Technical Report

SnapMirror Configuration and Best Practices Guide for Clustered Data ONTAP

Mike Worthen, NetApp
March 2016 | TR-4015

Abstract

This document describes information and best practices related to configuring replication in NetApp® clustered Data ONTAP®.

Data Classification

Public

Version	Date	Document Version History
Version 3.2	October 2016	Chris Winter
Version 3.1	March 2016	Mike Worthen
Version 3.0	April 2015	Vincent Goveas
Version 2.2	November 2013	Amit Prakash Sawant
Version 2.1	July 2013	Amit Prakash Sawant
Version 2.0	April 2013	Amit Prakash Sawant
Version 1.0	February 2012	Larry Touchette

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 Overview

There are several approaches to increasing data availability in the face of hardware, software, or even site failures. Backups provide a way to recover lost data from an archival medium (tape or disk). Redundant hardware technologies also help mitigate the damage caused by hardware issues or failures. Mirroring provides a third mechanism to facilitate data availability and minimize downtime. NetApp SnapMirror® technology offers a fast and flexible enterprise solution for mirroring or replicating data over local area networks (LANs) and wide area networks (WANs). SnapMirror is a key component in enterprise data protection (DP) strategies.

1.1 Purpose and Intended Audience

This document is intended for individuals who administer, install, or support clustered Data ONTAP operating system and who intend to configure and use SnapMirror technology for data replication.

This document assumes that the reader has an understanding of the following processes and technologies:

- Storage systems administration working knowledge of clustered Data ONTAP operating system operational processes
- Storage systems administration working knowledge of NetApp features such as NetApp Snapshot® copies, NetApp FlexVol® volumes, NetApp FlexClone® volumes, and NetApp Infinite Volumes
- General knowledge of disaster recovery (DR) and data replication solutions
- Familiarity with the clustered Data ONTAP 8.3 Data Protection Guide on the NetApp Support site

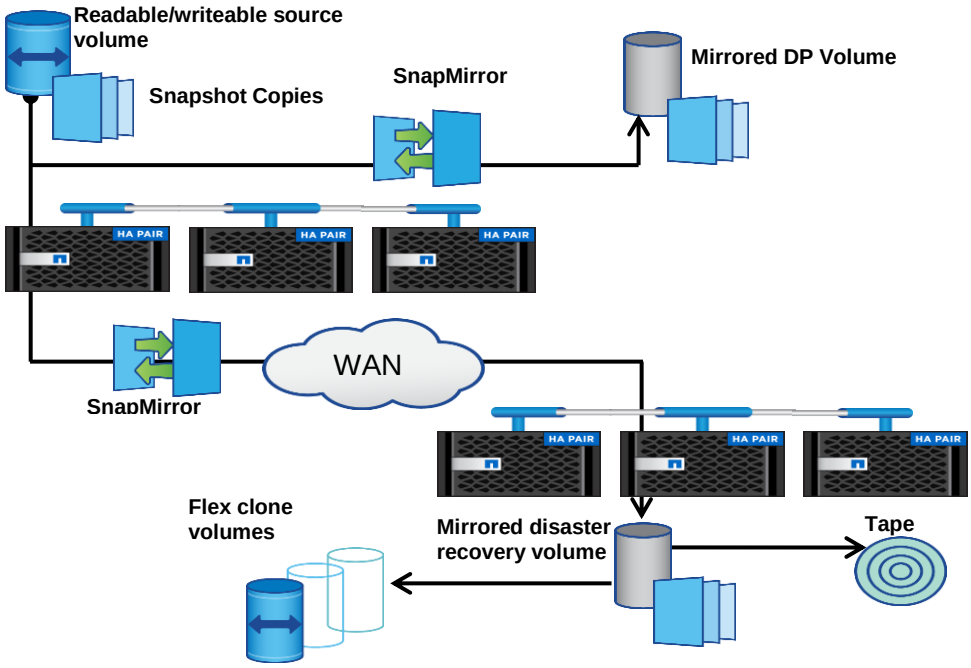
1.2 SnapMirror Unified Replication

Functionaltiy available in clustered Data ONTAP 8.3 onward removes the limitation of the destination controller needing to have a clustered Data ONTAP major version number equal to or higher than the major version of the source controller, allowing customers to have nondisrupted upgrades. In addition, the functionality only requires a single baseline and in addition reduces the number of secondary Snapshot copies needed on the destination. There are additional details regarding SnapMirror Unified Replication in section 9 of this document. Also, additional information is contained in the SnapMirror Unified Replication FAQ on the Field Portal site.

1.3 SnapMirror Uses and Benefits

Replication can be performed within the same cluster or remotely to another cluster. NetApp clustered Data ONTAP provides integrated data replication technologies for creating replica copies that can be used for DR, to offload tape backup processes from the primary, to distribute datasets to other locations, and to create read/write clones for test and development environments. For an overview of clustered Data ONTAP replication, refer to Figure 1.

Figure 1) NetApp clustered Data ONTAP replication overview.



Integrated Data Protection

DP capabilities are integrated within the NetApp Data ONTAP operating system. NetApp SnapMirror is integrated with NetApp Snapshot technology, which provides a method for quickly and efficiently creating on-disk replicas or point-in-time copies of data that do not require an actual copy operation to create.

NetApp Integrated Data Protection can be used to create an on-disk, quickly accessible history of application-consistent Snapshot copies that eliminates the concept of traditional backup windows. NetApp SnapMirror then replicates the history of Snapshot copies to the destination volumes that can be used for backup, DR, or test and development.

SnapMirror replication is efficient because it only replicates the 4KB blocks that have changed or have been added since the previous update. Additional efficiency is gained when SnapMirror is combined with NetApp storage efficiency technologies. When fabric-attached storage (FAS) deduplication is used on the primary storage, only unique data is replicated to the DR site. If compression is enabled on the source, then compression is maintained on the destination. Data is not uncompressed because it is replicated. These technologies can result in telecommunication savings and significant storage capacity savings.

SnapMirror for Disaster Recovery

SnapMirror technology is an integral part of DR plans. If critical data is replicated to a different physical location, a serious disaster does not have to result in extended periods of unavailable data. Clients can access replicated data across the network until the damage caused by the disaster is repaired. Application servers at the recovery site can access replicated data to restore operations for business-critical applications for as long as necessary to recover the production site. Recovery might include recovery from corruption, natural disaster at the production site, accidental deletion, and so on.

In cases in which a disaster requiring a failover occurs and the primary storage is not completely lost, SnapMirror provides an efficient means of resynchronizing the primary and DR sites. When the primary site is back online, SnapMirror resynchronizes the two sites, transferring only changed or new data back to the primary site from the DR site by simply reversing the SnapMirror relationships. After the primary production site resumes normal application operations, SnapMirror transfers to the DR facility resume without requiring another complete data transfer.

NetApp FlexClone Technology for Disaster Recovery Testing and Application Test/Development

NetApp FlexClone technology can be used to quickly create a read-write copy of a SnapMirror destination FlexVol volume, eliminating the need for additional copies of the data. For example, a 10GB FlexClone volume does not require another 10GB FlexClone volume; it requires only the metadata needed to define the FlexClone volume. FlexClone volumes only store data that is written or changed after a clone is created.

Data Distribution and Remote Data Access

SnapMirror technology can be used to distribute large amounts of data throughout the enterprise enabling access to data at remote locations. Remote data access provides faster access to data by clients in the remote locations; it also allows more efficient and predictable use of an expensive network and server resources because WAN usage occurs at a predetermined replication time. Storage administrators can replicate production data at a specific time to minimize overall network utilization.

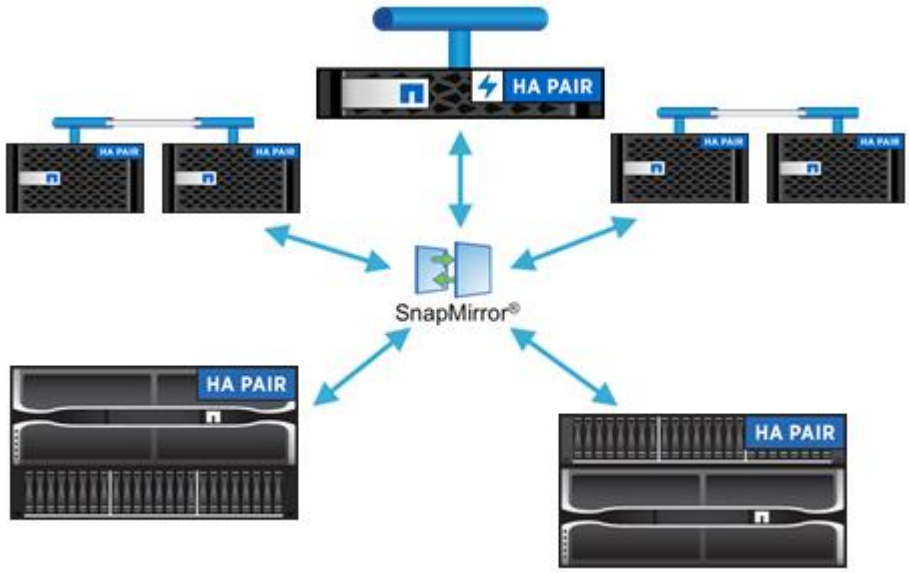
Backup Offloading and Remote Tape Archiving

SnapMirror technology can also be used for backup consolidation and for offloading tape backup overhead from production servers. This facilitates centralized backup operations, reducing backup administrative requirements at remote locations. Because NetApp Snapshot technology eliminates the traditional backup window on the primary storage system, offloading tape backup to a SnapMirror destination, as shown in Figure 1) NetApp clustered Data ONTAP replication overview., dramatically reduces the overhead of backup operations on production storage systems.

Unified Architecture Flexibility

Starting with clustered Data ONTAP 8.1 operating system, SnapMirror technology can be used between NetApp FAS and/or V-Series storage systems. Systems with different performance characteristics and different costs can be deployed at the primary and DR sites. For example, depending on the capabilities required, the DR site might contain a lower-end platform, SATA disk versus Fibre Channel (FC) disk, or the iSCSI or Fibre Channel over Ethernet (FCoE) protocol versus FC. Figure 2 illustrates the flexibility within a unified architecture.

Figure 2) Unified architecture flexibility.



A unified architecture, from low-end platforms to high-end platforms, also allows system administrators to learn and use the same management and monitoring paradigm.

2 Requirements

2.1 SnapMirror Technology Requirements

SnapMirror technology in clustered Data ONTAP operating system provides asynchronous volume-level replication based on a configured replication update interval. SnapMirror uses NetApp Snapshot technology as part of the replication process.

Clustered Data ONTAP 8.1 operating system onward provides the following replication capabilities:

- **Data protection mirrors.** Replication to create a backup copy within the same cluster (intracluster) or to create a DR copy in a different cluster (intercluster).
- **Load-sharing mirrors.** Replication from one volume to multiple volumes in the same cluster to distribute a read-only workload across a cluster. Note that Load Sharing Mirrors for data volumes are deprecated starting in ONTAP 9.1 and new relationships will be disallowed. However, Load Sharing Mirros for root volumes will continue to be supported.

Basics of SnapMirror Replication

When the scheduler triggers a replication update, the following operations are performed:

- A new Snapshot copy is created on the source volume.

  The block-level difference between the new Snapshot copy and the last replication Snapshot copy is determined and then transferred to the destination volume. This transfer includes other Snapshot copies that were created between the last replication Snapshot copy and the new one.

  When the transfer is complete, the new Snapshot copy exists on the destination volume.
- A SnapMirror destination volume is available for read-only access if it is shared using the Common Internet File System (CIFS) protocol or exported using the Network File System (NFS) protocol. A logical unit number (LUN) in the replicated volume can be made available to a client that supports connection to read-only LUNs.

Replication occurs at the volume level. Qtrees can be created in clustered Data ONTAP operating system and replicated along with the replicated volume; however, individual qtrees cannot be separately replicated.

Data Protection (DP) relationships can be resynchronized in either direction after a failover without recopying the entire volume. If a relationship is resynchronized in the reverse direction, only new data written since the last successful synchronization Snapshot copy will be sent back to the destination.

SnapMirror technology relationships in clustered Data ONTAP 8.1 operating system must be managed by a cluster administrator; administration cannot be delegated to a storage virtual machine (SVM) administrator. Starting with clustered Data ONTAP 8.2 operating system, a cluster administrator can delegate the management of SnapMirror relationships to an SVM administrator

2.2 Clustered Data ONTAP Overview

Some basic terms used in clustered Data operating system include:

- **Clustered Data ONTAP** operating system**.** The Data ONTAP operating mode that supports interconnection of nodes into a cluster.
- **Node.** A single NetApp controller, one of a high-availability pair.

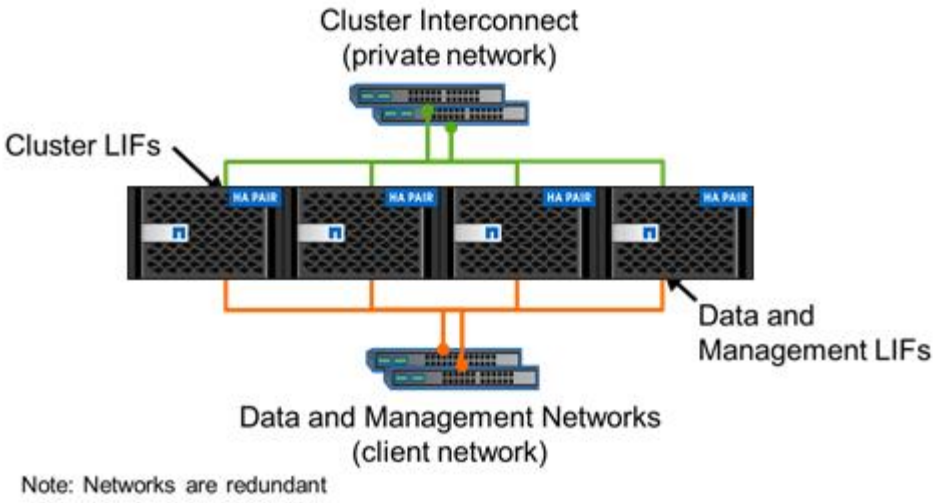
- **Cluster.** Consists of one or more nodes that are interconnected and managed as a single system.
- **Cluster interconnect.** A dedicated high-speed, low-latency, private network used for communication and replication between nodes in the same cluster.
- **Data network.** The network used by clients to access data.
- **Management network.** The network used for administration of the cluster, SVM, and nodes.
- **HA interconnect.** The dedicated interconnect between two nodes in one high-availability (HA) pair.
- **HA pair.** Two nodes configured in a pair for HA.
- **Physical Port.** A physical port such as `e0e` or `e0f` or a logical port such as a virtual LAN (VLAN) or an interface group (ifgrp).
- **Virtual Ports**
  - **Ifgrp.** A collection of physical ports combined to create one logical port used for link aggregation.
  - **VLAN** A VLAN subdivides a physical network into distinct broadcast domains. As a result, traffic is completely isolated between VLANs unless a router (Layer 3) is used to connect the networks. In clustered Data ONTAP VLANs subdivide a physical port into several separate virtual ports allowing for one of the key components of our secure multi-tenant messaging - isolation of data.

- **LIF.** A logical interface (LIF) is an IP address or a WWPN that is associated with a port. It is associated with attributes such as failover groups, failover rules, and firewall rules. A LIF communicates over the network through the port (physical or virtual) to which it is currently bound.
- **Intercluster LIF.** A LIF that is used for cross-cluster communication, backup, and replication. You must create an intercluster LIF on each node in the cluster before a cluster peering relationship can be established. These LIFs can only fail over to ports in the same node. They cannot be migrated or failed over to another node in the cluster.
- **Intercluster network.** The network used for communication and replication between different clusters.
- **Storage virtual machine (SVM).** A logical storage server that provides data access to LUNs and/or a network-attached storage (NAS) namespace from one or more logical interfaces (LIFs).

There are multiple types of networks in a clustered Data ONTAP solution, as shown in Figure 3 and Figure 4. It is important to understand for what each network type is used.

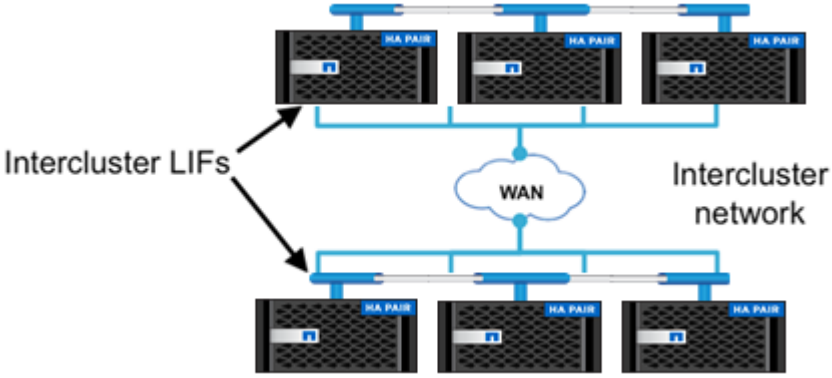
The cluster interconnect network is a dedicated, high-speed, low-latency private network used for communication and replication between nodes in the same cluster. This is a redundant back-end network that cannot be used or shared for client access to data or for managing the cluster, nodes, or SVMs. Client access to data occurs on the data network. Management of the cluster, nodes, and SVMs occurs on the management network. The data and management networks might share the same ports or physical network; however, the data and management networks must be a different physical network than the cluster interconnect network.

Figure 3) Cluster interconnect and data and management networks.



An intercluster network is a network that allows communication and replication between two different clusters operating in clustered Data ONTAP operating system, as shown in Figure 4. This network might be a network consisting of dedicated physical ports but could also be a network sharing ports with the data and/or management networks. The intercluster network is discussed in detail in the following section.

Figure 4) Intercluster network.



3 Architecture - Network Configuration for Replication Between Different Clusters

- **Cluster peering.** The act of connecting two clusters to allow replication to occur between them.
- **Intercluster logical interfaces.** Logical network interfaces used for intercluster communication.
- **Intercluster ports.** Ports dedicated to intercluster replication.

Clusters must be joined in a peer relationship before replication between different clusters is possible. Cluster peering is a one-time operation that must be performed by the cluster administrators.

Cluster peering must be performed because this defines the network on which all replication between different clusters occurs. Additionally, starting in clustered Data ONTAP 8.2 operating system, SVMs must be joined in a peer relationship before replication between different SVMs is possible.

For additional information regarding intercluster networking please refer to the Data Protection guide appropriate for the version of clustered Data ONTAP you are running. Listed below is the url for Data ONTAP 8 documentation:

http://mysupport.netapp.com/documentation/productlibrary/index.html?productID=30092

For example, the information relevant to cDOT 8.3.2 can be found on page 52 here.

3.1 Intercluster Networking

Cluster peer intercluster connectivity consists of intercluster logical interfaces (LIFs) that are assigned to network ports.

- Intercluster LIFs are node scoped; therefore, when the port hosting an intercluster LIF fails, the LIF can fail over to only another intercluster-capable port on that node, as defined by the LIF's failover policy. At least one intercluster LIF is required per node for replication between clusters. Maintain consistent settings between the intercluster LIFs (same MTUs, flow control, TCP options, and so on).
- SnapMirror replication over an FC network is not available in clustered Data ONTAP operating system.
- If a node fails while an intercluster SnapMirror transfer is in progress, the transfer automatically continues using an intercluster LIF on the surviving node of the HA pair. In clustered Data ONTAP 8.2 operating system, the same transfer will not automatically continue after the storage failover (SFO) of the destination. If SFO happens on the source, the transfer will continue. However, replication as such will continue automatically from the surviving node.

For additional information regarding intercluster networking please refer to the Data Protection guide appropriate for the version of clustered Data ONTAP you are running. Listed below is the url for Data ONTAP 8 documentation:

http://mysupport.netapp.com/documentation/productlibrary/index.html?productID=30092

For example, the information relevant to cDOT 8.3.2 can be found on page 53 here.

3.2 Cluster Peering

After the intercluster LIFs have been created and the intercluster network has been configured, cluster peers can be created. A cluster peer is a cluster that is allowed to replicate to or from another cluster.

Establishing cluster peering is a one-time operation that must be performed by the cluster administrators. A peer relationship can be created in two ways. In one method, a peer relationship is created by a cluster administrator who has security credentials (a cluster admin login and password) for the other cluster. The other method allows two administrators who do not want to exchange cluster admin passwords to peer their clusters. In this method, each administrator enters the `cluster peer create` command specifying intercluster IP addresses of the other cluster.

A cluster can be in a peer relationship with up to eight clusters, allowing multiple clusters to replicate between each other.

3.3 Cluster Peer Requirements

Cluster peer requirements include the following:

- The time on the clusters must be in sync within 300 seconds (five minutes) for peering to be successful. Cluster peers can be in different time zones.
- At least one intercluster LIF must be created on every node in the cluster.
- Every intercluster LIF requires an IP address dedicated for intercluster replication.
- The correct maximum transmission unit (MTU) value must be used on the network ports that are used for replication. The network administrator can identify which MTU value to use in the environment. The default value of 1,500 is correct for most environments.
- All paths on a node used for intercluster replication should have equal performance characteristics.
- The intercluster network must provide connectivity among all intercluster LIFs on all nodes in the cluster peers. Every intercluster LIF on every node in a cluster must be able to connect to every intercluster LIF on every node in the peer cluster.

NOTE: Please refer to TR-4182, section 3.7 for in depth information regarding cluster peering requirements and specific cluster peering configuration information.

3.4 Intercluster Multipathing and Network Redundancy

NetApp clustered Data ONTAP 8.1 operating system provides the following capabilities to configure two kinds of multipathing for intercluster SnapMirror replication:

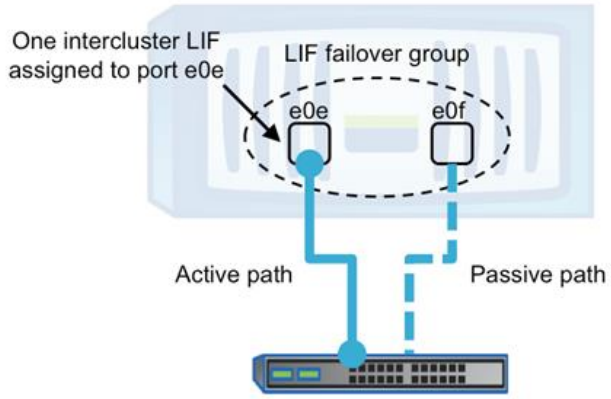
- **Active-passive.** Replication in which a particular path is used unless that path fails, in which case a different path is used.
- **Active-active.** Replication in which multiple paths are actively used at the same time. If one path fails, the surviving paths remain active, and all replication transfers continue.

Active-Passive Intercluster Multipathing in Data ONTAP

In many ways an intercluster LIF behaves in the same way as a LIF used for CIFS or NFS in terms of active-passive failover, except that an intercluster LIF cannot fail over to a port in a different node. The initial placement of a LIF on a specific port determines which port is used by that LIF. If ports are redundant for fail over on the same node, the active path is the port where the initial LIF was placed. The passive path is any port where the LIF may fail over.

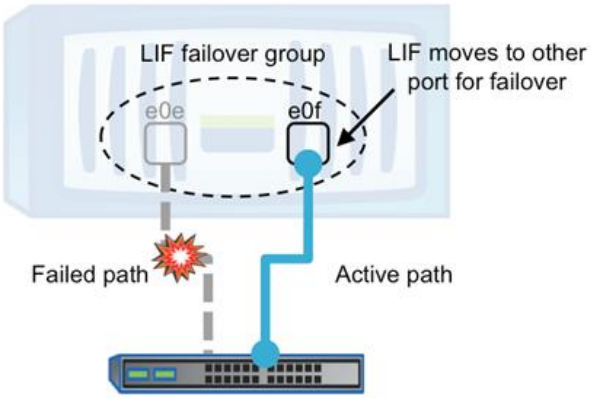
So, it can be said that a properly configured redundant LIF provides active-passive multipathing, as shown in Figure 5.

Figure 5) Active-passive multipathing.



Communication on an intercluster LIF occurs on only the port to which the LIF is assigned unless that port fails, which causes the LIF to move to another surviving port in that LIF's failover group.

Figure 6) Active-passive multipathing during LIF failover.

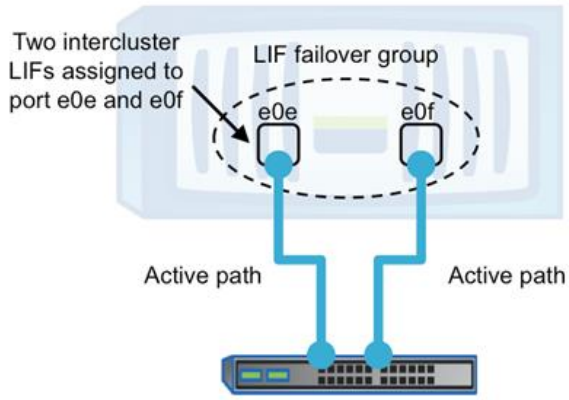


To configure active-passive multipathing, assign an intercluster LIF to an intercluster-capable port and make sure that another intercluster-capable port is configured that is capable of supporting that connection. Make sure that the LIF's failover policy is configured such that the LIF's failover group contains the necessary ports to allow failover, as shown in Figure 6.

Active-Active Intercluster Multipathing in clustered Data ONTAP

Active-active multipathing requires the configuration of additional intercluster LIFs on a node. SnapMirror uses all available intercluster LIFs on the source and destination nodes to send and receive data for all transferring SnapMirror relationships between those two nodes. If two intercluster LIFs are configured, and two ports are available for intercluster communication, then one LIF can be assigned to each port, and SnapMirror simultaneously uses both ports, as shown in Figure 17.

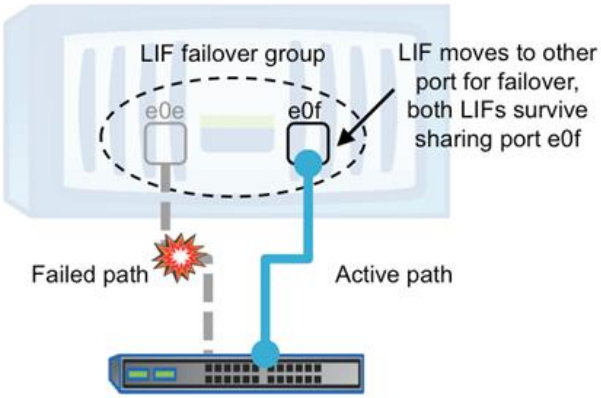
Figure 7) Active-active multipathing.



In clustered Data ONTAP 8.1 operating system, it is important that all paths on a node used in an active-active configuration for intercluster replication have equal performance characteristics. Configuring multipathing in such a way that one intercluster LIF is on a slow path and one on a fast path adversely affects performance because data is multiplexed across the slow and fast paths simultaneously. Starting in clustered Data ONTAP 8.2 operating system, SnapMirror multipathing with different types and speeds of networks is supported, without adversely affecting replication performance on the faster ports.

Communication occurs on both ports because an intercluster LIF is assigned to each port. If a port fails, the LIF that was on the failed port moves to another surviving port in that LIF's failover group. Depending on the number of ports in the failover group, multiple LIFs can now share a port, as shown in Figure 8.

Figure 8) Active-active multipathing during LIF failover.



To configure two-path active-active multipathing for SnapMirror, create two intercluster LIFs, and assign one LIF to each port. Make sure that each LIF's failover policy is configured such that the LIF's failover group contains the necessary ports to allow failover.

Depending on the replication workload between any given pair of source and destination nodes, it might be necessary to configure multiple paths on the source and destination node. There are no special configuration settings necessary to apply to each SnapMirror relationship to make use of the multipath connection. All SnapMirror relationships are automatically multiplexed across the available LIFs on the source and destination nodes.

Switch-Based Link Aggregation for Multipathing

As mentioned earlier in this document, an intercluster LIF can be assigned to any kind of port in the system, including a logical port such as an ifgrp. An ifgrp supports switch-based link aggregation. Multiple physical ports can be configured into an ifgrp, and then the intercluster LIF can be assigned to that ifgrp port. The switch ports can then be combined using link aggregation technology as a method of providing multipathing and/or redundancy.

Switch-based link aggregation does not guarantee that multiple physical paths in the ifgrp are used simultaneously. For example, assume that a single intercluster LIF is configured on both the source and destinations nodes; therefore, each node would have one IP address to use for intercluster communication and a two-port ifgrp. If the ifgrp is using an IP hash-based method of load balancing, then there is only one pair of source and destination IP addresses on which to perform the load balancing hash. The link might place all connections between these two nodes on the same path within that port group.

Keep in mind that replication can take place between multiple nodes; for example, one node might replicate different volumes to different nodes in the remote cluster. Each node has different intercluster LIFs, which have different pairs of source and destination IP addresses that enable multiple paths within the link to be used for that particular source node.

If switch-based link aggregation is used to allow multiple physical paths in the ifgrp to be used when replicating between two particular nodes, additional intercluster LIFs can be configured on either of the two nodes. Data ONTAP automatically establishes a connection between every LIF on the source and destination node for SnapMirror. This provides additional combinations of source and destination IP addresses for the load balancing hash, which could be placed on different paths within the link. However, in this example the purpose of configuring multiple LIFs on one node is to enable multiple paths to be used for replication between any two particular nodes. This would likely not be necessary in many WAN replication scenarios because WAN bandwidth might be significantly less than the bandwidth of the combined links in the ifgrp. Enabling multiple paths between two particular nodes might not be beneficial, because many nodes must share the WAN bandwidth anyway.

Best Practice

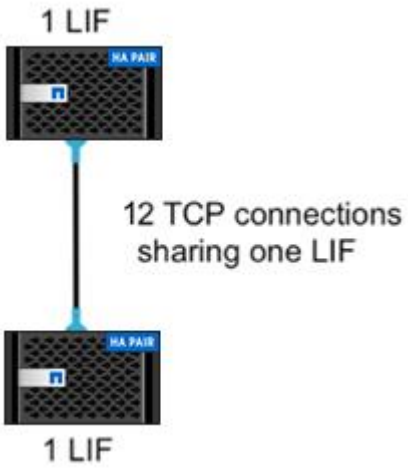
When using switch-based link aggregation, create the ifgrp with a `multimode_lacp` mode and set the distribution function of the ifgrp to `port`. Using the port value for the distribution function configures the ifgrp to distribute connections across paths by hashing the source/destination IP address, as well as the port used. This practice does not guarantee that connections will be evenly distributed across all paths in the ifgrp, but it does allow use of multiple physical links in the ifgrp.

3.5 Network Connections for Intercluster SnapMirror

In clustered Data ONTAP operating system, the number of intercluster LIFs determines the number of transmission control protocol (TCP) connections established between the source and destination node for SnapMirror. TCP connections are not created per volume or per relationship.

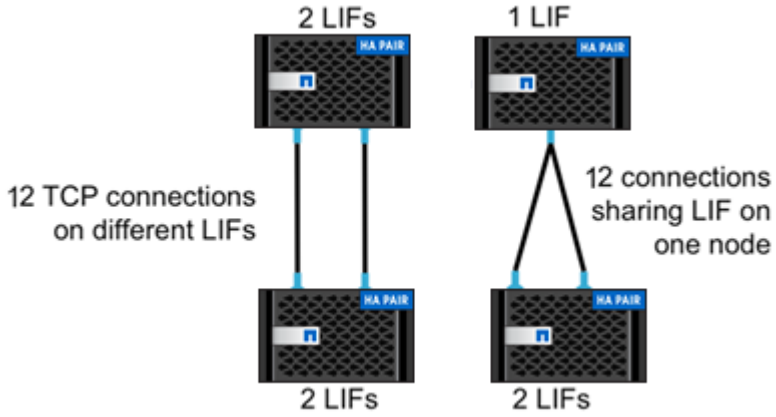
Remember that starting in clustered Data ONTAP 8.2 operating system, Data ONTAP establishes at least 12 intercluster TCP connections for sending data. A minimum of 12 TCP connections are created for sending data, as shown in Figure 9. This is true even if both the source and destination nodes have only one intercluster LIF and enough connections are created so that all intercluster LIFs on both the source and destination nodes are used.

Figure 9) TCP connections with one intercluster LIF.



If the source node, destination node, or both nodes are configured with 2 intercluster LIFs, then Data ONTAP establishes 12 TCP connections for sending data; however, instead of both connections using the same LIFs, one connection uses one LIF pair, and the other connection uses the other LIF pair, as shown in Figure 10. This example shows different combinations of intercluster LIFs that produce 12 intercluster TCP connections. It is not possible to select a specific LIF pair to use for a certain TCP connection; they are managed automatically by Data ONTAP.

Figure 10) TCP connections with two intercluster LIFs.



After scaling past 12 intercluster LIFs on a node, Data ONTAP creates additional intercluster TCP connections, creating enough so that all intercluster LIFs are used.

The creation of additional intercluster TCP connections continues as more intercluster LIFs are added to either the source or the destination node. A maximum of 24 intercluster connections are currently supported for SnapMirror on a single node in Data ONTAP

Best Practice
Although it is not required, the same number of intercluster LIFs can be configured on both the source and destination nodes for operational consistency. Multiple intercluster LIFs can be created to enable active-active multipathing across multiple physical paths, as described in the section titled “Switch-Based Link Aggregation for Multipathing.” For example, if a node is configured with four 1-Gigabit Ethernet (GbE) ports for intercluster replication, then four intercluster LIFs are required, one assigned to each port to make sure all paths are used to provide bandwidth beyond just one 1GbE link.

3.6 Determining Whether to Share or Dedicate Ports for Replication

There are a number of configurations and requirements to consider when determining whether to share or dedicate ports for replication; they include:

- **LAN type.** 1GbE or 10GbE connectivity.
- **Available WAN bandwidth (compared to LAN bandwidth).** The WAN can act as a throttle if there is significantly less available WAN bandwidth than LAN bandwidth.
- **Replication interval.** Replication during nonproduction hours may have an irrelevant impact on the data network.
- **Change rate.** The amount of data required for replication may not interfere with client data access.
- **Number of ports used by the solution.** Dedicating ports for replication requires additional switch ports and cable runs.

Refer to the appropriate “System Administration Guide for Cluster Administrators” version relevant to the version of clustered Data ONTAP you are running for additional information to help determine which option is best for your environment. Click here for the clustered Data ONTAP 8.3 version; page 317 begins the conversation regarding this step.

Best Practice
Intercluster LIFs are node scoped (they fail over to only other ports on the same node). Therefore, use a naming convention for intercluster LIFs that includes the node name followed by `ic` or `icl` for intercluster LIF: for example, `node_name_icl#` or `node-name-ic#`, depending on your preference. Also, verify that all relevant ports have access to the necessary networks or VLANs to allow communication after port failover.

3.7 Configuring Intercluster LIFs to share data ports

Refer to the appropriate “System Administration Guide for Cluster Administrators” version relevant to the version of clustered Data ONTAP you are running for a complete list of steps for configuring Intercluster LIFs to share data ports. Click here for the clustered Data ONTAP 8.3 version; page 319 begins the conversation regarding this step.

3.8 Configuring Intercluster LIFs to use dedicated ports

Refer to the appropriate “System Administration Guide for Cluster Administrators” version relevant to the version of clustered Data ONTAP you are running for a complete list of steps for configuring Intercluster

LIFs to use dedicated data ports. Click here for the clustered Data ONTAP 8.3 version; page 319 begins the conversation regarding this step.

Best Practice
As intercluster LIFs become available or unavailable, the list of active IP addresses can change. The discovery of active IP addresses is automatic in certain events, such as when a node reboots. The `-peer-addrs` option requires only one remote cluster address to be provided; however, in the event that the node hosting that address is down and it becomes unavailable, then the cluster peer relationship might not be rediscovered. Therefore, it is a best practice to use at least one intercluster IP address from each node in the remote cluster, so, in the event of a node failure, the peer relationship remains stable.

3.9 Intercluster SnapMirror Throttle

To limit the amount of bandwidth used by intercluster SnapMirror, apply a throttle to intercluster SnapMirror relationships. When creating a new relationship, a throttle can be set through the command line by adding the `-throttle` option and a value in kilobytes, by modifying an existing relationship with the `snapmirror modify command`. In this example, a 10MB throttle is applied to an existing relationship using the `snapmirror modify` command.

```
cluster02::> snapmirror modify -destination-path cluster02://vs1/vol1 -throttle 10240
```

To change the throttle of an active SnapMirror relationship, terminate the existing transfer and restart it to use the new value. SnapMirror restarts the transfer from the last restart checkpoint using the new throttle value, rather than restarting from the beginning.

Note: Starting with clustered Data ONTAP 8.2.1 operating system, intracluster throttle is supported, and it works exactly the same way as intercluster throttle.

3.10 Firewall Requirements for Intercluster SnapMirror

Open the following ports on the intercluster network between all source and destination nodes for intercluster replication:

- Port 11104
- Port 11105
- Clustered Data ONTAP operating system uses port 11104 to manage intercluster communication sessions; it uses port 11105 to transfer data.

4 Interoperability

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

5 SVM Peering

SVM peering is the act of connecting two SVMs to allow replication to occur between them (starting in clustered Data ONTAP 8.2 operating system). Cluster peering must be configured to allow any replication to occur between different clusters. In clustered Data ONTAP 8.1 operating system, any SVM could replicate data to any other SVM in the same cluster or any cluster peer. Control of replication security could be maintained at only a clusterwide level. Starting in clustered Data ONTAP 8.2 operating system, more granularity in SnapMirror security is provided. Replication permission must be defined by peering SVMs together.

Best Practice
Name an SVM with a unique fully qualified domain name (FQDN): for example, dataVserver.HQ or mirrorVserver.Offsite. SVM peering requires unique SVM names, and using FQDN naming style makes it much easier to make sure of uniqueness.

For additional information regarding SVM peering please refer to the Data Protection guide appropriate for the version of clustered Data ONTAP you are running. Listed below is the url for Data ONTAP 8 documentation:

http://mysupport.netapp.com/documentation/productlibrary/index.html?productID=30092

For example, the information relevant to cDOT 8.3.2 can be found on page 73 here.

6 SnapMirror Data Protection Relationships

Clustered Data ONTAP 8.1 operating system onward provides two types of SnapMirror relationships: DP mirrors and load-sharing (LS) mirrors. DP mirrors are discussed in this section; LS mirrors are discussed in a later section.

DP mirrors can be performed as intercluster or intracluster.

- **Intercluster DP mirrors.** Replication between volumes in two different SVMs in different clusters operating in clustered Data ONTAP operating system. They are primarily used for providing DR to another site or location.
- **Intracluster DP mirrors.** Replication between two volumes in different SVMs in the same cluster or between two volumes in the same SVM. They are primarily used for maintaining a local backup copy.

DP mirror relationships have the same characteristics regardless of whether intracluster or intercluster is being replicated. These characteristics include:

- DP mirror relationships are created and managed on the destination cluster.
- DP mirror relationship transfers are triggered by the scheduler in the destination cluster.
- Each DP mirror destination volume is a separate SnapMirror relationship that is performed independently of other DP mirror volumes; however, the same clustered Data ONTAP operating system schedule entry can be used for different DP mirror relationships.
- Destination volumes for both DP- and LS-type mirrors must be created with a volume type (`-type` option) of DP. The storage administrator cannot change the volume `-type` property after the volume has been created.
- DP mirror destination volumes are read-only until failover.
- DP mirror destination volumes can be failed over using the SnapMirror break operation, making the destination volume writable. The SnapMirror break must be performed separately for each volume.

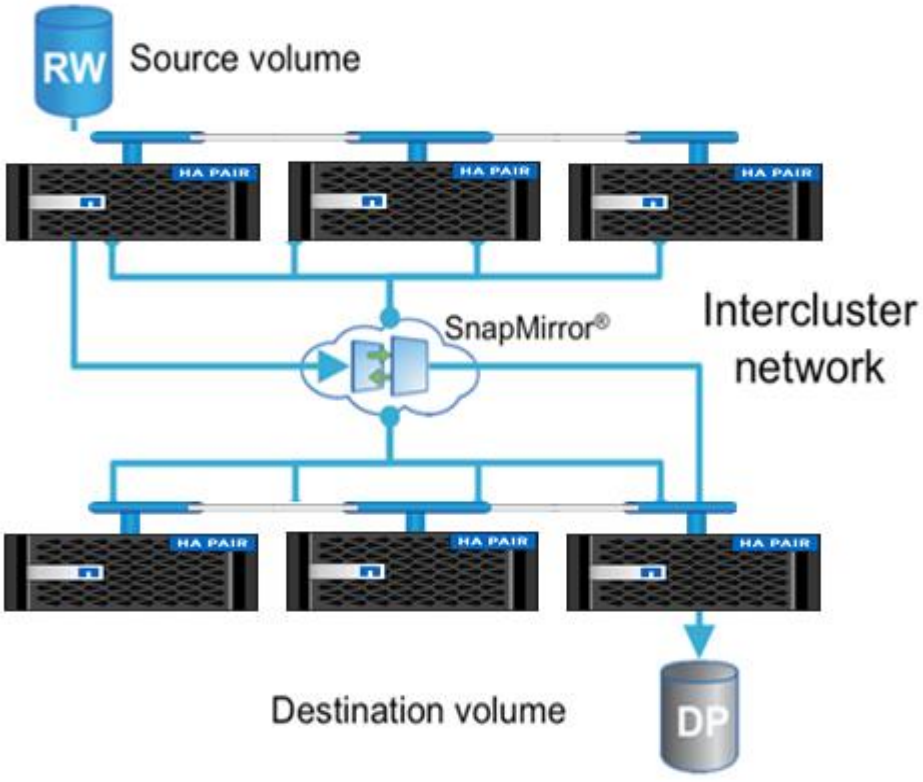
- DP mirror destination volumes can be mounted into an SVM namespace while still read-only, but only after the initial transfer is complete.
- An intercluster DP mirror destination volume cannot be mounted in the same namespace as the source volume, because intercluster DP mirror relationships are to a different cluster and therefore to a different SVM, which is a different namespace.
- An intracluster DP mirror destination volume can be mounted in the same namespace as the source volume if both the source and destination volumes exist in the same SVM; however, they cannot be mounted to the same mount point.
- LUNs contained in DP mirror destination volumes can be mapped to igroups and connected to clients; however, the client must be able to support connection to a read-only LUN.
- DP mirror relationships can be managed using the clustered Data ONTAP operating system command line interface (CLI), NetApp OnCommand System Manager 3.0, and NetApp OnCommand Unified Manager 6.0.
- If an in-progress transfer is interrupted by a network outage or aborted by an administrator, a subsequent restart of that transfer can automatically continue from a saved restart checkpoint.

Clustered Data ONTAP 8.2 operating system onward provides an additional SnapMirror relationship: XDP vault. For more information on SnapVault® in clustered Data ONTAP 8.2 operating system, refer to TR-4183.

Networks Used for SnapMirror Data Protection Relationships

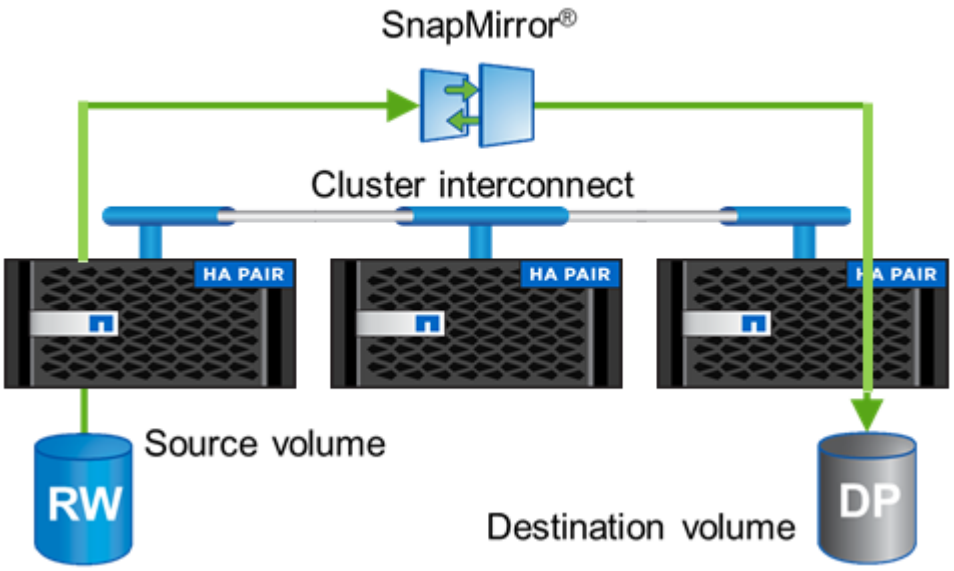
Intercluster and intracluster DP SnapMirror relationships are different based on the network that is used for sending data. Intercluster DP SnapMirror relationships use the intercluster network defined by intercluster LIFs. Figure 11 illustrates an intercluster network for SnapMirror.

Figure 11) Intercluster network for SnapMirror.



Intracluster DP mirror relationships use the cluster interconnect, which is the private connection used for communication between nodes in the same cluster. Figure 12 illustrates a cluster interconnect for intercluster SnapMirror.

Figure 12) Cluster interconnect for intercluster SnapMirror.



6.1 SnapMirror Data Protection Relationships

After the cluster peer relationship and SVM peer relationship have been successfully created between the two clusters, create the intercluster SnapMirror relationships. A peer relationship is not required to mirror data between two SVMs in the same cluster or between two volumes in the same SVM.

Both the source and destination SVMs must have the same language type setting to be able to replicate between them (in clustered Data ONTAP 8.1 operating system). Starting with clustered Data ONTAP 8.1.1 operating system, source and destination volumes MUST have the same language type. An SVM language type cannot be changed after it has been created.

Intercluster SnapMirror relationships are primarily used to provide DR capability in another site or location. If all necessary volumes have been replicated to a DR site with SnapMirror, then a recovery can be performed so that operations can be restored from the DR site.

The creation of SnapMirror relationships in clustered Data ONTAP operating system does not depend on SVM host name to IP address resolution. Whereas the cluster names are resolved through the peer relationship, the SVM names are internally resolved through the clusters. The host names of the source and destination SVM and cluster are used to create SnapMirror relationships in clustered Data ONTAP; it is not necessary to use the IP address of a LIF.

Intercluster SnapMirror Requirements

Complete the following requirements before creating an intercluster SnapMirror relationship:

- Configure the source and destination nodes for intercluster networking.
- Configure the source and destination clusters in a peer relationship.
- Create a destination SVM that has the same language type as the source SVM; volumes cannot exist in clustered Data ONTAP operating system without an SVM (in clustered Data ONTAP 8.1 operating system).

- Both the source and destination SVM can have different language types, but the source and destination volumes *MUST* have the same language type. The SVM language type can be set *ONLY* at the time of SVM creation (starting in clustered Data ONTAP 8.1.1 operating system).
- Configure the source and destination SVM in a peer relationship.
- Create a destination volume with a type of DP, with a size equal to or greater than that of the source volume.
- Assign a schedule to the SnapMirror relationship in the destination cluster to perform periodic updates. If any of the existing schedules are not adequate, a new schedule entry must be created.

SVM Fan-Out and Fan-In

It is possible to fan out or fan in volumes between different SVMs. For example, multiple different volumes from a single SVM in the source cluster might be replicated with each volume replicating into a different SVM in the destination cluster, referred to as fan-out. Alternatively, multiple different volumes might also be replicated, each existing in a different SVM in the source cluster, to a single SVM in the destination cluster, referred to as fan-in.

Best Practice
When replicating to provide DR capabilities, mirror all required volumes from a given SVM in the source cluster to a particular matching SVM in the destination cluster. Design considerations that determine that a given set of volumes should reside in the same SVM should also apply to keeping those same volumes in a like SVM at a DR site. In order for different volumes to be accessible in the same namespace, they must exist in the same SVM (an SVM is a namespace).

Volume Fan-Out and Fan-In

For SnapMirror DP relationships, a single NetApp FlexVol volume can be replicated to up to five different destination volumes. Each destination volume can exist in a different SVM, or all can exist in the same SVM; this is referred to as volume fan-out. Volume fan-in, which is replication of multiple different volumes into the same destination volume, is not possible.

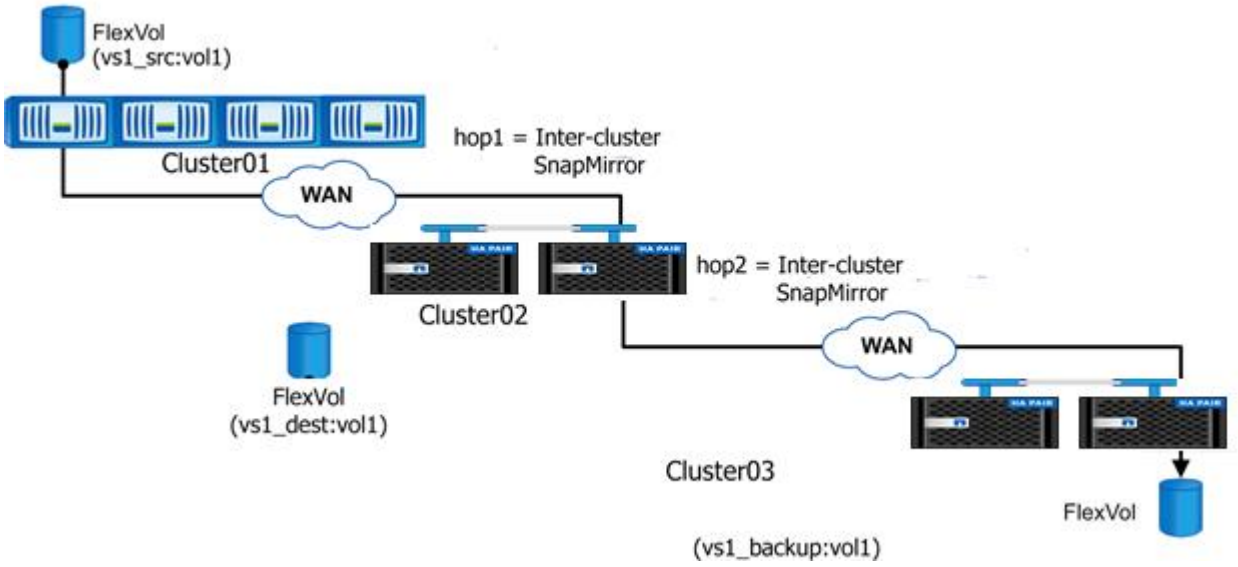
Cascade Relationships or Multihop Replication

Starting in clustered Data ONTAP 8.2 operating system, SnapMirror relationships can be cascaded. However, only one of the relationships in the cascade configuration can be a SnapVault relationship.

Cascading is defined as replicating from established replicas. Suppose there are three storage systems, A, B, and C. Replicating from A to B and from B to C is considered a cascade configuration.

An example cascade configuration with two hops is shown in Figure 13.

Figure 13) Cascaded volume replication using SnapMirror.



The function of this deployment is to make a uniform set of data available on a read-only basis to users from various locations throughout a network and to allow updating that data uniformly at regular intervals.

Note: Snapshot copy behaviors:

1. SnapMirror creates a soft lock on the Snapshot copy of the source volume (`snapmirror` tag).

Destination system carries an extra Snapshot copy.

Dual-Hop Volume SnapMirror

This configuration involves volume SnapMirror replication among three clusters.

vs1_src:vol1 → vs1_dest:vol1 → vs1_backup:vol1

Note: In the preceding configuration, vs1_src:vol1 to vs1_dest:vol1 and vs1_dest:vol1 to vs1_backup:vol1 transfers can occur at the same time.

Table 1) Snapshot copy propagation for dual-hop volume SnapMirror.

Timeline	Snapshot Copies on cluster01	Snapshot Copies on cluster02	Snapshot Copies on cluster03
1) After volume initialization on cluster02	hourly.2013-02-26_1505 snapmirror.filev1	hourly.2013-02-26_1505 snapmirror.filev1	
2) Volume SnapMirror update on cluster02	hourly.2013-02-26_1505 snapmirror.filev2	hourly.2013-02-26_1505 snapmirror.filev1 snapmirror.filev2	
3) After volume initialization on cluster03	hourly.2013-02-26_1505 snapmirror.filev2	hourly.2013-02-26_1505 snapmirror.filev1 snapmirror.filev2	hourly.2013-02-26_1505 snapmirror.filev1 snapmirror.filev2

4) Volume SnapMirror update on cluster02	hourly.2013-02-26_1505 snapmirror.filev2 snapmirror.filev3	hourly.2013-02-26_1505 snapmirror.filev2 snapmirror.filev3	hourly.2013-02-26_1505 snapmirror.filev1 snapmirror.filev2
5) Volume SnapMirror update on cluster03	hourly.2013-02-26_1505 snapmirror.filev2 snapmirror.filev3	hourly.2013-02-26_1505 snapmirror.filev2 snapmirror.filev3	hourly.2013-02-26_1505 snapmirror.filev2 snapmirror.filev3

Snapshot copy behaviors to note:

- There is an extra Snapshot copy on cluster02 (destination) after the first SnapMirror update (step 2).
- Cluster03 also has the same number of Snapshot copies as cluster02 after step 3 because there is a volume SnapMirror relationship between cluster02 and cluster03 systems.
- A new soft lock exists on cluster02 after step 3 because cluster02 is now the volume SnapMirror source for cluster03.
- After step 4, the source cluster, cluster01, contains two SnapMirror Snapshot copies. This is because the Snapshot copy 'snapmirror.filev2' is locked by cluster02 because it is required to continue to perform SnapMirror updates with cluster03. This Snapshot copy on cluster01 system is also used to perform SnapMirror resync with cluster03 system in case cluster02 system meets disaster.
- After an update is performed on cluster03 (step 5), the soft lock now exists on the latest SnapMirror Snapshot copy, 'snapmirror.filev3,' because this is the new baseline SnapMirror Snapshot copy between cluster02 and cluster03 systems.

Seeding Intercluster SnapMirror Relationships

The term seeding refers to the initial transfer of data for a newly created SnapMirror relationship.

When a new SnapMirror relationship is created using the `snapmirror create` command, an initial transfer is not automatically performed. The `create` command simply establishes the relationship and the metadata that defines it. Follow the `snapmirror create` command with the `snapmirror initialize` command to perform the initial transfer. Alternatively, use the `snapmirror initialize` command alone to perform the initial transfer as soon as the relationship is created. If the SnapMirror relationship does not exist, then the `initialize` command creates the relationship and performs the initial transfer.

NetApp OnCommand System Manager 3.0 provides the option of initializing a relationship using the SnapMirror relationship create wizard. Managing SnapMirror with System Manager is described later in this document.

6.2 Scheduling SnapMirror Updates

Clustered Data ONTAP operating system has a built-in scheduling engine similar to cron. Periodic replication updates in clustered Data ONTAP operating system can be scheduled by assigning a schedule to a SnapMirror relationship in the destination cluster. Create a schedule through the command line using the `job schedule cron create` command. This example demonstrates the creation of a schedule called `Hourly_SnapMirror` that runs at the top of every hour (on the zero minute of every hour).

```
cluster02::> job schedule cron create Hourly_SnapMirror -minute 0
cluster02::> job schedule cron show
Name                Description
----------------    ----------------------------------------------
5min                @:00,:05,:10,:15,:20,:25,:30,:35,:40,:45,:50,:55
8hour               @2:15,10:15,18:15
Hourly_SnapMirror   @:00
```



```
avUpdateSchedule     @2:00
daily                @0:10
hourly               @:05
weekly               Sun@0:15
```

The schedule can then be applied to a SnapMirror relationship at the time of creation using the `-schedule` option or to an existing relationship using the `snapmirror modify` command and the `-schedule` option. In this example, the `Hourly_SnapMirror` schedule is applied to an existing relationship.

```
cluster02::> snapmirror modify -destination-path cluster02://vs1/vol1 -schedule
Hourly_SnapMirror
```

Schedules can also be managed and applied to SnapMirror relationships using NetApp OnCommand System Manager 3.0.

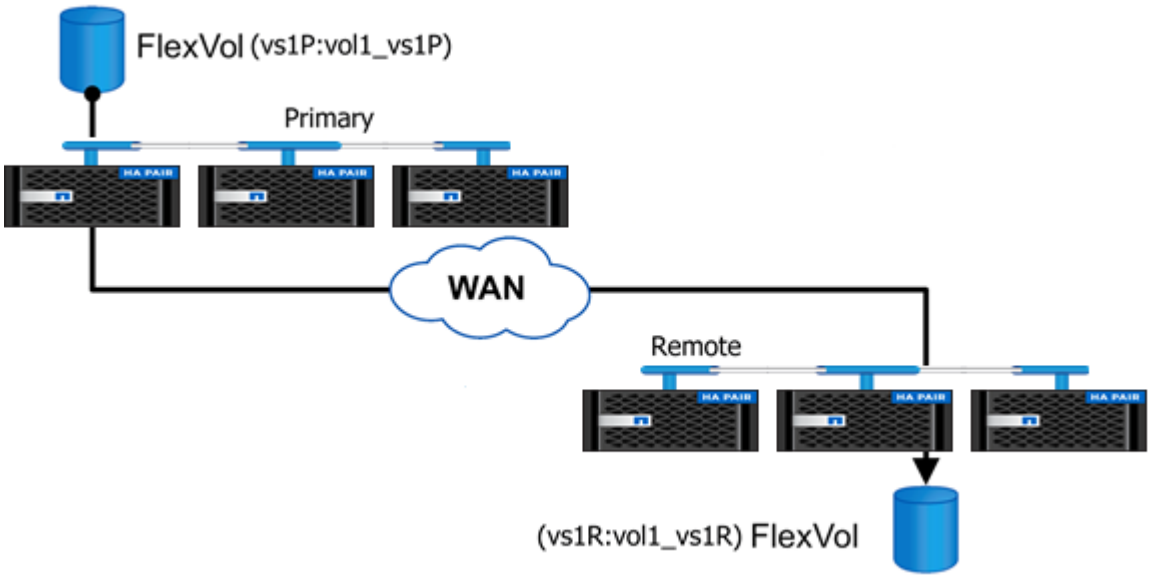
6.3 Converting a SnapMirror Relationship to a SnapVault Relationship

One scenario in which you would want to convert an existing SnapMirror relationship to a SnapVault relationship: An existing customer using SnapMirror in clustered Data ONTAP 8.1 operating system wants to make use of SnapVault in clustered Data ONTAP 8.2 operating system for longer retention.

Upgrade your source and destination clusters to clustered Data ONTAP 8.2 operating system. Your existing SnapMirror relationships will continue to remain cluster scope and will behave as they did in clustered Data ONTAP 8.1 operating system. They will not benefit from the scalability improvements unless they are deleted and recreated. However, both clustered Data ONTAP 8.1 and clustered Data ONTAP 8.2 operating systems use the block-level engine for mirrors, and it is important to note that no rebaseline will be required, only resync.

Figure 14 outlines an example based on the details from the above paragraph.. Cluster peering and SVM peering have already been setup in this example..

Figure 14) Conversion of SnapMirror relationship to SnapVault relationship.



It consists of the following steps:

1. Delete mirror (DR) relationship.

2. Break the mirror destination.
3. Create an XDP (vault) relationship between the same endpoints.
4. Perform resync between the endpoints. This will convert a DR destination to a vault destination without having to do a rebaseline.

Create a Volume on the Primary Cluster

```
Primary::> vol create -vserver vs1P -volume vol1_vs1P -aggregate aggr1_Primary_01
-size 10GB (volume create)
[Job 81] Job succeeded: Successful
```

Create a DP Volume on the Remote Cluster

```
Remote::> vol create -vserver vs1R -volume vol1_vs1R -aggregate aggr1_Remote_01
-size 10GB -type DP              (volume create)
[Job 81] Job succeeded: Successful
```

Create a SnapMirror Relationship Between the Volumes on the Primary and the Remote Clusters

```
Remote::> snapmirror create -source-path vs1P:vol1_vs1P -destination-path
vs1R:vol1_vs1R -type DP -schedule daily
Operation succeeded: snapmirror create the relationship with destination
vs1R:vol1_vs1R.
```

```
Remote::> snapmirror show
                                                                       Progress
Source            Destination  Mirror  Relationship  Total             Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1P:vol1_vs1P
            DP   vs1R:vol1_vs1R
                              Uninitialized
                                      Idle           -         true    -
1 entries were displayed.
```

Initialize the SnapMirror Relationship

```
Remote::> snapmirror initialize -destination-path vs1R:vol1_vs1R
Operation is queued: snapmirror initialize of destination vs1R:vol1_vs1R.

Remote::> snapmirror show
                                                                       Progress
Source            Destination  Mirror  Relationship  Total             Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1P:vol1_vs1P
            DP   vs1R:vol1_vs1R
                              Snapmirrored
                                      Idle           -         true    -
1 entries were displayed.
```

Conversion of SnapMirror to SnapVault

SnapMirror Delete

```
Remote::> snapmirror delete -destination-path vs1R:vol1_vs1R
Operation succeeded: snapmirror delete the relationship with destination
vs1R:vol1_vs1R.
```


SnapMirror Break

```
Remote::> snapmirror break -destination-path vs1R:vol1_vs1R
[Job 128] Job succeeded: SnapMirror Break Succeeded
```

SnapVault Create

```
Remote::> snapmirror create -source-path vs1P:vol1_vs1P -destination-path
vs1R:vol1_vs1R -type XDP
Operation succeeded: snapmirror create the relationship with destination
vs1R:vol1_vs1R.
```

```
Remote::> snapmirror show
                                                                    Progress
Source            Destination  Mirror  Relationship  Total             Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1P:vol1_vs1P
            XDP  vs1R:vol1_vs1R
                             Broken-off
                                    Idle           -         true    -
```

SnapMirror Resync

```
Remote::> snapmirror resync -destination-path vs1R:vol1_vs1R

Warning: All data newer than Snapshot copy
         snapmirror.3fd9730b-8192-11e2-9caa-123478563412_2147484699.2013-02-28_1
         10732 on volume vs1r:vol1_vs1r will be deleted.
         Verify there is no XDP relationship whose source volume is
         "vs1R:vol1_vs1R".  If such a relationship exists then you are creating
         an unsupported XDP to XDP cascade.
Do you want to continue? {y|n}: y
[Job 133] Job succeeded: SnapMirror Resync Transfer Queued
```

```
Remote::> snapmirror show
                                                                    Progress
Source            Destination  Mirror  Relationship  Total             Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1P:vol1_vs1P
            XDP  vs1R:vol1_vs1R
                             Snapmirrored
                                    Idle           -         true    -
```

After completing the preceding steps, you would adjust the schedules and policies accordingly to keep desired Snapshot copies on the vault destination. Also, you cannot make a SnapVault destination volume read/write for use as a DR volume.

7 Managing SnapMirror Data Protection Relationships with NetApp OnCommand System Manager

NetApp OnCommand System Manager 3.0 can be used for creating and managing SnapMirror DP relationships. System Manager includes a wizard used to create SnapMirror DP relationships, create schedules to assign to relationships, and create the destination volume, all within the same wizard.

However, the capability to create and manage LS mirrors and manage SnapMirror throttle settings is not available in System Manager 3.0.

Note:

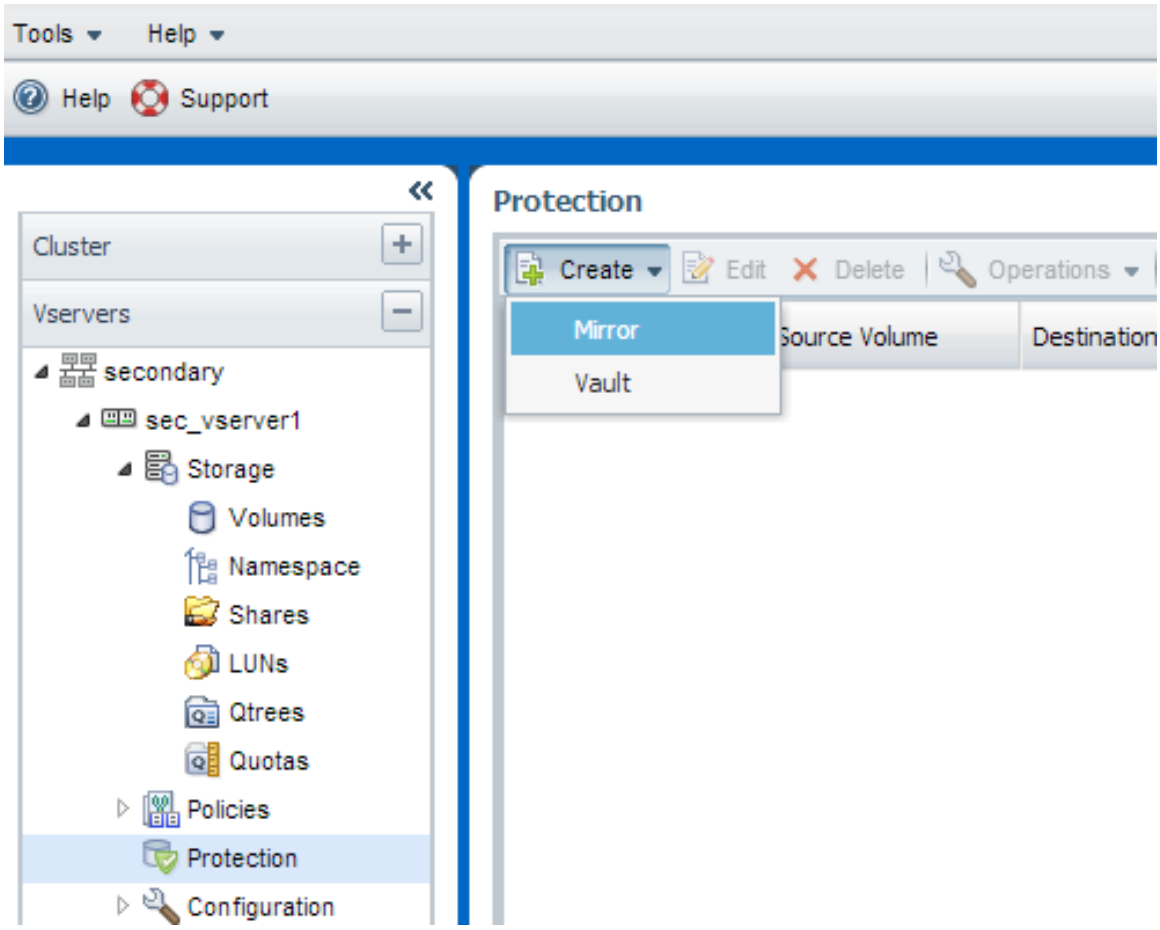
- Starting with clustered Data ONTAP 8.2 operating system, a cluster administrator can delegate the management of SnapMirror relationships to an SVM administrator. Prior to this version SnapMirror relationships must be managed by a cluster administrator.

7.1 Creating a SnapMirror Relationship in System Manager

This section describes how to create a SnapMirror relationship using System Manager. In this example, a new relationship is created to mirror volume `vol1` from SVM `vs1_src` in cluster `Cluster01` to SVM `vs1_dest` in cluster `Cluster02`.

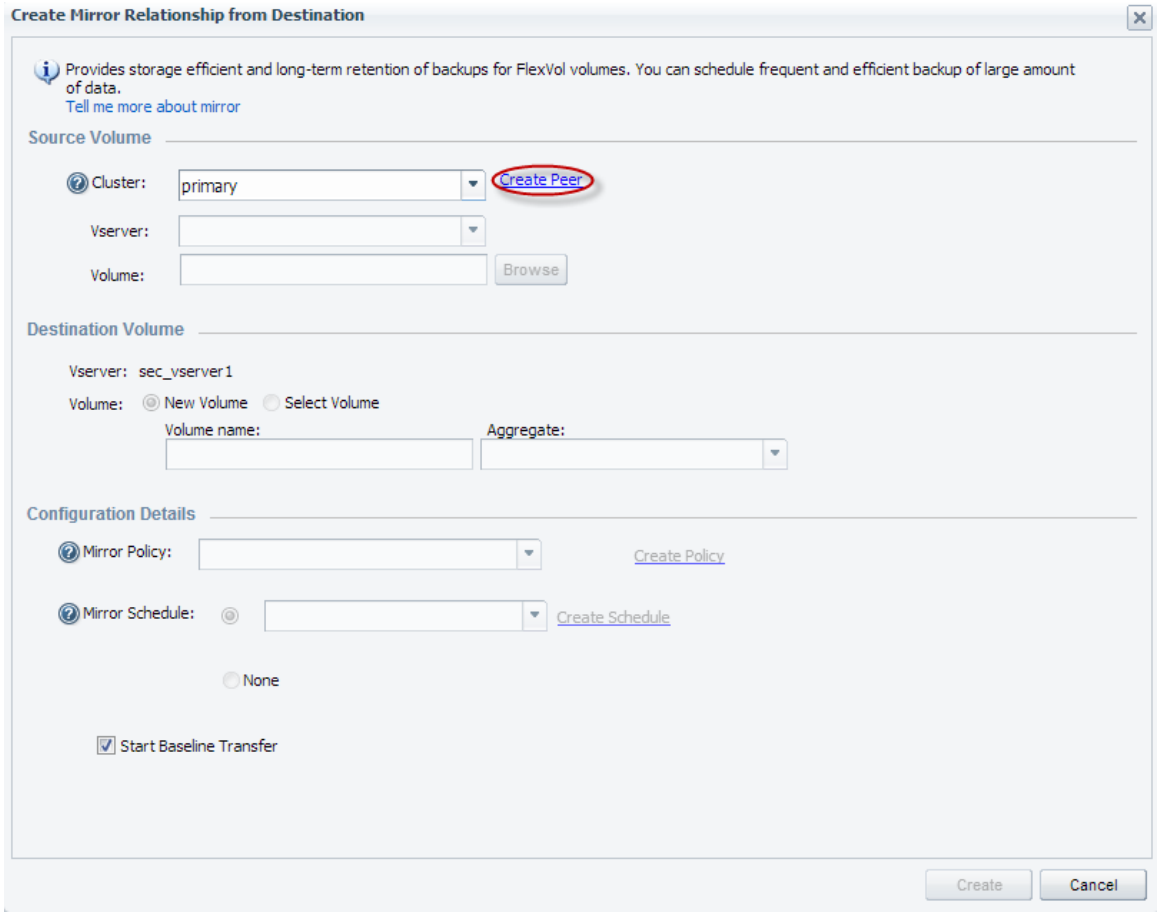
1. In System Manager 3.0, a new relationship can be created from only the destination cluster. In this example, the destination SVM named `vs1_dest` is selected. Click Vserver > Protection > and then click Create.

Figure 15) Create SnapMirror relationship from destination: select mirror.



2. Using System Manager, a relationship can be created from only the destination cluster; therefore, identify the source cluster `cluster01`.

Figure 16) Create SnapMirror relationship from destination: select source cluster.



3. Next, select the source cluster. If credentials for the source cluster have already been stored in System Manager, or if System Manager is already logged in to that cluster, then the cluster credentials are automatically entered. Otherwise, enter the source cluster credentials. If cluster peering is not established, peer the clusters.

Figure 17) Create SnapMirror relationship from destination: cluster peering.

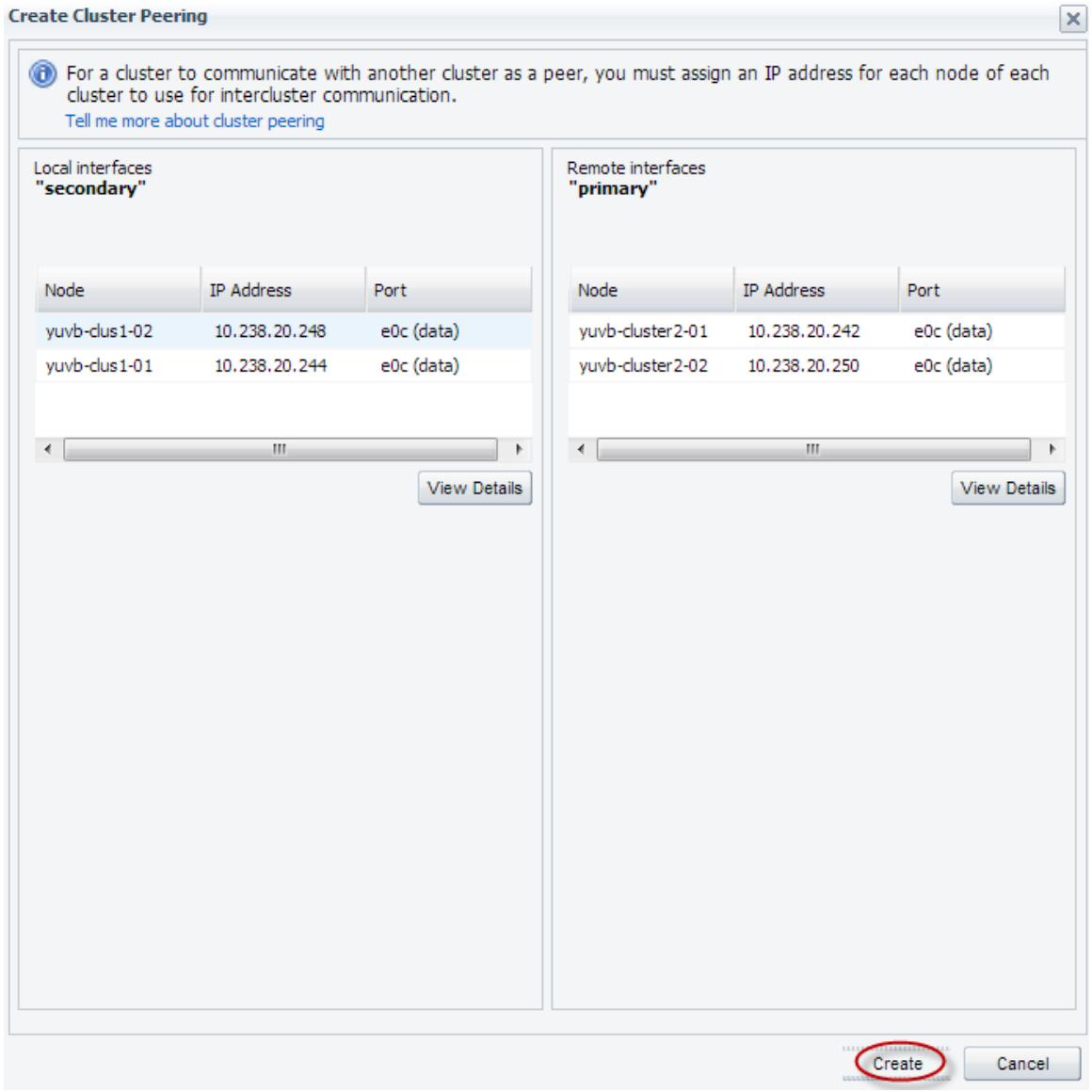
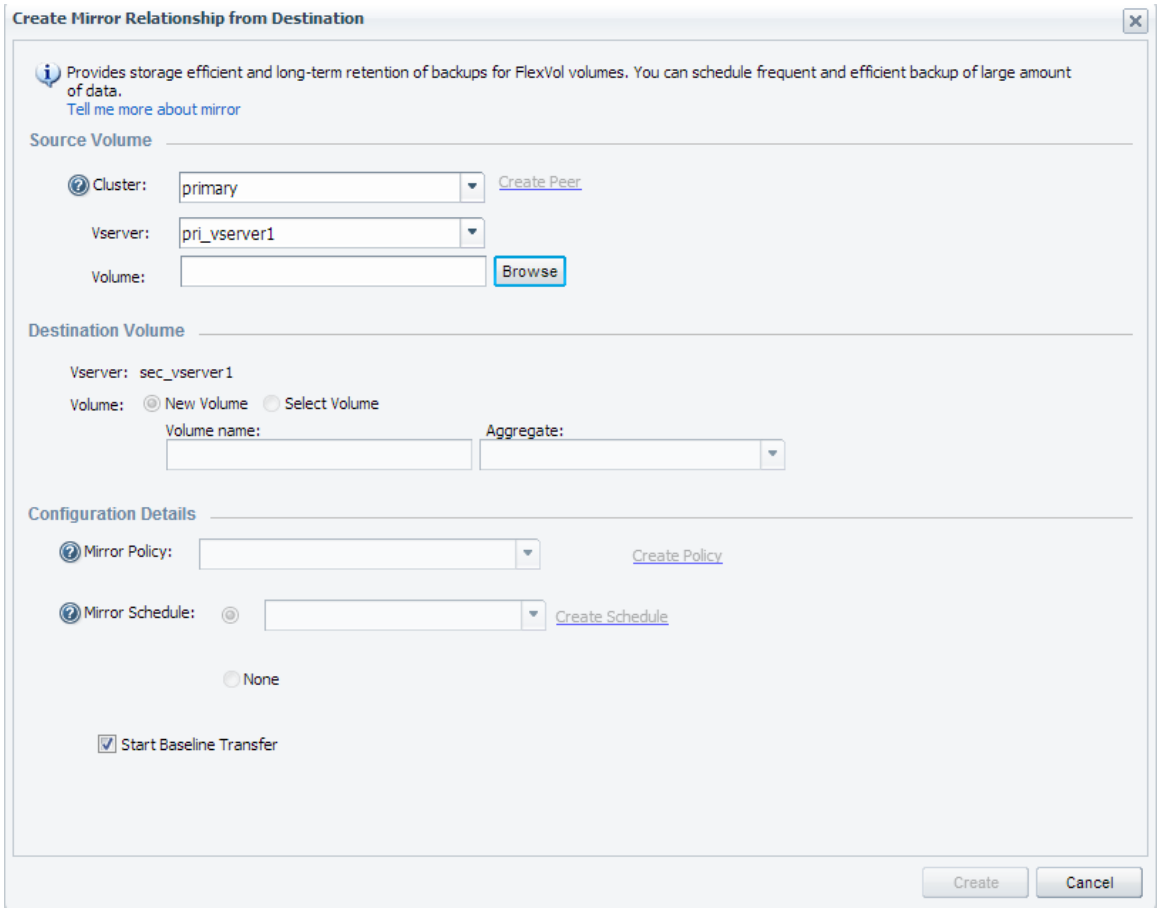
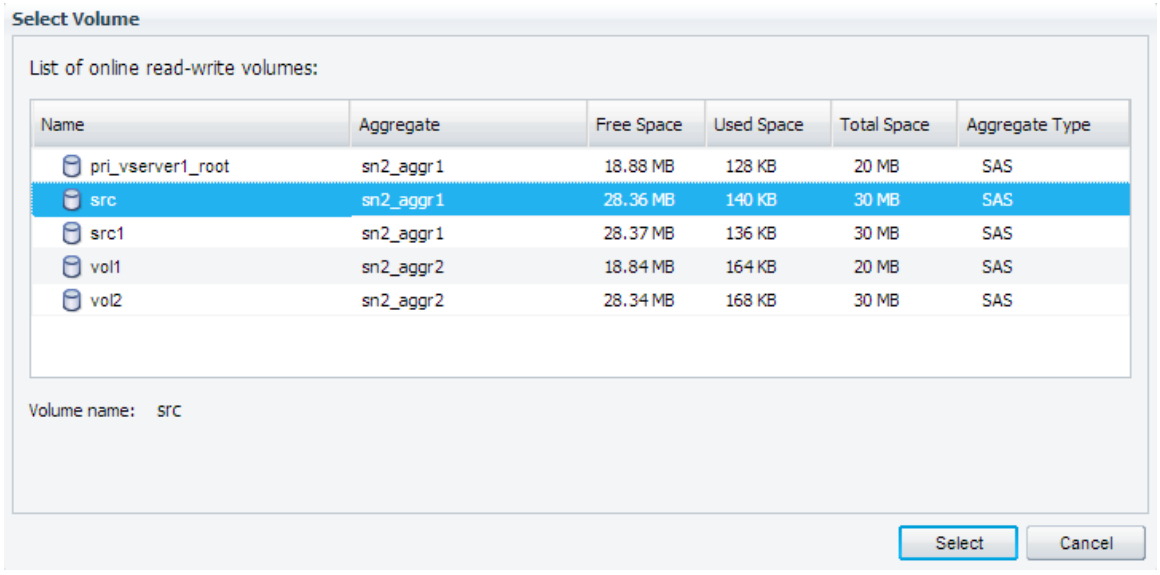


Figure 18) Create SnapMirror relationship from destination: select source SVM.



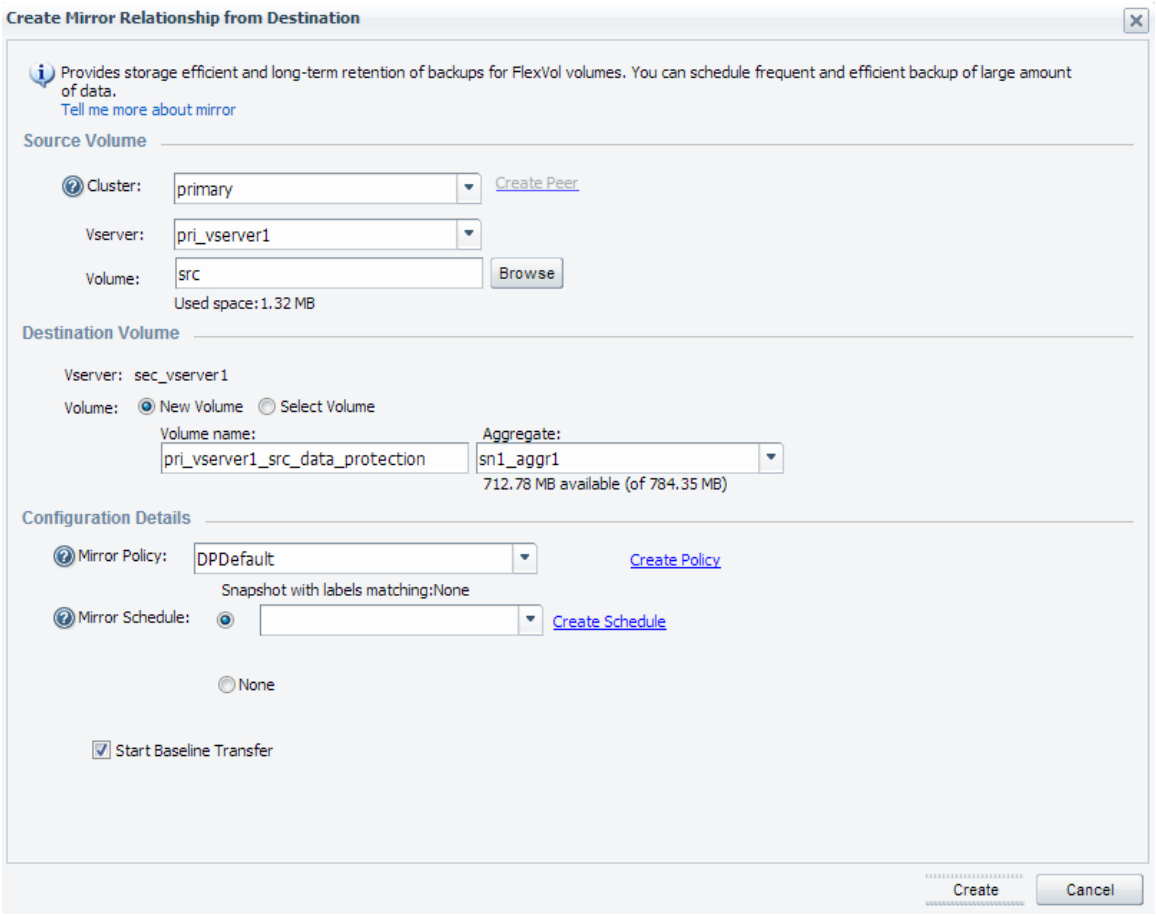
4. Select a source SVM. If the source SVM is not peered with the destination SVM, then System Manager 3.0 will prompt you to peer the two SVMs.

Figure 19) Create SnapMirror relationship from destination: select source volume.



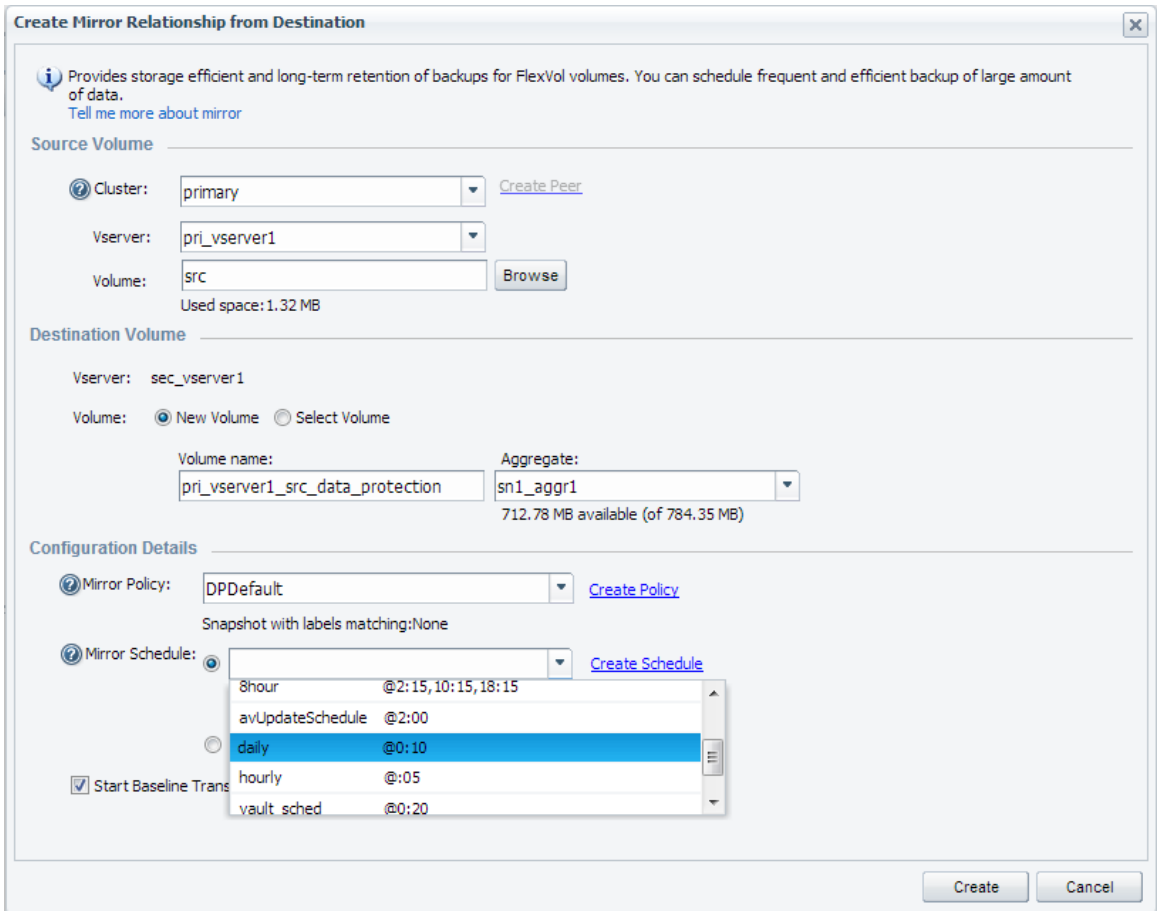
5. Select an existing volume on the source SVM.

Figure 20) Create SnapMirror relationship from destination: select destination volume.



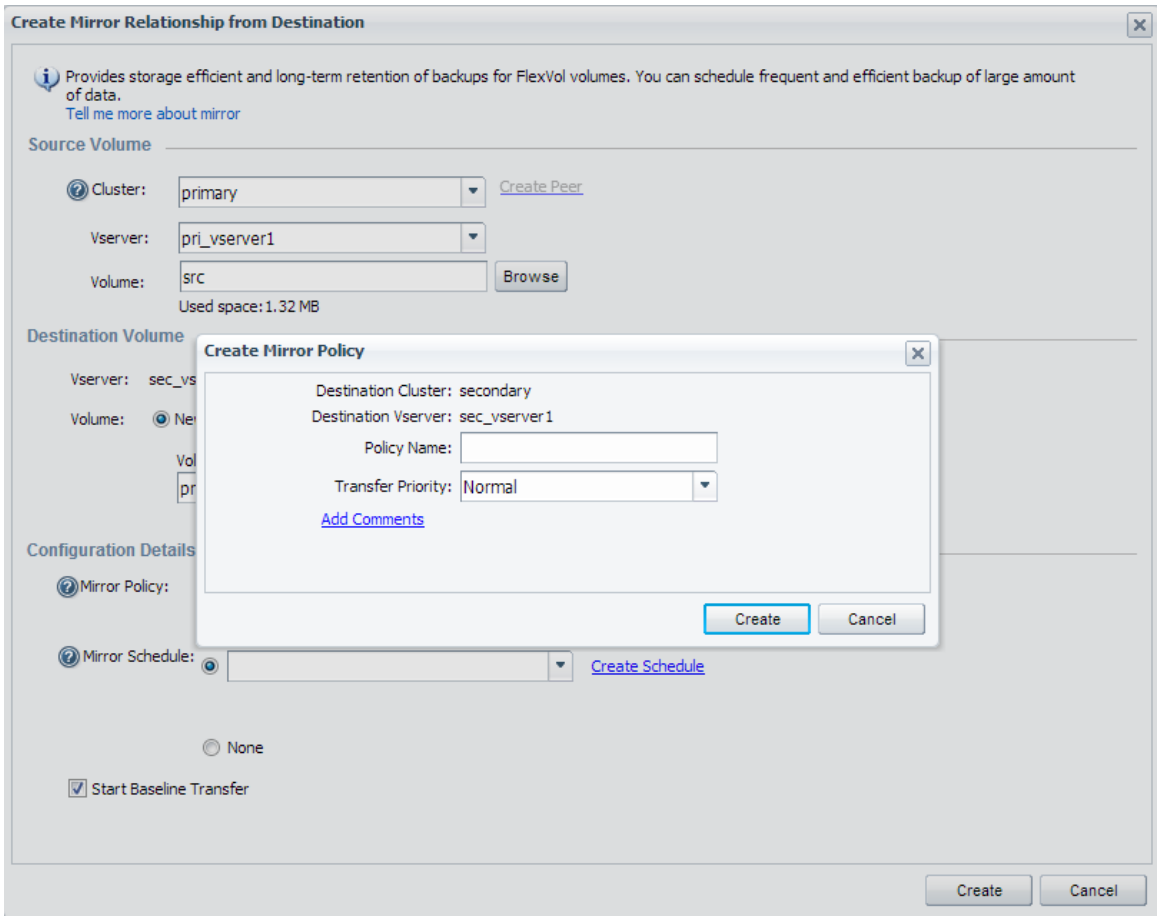
6. Select the destination volume on the destination SVM or create a destination volume on the destination SVM.

Figure 21) Create SnapMirror relationship from destination: select or create SnapMirror policy and schedule.



7. Select an existing SnapMirror policy or create a new policy (default policy is *DPDefault*). Select an existing SnapMirror schedule or create a new schedule.

Figure 22) Create SnapMirror relationship from destination: create new SnapMirror policy.



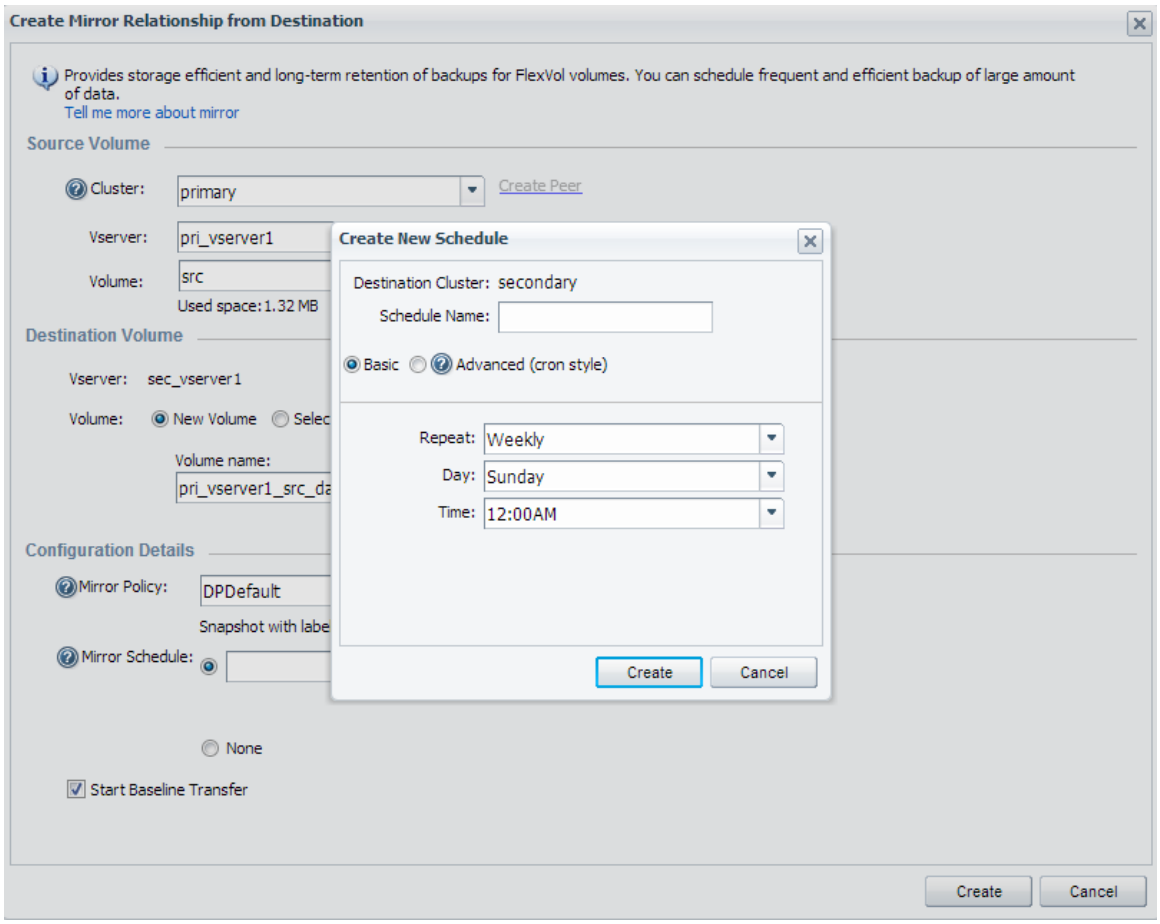
8. Create a new SnapMirror policy. Transfer priority has two levels: normal and low (default is normal).

   Transfer priority can be changed at any time; it affects the next operation. It comes into effect when there are enough operations pending on a node such that the meter* is filled. Low-priority operations get delayed by few minutes even if the meter is empty. They are delayed by one minute.

NOTE regarding "meter*"

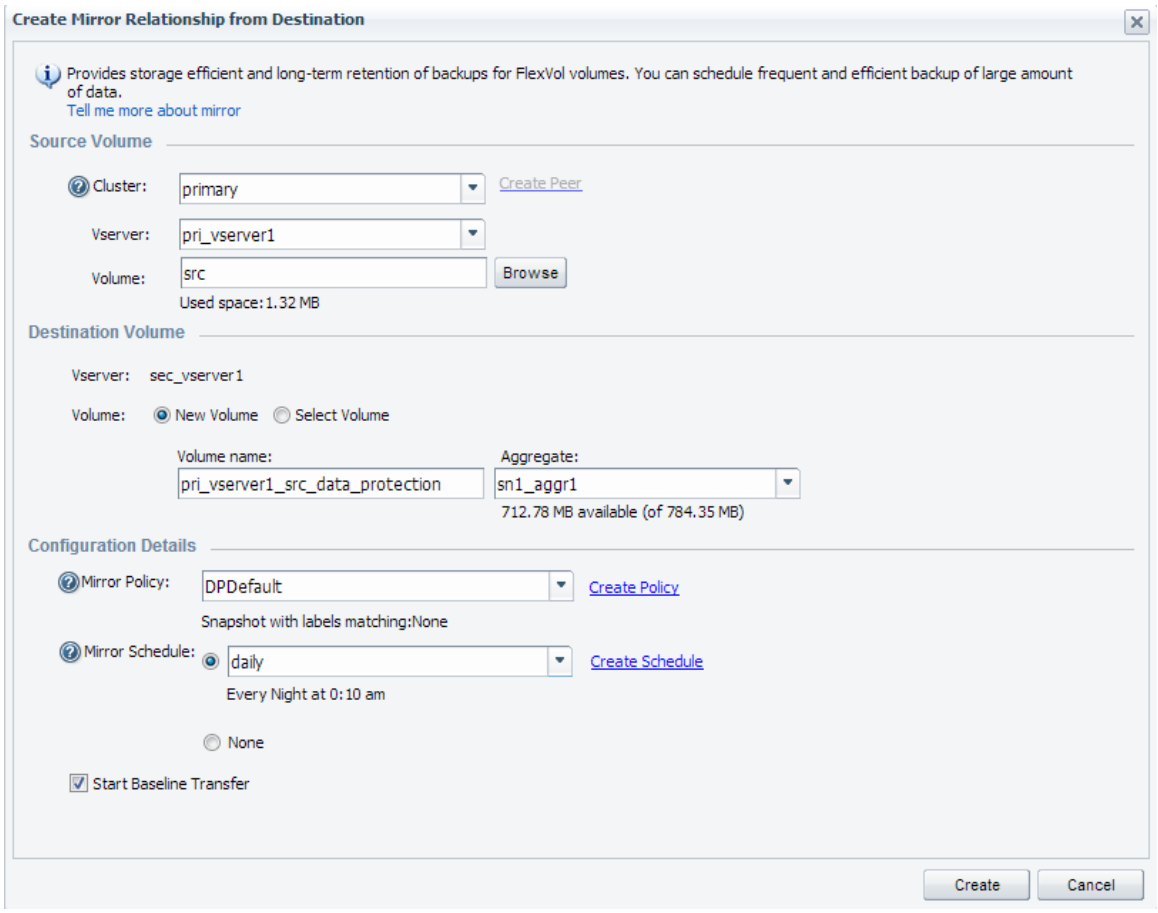
Meter value depends on the platform and memory. The value for high-end platforms with more than 8GB of memory is 100 and for low-end and midrange platforms with less than or equal to 8GB of memory is 20. Part of the meter can be reserved for SnapMirror and part for SnapVault. By default there is no reservation.

Figure 23) Create SnapMirror relationship from destination: create new SnapMirror schedule.



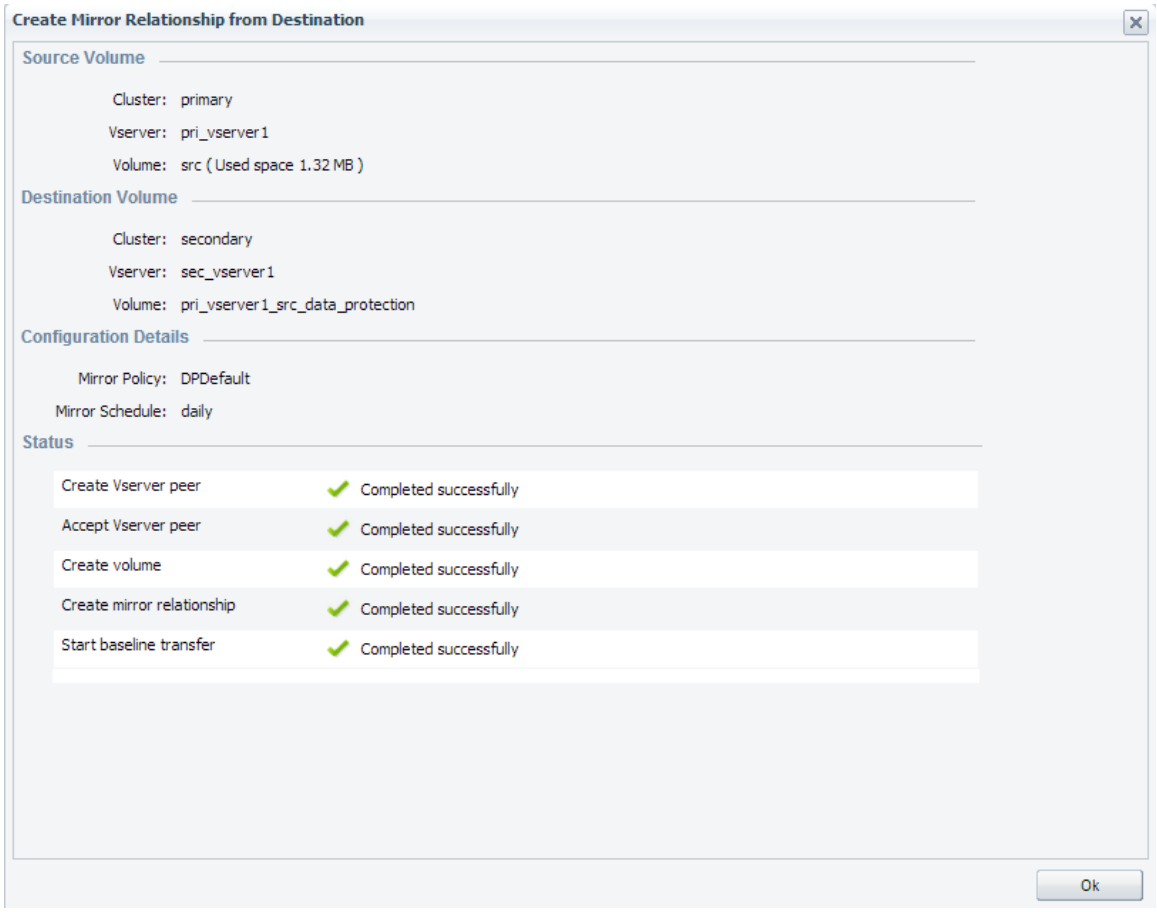
9. Create a new SnapMirror schedule.

Figure 24) Create SnapMirror relationship from destination: start baseline transfer.



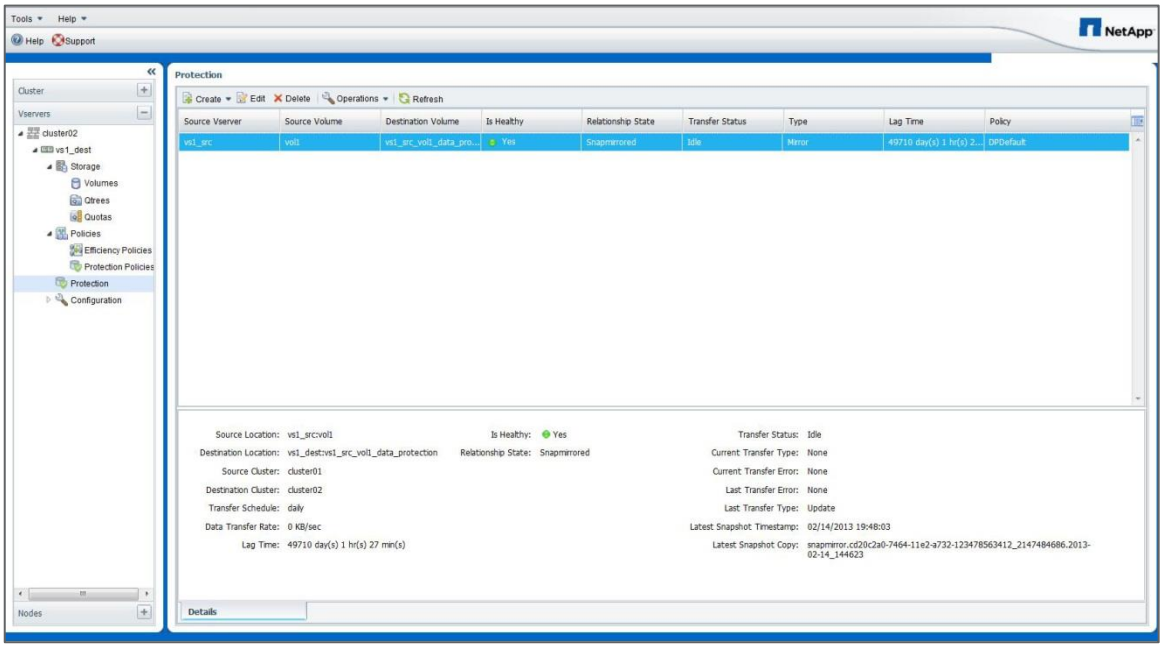
10. To automatically start the SnapMirror initialization (initial baseline copy) after the relationship is created, check the Start Baseline Transfer checkbox.

Figure 25) Create SnapMirror relationship from destination: summary of SnapMirror relationship configuration and status.



11. The wizard displays a summary of the SnapMirror relationship configurations and the status of the SnapMirror relationship.

Figure 26) SnapMirror baseline transfer details.

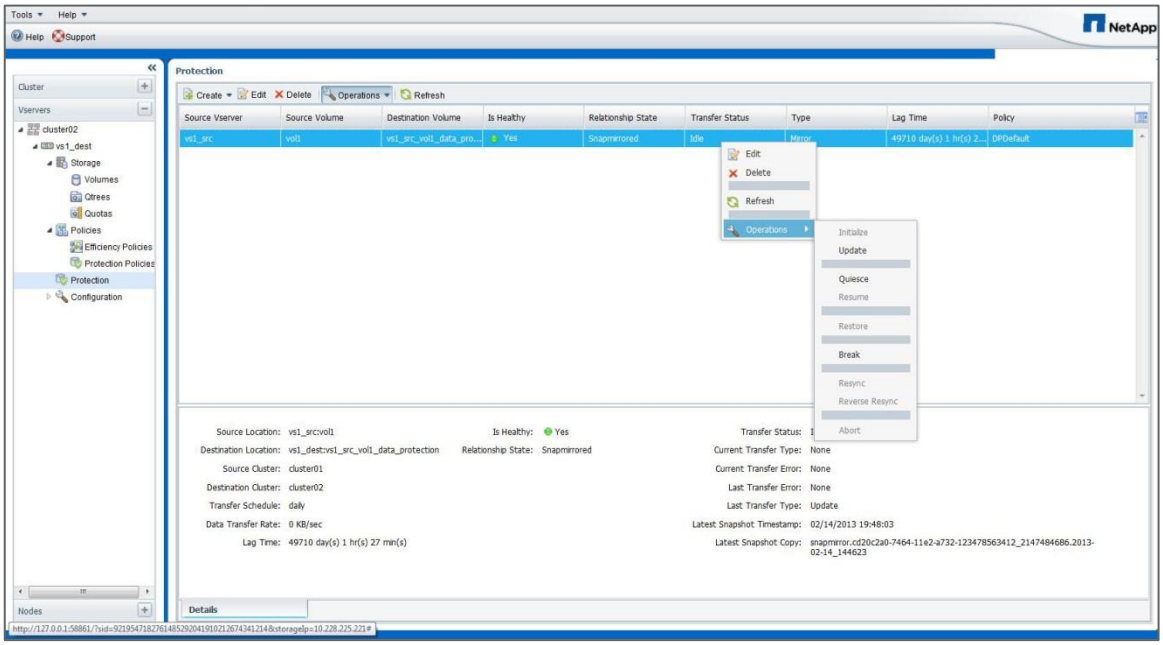


After the SnapMirror relationship create wizard completes, the SnapMirror window opens. Click Refresh, if needed, after the initial baseline transfer is complete to view the finished status.

7.2 Managing SnapMirror Relationships with System Manager

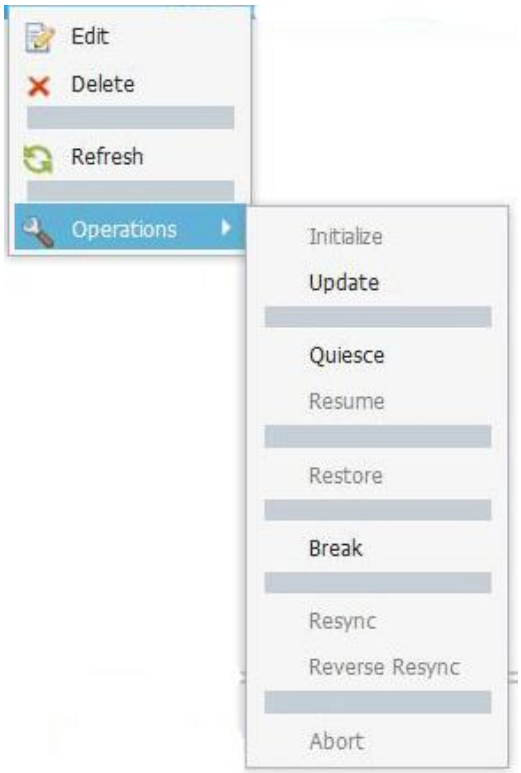
To manage SnapMirror DP relationships in System Manager, click the Operations menu at the top of the SnapMirror screen, as shown in Figure 27, or right-click a specific SnapMirror relationship, and open a context menu. Only operations that are currently allowed for that SnapMirror relationship are enabled in the context menu.

Figure 27) SnapMirror relationships list.



The context menu provides several other options. Grayed-out options are not available based on the current state of the selected SnapMirror relationship. Figure 28 shows all available operations that can be performed in the System Manager context menu.

Figure 28) System Manager context menu.



The operations listed in the SnapMirror context menu perform the following functions:

- **Edit.** Edits the schedule for the relationship.
- **Delete.** Deletes the SnapMirror relationship. This function does not delete the destination volume.
- **Initialize.** Performs the first initial baseline transfer of data to establish a new relationship.
- **Update.** Performs an on-demand update of the relationship, replicating any new data and Snapshot copies included since the last update to the destination.
- **Quiesce.** Prevents any further updates for a relationship.
- **Resume.** Resumes a relationship that was quiesced.
- **Restore.** Restores a Snapshot copy from a source volume to a destination volume.
- **Break.** Makes the destination volume read/write.
- **Resync.** Reestablishes a broken relationship in the same direction before the SnapMirror break occurred.

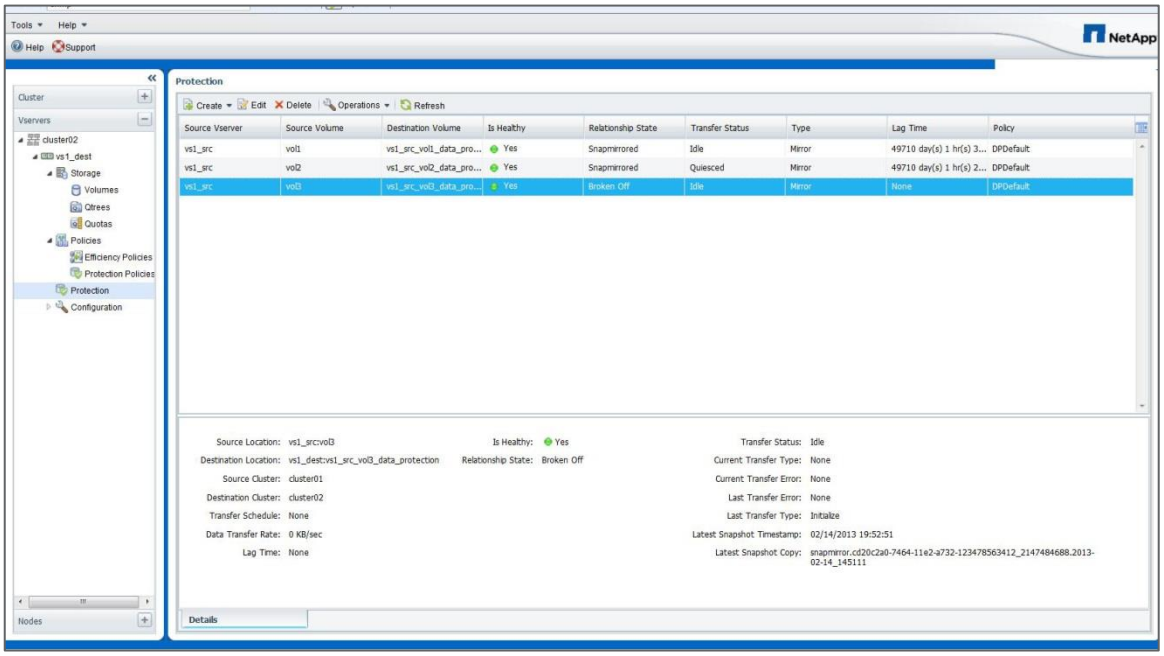
  Note: If a SnapMirror relationship is broken, deleted, and then recreated, perform a SnapMirror resync to resynchronize the volumes without having to rebaseline. This task requires that a common Snapshot copy exist on both volumes.

- **Reverse resync.** Automates the necessary steps to reverse a SnapMirror relationship, recreating it and then resyncing it in the opposite direction. This can be done only if the existing relationship is in a broken state. Determine that clients are not using the original source volume, because the reverse/resync operation makes the original source volume read-only. The original source volume reverts to the most recent common Snapshot copy and resynchronizes with the destination. Any changes that are made to the original source volume since the last successful SnapMirror update are lost. Any changes that were made to, or new data written into, the current destination volume is sent back to the original source volume. When selecting this option, System Manager displays a confirmation screen explaining the operation that is being performed.
- **Abort.** Cancels a current transfer in progress. If a SnapMirror update is issued for an aborted relationship, the relationship continues with the last transfer from the last restart checkpoint that was created before the abort occurred.

Relationship Health in System Manager

SnapMirror relationships are primarily managed from the destination system; however, up-to-date information about a SnapMirror relationship can be reviewed using System Manager. When the SnapMirror status screen initially loads, authoritative information displays for only destination volume relationships that are on the selected SVM, as shown in Figure 29.

Figure 29) SnapMirror status screen.



Relationships in which only the source volume is on the selected SVM are initially shown with health unknown. Click that relationship and refresh the status from the destination to show the correct status in the Health column. Clicking that relationship causes System Manager to contact the destination and collect authoritative information about that relationship and display the status. Clicking the relationship also causes the detailed information pane at the bottom of the window to be updated with more information about that relationship, such as the last replication time stamp.

8 SnapMirror Load-Sharing Mirror Relationships

SnapMirror LS mirrors increase performance and availability for NAS clients by distributing an SVM namespace root volume to other nodes in the same cluster and distributing data volumes to other nodes in the cluster to improve performance for large read-only workloads.

Note: SnapMirror LS mirrors are capable of supporting NAS only (CIFS/NFSv3). LS mirrors do not support NFSv4 clients or SAN client protocol connections (FC, FCoE, or iSCSI). However, you can use NFSv4 and LS mirrors in the same environment; NFSv4 will just never use the LS mirror and will always use the source volume.

Note: SnapMirror LS mirrors for data volumes are deprecated starting in ONTAP 9.1 and new relationships will be disallowed. SnapMirror LS Mirrors for root volumes will continue to be supported.

For additional information regarding Load Sharing Mirrors please refer to “SVM Root Volume Protection Express Guide” appropriate for the version of clustered Data ONTAP you are running. Listed below is the link for Data ONTAP 8 documentation:

https://library.netapp.com/ecm/ecm_get_file/ECMP1653502

Listed here is the version specific to cDOT 8.3:

https://library.netapp.com/ecm/ecm_get_file/ECMP1653502

9 SnapMirror Unified Replication

Functionaltiy available in clustered Data ONTAP 8.3 onward removes the limitation of the destination controller needing to have a clustered Data ONTAP major version number equal to or higher than the major version of the source controller, allowing customers to have nondisrupted upgrades. In addition, the functionality reduces the number of secondary Snapshot copies needed on the destination.

9.1 Default Policies

Three additional SnapMirror policies are defined for replication starting in clustered Data ONTAP 8.3 operating system. They are:

- **MirrorLatest.** A Snapshot copy of the active file system is created and transferred from the source to the destination.
- **MirrorAllSnapshots.** This option is similar to default SnapMirror. All source Snapshot copies, including the active file system SnapMirror Snapshot copy, created are transferred from the source to the destination.
- **MirrorAndVault.** This option gives the capability of disaster recovery and backup in a single volume. Retention is set similar to vault policies with SnapMirror labels and their corresponding keep count. In addition to transferring Snapshot copies' matching labels, the active file system SnapMirror Snapshot copy is also created and transferred.

9.2 Configuring SnapMirror - Unified Replication

The following is an example of how Unified replication can be configured with the MirrorAllSnapshots policy from the CLI:

```
cluster02::> snapmirror create -source-path svmA:srcvolA -destination-path
svmB:dstvolB –type XDP –policy MirrorAllSnapshots
```

9.3 Converting Default SnapMirror to SnapMirrror - Unified Replication

Consider the following scenario:

An existing customer using SnapMirror in clustered Data ONTAP 8.2 operating system wants to make use of SnapMirror unified replication in clustered Data ONTAP 8.3 operating system to use a single destination volume for disaster recovery and backup.

Upgrade your source and destination clusters to clustered Data ONTAP 8.3 operating system. Cluster peering and SVM peering have already been done.

The following are the steps for the conversion:

1. Delete mirror (DR) relationship.
2. Break the mirror destination.
3. Create an XDP relationship between the same endpoints with one of the default SnapMirror - unified replication policies.
4. Perform resync between the endpoints. This will convert the relationship to a SnapMirror - unified replication configuration without having to do a rebaseline.

Create a Volume on the Primary Cluster

```
Primary::> vol create -vserver vs1P -volume vol1_vs1P -aggregate aggr1_Primary_01
```



```
-size 10GB (volume create)
[Job 81] Job succeeded: Successful
```

Create a DP Volume on the Remote Cluster

```
Remote::> vol create -vserver vs1R -volume vol1_vs1R -aggregate aggr1_Remote_01
-size 10GB -type DP              (volume create)
[Job 81] Job succeeded: Successful
```

Create a SnapMirror Relationship Between the Volumes on the Primary and the Remote Clusters

```
Remote::> snapmirror create -source-path vs1P:vol1_vs1P -destination-path
vs1R:vol1_vs1R -type DP -schedule daily
Operation succeeded: snapmirror create the relationship with destination
vs1R:vol1_vs1R.
```

```
Remote::> snapmirror show
                                                                    Progress
Source            Destination  Mirror  Relationship  Total             Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1P:vol1_vs1P
            DP   vs1R:vol1_vs1R
                             Uninitialized
                                    Idle           -         true    -
1 entries were displayed.
```

Initialize the SnapMirror Relationship

```
Remote::> snapmirror initialize -destination-path vs1R:vol1_vs1R
Operation is queued: snapmirror initialize of destination vs1R:vol1_vs1R.

Remote::> snapmirror show
                                                                    Progress
Source            Destination  Mirror  Relationship  Total             Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1P:vol1_vs1P
            DP   vs1R:vol1_vs1R
                             Snapmirrored
                                    Idle           -         true    -
1 entries were displayed.
```

Conversion of defatult SnapMirror to SnapMirror Unified Replication

SnapMirror Delete

```
Remote::> snapmirror delete -destination-path vs1R:vol1_vs1R
Operation succeeded: snapmirror delete the relationship with destination
vs1R:vol1_vs1R.
```

SnapMirror Break

```
Remote::> snapmirror break -destination-path vs1R:vol1_vs1R
[Job 128] Job succeeded: SnapMirror Break Succeeded
```

SnapVault Create


```
Remote::> snapmirror create -source-path vs1P:vol1_vs1P -destination-path
vs1R:vol1_vs1R -type XDP -policy MirrorLatest
Operation succeeded: snapmirror create the relationship with destination
vs1R:vol1_vs1R.
```

```
Remote::> snapmirror show
                                                                    Progress
Source            Destination  Mirror  Relationship  Total        Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1P:vol1_vs1P
            XDP  vs1R:vol1_vs1R
                              Broken-off
                                      Idle           -         true    -
```

SnapMirror Resync

```
Remote::> snapmirror resync -destination-path vs1R:vol1_vs1R

Warning: All data newer than Snapshot copy
         snapmirror.3fd9730b-8192-11e2-9caa-123478563412_2147484699.2013-02-28_1
         10732 on volume vs1r:vol1_vs1r will be deleted.
         Verify there is no XDP relationship whose source volume is
         "vs1R:vol1_vs1R".  If such a relationship exists then you are creating
         an unsupported XDP to XDP cascade.
Do you want to continue? {y|n}: y
[Job 133] Job succeeded: SnapMirror Resync Transfer Queued
```

```
Remote::> snapmirror show
                                                                    Progress
Source            Destination  Mirror  Relationship  Total        Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1P:vol1_vs1P
            XDP  vs1R:vol1_vs1R
                              Snapmirrored
                                      Idle           -         true    -
```

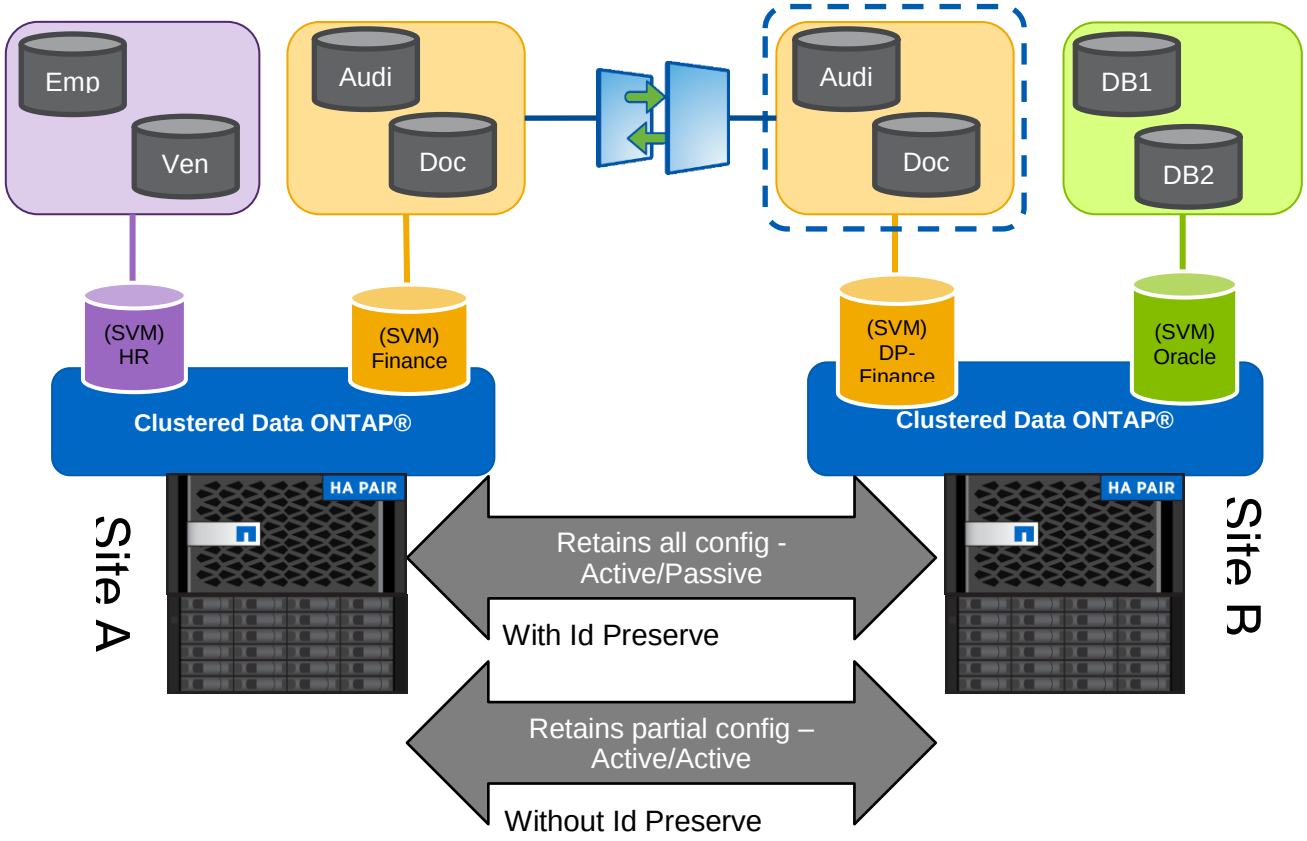
After completing the preceding steps, you can adjust the schedules and policies accordingly to keep desired Snapshot copies on the destination.

Note: The SnapMirror unified replication relationship cannot be converted back to a default SnapMirror relationship unless a rebaseline is created to a new destination volume

Please refer to the Unified Replication FAQ on Field Portal for additional information.

10 Storage Virtual Machine Disaster Recovery

10.1 Overview

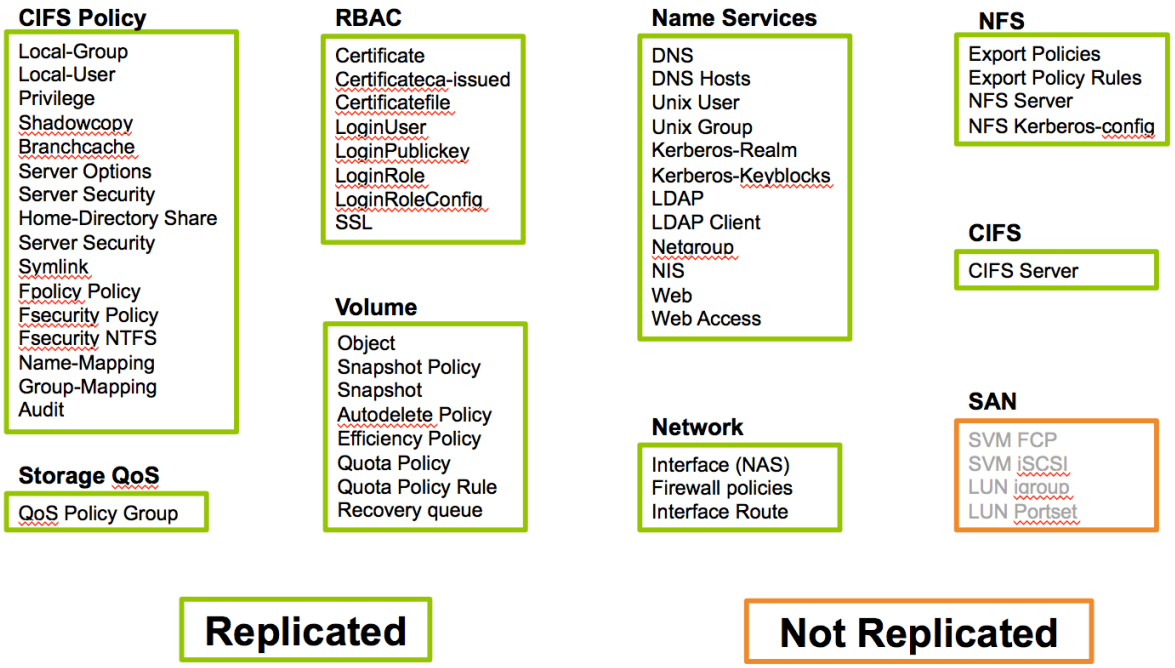


- ***Simple*** pre-defined steps to Failover
- ***Ease*** of Management with Automation
- ***Assured*** Protection for SVM Data
- ***Proven*** SnapMirror Engine inside
- Protect SVM Namespace not just vols
- Automated Setup & Provisioning
- Automated Change Management
- Familiar SnapMirror Cmds on CLI
- GUI based management using WFA

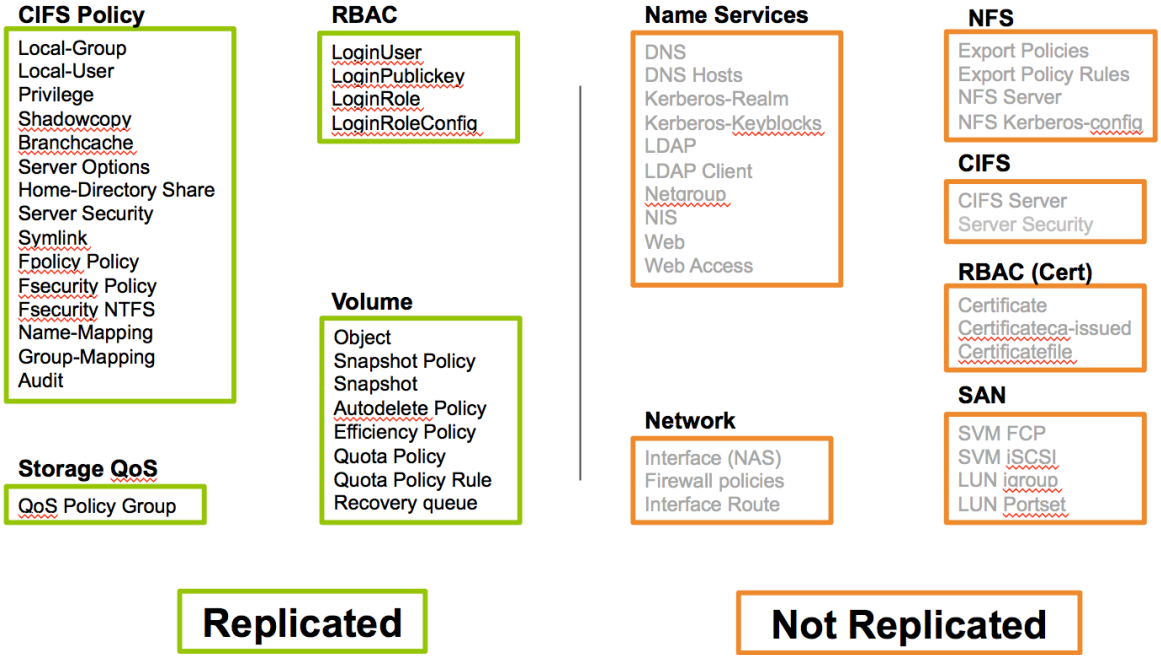
10.2 Options

When setting up SVM DR, there are really only two options. The options are identity-preserve=true or identity-preserve=false. For both Idenity-preserve=true and identity-preserve=false, all volumes/data is replication, the differences between the two options is in the configuration data that is replicated.

Identity-preserve=true



Identity-preserve=false



10.3 Requirements

Please reference the appropriate Express Guide in the “Disaster Recovery and Backup” section.

10.4 Use Cases

With only two options for SVM DR, there are only a handful of use cases. Overall SVM DR will be used when the entire SVM needs to be replicated or moved to a destination cluster. When you identity preserve true or false will determine how much of the configuration data is sent to the destination, also it will determine how the destination SVM will operate while the relationship is in place.

When using identity preserve true, we will maintain the CIFS server identity as well as the network configuration. Because of this the destination SVM will be offline until the snapmirror relationship is broken and the source SVM is offline. Here are a few use cases for using this option:

- Source and destination SVM will remain in the same layer-2 network
- Source and destination SVM will be in different layer-2 network but will have access to the same Active Directory structure
- Moving a SVM from one cluster to a different cluster and maintaining the CIFS server configuration and possibly network configuration

In the first use case listed above, this will be used for customers who have two clusters in the same layer-2 network. This could be in the same data center, or an extended layer-2 network across data centers. The cutover from source to destination cluster does not require any additional SVM configuration changes to bring the SVM online.

In the second use case, since we are maintaining the network configuration, but moving the SVM into a different network there are a couple of configuration changes that will need to be made. First, you will need to change the IP addresses on the data LIFs on the SVM after the cutover. Second, you will have to change the routing table of the SVM itself. Each SVM has a unique routing table which determines the default gateway for the network. In most cases only these two changes will be required. If the DNS server that is configuration for the SVM is not reachable on the network, then you will have to change the DNS settings. This should be the extent of the changes that are required for CIFS envrionments. For NFS environments, if your NFS clients also changes their IP addresses (think whole site failover), then you will need to ensure that your export policies are updated to use the new ip addresses of those hosts.

The third example is more of a move a SVM rather then use it for SVM DR. For instance lets say you have a SVM that is in the cloud and you want to move it back to your on premises. You can use SVM DR to establish a whole SVM relationship between clusters and move the SVM from one cluster to another. After the cutover to the new cluster you just make the necessary changes to the network/route/dns/exports as needed, delete the snapmirror relationship and continue serving data.

There is one primary use case for using identity preserve false. Since we are not maintaining the network configuration, the CIFS server configuration or any of the export policies, we can have the destination SVM in a active read only environment.

11 SnapMirror and Data ONTAP Feature Interaction

11.1 SnapMirror and Snapshot Copies

SnapMirror creates a Snapshot copy before it performs a replication update. A SnapMirror Snapshot copy is created on the source volume, and that Snapshot copy is then compared to the previous SnapMirror Snapshot copy that was replicated. All data between the new SnapMirror Snapshot copy and the previous one (including all Snapshot copies on the volume between those and all data in those Snapshot copies) is

replicated to the destination volume. After the SnapMirror update is complete, the new SnapMirror Snapshot copy is exported on the destination system.

SnapMirror maintains a history of one SnapMirror Snapshot copy on the source volume and two on the destination volume.

Best Practice
Verify that SnapMirror updates are not scheduled to occur on the source volume at the same time as other Snapshot copies.

Data ONTAP maintains locks on Snapshot copies created by SnapMirror to prevent them from being deleted; these Snapshot copies are required to perform scheduled updates. If the Snapshot copies created by SnapMirror must be deleted, the volumes can still be resynchronized without having to perform a full baseline as long as other common Snapshot copies between the two volumes still exist on the volumes. In this example, a SnapMirror resync is performed on a volume where all Snapshot copies created by SnapMirror were deleted.

Note: The system specifies the name of an hourly Snapshot copy used for the base of the resync.

```
cluster02::> snapmirror resync -source-path cluster01://vs1/vol1 -destination-path
cluster02://vs2/vol1
Warning: All data newer than Snapshot copy hourly.2011-12-06_1805 on volume
cluster02://vs2/vol1 will be deleted.
Do you want to continue? {y|n}: y
[Job 1364] Job is queued: snapmirror resync to destination cluster02://vs2/vol1.
```

11.2 SnapMirror and Qtrees

Qtrees are special directories that allow the application of file system quotas for NAS. Clustered Data ONTAP operating system allows creation of qtrees, and qtrees can exist in volumes that are replicated with SnapMirror. However, SnapMirror does not allow replication of individual qtrees or qtree-level replication. In addition, nothing otherwise can be done with a Qtree in clustered Data ONTAP.

11.3 SnapMirror and FlexClone

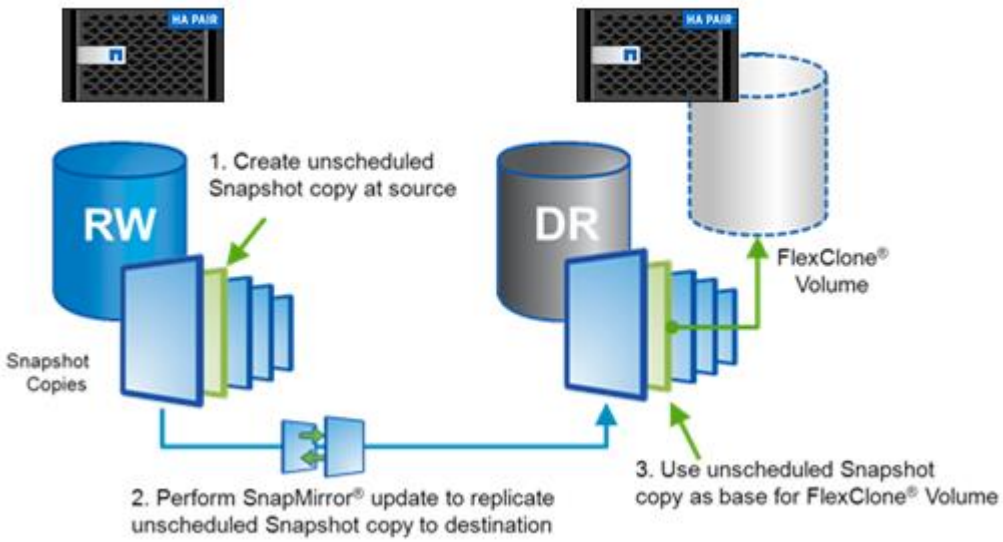
A NetApp FlexClone volume is a writable point-in-time clone of a FlexVol volume. A FlexClone volume shares data blocks with the parent volume, storing only new data or changes made to the clone. A FlexClone volume can also be split from its parent to create a new standalone volume.

A SnapMirror relationship can be created using a FlexClone volume as the source; however, a SnapMirror destination volume cannot be a FlexClone volume. Starting in clustered Data ONTAP 8.3 operating system, a SnapMirror relationship can be created using a FlexClone volume as the source or destination or both.

FlexClone technology also makes it possible to create a writable volume from a read-only SnapMirror destination without interrupting the SnapMirror replication process or the production operations. Figure 30 illustrates the creation of a FlexClone volume at the SnapMirror destination.

Best Practice
SnapMirror replicates Snapshot copy history from source to destination volumes. If a Snapshot copy is removed from the source volume, the next SnapMirror update removes that Snapshot copy from the destination volume. If that Snapshot copy cannot be removed from the destination, for example, if the Snapshot copy is locked because it is the base Snapshot copy of a FlexClone volume, then the SnapMirror update fails. The only way for a SnapMirror update to proceed is to delete the FlexClone volume or split it to remove the Snapshot copy dependency. To avoid this issue when creating FlexClone volumes on SnapMirror destinations, create the base Snapshot copy required by the FlexClone volume on the source system and then replicate that Snapshot copy to the destination system and use that Snapshot copy as the base for the FlexClone volume, as shown in Figure 30. Using a Snapshot copy specifically created for the FlexClone volume in this manner prevents the SnapMirror update from failing due to an automatically created Snapshot copy being removed from the source system.

Figure 30) Creating FlexClone volume at SnapMirror destination.



11.4 SnapMirror and Infinite Volume

SnapMirror works with Infinite Volume just like a FlexVol volume.

There are a few key differences:

- For the namespace (NS) constituent volume, mirroring is restricted to intracluster only. Starting in clustered Data ONTAP 8.2 operating system, the NS mirror is automatically created when you create the Infinite Volume. If you use SnapDiff, it will automatically create one NS mirror per node; if you don't use SnapDiff, then you will have only one NS mirror on the Infinite Volume.
- Only intercluster SnapMirror is supported for mirroring the entire Infinite Volume.

The process of creating an Infinite Volume is different compared to a FlexVol volume. Apart from that, the SnapMirror relationship setup is the same as with a FlexVol volume. This section walks through the SnapMirror lifecycle operations with Infinite Volume.

For more information on Infinite Volumes in clustered Data ONTAP 8.2 operating system, refer to TR-4178.

11.5 SnapMirror and NetApp Storage Efficiency

SnapMirror maintains storage efficiency benefits in replicated volumes. If the source volume is deduplicated, the destination volume is in a deduplicated state as well. SnapMirror does not inflate deduplicated data during a transfer. If the source volume is compressed, the destination volume is in a compressed state as well. Replication of compressed volumes does not uncompress the source volume to read data for a transfer; data is replicated in a compressed state to the destination volume.

It is not possible to have different configurations of storage efficiency enabled between the source and destination volumes. For example, it is not possible to compress or deduplicate the SnapMirror destination volume alone without enabling compression or deduplication on the SnapMirror source volume.

SnapMirror creates a Snapshot copy before performing an update transfer. Any blocks in the Snapshot copy are locked and cannot be deduplicated. Therefore, if maximum space savings from deduplication are required, run the dedupe process before performing SnapMirror updates.

11.6 SnapMirror and Volume Move

The volume move capability allows volumes to be moved nondisruptively between nodes in the cluster. DP mirror source or destination volumes can be moved using the `volume move` command. The SnapMirror relationship does not have to be reconfigured or modified on the source or destination when a volume move is performed. If a volume that is in an intercluster SnapMirror relationship is moved, the node to which the volume is moved must have an intercluster LIF and be connected to the intercluster network in order to perform future SnapMirror updates.

The effect a volume move has on a SnapMirror relationship depends on whether the source volume or the destination volume is being moved. If a SnapMirror transfer is currently in progress and the SnapMirror source volume is being moved, then both the SnapMirror transfer and the volume move transfer can run simultaneously. However, when the volume move cutover occurs (the moment the clustered Data ONTAP operating system redirects I/O to the new volume), the active SnapMirror transfer is then momentarily interrupted and automatically continues from the source volume's new location.

Note: In clustered Data ONTAP 8.1 operating system, for SnapMirror destination volumes, a SnapMirror transfer and a volume move transfer are mutually exclusive. A SnapMirror destination volume move cannot start while a SnapMirror transfer to that volume is in progress. A SnapMirror update transfer cannot be performed if the SnapMirror destination volume is currently in the process of being migrated with volume move. But, starting in clustered Data ONTAP 8.2 operating system, for SnapMirror destination volumes, a SnapMirror transfer and a volume move transfer can run simultaneously, except during volume move cutover, when they will be mutually exclusive (brief duration of a few seconds).

For more information on volume move, refer to TR-4075, Data Motion for Volumes for Data ONTAP 8.2 and 8.3

11.7 SnapMirror for Disk Shelf Failure Protection

If you decided that you want to use SnapMirror to protect against disk shelf failure, you need to be aware of two things:

- You cannot mirror the volumes to be in the same HA pair.
- It will not automatically fail over.

You can mirror the volumes to different nodes in a different HA pair on the same cluster. Mirroring to a different node makes sure that the other volume is always in a different shelf. If you try to mirror to a different shelf on the same node, then the mirror has to be on a different aggregate; however, there is still the risk that an aggregate might have a disk in any shelf. Even if you try to configure otherwise (keeping aggregates on their own shelves), that can change because drives fail and spares get used. This configuration would avoid having a single point of failure and would provide protection against disk shelf failure. The caveat here is that the configuration will not fail over automatically. You have to manually break the SnapMirror relationship, unmount the clients, remount the clients on the destination volumes, and change the NFS export policies.

11.8 SnapMirror and Volume Autosize

The destination volume must be the same size as or larger than the source volume. SnapMirror updates fail if the destination volume is smaller than the source volume.

Best Practice
Keep the source and destination volumes the same size; however, the destination volume can be slightly larger. The `-filesys-size-fixed` option makes sure that the file system size of a SnapMirror volume remains the same to allow a SnapMirror relationship to be reversed, even if the destination volume size is larger than the source. If this is not set ahead of time and a destination grows larger than a source, a reverse resync will fail.

If the source volume size is automatically increased by the volume autosize feature, or if it is manually increased, then the destination volume size must be increased to match the size of the source volume. Clustered Data ONTAP 8.1 operating system does not automatically increase the size of the destination volume. Use the CLI or System Manager to increase the destination volume; the next SnapMirror update automatically replicates the value of the file system size to the destination volume to match that of the source.

If the autosize feature increases the size of the source volume, to avoid having to manually resize the destination volume, size the destination volume so that it is at least as large as the source volume's maximum autosize value. To eliminate the need for the additional capacity required to guarantee the larger destination volume, the space guarantee can be disabled on the destination. However, keep in mind that the capacity of the destination system must be properly managed so that there is room for operations that generate data on the destination system.

Starting in Data ONTAP 8.2, when autosize increases the size of the source volume of a SnapMirror relationship, the destination volume also automatically increases in size. This is applicable to only FlexVol volumes, and not Infinite Volumes.

11.9 SnapMirror and Network Data Management Protocol

Network Data Management Protocol (NDMP) backups can be performed from SnapMirror source or destination volumes. There are advantages to performing NDMP backups from SnapMirror destination volumes rather than from source volumes; they include:

- SnapMirror transfers can happen quickly and with less impact on the source system than that of NDMP backups. Use NetApp Snapshot copies and perform SnapMirror replication from a primary system as a first stage of backup to significantly shorten or eliminate backup windows. Then perform NDMP backup to tape from the secondary system.

- SnapMirror source volumes are more likely to be moved using volume move capability for performance or capacity reasons. When a volume is moved to a different node, the NDMP backup job must be reconfigured to back up the volume from the new location. If backups are performed from the SnapMirror destination volume, these volumes are less likely to require a move; therefore, it is less likely that the NDMP backup jobs need to be reconfigured.

11.10 SnapMirror and Data ONTAP Version Dependencies

Replication for DP or DR is not possible between systems operating in 7-Mode and clustered Data ONTAP operating systems.

- Several new replication capabilities have been implemented in SnapMirror in clustered Data ONTAP 8.1 operating system such as block-level replication; support for NetApp storage efficiency; and the ability to replicate between clusters and break, reverse, and resync relationships. The Data ONTAP 8.1 implementation of SnapMirror is not compatible with the Data ONTAP 8.0 implementation. Replication between systems running clustered Data ONTAP 8.0 and 8.1 operating systems is not possible. For information about upgrading systems operating in clustered Data ONTAP 8.0 operating system to 8.1, refer to the NetApp Data ONTAP 8.1 Cluster-Mode Upgrade and Revert/Downgrade Guide on the NetApp Support site.
- Clustered Data ONTAP 8.2 operating system introduces SnapVault, supports SnapMirror cascading and SnapMirror to tape for seeding only, and is multi-tenancy ready with the ability for SVM administrators to manage replication. Additionally, clustered Data ONTAP 8.2 operating system improves scalability (number of concurrent transfers) and increases data transfer speeds.
- The clustered Data ONTAP 8.2 operating system implementation of SnapMirror is compatible with the clustered Data ONTAP 8.1 operating system implementation. Replication between systems running clustered Data ONTAP 8.1 and 8.2 is possible. On an upgrade from clustered Data ONTAP 8.1 operating system to 8.2, existing SnapMirror relationships will continue to remain cluster scope. The SnapMirror relationships will not benefit from the scalability improvements unless SVM peering is established and the SnapMirror relationships are deleted and recreated after the source and destination nodes are both upgraded to clustered Data ONTAP 8.2 operating system.
- Starting in clustered Data ONTAP 8.2.1 operating system, on an upgrade from 8.1 to 8.2.1, the preceding procedure is automated. That is, the SnapMirror relationships are autoconverted to benefit from the scalability improvements after the destination node is upgraded to 8.2.1, source node is upgraded to 8.2 or above, and source and destination volumes are in the same SVM or SVM peering is established between the two SVMs that host the source and destination volumes.

The following replication is supported between different versions of clustered Data ONTAP 8.1 operating system and higher:

- Replication is allowed in either direction between minor versions. Clustered Data ONTAP 8.1.x operating system is a minor version; therefore, replication is supported from 8.1.x to 8.1.y or from 8.1.y to 8.1.x.
- Replication is allowed only from older to newer major versions. Clustered Data ONTAP 8.1 operating system is a major version; therefore, replication is allowed from 8.1 to a later major release (for example, 8.2). However, replication is not allowed from a later release (for example, 8.2) to an earlier major release (for example, 8.1).

  Note: The clustered Data ONTAP 8.0 operating system release family is excluded.

12 Performance

12.1 SnapMirror and Network Compression

With increasing network bandwidth costs coupled with data growth, customers have to do more with less. As the amount of data to be protected increases, more network bandwidth is needed to maintain the recovery point objective (RPO) or the replication window. Otherwise, replication times increase as the amount of data sent over the network to the DR site increases. Differently put, if you do not want to or cannot increase the network bandwidth, you need to lower the replication frequency that is causing larger RPO values and thus increasing your exposure to larger data loss.

The SnapMirror native network compression feature can cut down on the amount of data replicated over the network. It also offers you more flexibility and choices, as described below.

Maintaining the Same RPO Level

Challenge. Your data replication needs are growing. You need more bandwidth to maintain the same level of RPO.

Solution. By using network compression, it is possible to maintain the same RPO without purchasing additional network bandwidth.

Improve Your RPO Without Buying Additional Bandwidth

Challenge. You are using all of your network bandwidth. However, your customer wants to reduce its exposure to data loss—in other words, to improve its RPO.

Solution. By using network compression, you can improve your RPO without purchasing more network bandwidth.

Use the Network Bandwidth for Other Purposes

Challenge. Your replication is consuming all of your bandwidth. You want to use the network bandwidth for other purposes such as client access or applications without purchasing additional bandwidth.

Solution. By using network compression, it is possible to reduce the bandwidth consumed by SnapMirror without sacrificing RPO, thereby freeing up network bandwidth for other purposes.

Speeding Up the Initial Transfers

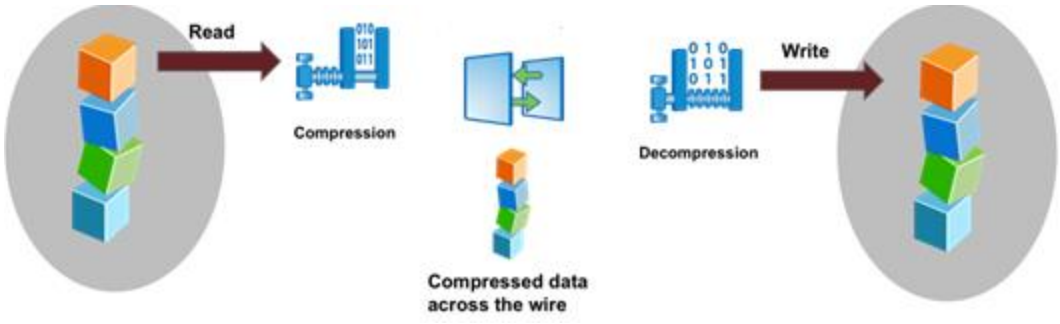
Challenge. Initial SnapMirror transfers could be large and therefore could take a long time to complete under bandwidth constraints.

Solution. By using network compression, it is possible to speed up the initial SnapMirror transfers.

What Is SnapMirror Network Compression?

SnapMirror network compression enables data compression over the network for SnapMirror transfers. It is a native feature that is built into SnapMirror software. SnapMirror network compression is not the same as volume compression. SnapMirror network compression does not compress data at rest. The following figure shows a very high-level flow of SnapMirror network compression.

Figure 31) SnapMirror network compression functional diagram.



On the source system, the data blocks that need to be sent to the destination system are handed off to the compression engine, which compresses the data blocks. The compression engine on the source system creates several threads depending on the number of CPUs available on the storage system. These compression threads help to compress data in a parallel fashion. The compressed blocks are then sent over the network.

On the destination system, the compressed blocks are received over the network and are then decompressed. The destination compression engine also has several threads to decompress the data in a parallel fashion. The decompressed data is reordered and is saved to the disk on the appropriate volume.

In other words, when SnapMirror network compression is enabled, two additional steps are performed: compression processing on the source system before data is sent over the network and decompression processing on the destination system before the data is written to the disk.

Prerequisites

SnapMirror network compression is supported from clustered Data ONTAP 8.3 operating system on both source and destination systems.

All platforms that support clustered Data ONTAP 8.3 operating system also support SnapMirror network compression.

Enabling and Disabling Network Compression

SnapMirror network compression can be enabled or disabled by the `-is-network-compression-enabled` option in SnapMirror policy. It cannot be enabled for an active transfer. To enable compression for an existing transfer, you must first abort the transfer, set the `-is-network-compression-enabled` option to true in SnapMirror policy, and then resume the transfer.

Reporting the Compression Ratio

The SnapMirror network compression ratio is reported in the `snapmirror show -instance` output.

```
cluster::> snapmirror show -destination-path vs3:dst -instance

                            Source Path: vs1:src_test
                       Destination Path: vs3:dst
                      Relationship Type: DP
                Relationship Group Type: none
                    SnapMirror Schedule: -
                 SnapMirror Policy Type: async-mirror
                      SnapMirror Policy: DPDefault
                            Tries Limit: -
                      Throttle (KB/sec): unlimited
                           Mirror State: Snapmirrored
```

Compression ratio is only shown in transferring state

```
                    Relationship Status: Transferring
                File Restore File Count: -
                 File Restore File List: -
                      Transfer Snapshot: snapmirror.89659724-bd35-11e4-9f11-
000c299bf0b8_2147484674.2015-03-02_134417
                     Snapshot Progress: 0B
                        Total Progress: 0B
              Network Compression Ratio: 2:1
                    Snapshot Checkpoint: 0B
                        Newest Snapshot: snapmirror.89659724-bd35-11e4-9f11-
000c299bf0b8_2147484674.2015-02-25_134212
              Newest Snapshot Timestamp: 02/25 13:22:08
                      Exported Snapshot: snapmirror.89659724-bd35-11e4-9f11-
000c299bf0b8_2147484674.2015-02-25_134212
            Exported Snapshot Timestamp: 02/25 13:22:08
                                Healthy: true
                         Unhealthy Reason: -
               Constituent Relationship: false
                Destination Volume Node: vsim
                        Relationship ID: d8b4cbc8-bd36-11e4-9f11-000c299bf0b8
                   Current Operation ID: 46da2fc6-c125-11e4-9f1a-000c299bf0b8
                          Transfer Type: update
                         Transfer Error: -
                       Current Throttle: unlimited
             Current Transfer Priority: normal
                     Last Transfer Type: initialize
                    Last Transfer Error: -
                     Last Transfer Size: 240KB
Last Transfer Network Compression Ratio: 1:1
                  Last Transfer Duration: 0:0:3
                      Last Transfer From: vs1:src_test
            Last Transfer End Timestamp: 02/25 13:42:15
                  Progress Last Updated: 03/02 13:44:17
                Relationship Capability: 8.2 and above
                                Lag Time: 120:22:10
           Number of Successful Updates: 0
               Number of Failed Updates: 0
           Number of Successful Resyncs: 0
               Number of Failed Resyncs: 0
            Number of Successful Breaks: 0
                Number of Failed Breaks: 0
                   Total Transfer Bytes: 245760
         Total Transfer Time in Seconds: 3
```

12.2 SnapMirror Sizing Recommendations

12.3 Concurrent Replication Operations

The number of supported simultaneous SnapMirror operations is limited. This limit is per node and varies depending on the platform and version of Data ONTAP. For information about the number of concurrent SnapMirror operations allowed per node, refer to the NetApp clustered Data ONTAP Data Protection Management Guide on the NetApp Support site for the appropriate Data ONTAP release.

Best Practice
It is also important to understand which operations in clustered Data ONTAP operating system constitute SnapMirror operations. Regularly scheduled SnapMirror updates of SnapMirror DP or LS relationships are SnapMirror operations. However, volume move and volume copy operations also use SnapMirror as the mechanism to move data from one aggregate to another. Therefore, when planning concurrent operations, it is a best practice to consider the frequency of volume move and volume copy operations in the environment.

Clustered Data ONTAP operating system provides a greater level of scalability by allowing expansion of a NetApp cluster beyond two nodes. Each node in the cluster provides CPU and memory resources that are used for replication of volumes owned by that node.

Best Practice
In order to optimize replication, distribute replicated volumes across different nodes in the clusters rather than placing all volumes requiring replication on a single node. This best practice allows all nodes in the cluster to share replication activity.

12.4 Recommended Replication Intervals

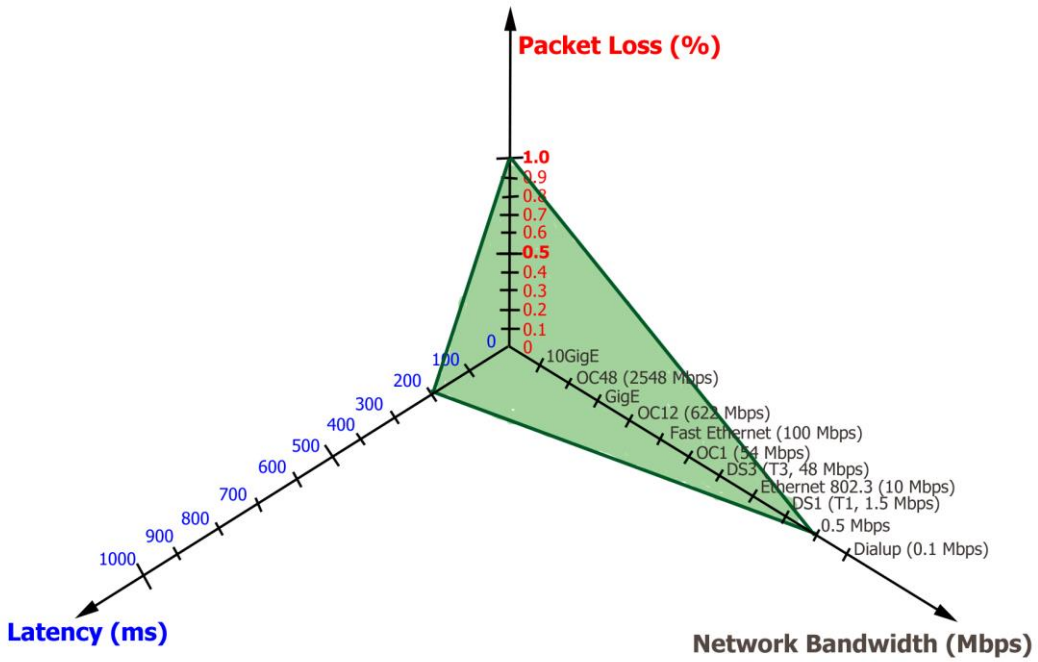
SnapMirror updates require establishing a communication session between the source and destination nodes, creating and deleting Snapshot copies, and determining which blocks of data to send to the destination. Therefore, while the Data ONTAP scheduler supports creating schedules that run every minute, NetApp does not recommend performing a SnapMirror update operation every minute. However, SnapMirror update operations in single digits are possible depending upon your environment. See the System Performance Modeler for proper SnapMirror and system sizing guidelines.

12.5 Network Sizing Requirements

A network with the appropriate bandwidth available to transfer the system's data ingest rate is required to support the desired replication interval. There are limitations on the network characteristics that are supported for intercluster replication.

Network Sizing Requirements for Intercluster Replication

Figure 32) Factors to consider for optimum performance: packet loss (%), latency (ms), and network bandwidth (Mbps).



The intercluster network must be sized appropriately depending on the data change rate and update interval to meet the recovery point objective (RPO) of the solution and individual node performance characteristics. Intercluster SnapMirror is supported across networks that have a minimum bandwidth of 0.5Mbps, a maximum round-trip network latency of 200ms round-trip time (RTT), and a packet loss of 1% (volume covered by the green triangle in the above figure).

Best Practice
It is important that all paths used for intercluster replication have equal performance characteristics. Configuring multipathing in such a way that a node has one intercluster LIF on a slow path and the same node has another intercluster LIF on a fast path adversely affects performance because data is multiplexed across the slow and fast paths simultaneously.

Network Sizing Requirements for Intracluster Replication

All intracluster transfers, including intracluster SnapMirror DP mirrors, LS mirrors, and volume move and volume copy operations, use the private cluster interconnect between nodes in the same cluster. The cluster interconnect bandwidth is not configurable.

13 Troubleshooting Tips

13.1 Troubleshooting Cluster Peer Relationships

1. Run the `cluster peer show` command to verify the availability of the cluster peer relationship; this command displays all existing configured cluster peer relationships.


```
cluster01::> cluster peer show
Peer Cluster Name         Cluster Serial Number Availability
------------------------- --------------------- --------------
cluster02                 1-80-000013           Available
```

2. Add `-instance` to the command to view more detailed information about the cluster peers; include `-cluster <cluster_name>` to view results for a specific cluster. The `-instance` option displays the remote addresses that are used for intercluster communication.

```
cluster01::> cluster peer show -cluster cluster02 -instance
            Peer Cluster Name: cluster02
Remote Intercluster Addresses: 10.12.12.3,10.12.12.4
                Availability: Available
          Remote Cluster Name: cluster02
          Active IP Addresses: 10.12.12.3,10.12.12.4
        Cluster Serial Number: 1-80-000013
```

3. Run the `cluster peer ping` command to view information about connectivity between each intercluster address, including RTT response times. For multiple configured cluster peers, use the `-cluster <cluster_name>` option to perform the ping for one specific peer relationship. The `cluster peer ping` command displays the results of a ping between intercluster interfaces. As mentioned earlier, when performing intercluster SnapMirror mirroring over multiple paths between the local and remote cluster, each path must have the same performance characteristics. In this example, the ping response times (RTTs) are comparatively equal to the pings to nodes where the destination cluster displays as `cluster02`.

```
cluster01::> cluster peer ping cluster02

Node: cluster01-01           Destination Cluster: cluster01
Destination Node IP Address       Count TTL  RTT(ms) Status
---------------- ---------------- ----- ---- ------- ------------------
cluster01-01     10.12.12.1       1     255  0.186   interface_reachable
cluster01-02     10.12.12.2       1     255  1.156   interface_reachable

Node: cluster01-01           Destination Cluster: cluster02
Destination Node IP Address       Count TTL  RTT(ms) Status
---------------- ---------------- ----- ---- ------- ------------------
cluster02-01     10.12.12.3       1     255  7.164   interface_reachable
cluster02-02     10.12.12.4       1     255  7.065   interface_reachable

Node: cluster01-02           Destination Cluster: cluster01
Destination Node IP Address       Count TTL  RTT(ms) Status
---------------- ---------------- ----- ---- ------- ------------------
cluster01-01     10.12.12.1       1     255  1.324   interface_reachable
cluster01-02     10.12.12.2       1     255  0.809   interface_reachable

Node: cluster01-02           Destination Cluster: cluster02
Destination Node IP Address       Count TTL  RTT(ms) Status
---------------- ---------------- ----- ---- ------- ------------------
cluster02-01     10.12.12.3       1     255  7.279   interface_reachable
cluster02-02     10.12.12.4       1     255  7.282   interface_reachable
```

13.2 Troubleshooting SVM Peer Relationships

Here is the list of common issues and how to troubleshoot them:

1. SVM peer action failure for intercluster environment:
   a. Check if both the clusters are in same league.
   b. Check if peer cluster is reachable.

c. Check if both the clusters are running SN and SVM peering capability is enabled.
d. Check if the peer SVM name is not associated with another cluster from peer SVM names in the SVM peering table.
e. Check mgwd.log and console logs for error messages.

2. SVM peer action failure for intracluster/intercluster environment:
   a. Check if both the clusters are running SN and SVM peering capability is enabled.
   b. Check if local and peer SVM names are not same.
   c. Check mgwd.log and console logs for error messages.
3. Run the `vserver peer show` command to verify the SVM peer relationship; this command displays all existing configured SVM peer relationships.

```
cluster02::> vserver peer show
            Peer        Peer
Vserver     Vserver     State
----------- ----------- ------------
vs1_dest    vs1_backup  peered
vs1_dest    vs1_src     peered
```

4. Check for any notifications by `vserver peer show-all`.

```
cluster02::> vserver peer show-all
            Peer        Peer                                    Peering
Vserver     Vserver     State        Peer Cluster               Applications
----------- ----------- ------------ -------------------------- ---------------
vs1_dest    vs1_backup  peered       cluster03                  snapmirror
vs1_dest    vs1_src     peered       cluster01                  snapmirror
```

13.3 Understanding SnapMirror Relationship Status

The Healthy column indicates the SnapMirror relationship status. This column is shown in the output of the `snapmirror show` command on the CLI, in the Cluster Element Manager web interface, and as the Healthy column in the displayed status of SnapMirror relationships in OnCommand System Manager.

In this example, the `snapmirror show` command displays the Healthy column.

```
cluster02::> snapmirror show
                                                                   Progress
Source            Destination  Mirror  Relationship  Total       Last
Path        Type  Path         State   Status        Progress  Healthy Updated
----------- ---- ------------ ------- -------------- --------- ------- --------
vs1_src:vol1
            DP   vs1_dest:vol1
                              Snapmirrored
                                      Transferring   128KB     true    02/25 15:43:53
```

The Healthy column displays the health of the SnapMirror relationship. It also indicates whether the RPO is maintained without needing to determine the age of the last update in order to interpret the relationship's health. For example, the Healthy column displays `true` for a SnapMirror relationship scheduled for regular updates if the last update completed before a following update attempted to start, as shown in the first relationship in the output presented in this example.

If a scheduled update is in progress when the next scheduled update begins, the Healthy column displays `false` for that relationship. Additionally, if the previously scheduled or manual update fails, then the Healthy column also displays `false` for that relationship.

If a transfer is currently in progress, the Healthy column displays – and the Total Progress column displays the amount of progress for the currently running transfer.

The Healthy column also displays a – when the relationship is in an uninitialized state, as shown in the third relationship. It also displays a – if the relationship is in a broken state because the `snapmirror break` command is used.

The Healthy column displays – for the relationship on the source system. To view authoritative information about the health of a SnapMirror relationship, look at that relationship from the destination.

The Mirror State column also displays – if the destination volume is offline or if it cannot be reached.

13.4 Troubleshooting SnapMirror Relationships

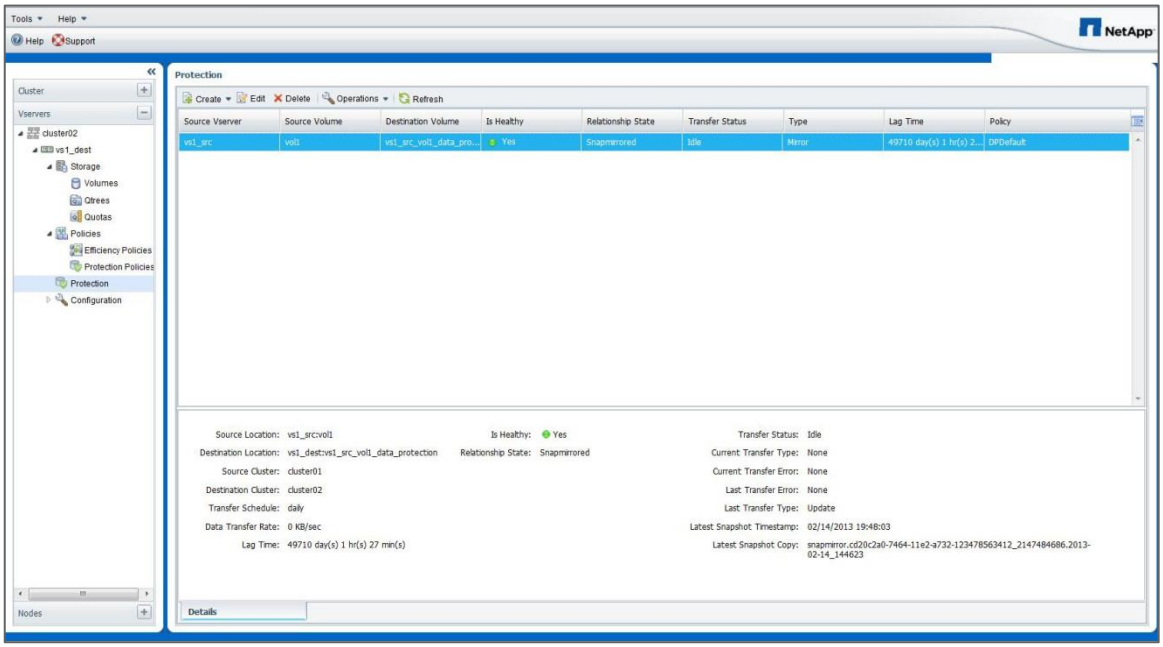
To determine when the last SnapMirror transfer for a specific relationship completed, refer to the exported Snapshot timestamp for instance information in clustered Data ONTAP 8.2 operating system.

```
cluster02::> snapmirror show -instance

                Source Path: vs1_src:vol1
           Destination Path: vs1_dest:vol1
          Relationship Type: DP
        SnapMirror Schedule: 8hour
                Tries Limit: -
          Throttle (KB/sec): unlimited
               Mirror State: Snapmirrored
        Relationship Status: Idle
          Transfer Snapshot: -
          Snapshot Progress: -
             Total Progress: -
        Snapshot Checkpoint: -
            Newest Snapshot: snapmirror.cd20c2a0-7464-11e2-a732-
123478563412_2147484690.2013-02-25_154353
  Newest Snapshot Timestamp: 02/25 20:45:36
          Exported Snapshot: snapmirror.cd20c2a0-7464-11e2-a732-
123478563412_2147484690.2013-02-25_154353
Exported Snapshot Timestamp: 02/25 20:45:36
                    Healthy: true
             Unhealthy Reason: -
   Constituent Relationship: false
    Destination Volume Node: cluster02-02
            Relationship ID: fdb1c700-7f5c-11e2-9caa-123478563412
              Transfer Type: -
             Transfer Error: -
           Current Throttle: -
  Current Transfer Priority: -
         Last Transfer Type: update
        Last Transfer Error: -
         Last Transfer Size: 206.1MB
     Last Transfer Duration: 0:0:3
         Last Transfer From: vs1_src:vol1
Last Transfer End Timestamp: 02/25 15:43:56
      Progress Last Updated: -
    Relationship Capability: 8.2 and above
                  Lag Time: 1193041:26:42
          SnapMirror Policy: DPDefault
```

Note: The last Snapshot timestamp information also displays at the bottom of the System Manager interface, as shown in Figure .

Figure 33) Transfer timestamp information.



For SnapMirror relationship troubleshooting issues, review information about relationships in the event log. Use the `-messagename` option with the `event log show` command to filter the event log for messages related to SnapMirror, as shown in the following example. Specify the `mgmt.snapmir*` message name to filter the output and find only messages related to SnapMirror.

```
cluster01::> event log show -messagename mgmt.snapmir*
Time                Node              Severity      Event
------------------- ----------------- ------------- ---------------------------
12/6/2011 17:35     cluster02-01      ERROR         mgmt.snapmir.update.fail: Update
from source volume 'cluster01://vs1/vol03' to destination volume(s)
'cluster02://vs2/vol03' failed with error 'Failed to setup transfer. (Duplicate
transfer specified. (Other error.))'. Job ID 1322.
12/6/2011 17:34:35  cluster02-01      DEBUG         mgmt.snapmir.abnormal.abort: Source
Path cluster01://vs1/vol01, Destination Path cluster02://vs2/vol01, Error Transfer
failed. (Destination volume cluster02://vs2/vol01 is smaller than the source volume.),
Function copySnapshot, line 5030, job ID 1355.
12/5/2011 05:15:45  cluster02-01      DEBUG         mgmt.snapmir.abnormal.abort: Source
Path cluster01://vs2/vol12, Destination Path cluster02://vs8/vol12, Error Failed to
delete Snapshot copy weekly.2011-12-04_0015 on volume cluster02://vs8/vol12. (Snapshot
is in use.), Function deleteSnapshot, line 4285, job ID 1215.
```

To find an error message about a specific volume, filter the message list further by specifying the name of the volume, enclosed in asterisks, with the `-event` option, as shown in the following example.

```
cluster01::> event log show -messagename mgmt.snapmir* -event *vol01*
Time                Node              Severity      Event
------------------- ----------------- ------------- ---------------------------
12/6/2011 17:34:35  cluster02-01      DEBUG         mgmt.snapmir.abnormal.abort: Source
Path cluster01://vs1/vol01, Destination Path cluster02://vs2/vol01, Error Transfer
failed. (Destination volume cluster02://vs2/vol01 is smaller than the source volume.),
Function copySnapshot, line 5030, job ID 1355.
```

All SnapMirror events are logged to the SnapMirror_audit.log and SnapMirror_error.log files on the node where the destination volume resides. This node might be different from the one where the command was issued. The node running the operation can be determined by running the "`snapmirror show -`

`fields destination-volume-node`" command. OnCommand System Manager 3.0 allows viewing of the SnapMirror log files.

You can also use System Manager to view the SnapMirror log separately from the rest of the event logs: Cluster > Diagnostics > Logs > SnapMirror Log. From the Select node drop-down list, select the node that owns the volume in which you are interested..

14 Best Practices for DR Configurations

Best Practices
• Volumes that belong to one SVM at the source site should be replicated to one SVM at the destination site. An SVM is the root of a NAS namespace for NAS clients and a single storage target in SAN environments. If some NAS volumes are replicated from one SVM into different SVMs at the destination, then all of those volumes cannot be recovered into the same namespace. The same is true of volumes containing LUNs; if the volumes are replicated into different SVMs at the destination, then all of the LUNs are not presented under the same SAN target. • The destination SVM should be a member of the same Active Directory, LDAP, or NIS domain of which the source SVM is a member. This is required so that access control lists (ACLs) stored within NAS files are not broken if a NAS volume is recovered into an SVM that cannot authenticate those ACLs. The processes of changing file-level ACLs to correct them for access from a different domain can be extremely difficult and time consuming. It is also important so that authentication of tools running in SAN clients such as NetApp SnapDrive® for Windows® can be done using the same credentials. • Because the destination SVM is a different SVM than the source, and because NetApp recommends that it be a member of the same Active Directory domain, the destination SVM must be joined to the domain with a different SVM name. It is common practice to have a DR system with a different name than the source system. In DR failover scenarios, it is typical to change DNS name resolution or use DNS aliases to redirect clients to the name of the recovered storage systems so that the CIFS shares are still accessible using the same UNC path name and NFS clients are also able to access the expected path. • Using destination volume names that are the same as the source volume names is not required but can make mounting destination volumes into the destination simpler to manage if the junction path where the volume is mounted also has the same name as the volume. • Construct the destination NAS namespace for an SVM such that it is identical in paths and directory structure as the source SVM. • Many SAN clients cannot access a LUN that resides in a completely read-only container, such as a SnapMirror destination volume. Generally LUNs should be mapped to igroups and mounted by SAN clients after the SnapMirror break operation is performed. • Configure the destination SVMs ahead of time as described in the following section. This can greatly speed up the storage system DR process, possibly reducing it to a few SnapMirror break operations and the update of some DNS aliases. • As new volumes are created at the source site, SnapMirror relationships must be created to replicate those volumes. Configuration settings pertaining to those volumes should be made in the DR site after the volumes are created and replicated so they can be ready in the event of a disaster.

15 Configuration and Failover for Disaster Recovery

Configuration and failover for DR are an overview of the DR process for intracluster SnapMirror DP mirrors. The process is presented in two sections. The first section provides steps that must be completed before a failover is required to prepare the destination for failover. These steps should be completed to prepare the DR site for a DR scenario. The second section provides the steps necessary to perform a failover.

Every environment has its own unique characteristics; each environment can have an effect on a DR plan. Depending on the type of DR solutions deployed, each organization's DR situation could be very different. To enable success, proper planning, documentation, and a realistic walkthrough of a DR scenario are required.

15.1 Environment Failover Requirements and Assumptions

To provide a successful DR experience, consider some general requirements and assumptions. The following is not an all-inclusive list. There are many variables for which to plan depending on the configuration of each environment.

- Systems administrators have access to a workstation or server desktop session from which to administer the DR site and perform the failover.
- Systems administrators have all appropriate credentials, accounts, passwords, and so on required to access the systems.
- Connectivity to the DR network is available from wherever operations are performed.
- Certain infrastructure servers already exist in the DR site and are accessible. These systems provide basic services necessary for the administrators to work in the environment and execute the recovery plan.
  - DR site Active Directory® services to provide authentication
  - DR site DNS services to provide name resolution
  - DR site license servers to provide licensing services for all applications that require them

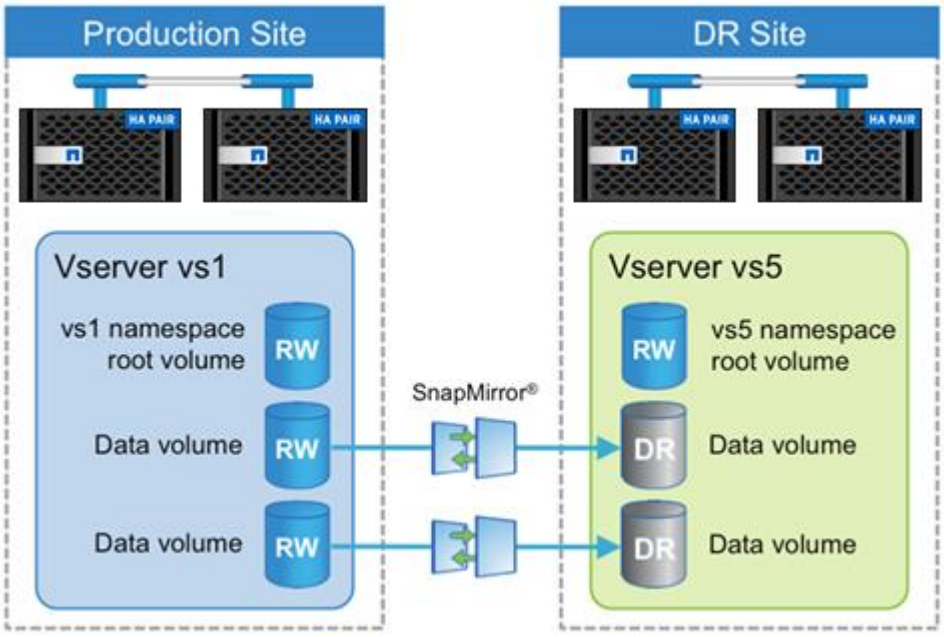
  Note: It is important that a server performing the necessary Active Directory FSMO roles is available at the DR site. For information regarding transferring roles to a surviving Active Directory server or seizing these roles from a failed server, refer to Microsoft KB 255504.http://support.microsoft.com/kb/255504.
- The DR site has time synchronized to the same source as the primary site or a source in sync with the primary site.
- All required NetApp volumes are being replicated using SnapMirror to the DR site.
- The SnapMirror operations have been monitored and are up to date with respect to the designed RPO.
- The required capacity exists on the DR NetApp controller. This refers to capacity required to support day-to-day operations that have been planned for in the DR environment.
- All DR site application servers have the proper connectivity configured to be able to connect to the DR storage arrays.
- A method exists to isolate or fence the failed primary network from the DR site. This is necessary because, if the event causing the disaster is temporary or intermittent in nature, such as an extended power outage, when the primary site systems restart, services might conflict with the recovered operations that are then running at the DR site.
- Plans have been made for providing users and applications access to the data and services at the DR site: for example, updating DNS such that home directory mount requests to the primary site SVM are directed to the DR site SVM instead.

15.2 Preparing the Destination for Failover

Many parts of a DR process for clustered Data ONTAP 8.1 operating system onward can be prepared ahead of time, prior to a DR event. For example, mounting volumes into the namespace, creating CIFS shares, assigning NFS export policies, and other things can all be done ahead of time. SnapMirror cannot be used to replicate configuration information that could be independent in the destination SVMs, such as SVM domain membership, CIFS configuration, NFS policies, Snapshot policy schedules, or NetApp storage efficiency policies.

Figure 34 illustrates volume layout for DR.

Figure 34) Volume layout for DR.



After volumes have been replicated, complete the following steps to prepare the destination system for failover, as shown in 15.3 Performing a Failover.

NAS and SAN Environments

1. Configure the destination SVM membership into the appropriate Active Directory, LDAP, or NIS domain.
2. Determine that the destination SVM is a member of the same domain as the source SVM so that authentication is not broken for tools, such as NetApp SnapDrive for Windows, and so that the same users can be authenticated against file-level ACLs that are replicated by SnapMirror.
3. Create any nondefault Snapshot copy policies needed in the destination cluster.

   Note: NetApp recommends configuring Snapshot copy policies in the destination cluster with the same schedules as those in the source. Snapshot copy policies must be applied to DP volumes after failover.

4. Create NetApp storage efficiency policies in the destination SVM.

   Note: If NetApp storage efficiency policies are assigned to the volumes in the source SVM, a policy must be created in the destination SVM in order to schedule the dedupe process after failover at the DR site. NetApp storage efficiency policies must be applied to DP volumes after failover.

NAS Environments

1. Verify that all necessary volumes in the source SVM are being replicated to the destination SVM. Volumes can be mounted in subfolders or inside other volumes in the namespace. If this condition exists, it is important to make sure that all the volumes required to properly reconstruct the namespace at the destination are being replicated.
2. Verify security style and permissions on the destination SVM root volume. The security style and permissions of the root of the destination SVM namespace must be set correctly, or the NAS namespace might be inaccessible after failover.
3. Mount the destination NAS volumes into the destination SVM namespace.

   SnapMirror does not replicate the SVM namespace junction path information. NAS volumes have no junction path, so they are not accessible after a SnapMirror break occurs unless they are premounted before failover or until they are mounted after failover.

   When mounting the volumes, mount them into the namespace using the same junction path into which the source volume was mounted in the source SVM. This is important so that paths in the recovered namespace are not different than paths that existed at the primary site. If the paths are different, then client mount points, links, shortcuts, and aliases might not be able to find the correct paths.

   Note: Volumes cannot be mounted inside of (nested in) other volumes that are still in a DP state. After using the `snapmirror break` command, any volume that has a mount point nested inside a replicated volume must be mounted, and any CIFS shares must be created.
4. Create CIFS shares on the destination SVM using the same share names that were used at the source. Clients are able to access the CIFS shares; however, all data is read-only until the volume is failed over.
5. Apply the proper ACLs to the CIFS shares at the destination.
6. Create appropriate NFS export policies for the destination SVM.
7. Assign the NFS export policies to the destination volumes. Clients are able to access the NFS exports; however, all data is read-only until the volume is failed over.

SAN Environments

1. If the destination SVMs use portsets, they can be configured as required before failover.
2. Configure igroups on the destination SVM.

Typically, there are different application servers that connect to the recovered storage at the DR site. The initiators from these servers can be preconfigured into appropriate igroups in the destination SVM.

Because some hosts do not support connecting to LUNs in read-only containers, which is what a SnapMirror destination volume is, mapping LUNs to igroups is normally done after failover.

SnapMirror ToolKit (for Clustered Data ONTAP 8.2 operating system)

The main goal of this tool (SnapMirror ToolKit) is to improve the user experience of setting up and running SnapMirror (and SnapVault) in clustered Data ONTAP 8.2 operating system. The feedback from QA, the usability team, and customers who participated in the clustered Data ONTAP 8.2 operating system early validation program indicates that SnapMirror in clustered Data ONTAP 8.2 operating system is more complicated to set up and manage than 7-Mode SnapMirror. We will improve the usability of SnapMirror in future releases of clustered Data ONTAP operating system, but these scripts provide immediate benefit. They are lightweight and portable and provide a simpler user experience than using the clustered Data ONTAP operating system CLI. Furthermore, customers can build in-house automated tools using these scripts as a foundation.

You can download the SnapMirror ToolKit (SMTK) from the SE Utility Toolchest at http://support.netapp.com/NOW/download/tools/smtk.

15.3 Performing a Failover

With most of the configuration necessary for DR performed prior to a failover, the actual steps required to fail over during a DR scenario are greatly reduced. They are as follows.

NAS Environment

1. Perform a SnapMirror break operation to fail over each volume. In clustered Data ONTAP operating system, wildcards can be used to perform a SnapMirror operation on multiple volumes with one command. The following example performs failover for all volumes in the destination SVM called `vs5`; it can be restricted to certain volumes by using part of the volume name in the command.

```
cluster02::> snapmirror break -destination-path cluster02://vs5/*
```

2. If the volumes have been mounted in the namespace and CIFS shares and NFS export policies created and applied, clients then have read-write access to the NAS data.
3. Redirect clients to the recovered storage.

It is common practice to have a DR system with a different name than the source system. In DR failover scenarios it is typical to change DNS name resolution or use DNS aliases to redirect clients to the name of the recovered storage systems. This enables CIFS shares to be accessible using the same UNC path name, and NFS clients can also access the expected path. Alternatively, the failed source storage system might be removed from Active Directory and the recovery storage system removed and readded to Active Directory using the same name as the source system. However, it can take time for this change to propagate through a large Active Directory environment.

SAN Environment

1. Perform a SnapMirror break operation to fail over each volume. In clustered Data ONTAP 8.1 operating system, wildcards can be used to perform a SnapMirror operation on multiple volumes with one command. The following example performs failover for all volumes in the destination SVM called `vs5`; it can be restricted to certain volumes by using part of the volume name in the command.

```
cluster02::> snapmirror break -destination-path cluster02://vs5/*
```

2. Make the LUNs in the volume available to the SAN clients at the DR site by mapping the LUN into the appropriate igroup.
3. On the SAN client, perform a storage rescan to detect the connected LUN.

15.4 Postfailover Volume Configuration

Snapshot copy policies and NetApp storage efficiency policies cannot be assigned to volumes in a DP state, so they must be assigned after failover.

1. If using the Data ONTAP Snapshot copy schedule, assign a Snapshot copy policy to the recovered volumes. In SAN environments Snapshot copies are typically scheduled in the client.
2. If using NetApp storage efficiency technology, assign a storage efficiency policy to the recovered volumes.

16 SnapMirror Transition

There are existing 7-Mode customers who are using QSM and VSM (sync, semi-sync, and async). How would you transition those customers to clustered Data ONTAP operating system? This will be covered in TR-4052: Clustered Data ONTAP Transition Guide.

Additional Resources

The following references were used in this TR:

- TR-3975: DataMotion for Volumes Overview in Clustered Data ONTAP 8.2
- TR-4178: Infinite Volume Deployment and Implementation Guide
- TR-4183: SnapVault Best Practices Guide for Clustered Data ONTAP
- TR-4052: Clustered Data ONTAP Transition Guide
- NetApp Support documentation library

Contact Us

Let us know how we can improve this technical report.

Contact us at docfeedback@netapp.com.

Include TECHNICAL REPORT 4015 in the subject line.

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

Copyright Information

Trademark Information