COMPAQ

Software Product Description

PRODUCT NAME: **HSG80 Array Controller Software Version 8.6-1S for Switched Fabrics with Snapshot** **SPD: 80.08.01**

Description
HSG80 Array Controller Software for Fibre Channel Switched Fabrics utilizing Snapshot provides storage controller software capability for the StorageWorks HSG80 Array Controller in fibre channel switched fabric environments. Snapshot provides the ability to create a virtual copy of the data in a storageset for backup or manipulation. ACS Snapshot capability can be used manually via Command Line Interface (CLI) or via an automated user interface, Enterprise Volume Manager (EVM). Refer to the EVM QuickSpec (DA-10432) for qualified operating systems and support information.

The HSG80 is configured into product offerings that include the RAID Array 8000, Enterprise Storage Array 12000, Modular Array 8000, and Enterprise Modular Array 12000 storage systems.

Operating system platforms supporting ACS V8.6-1S are:

Platform	Operating System Versions
Windows NT Windows 2000	V4.0 SP 6a SP 1
Compaq Tru64 UNIX	V4.0f/g, 5.1 & 5.1a
Compaq OpenVMS	V7.2-1H1 and 7.3
Sun Solaris	V2.6 & V7.0[1] (32/64bit)

[1] Sun Solaris V7.0 is also known as V2.7, V8.0

Platform dependencies, interconnect configurations, feature restrictions, and requirements for host software and hardware are shown in the individual host platform kit, HSG80 Solution Software kit, V8.6. These kits must be purchased separately, one per operating system.

Array Controller Software for HSG80
Description of ACS
The HSG80 Array Controller software is the software component of the HSG80 Array Controller. The HSG80 Array Controller is an intelligent mass storage controller that interfaces between host computer systems using

a Fibre Channel bus and attached mass storage devices, using Ultra Wide Single Ended SCSI buses. ACS software executes in the HSG80 Array Controller; it processes I/O requests from hosts, performing the device-level operations required to satisfy the requests.

ACS Software Functions
ACS software includes the following capabilities:

- Host interconnect and protocol services Microsoft Cluster Server (MSCS) Support
- Support for up to 84 devices per storage system
- Dual Redundant Controller Operation
- Testing and diagnosis of the HSG80 Array Controller
- SCSI device control
- Transparent Controller Failover Support
- Multiple Bus Failover Support
- Asynchronous Disk Swap (Hot Swap)
- ACS system management services
- Local program support
- Snapshot capability
- Mirrored Write-Back Cache support
- Read Ahead Cache support
- Disk Mirroring capability (RAID 1)
- Disk Striping capability (RAID 0, 0+1)
- RAID capability (RAID 3/5)
- StorageSet Expansion
- Selective Storage Presentation
- Disk Partitioning capability
- Support for 14 drives per SCSI bus
- Support for 96 host port connections

The following sections describe these capabilities:

Host Interconnect and Protocol Services
The HSG80 Array Controller attaches to up to 24 single servers or 12 clustered pairs, with 2 adapters each using an optical switch. In a switched configuration, up to 4 dual redundant RAID Arrays are supported (8 controllers). The HSG80 has two Fibre Channel host ports per controller and can be used in single controller or dual redundant configurations.

The number of servers and controllers supported is operating system dependent; check the operating system solution kit for configuration and support requirements when configuring the controllers.

Microsoft Cluster Server (MSCS)
MSCS enables the hosts to share the storage system through the fibre channel bus with Windows NT cluster software. Should a failure occur on one host, the storage I/O is re-routed to the functioning host.

Storage System Device Support
HSG80 controllers using ACS V8.6-1S provide support for up to 84 devices on a storage system.

Dual Redundant Controller Operation
HSG80 controllers using ACS can operate as a redundant pair of controllers when configured identically and running identical software versions, including patches, and connected in the same backplane. ACS provides facilities to detect controller failure and perform automatic controller failover.

Testing and Diagnosis of the HSG80 Array Controller
ACS software internal diagnostics execute automatically whenever controller power is turned on, whenever the array controller is reset and periodically during use.

LEDs on the front bezel of the controller provide diagnostic information upon controller failure.

A local serial connection asynchronous I/O port is provided for configuration and diagnosis.

SCSI Device Control
ACS converts host I/O requests into device-specific SCSI commands. ACS software supports concurrent commands and data transfers on multiple SCSI device buses for supported disks.

ACS device control functions include the following:

Error Detection and Recovery
ACS recovers from device errors, including bad block replacement for supported disk drives, which do not perform this function for themselves.

For errors on the Fibre Channel host interface, HSG80 Array Controller hardware and ACS cooperate to provide the following:

- Automatic retransmission of data, if errors are detected in the original transmission
- Automatic detection of internal data path errors
- Automatic failover of attached devices between HSG80 controllers operating as dual redundant controllers.

Device Integrity Testing
ACS executes Device Integrity Test programs upon system manager command. These tests perform the following functions:

- Verify correct operation of individual disk devices and units.
- Place the HSG80 Array Controller under load to verify correct storage system operation

Error Logging
ACS uses SCSI protocol messages to report faulty or failing devices and controller faults to connected hosts that have error logging enabled.

Save Configuration on Disk
ACS can save device configuration information, HSG80 controller configuration information and controller software patches on to a disk. The stored information can be restored for use by a HSG80 replacement controller. This functionality is used for HSG80-to-HSG80 controller replacements in non-redundant configurations and certain Array Controller product upgrades. For additional information refer to the HSG80 Array Controller ACS V8.6-1 Installation and Configuration Guide and HSG80 Array Controller ACS V8.6-1 CLI Reference Guide.

Transparent Controller Failover
The ACS supports the connection of two host fibre channel buses to a dual-redundant HSG80 controller pair. This configuration provides active ports on two separate paths.

The use of transparent controller failover is independent of the host operating system.

The controller pair provides 2 active and 2 standby ports. If the active port, on one controller, becomes non-operational the standby port, on the other controller, will be presented to the host without host intervention.

Multiple Bus Controller Failover
In multiple bus failover, the controller can present units to the host on all four ports. Software on the host is responsible for switching to another path if it can't access the units on the primary path. Failover support is described in Table 1.

Table 1 Failover Support

Operating System	Versions	Transparent Failover	Multiple Bus Failover[1]
Windows NT x86 Windows 2000	V4.0 SP 6a SP 1	Yes	Yes
Compaq Tru64 UNIX	V4.0f/g, 5.1, & 5.1a	Yes	Yes[2]
Compaq OpenVMS	V7.2-1H1, 7.3	No	Yes
Sun Solaris	V2.6, V7, V8	Yes	Yes

[1] Requires Multipath software support on host
[2] Compaq Tru64 UNIX 5.1 or later only

Asynchronous Disk Swap (Hot Swap)
ACS supports asynchronous disk swaps (also known as Disk Hot Swap). This is defined as disk removal and insertion without regard to a quiescent device bus. Disks can be removed or inserted at any time with some restrictions. Restrictions are noted in the user documentation.

ACS System Management Services
ACS software provides the following storage system management services:

Alteration of Storage System Parameters
- ACS includes a Command Language Interpreter (CLI) that allows a system manager to display and manipulate controller parameters and device configuration information as required.
- The CLI utility provides type ahead, recall and editing features. Any of the last four commands entered may be recalled and edited.

Environmental Monitor Unit (EMU)
- The ACS monitors data on the state of the HSG80 controller and storage system. This data can be reported via the CLI and is reported in the Environmental Monitor Unit (EMU) LEDs and in some cases, activate an audible alarm.

Local Program Support
ACS software supports the following local utilities and commands:

CLONE utility for obtaining physical copies of data in concert with Disk Mirroring software. The CLONE Utility cannot be used with partitioned units.

Code Load/Code Patch (CLCP) for controller software changes

CONFIG for automatically adding new devices to the configuration

DILX disk inline exerciser

FMU for displaying controller last failure and memory system failure information as well as control of spontaneous event logging and last failure logging displays

ACS Dynamic Status Display

- The ACS VTDPY utility allows a system manager to view the HSG80-based storage system state dynamically.
- Terminal port connections are supported at 9600, and 19200bps.

HSUTIL

- The HSUTIL utility provides two functions: device format and device code load. Device format enables the system manager to perform a basic format operation on a single or multiple disk device(s). Device code load provides the functionality to download device firmware onto supported drives via the controller.

Snapshot Capability

ACS with Snapshot capability provides a quick and efficient way to make a point-in-time copy of a storage container's data. Snapshot freezes a map of the container' data, which can be separated and used for back-up or testing and manipulation without impacting the original data. After the Snapshot, the original data can continue to be updated and utilized while the Snapshot copy remains unchanged.

When the need for the duplicate copy of data is ended a new snap of a different storage container can be made and the process repeated. Snapshot eliminates much of the overhead associated with mirroring and cloning as the snap is dissolved without having to re-merge the data. Refer to the solution documentation for configuration information and restrictions.

Mirrored Write-Back Cache Capability

The battery or UPS backed write-back cache capability provides the following functions:

Stores data to be written temporarily in the controller's non-volatile write-back cache and if the mirrored cache option is set, the write-back data is mirrored in the redundant controller cache for fault tolerance. The controller then informs the host that the write request is complete. This allows the host to continue working without waiting for data to be written to disk media

Writes the data stored in cache to the disk media based on a least-recently-used cache flushing policy or when a device port has been inactive for a defined period of time

Consolidates contiguously located data blocks from multiple host write requests into a single device request to reduce average latency

On recovery from a single cache failure or power outage, the controller detects that unwritten data still exists in cache and writes it to disk media before enabling normal controller operations

Read Ahead Cache Capability

If sequential read requests are received from the host, Read Ahead Cache allows the controller to anticipate subsequent read requests and prefetch the next data blocks. This provides read performance optimization.

Disk Mirroring Capability (RAID 1)
The disk mirroring capability provides the following functions:

- Real-time maintenance of up to six identical copies of data on mirrorsets of separate disks attached to a single array controller
- Protects data against disk failure by replicating all data on each member of the mirrorset. Disk mirroring offers extremely high data reliability
- Captures a designated spare (if one exists) in the event of a mirrorset member disk failure and reconstructs the data of the failed member disk onto it
- The ability to increase or decrease the number of members in a mirrorset as requirements change
- Flexible policy options for determining both how read requests are satisfied and the speed of copying when a new member is being added
- ACS disk mirroring can utilize the UNMIRROR command to change devices back to single-disk units

Disk Striping (RAID 0 & 0+1)
ACS treats sets of disk drives or mirrorsets as stripesets (2 to 24 members up to a storageset size of 1.024 TB) for improved I/O performance through load distribution. A stripeset appears to the operating system as a single virtual disk drive.

Striping of mirrorsets can be used for high-performance access to large amounts of highly available data.

RAID Capability (RAID 3/5)
The RAID capability provides the following functions:

- Manages up to 20 sets of between 3 and 14 disks as RAIDsets (up to a maximum RAIDset size of 1.024 TB). The host views a RAIDset as a single virtual disk. RAIDsets can tolerate the failure of a single member disk without loss of ability to deliver data to hosts.
- Dynamically adjusts between RAID Level 5 and RAID Level 3-like data protection algorithms depending on instantaneous workload.
- Maintains consistency of data and parity across all member disks in a RAIDset. This includes recovery from media errors.
- Detects failure of a single RAIDset member disk and invokes data regeneration algorithms to provide continued data availability to hosts.
- Captures a designated spare (if one exists) in the event of a member disk failure and reconstructs the data and parity of the failed member disk onto it. Settable chunksize to match RAIDset performance attributes to host I/O profile.

For information regarding default chunksize, refer to the HSG80 Array Controller ACS V8.6-1 Installation and Configuration Guide and the HSG80 Array Controller ACS V8.6-1CLI Reference Guide.

StorageSet Expansion
StorageSet Expansion allows for the joining of 2 of the same kind of storage containers. StorageSet Expansion can be utilized to easily expand a storage container by concatenating RAIDsets, Stripesets or individual disks thereby forming a larger virtual disk that is presented as a single unit.

The joining of RAIDsets provides the user with the same redundancy and reliability as the individual sets without having to back-up and restore the data. StorageSet Expansion of RAID 3/5 sets provides the same functional capabilities as the original RAID 3/5 sets. In addition to the easy creation of a larger RAIDset, expanded RAIDsets can tolerate the failure of two member disks (a single member out of each original RAIDset) without loss of ability to deliver data to hosts. See the operating system configuration manual for any restrictions.

Selective Storage Presentation
Selective Storage presentation is a feature of the HSG80 controller that enables the user to control the allocation of storage space and shared access to storage across multiple hosts. This is also known as "Restricting Host Access". In a subsystem that is attached to more than one host or if the hosts have more than one adapter, it is possible to reserve certain units for the exclusive use of certain host connections.

Disk Partitioning
ACS allows partitioning of disk drives or storage sets for improved device management. A partition appears to the operating system as a single virtual disk. Up to 8 partitions may be created per storage set or disk drive. Disk partitioning is supported in both transparent and multiple bus failover. See the operating system configuration manual for any restrictions.

SCSI Bus Drive Support
ACS supports 14 devices per SCSI bus. In a maximum 6-bus configuration, the total drives supported is 84.

Host Connection Support
ACS supports 96 host connections to a single array controller allowing the user to build and manage larger SANs by attaching to up to 24 single servers or 12 clustered pairs.

ACS HARDWARE REQUIREMENTS

ACS requires an HSG80 Array Controller on which to execute. The HSG80 Array Controller includes six ultra wide single-ended device ports. Up to 84 devices can be supported and up to 512MB of cache per controller (1.024TB per pair). Ultra SCSI wide single-ended disks may be attached to the HSG80 Array Controller. The specific devices supported are listed in *Supported Operating Systems, Adapters, and Devices* section.

Configuration Restrictions

The following configuration restrictions apply:

HSG80 controllers require a minimum ACS revision level of V8.6-1S for features in this document.

Two controllers in the same controller backplane must be configured as a dual-redundant configuration.

A maximum of 84 devices may be configured on a pair of HSG80 with an expansion cabinet.

Supports switch fabric configurations. See the Solution Kit documentation for qualified switches and configuration support. Requires a cache module configured with 512MB of cache memory

When using Snapshot the destination container cannot be a partitioned device.

The number of outstanding Snapshots is limited to four.

Supported Operating Systems, Adapters, and Devices

A valid operating system configuration with a supported Fibre Channel interface, as referenced in the following section, is required to operate an HSG80 controller with ACS software.

Snapshot can be utilized manually on any Switched Fabric configuration. See the solution documentation for configuration information and restrictions. For support information on automated usage of Snapshot by way of Enterprise Volume Manager (EVM), refer to the EVM SPD, 80.07.01

Table 2 lists the Microsoft Windows 2000 and Windows NT, ProLiant and other x86 system Hardware, Software, and host platform kit information.

Table 3 lists Compaq Tru64 UNIX Hardware, Software, and host platform kit information.

Table 4 lists Compaq OpenVMS Hardware, Software, and host platform kit information.

Table 5 lists Sun Solaris Hardware, Software, and host platform kit information.

Tables 6 and 7list the supported Ultra SCSI Wide disk drives.

Table 2 Windows 2000 and Windows NT on ProLiant and other x86 Systems

Compaq Adapter	Operating System	Adapter Description	Operating System Platform Kit
380574-001	Windows 2000 SP1 or Windows NT 4.0 SP 6a	(KGPSA-BC) PCI to Fibre Host Bus Adapter	222322-B21
176479-B21	Windows 2000 SP1 or Windows NT 4.0 SP6a	(KGPSA-CB) PCI to Fibre Host Bus Adapter	222322-B21

Table 3 Compaq Tru64 UNIX

Compaq Adapter	Operating System	Adapter Description	Operating System Platform Kit
168794-B21	4.0f /g, 5.1 & 5.1a	64-bit PCI to Fibre Channel Host Bus Adapter for Tru64 and OVMS	222320-B21
380574-001	4.0f /g, 5.1 & 5.1a	(KGPSA-CA) PCI to Fibre Host Bus Adapter	222320-B21

Table 4 Compaq OpenVMS

Compaq Adapter	Operating System	Adapter Description	Operating System Platform Kit
168794-B21	V7.2-1H1 & 7.3	64-bit PCI to Fibre Channel Host Bus Adapter for Tru64 and OVMS	222321-B21
380574-001	V7.2-1H1 & 7.3	(KGPSA-CA) PCI to Fibre Host Bus Adapter	222321-B21

Table 5 Sun Solaris

Compaq Adapter	Operating System	Adapter Description	Operating System Platform Kit
380576-001	V2.6 (32 bit), V7 & 8	PCI 32-bit to Fibre Host Bus Adapter	222324-B21
123503-001	V7 & V8 (64bit)	SBUS 64-bit to Fibre Host Bus Adapter	222324-B21

Table 6 Supported Ultra SCSI Wide Disks

Part Number	Device/Model	Capacity GB	Microcode[1]	H/W Rev[2]
176494-B21	BC072638A2	72.8	BDC4	A01
176496-B22	BD03663622 BD0366349C BD036635C5	36.4	BDC4 3B02/3B06 B020	A01 A01 A05
127968-001	DS-RZ1FC-VW	36.4	3B02/2B07/B020/BDC4	A01
147599-001	DS-RZ1FB-VW	36.4	N1H1/0372/1614/3B05	A01
188122-B22	BF01863644	18.2	3B01	A01
188120-B22	BF00963643	9.1	3B01	A01
147598-001	DS-RZ1EA-VW	18.2	3B05	A01
380589-B21	DS-RZ1ED-VW	18.2	0306/1614/3B07/B020/BDC4	A01
380694-B21	DS-RZ1EF-VW	18.2	N1H1/0372	A01
388144-B22	N/A	18.2	3B05	A01
128418-B22	N/A	18.2	B016	A01
142673-B22	BD01862376 BD01862A67	18.2	BCJE B007	A01 A01
147597-001	DS-RZ1DA-VW	9.1	3B05/B020	A01
380588-B21	DS-RZ1DD-VW	9.1	0306/1614/3B07/B020/BDC4	A01
380595-B21	DS-RZ1DF-VW	9.1	N1H1/0372/1614	A01
123065-B22	N/A	9.1	3B05	A01
328939-B22	N/A	9.1	3B07	A01
142671-B22	BD00962373 BD00962A66	9.1	BCJE B007	A01 A01

[1]Minimum Microcode Version
[2]Minimum Hardware Revision Level

Table 7 Other Supported Ultra SCSI Wide Disks

Part Number	Device	Capacity GB	Microcode[1]	H/W Rev[2]
—	DS-RZ1CB- VW	4.3	LYJ0/0656	A01
—	DS-RZ1CD-VW	4.3	0306	A01
380691-B21	DS-RZ1CF-VW	4.3	N1H1/1614	A01
—	DS-RZ1DB-VW	9.1	LYJ0/0307	A01

[1]Minimum Microcode Version
[2]Minimum Hardware Revision Level

Devices qualified for Compaq support are identified in Disk Tables 6 and 7. Compaq will not assure correct operation of any unqualified device nor assure that such devices when used will not have impact on other supported devices, on the operation of the controller, or on the operation of the system configuration.

ORDERING INFORMATION

The HSG80 Array Controller Software kit is available for the HSG80 Controller when utilized in a fibre channel switched configuration (see operating system solution kit for support information). The kit provides the software media containing ACS V8.6-1S.

A separate kit is required for each HSG80 Array Controller.

A co-requisite software kit is an operating system platform kit, HSG80 Solution Software kit, containing SWCC, and the appropriate installation scripts and drivers for each operating system. One kit is required per operating system supported. Refer to Table 8 for the part number of the switched fabric and table 9 for the solution software kit part numbers.

Table 8 HSG80 Array Controller Software Kit for Switched Fabric Part Number

Part Number	Description
222364-B21	HSG80 ACS Switched Fabric with Snapshot, V8.6-1S Media and License package

Table 9 HSG80 Solution Software Platform Kit Part Numbers

Part Number	Description
222322-B21	HSG80 Solution Software for Windows NT/Windows 2000 Proliant and other x86 systems, Media, and License package
222320-B21	HSG80 Solution Software for Tru64 UNIX, Media, and License package
222321-B21	HSG80 Solution Software for OpenVMS, Media, and License package
222324-B21	HSG80 Solution Software for Sun Solaris, Media, and License package

SOFTWARE PRODUCT SERVICES
A variety of service options are available from Compaq. For more information, contact your local Compaq office.

Software service for HSG80 Solution Software is covered under the terms and conditions of the Integrated Hardware and Software Customer Service contracts.

Multivendor Customer Services for the HSG80 controller and HSG80 Solutions Software are covered under the terms and conditions of the following:

Hardware Customer Service contract

Software Customer Service contract

Software Subscription Service contract

SOFTWARE WARRANTY
HSG80 Array Controller Software is provided with 90-day Telephone Support and 90 days conformance to the SPD.

NOTICE