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About this guide

This guide defines concepts and describes the setup and use of HP StorageWorks Continuous Access EVA for disaster recovery.


Intended audience

This guide is intended for operators and administrators of storage area networks that include HP StorageWorks Enterprise Virtual Arrays (EVAs). It requires skills in:

- Local area networks
- Storage area networks
- Operating systems
- Windows operating system

Prerequisites

Use of this product requires the following:

- A storage area network
- Two or more Enterprise Virtual Arrays running supported versions of controller software
- Supported version of HP Command View EVA installed on one or more management servers
- License to use HP StorageWorks Continuous Access EVA

For supported storage arrays, management server hardware and software, and replication environments, including restrictions, see the HP StorageWorks EVA software compatibility reference on the HP Continuous Access EVA web site: http://h18006.www1.hp.com/products/storage/software/conaccesseva/index.html.

Related documentation

The following documents are referenced in this guide:

- HP StorageWorks Enterprise Virtual Array user guide (see the web site for your EVA model
Table 1 Document conventions

<table>
<thead>
<tr>
<th>Convention</th>
<th>Element</th>
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<tr>
<td>Blue text: Table 1</td>
<td>Cross-reference links and e-mail addresses</td>
</tr>
<tr>
<td>Blue, underlined</td>
<td>Web site addresses</td>
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<td>buttons, tabs, and check boxes</td>
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<td><strong>Italic</strong> text</td>
<td>Text emphasis</td>
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<tr>
<td><strong>Monospace</strong> text</td>
<td>• File and directory names</td>
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<td>• System output</td>
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<td>• Code</td>
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<td>• Commands, their arguments, and argument values</td>
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<td><strong>Monospace, italic</strong> text</td>
<td>Code variables</td>
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<td></td>
<td>• Command variables</td>
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<tr>
<td><strong>Monospace, bold</strong> text</td>
<td>Emphasized monospace text</td>
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</tbody>
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△ **CAUTION:**
Indicates that failure to follow directions could result in damage to equipment or data.

 пользуют: Provides clarifying information or specific instructions.

**NOTE:**
Provides additional information.

**TIP:**
Provides helpful hints and shortcuts.

HP technical support

Telephone numbers for worldwide technical support are listed on the HP support web site: [http://www.hp.com/support/](http://www.hp.com/support/).

Collect the following information before calling:

• Technical support registration number (if applicable)
• Product serial numbers
• Product model names and numbers
• Error messages
• Operating system type and revision level
• Detailed questions
For continuous quality improvement, calls may be recorded or monitored.

Subscription service

HP strongly recommends that customers register online using the Subscriber’s choice web site: http://www.hp.com/go/e-updates.

Subscribing to this service provides you with e-mail updates on the latest product enhancements, newest driver versions, and firmware documentation updates as well as instant access to numerous other product resources.

After subscribing, locate your products by selecting Business support and then Storage under Product Category.

HP web sites

For additional information, see the following HP web sites:

- http://www.hp.com
- http://www.hp.com/go/storage
- http://www.hp.com/service_locator
- http://www.docs.hp.com

Providing feedback

We welcome your feedback.

For HP StorageWorks Command View EVA, please mail your comments and suggestions to CVfeedback@hp.com.

For HP StorageWorks Business Copy EVA, HP StorageWorks Continuous Access EVA, and HP StorageWorks Replication Solutions Manager, please mail your comments and suggestions to EVAReplication@hp.com.
HP StorageWorks Continuous Access EVA is the remote replication component of HP StorageWorks Enterprise Virtual Array (EVA) controller software. When this component is licensed and configured, the controller copies data online, in real time, to a remote array over a storage area network (SAN). Properly configured, HP Continuous Access EVA is a disaster-tolerant storage solution that ensures data integrity if an array or site fails. You must have an HP StorageWorks Continuous Access EVA license to use this feature.

This chapter describes HP Continuous Access EVA features, concepts, and interfaces.

Features

HP Continuous Access EVA features include:

- Continuous replication of local virtual disks on remote virtual disks
- Synchronous and asynchronous remote replication
- Automated failover
- Failsafe data protection mode
- Ability to suspend and resume replication
- Bidirectional replication
- Graphical and command-line user interfaces
- Automatic suspension of replication if the link between arrays is down

For supported maximums, see the product release notes.

Remote replication concepts

Remote replication is the continuous copying of data from selected virtual disks on a local (source) array to related virtual disks on a remote (destination) array. Applications continue to run while data replicates in the background over a separate connection. Remote replication requires a fabric connection between the local and remote arrays and a logical relationship (DR group) between source virtual disks and destination virtual disks.

Replication modes

The remote replication modes are asynchronous and synchronous. In asynchronous mode, the array acknowledges I/O completion before data is replicated on the remote array. In synchronous mode, the array acknowledges I/O completion after the data is cached on the local and remote arrays. Asynchronous mode provides faster response to the host server and synchronous mode provides greater data protection. The choice of asynchronous or synchronous mode is generally a business decision and has implications for bandwidth requirements. For information about the performance impact of choosing asynchronous or synchronous replication mode, see the HP Continuous Access EVA Performance Estimator user guide.

You set the replication mode when you create data replication (DR) groups.
Bidirectional replication

When an array contains both source virtual disks and destination virtual disks, it is bidirectional. An array can have a bidirectional data replication relationship with up to two other arrays. Individual virtual disks can have only unidirectional relationships with one other virtual disk.

DR groups

A data replication (DR) group is a named group of virtual disks selected from one or more disk groups so that they remotely replicate to the same destination, fail over together, share a log, and preserve write order within the group. For example, all the virtual disks used by one application instance must be in one DR group. The maximum number of virtual disks in a DR group and the maximum number of DR groups per array vary with the controller software version. For current supported limits, see the latest release notes.

DR groups occur in pairs, the source DR group containing the source virtual disks and the destination DR group containing the destination virtual disks. (Source and destination pairs are also known as copy sets.) Hosts write data to the virtual disks in the source DR group and the array software copies the data to the virtual disks in the destination DR group. When a DR group fails over, the roles reverse. The destination DR group becomes the source, and the original source DR group becomes the new destination.

The DR group state indicates the role of the DR group relative to its initial role. When the source is the same array that was the source when the DR group was created, the DR groups are in an original state. When replication occurs from an array that was created as a destination, the DR group state is failed over.

Figure 1 depicts the replication of one DR group between local and remote sites.
DR group log

The DR group log is a designated virtual disk that stores a source DR group’s host writes while replication to the destination DR group is stopped. This process is called logging. Replication can be stopped because the destination DR group is unavailable or because the DR group is suspended. When replication resumes, the contents of the log are written to the destination virtual disks. This method of synchronizing destination virtual disks with source virtual disks is called merging. Because the data is written to the destination in the order that it was written to the log, merging maintains a crash consistent copy at the destination. The DR group log is created when you create a DR group.
DR group log states

A DR group log can be in one of the following states:

- Unused (Normal)—No source virtual disk is logging or merging.
- Logging—At least one source virtual disk is writing to the DR group log but none are merging.
- Merging—At least one source virtual disk is merging and logging.

DR group log size

When created, a log disk contains 139 MB of Vraid1 space. The log disk grows as needed when the DR group is logging. The controller considers the log disk full when any of the following occurs:

- No free space remains in the disk group that contains the log disk.
- The log disk reaches 2 TB of Vraid1 (4 TB total).
- The log reaches the default or user-specified maximum log disk size (for the default maximum log disk size, see the EVA replication software release notes)

Full copy

When a DR group log is full, the controller deletes the log contents, returns all but 139 MB to the disk group, and copies data in one–MB blocks directly from the source DR group’s virtual disks to the destination DR group’s virtual disks. This method of synchronizing local and remote virtual disks is called full copy. It is optimized to copy only blocks that were written after the remote connection was lost. Unlike a merge, full copy does not provide crash consistency during the operation. If the full copy is not completed due to an event such as loss of the local array, the remote copy can be left in an indeterminate state.

When logs are merging, you can use a replication interface to initiate a full copy of the source virtual disk to the destination virtual disk (except on arrays with VCS 3.x). Unlike the automatic full copy, the interactive version copies all blocks from the source disk to the destination disk. For information to perform a full copy, see online help.

Managed sets

Managed sets are a feature of the replication manager. A managed set is a named collection of resources banded together for convenient management. Performing an action on a managed set performs the action on all members of the set. For example, the managed set Sales_Disks might include two virtual disks, West_Sales and East_Sales. If you perform the New Snapshot action on the managed set Sales_Disks, the interface creates a snapshot of West_Sales and a snapshot of East_Sales. A managed set can contain DR groups, enabled hosts, host volumes, storage systems, or virtual disks.

Here are a few facts about managed sets:

- All resources, or members, in a single managed set must be of the same type (for example, all virtual disks).
- You can add a specific resource to more than one managed set.
- You can add resources on more than one array to a managed set.
- Create separate managed sets for source and destination DR groups so that if a failover occurs, you can perform the actions that correspond to the changed source/destination role of the managed set members.

Failover

Failover in the context of replication is an operation that reverses replication direction. The destination array assumes the role of the source and the source assumes the role of the destination. For example, if a DR group is replicating from array A to array B, a failover would cause data to be replicated from array B to array A. You can fail over DR groups and managed sets containing DR groups.
NOTE:

Failover can take other forms in the EVA environment:

- Controller failover is the process that takes place when one controller in a pair assumes the workload of a failed or redirected companion controller in the same cabinet.
- Fabric or path failover is the act of transferring I/O operations from one fabric or path to another.

This guide describes the failover of DR groups and managed sets. It does not address controller failover within a cabinet, or path or fabric failover because redundancy is assumed.

Here are some facts about failover:

- Failover is permitted only on a destination DR group.
- If only one component fails, repairing the component can be preferable to failing over the whole site.

Figure 2 shows data replication among DR groups at three locations. Arrays 1 and 4 are at the local site, and arrays 2 and 5 are at a remote site. On the local site, array 1 contains source DR groups (replicating to array 2), and array 4 contains destination DR groups (replicated from array 5). If the arrays at the local site become unavailable, the destination DR groups on array 2 fail over and become source DR groups (in failover state), providing storage for the hosts that were using array 1. On array 5, the source DR groups begin logging until the local site is re-established or replaced with another destination.
Normal replicating relationships

Behavior after loss of active site

1. Source array before failover
2. Destination array before failover
3. Replication
4. Destination array
5. Source array
6. Local site
7. Remote site
8. Failover
9. Logging

Figure 2 Replicating relationships among DR groups

Failsafe mode

Failsafe mode specifies how host writes and remote replication behave when a group member fails. The failsafe mode can be either:
• Failsafe enabled—If any virtual disk within the DR group fails or becomes unreachable, host I/O and remote replication automatically stop for all DR group members. This preserves the order of the replicated data. A failsafe-enabled DR group can be in one of two states:
  • Locked (failsafe-locked)—Host I/O and remote replication automatically stop.
  • Unlocked (failsafe-unlocked)—Host I/O and remote replication occur.
• Failsafe disabled—If any destination virtual disk (remote copy) within the DR group fails or becomes unreachable, all host writes to the source DR group continue, but all remote replication to the destination DR group automatically stops; the source DR group logs its host writes to the DR group log until remote replication is re-established. If a source virtual disk fails, host writes to the failed disk stop, as well as remote replication to its remote copy; host writes and remote replication to the other members of the DR group continue normally.

### Interface options

Performing replication can involve one or more of the interfaces and products described in Table 2.

#### Table 2 Replication products and interfaces

<table>
<thead>
<tr>
<th>HP product</th>
<th>Interface</th>
<th>Remarks</th>
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| HP StorageWorks Command View EVA               | Browser–based graphical user interface (GUI)  | • Required
• Array management software that creates snapshots, snapclones, and DR groups using a GUI
• Replicates by specifying an array and virtual disk, not by a host and host volume
• Cannot perform dynamic mounting or interact with hosts
• Does not provide jobs, job templates, or scripting
• See HP Command View EVA for more information |
| HP StorageWorks Replication Solutions Manager  | Browser-based GUI and command line user interface (CLUI) | • Optional
• A specialized replication interface that creates snapshots, snapclones, and DR groups using a GUI, jobs, and a CLUI
• Replicates by specifying an array and virtual disk (LUN), a host and host volume, or an application database
• Performs dynamic mounting and interacts with hosts
• Provides integrated job editor, job templates and job scripting
• Includes integrated job management |
| HP StorageWorks Storage System Scripting Utility (SSSU) | Host command line | • Optional
• EVA host platform software that creates snapshots, snapclones, and DR groups using a command line or custom script
• Replicates by specifying an array and virtual disk, not by a host and host volume
• Performs dynamic mounting and host interaction through custom scripts |
| HP StorageWorks SMI–S Interface for Command View EVA | WEBM client–server using XML | • Optional
• Provides an SMI–S compliant interface for HP StorageWorks Command View EVA |

### HP Command View EVA tasks

HP Command View EVA is a user interface that communicates with the EVA controllers to control and monitor the storage. HP Command View EVA maintains a database for each managed array and the
database resides on that array. Instructions for its use can be found in the HP StorageWorks Command View EVA Online Help.

To use HP Continuous Access EVA you must first use HP Command View EVA to:

- Add licenses
- Initialize controllers—This process binds the controllers together as an operational pair and establishes the first disk group on the disk array.
- Create disk groups—A disk group is a set of physical disks from which storage pools are created. When an array is initialized, a default disk group is created. If you are performing bidirectional replication, the disk groups should be symmetric with respect to capacity on both arrays.
- Create host definitions—the host connects to dual fabrics through a pair of host bus adapters (HBA) and accesses storage through the array controller. Creating hosts in HP Command View EVA defines a path from a controller to at least one HBA.
- Create virtual disks—a virtual disk is variable disk capacity that is defined and managed by the array controller and presentable to hosts as a disk. You can assign a combination of characteristics to a virtual disk, such as a name, redundancy level, size, and other performance characteristics.
- Present virtual disks to hosts—Assigning a virtual disk to a host results in a host presentation. You can present a virtual disk when you create it, or wait until later. The virtual disk must be presented to a host before it can be used for replication.

**NOTE:**
You can present a virtual disk to a predefined but nonexistent host; for example, NULL_HOST with a WWN of all zeros.

---

**HP Replication Solutions Manager tasks**

HP Replication Solutions Manager is an interactive, visual environment for managing data replication. After you create hosts, virtual disks and their presentations, and your hosts can access your virtual disks, you are ready to replicate data using HP Replication Solutions Manager. Additional operational information is in the online help system.

HP recommends that you use the replication manager to:

- Create and delete DR groups.
- Change properties for DR groups.
- Add and remove members from DR groups.
- Failover, suspend, resume, and change failsafe mode by DR group.
- Create and delete managed sets.
- Fail over, suspend, resume, enable and change failsafe mode, and revert to Home by managed set.
- Direct commands to the appropriate array regardless of selected array.
- Actively monitor arrays (copy, failsafe, logging, merging).
- Create and restore configuration databases for managed sets and jobs.
2 Remote replication setup

Local and remote sites can be as close as the same room or thousands of miles apart. Performance-optimized implementations may include three or four sites in multiple replication relationships. For supported distances and multiple replication relationships, see HP StorageWorks Continuous Access EVA planning guide. For distance technologies and fabric rules, see Volumes 2 and 4 of HP StorageWorks SAN design reference guide on the HP SAN Infrastructure web site:

This chapter describes the basic steps for setting up HP Continuous Access EVA.

Verify EVA setup

Your EVA purchase includes installation services provided by HP-authorized service representatives at local and remote sites. Verify that the EVAs are properly setup and cabled for remote replication.

Installation checklist

Verify that the following items are completely installed:

• External connections from the array controllers to two or, for some controllers, four fabrics that are also connected to application servers (hosts).

NOTE:
Remote replication is not supported on arrays that are connected to hosts without an intermediate Fibre Channel switch.

• Internal connections from array controllers to disk enclosures and loop switches

• Controller World Wide Name and optional HP Command View EVA password set on the array

• HP Command View EVA installed on a management server that is connected to the same fabrics as the array controllers

Supported cabling

Verify that the cabling between your arrays and Fibre Channel switches meets remote replication requirements. The supported cabling scheme depends on the array controller ports and software features, as shown in the following figures. (To determine if your controllers have two or four ports and if they support active/active failover, see your EVA user guide.) In mixed EVA configurations, use the cabling scheme specific to each controller. For optional high-availability cabling options, see Volume 1 of HP StorageWorks SAN design reference guide.

Figure 3 shows the supported cabling scheme for remote replication on arrays with 2–port controllers and support for active/active failover (arrays not running VCS 3.x). The even-numbered ports on both controllers are connected to one fabric and the odd-numbered ports on both controllers are connected to the other fabric.
Figure 3 Cabling EVAs with 2-port controllers and active-active failover support

Figure 4 shows the supported cabling scheme for remote replication on EVA models with 4-port controllers. On these models, each controller has redundant connections to both fabrics. Even-numbered ports are connected to one fabric and odd-numbered ports are connected to the other fabric.

Figure 4 Cabling EVAs with 4-port controllers

Figure 5 shows the supported cabling scheme for remote replication on arrays with controller software version VCS 3.x. These models require the order in which ports are attached to a fabric to be reversed on the two controllers. For example, if you attach the first port on one controller to the gray fabric, attach the second port on the other controller to the gray fabric.

Figure 5 Cabling EVAs with controller software version VCS 3.x.

Remote replication setup
Install replication licenses

When you purchase HP Continuous Access EVA, you receive a replication license for each array (local and remote) in a remote replication relationship. Replication licenses are based on the amount (in TB) of replicated data on each array. For license offerings, see the product Quickspecs on the HP Continuous Access EVA web site. License kits include instructions for retrieving electronic license keys and for installing the keys in HP Command View EVA. Entering the keys on the HP Command View EVA license page activates remote replication features on specified arrays.

Follow the instructions provided in the license kit for retrieving electronic license keys from the HP License Key Renewal web site and for installing the keys using HP Command View EVA. License keys arrive in e-mail within 48 hours after you submit the credentials from the license kit. Install the license keys on each active and standby management server at local and remote sites.

Install optional replication manager

For additional replication capabilities, install HP StorageWorks Replication Solutions Manager on local and remote management servers. The unique features of this software are shown in Table 2. For installation requirements and instructions, see HP StorageWorks Replication Solutions Manager installation guide.

Install interswitch links

An interswitch link is a connection between two switches. For remote replication, install interswitch links between the local and remote sites.

Figure 6 shows a typical remote replication setup with two arrays (each represented by two controllers), one at a local site and the other at a remote site. One controller at each site is connected to each fabric (black and gray). Redundant management servers are connected to both fabrics at each site. Interswitch links connect the fabrics between the two sites. Except for the redundant management servers, the setup at each site is a standard EVA installation.
1. Local active management server
2. Local host
3. Local controller 1
4. Local black fabric switch
5. Local controller 2
6. Local gray fabric switch
7. Local standby management server (optional)
8. Interswitch link—black fabric
9. Remote standby management server
10. Remote host
11. Remote controller 1
12. Remote black fabric switch
13. Remote controller 2
15. Remote standby management server (optional)
16. Interswitch link—gray fabric

**Figure 6 Remote replication fabrics with redundant servers**

When you connect the local and remote sites with an interswitch link, ensure that the combined fabric stays within switch, port, and hop limitations. For fabric topologies, switch and fabric rules, SAN integration issues, and extended SANs, see *HP StorageWorks SAN design reference guide* on the HP SAN Infrastructure web site: [http://h18006.www1.hp.com/storage/saninfrastructure.html](http://h18006.www1.hp.com/storage/saninfrastructure.html).

**Create zones**

Switch zoning allows incompatible resources to coexist in a heterogeneous SAN. Using switch management software, create separate zones for hosts that are incompatible in a SAN, including in each zone the arrays that the host will access before and after a failover. Array controller ports can be in overlapping zones.

Include management servers in the zones containing hosts and arrays, or create zones exclusively for management servers and the arrays that they manage. The HP OpenView Storage Management Appliance, for example, must be zoned separately from hosts. Each management server must be able to manage the local and remote arrays, but only one server at a time can manage any array. Include one active and one standby management server in each management zone. **Figure 7** shows a zoning configuration in which the management servers at the local and remote sites are in separate zones with arrays in both zones. If the management server or links fail at either site, the management server at the other site can manage the arrays at both sites.
1. Local management server  
2. Remote management server  
3. Local array 1  
4. Local array 2  
5. Remote array 1  
6. Remote array 2  
7. Management zone A  
8. Management zone B  
9. Remote replication management zone  
10. Fabric

**Figure 7 Local and remote management server zones**

For instructions to create zones, see your switch user guide. Also follow the best practices in Volume 2 of *HP StorageWorks SAN design reference guide*.

**IMPORTANT:**

When adding array controllers to a zone, use the array’s world wide name, not the controller’s port world wide names. The array’s world wide name is a hexadecimal number that begins with 50 and ends with 0, for example, 50:00:1f:e1:00:15:40:80. The controller port world wide names are similar but end in digits greater than 0, for example, 50:00:1f:e1:00:15:40:88 and 50:00:1f:e1:00:15:40:8d.

Zoning also allows you to limit visible connections to the supported maximums. Create separate zones for resources that exceed the following maximums:

- Maximum number of EVAs in a SAN
- Maximum number of HBAs per EVA controller (see Volume 3 of *HP StorageWorks SAN design reference guide*)
- Maximum number of switches in a SAN (see Volume 2 of *HP StorageWorks SAN design reference guide*)

Exclude the following from remote replication zones:
• Hosts without multipathing software
• Hosts with operating systems not supported by HP Continuous Access EVA (for supported operating systems, see HP StorageWorks EVA software compatibility reference)
• Incompatible storage system products (for compatible storage systems, see HP StorageWorks EVA software compatibility reference); for example, HSG controllers with Data Replication Manager

Remote replication zones can include compatible offline tape devices.

Configure hosts

Configure native or installed multipath software on all hosts in remote replication configurations. Multipathing software redirects I/O requests from a failed path to the alternate path, preventing disruptions in data access if the path to the array fails. Multipath software is required for remote replication. If the multipath software is Secure Path, turn off dynamic load balancing. See your multipath documentation for installation and configuration information.

For supported host operating systems, see HP StorageWorks EVA software compatibility reference.

Initialize the arrays and create disk groups

Initializing an array creates a default disk group of at least eight disks. To control the number and composition of the disk groups in your array, install only the disks that you want in the first disk group and then initialize the array. Add disks and create additional disk groups as needed. For instructions to initialize the array and add disk groups, see HP Command View EVA user guide and online help.

Determining the number of disk groups

To determine if the default disk group is sufficient for your remote replication needs, consider the following:

• Separate disk groups can ensure that data is recoverable if a disk group fails. On the other hand, multiple disk groups result in a slightly higher cost of ownership and potentially lower performance. To assess the trade-offs between cost, availability, and performance of multiple disk groups versus a single large disk group, see the HP StorageWorks Enterprise Virtual Array configuration best practices white paper on the EVA web site.
• In general, distributing the workload across the greatest number of disks in a single disk group provides the best performance. However, separate disk groups for sequential (database logs, rich content) versus random (database information store, file shares) workloads can improve performance. To understand performance and remote replication, see HP StorageWorks Continuous Access EVA planning guide. To assess the effect of distance on performance, use HP StorageWorks EVA Performance Estimator.
• Disk groups must provide sufficient free space for sparing, snapshots and snapclones (if used), and DR group logs. For guidelines, see HP StorageWorks Enterprise Virtual Array configuration best practices white paper.
• A DR group can contain virtual disks from multiple disk groups, but all virtual disks must be in the same array.
• Bidirectional replication requires symmetric disk groups on local and remote arrays.

Specifying disk group properties

Using HP Command View EVA, initialize each local and remote array and create additional disk groups as needed. When configuring disk groups for remote replication, consider the following:

• Assign different names to local and remote arrays, or you will not be able to fail over DR groups.
• Select double disk protection level for disk groups. (This differs from the best practice in nonreplicating configurations.) The protection level determines the capacity that is reserved for reconstructing disks after a disk failure. Selecting double reserves the largest amount of disk capacity and provides the most data protection.
• Calculate the disk group occupancy alarm setting according to the EVA best practice, being sure to include the total maximum capacity for all DR group logs. (See HP StorageWorks Enterprise Virtual Array configuration best practices white paper.)

Add hosts

Adding a host defines a path between the host HBAs and the arrays in the management zone. Using HP Command View EVA, add each host that needs access to the local (source) or remote (destination) arrays. For convenience, you can perform this and subsequent HP Command View EVA procedures on the local management server and copy the finished configuration to the standby and remote management servers.

When you add a host for remote replication, select only two host ports—one on each fabric. This requirement ensures that virtual disks are presented to the same HBA pair. For more information about adding hosts, see the HP StorageWorks Command View EVA user guide and HP Command View EVA online help.

Create and present source virtual disks

Virtual disks are the primary storage objects. Using HP Command View EVA, create virtual disks on the local (source) array, paying special attention to the preferred path.

Selecting a preferred path

For all virtual disks that will share a DR group, select a common preferred path (controller port). Host I/O goes to the controller you designate, as long as that path is available. Select failover only or failover and failback as follows:

• If the virtual disks will be presented to a host that uses Secure Path, select one of the failover only paths. The failover-only selections automatically redirect I/O to the alternate path if the preferred path becomes unavailable, but allow the host to control the return to the preferred path when it becomes available.
• If the virtual disks will be presented to a host that uses other multipathing software, select a failover only or failover and failback path.

For the procedure to create virtual disks, see HP Command View EVA online help.

Presenting virtual disks

Presenting virtual disks is necessary to allow host access. Using HP Command View EVA or the replication manager, present source virtual disks to the host servers that will use the storage. Be sure to present all virtual disks that will share a DR group to a common host HBA pair. For the procedure to present virtual disks, see online help.

Presenting virtual disks to hosts is an array requirement. You must also make virtual disks accessible from the host’s perspective. Using host operating system tools, discover and mount the source virtual disks (disk devices) as required by the host.

Create DR groups

Before you create DR groups, ensure that:

• Local and remote arrays are online and accessible to the management server.
• HP Command View EVA on the active local management server has control of the local and remote arrays. After you create the DR groups, you can divide the management responsibilities for multiple arrays between the local and remote management servers. See HP Command View EVA user guide for instructions to change the management server that is managing an array.
Using HP Replication Solutions Manager or HP Command View EVA, create DR groups on the local (source) array. At a minimum, you must specify a source virtual disk and a destination array. The array software creates a corresponding DR group and virtual disk on the remote array.

Specifying virtual disks

Select one virtual disk to create the source DR group. If this and other virtual disks are assigned to an application that requires write order to be consistent across the virtual disks, add the other virtual disks to the DR group. A database application, for example, may require consistent writes across separate virtual disks for data and logs. For optimum performance, do not mix virtual disks assigned to multiple applications in a DR group.

To be eligible for inclusion in a DR group, a source virtual disk:
- Cannot be a member of another DR group
- Cannot be a snapshot
- Must be in normal operational state
- Must use mirrored write cache (the default)
- Must have the same presentation status as other virtual disks in the DR group

Specifying DR group log location and size

You can specify the location of the DR group log when you create a DR group. By default, the array software creates a 139-MB log on local and remote arrays, using a near-online (FATA) disk group if available. If there are no near-online drives, the software selects the disk group with the largest amount of average free space. HP recommends using the same priorities when you specify the log disk group.

You can also specify the size of the DR group log that is considered full and thereby influence the point at which the software abandons the log and starts a full copy. The value must be less than 2 TB, or it has no effect. If the disk group runs out of free space, the software starts a full copy regardless of the value specified. For the default maximum size, see the EVA replication software release notes.

The ability to specify DR group log location and size is not supported on VCS 3.x.

Selecting replication mode

Select the replication mode when you create a DR group. Synchronous is the default and the most reliable replication mode, providing identical copies on local and remote arrays at all times. Asynchronous offers faster responses to host servers and potentially greater lags between local and remote writes. The choice of replication mode has design implications and depends on business requirements. For detailed descriptions of synchronous and asynchronous modes, see the HP Continuous Access EVA planning guide.

Present destination virtual disks

After creating the DR groups, present the destination virtual disks to the hosts that the source virtual disks are presented to. This enables local hosts to access data at the remote site if the local array fails and DR groups are failed over. Also present destination virtual disks to the remote hosts that will be used if the local site fails and server software is used to fail over applications. Use HP Command View EVA or the replication manager to present destination virtual disks to hosts.

Back up the configuration

Back up your storage and replication configuration now and anytime it changes. Regular backups are essential to effective disaster recovery. You can use the initial backup to re-create the configuration on remote and standby management servers. For backup procedures, see Backing up replication configuration.
Set up remote and standby management servers

Use the backup from the local management server to duplicate the replication configuration on remote and standby management servers. Before importing the configuration from the local replication manager, you must assume active management of the arrays in the configuration using HP Command View EVA on the remote or standby management server. For the procedure to acquire control of the arrays, see HP Command View EVA user guide.

After setting up all management servers, acquire control of the arrays on the local management server. Only one management server at a time can manage an array.

Synchronize management servers and arrays

Using a common time clock such as the network time protocol, synchronize the system clocks on local and remote, active and standby management servers. If a failover or other need arises to use the standby server, you want event and log time stamps to be consistent.

Also use HP Command View EVA's Set time options to synchronize each array with the active management server. Select the option to Resync controller time with the SAN management time. Synchronizing the management server and the arrays ensures that event and log time stamps are consistent. See HP command View EVA online help for instructions.

Test failover

At some point before actually using the new virtual disks, practice both planned and unplanned failovers. For failover procedures, see Planned failover and Unplanned failover.
This chapter provides information for failing over and resuming operations after a planned or unplanned loss of operation. Several scenarios cover most situations you could encounter, with procedures for handling each scenario.

Planning for a disaster

Planning helps minimize the downtime brought on by a disaster. Include the following in your disaster recovery planning:

- Operate with a supported disaster-tolerant configuration. Ensure that there are two fabrics with one interswitch link per fabric or, in extended SANs, an intersite link for each fabric.
- Ensure that array controllers are cabled in the supported configuration.
- Have at least one management server available at every site, in case of a hardware or communication failure.
- Verify that each destination virtual disk within a DR group has been presented to a host. This allows the host access to the virtual disk immediately after a failover.
- Ensure that local and remote hosts are installed with the latest patches, virus protection, HP Storage System Scripting Utility, and multipath software versions for the specific operating system.
- Keep your configuration current and documented at all sites. Install the latest versions of controller software, HP Command View EVA, and the replication manager. Consider replicating the boot disks of all servers attached to the array.
- Keep a record of your virtual disks, DR groups, and host volume and volume group names. Capture the configuration information after each significant change or at scheduled intervals (see Backing up replication configuration).
- Keep the replication manager on every management server synchronized with configuration changes. See the replication manager online help for the procedure to export and import the replication manager database.
- Back up the replication manager database. These databases contain managed set and job information that you can restore on another management server if its role changes.
- Practice the recovery plan. Ensure that everyone in your storage administration practices for disaster recovery. Practice different failure scenarios and make decisions ahead of time about them. For example, if a controller fails, is it more important not to disrupt processing by doing a planned failover, or not to be at risk for a second controller failure that will result in an unplanned failover? In the case of multiple sites, which site has precedence for troubleshooting? Simulated disaster recoveries are a good way to verify that your records are up-to-date and that all required patches are installed.

Failover and recovery procedures

The failover procedure depends on the severity of the failure or the reason for the failover. For example, the procedure for a planned failover applies to anticipated power disruptions, scheduled equipment maintenance at the local site, or a need to transfer operations to another array. Another procedure applies to unplanned events such as multiple controller failures, multiple host failures, or a power outage at the local site.

You may decide not to fail over in some situations. For example, if only one component fails, you may be able to repair that component and avoid failing over an entire DR group. On the other hand, if a local array fails, or if you are planning downtime with a local array, failing over to the remote array can ensure minimal interruption of data access.
Always verify that all components of the remote array are operational before you fail over.

**NOTE:**
HP recommends that you not fail over any DR group more frequently than once every 15 minutes.

---

Performing failover and recovery

Failover and recovery procedures include such actions as failover, suspend, resume, disable failsafe, mounting, and unmounting. You can perform these actions using the following interfaces and tools:

- Replication manager
- Replication manager command line interface
- Replication manager jobs
- Storage System Scripting Utility
- HP Command View EVA

For specific procedures, see the interface documentation.

Choosing a failover procedure

Table 3 summarizes situations that require a failover and those that do not. Each recommended action corresponds to a procedure documented later in this chapter. Because replication can be bidirectional, your array may be a source and a destination for separate DR groups. Use this table to customize contingency plans for your environment.
<table>
<thead>
<tr>
<th>Failure situation</th>
<th>Recommended action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance requiring loss of access to source array</td>
<td>Perform <strong>Planned failover</strong> on destination array.</td>
</tr>
<tr>
<td>Total loss of source array</td>
<td>Manually intervene to fail over data on destination array, and then restart processing at the destination array. Perform an <strong>Unplanned failover</strong>.</td>
</tr>
<tr>
<td>Loss of both source controllers</td>
<td>Manually intervene to continue processing at source array. Resume operations from failsafe-locked condition after destination loss.</td>
</tr>
<tr>
<td>Loss of single source controller</td>
<td>Failover not necessary.</td>
</tr>
<tr>
<td>Total destination array loss</td>
<td>Failover not necessary.</td>
</tr>
<tr>
<td>Loss of both destination controllers</td>
<td>Manually intervene to fail over data to destination array, then restart processing at the destination array. Perform an <strong>Unplanned failover</strong>.</td>
</tr>
<tr>
<td>Loss of all intersite links</td>
<td>Manually intervene to fail over data on destination array, and then restart processing at the destination array. Perform an <strong>Unplanned failover</strong>.</td>
</tr>
<tr>
<td>Loss of source interswitch links</td>
<td>Failover not necessary.</td>
</tr>
<tr>
<td>Loss of single source intersite switch</td>
<td>Manually intervene to fail over data to destination array, then restart processing at the destination array. Perform an <strong>Unplanned failover</strong>.</td>
</tr>
<tr>
<td>Extended power outage at primary site</td>
<td>Manually intervene to fail over data to destination array, then restart processing at the destination array. Perform an <strong>Unplanned failover</strong>.</td>
</tr>
<tr>
<td>Loss of a managing server</td>
<td>Failover not necessary. Browse to standby managing server.</td>
</tr>
<tr>
<td>Loss of single disk in redundant storage</td>
<td>Failover not necessary.</td>
</tr>
<tr>
<td>Loss of single host of cluster</td>
<td>Failover not necessary.</td>
</tr>
<tr>
<td>Disk group hardware failure (loss of redundancy) on the source array</td>
<td>Fail over to destination, and repair the array. Perform the procedure for <strong>Disk group hardware failure on the source array</strong>.</td>
</tr>
<tr>
<td>Disk group hardware failure (loss of redundancy) on the destination array</td>
<td>Failover not necessary. Perform the procedure for <strong>Disk group hardware failure on the destination array</strong>.</td>
</tr>
</tbody>
</table>

### Planned failover

**Possible scenario:** Due to scheduled maintenance at the local site, you need to move operations from the local array to the remote array.

**Action summary:** Prepare the local array and fail over the remote array. When the failover is complete, you can continue to operate from the new source and engage failsafe mode as desired. When the planned maintenance is complete, you can fail back to the original source. **Figure 8** diagrams a planned transfer of operations to a remote site.
**Figure 8 Planned and unplanned transfer of operations**

**TIP:**
In the replication manager, you can designate a Home array to identify the preferred source. By default, the source array at the time the DR group is created is Home. As the role of the array changes after multiple failover and failback events, the Home designation persists.

**Procedure:**

1. If desired, move storage management to another management server. For instructions, see *HP Command View EVA user guide*.

2. Ensure that all DR groups are resumed and fully normalized.
   Check DR group status using HP Command View EVA or HP Replication Solutions Manager. If a DR group is merging or a full copy is in progress, wait for the process to complete.

3. Stop all host I/O on the source array.
For all operating systems, including VMware Virtual OSs, but excluding Windows, stop all I/O to the virtual disks in source DR groups and unmount associated volumes or file systems.

For VMware, also shut down each virtual machine on the VMware server, and either leave the virtual machines off until you fail back the LUNs, or, using the VM configuration editor, remove all LUN assignments in the hardware configuration files.

For Windows, flush all cache files and shut down the operating system. Small files held in Windows cache can disrupt remote replication. Reboot the host as Windows requires; HP Continuous Access EVA is neutral to rebooting the host.

4. Fail over the destination DR group.

In the replication manager, select the destination DR group and then select Actions > Failover. See online help for additional information.

5. To control the merging of data at the destination (previous source), suspend replication on the less important DR groups. This forces the controllers to replicate the most important data first when the links to the previous source are re-established. For more information, see Throttling merge I/O after logging.

6. If you plan to operate for an extended time at the remote site and you need to enable failsafe mode on a DR group, perform these steps. The new destination (previous source) array and Fibre Channel links must be functioning.
   a. If the DR group is suspended, resume it and wait for the log disk to finish merging.
   b. Change the DR group to failsafe mode.

   NOTE: You can enable failsafe mode at the destination array while a merge or full copy is being performed.

7. Issue operating system commands for resuming host I/O to the new source disks. For operating system specifics, see Resuming I/O after failover.

After a failover, you have three options if the cause of the failover is resolved:

- Remained failed over on the remote array.
- Return operations to the local array (see Fail back to the original source (Revert to Home)).
- Return operations to new hardware at the local site (see Return operations to new hardware).

Unplanned failover

Possible scenario: You have experienced an unplanned loss of the local site or the source array. The duration of the outage is unknown. The hardware components (hosts, array controllers, and switches, for example) at the local site may or may not remain intact.

Action summary: Fail over the destination DR group. When the local site is back online, you can fail back to the previous source array or to a replacement array. Figure 8 diagrams an unplanned transfer of operations to a remote site.

Procedure:

1. If local hosts are running and you can access them, stop all host I/O.
   For all operating systems, including VMware Virtual OSs, but excluding Windows, stop all I/O to the virtual disks in source DR groups and unmount associated volumes or file systems.
   For VMware, also shut down each virtual machine on the VMware server, and either leave the virtual machines off until you fail back the LUNs, or, using the VM configuration editor, remove all LUN assignments in the hardware configuration files.
For Windows, flush all cache files and shut down the operating system. Small files held in Windows cache can disrupt remote replication. Reboot the host as Windows requires; HP Continuous Access EVA is neutral to rebooting the host.

2. If you cannot access the management server that is managing the arrays, establish management control with another management server. For instructions, see HP Command View EVA user guide.

3. Fail over the destination DR groups.
   In the replication manager, select the destination DR group and then select Actions > Failover. See online help for additional information.

4. To control the merging of data at the destination (previous source), suspend replication on the less important DR groups. This forces the controllers to replicate the most important data first when the links to the previous source are re-established. For more information, see Throttling merge I/O after logging.

5. Issue operating system commands to resume host I/O to the new source. See Resuming I/O after failover.

After a failover, you have three options if the cause of the failover is resolved:

- Remain failed over on the remote array.
- Return operations to the local array (see Fail back to the original source (Revert to Home)).
- Return operations to a replacement array at the local site (see Return operations to new hardware).

**Recover from failsafe-locked after destination loss**

Possible scenario: You have experienced an unplanned loss of the remote array, or a loss of the connection to the remote array, due to failure of the interswitch links, loss of power at the remote site, loss of both remote switches, and so on. The duration of the outage is unknown. The DR groups are failsafe-locked and host I/O is paused.

Action summary: Change from failsafe-enabled to normal mode, and resume host I/O until the connection to the remote array is re-established. When the connection to the remote site is stable, change back to the failsafe-enabled mode. Figure 9 diagrams the steps to resume operations if you cannot access the destination while in a failsafe-locked state.
Procedure:

1. Change affected source DR groups from failsafe-enabled mode to normal mode.
2. If necessary, issue operating system commands to the local hosts to restart I/O on the virtual disks that were failsafe-locked. See Resuming I/O after failover.
3. To control the merging of data at the destination, suspend replication on the less important DR groups. This forces the controllers to replicate the most important data first when the links to the destination are re-established. For more information, see Throttling merge I/O after logging.

**NOTE:**

If DR groups are suspended for an extended time, the log can be overrun. Restoring the connection to the destination array will initiate a full copy of these DR groups. During the full copy, the data will be inconsistent at the destination.

4. When connections to the destination are re-established and merging is complete, change DR groups from normal mode to failsafe-enabled mode, if desired.

**NOTE:**

If source DR groups start a full copy, you can enable failsafe mode.
Fail back to the original source

Possible scenario: You are operating from an array that is not the original source (designated Home in the replication manager). You need to move operations from the remote array back to the local array.

Action summary: Prepare the source array for the failover and fail over the destination (original source) DR group. Failback (also known as reverting to Home) is similar to a planned failover. Fifteen minutes after failing over from a source to a destination array, you can fail back in the other direction.

Procedure:

1. If desired, move storage management to another management server. For instructions, see HP Command View EVA user guide.
2. Ensure that all DR groups are resumed and fully normalized. If a DR group is merging or a full copy is in progress, wait for the process to complete.
3. Stop all host I/O on the current source array.
   For all operating systems, including VMware Virtual OSs, but excluding Windows, stop all I/O to the virtual disks in source DR groups and unmount associated volumes or file systems.
   For VMware, also shut down each virtual machine on the VMware server, and either leave the virtual machines off until you fail back the LUNs, or, using the VM configuration editor, remove all LUN assignments in the hardware configuration files.
   For Windows, flush all cache files and shut down the operating system. Small files held in Windows cache can disrupt remote replication. Reboot the host as Windows requires; HP Continuous Access EVA is neutral to rebooting the host.
4. Fail over the destination (original source) DR groups (or perform "revert to Home" in the replication manager).
5. Issue operating system commands to resume I/O to the new (original) source. See Resuming I/O after failover.

Return operations to new hardware

Possible scenario: Some type of disaster (lightning, flood, fire, severe equipment failure, or so on) damaged local equipment and forced a failover to a remote site.Hardware on the local source array was replaced. The new hardware now acts as the destination array and you are operating from an array that is not the original source (designated as Home).

Action summary: When the damaged components at the local site (hosts, array controllers, or switches, for example) are repaired, and the site is operational and back online, fail over to new hardware at the local site. Figure 10 diagrams the steps to return operations to new hardware.
Figure 10 Array with failed or new hardware (destination) and the surviving array (source)

Procedure:
This procedure does not include steps to rebuild servers using the storage (this should be part of your overall disaster plan). For information to perform the following steps, see the online help of the HP Command View EVA or Replication Solutions Manager interface.
Table 4 Array log

<table>
<thead>
<tr>
<th>Array Name</th>
<th>Array with failed or new hardware</th>
<th>Current source array</th>
</tr>
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<tbody>
<tr>
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</tbody>
</table>

1. Record the names of the array with failed or new hardware (current destination) and the current source array in a table such as Table 4. For example, your array with new hardware may be named HSV01 and your current source array may be named HSV02. Refer to this table during the procedure as needed.

2. On the current source array, resume all DR groups.

3. Delete all DR groups that ever had a relationship with the failed hardware.

4. Contact HP-authorized personnel to replace the hardware on the failed (previous source, current destination) array. Depending on the failure, they may replace hard drives or controllers, delete disk groups, and so on.

5. Remove the connection between the source and destination arrays. This can be accomplished by removing the repaired (destination) array from the SAN, by disabling the interswitch links, or by placing the arrays in separate zones.

To place the array in separate zones, you need two zones. One zone contains the source array, source hosts, and the management server. The second zone contains the destination array, destination hosts, and the management server. For more information about zoning, see HP StorageWorks SAN design reference guide.

6. (Optional. Not needed if entire array was replaced.) Delete any destination DR groups on the repaired array. If this is not successful, the source-destination connection still exists, so go to the previous step.

7. (Optional. Not needed if entire array was replaced.) Delete all virtual disks that were members of DR groups on the repaired array.

8. Re-establish communication between the source and destination arrays. Either add the repaired array back into the SAN, enable the interswitch links, or place the arrays into the same zone.

9. Perform one of the following:
   a. If the replaced array configuration was captured with the Storage System Scripting Utility (SSSU), execute the script ConfigName_step1A on the new hardware, and then proceed to Step 14. See the SSSU reference for instructions. ConfigName is a user-assigned name given to the SSSU script at the time of creation. See the procedure titled Backing up replication configuration.
   
   b. If you are not using an SSSU script for recovery, initialize the repaired or replaced array using the information you recorded in the Table 4. See HP Command View EVA user guide for initialization instructions.

**NOTE:**

To preserve existing zoning, give the new hardware the World Wide Names of the failed hardware.

10. Add the disk groups on the new hardware.
11. Add the hosts for the system with new hardware.
12. Create the non-DR group virtual disks.
13. Present all non-DR group virtual disks to their hosts.
14. Perform one of the following:
   a. If the source array configuration was captured with the SSSU, execute ConfigName_step2 on the source array. ConfigName is a user-assigned name given to the SSSU script at the time of creation. DR groups are re-created with the SSSU if they were performing as the source when the configuration was captured. This step may take some time to complete.
   b. If you are not using an SSSU script for recovery, re-create all DR groups on the source array, using the information recorded in the Table 6. Specify the repaired or replaced array for the destination.
15. If, in the previous step, you used the SSSU to re-create DR groups on the source array, you must manually re-create any additional DR groups that had their source on the failed hardware. This is necessary because the SSSU will not re-create the DR groups on the source array if they performed as the destination when the configuration was captured. After you perform this step, all DR groups reside on the source array.
16. If desired, set all affected DR groups from normal mode to failsafe-enabled mode.
17. Perform one of the following:
   a. If the original array configuration was captured with the SSSU, execute ConfigName_step3 on the new hardware. ConfigName is a user-assigned name given to the SSSU script at the time of creation.
   b. If you are not using an SSSU script for recovery, present the destination virtual disks on the array with new hardware to the appropriate hosts using the information you recorded in the Table 6.
18. If, in the previous step, you used the SSSU to present destination virtual disks to their hosts, manually present any additional virtual disks that originally had their sources on the failed hardware to their hosts on the array with new hardware. This is necessary because the SSSU will not present virtual disks whose destinations were the current source array when the configuration was captured. After performing this step, all destination virtual disks are presented to hosts.
19. If the repaired or replaced array is to be the source for the DR groups, fail over any DR groups using the procedure Planned failover.
20. Issue operating system commands to restart host I/O on the source array. For specifics, see Resuming I/O after failover.
21. (Optional) Set the DR groups to the desired Home setting.

Recovering from a disk group hardware failure

Disk group hardware failure occurs when a disk group loses more disks than a given Vraid type can recover from, a loss of redundancy that results in an inoperative disk group. This condition can occur from the loss of one disk for Vraid0 or, less likely, of two disks for Vraid1 and Vraid5. In each case, the hardware must be replaced, and the disk group data rebuilt. (For a complete description of disk group failures, see the EVA best practices white paper.) This section describes the symptoms and recovery of an inoperative disk group at either the source or destination array.

If an array only has one disk group, and that disk group fails, the array becomes inoperative. Reinitialize the array to manage it (see Return operations to new hardware).

If you have multiple disk groups and one fails, follow the procedure Disk group hardware failure on the source array or Disk group hardware failure on the destination array.

Failed disk group hardware indicators

If disk group hardware fails, the replication manager displays the following:
<table>
<thead>
<tr>
<th>Resource</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Array</td>
<td><img src="image" alt="Alert" /></td>
<td>Indicates the array is in an abnormal state and requires attention.</td>
</tr>
<tr>
<td>Virtual disks</td>
<td><img src="image" alt="Error" /></td>
<td>Indicates a catastrophic failure and requires immediate action.</td>
</tr>
<tr>
<td>DR groups</td>
<td><img src="image" alt="Alert" /> <img src="image" alt="Degraded" /></td>
<td>Red indicates a failure; yellow indicates the DR group is in a degraded state. Either condition requires immediate attention.</td>
</tr>
</tbody>
</table>

### Disk group hardware failure on the source array

**Possible scenario:** A hardware failure on a source array causes a disk group to become inoperative. This can be caused by the loss of enough disks to lose redundancy within the disk group and affects all Vraid types present on the disk group.

**Action summary:** If you plan to recover using data on the destination array, then fail over the destination array. Delete DR groups and virtual disks on the failed array. Repair the failed disk group. Re-create DR groups, virtual disks, and host presentations. If the failed source array was logging at the time of the hardware failure, you must recover with data at the destination site or from a backup.

There are two ways to recover from a disk group hardware failure on the source array:

- If data replication was occurring normally when the source disk group became inoperative, the data at the destination array is current and crash consistent. Fail over on the destination array, delete DR groups, repair the inoperative disk group, and re-create the DR groups. Copy data from the destination to the repaired source.

- If your disk group becomes inoperative when the DR groups are logging (for example, your DR groups were suspended, or the interswitch links are down), the data is stale but still crash consistent on the destination array (unless a full copy was in progress). Stale data is older data that is not as current as what exists on the other array. If you prefer to use stale data for recovery, the steps are the same as if replication was occurring normally. However, if you prefer to continue from a point-in-time, copy and then repair the inoperative disk group, and data is restored from a backup or full copy.

**NOTE:**

When you delete DR groups to recover from a disk group hardware failure, you lose the disaster tolerance of your data.

**Procedure:**

Perform this procedure when a disk group hardware failure occurs on the source array and the data on the destination array is current.

1. Using HP Command View EVA, navigate to each DR group on the destination array and fail over (see Unplanned failover).
2. On the failed (previous source) array, navigate to the failed disk group.
   A list of failed virtual disks and DR groups is displayed.
3. Click **Start deletion process**.

   After a prompt for confirmation, a list of failed DR groups is displayed.

4. One at a time, select the affected DR groups and click **Delete**. Deleting a DR group removes the relationship between the virtual disk members. It does not delete data from the virtual disks.

5. Select and delete the failed virtual disks that were members of the affected DR groups.

   When the deletion completes, an HP Command View EVA virtual disk Folder Properties screen is displayed, showing the virtual disk was deleted.

6. Navigate to the disk group and click **Finish**.

7. On the new source array, delete the source DR groups associated with the DR groups deleted in step 5.

8. (Optional) Repair your hard drives and re-create the disk group on the failed array. For instructions to create disk groups, see EVA and HP Command View EVA user guides.

9. Refresh the new source array, and re-create the DR groups.

10. On the repaired array (new destination), present the destination virtual disks.

11. After normalization occurs between the source and destination arrays, fail over the DR groups on the destination array, using the procedure described in **Planned failover**.

If data is logging when a source disk group hardware failure occurs, the data on the destination array is stale (not current). You have the following options:

- Recover using the stale data on the destination array (see **Disk group hardware failure on the source array**).
- Recover from a known, good point using a backup.
- If you want to perform a failover to activate the destination array before repairing the inoperative disk group, use the procedure on **Disk group hardware failure on the source array**.
- If you want to repair the inoperative disk group first, perform the repair, delete the inoperative DR groups and virtual disks on the failed system, re-create virtual disks and DR groups, and then restore your data from an external backup.
Disk group hardware failure on the destination array

Possible scenario: A hardware failure on a destination array causes a disk group to become inoperative. This can be caused by the loss of enough disks to create a loss of redundancy within the disk group and affects all Vraid types present on the disk group.

Action summary: Delete the DR groups on the source array that replicated to the failed disk group. Repair the failed disk group on the destination array. Re-create your DR groups on the source array and make host presentations at the destination array.

Your first indications that a disk group has become inoperative may be icons like those shown in Table 5, except that your destination disk group status is Unknown.

**NOTE:**

When you delete DR groups to recover from a disk group hardware failure, you lose the redundancy of the other site or disaster tolerance of your data.

Procedure:

Perform this procedure when a disk group hardware failure occurs on the destination array and the data on the source array is current.

1. Using HP Command view EVA, navigate to the failed disk group.

   A list of failed virtual disks and DR groups is displayed.

   ![Disk Group Hardware Failure window](image)

   **Figure 12 Disk Group Hardware Failure window**

2. Click **Start deletion process**.

   After a confirmation message, a list of failed DR groups appears.

3. Select an affected DR group and click **Delete**. Deleting a DR group removes the relationship between the virtual disk members. It does not delete data from the virtual disks.

4. Repeat Step 3 for each affected DR group.

5. Select failed virtual disks that were members of the failed DR groups.

   When the deletion completes, an HP Command View EVA virtual disk Folder Properties screen is displayed showing the virtual disk was deleted.

6. Navigate to the disk group and click **Finish** to resolve the disk group hardware failure.
7. On the surviving (source) array, delete the source DR group associated with the DR groups deleted in Step 3.

8. (Optional) Repair your hard drives and re-create your disk group on the destination array. (See the HP Command View EVA documentation).

9. Refresh the surviving (source) array and re-create the DR groups.

10. On the destination array, present the destination virtual disks.
This chapter describes operating system procedures that accompany remote replication procedures, especially for failover and recovery.

Resuming host I/O after failover

Procedures for detecting disk devices and restarting I/O operations after DR group failover differ among operating systems. Host operating system procedures are provided here for your convenience.

HP OpenVMS procedure to resume I/O

1. If the remote hosts are shut down, boot them now. Booting the hosts enables OpenVMS to recognize the drives.
2. If the remote hosts are not shut down, use the following command from a privileged account to enable OpenVMS to recognize the drives: `MCR SYSMAN IO AUTOCONFIGURE/LOG`

HP Tru64 UNIX procedure to resume I/O

1. If the remote hosts are shut down, boot them now. Booting the hosts enables Tru64 UNIX to recognize the drives.
2. If the remote hosts are not shut down, use the following command to recognize the drives:
   ```
   hwmgr -scan scsi
   ```
   This may take a while for large configurations. If this is the case, scan only the SCSI buses that have new units added. Scan only one bus at a time. Use the following command:
   ```
   hwmgr -scan scsi -bus x
   ```
   (where x is the SCSI bus number)

HP–UX procedure to resume I/O

1. If the remote hosts are shut down, boot them now. Booting the hosts enables HP-UX to recognize the drives. If the system is already up, you will need to execute the following command to scan for the new devices:
   ```
   # ioscan -fnCdisk
   ```
2. If the device special files are not present you would need to execute the following. This will add the special files.
   ```
   # insf -e
   ```
   A subsequent `ioscan` will return the devices with the special files.
   - Once the system is up (and disks / special files are present), you need to create the folders for the new `vgxx` devices. Create the initial directory using `mkdir` command, then make the special file using the `mknod` command.
     ```
     # mkdir <volumeGroupName>
     # mknod <volumeGroupName> group c 64 minor#
     ```
     Example:
     ```
     # mkdir /dev/vg09
     # mknod /dev/vg09/group c 64 0x090000
     ```
   - Once the folders are created, the disks show up, and special files are present, you can then use the `vgimport` to create the virtual group.
# vgimport <volumeGroupName> <deviceSpecialFiles>

Example:
```
# vgimport /dev/vg09 /dev/dsk/c18t0d /dev/dsk/c18t1d0
/dev/dsk/c25t0d0
```

- You can then attempt to display this virtual group using `# vgdisplay -v /dev/vg09`. If this returns an error about "Volume group not activated" then you will need to activate it using the `vgchange` command.
```
# vgchange -a y <volumeGroupName>
```

Example:
```
# vgchange -a y /dev/vg09
```

- You may receive errors trying to mount the failed over volume (an error stating the volume is corrupt). You will need to run a file system check (this is fairly typical as the file system may not have been properly dismounted). You can repair the device using the `fsck` command.
```
# fsck <logicalVolumeName>
```

Once the devices are clean, the devices can be mounted.

**NOTE:**

*VolumeGroupName* is the name of the volume group you originally created at the local site. The *DeviceSpecialFiles* are from the `ioscan` in the form of `/dev/dsk/c_t_d/`. For consistency, configure the same *DeviceSpecialFiles* with the same volume groups, logical volumes, and file systems for the failed–over LUNs at the remote site with the same LUNs at the local site.

---

**IBM AIX procedure to resume I/O**

1. If the remote hosts are shut down, boot them now. Booting the hosts enables AIX to recognize the drives.
2. If the remote hosts are not shut down, use the following commands to recognize the drives and verify that they are present:
   ```
   cfgmgr -v
   lsdev -Cc disk
   ```
   Use the following commands to access file systems on the failed–over virtual disks:
   ```
   importvg -y VolumeGroupName hdiskx
   mount all
   ```

**NOTE:**

*VolumeGroupName* is the name of the volume group you originally created at the local site, and `x` is the number of the hdisk assigned to the failed–over virtual disk. If the `-y VolumeGroupName` parameter is omitted, AIX creates a default volume group name for you (for example, `vg00`).

---

**Linux procedure to resume I/O**

1. Reboot the servers at the remote site.
2. Remount the file system.

Also see Bootless failover using Linux and LVM.

---

**Novell NetWare procedure to resume I/O**

- If the remote hosts are shut down, boot them now. If you are using traditional NetWare volumes, booting the hosts allows Novell NetWare to recognize the drives and automatically mount the volumes. If you are using NSS logical volumes, booting the hosts will recognize the NSS pools.
and activate them. However, you must manually mount each individual NSS volume by entering $MOUNT$ VolumeName at the NetWare console.

- If the remote hosts are already up and running, or if they do not recognize the drives, issue the following command from the console before mounting the volumes:

  $SCAN$ FOR NEW DEVICES

  Alternatively, you can use the $NWCONFIG$ utility to issue this same command.

Next, mount the volumes with the following commands:

- MOUNT ALL (for traditional NetWare volumes)
- MOUNT VolumeName (for NSS logical volumes)

Sun Solaris procedure to resume I/O

- Reboot the remote hosts using the $reboot$ -- --r command, or use the following version–dependent commands to update the Secure Path Manager:
  - Solaris 6, 7, and 8–
    - $drvconfig$ -v
    - disks
    - /opt/CPQswsp/bin/spmgr display
  - Solaris 9–
    - Present new units with LUN numbers sequentially following the old LUNs.
    - Run the following commands:
      - devfsadm -C
      - If you are using Secure Path:
        - /opt/CPQswsp/bin/spmgr display
  - If Secure Path was not configured for these units, use the following version–dependent commands to add them to the Secure Path Manager.
    - Solaris 2.6, 7, and 8 –
      - /opt/CPQswsp/bin/spconfig
      - /opt/CPQswsp/bin/spmgr/display -u
      - /opt/CPQswsp/bin/spmgr add <WWLUNID>
      - devfsadm -C
      - /opt/CPQswsp/bin/spmgr display
    - Solaris 9 –
      - Add the units with $spmgr$ add <WWLUNID> or $spmgr$ add-r WWNN all.
      - Run $update_drv$ -f sd to inform the system about attribute changes to the sd driver.
      - Run $devfsadm$ -C to create /dev entries for the new units.
  - If you are using the mpio, and it has not been configured for these devices, issue the following commands to configure the new devices:
    - Use the following $cfgadm$ command as follows to list of the paths to the LUNS.
      - # $cfgadm$ -a1 -o show_FCP_dev
      - Output:
        - c3 fc-private connected unconfigured unknown
        - c3::21000e08b0a5b65 unknown connected unconfigured unknown
        - c3::500060e802eb2b0b,0 disk connected unconfigured unknown
        - c4 fc-private connected unconfigured unknown
        - c4::21010e08b2a5b65 unknown connected unconfigured unknown
        - c4::500060e802eb2b14,0 disk connected unconfigured unknown
    - The $cfgadm$ command is used to configure the controller instances for mpxio control. Run this command for each EVA port on the storage array.
Example:
# cfgadm -c configure c3::500060e802eb2b0b
# cfgadm -c configure c4::500060e802eb2b14

**NOTE:**
The controller instance (c#) may differ between systems.

- If you are using Solaris 9, run this command to update the sd driver:
  
  ```bash
  #update_drv -f sd
  ```

- Run the devfsadm command to build the appropriate device files:
  
  ```bash
  #devfsadm -C
  ```

- If you are using Solaris 2.6, 7, or 8, reboot the host to finish configuring the new devices with the following command:
  
  ```bash
  # reboot -r
  ```

- You can now view the drives using the format command. See the current version of the multipath driver documentation, located at [http://www.sun.com/storage/san](http://www.sun.com/storage/san) for additional assistance.

- If you are using a volume manager application, import your volume groups. See your volume manager documentation.

- You may need fsck to repair any devices that were improperly dismounted.

**VMware procedure to resume I/O**

Perform these procedures as root user from the VMware server console.

1. Click **Storage Management** on the Options tab.
2. Click **Rescan SAN** and then **Refresh**.
   
   New devices will be listed on the Disks and LUNs page.

   Alternatively, you can issue the following command from the VMware server command shell:
   
   ```bash
   cos-rescan.sh <hba adapter>
   ```

   Where *hba adapter* is the VMware adapter on the SAN.

**Windows 2000/2003 procedure to resume I/O**

1. On each host, log on using an account that has administrative privileges.
2. Open Computer Management and click **Disk Management**.
3. After Disk Management has initialized, select **Actions** > **Rescan Disks**. If the units fail to appear, click **F5** (Refresh). All of the failed-over units are displayed in the right pane.

**Red Hat and SuSE Linux Lifekeeper clusters**

SuSE Linux Lifekeeper clusters must be zoned so that clustered hosts can see only one controller port per fabric. The operating system host mode of the controller must also be set to custom.

**Bootless failover using Linux and LVM**

The following procedures describe how to perform a bootless DR group failover using Logical Volume Manager (LVM) with Linux. There are separate procedures for standalone LVM and LVM with clusters (SuSE SLES 8 running LifeKeeper 4.4.3). Perform the procedures for the source host, followed by the procedures for the destination host.
NOTE:
This procedure is not supported for unplanned failovers. The term "bootless" means that after the LUNs are first presented to a destination host, which requires an initial reboot, no further reboot of that host should be required.

Source host procedure

Perform one of the following steps on the source host, depending on whether or not you are running LifeKeeper 4.4.3.

1. If you are running LifeKeeper 4.4.3, proceed to step 2. If you are not running LifeKeeper, perform the following steps:
   a. From your source host, stop I/O to your LUNs. Allow enough time for the I/O to complete before proceeding to the next step.
   b. Unmount the volumes contained in the DR group.
      Example: unmount /mounts/lvol1
   c. Change the status of the LUNs to inactive with the following command:
      vgchange VolumeGroupName -a n
      Example: vgchange vg01 -a n
   d. Make the group unknown to the system with the vgexport command.
      Example: vgexport vg01
   e. Perform a failover of the DR group using the HP Continuous Access EVA user interface.
   f. Depending on the number of LUNs, do one of the following to prevent Secure Path from detecting a failed disk:
      • For individual LUNs, run spmgr quiesce -p path (for each path visible to the LUNs).
      • For all LUNs at once, run spmgr set -p off. This method will turn off path verification for all LUNs still visible to the system.

2. If you are running LifeKeeper 4.4.3 clusters:
   a. Bring your resources "out of service" with the LifeKeeper GUI.
   b. From the system console:
      i. Enter the mount command to verify the volume is unmounted.
      ii. Enter the vgscan command to verify that the volume group is exported.
   c. Perform a failover of the DR group with the HP Continuous Access EVA user interface.
   d. Depending on the number of LUNs, do one of the following to prevent Secure Path from detecting a failed disk:
      • For individual LUNs, run spmgr quiesce -p path (for each path visible to the LUNs).
      • For all LUNs at once, run spmgr set -p off. This method will turn off path verification for all LUNs still visible to the system.

Destination host procedure

If this is the first time that LUNs are being presented to the destination host, reboot the host to pick up the new LUNs. If a reboot is not required (LUNs have been previously presented), and the paths are quiesced, issue the spmgr restart all command to unquiesce the paths.
Perform one of the following steps on the destination host, depending on whether or not you are running LifeKeeper 4.4.3.

1. If you are running LifeKeeper 4.4.3, proceed to step 2. If you are not running LifeKeeper, perform the following steps:
   a. Issue the following command to make the volume known to the system:
      
      \text{vgimport VolumeGroupName PhysicalVolumePath}
      
      Example: \text{vgimport vg01 /dev/sda1}
   
   b. Mount the file systems.
      
      Example: \text{mount –t reiserfs /dev/vg01/lvol1 /mounts/lvol1}
   
   c. Start host I/O.
   
   d. If the verification path is turned off, issue the following command:
      
      \text{spmgr set –p on}

2. If you are running LifeKeeper 4.4.3 clusters:
   a. If this is the first time LUNs are being presented to the destination host, you must build the resource hierarchies for each new LUN presented (see the documentation on the LifeKeeper CD).
   
   b. Bring your resources "out of service" with the LifeKeeper GUI.
   
   c. Start host I/O.
   
   d. If the verification path is turned off, issue the following command:
      
      \text{spmgr set –p on}
5 Managing remote replication

This chapter describes replication routine and advanced procedures.

Using remote replication in a mixed EVA environment

Specific remote replication features depend on the controller software version. The following rules apply to remote replication between an array with XCS controller software and an array with VCS controller software:

- If a feature is supported differently in the source and destination arrays, such as the supported number of virtual disks in a DR group, the more restrictive value applies to the source-destination pair.
- If a feature is not available in both arrays, the feature cannot be used in a source-destination pair.

For version-specific features and current support limits, see the EVA replication software release notes.

Managing merges and full copy

When logging occurs on a source array, there is a temporary disparity between data being processed at the local site and the data that exists at the remote site. A merge or full copy corrects this disparity when the reason for the interruption is remedied. A merge sends data from the log disk in write order so the destination copy remains crash consistent. A full copy copies data in one–MB chunks from the source virtual disk to the destination virtual disk, and data is inconsistent until the full copy is complete.

Throttling merge I/O after logging

Throttling is the channeling of merge I/O to merge critical data first by suspending and resuming specific DR groups.

When I/O has been halted and links to the remote arrays are restored, DR groups not in failsafe-enabled mode automatically resume replication. If there are dozens of DR groups with large logs, they compete for bandwidth as they try to synchronize simultaneously. By suspending noncritical DR groups, the controllers merge only the most critical data first, allowing this data to be synchronized and become accessible before the less important data. As the more important groups finish merging, resume the I/O of the groups that were suspended.

Maintaining I/O performance while merging

During a merge, the controller software manages merge writes and host I/O, completing two merge writes for every host I/O. This ratio ensures that the log empties faster than it fills. If host performance is an issue during merging, you can postpone merging to a period of low demand. Use the suspend command in the replication manager to prevent merging and then the resume command to allow merging.

Preparing for a full copy

NOTE:
A Business Copy EVA license is required for this procedure.

When a DR group log is marked for a full copy, there is a risk to the destination copy once the process begins. Creating a snapclone of the destination virtual disk before a full copy starts can eliminate this
risk. If a major failure occurs at the local site during a full copy, the snapclone provides a clean copy of data as it existed before full copy writes started on the remote array. (Any new writes that occurred on the source between the time the snapclone was created and the major failure occurred would be lost.) As a best practice, whenever a link is expected to be down more than several minutes, create a snapclone of the destination virtual disk.

**NOTE:**
You cannot use this procedure if a full copy has been started.

1. Using the replication manager, navigate to each affected DR group and suspend replication.
2. Make a snapclone of the destination virtual disks, using the procedures described in HP StorageWorks Replication Solutions Manager online help and user guide.
3. Using the replication manager, navigate to each affected DR group and resume replication. Replication will resume once links are restored.

### Optimizing performance

#### Load balancing

For best performance of remote replication, the average workload (reads and writes) should be equal on both controllers, and on both fabrics and interswitch links. To obtain this balance, take manual measurements and keep the utilization rate of each interswitch link below 40 percent. If one link fails, the average utilization of the surviving link would not exceed 80 percent. Similarly, the utilization rate of a single controller as measured on all host ports should not exceed 45 percent on average, or peak above 50 percent, to prevent overloading a surviving controller should one of them fail.

In general, let hosts manage load balancing. To support host load balancing, all members of a DR group must share a preferred controller path and HBA port pair. Load balancing a single application with all its virtual disks in a single DR group (as required) is not possible.

#### Minimize simultaneous replication events

Minimize the number of replication requests to the same array at the same time. Consider limiting access to the various management and command line interfaces. Too many simultaneous replication events can reduce array performance.

Also, avoid making multiple replication requests to the same virtual disk at the same time. Multiple replication events to the same virtual disk not only slow performance, but in the case of automated jobs, can lead to job failures. For example, if the maximum number of snapshots per virtual disk is exceeded when the job is running, the job will fail.

### Backing up replication configuration

HP recommends regular backups of replication configurations and jobs. Current backups are essential to successful disaster recovery. You can also use backups to duplicate the local configuration and jobs on remote and standby management servers and keep those servers current.

The replication manager and Storage System Scripting Utility (SSSU) provide backup methods, or you can back up your configuration manually.

### Using the replication manager for backups

The replication manager’s export feature copies the replication database, including DR groups, jobs, and the encrypted HP Command View EVA (Storage Agent) password. You can import the export file to restore the database or to duplicate the database on another management server. See *HP StorageWorks Replication Solutions Manager administrator guide* for export and import procedures.
IMPORTANT:

If the password for the HP Command View EVA instance on the remote or standby server is different from
the password imported with the local replication manager database, all storage resources on the remote
management server will be displayed in an unknown state. You must change the imported replication
manager HP Command View EVA (Storage Agent) password to match the resident HP Command View
EVA’s password, or change the password of the resident HP Command View EVA instance to match
the imported password.

Using SSSU to capture your configuration

The Storage System Scripting Utility (SSSU) Capture Configuration command copies array and DR group
configuration to the console or a user-specified file. You can use this output to re-create the configuration
after a hardware failure (see Return operations to new hardware). For more information about command
syntax and usage, see HP StorageWorks Storage System Scripting Utility reference.

Capture Configuration executes one or more of the following scripts. You can append a
user-defined name to the output file in the form UserName_StepX.txt, where StepX is one of these five
configuration text files:

• Step1A–Captures the data needed to re-create the array itself, disk groups, hosts, virtual disks that
  are not used for data replication (either source or destination), and LUNS for the disks created.
• Step1B–Captures the data needed to re-create all source virtual disks used in DR groups on this
  array. The data captured by this step is not currently used in any recovery procedure.
• Step1C–Captures the data needed to present all source virtual disks (creates LUNs) used for
  DR groups to their hosts. The data captured by this step is not currently used in any recovery
  procedure.
• Step2–Captures the data needed to re-create all replication–specific configuration information
  and DR-specific information for which the array is the source. This consists of source DR groups
  and their members only.
• Step3–Captures the data needed to create an SSSU script that will again present all remote
  virtual disks to their hosts.

Example:

You have a management server with an IP address of 111.222.333.444. You want to back up your
configuration for an array named HSV01 with the SSSU. Follow these steps:

1. Run the SSSU executable (SSSU.exe) to get a command prompt.
2. At the command prompt, log onto the management server using your user name and password. For
   example:
   
   `select manager 111.222.333.444 username=user1 password=admin`

3. Select the array whose configuration you want to save. Use the following command with your array
   name (HSV01 is the array name used in this example):

   `select system HSV01`

   The command line prompt changes to reflect your array is selected.

4. At the SSSU command prompt, enter the Capture Configuration command along with a path
   and file name where you want the configuration text files to reside. For example, to copy these files
to a folder called storage_systems\hsv01, use the command:

   `capture configuration c:\storage_systems\hsv01.txt`

   Messages on the screen confirm that each step was successfully saved.
Manually capturing your configuration

You can capture configuration information by writing it down manually. Use the following form as a guideline for capturing the information.

Record the World Wide Name (WWN) of each host HBA, array controller, and management server on local and remote sites. The WWN is a hexadecimal number on the bottom of the HBA board. Look for a small bar code label with an IEEE precursor. An example is 1000–0000–C920–A5BA. Keep a copy of the record at each site.
### Table 6 Manual configuration form

| Array name: | |
| Array WWN: | |
| Console LUN ID: | (default = 0) |

**Disk group information**

| Disk group name: | (default = default disk group) |
| Device count: | |
| Spare policy: | (none, single, or double) |
| Disk type: | (online or nearline) |
| Occupancy alarm: | (default = 95%) |

**Host information**

| Folder name: | (default = \Hosts\) |
| Host name: | |
| Operating system: | |
| For each HBA port: | WWN: |

**Virtual disk information**

| Folder name: | (default = \Virtual Disks\) |
| Virtual disk name: | |
| Disk group: | |
| Size: | |
| Redundancy level: | (Vraid0, Vraid1, Vraid5) |
| Write cache policy: | (Mirrored write–back, unmirrored write–back) |
| Read cache policy: | (On, off) |
| Read/write permissions: | (Read/write, read–only) |
| OS unit ID: | (default = 0) |
| Preferred path: | (None, Path A FO, Path A FO/FB, Path B FO, Path B FO/FB) |
| Presentation: | Host name: |
| LUN: | |

**DR group information**

| Source: | |
| Virtual disk members: | |
| Destination: | |
| Array name: | |
| Virtual disk members: | |
| Parameters: | Failsafe mode: (disabled, enabled) |
| Write mode: (synchronous, asynchronous) |
| Destination mode: (none, read-only) |
Upgrading controller software

Planning a controller software upgrade

Before upgrading array controller software, ensure that all arrays in remote replication relationships are fully functional with no failed hardware. The following additional conditions must be met:

- All arrays in remote replication relationships are running the same version of controller software in the VCS or XCS series.
- In multiple replication relationships, ensure that:
  - No more than two versions (the previous version and the new version) of the controller software that is being upgraded are running at any time.
  - No more than one version of the controller software (XCS or VCS) that is not being upgraded is running.
  - If you need to update both VCS and XCS, complete the upgrade of one before upgrading the other.
- Complete the upgrade process within one week (168 hours). The upgrade window begins with the upgrade of the first array. It concludes when all arrays in a direct or indirect replication relationship with the first array have been upgraded.
- Suspend DR group replication for the duration of the upgrade process on the destination, even if the intersite links are unavailable.
- Do not create or delete DR groups or add or remove members from DR groups while any array in a remote replication relationship is on the previous version and others are on the new version.

HP recommends upgrading controller software during the lowest I/O activity on the array.

Coordinating controller software upgrades on source and destination arrays

HP recommends the following procedure for upgrading controller software on source and destination arrays:

1. Suspend remote replication of DR groups on the source array. Logging of source DR groups will begin and there will be little, if any, remote replication to the destination array. Replication must be suspended, even if the intersite links are unavailable.
2. While source DR groups are suspended, upgrade the controller software on the destination array.
3. After upgrading the controller software on the destination array, resume remote replication of the source DR groups.
4. Wait for the source DR group logs to complete merging on the destination array.
5. When merging is complete, upgrade the controller software on the source array.

Special remote replication uses

Using DR groups and snapclones to move data

**NOTE:**

An HP Business Copy EVA license is required for the following procedure.

Use this procedure to move a copy of your data residing on a virtual disk to a remote location by the use of a snapclone. A snapclone is an exact copy of your virtual disk at the particular point-in-time it was created. The virtual disk being copied to the remote site becomes part of a DR group that can then be used as a new source virtual disk. You can use this procedure with data movement services such as:
• Data distribution—Pushing copies of data to other geographic locations to make it locally accessible.
• Data migration—Moving data to a new location or to one with a larger storage capacity.

To move data using a snapclone:

1. Make a snapclone of the virtual disk containing the data to be moved. See the online help for procedures on creating snapclones.
   
   After the snapclone is created, the link from the snapclone to its original virtual disk dissolves, and the snapclone becomes a separate virtual disk.

2. Create a DR group with the new snapclone–created virtual disk linked to the remote array where you want the data to reside. The creation of the DR group replicates the virtual disk to your desired destination.

3. Delete the source–cloned virtual disk. You have the option of keeping the remote virtual disk or deleting the remote virtual disk

4. Choose to keep remote virtual disk.

The data now resides as a new virtual disk on the remote array. It can be used as a source for another DR group, subject to the restriction that an array can be involved in a replicating relationship with only one other array.

Figure 13 provides a high–level summary of the following steps that perform data movement using a snapclone.
Using snapclones to cascade data replication across three sites

NOTE:
An HP Business Copy EVA license is required for the following procedure.

This procedure allows you to move copies of your data to a second remote location using HP Command View EVA and snapclones. The remote location can be an array without a replicating relationship to the array where the data was created. Exact copies of the virtual disks containing the data are created by using snapclones, and these are placed into a DR group for movement to the remote system.

For example, in Figure 14 a production environment contains a DR group that replicates between arrays at Site 1 and Site 2. The DR group contains two virtual disks (05–06vdisk1 and 05–06vdisk2) that are to be archived on another array (Site 3). A snapclone of each virtual disk is created on the Site 2 array. After presentation to a host (set up only for presentation purposes, but required for the creation of a DR...
group), these members are added to a DR group called DR snapclone1. This DR group now resides on a source array that replicates to the desired destination array (Site 3). At the remote location, you can remove the virtual disk members from the DR group, renamed, and archived.

**NOTE:**
For this procedure, Site 1 is called the source array, Site 2 (the destination for the DR group from Site 1) is called the intermediate array, and Site 3 is referred to as the remote array.

![Diagram showing data movement using snapclones example](CXO8261b.png)

1. HSV05 array  
2. HSV06 array  
3. HSV18 array  
4. DR group  
5. Virtual disk 1  
6. Virtual disk 2  
7. Replication  
8. Virtual disk snapclone

**Figure 14 Data movement using snapclones example**

You can perform cascaded replication using any of the following methods:
- Using the job template in the replication manager
- Manually in the replication manager
- Manually with the command line user interface (CLUI)

The following procedure describes the steps you must perform, regardless of the method you use. See the replication manager online help and the *HP StorageWorks Replication Solutions Manager Command Line User Interface reference guide* for additional instructions.

**NOTE:**
A replication manager job template is available for cascaded replication.

**Before you begin**

Before you begin the procedure, ensure that you have done the following tasks:

1. Set up DR groups at the source (site 1 in Figure 14) and the destination (site 2 in Figure 14).
2. Set up the host on the intermediate site (site 2 in Figure 14) using HP Command View EVA:
   - In the Add a Host window, enter a host name in the Host name box and a WWN in the Port WW Name box. Click the Add host tab.
An Operation completed page is displayed.

Procedure

1. Enable failsafe mode for any DR group containing more than one replication pair.
2. Set synchronous write mode for any DR groups in this procedure.
3. If normalization is occurring to members of the DR group to be moved, wait for the members to normalize.
4. If an application requires that I/O be suspended before creation of a snapclone, suspend I/O at this time.
5. Create a snapclone of each virtual disk on the intermediate array (Site 2 in Figure 14).
6. Set the DR group back to asynchronous, if applicable.
7. Set failsafe mode back to Disabled for the DR group, if applicable.
8. If the application was suspended in step 4, restart the host application.
9. Present the snapclone(s) to the host on the intermediate site (site 2 in Figure 14).
10. Place the snapcloned virtual disks into a new DR group.
11. Wait for normalization to complete.
12. Unpresent the host from the snapcloned virtual disks in the DR group on the intermediate array (Site 2 in Figure 14).
13. Remove the remaining snapcloned virtual disks from the DR group by deleting the DR group. Leave the remote virtual disks intact by not discarding them during the deletion.
14. Delete the remaining snapcloned virtual disks from the intermediate array (Site 2 in Figure 14).

Post procedure

1. In HP Command View EVA, on the remote array (Site 3 in Figure 14), change the write protection of the mirrored snapcloned virtual disks to that of no write protection.
2. Rename the virtual disk to a useful name in the HP Command View EVA interface.

The virtual disks are now available on the remote array for any purpose.
6 Troubleshooting

This chapter provides troubleshooting guidance for arrays and links between multiple sites.

Synchronizing replication manager log files

The replication manager server and host agents generate log files for job events. These detailed event log files can be helpful to HP support personnel when troubleshooting replication jobs. Ensure the usefulness of these logs by synchronizing the array clocks to the management server (see Synchronize management servers and arrays).

Troubleshooting the environment

When problems occur in remote replication operations, inspect the environment for changes. For example, look for changes in:

- Intersite network performance or bandwidth
- Application users or versions
- Number and type of applications
- Array configuration, including disk losses and subsequent reconstruction

Troubleshooting the SAN

- Use IP network analyzers to examine network performance.
- For each switch in a fabric, confirm that all host ports are on the correct fabrics.
- For each array, confirm that all controller ports are on the correct fabric.
- Check performance on each switch port.

Troubleshooting arrays

Use HP Command View EVA or the replication manager to check array status. If either array is not displayed, there could be a zoning problem. If both arrays are displayed, examine the source array first:

- Are all ports working?
- Are DR groups replicating?
- Are the source virtual disks presented correctly?

Then check the status of the destination array:

- Are all ports working?
- Are destination virtual disks and DR groups available?

When a destination array is offline

HP recommends that you suspend DR groups when the destination array is offline. This prevents potential issues such as loss of host access to source virtual disks if the source array is restarted while the destination array is unavailable. By design the array does not present virtual disks to host servers if it cannot determine the source/destination status of the remote virtual disk.

If hosts lose access to source virtual disks after the array is powered off and on, consider the possibility that the destination array is offline. To confirm, check the controller event log for the event code...
Severity: Critical – failure or failure imminent. The members of the specified Source Data Replication Group have not been presented to the host because the remote Storage System is not accessible. To resolve this situation, you can:

- Fail over the destination DR groups and present the virtual disks from the new source to the desired hosts. With this option, any data in the DR group log on the previous source array is lost. When communication is restored, the new source array will update the previous source (new destination) and any data written to the previous source in the interim will be overwritten.
- Using HP Command View EVA or HP Replication Solutions Manager, manually suspend replication on each affected DR group, and the controller software will automatically re-present the virtual disk members. When the links are repaired, allow the DR group merge process by selecting each DR group and manually resuming replication. For the procedures to suspend and resume replication, see HP Command View EVA or HP Replication Solutions Manager online help.

LUN inaccessible to host
A "stalled LUN" event (4206001b) in HP Command View EVA indicates that a LUN has been inaccessible to the host for at least four minutes, causing the LUN to be in a quiesced state. Take the following actions to troubleshoot this situation and prevent possible data loss:

1. Verify that the host still cannot access the LUN.
2. Try to resynchronize the controller from the HP Command View EVA field service page.
3. If the situation still exists, unpresent and re-present the LUN to the host.
4. If the situation still exists, restart the controller and its partner controller, if necessary.

Remote server cannot detect a destination LUN
If you have a remote server that cannot detect a destination LUN, it could be that the DR group access mode is set to "disabled." A remote server can detect a LUN with a "read-only" access mode, but cannot detect it if the mode is set to "disabled." The replication manager allows you to change the DR group’s access mode from "disabled" to "read-only," thereby allowing the remote server to detect the destination LUN. See the online help for information on editing a DR group’s properties.

DR groups in unknown state
If your DR groups are in an unknown state, check to see if you have recently imported the replication manager database from an active management server to the management server where the DR groups are in an unknown state. If so, the problem is probably that the passwords do not match on the management servers.

Tunnel thrash
Tunnel thrash is the frequent closing and opening of a tunnel while holding host I/O in the transition. This occurs when peer controllers can see each other, but cannot sustain replication data with any path, even when throttled to the minimum. Some possible causes of tunnel thrash are:

- High volumes of packet loss
- Incorrectly configured routers
- Re-routed IP circuits
- Oversubscribed circuits

Although tunnel thrash is rare, a critical event (c23670c) is generated and displayed in HP Command View EVA for each DR group that shares the affected tunnel. You must intervene to prevent possible data loss. Take the following actions to resolve this situation:

- Check all routers and look for high volumes of packet loss.
• Ensure that all router are configured correctly.
• Contact your service provider to check if the circuit has been alternate routed.
• Check to see if thrashing occurs during peak times and not during low volume times. If so, the circuit may be over subscribed and you may need to increase bandwidth.

**NOTE:**
An informational event (c22000c) is generated for an open tunnel. No action is required.

---

**Long delays or time-outs on HP–UX**

If an HP–UX host has multiple disk devices with failed or no longer presented LUNs behind them, it can take an increasingly long time to gather host information as the number of disk devices increases. If an HP–UX host exhibits time-outs on host discovery or failed jobs while waiting for host operations to complete, take the following actions:

• Check the disk devices showing long time-outs. Secure Path can display the status of the disk devices it is managing. For disk devices not managed by Secure Path, check for I/O time-outs by running an OS tool such as `diskinfo` on each disk device.

Remove any disk devices that show long time-outs, if they are no longer needed.

• If the disk devices are intentionally in this state, improve performance by modifying the I/O time-out setting for those disks with the `pvchange -t` command. HP–UX has a default I/O time-out of 30 seconds for SCSI disks. The `pvchange -t` command allows you to reduce the amount of time before a time-out occurs. Reducing the time-out decreases the amount of time a host discovery takes.
This glossary defines terms used in this guide or related to this product and is not a comprehensive glossary of computer terms.

**array**

See virtual array and storage system.

**asynchronous**

A descriptive term for computing models that eliminate timing dependencies between sequential processes. In asynchronous replication, the array controller acknowledges that data has been written at the source before the data is copied at the destination. Asynchronous replication is an optional DR group property. See also synchronous.

**bidirectional**

A descriptive term for an array that contains both source and destination virtual disks. This configuration allows multidirectional I/O flow among several arrays.

**copy set**

A source-destination pair of virtual disks.

**crash consistency**

A point-in-time view of data as if the server just crashed. Server cache is lost but stored data is recoverable.

**default disk group**

The disk group that is created when an array is initialized. The minimum number of disks the group can contain is eight. The maximum is the number of installed disks.

**destination**

The targeted recipient (for example, a DR group, array, virtual disk) of replicated data. See also source.

**disk group**

A named group of disks selected from all the available disks in an array. One or more virtual disks can be created from a disk group.

**DR group**

Data replication group. A named group of virtual disks selected from one or more disk groups so that they replicate to the same destination, fail over together, and preserve write order within the group.

**dual fabric**

Two independent fabrics providing multipath connections between Fibre Channel end devices.

**EVA**

Enterprise Virtual Array, an HP StorageWorks storage array.

**event**

A system-generated status message, resulting from a:

- User-initiated action (for example, “suspend DR group”)
- Replication or system transaction (for example, “retrieved data for storage system”)
- Job operation (for example, “job complete”)

**fabric**

A network of Fibre Channel switches or hubs and other devices.

**failover**

An operation that reverses replication direction so that the destination becomes the source and the source becomes the destination. Failovers can be planned or unplanned and can occur between DR groups, managed sets, fabrics or paths, and array controllers.

**failsafe**

A descriptive term for devices that automatically assume a safe condition after a malfunction. Failsafe DR groups stop accepting host input and stop logging write history if a member of the group becomes unreachable.
HP Continuous Access EVA is a storage-based HP StorageWorks product consisting of two or more arrays performing disk-to-disk replication, along with the management user interfaces that facilitates configuring, monitoring, and maintaining the replicating capabilities of the arrays.

**Home**
The DR group that is the preferred source in a replication relationship. By default, Home is the original source, but it can be set to the destination DR group.

**host**
A computer that runs user applications and uses the information stored on an array.

**host volume**
Storage capacity that is defined and mountable by a host operating system. In HP Replication Solutions Manager, host volumes are disks or volumes that are reported by an enabled host.

**initialization**
A configuration step that binds the controllers together and establishes preliminary data structures on the array. Initialization also sets up the first disk group, called the default disk group, and makes the array ready for use.

**LUN**
Logical unit number. Logical units are the components within SCSI targets that execute I/O commands. Virtual disks that are presented to hosts correspond to logical units and are identified by LUN IDs. See also present.

**managed set**
Selected resources grouped together for convenient management. For example, you can create a managed set to manage all DR groups whose sources reside in the same rack.

**management server**
A server where HP StorageWorks Enterprise Virtual Array (EVA) management software is installed, including HP StorageWorks Command View EVA and HP StorageWorks Replication Solutions Manager, if used. A dedicated management server runs EVA management software exclusively. Other management servers are a general-purpose server, an HP ProLiant Storage Server (NAS), and an HP OpenView Storage Management Appliance.

**merge**
The act of transferring log contents to the destination virtual disk to synchronize the source and destination.

**mount point**
The file system path and directory where a host volume is accessed.

**normalization**
The initial full copy that occurs between source and destination virtual disks.

**(to) present**
The array controller act of making a virtual disk accessible to a host computer.

**remote copy**
A replica virtual disk on the destination array.

**resource**
An object in the Replication Solutions Manager navigation pane; namely, DR groups, enabled hosts, host volumes, managed sets, storage systems, and virtual disks. Replication is performed using these resources.

**SAN**
Storage area network, a network of storage devices and the initiators that store and retrieve information on those devices, including the communication infrastructure.

**snapclone**
A copy that begins as a fully allocated snapshot and becomes an independent virtual disk. Applies only to the HP StorageWorks EVA.

**snapshot**
A nearly instantaneous copy of the contents of a virtual disk created without interruption of operations on the source virtual disk. Snapshots are typically used for short-term tasks such as backups.

**source (Home)**
A descriptive term for the virtual disk, DR group, or virtual array where an original I/O is stored before replication. See also destination.
source–destination pair  A copy set.

Storage Management Appliance  HP OpenView Storage Management Appliance, an HP hardware–software product designed to run SAN management applications such as HP StorageWorks Command View EVA and HP StorageWorks Replication Solutions Manager.

storage system  Synonymous with virtual array. The HP StorageWorks Enterprise Virtual Array consists of one or more storage systems. See also virtual array.

synchronous  A descriptive term for computing models that perform tasks in chronological order without interruption. In synchronous replication, the source waits for data to be copied at the destination before acknowledging that it has been written at the source. See also asynchronous.

UUID  Unique Universal Identifier, a unique 128–bit identifier for each component of an array. UUIDs are internal system values that users cannot modify.

VCS  Virtual Controller Software. The software in HP StorageWorks Enterprise Virtual Array controllers on specific models. Controller software manages all aspects of array operation, including communication with HP StorageWorks Command View EVA. See also XCS.

virtual array  Synonymous with disk array and storage system, a group of disks in one or more disk enclosures combined with control software that presents disk storage capacity as one or more virtual disks. See also virtual disks.

Virtual Controller Software  See VCS.

virtual disk  Variable disk capacity that is defined and managed by the array controller and presentable to hosts as a disk.

Vraid  Techniques for configuring virtual disks to provide fault tolerance and increase performance. Vraid techniques are identified by level numbers. Level Redundancy Technique

Vraid0  None Striping
Vraid1  High Mirroring
Vraid5  Medium Striping and parity

Vraid0  A virtualization technique that provides no data protection. Data chunks are distributed across the disk group from which the virtual disk is created. Reading and writing to a Vraid0 virtual disk is very fast and uses available storage to the fullest, but provides no data protection (redundancy) unless there is parity.

Vraid1  A virtualization technique that provides the highest level of data protection. All data blocks are mirrored, or written twice, on separate disks. For read requests, the block can be read from either disk, which can increase performance. Mirroring requires the most storage space because twice the storage capacity must be allocated for a given amount of data.

Vraid5  A virtualization technique that uses parity striping to provide moderate data protection. For a striped virtual disk, data is broken into chunks and distributed across the disk group. If the striped virtual disk has parity, another chunk (a parity chunk) is calculated from the data chunks and written to the disks. If a data chunk becomes corrupted, the data can be reconstructed from the parity chunk and the remaining data chunks.

XCS  The software in HP StorageWorks Enterprise Virtual Array controllers on specific models. Controller software manages all aspects of array operation, including communication with HP StorageWorks Command View EVA. See also VCS.
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