and so forth.
 - Depending on your specific application needs, configure either for maximum LUNs or for maximum controller port paths
 - For Maximum LUN Count – Up to 64 LUNs, 16 available to each server with 4 active controller host ports. The suggested unit numbering and connection parameters that result in the units being distributed equally across controller host ports follow:
 - ❑ Server 1 Port 1 units D0 – D7, Port 2 units D100 – D107
 - Prefer units D0 – D3, D100 – D103 to Controller A
 - Prefer units D4 – D7, D104 – D107 to Controller B
- Connection names, unit offset values: SRV1A1P1A, 0. SRV1A2P1B, 0. SRV1A1P2B, 100. SRV1A2P2A, 100.

Set exclusive access for each unit to the listed connection names, for example: D0 ENABLE = SRV1A1P1A, SRV1A2P1B. D100 ENABLE = SRV1A1P2B, SRV1A2P2A

- ❑ Server 2 Port 1 units D10 – D17, Port 2 units D110 – D117

Prefer units D10 – D13, D110 – D113 to Controller A

Prefer units D14 – D17, D114 – D117 to Controller B

Connection names, unit offset values: SRV2A1P1A, 10. SRV2A2P1B, 10. SRV2A1P2B, 110. SRV2A2P2A, 110.

Set exclusive access for each unit to the listed connection names, for example: D10 ENABLE = SRV2A1P1A, SRV2A2P1B. D110 ENABLE = SRV2A1P2B, SRV2A2P2A

- ❑ Server 3 Port 1 units D20 – D27, Port 2 units D120 – D127

Prefer units D20 – D23, D120 – D123 to Controller A

Prefer units D24 – D27, D124 – D127 to Controller B

Connection names, unit offset values: SRV3A1P1A, 20. SRV3A2P1B, 20. SRV3A1P2B, 120. SRV3A2P2A, 120.

Set exclusive access for each unit to the listed connection names, for example: D20 ENABLE = SRV3A1P1A, SRV3A2P1B. D120 ENABLE = SRV3A1P2B, SRV3A2P2A

- ❑ Server 4 Port 1 units D30 – D37, Port 2 units D130 – D137

Prefer units D30 – D33, D130 – D133 to Controller A

Prefer units D34 – D37, D134 – D137 to Controller B

Connection names, unit offset values: SRV4A1P1A, 30. SRV4A2P1B, 30. SRV4A1P2B, 130. SRV4A2P2A, 130.

Set exclusive access for each unit to the listed connection names, for example: D30 ENABLE = SRV4A1P1A, SRV4A2P1B. D130 ENABLE = SRV4A1P2B, SRV4A2P2A

- For Maximum Controller Port PATH Accessibility – Up to 32 LUNs, 8 available to each server with 4 active controller host ports and dynamic load distribution between two ports on the same controller. The suggested unit numbering and connection parameters that result in 8 LUNs for each server being accessible through all 4 controller ports follow:

- ❑ Server 1 units D0 – D7

Prefer units D0 – D3 to Controller A

Prefer units D4 – D7 to Controller B

Connection names, unit offset values: SRV1A1P1A, 0. SRV1A2P1B, 0. SRV1A1P2B, 0. SRV1A2P2A, 0.

Set exclusive access for each unit to the listed connection names, for example: D0 ENABLE = SRV1A1P1A, SRV1A2P1B, SRV1A1P2B, SRV1A2P2A

- ❑ Server 2 units D10 – D17

Prefer units D10 – D13 to Controller A

Prefer units D14 – D17 to Controller B

Connection names, unit offset values: SRV2A1P1A, 10. SRV2A2P1B, 10. SRV2A1P2B, 10. SRV2A2P2A, 10.

Set exclusive access for each unit to the listed connection names, for example: D10 ENABLE = SRV2A1P1A, SRV2A2P1B, SRV2A1P2B, SRV2A2P2A

❑ Server 3 units D20 – D27

Prefer units D20 – D23 to Controller A

Prefer units D24 – D27 to Controller B

Connection names, unit offset values: SRV3A1P1A, 20. SRV3A2P1B, 20. SRV3A1P2B, 20. SRV3A2P2A, 20.

Set exclusive access for each unit to the listed connection names, for example: D20 ENABLE = SRV3A1P1A, SRV3A2P1B, SRV3A1P2B, SRV3A2P2A

❑ Server 4 units D30 – D37

Prefer units D30 – D33 to Controller A

Prefer units D34 – D37 to Controller B

Connection names, unit offset values: SRV4A1P1A, 30. SRV4A2P1B, 30. SRV4A1P2B, 30. SRV4A2P2A, 30.

Set exclusive access for each unit to the listed connection names, for example: D30 ENABLE = SRV4A1P1A, SRV4A2P1B, SRV4A1P2B, SRV4A2P2A

HA Configuration 7 Performance Considerations

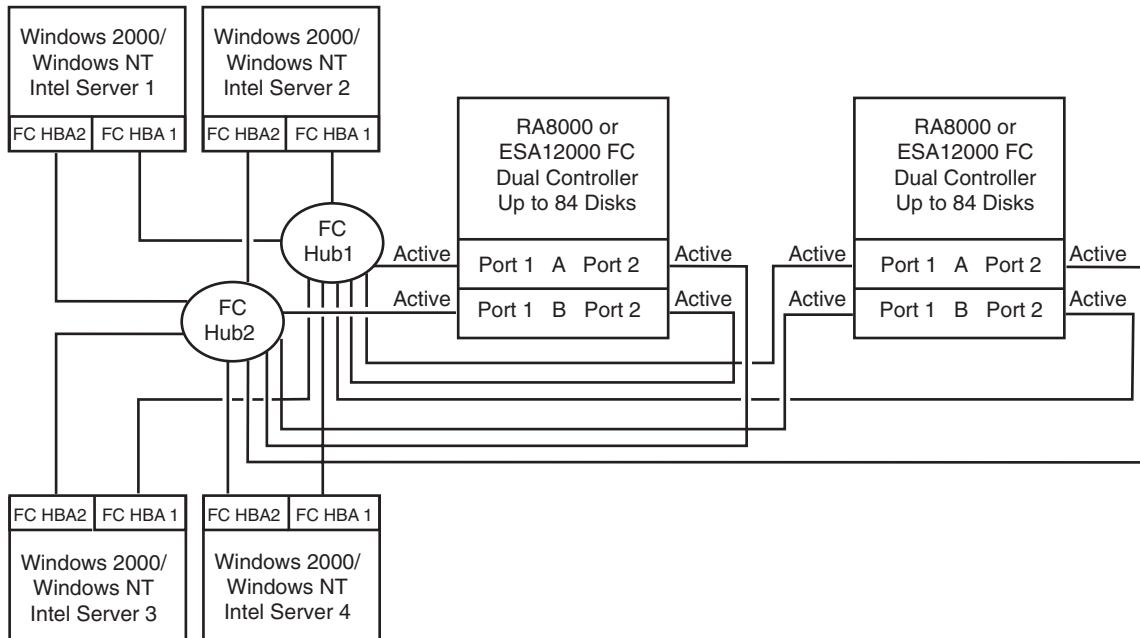
This configuration uses dual controllers with two active controller host ports. The overall aggregate limit is based on the dual controller, four active port limit of 24,000(cache)/8,200(media) I/O/sec and 195(cache)/102(media) MB/sec data rate. The primary advantage of this configuration is the ability to provide redundant independent paths to the storage for up to four servers.

This is a general-purpose configuration that can be used for intensive I/O applications and extremely intensive bandwidth applications.

HA Configuration 8 – Up to Four Servers, Secure Path, Two Dual Controller Pairs Multiple-Bus Failover, Shared Storage Enclosure

HA Configuration 8 (Figure 9) builds on Configuration 7 by adding storage capacity using a second enclosure and second pair of controllers. The second pair of controllers are connected to two fibre channel loops providing redundant paths for up to four separate (non-cooperating) servers. The four servers share both storage enclosures in that each server has exclusive access to its own LUNs in each enclosure through the use of mutually exclusive LUN numbering, explicit unit host access, and the use of connection unit offsets. Additional levels of access control are necessary for this configuration because all servers are sharing the two fibre channel loops. The configuration uses two separate paths to

the storage from each server. In the event of a failure of any component within the access path – host bus adapter, cables, hub, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path.



SHR-2248A

Figure 9. HA Configuration 8

HA Configuration 8 Notes

- Two Fibre Channel loops
- Shared storage enclosure
- Uses Compaq Secure Path for Windows NT/Windows 2000 (minimum version 3.0). Dynamic load distribution is available in this configuration when configured for maximum controller port paths
- One instance of Secure Path Manager can control all paths
- Two Dual HSG80 controller pairs configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 168 disks
- In this configuration 16 logical connections are available, 8 in each enclosure
- In each server set the ALPA for each Fibre Channel host bus adapter to the same hexadecimal hard address, but unique on the loop. Suggested settings: Server 1 HBA1 = 01, HBA2 = 01, Server 2 HBA1 = 02, HBA2 = 02, and so forth.
- For the second controller enclosure, Enclosure 2, set each controller host port ALPA to a different address then set on the first enclosure:
 - Controller Enclosure 1: Controller Host Port 1 = 71, Port 2 = 72
 - Controller Enclosure 2: Controller Host Port 1 = 73, Port 2 = 74
- Depending on your specific application needs, configure either for maximum LUNs or for maximum controller port paths

- ❑ For Maximum LUN Count – Up to 128 LUNs, 32 available to each server with 8 active controller host ports. Refer to Configuration 7, “Maximum LUN Count” Controller Enclosure settings for a suggested way to define the units that distributes them equally across controller host ports. Unit configurations and numbering can be identical for each storage enclosure, as each server will see each active controller host port as a unique target ID with a unique set of LUNs.
- ❑ For Maximum Controller Port PATH Accessibility – Up to 64 LUNs, 16 available to each server with 8 active controller host ports and dynamic load distribution between two ports on the same controller. Refer to Configuration 7, Controller Enclosure “Maximum Controller Port PATH Accessibility” settings for a suggested way to define the units that distributes them equally across controller host ports. Unit configurations and numbering can be identical for each storage enclosure, as each server will see each active controller host port as a unique target ID with a unique set of LUNs.

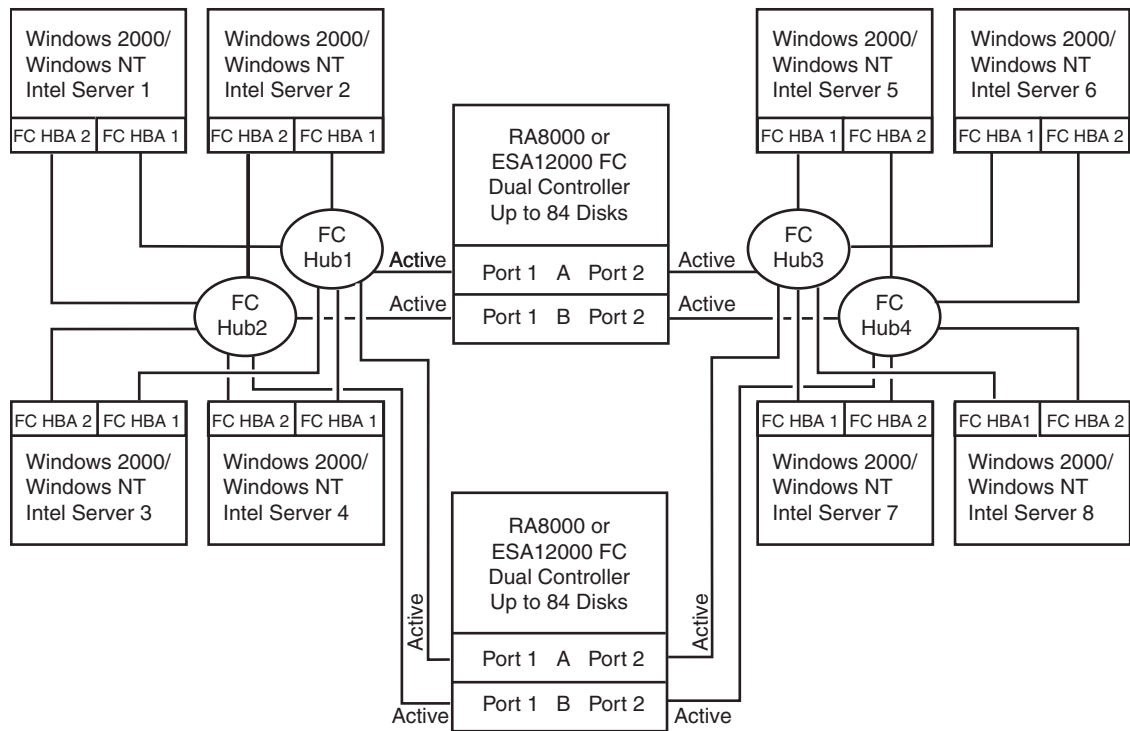
HA Configuration 8 Performance Considerations

This configuration uses 2 dual controller pairs with an overall aggregate limit based on a theoretical two-loop limit of 33,200 I/O/sec and 200 MB/sec data rate. The primary advantage of this configuration is the ability to connect up to four servers and two storage systems with redundant independent paths to the storage.

This is a high availability, high connectivity configuration that can be used for extremely intensive I/O applications and extremely intensive bandwidth applications.

HA Configuration 9 – Up to Eight Servers, Secure Path, Two Dual Controller Pairs Multiple-Bus Failover, Two Shared Storage Enclosures

Configuration 9 (Figure 10) builds on Configurations 7 and 8 using two dual controller pairs on four loops to provide storage path and controller redundancy for up to eight separate (non-cooperating) servers. The eight servers share both storage enclosures in that each server has exclusive access to its own LUNs in each enclosure through the use of mutually exclusive LUN numbering, explicit unit host access, and the use of connection unit offsets. Additional levels of access control are necessary for this configuration because each group of four servers is sharing two fibre channel loops. The configuration uses two separate paths to the storage from each server. In the event of a failure of any component within the access path – host bus adapter, cables, hub, or controller host port interface, all LUNs on the failing path will become accessible through the alternate path.



SHR-2249A

Figure 10. HA Configuration 9

HA Configuration 9 Notes

- Four Fibre Channel loops
- Shared storage enclosure
- Uses Compaq Secure Path for Windows NT/Windows 2000 (minimum version 3.0). Dynamic load distribution is not available in this configuration
- One instance of Secure Path Manager can control all paths
- Two Dual HSG80 controller pairs configured in Multiple-Bus Failover Mode
- Up to 500 meters per cable segment
- Up to 144 disks with 4 optional expansion cabinets
- In this configuration 32 logical connections are available, 16 in each enclosure
- In each server set the ALPA for each Fibre Channel host bus adapter to the same hexadecimal hard address, but unique on the loop. Suggested settings: Server 1 HBA1 = 01, HBA2 = 01, Server 2 HBA1 = 02, HBA2 = 02, and so forth.
- For the second controller enclosure, Enclosure 2, set each controller host port ALPA to a different address than set on the first enclosure:
 - Controller Enclosure 1: Controller Host Port 1 = 71, Port 2 = 72
 - Controller Enclosure 2: Controller Host Port 1 = 73, Port 2 = 74

- Up to 128 LUNs, 16 available to each server with 8 active controller host ports. The suggested unit numbering and connection parameters that result in the units being distributed equally across controller host ports follow:

 - ❑ Server 1 Port 1 units D0 – D7

Prefer units D0 – D3 to Controller A

Prefer units D4 – D7 to Controller B

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

Set exclusive access for each unit to the listed connection names, for example: D0 ENABLE = SRV1A1P1A, SRV1A2P1B
 - ❑ Server 2 Port 1 units D10 – D17

Prefer units D10 – D13 to Controller A

Prefer units D14 – D17 to Controller B

Connection names, unit offset values: SRV2A1P1A, 10. SRV2A2P1B, 10.

Set exclusive access for each unit to the listed connection names, for example: D10 ENABLE = SRV2A1P1A, SRV2A2P1B
 - ❑ Server 3 Port 1 units D20 – D27

Prefer units D20 – D23 to Controller A

Prefer units D24 – D27 to Controller B

Connection names, unit offset values: SRV3A1P1A, 20. SRV3A2P1B, 20.

Set exclusive access for each unit to the listed connection names, for example: D20 ENABLE = SRV3A1P1A, SRV3A2P1B
 - ❑ Server 4 Port 1 units D30 – D37

Prefer units D30 – D33 to Controller A

Prefer units D34 – D37 to Controller B

Connection names, unit offset values: SRV4A1P1A, 30. SRV4A2P1B, 30.

Set exclusive access for each unit to the listed connection names, for example: D30 ENABLE = SRV4A1P1A, SRV4A2P1B
 - ❑ Server 5 Port 2 units D100 – D107

Prefer units D100 – D103 to Controller A

Prefer units D104 – D107 to Controller B

Connection names, unit offset values: SRV5A1P2B, 100. SRV5A2P2A, 100.

Set exclusive access for each unit to the listed connection names, for example: D100 ENABLE = SRV5A1P2B, SRV5A2P2A
 - ❑ Server 6 Port 2 units D110 – D117

Prefer units D110 – D113 to Controller A

Prefer units D114 – D117 to Controller B

Connection names, unit offset values: SRV6A1P2B, 110. SRV6A2P2A, 110.

Set exclusive access for each unit to the listed connection names, i.e D110 ENABLE = SRV6A1P2B, SRV6A2P2A

- ❑ Server 7 Port 2 units D120 – D127
 - Prefer units D120 – D123 to Controller A
 - Prefer units D124 – D127 to Controller B
 - Connection names, unit offset values: SRV7A1P2B, 120. SRV7A2P2A, 120.
 - Set exclusive access for each unit to the listed connection names, i.e D120 ENABLE = SRV7A1P2B, SRV7A2P2A
- ❑ Server 8 Port 2 units D130 – D137
 - Prefer units D130 – D133 to Controller A
 - Prefer units D134 – D137 to Controller B
 - Connection names, unit offset values: SRV8A1P2B, 130. SRV8A2P2A, 130.
 - Set exclusive access for each unit to the listed connection names, i.e D130 ENABLE = SRV8A1P2B, SRV8A2P2A
- Unit configurations and numbering can be identical for each storage enclosure, as each server will see each active controller host port as a unique target ID with a unique set of LUNs

HA Configuration 9 Performance Considerations

This configuration uses 2 dual controller pairs with an overall aggregate limit based on the dual controller four active port limit (times 2) of 48,000(cache) I/O/sec and 390(cache) MB/sec data rate. The primary advantage of this configuration is the ability to connect up to eight servers and two storage systems with redundant independent paths to the storage.

This is a high availability, high connectivity configuration that can be used for extremely intensive I/O applications and extremely intensive bandwidth applications.

Configuration Parts Lists

Configuration 1 Parts List

The following table describes one Intel Server with Microsoft Windows NT/Windows 2000 4.0 Service Pack 3-6 (minimum Service Pack 3 for ACS V8.3), or Service Pack 4-6 (minimum Service Pack 4 for ACS V8.6)

Table 1 Configuration 1 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	1
128697-B21	ACS V8.6F Controller Software	2
380594-001	Secure Path for WNT	1
380574-001	KGPSA-BC PCI Fibre Channel host bus adapter	2
380560-B21 (Blue) 380560-B22 (Opal) 380670-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
234453-001/B31/291 295573-B22	Fibre Channel 7-Port Hub/Domestic/Intl/Japan Fibre Channel 12-Port Hub 41U/42U Bracket	Choose 2
380561-B21	Fibre Channel Optical GBIC	4
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	Fibre Channel 2 Meter Optical Cable Fibre Channel 5 Meter Optical Cable Fibre Channel 15 Meter Optical Cable Fibre Channel 30 Meter Optical Cable Fibre Channel 50 Meter Optical Cable	Choose 4
380691-B21 380595-B21 380694-B21 380588-B21 380589-B21 147599-001	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 18GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 10000 RPM Disk 36GB UW 7200 RPM Disk	Choose up to 84 (48 for ESA 48 slot)

Configuration 1 Optional Components**Table 2 Configuration 1 Optional Components**

Compaq Part #	Description	Quantity
380570-B21 (Blue)	Pedestal Expansion 24 slots	Up to 2
380570-B22 (Opal)	Pedestal Expansion 24 slots	OR Choose 1
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)	SA12000 Expansion 48 Slot 50HZ	
380650-B22 (Opal)	ESA/EMA12000 Expansion 48 Slot 50HZ	
See Table 1.	Additional Disk Drives	Up to 48

Configuration 2 Parts List

The following table lists the parts for one Intel Server with Microsoft Windows NT/Windows 2000 4.0, Service Pack 3-6 (minimum Service Pack 3 for ACS V8.3), or Service Pack 4-6 (minimum Service Pack 4 for ACS V8.6).

Table 3 Configuration 2 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	1
128697-B21	ACS V8.6 Controller Software	2
380574-001	KGPSA-BC PCI Fibre Channel Host Bus Adapter	2
380560-B21 (Blue)	RA/MA8000 Pedestal w/dual HSG80	Choose 1
380560-B22 (Opal)	RA/MA8000 Pedestal w/dual HSG80	
380670-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	
80600-002 (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	
234453-001/B31/291	Fibre Channel 7-Port Hub/Domestic/Intl/Japan	Choose 1
295573-B22	Fibre Channel 12-Port Hub 41U/42U Bracket	
380561-B21	Fibre Channel Optical GBIC	4

Table 3 Configuration 2 Parts List (Continued)

Compaq Part #	Description	Quantity
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	Fibre Channel 2 Meter Optical Cable Fibre Channel 5 Meter Optical Cable Fibre Channel 15 Meter Optical Cable Fibre Channel 30 Meter Optical Cable Fibre Channel 50 Meter Optical Cable	Choose 4
380691-B21 380595-B21 380694-B21 380588-B21 380589-B21 147599-001	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 18GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 10000 RPM Disk 36GB UW 7200 RPM Disk	Choose up to 84 (48 for ESA 48 slot)

Configuration 2 Optional Components**Table 4 Configuration 2 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
See Table 3.	Additional Disk Drives Additional Fibre Channel Optical GBIC Additional Fibre Channel Optical Cable	Up to 48 2 Choose 2

Configuration 3 Parts List

The following table lists the parts for one Intel Server with Microsoft Windows NT/Windows 2000 4.0, Service Pack 3-6 (minimum Service Pack 3 for ACS V8.3), or Service Pack 4-6 (minimum Service Pack 4 for ACS V8.6).

Table 5 Configuration 3 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	1
128697-B21	ACS V8.6 Controller Software	2
380574-001	KGPSA-BC PCI Fibre Channel Host Bus Adapter	4

Table 5 Configuration 3 Parts List (Continued)

Compaq Part #	Description	Quantity
380560-B21 (Blue)	RA/MA8000 Pedestal w/dual HSG80	Choose 1
380560-B22 (Opal)	RA/MA8000 Pedestal w/dual HSG80	
380670-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	
234453-001/B31/291 2955733-B22	Fibre Channel-7-Port Hub/Domestic/Intl/Japan Fibre Channel 12-Port Hub 41U/42U Bracket	Choose 2
380561-B21	Fibre Channel Optical GBIC	8
234457-B21	Fibre Channel 2 Meter Optical Cable	Choose 8
234457-B22	Fibre Channel 5 Meter Optical Cable	
234457-B23	Fibre Channel 15 Meter Optical Cable	
234457-B24	Fibre Channel 30 Meter Optical Cable	
234457-B25	Fibre Channel 50 Meter Optical Cable	
380691-B21	4GB UW 7200 RPM Disk	Choose up to 84 (48 for ESA 48 slot)
380595-B21	9GB UW 7200 RPM Disk	
380694-B21	18GB UW 7200 RPM Disk	
380588-B21	9GB UW 10000 RPM Disk	
380589-B21	18GB UW 10000 RPM Disk	
147599-001	36GB UW 7200 RPM Disk	

Configuration 3 Optional Components**Table 6 Configuration 3 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)	SA12000 Expansion 48 Slot 50HZ	
380650-B22 (Opal)	ESA/EMA12000 Expansion 48 Slot 50HZ	
See Table 5.	Additional Disk Drives	Up to 48

Configuration 4 Parts List

The following table lists the parts for two Intel Servers with Microsoft Windows NT/Windows 2000 4.0, Service Pack 3-6 (minimum Service Pack 3 for ACS V8.3), or Service Pack 4-6 (minimum Service Pack 4 for ACS V8.6).

Table 7 Configuration 4 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	1
128697-B21	ACS V8.6 Controller Software	2
380574-001	KGPSA-BC PCI Fibre Channel Host Bus Adapter	1
380560-B21 (Blue) 380560-B22 (Opal) 380670-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
234453-001/B31/291 295573-B22	Fibre Channel 7-Port Hub/Domestic/Intl/Japan Fibre Channel 12-Port Hub 41U/42U Bracket	Choose 2
380561-B21	Fibre Channel Optical GBIC	6
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	Fibre Channel 2 Meter Optical Cable Fibre Channel 5 Meter Optical Cable Fibre Channel 15 Meter Optical Cable Fibre Channel 30 Meter Optical Cable Fibre Channel 50 Meter Optical Cable	Choose 6
380691-B21 380595-B21 380694-B21 380588-B21 380589-B21 147599-001	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 18GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 10000 RPM Disk 36GB UW 7200 RPM Disk	Choose up to 84 (48 for ESA 48 slot)

Configuration 4 Optional Components**Table 8 Configuration 4 Optional Components**

Compaq Part #	Description	Quantity
380570-B21 (Blue)	Pedestal Expansion 24 slots	Up to 2
380570-B22 (Opal)	Pedestal Expansion 24 slots	OR Choose 1
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	
See Table 7.	Additional Disk Drives	Up to 48

Configuration 5 Parts List

The following table lists the parts for two Intel Servers with Microsoft Windows NT/Windows 2000 4.0, Service Pack 3-6 (minimum Service Pack 3 for ACS V8.3), or Service Pack 4-6 (minimum Service Pack 4 for ACS V8.6).

Table 9 Configuration 5 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	4
128697-B21	ACS V8.6 Controller Software	8
380594-001	Secure Path for WNT (requires v2.1)	4
380574-001	KGPSA-BC PCI Fibre Channel Host Bus Adapter	8
380560-B21 (Blue)	RA/MA8000 Pedestal w/dual HSG80	Choose 4
380560-B22 (Opal)	RA/MA8000 Pedestal w/dual HSG80	
380670-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	OR
380620-001 (Blue)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 60HZ	Choose 1
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	

Table 9 Configuration 5 Parts List (Continued)

Compaq Part #	Description	Quantity
234453-001/B31/291 295573-B22	Fibre Channel 7-Port Hub/Domestic/Intl/Japan Fibre Channel 12-Port Hub 41U/42U Bracket	Choose 4
380561-B21	Fibre Channel Optical GBIC	16
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	Fibre Channel 2 Meter Optical Cable Fibre Channel 5 Meter Optical Cable Fibre Channel 15 Meter Optical Cable Fibre Channel 30 Meter Optical Cable Fibre Channel 50 Meter Optical Cable	Choose 16
380691-B21 380595-B21 380694-B21 380588-B21 380589-B21 147599-001	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 18GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 10000 RPM Disk 36GB UW 7200 RPM Disk	Choose up to 96 (192 for ESA 48 slot)

Configuration 5 Optional Components**Table 10 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 8 OR Choose 2 OR Choose 4
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	
See Table 9.	Additional Disk Drives	Up to 48

Configuration 6 Parts List

The following table lists the parts for four Intel Servers with Microsoft Windows NT 4.0, Service Pack 3-6 (minimum Service Pack 3 for ACS V8.3), or Service Pack 4-6 (minimum Service Pack 4 for ACS V8.6).

Table 11 Configuration 6 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	1
128697-B21	ACS V8.6 Controller Software	2

Table 11 Configuration 6 Parts List (Continued)

Compaq Part #	Description	Quantity
380594-001	Secure Path for WNT	1
380574-001	KGPSA-BC PCI Fibre Channel Host Bus Adapter	8
380560-B21 (Blue) 380560-B22 (Opal) 380670-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
234453-001/B31/291 295573-B22	Fibre Channel 7-Port Hub/Domestic/Intl/Japan Fibre Channel 12-Port Hub 41U/42U Bracket	Choose 4
380561-B21	Fibre Channel Optical GBIC	12
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	Fibre Channel 2 Meter Optical Cable Fibre Channel 5 Meter Optical Cable Fibre Channel 15 Meter Optical Cable Fibre Channel 30 Meter Optical Cable Fibre Channel 50 Meter Optical Cable	Choose 12
380691-B21 380595-B21 380694-B21 380588-B21 380589-B21 147599-001	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 18GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 10000 RPM Disk 36GB UW 7200 RPM Disk	Choose up to 84 (48 for ESA 48 slot)

Configuration 6 Optional Components**Table 12 Configuration 6 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
See Table 11.	Additional Disk Drives	Up to 48

Configuration 7 Parts List

The following table lists the parts for four Intel Servers with Microsoft Windows NT 4.0 Service Pack 3-6 (minimum Service Pack 3 for ACS V8.3), or Service Pack 4-6 (minimum Service Pack 4 for ACS V8.6).t

Table 13 Configuration 7 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	1
128697-B21	ACS V8.6 Controller Software	2
380594-001	Secure Path for WNT	1
380574-001	KGPSA-BC PCI Fibre Channel Host Bus Adapter	8
380560-B21 (Blue) 380560-B22 (Opal) 380670-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) 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 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 1
234453-001/B31/291 295573-B22	Fibre Channel 7-Port Hub/Domestic/Intl/Japan Fibre Channel 12-Port Hub 41U/42U Bracket	Choose 2
380561-B21	Fibre Channel Optical GBIC	10
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	Fibre Channel 2 Meter Optical Cable Fibre Channel 5 Meter Optical Cable Fibre Channel 15 Meter Optical Cable Fibre Channel 30 Meter Optical Cable Fibre Channel 50 Meter Optical Cable	Choose 10
380691-B21 380595-B21 380694-B21 380588-B21 380589-B21 147599-001	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 18GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 10000 RPM Disk 36GB UW 7200 RPM Disk	Choose up to 84 (48 for ESA 48 slot)

Configuration 7 Optional Components**Table 14 Configuration 7 Optional Components**

Compaq Part #	Description	Quantity
380570-B21 (Blue)	Pedestal Expansion 24 slots	Up to 2
380570-B22 (Opal)	Pedestal Expansion 24 slots	OR Choose 1
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	
See Table 13.	Additional Disk Drives	Up to 48

Configuration 8 Parts List

The following table lists the parts for eight Intel Servers with Microsoft Windows NT 4.0, Service Pack 3-6 (minimum Service Pack 3 for ACS V8.3), or Service Pack 4-6 (minimum Service Pack 4 for ACS V8.6).

Table 15 Configuration 8 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	2
128697-B21	ACS V8.6 Controller Software	4
380594-001	Secure Path for WNT	2
380574-001	KGPSA-BC PCI Fibre Channel Host Bus Adapter	8
380560-B21 (Blue)	RA/MA8000 Pedestal w/dual HSG80	Choose 2
380560-B22 (Opal)	RA/MA8000 Pedestal w/dual HSG80	
380670-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	OR
380620-001 (Blue)	ESA/EMA12000 w/2 pairs/dual HSG80 48 Slot 60HZ	Choose 1
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	

Table 15 Configuration 8 Parts List (Continued)

Compaq Part #	Description	Quantity
234453-001/B31/291 295573-B22	Fibre Channel 7-Port Hub/Domestic/Intl/Japan Fibre Channel 12-Port Hub 41U/42U Bracket	Choose 2
380561-B21	Fibre Channel Optical GBIC	12
234457-B21 234457-B22 234457-B23 234457-B24 234457-B25	Fibre Channel 2 Meter Optical Cable Fibre Channel 5 Meter Optical Cable Fibre Channel 15 Meter Optical Cable Fibre Channel 30 Meter Optical Cable Fibre Channel 50 Meter Optical Cable	Choose 12
380691-B21 380595-B21 380694-B21 380588-B21 380589-B21 147599-001	4GB UW 7200 RPM Disk 9GB UW 7200 RPM Disk 18GB UW 7200 RPM Disk 9GB UW 10000 RPM Disk 18GB UW 10000 RPM Disk 36GB UW 7200 RPM Disk	Choose up to 84 (48 for ESA 48 slot)

Configuration 8 Optional Components**Table 16 Configuration 8 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 4 OR Choose 1 OR Choose 2
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	
See Table 15.	Additional Disk Drives	Up to 96

HA Configuration 9 Parts List

The following table lists the parts for eight Intel Servers with Microsoft Windows NT 4.0, Service Pack 3 - 6 (minimum Service Pack 3 for ACS V8.3) or Service Pack 4 - 6 (minimum Service Pack 4 for ACS V8.6).

Table 17 HA Configuration 9 Parts List

Compaq Part #	Description	Quantity
380551-001	RA/MA8000 and ESA/EMA12000 Fibre Channel Solution Software V8.6 for Windows NT/Windows 2000/Intel	2

HA Configuration 9 Optional Components

Table 18 HA Configuration 9 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	
80640-001 (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	
See Table 17.	Additional Disk Drives	Up to 96

Product Details

The Enterprise/Modular Storage RAID Array systems use the Compaq HSG80 RAID controller running Array Controller Software (ACS) V8.3 or V8.6. The ACS software is designed to support multiple platforms providing features including: dual controller operation, two controller failover modes – Transparent and Multiple-Bus, mirrored write back cache, read ahead cache, RAID implementation, disk mirroring, and disk partitioning capabilities. In addition, ACS manages host interconnect and protocol services to provide data for event notification and status such as displayed by SWCC.

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

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

ESA/EMA8000 Fibre Channel controllers come with 128 MB of cache. Cache options allow for 128 MB, 256 MB and 512MB of cache in each controller. ESA/EMA12000 Fibre Channel controllers come with 256 MB of cache. Cache options allow for 512MB of cache in each controller. Cache features include read ahead and mirrored write back cache for use in optimizing performance where redundant capabilities are required for high availability system configurations. In the rare event that a storage controller fails the mirrored data is immediately available to the remaining controller for continuing operation.

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

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

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

The Command Console client is available on Windows 95 and on Intel/Alpha platforms running Windows NT/Windows 2000. A Storage Window for the HSG80 controller supports the Array Controller Software and offers integration with Compaq's Insight Manager(CIM). Insight Manager can receive SNMP traps from the Command Console Agent and Insight Manager services can directly launch SWCC for notification or configuring operations.