

Single Path Implementation on the Enterprise Virtual Array Storage System

Technical white paper



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Multi-path failover mode ensures the proper level of fault tolerance for the enterprise with mission-critical application environments.

Abstract

This document provides guidance for connecting servers with a single path host bus adapter (HBA) to the Enterprise Virtual Array (EVA) storage controller with no multi-path software installed. A single path HBA is defined as an HBA that has a single path to its LUNs. These LUNs are not shared by any other HBA in the server or in the SAN.

The information in this document is applicable to both the eva3000 and eva5000 storage product family. The failure scenarios demonstrate behavior when recommended configurations are employed, as well as expected failover behavior if guidelines are not met. To implement single-adapter servers into a multi-path EVA environment, configurations should follow the recommendations set forth.

HP OpenVMS and Tru64 UNIX® have built-in multi-path features that are not removable. In addition, cluster configurations of both OpenVMS and Tru64 UNIX provide enhanced availability and security.

Note: HP continually makes additions to its storage solution product line. For more information about the HP Fibre Channel product line, the latest drivers, and technical tips and to view other documentation, refer to the HP website at <http://www.hp.com/country/us/eng/prodserv/storage.html>.

High-level solution overview

EVA was designed for highly dynamic enterprise environments requiring high data availability, fault tolerance, and high performance; thus, the EVA controller runs only in

multi-path failover mode. Multi-path failover mode ensures the proper level of fault tolerance for the enterprise with mission-critical application environments. However, this white paper addresses the need for non-mission-critical applications to gain access to the EVA system running mission-critical production applications.

The non-mission-critical applications gain access to the EVA from a single path HBA server without running a multi-path driver. When a single path HBA server uses the supported configurations, a fault in the single path HBA server does not result in a fault in the other servers.

Benefits at a glance

The EVA is a high-performance array controller utilizing the benefits of virtualization. Virtualization within the storage system is ideal for environments needing high performance, high data availability, fault tolerance, efficient storage management, data replication, and cluster support. However, enterprise-level data centers incorporate non-mission-critical applications as well as applications that require high availability.

Single-path capability adds flexibility to budget allocation. There is a per-path savings as the additional cost of HBAs and multi-path software is removed from non-mission-critical application requirements. These servers can still gain access to the EVA by using single path HBAs without multi-path software. This reduces the costs at the server and infrastructure level.

Installation requirements

- The host must be placed in a zone with any EVA worldwide IDs (WWIDs) that access storage devices presented by the hierarchical storage virtualization (HSV) controllers to the single path HBA host. The preferred method is to use HBA and HSV WWIDs in the zone configurations.
- On HP-UX, Solaris, Microsoft® Windows® Server 2003 (32-bit), Windows 2000, Windows NT®, Novell NetWare, Linux® and IBM AIX operating systems, the zones consist of the single path HBA systems and one HSV controller port.
- On OpenVMS and Tru64 UNIX operating systems, the zones consist of the single path HBA systems and two HSV controller ports.

Note: Windows 2000 Datacenter operating system is not currently supported.

Recommended mitigations

EVA is designed for the mission-critical enterprise environment. When used with multi-path software, high data availability and fault tolerance are achieved. In single path HBA server configurations, neither multi-path software nor redundant I/O paths are present. Server-based operating systems are not designed to inherently recover from unexpected failure events in the I/O path (for example, loss of connectivity between the server and the data storage). It is expected that most operating systems will experience undesirable behavior when configured in non-high-availability configurations.

Because of the risks of using servers with a single path HBA, HP recommends the following actions:

- Use servers with a single path HBA that are not mission-critical or highly available.
- Perform frequent backups of the single path server and its storage.

Supported configurations

All examples detail a small homogeneous Storage Area Network (SAN) for ease of explanation. Mixing of dual and single path HBA systems in a heterogeneous SAN is supported. In addition to this document, reference and adhere to the *SAN Design Reference Guide* for heterogeneous SANs, located at:

<http://h18006.www1.hp.com/products/storageworks/san/documentation.html>

General configuration components

All configurations require the following components:

- Enterprise VCS software
- HBAs
- Fibre Channel switches

Additionally, if dual HBA systems are used, HP StorageWorks Secure Path software may be required.

For more information about the product part number and software versions supported for each operating system, refer to the HP Web site at:

- <http://www.hp.com/go/eva5000> or <http://www.hp.com/go/eva3000> and select Technical Documentation for Release Notes.
- <http://www.hp.com/go/eva5000> or <http://www.hp.com/go/eva3000> and select Specifications & Warranty for Quick Spec documentation.

Connecting a single path HBA server to a switch in a fabric zone

Each host must attach to one switch (fabric) using standard Fibre Channel cables. Each host has its single path HBA connected through switches on a SAN to one port of an EVA.

Because a single path HBA server has no software to manage the connection and ensure that only one controller port is visible to the HBA, the fabric containing the single path HBA server, SAN switch, and EVA controller must be zoned. Configuring the single path by switch zoning and the LUNs by Selective Storage Presentation (SSP) allows for multiple single path HBAs to reside in the same server. A single path HBA server with OpenVMS or Tru64 UNIX operating system can be zoned with two EVA controllers. Refer to the *SAN Design Reference Guide* at the following HP Web site for additional information about zoning:

<http://h18006.www1.hp.com/products/storageworks/san/documentation.html>

To connect a single path HBA server to a SAN switch:

1. Plug one end of the Fibre Channel cable into the HBA on the server.
2. Plug the other end of the cable into the switch.

On the following pages, Figure 1 and Figure 2 represent configurations containing both single path HBA server and dual HBA server, as well as a SAN appliance, connected to redundant SAN switches and EVA controllers. Whereas the dual HBA server has multi-path software that manages the two HBAs and their connections to the switch, the single path HBA has no software to perform this function. The dashed line in the figure represents the fabric zone that must be established for the single path HBA server. Note that in Figure 2, servers with OpenVMS or Tru64 UNIX operating system can be zoned with two controllers.

Fig 1. Single path HBA server *without* OpenVMS or Tru64 UNIX operating systems connected to a SAN switch in a fabric zone

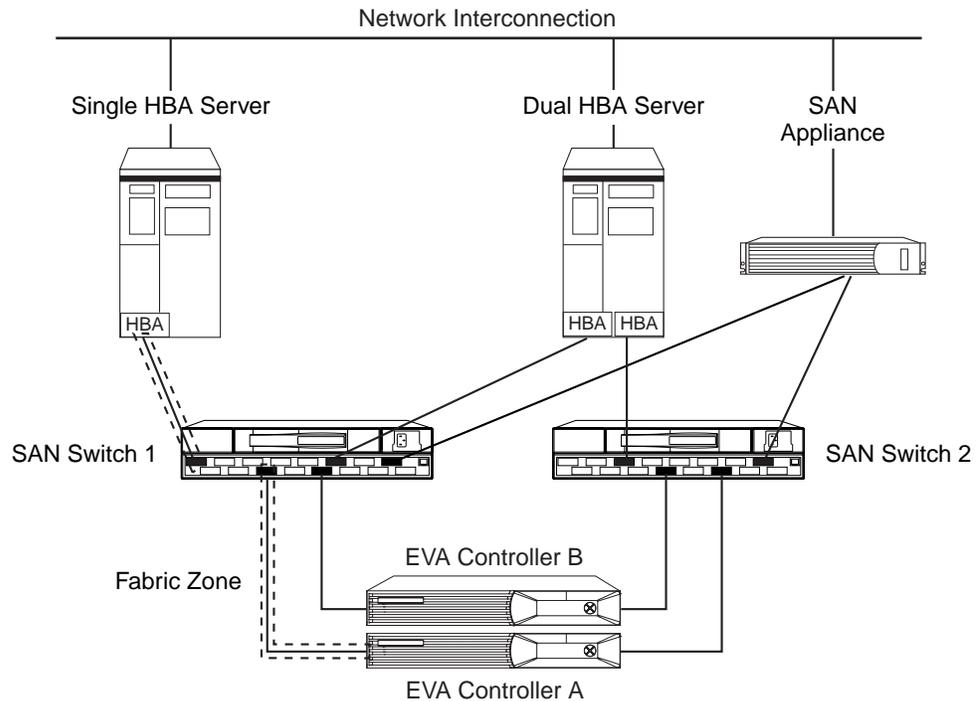
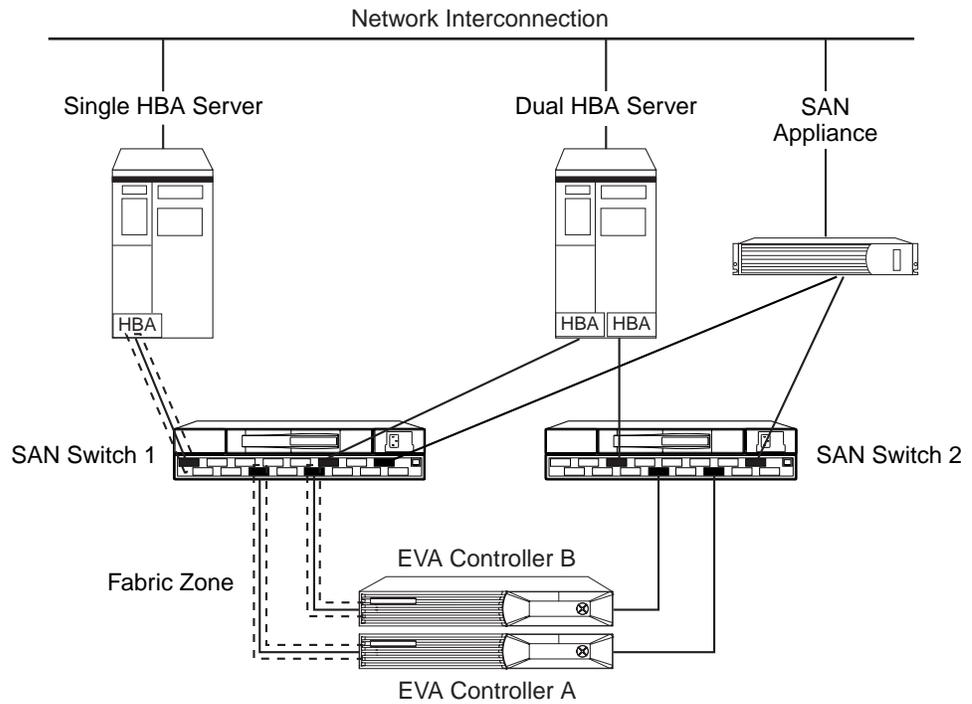


Fig 2. Single path HBA server *with* OpenVMS or Tru64 UNIX operating systems connected to a SAN switch in a fabric zone



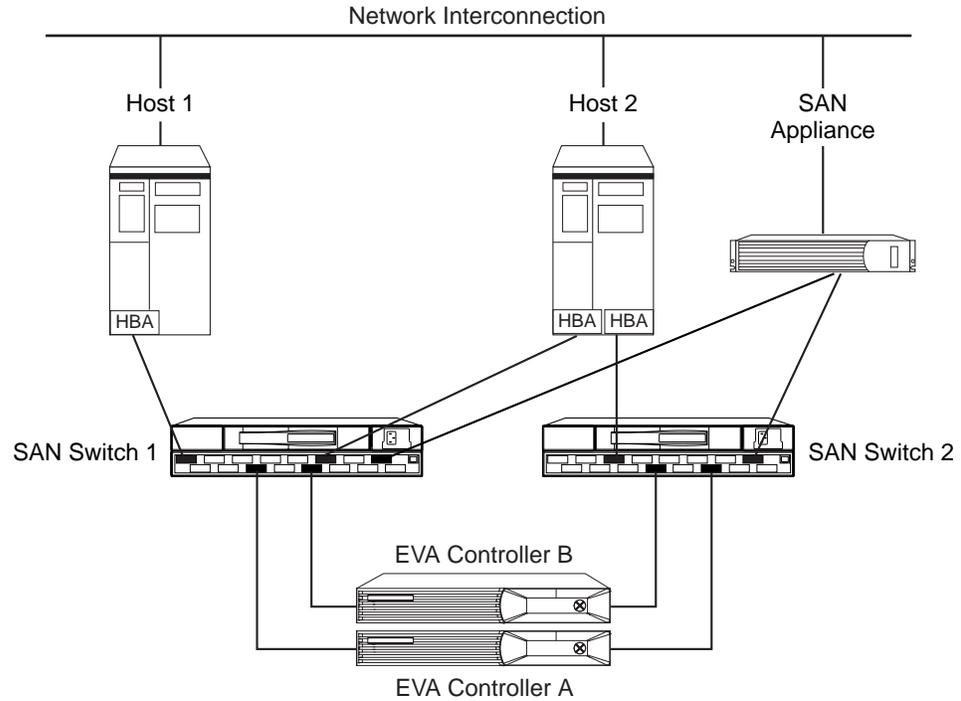
HP-UX configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.

- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

Fig 3. HP-UX configuration



HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with Secure Path.

Risks

- Disabled jobs hang and cannot unmount disks.
- Path or controller failure may result in loss of data accessibility and loss of host data that has not been written to storage.

Note: For additional risks, refer to the HP-UX table in the "Failure Scenarios" section.

Limitations

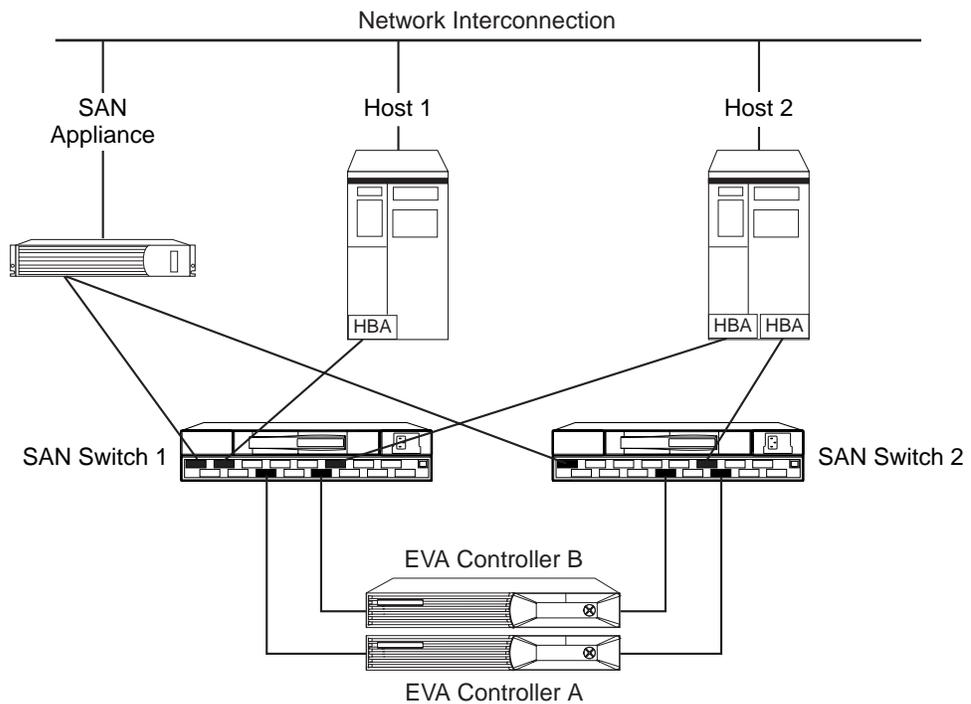
- Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

Windows Server 2003 (32-bit), Windows 2000, and Windows NT configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

Fig 4. Windows Server 2003 (32-bit), Windows 2000, and Windows NT configuration



HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with Secure Path.

Risks

- Single path failure will result in loss of connection with the storage system.
- Single path failure may cause the server to reboot.
- Controller shutdown puts controller in a failed state that results in loss of data accessibility and loss of host data that has not been written to storage.

Note: For additional risks, refer to the Windows Server 2003, Windows 2000, and Windows NT 4.0 table in the "Failure Scenarios" section.

Limitations

- Continuous Access is not supported with single path configurations.

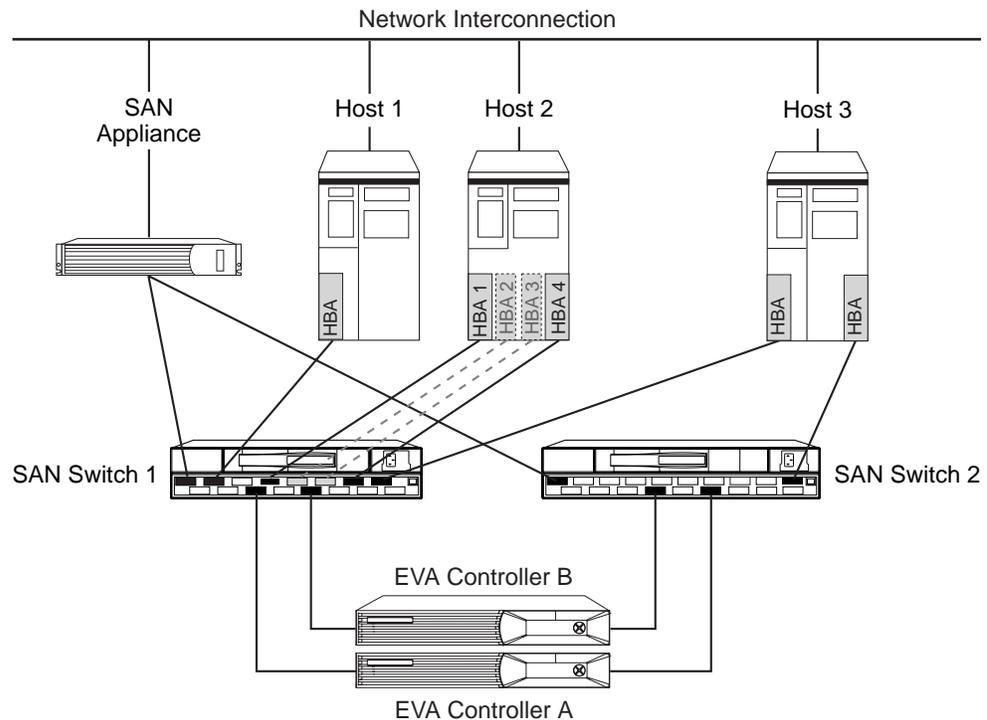
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported on single path HBA servers.

Windows Server 2003 (64-bit), configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.

Fig 5. Windows Server 2003 (64-bit) configuration



HBA configuration

- Hosts 1 and 2 are single path HBA hosts.
- Host 3 is a multiple HBA host with Secure Path.

Note: Single path HBA servers running the Windows Server 2003 (64-bit) operating system will support multiple single path HBAs in the same server. This is accomplished through a combination of switch zoning and controller level SSP. Any single path HBA server will support up to four single path HBAs.

Risks

- Single path failure will result in loss of connection with the storage system.
- Single path failure may cause the server to reboot.
- Controller shutdown puts controller in a failed state that results in loss of data accessibility and loss of host data that has not been written to storage.

Note: For additional risks, refer to the Windows Server 2003, Windows 2000, and Windows NT 4.0 table in the "Failure Scenarios" section.

Limitations

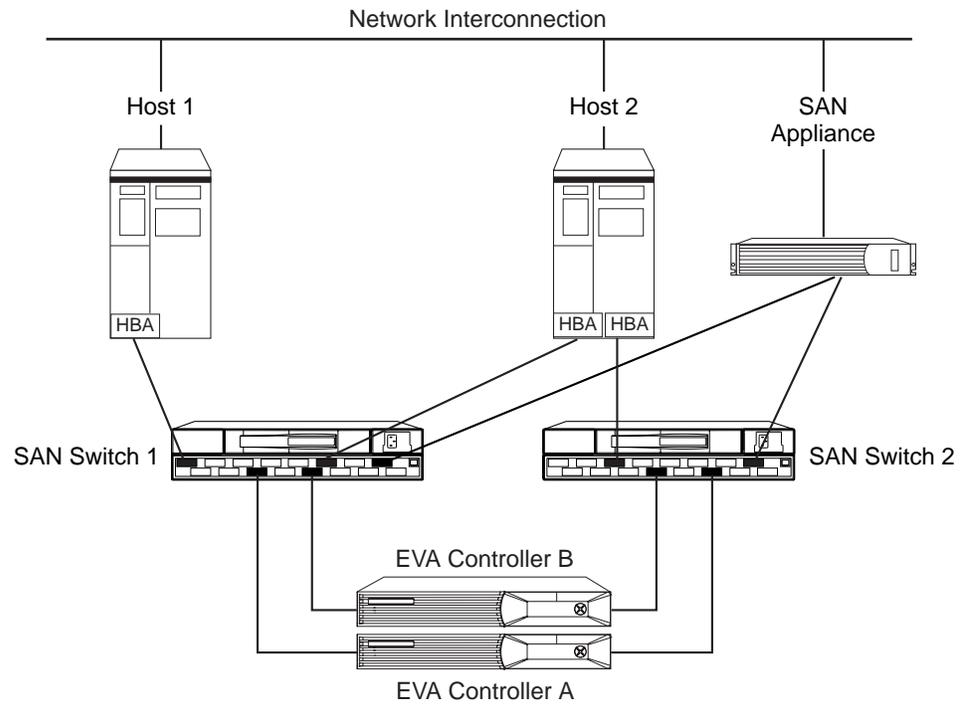
- Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported on single path HBA servers.

Sun configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.
- HBA must be properly configured to work in a single HBA server configuration. The user is required to:
 1. Download and extract the contents of the TAR file:
<ftp://ftp.compaq.com/pub/products/storageworks/techdoc/san/AA-RMPNH-TE.pdf>

Fig 6. Sun configuration



HBA configuration

- Host 1 is single path HBA host.
- Host 2 is a multiple HBA host with Secure Path.

Risks

- Single path failure may result in loss of data accessibility and loss of host data that has not been written to storage.
- Controller shutdown results in loss of data accessibility and loss of host data that has not been written to storage.

Note: For additional risks, refer to the Sun Solaris table in the "Failure Scenarios" section.

Limitations

- Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

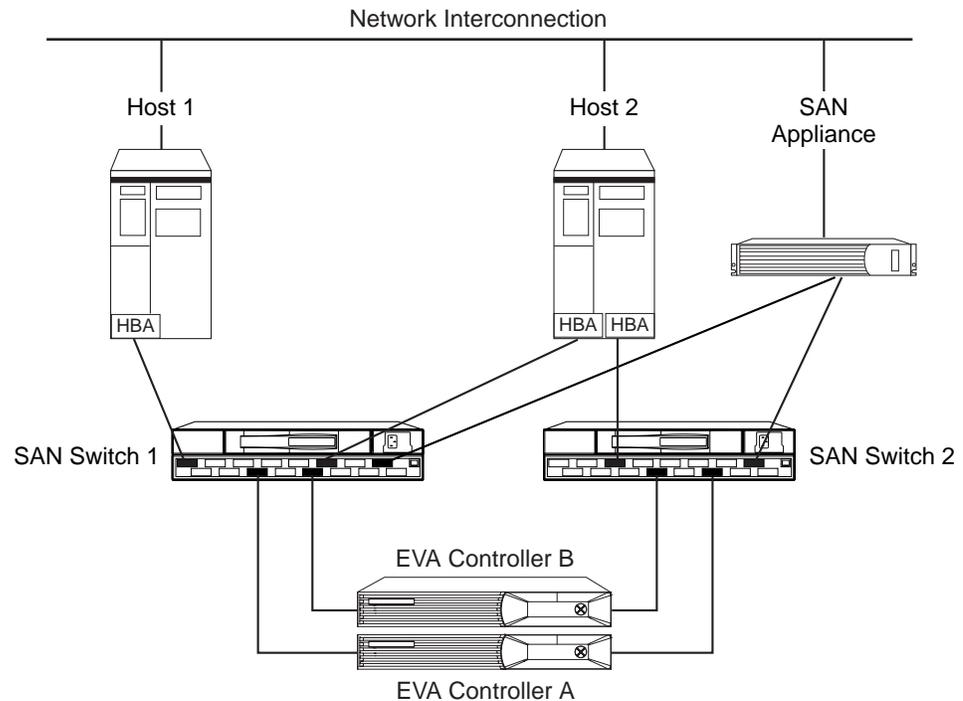
Tru64 UNIX configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.

- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

Fig 7. Tru64 UNIX configuration



HBA configuration

- Host 1 is single path HBA host with Tru64.
- Host 2 is a dual HBA host.

Risks

- For nonclustered nodes with a single path HBA, a path failure from the HBA to the SAN switch will result in a loss of connection with storage devices.
- If a host crashes or experiences a power failure, or if the path is interrupted, data will be lost. Upon re-establishment of the path, a retransmit can be

performed to recover whatever data may have been lost during the outage. The option to retransmit data after interruption is application-dependent.

Limitations

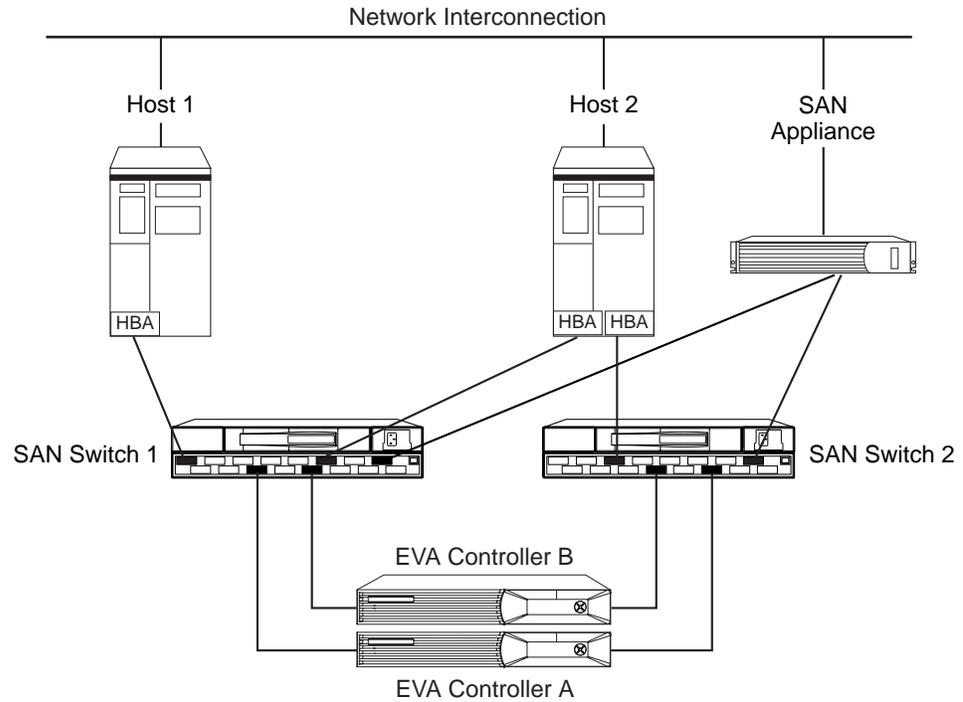
- Continuous Access is not supported with single path configurations.

OpenVMS configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

Fig 8. OpenVMS configuration



HBA configuration

- Host 1 is single path HBA host.
- Host 2 is a dual HBA host.

Risks

- For nonclustered nodes with a single path HBA, a path failure from the HBA to the SAN switch will result in a loss of connection with storage devices.

Limitations

- Continuous Access is not supported with single path configurations.

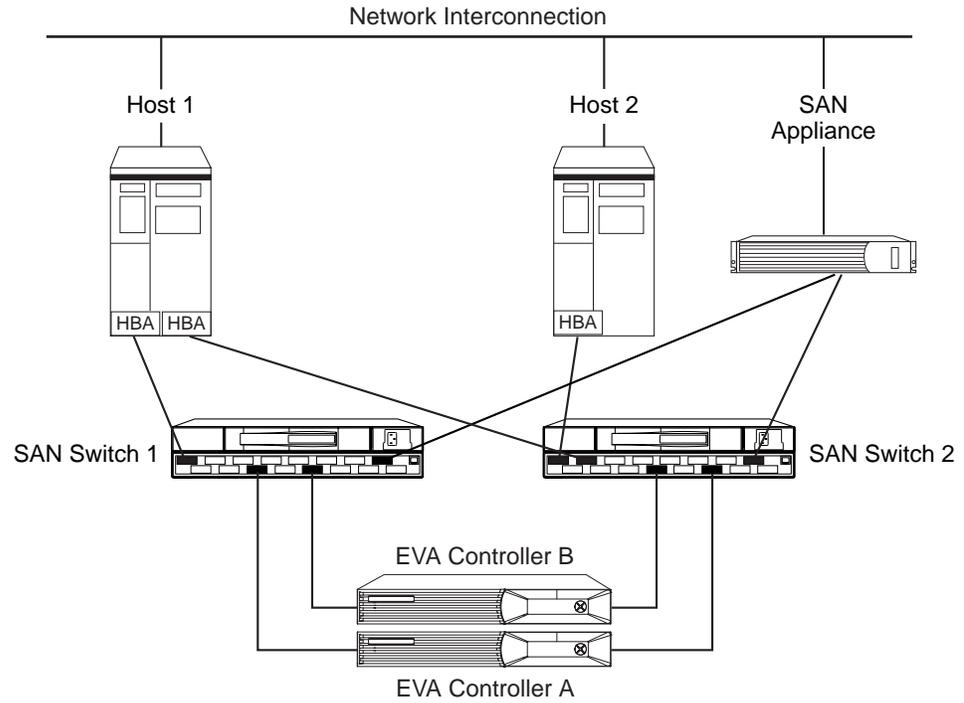
NetWare configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server cannot share LUNs with any other HBAs.

- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

Fig 9. NetWare configuration



HBA configuration

- Host 1 is a dual HBA host with an operating system other than NetWare.
- Host 2 is a single path HBA host with NetWare.

Risks

- Single path failure will result in a loss of connection with storage devices.

Note: For additional risks, refer to the NetWare table in the "Failure Scenarios" section.

Limitations

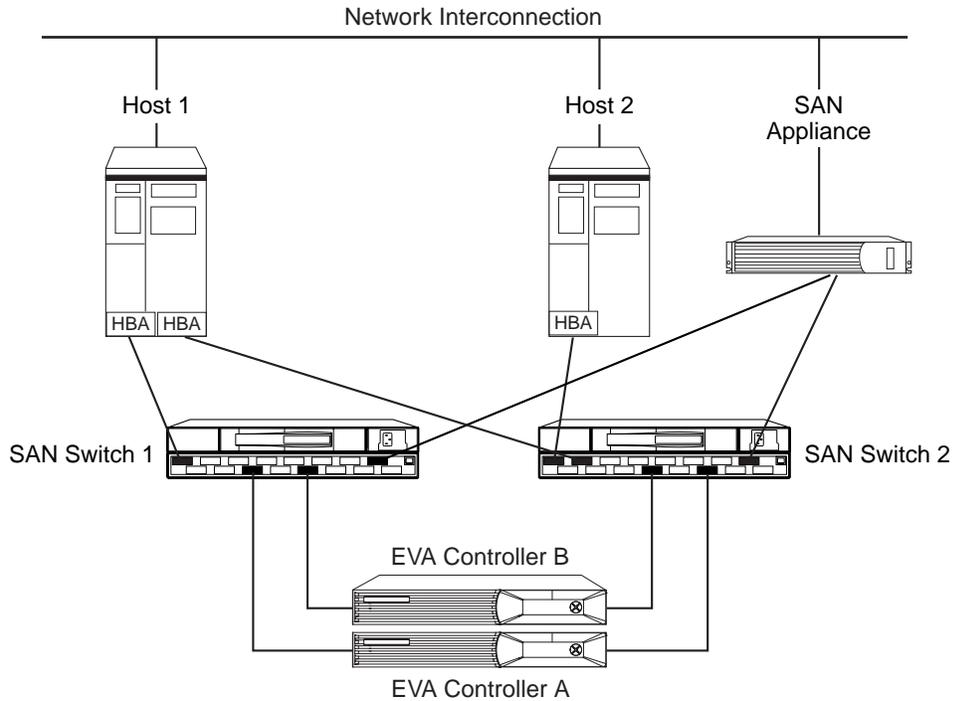
- Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported on single path HBA servers.

Linux (32-bit) configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

Fig 10. Linux (32-bit) configuration



HBA configuration

- Host 1 is a dual HBA host with Secure Path.
- Host 2 is a single path HBA host.

Risks

- Single path failure may result in data loss or disk corruption.

Note: For additional risks, refer to the Linux table in the "Failure Scenarios" section.

Limitations

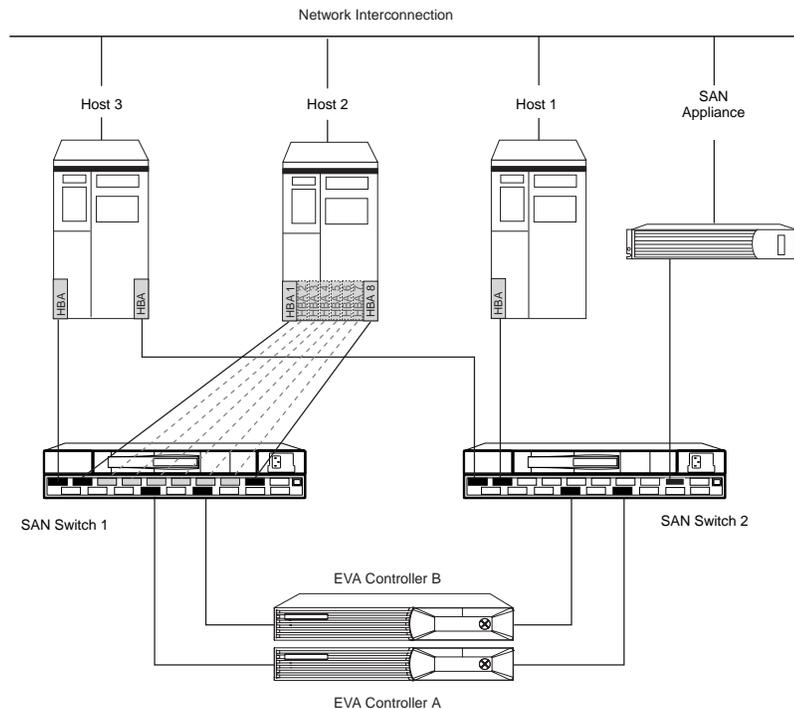
- Continuous Access is not supported with single path configurations.
- Booting from the SAN is not supported on single path HBA servers.
- Single path HBA server is not part of a cluster.

Linux (64-bit) configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.
- Linux 64-bit servers can support up to eight single path HBAs per server. Switch zoning and SSP are required to isolate the LUNs presented to each HBA from each other.

Fig 11. Linux (64-bit) configuration



HBA configuration

- Host 1 and 2 are single path HBA hosts.
- Host 3 is a dual HBA host with Secure Path.

Risks

- Single path failure may result in data loss or disk corruption.

Note: For additional risks, refer to the Linux table in the "Failure Scenarios" section.

Limitations

- Continuous Access is not supported with single path configurations.
- Booting from the SAN is not supported on single path HBA servers.
- Single path HBA server is not part of a cluster.

IBM AIX Configuration

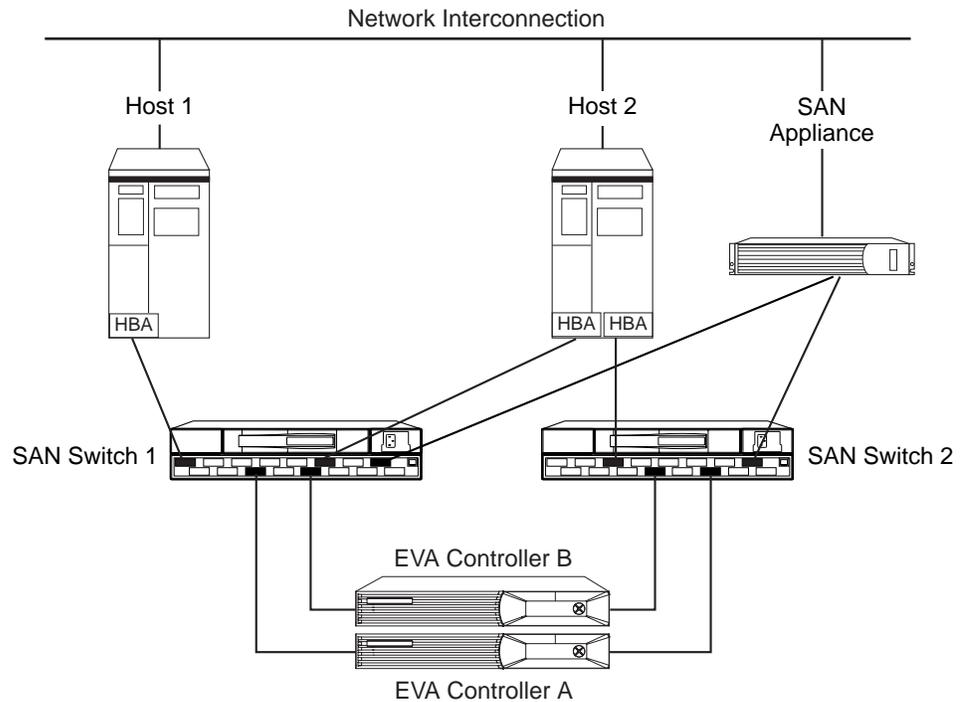
Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source

virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

- HBA must be properly configured to work in a single HBA server configuration. The single path adapter driver from the AIZ V2.0B EVA Kit should be installed: PC1000.image.

Fig 12. AIX Configuration



HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with Secure Path.

Risks

- Single path failure may result in loss of data accessibility and loss of host data that has not been written to storage.
- Controller shutdown results in loss of data accessibility and loss of host data that has not been written to storage.

Note: For additional risks, refer to IBM IAX table in the "Failure Scenarios" section.

Limitations

- Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

Failure scenarios

HP-UX

Table 1. HP-UX failure scenarios.

Fault stimulus	Failure effect
Server failure (host powered-cycled)	Extremely critical event on UNIX. Can cause loss of system disk.
Switch failure (SAN switch disabled)	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Controller failure	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Controller restart	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Server path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Storage path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, replace cable, I/O continues. Without cable replacement job must be aborted; disk seems error free.

Windows Server 2003, Windows 2000, and Windows NT 4.0

Table 2. Windows Server 2003, Windows 2000, and Windows NT 4.0 failure scenarios.

Fault stimulus	Failure effect
Server failure (host powered-cycled)	OS runs a command called chkdsk when rebooting. Data lost, data that finished copying survived.
Switch failure (SAN switch disabled)	Write delay, server hangs until I/O is cancelled or cold reboot.
Controller failure	Write delay, server hangs or reboots. One controller failed, other controller and shelves critical, shelves offline. Volume not accessible. Server cold reboot, data lost. Check disk when rebooting.
Controller restart	Controller momentarily in failed state, server keeps copying. All data copied, no interruption. Event error warning error detected during paging operation. Event error warning error detected during paging operation.
Server path failure	Write delay, volume inaccessible. Host hangs and restarts.
Storage path failure	Write delay, volume disappears, server still running. When cables plugged back in, controller recovers, server finds volume, data loss.

Table 3. Sun Solaris failure scenarios.

Fault stimulus	Failure effect
Server failure (host powered-cycled)	Check disk when rebooting. Data loss, data that finished copying survived.
Switch failure (SAN switch disabled)	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.
Controller failure	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.
Controller restart	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.
Server path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.
Storage path failure	Short term: Job hung, data lost. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.

Table 4. OpenVMS and Tru64 UNIX failure scenarios.

Fault stimulus	Failure effect
Server failure (host powered-cycled)	<p>Nonclustered-Processes fail.</p> <p>Clustered-Other nodes running processes that used devices served from the single-path HBA failed over access to a different served path. When the single-path node crashes, only the processes executing on that node fail.</p> <p>In either case, no data is lost or corrupted.</p>
Switch failure (SAN switch disabled)	<p>I/O is suspended or process is terminated across this HBA until switch is back online. No data is lost or corrupted.</p> <p>OpenVMS-OS will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout. No data is lost or corrupted.</p> <p>Tru64 UNIX-How long the application will wait for reconnect is application-dependent.</p>
Controller failure	<p>I/O fails over to the surviving controller. No data is lost or corrupted.</p>
Controller restart	<p>I/O is suspended or process is terminated across this HBA until EVA is back online. No data is lost or corrupted.</p> <p>OpenVMS-OS will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout.</p>

Server path failure

If the LUN is not shared, I/O is suspended or process is terminated across this HBA until path is restored.

If running OpenVMS 7.3-1 or Tru64 UNIX 5.1A and the LUN is shared, another cluster node having direct access will take over serving the device, resulting in no loss of service.

In either case, no data is lost or corrupted.

OpenVMS-OS will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout.

Tru64 UNIX-How long the application will wait for reconnect is application-dependent.

Storage path failure

I/O is suspended or process is terminated across this HBA until path is restored. No data is lost or corrupted.

OpenVMS-OS will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout.

Tru64 UNIX - How long the application will wait for reconnect is application-dependent.

Table 5. NetWare failure scenarios.

Fault stimulus	Failure effect
Server failure (host powered-cycled)	OS reboots. When mounting volumes, volume repair or NSS rebuild executes to cleanup volumes. Data loss, data that finished writing survived.
Switch failure (SAN switch disabled)	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Controller failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Controller restart	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Server path failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Storage path failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.

Table 6. Linux failure scenarios.

Fault stimulus	Failure effect
Server failure (host powered-cycled)	OS reboots, automatically checks disks. HSV disks must be manually checked unless auto mounted by the system.
Switch failure (SAN switch disabled)	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.
Controller failure	Short term: I/O suspended, possible data loss. Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting.
Controller restart	Short term: I/O suspended, possible data loss. Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting.
Server path failure	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.
Storage path failure	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.

Table 6. IBM AIX

Fault stimulus	Failure effect
Server failure (host powered-cycled)	Check disk when rebooting. Data loss, data that finished copying survived
Switch failure (SAN switch disabled)	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.
Controller failure	Short term: Data transfer stops. Possible I/O errors Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.
Controller restart	Short term: Data transfers stops. Possible I/O errors. Long term: Repeated error messages in errpt log. System reboot causes loss of data on disk. Must crfs disk.
Server path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages in errpt log. System reboot causes loss of data on disk. Must crfs disk.
Storage path failure	Short term: Job hung, data lost. Long term: Repeated error messages in errpt log. System reboot causes loss of data on disk. Must crfs disk.

Web site

For more information about the complete line of Fibre Channel storage products, product certification, technical information, updates, and documentation, refer to the HP Web site at <http://www.hp.com/country/us/eng/prodserv/storage.html>.

Documents

For additional product information see the OpenVMS software product description (SPD) at <http://h71000.www7.hp.com/> or the Tru64 Unix SPD at <http://h30097.www3.hp.com/>

Glossary

- **Selective Storage Presentation (SSP)**—The process whereby a controller presents a virtual disk only to a select subset of host computer(s) connected to a SAN.
- **Single Path**—A single connection from the host node to a Fibre Channel switch.
- **Shared LUN**—Allowing LUN access across the switch to multiple nodes designated by the WWID. By definition, this sharing can happen only in a cluster configuration for nodes that use a common SAN rail and have the same access paths.
- **WWID**—Identifier that is unique worldwide. Each entity in a fabric has a separate WWID.
- **Zone**—Set of hosts and devices attached to same fabric and having access permission (including RSCNs and user data) to each other. Entities inside a zone are not visible to entities outside the same zone, even if the outside entities are in another zone.

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