Data protection and disaster recovery

ONTAP 9

NetApp
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Data protection and disaster recovery

Data protection with System Manager

Data protection overview with System Manager

The topics in this section show you how to configure and manage data protection with System Manager in ONTAP 9.7 and later releases.

If you are using System Manager in ONTAP 9.7 or earlier, see ONTAP System Manager Classic documentation

Protect your data by creating and managing Snapshot copies, mirrors, vaults, and mirror-and-vault relationships.

SnapMirror is disaster recovery technology, designed for failover from primary storage to secondary storage at a geographically remote site. As its name implies, SnapMirror creates a replica, or mirror, of your working data in secondary storage from which you can continue to serve data in the event of a catastrophe at the primary site.

A *vault* is designed for disk-to-disk Snapshot copy replication for standards compliance and other governance-related purposes. In contrast to a SnapMirror relationship, in which the destination usually contains only the Snapshot copies currently in the source volume, a vault destination typically retains point-in-time Snapshot copies created over a much longer period.

Beginning with ONTAP 9.10.1, you can create data protection relationships between S3 buckets using S3 SnapMirror. Destination buckets can be on local or remote ONTAP systems, or on non-ONTAP systems such as StorageGRID and AWS. For more information, see S3 SnapMirror overview.

Create custom data protection policies

You can create custom data protection policies with System Manager when the existing default protection policies are not appropriate for your needs. Beginning with ONTAP 9.11.1, you can use System Manager to create custom mirror and vault policies, to display and select legacy policies. This capability is also available in ONTAP 9.8P12 and later patches of ONTAP 9.8.

Create custom protection policies on both the source and destination cluster.

Steps

1. Click **Protection > Local Policy Settings**.
2. Under **Protection Policies**, click →.
3. In the **Protection Policies** pane, click + Add .
4. Enter the new policy name, and select the policy scope.
5. Choose a policy type. To add a vault-only or mirror-only policy, choose **Asynchronous**, and click **Use a legacy policy type**.
6. Complete the required fields.
7. Click **Save**.

8. Repeat these steps on the other cluster.

Configure Snapshot copies

You can create Snapshot copy policies to specify the maximum number of Snapshot copies that are automatically created and how frequently they are created. The policy specifies when to create Snapshot copies, how many copies to retain, and how to name them.

This procedure creates a Snapshot copy policy on the local cluster only.

Steps

1. Click **Protection > Overview > Local Policy Settings**.
2. Under **Snapshot Policies**, click →, and then click + Add .
3. Type the policy name, select the policy scope, and under **Schedules**, click + Add to enter the schedule details.

Calculate reclaimable space before deleting Snapshot copies

Beginning with ONTAP 9.10.1, you can use System Manager to select Snapshot copies you want to delete and calculate the reclaimable space before you delete them.

Steps

1. Click **Storage > Volumes**.
2. Select the volume from which you want to delete Snapshot copies.
3. Click **Snapshot Copies**.
4. Select one or more Snapshot copies.
5. Click **Calculate Reclaimable Space**.

Enable or disable client access to Snapshot copy directory

Beginning with ONTAP 9.10.1, you can use System Manager to enable or disable client systems to access to a Snapshot copy directory on a volume. Enabling access makes the Snapshot copy directory visible to clients and allows Windows clients to map a drive to the Snapshot copies directory to view and access its contents.

You can enable or disable access to a volume's Snapshot copy directory by editing the volume settings or by editing the volume's share settings.

Enable or disable client access to Snapshot copy directory by editing a volume

The Snapshot copy directory on a volume is accessible to clients by default.

Steps

1. Click **Storage > Volumes**.
2. Select the volume containing the Snapshot copies directory you want to either show or hide.
3. Click ⋮ and select **Edit**.

4. In the **Snapshot Copies (Local) Settings** section, select or deselect **Show the Snapshot copies directory to clients**.
5. Click **Save**.

Enable or disable client access to Snapshot copy directory by editing a share

The Snapshot copy directory on a volume is accessible to clients by default.

Steps

1. Click **Storage > Shares**.
2. Select the volume containing the Snapshot copies directory you want to either show or hide.
3. Click ⋮ and select **Edit**.
4. In the **Share Properties** section, select or deselect **Allow clients to access Snapshot copies directory**.
5. Click **Save**.

Recover from Snapshot copies

You can recover a volume to an earlier point in time by restoring from a Snapshot copy.

This procedure restores a volume from a Snapshot copy.

Steps

1. Click **Storage** and select a volume.
2. Under **Snapshot Copies**, click ⋮ next to the Snapshot copy you want to restore, and select **Restore**.

Prepare for mirroring and vaulting

You can protect your data by replicating it to a remote cluster for data backup and disaster recovery purposes.

Several default protection policies are available. You must have created your protection policies if you want to use custom policies.

Steps

1. In the local cluster, click **Protection > Overview**.
2. Expand **Intercluster Settings**. Click **Add Network Interfaces** and add intercluster network interfaces for the cluster.

   Repeat this step on the remote cluster.

3. In the remote cluster, click **Protection > Overview**. Click ⋮ in the Cluster Peers section and click **Generate**

Passphrase.

4. Copy the generated passphrase and paste it in the local cluster.
5. In the local cluster, under Cluster Peers, click **Peer Clusters** and peer the local and remote clusters.
6. Optionally, under Storage VM Peers, click ⋮ and then **Peer Storage VMs** to peer the storage VMs.
7. Click **Protect Volumes** to protect your volumes. To protect your LUNs, click **Storage > LUNs**, select a LUN to protect, and then click Protect.

   Select the protection policy based on the type of data protection you need.

8. To verify the volumes and LUNs are successfully protected from the local cluster, click **Storage > Volumes** or **Storage > LUNs** and, expand the volume/LUN view.

Other ways to do this in ONTAP

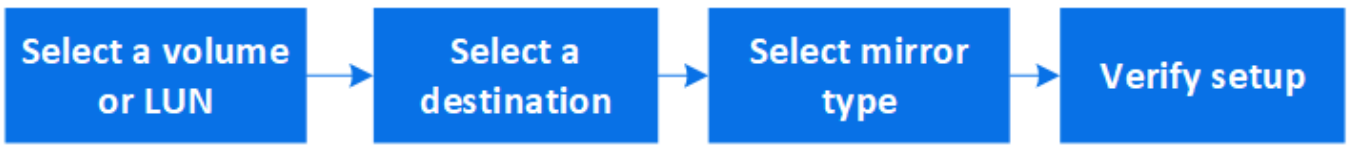
To perform these tasks with…	See this content…
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume disaster recovery preparation overview
The ONTAP command line interface	Create a cluster peer relationship

Configure mirrors and vaults

Create a mirror and vault of a volume to protect data in case of a disaster and to have multiple archived versions of data to which you can roll back. Beginning with ONTAP 9.11.1, you can use System Manager to select pre-created and custom mirror and vault policies, to display and select legacy policies, and to override the transfer schedules defined in a protection policy when protecting volumes and storage VMs. This capability is also available in ONTAP 9.8P12 and later patches of ONTAP 9.8.

ⓘ If you are using ONTAP 9.8P12 or later ONTAP 9.8 patch release and you configured SnapMirror using System Manager, you should use ONTAP 9.9.1P13 or later and ONTAP 9.10.1P10 or later patch releases if you plan to upgrade to ONTAP 9.9.1 or ONTAP 9.10.1 releases.

This procedure creates a data protection policy on a remote cluster. The source cluster and destination cluster use intercluster network interfaces for exchanging data. The procedure assumes the intercluster network interfaces are created and the clusters containing the volumes are peered (paired). You can also peer storage VMs for data protection; however, if storage VMs are not peered, but permissions are enabled, storage VMs are automatically peered when the protection relationship is created.



Steps

1. Select the volume or LUN to protect: click **Storage > Volumes** or **Storage > LUNs**, and then click the desired volume or LUN name.
2. Click Protect.

3. Select the destination cluster and storage VM.
4. The asynchronous policy is selected by default. To select a synchronous policy, click **More Options**.
5. Click **Protect**.
6. Click the **SnapMirror (Local or Remote)** tab for the selected volume or LUN to verify that protection is set up correctly.

Other ways to do this in ONTAP

To perform these tasks with…	See this content…
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume backup using SnapVault overview
The ONTAP command line interface	Create a replication relationship

Resynchronize a protection relationship

When your original source volume is available again after a disaster, you can resynchronize data from the destination volume and reestablish the protection relationship.

This procedure replaces the data in the original source volume in an asynchronous relationship so that you can start serving data from the original source volume again and resume the original protection relationship.

Steps

1. Click **Protection > Relationships** and then click the broken off relationship you want to resynchronize.
2. Click ⋮ and then select **Resync**.
3. Under **Relationships**, monitor the resynchronization progress by checking the relationship state. The state changes to "Mirrored" when resynchronization is complete.

Restore a volume from an earlier Snapshot copy

When data in a volume is lost or corrupted, you can roll back your data by restoring from an earlier Snapshot copy.

This procedure replaces the current data on the source volume with data from an earlier Snapshot copy version. You should perform this task on the destination cluster.

Steps

1. Click **Protection > Relationships**, and then click the source volume name.
2. Click ⋮ and then select **Restore**.
3. Under **Source**, the source volume is selected by default. Click **Other Volume** if you want to choose a volume other than the source.
4. Under **Destination**, choose the Snapshot copy you want to restore.
5. If your source and destination are located on different clusters, on the remote cluster, click **Protection > Relationships** to monitor the restore progress.

Other ways to do this in ONTAP

To perform these tasks with…	See this content…
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume restore using SnapVault overview
The ONTAP command line interface	Restore the contents of a volume from a SnapMirror destination

Recover from Snapshot copies

You can recover a volume to an earlier point in time by restoring from a Snapshot copy.

This procedure restores a volume from a Snapshot copy.

Steps

1. Click **Storage** and select a volume.
2. Under **Snapshot Copies**, click ⋮ next to the Snapshot copy you want to restore, and select **Restore**.

Restore to a new volume

Beginning with ONTAP 9.8, you can use System Manager to restore backed up data on the destination volume to a volume other than the original source.

When you restore to a different volume, you can select an existing volume, or you can create a new volume.

Steps

1. Select the desired protection relationship: click **Protection > Relationships**.
2. Click ⋮ and click **Restore**.
3. In the **Source** section, select **Other Volume** and select the cluster and Storage VM.
4. Select either **Existing volume** or **Create a new volume**.
5. If you are creating a new volume, enter the volume name.
6. In the **Destination** section, select the Snapshot copy to restore.
7. Click **Save**.
8. Under **Relationships**, monitor the restore progress by viewing **Transfer Status** for the relationship.

Reverse Resynchronizing a Protection Relationship

Beginning with ONTAP 9.8, you can use System Manager to perform a reverse resynchronization operation to delete an existing protection relationship and reverse the functions of the source and destination volumes. Then you use the destination volume to serve data while you repair or replace the source, update the source, and reestablish the original configuration of the systems.

ⓘ System Manager does not support reverse resynchronization with intracluster relationships. You can use the ONTAP CLI to perform reverse resync operations with intracluster relationships.

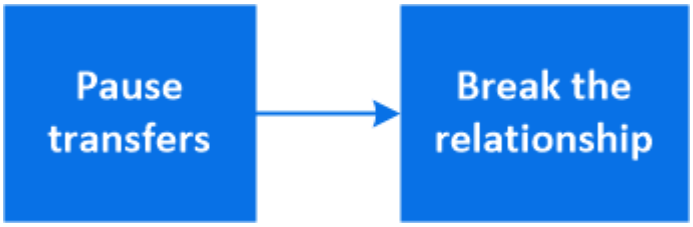
When you perform a reverse resynch operation, any data on the source volume that is newer than the data in the common Snapshot copy is deleted.

Steps

1. Select the desired protection relationship: click **Protection > Relationships**.
2. Click ⋮ and click **Reverse Resync**.
3. Under **Relationships**, monitor the reverse resynchronization progress by viewing **Transfer Status** for the relationship.

Serve data from a SnapMirror destination

To serve data from a mirror destination when a source becomes unavailable, stop scheduled transfers to the destination, and then break the SnapMirror relationship to make the destination writable.



Steps

1. Select the desired protection relationship: click **Protection > Relationships**, and then click the desired volume name.
2. Click ⋮.
3. Stop scheduled transfers : click **Pause**.
4. Make the destination writable: click **Break**.
5. Go to the main **Relationships** page to verify that the relationship state displays as "broken off".

Next steps:

When the disabled source volume is available again, you should resynchronize the relationship to copy the current data to the original source volume. This process replaces the data on the original source volume.

Other ways to do this in ONTAP

To perform these tasks with…	See this content…
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume disaster recovery overview
The ONTAP command line interface	Activate the destination volume

Configure storage VM disaster recovery

Using System Manager, you can create an storage VM disaster recovery (storage VM DR) relationship to replicate one storage VM configuration to another. In the event of a disaster at the primary site, you can quickly activate the destination storage VM.

Complete this procedure from the destination. If you need to create a new protection policy, for instance, when your source storage VM has SMB configured, you should use System Manager to create the policy and select the **Copy source storage VM configuration** option in the **Add Protection Policy** window.
For details see Create custom data protection policies.

Steps

1. On the destination cluster, click **Protection > Relationships**.
2. Under **Relationships**, click Protect and choose **Storage VMs (DR)**.
3. Select a protection policy. If you created a custom protection policy, select it, then choose the source cluster and storage VM you want to replicate. You can also create a new destination storage VM by entering a new storage VM name.
4. Click **Save**.

Serve data from an SVM DR destination

Beginning with ONTAP 9.8, you can use System Manager to activate a destination storage VM after a disaster. Activating the destination storage VM makes the SVM destination volumes writable and enables you to serve data to clients.

Steps

1. If the source cluster is accessible, verify that the SVM is stopped: navigate to **Storage > Storage VMs** and check the **State** column for the SVM.
2. If the source SVM state is "Running", stop it: select ⋮ and choose **Stop**.
3. On the destination cluster, locate the desired protection relationship: navigate to **Protection > Relationships**.
4. Click ⋮ and choose **Activate Destination Storage VM**.

Reactivate a source storage VM

Beginning with ONTAP 9.8, you can use System Manager to reactivate a source storage VM after a disaster. Reactivating the source storage VM stops the destination storage VM, and it reenables replication from the source to the destination.

About this task

When you reactivate the source storage VM, System Manager performs the following operations in the background:

- Creates a reverse SVM DR relationship from the original destination to original source using SnapMirror resync
- Stops the destination SVM
- Updates the SnapMirror relationship
- Breaks the SnapMirror relationship
- Restarts the original SVM
- Issues a SnapMirror resync of the original source back to the original destination
- Cleans up the SnapMirror relationships

Steps

1. Select the desired protection relationship: click **Protection > Relationships**.
2. Click ⋮ and click **Reactivate Source Storage VM**.
3. Under **Relationships**, monitor the source reactivation progress by viewing **Transfer Status** for the protection relationship.

Resynchronize a destination storage VM

Beginning with ONTAP 9.8, you can use System Manager to resynchronize the data and configuration details from the source storage VM to the destination storage VM in a broken protection relationship and reestablish the relationship.

ONTAP 9.11.1 introduces an option to bypass a full data warehouse rebuild when you perform a disaster recovery rehearsal, enabling you to return to production faster.

You perform the resync operation only from the destination of the original relationship. The resync deletes any data in the destination storage VM that is newer than the data in the source storage VM.

Steps

1. Select the desired protection relationship: click **Protection > Relationships**.
2. Optionally, select **Perform a quick resync** to bypass a full data warehouse rebuild during a disaster recovery rehearsal.
3. Click ⋮ and click **Resync**.
4. Under **Relationships**, monitor the resynchronization progress by viewing **Transfer Status** for the relationship.

Back up data to the cloud using SnapMirror

Beginning with ONTAP 9.9.1, you can back up your data to the cloud and to restore your data from cloud storage to a different volume by using System Manager. You can use either StorageGRID or ONTAP S3 as your cloud object store.

Before using the SnapMirror Cloud feature, you should request a SnapMirror Cloud API license key from the NetApp Support Site: Request SnapMirror Cloud API license key.
Following the instructions, you should provide a simple description of your business opportunity and request the API key by sending an email to the provided email address. You should receive an email response within 24 hours with further instructions on how to acquire the API key.

Add a cloud object store

Before you configure SnapMirror Cloud backups, you need to add a StorageGRID or ONTAP S3 cloud object store.

Steps

1. Click **Protection > Overview > Cloud Object Stores**.
2. Click + Add .

Back up using the default policy

You can quickly configure a SnapMirror Cloud backup for an existing volume using the default cloud protection

policy, DailyBackup.

Steps

1. Click **Protection > Overview** and select **Back Up Volumes to Cloud**.
2. If this is your first time backing up to the cloud, enter your SnapMirror Cloud API license key in the license field as indicated.
3. Click **Authenticate and Continue**.
4. Select a source volume.
5. Select a cloud object store.
6. Click **Save**.

Create a custom cloud backup policy

If you do not want to use the default DailyBackup cloud policy for your SnapMirror Cloud backups, you can create your own policy.

Steps

1. Click **Protection > Overview > Local Policy Settings** and select **Protection Policies**.
2. Click **Add** and enter the new policy details.
3. In the **Policy Type** section, select **Back up to Cloud** to indicate that you are creating a cloud policy.
4. Click **Save**.

Create a backup from the Volumes page

You can use the System Manager **Volumes** page to when you want to select and create cloud backups for multiple volumes at one time or when you want to use a custom protection policy.

Steps

1. Click **Storage > Volumes**.
2. Select the volumes you want to back up to the cloud, and click **Protect**.
3. In the **Protect Volume** window, click **More Options**.
4. Select a policy.

   You can select the default policy, DailyBackup, or a custom cloud policy you created.

5. Select a cloud object store.
6. Click **Save**.

Restore from the cloud

You can use System Manager to restore backed up data from cloud storage to a different volume on the source cluster.

Steps

1. Click **Storage > Volumes**.
2. Select the **Back Up to Cloud** tab.
3. Click ⋮ next to the source volume you want to restore, and select **Restore**.

4. Under **Source**, select a storage VM and then enter the name of the volume to which you want the data restored.
5. Under **Destination**, select the Snapshot copy you want to restore.
6. Click **Save**.

Delete a SnapMirror Cloud relationship

You can use System Manager to delete a cloud relationship.

Steps

1. Click **Storage > Volumes** and select the volume you want to delete.
2. Click ⋮ next to the source volume and select **Delete**.
3. Select **Delete the cloud object store endpoint (optional)** if you want to delete the cloud object store endpoint.
4. Click **Delete**.

Remove a cloud object store

You can use System Manager to remove a cloud object store if it is not part of a cloud backup relationship. When a cloud object store is part of a cloud backup relationship, it cannot be deleted.

Steps

1. Click **Protection > Overview > Cloud Object Stores**.
2. Select the object store you want to delete, click ⋮ and select **Delete**.

Back up data using Cloud Backup

Beginning with ONTAP 9.9.1, you can use System Manager to back up data in the cloud using Cloud Backup.

ⓘ Cloud Backup supports FlexVol read-write volumes and data-protection (DP) volumes. FlexGroup volumes and SnapLock volumes are not supported.

Before you begin

You should perform the following procedures to establish an account in BlueXP. For the service account, you need to create the role as "Account Admin". (Other service account roles do not have the required privileges needed to establish a connection from System Manager.)

1. Create an account in BlueXP.
2. Create a connector in BlueXP with one of the following cloud providers:
   - Microsoft Azure
   - Amazon Web Services (AWS)
   - Google Cloud Platform (GCP)
   - StorageGrid (ONTAP 9.10.1)

Beginning with ONTAP 9.10.1, you can select StorageGrid as a cloud backup provider, but only if BlueXP is deployed on premises. The BlueXP connector must be installed on premises and available through the BlueXP software-as-a-service (SaaS) application.

3. Subscribe to Cloud Backup Service in BlueXP (requires the appropriate license).
4. Generate an access key and a secret key using BlueXP.

Register the cluster with BlueXP

You can register the cluster with BlueXP by using either BlueXP or System Manager.

Steps

1. In System Manager, go to **Protection Overview**.
2. Under **Cloud Backup Service**, provide the following details:
   - Client ID
   - Client secret key
3. Select **Register and Continue**.

Enable Cloud Backup

After the cluster is registered with BlueXP, you need to enable the Cloud Backup and initiate the first backup to the cloud.

Steps

1. In System Manager, click **Protection > Overview**, then scroll to the **Cloud Backup Service** section.
2. Enter the **Client ID** and **Client Secret**.

   Beginning with ONTAP 9.10.1, you can learn about the cost of using the cloud by clicking **Learn more about the cost of using the cloud**.

3. Click **Connect and Enable Cloud Backup Service**.
4. On the **Enable Cloud Backup Service** page, provide the following details, depending on the provider you selected.

For this cloud provider…	Enter the following data…
Azure	• Azure Subscription ID • Region • Resource group name (existing or new)
AWS	• AWS Account ID • Access key • Secret key • Region

Google Cloud Project (GCP)	• Google Cloud Project name • Google Cloud Access key • Google Cloud Secret key • Region
StorageGrid (ONTAP 9.10.1 and later, and only for on-premises deployment of BlueXP)	• Server • SG Access Key • SG Secret Key

5. Select a **Protection policy**:
   - **Existing policy**: Choose an existing policy.
   - **New Policy**: Specify a name and set up a transfer schedule.

     Beginning with ONTAP 9.10.1, you can specify whether you want to enable archiving with Azure or AWS.

     If you enable archiving for a volume with Azure or AWS, you cannot disable the archiving.

     If you enable archiving for Azure or AWS, specify the following:

     - The number of days after which the volume is archived.
     - The number of backups to retain in the archive. Specify “0” (zero) to archive up to the latest backup.
     - For AWS, select the archive storage class.
6. Select the volumes you want to back up.
7. Select **Save**.

Edit the protection policy used for Cloud Backup

You can change which protection policy is used with Cloud Backup.

Steps

1. In System Manager, click **Protection > Overview**, then scroll to the **Cloud Backup Service** section.
2. Click ⋮, then **Edit**.
3. Select a **Protection policy**:
   - **Existing policy**: Choose an existing policy.
   - **New Policy**: Specify a name and set up a transfer schedule.

     Beginning with ONTAP 9.10.1, you can specify whether you want to enable archiving with Azure or AWS.

If you enable archiving for a volume with Azure or AWS, you cannot disable the archiving.

If you enable archiving for Azure or AWS, specify the following:

- The number of days after which the volume is archived.
- The number of backups to retain in the archive. Specify “0” (zero) to archive up to the latest backup.
- For AWS, select the archive storage class.

4. Select **Save**.

Protect new volumes or LUNs on the cloud

When you create a new volume or LUN, you can establish a SnapMirror protection relationship that enables backing up to the cloud for the volume or LUN.

Before you begin

- You should have a SnapMirror license.
- Intercluster LIFs should be configured.
- NTP should be configured.
- Cluster must be running ONTAP 9.9.1.

About this task

You cannot protect new volumes or LUNs on the cloud for the following cluster configurations:

- The cluster cannot be in a MetroCluster environment.
- SVM-DR is not supported.
- FlexGroups cannot be backed up using Cloud Backup.

Steps

1. When provisioning a volume or LUN, on the **Protection** page in System Manager, select the checkbox labeled **Enable SnapMirror (Local or Remote)**.
2. Select the Cloud Backup policy type.
3. If the Cloud Backup is not enabled, select **Enable Cloud Backup Service**.

Protect existing volumes or LUNs on the cloud

You can establish a SnapMirror protection relationship for existing volumes and LUNs.

Steps

1. Select an existing volume or LUN, and click **Protect**.
2. On the **Protect Volumes** page, specify **Backup using Cloud Backup Service** for the protection policy.
3. Click **Protect**.
4. On the **Protection** page, select the checkbox labeled **Enable SnapMirror (Local or Remote)**.
5. Select **Enable Cloud Backup Service**.

Restore data from backup files

You can perform backup management operations, such as restoring data, updating relationships, and deleting relationships, only when using the BlueXP interface. Refer to Restoring data from backup files for more information.

Cluster and SVM peering with the CLI

Cluster and SVM peering overview with the CLI

You can create peer relationships between source and destination clusters and between source and destination storage virtual machines (SVMs). You must create peer relationships between these entities before you can replicate Snapshot copies using SnapMirror.

ONTAP 9.3 offers enhancements that simplify the way you configure peer relationships between clusters and SVMs. The cluster and SVMs peering procedures are available for all ONTAP 9 versions. You should use the appropriate procedure for your version of ONTAP.

You perform the procedures using the command-line interface (CLI), not System Manager or an automated scripting tool.

Prepare for cluster and SVM peering

Peering basics

You must create *peer relationships* between source and destination clusters and between source and destination SVMs before you can replicate Snapshot copies using SnapMirror. A peer relationship defines network connections that enable clusters and SVMs to exchange data securely.

Clusters and SVMs in peer relationships communicate over the intercluster network using *intercluster logical interfaces (LIFs)*. An intercluster LIF is a LIF that supports the "intercluster-core" network interface service and is typically created using the "default-intercluster" network interface service policy. You must create intercluster LIFs on every node in the clusters being peered.

Intercluster LIFs use routes that belong to the system SVM to which they are assigned. ONTAP automatically creates a system SVM for cluster-level communications within an IPspace.

Fan-out and cascade topologies are both supported. In a cascade topology, you need only create intercluster networks between the primary and secondary clusters and between the secondary and tertiary clusters. You need not create an intercluster network between the primary and the tertiary cluster.

It is possible (but not advisable) for an administrator to remove the intercluster-core service from the default-intercluster service policy. If this occurs, LIFs created using "default-intercluster" will not actually be intercluster LIFs. To confirm that the default-intercluster service policy contains the intercluster-core service, use the following command:

```
network interface service-policy show -policy default-intercluster
```

Prerequisites for cluster peering

Before you set up cluster peering, you should confirm that the connectivity, port, IP address, subnet, firewall, and cluster-naming requirements are met.

> Beginning with ONTAP 9.6, cluster peer encryption provides TLS 1.2 AES-256 GCM encryption support for data replication by default. The default security ciphers ("PSK-AES256-GCM-SHA384") are required for cluster peering to work even if encryption is disabled.
>
> Beginning with ONTAP 9.11.1, DHE-PSK security ciphers are available by default.

Connectivity requirements

Every intercluster LIF on the local cluster must be able to communicate with every intercluster LIF on the remote cluster.

Although it is not required, it is typically simpler to configure the IP addresses used for intercluster LIFs in the same subnet. The IP addresses can reside in the same subnet as data LIFs, or in a different subnet. The subnet used in each cluster must meet the following requirements:

- The subnet must belong to the broadcast domain that contains the ports that are used for intercluster communication.
- The subnet must have enough IP addresses available to allocate to one intercluster LIF per node.

  For example, in a four-node cluster, the subnet used for intercluster communication must have four available IP addresses.

Each node must have an intercluster LIF with an IP address on the intercluster network.

Intercluster LIFs can have an IPv4 address or an IPv6 address.

> ONTAP enables you to migrate your peering networks from IPv4 to IPv6 by optionally allowing both protocols to be present simultaneously on the intercluster LIFs. In earlier releases, all intercluster relationships for an entire cluster were either IPv4 or IPv6. This meant that changing protocols was a potentially disruptive event.

Port requirements

You can use dedicated ports for intercluster communication, or share ports used by the data network. Ports must meet the following requirements:

- All ports that are used to communicate with a given remote cluster must be in the same IPspace.

  You can use multiple IPspaces to peer with multiple clusters. Pair-wise full-mesh connectivity is required only within an IPspace.

- The broadcast domain that is used for intercluster communication must include at least two ports per node so that intercluster communication can fail over from one port to another port.

  Ports added to a broadcast domain can be physical network ports, VLANs, or interface groups (ifgrps).

- All ports must be cabled.

- All ports must be in a healthy state.
- The MTU settings of the ports must be consistent.

Firewall requirements

Beginning with ONTAP 9.10.1, firewall policies are deprecated and wholly replaced with LIF service policies. For more information, see Configure firewall policies for LIFs.

Firewalls and the intercluster firewall policy must allow the following protocols:

- ICMP service
- TCP to the IP addresses of all the intercluster LIFs over the ports 11104 and 11105
- Bidirectional HTTPS between the intercluster LIFs

  Although HTTPS is not required when you set up cluster peering using the CLI, HTTPS is required later if you use System Manager to configure data protection.

The default `intercluster` firewall policy allows access through the HTTPS protocol and from all IP addresses (0.0.0.0/0). You can modify or replace the policy if necessary.

Cluster requirement

Clusters must meet the following requirement:

- A cluster cannot be in a peer relationship with more than 255 clusters.

Use shared or dedicated ports

You can use dedicated ports for intercluster communication, or share ports used by the data network. In deciding whether to share ports, you need to consider network bandwidth, the replication interval, and port availability.

You can share ports on one peered cluster while using dedicated ports on the other.

Network bandwidth

If you have a high-speed network, such as 10 GbE, you might have enough local LAN bandwidth to perform replication using the same 10 GbE ports used for data access.

Even then, you should compare your available WAN bandwidth to your LAN bandwidth. If the available WAN bandwidth is significantly less than 10 GbE, you might need to use dedicated ports.

The one exception to this rule might be when all or many nodes in the cluster replicate data, in which case bandwidth utilization is typically spread across nodes.

If you are not using dedicated ports, the maximum transmission unit (MTU) size of the replication network should typically be the same as the MTU size of the data network.

Replication interval

If replication takes place in off-peak hours, you should be able to use data ports for replication even without a 10-GbE LAN connection.

If replication takes place during normal business hours, you need to consider the amount of data that will be replicated and whether it requires so much bandwidth that it could cause contention with data protocols. If network utilization by data protocols (SMB, NFS, iSCSI) is above 50%, you should use dedicated ports for intercluster communication, to allow for non-degraded performance if node failover occurs.

Port availability

If you determine that replication traffic is interfering with data traffic, you can migrate intercluster LIFs to any other intercluster-capable shared port on the same node.

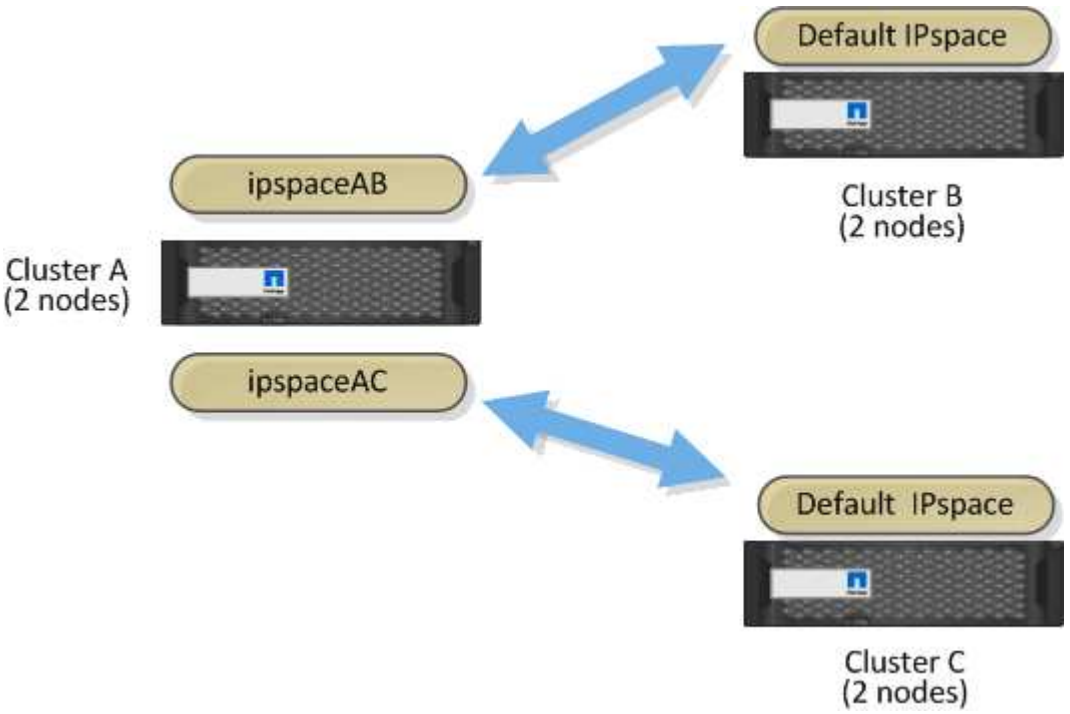
You can also dedicate VLAN ports for replication. The bandwidth of the port is shared between all VLANs and the base port.

Use custom IPspaces to isolate replication traffic

You can use custom IPspaces to separate the interactions that a cluster has with its peers. Called *designated intercluster connectivity*, this configuration allows service providers to isolate replication traffic in multitenant environments.

Suppose, for example, that you want replication traffic between Cluster A and Cluster B to be separated from replication traffic between Cluster A and Cluster C. To accomplish this, you can create two IPspaces on Cluster A.

One IPspace contains the intercluster LIFs that you use to communicate with Cluster B. The other contains the intercluster LIFs that you use to communicate with Cluster C, as shown in the following illustration.



For custom IPspace configuration, see the *Network Management Guide*.

Configure intercluster LIFs

Configure intercluster LIFs on shared data ports

You can configure intercluster LIFs on ports shared with the data network. Doing so reduces the number of ports you need for intercluster networking.

Steps

1. List the ports in the cluster:

   `network port show`

   For complete command syntax, see the man page.

   The following example shows the network ports in `cluster01`:

```
cluster01::> network port show
                                                                  Speed
(Mbps)
Node   Port      IPspace      Broadcast Domain Link   MTU    Admin/Oper
------ --------- ------------ ---------------- ----- -------
------------
cluster01-01
       e0a       Cluster      Cluster          up     1500   auto/1000
       e0b       Cluster      Cluster          up     1500   auto/1000
       e0c       Default      Default          up     1500   auto/1000
       e0d       Default      Default          up     1500   auto/1000
cluster01-02
       e0a       Cluster      Cluster          up     1500   auto/1000
       e0b       Cluster      Cluster          up     1500   auto/1000
       e0c       Default      Default          up     1500   auto/1000
       e0d       Default      Default          up     1500   auto/1000
```

2. Create intercluster LIFs on the system SVM:

Option	Description
In ONTAP 9.6 and later:	`network interface create -vserver` *`system_SVM`* `-lif` *`LIF_name`* `-service -policy default-intercluster -home -node` *`node`* `-home-port port -address` *`port_IP`* `-netmask` *`netmask`*

Option	Description
In ONTAP 9.5 and earlier:	`network interface create -vserver` *`system_SVM`* `-lif` *`LIF_name`* `-role intercluster -home-node` *`node`* `-home -port` *`port`* `-address` *`port_IP`* `-netmask` *`netmask`*

For complete command syntax, see the man page.

The following example creates intercluster LIFs `cluster01_icl01` and `cluster01_icl02`:

```
cluster01::> network interface create -vserver cluster01 -lif
cluster01_icl01 -service-
policy default-intercluster -home-node cluster01-01 -home-port e0c
-address 192.168.1.201
-netmask 255.255.255.0

cluster01::> network interface create -vserver cluster01 -lif
cluster01_icl02 -service-
policy default-intercluster -home-node cluster01-02 -home-port e0c
-address 192.168.1.202
-netmask 255.255.255.0
```

3. Verify that the intercluster LIFs were created:

Option	Description
In ONTAP 9.6 and later:	`network interface show -service-policy default-intercluster`
In ONTAP 9.5 and earlier:	`network interface show -role intercluster`

For complete command syntax, see the man page.

```
cluster01::> network interface show -service-policy default-intercluster
            Logical    Status     Network            Current
Current Is
Vserver     Interface  Admin/Oper Address/Mask       Node          Port
Home
----------- ---------- ---------- ------------------ -------------
------- ----
cluster01
            cluster01_icl01
                       up/up      192.168.1.201/24   cluster01-01  e0c
true
            cluster01_icl02
                       up/up      192.168.1.202/24   cluster01-02  e0c
true
```

4. Verify that the intercluster LIFs are redundant:

Option	Description
In ONTAP 9.6 and later:	`network interface show –service-policy default-intercluster -failover`
In ONTAP 9.5 and earlier:	`network interface show -role intercluster -failover`

For complete command syntax, see the man page.

The following example shows that the intercluster LIFs `cluster01_icl01` and `cluster01_icl02` on the `e0c` port will fail over to the `e0d` port.

```
cluster01::> network interface show -service-policy default-intercluster
–failover
         Logical         Home                  Failover        Failover
Vserver  Interface       Node:Port             Policy          Group
-------- --------------- --------------------- --------------- --------
cluster01
         cluster01_icl01 cluster01-01:e0c   local-only
192.168.1.201/24
                            Failover Targets: cluster01-01:e0c,
                                              cluster01-01:e0d
         cluster01_icl02 cluster01-02:e0c   local-only
192.168.1.201/24
                            Failover Targets: cluster01-02:e0c,
                                              cluster01-02:e0d
```

Configure intercluster LIFs on dedicated ports

You can configure intercluster LIFs on dedicated ports. Doing so typically increases the available bandwidth for replication traffic.

Steps

1. List the ports in the cluster:

   `network port show`

   For complete command syntax, see the man page.

   The following example shows the network ports in `cluster01`:

```
cluster01::> network port show
                                                                  Speed
(Mbps)
Node   Port      IPspace      Broadcast Domain Link   MTU    Admin/Oper
------ --------- ------------ ---------------- ----- -------
------------
cluster01-01
       e0a       Cluster      Cluster          up     1500   auto/1000
       e0b       Cluster      Cluster          up     1500   auto/1000
       e0c       Default      Default          up     1500   auto/1000
       e0d       Default      Default          up     1500   auto/1000
       e0e       Default      Default          up     1500   auto/1000
       e0f       Default      Default          up     1500   auto/1000
cluster01-02
       e0a       Cluster      Cluster          up     1500   auto/1000
       e0b       Cluster      Cluster          up     1500   auto/1000
       e0c       Default      Default          up     1500   auto/1000
       e0d       Default      Default          up     1500   auto/1000
       e0e       Default      Default          up     1500   auto/1000
       e0f       Default      Default          up     1500   auto/1000
```

2. Determine which ports are available to dedicate to intercluster communication:

   `network interface show -fields home-port,curr-port`

   For complete command syntax, see the man page.

   The following example shows that ports `e0e` and `e0f` have not been assigned LIFs:

```
cluster01::> network interface show -fields home-port,curr-port
vserver lif                  home-port curr-port
------- -------------------- --------- ---------
Cluster cluster01-01_clus1   e0a       e0a
Cluster cluster01-01_clus2   e0b       e0b
Cluster cluster01-02_clus1   e0a       e0a
Cluster cluster01-02_clus2   e0b       e0b
cluster01
        cluster_mgmt         e0c       e0c
cluster01
        cluster01-01_mgmt1   e0c       e0c
cluster01
        cluster01-02_mgmt1   e0c       e0c
```

3. Create a failover group for the dedicated ports:

   `network interface failover-groups create -vserver` *`system_SVM`* `-failover-group` *`failover_group`* `-targets` *`physical _or_logical_ports`*

   The following example assigns ports `e0e` and `e0f` to the failover group `intercluster01` on the system SVM `cluster01`:

```
cluster01::> network interface failover-groups create -vserver cluster01
-failover-group
intercluster01 -targets
cluster01-01:e0e,cluster01-01:e0f,cluster01-02:e0e,cluster01-02:e0f
```

4. Verify that the failover group was created:

   `network interface failover-groups show`

   For complete command syntax, see the man page.

```
cluster01::> network interface failover-groups show
                                  Failover
Vserver          Group            Targets
---------------- ----------------
--------------------------------------------
Cluster
                 Cluster
                                  cluster01-01:e0a, cluster01-01:e0b,
                                  cluster01-02:e0a, cluster01-02:e0b
cluster01
                 Default
                                  cluster01-01:e0c, cluster01-01:e0d,
                                  cluster01-02:e0c, cluster01-02:e0d,
                                  cluster01-01:e0e, cluster01-01:e0f
                                  cluster01-02:e0e, cluster01-02:e0f
                 intercluster01
                                  cluster01-01:e0e, cluster01-01:e0f
                                  cluster01-02:e0e, cluster01-02:e0f
```

5. Create intercluster LIFs on the system SVM and assign them to the failover group.

Option	Description
In ONTAP 9.6 and later:	`network interface create -vserver` *`system_SVM`* `-lif` *`LIF_name`* `-service -policy default-intercluster -home -node` *`node`* `-home- port` *`port`* `-address` *`port_IP`* `-netmask` *`netmask`* `-failover -group` *`failover_group`*
In ONTAP 9.5 and earlier:	`network interface create -vserver` *`system_SVM`* `-lif` *`LIF_name`* `-role intercluster -home-node` *`node`* `-home -port` *`port`* `-address` *`port_IP`* `-netmask` *`netmask`* `-failover-group` *`failover_group`*

For complete command syntax, see the man page.

The following example creates intercluster LIFs `cluster01_icl01` and `cluster01_icl02` in the failover group `intercluster01`:

```
cluster01::> network interface create -vserver cluster01 -lif
cluster01_icl01 -service-
policy default-intercluster -home-node cluster01-01 -home-port e0e
-address 192.168.1.201
-netmask 255.255.255.0 -failover-group intercluster01

cluster01::> network interface create -vserver cluster01 -lif
cluster01_icl02 -service-
policy default-intercluster -home-node cluster01-02 -home-port e0e
-address 192.168.1.202
-netmask 255.255.255.0 -failover-group intercluster01
```

6. Verify that the intercluster LIFs were created:

Option	Description
In ONTAP 9.6 and later:	`network interface show -service-policy default-intercluster`
In ONTAP 9.5 and earlier:	`network interface show -role intercluster`

For complete command syntax, see the man page.

```
cluster01::> network interface show -service-policy default-intercluster
            Logical    Status     Network            Current
Current Is
Vserver     Interface  Admin/Oper Address/Mask       Node          Port
Home
----------- ---------- ---------- ------------------ -------------
------- ----
cluster01
            cluster01_icl01
                       up/up      192.168.1.201/24   cluster01-01  e0e
true
            cluster01_icl02
                       up/up      192.168.1.202/24   cluster01-02  e0f
true
```

7. Verify that the intercluster LIFs are redundant:

Option	Description
In ONTAP 9.6 and later:	`network interface show -service-policy default-intercluster -failover`
In ONTAP 9.5 and earlier:	`network interface show -role intercluster -failover`

For complete command syntax, see the man page.

The following example shows that the intercluster LIFs `cluster01_icl01` and `cluster01_icl02` on the SVM`e0e` port will fail over to the `e0f` port.

```
cluster01::> network interface show -service-policy default-intercluster
-failover
         Logical         Home                  Failover        Failover
Vserver  Interface       Node:Port             Policy          Group
-------- --------------- --------------------- --------------- --------
cluster01
         cluster01_icl01 cluster01-01:e0e   local-only
intercluster01
                            Failover Targets:  cluster01-01:e0e,
                                               cluster01-01:e0f
         cluster01_icl02 cluster01-02:e0e   local-only
intercluster01
                            Failover Targets:  cluster01-02:e0e,
                                               cluster01-02:e0f
```

Configure intercluster LIFs in custom IPspaces

You can configure intercluster LIFs in custom IPspaces. Doing so allows you to isolate replication traffic in multitenant environments.

When you create a custom IPspace, the system creates a system storage virtual machine (SVM) to serve as a container for the system objects in that IPspace. You can use the new SVM as the container for any intercluster LIFs in the new IPspace. The new SVM has the same name as the custom IPspace.

Steps

1. List the ports in the cluster:

   `network port show`

   For complete command syntax, see the man page.

   The following example shows the network ports in `cluster01`:

```
cluster01::> network port show
                                                                  Speed
(Mbps)
Node   Port      IPspace      Broadcast Domain Link   MTU    Admin/Oper
------ --------- ------------ ---------------- ----- -------
------------
cluster01-01
       e0a       Cluster      Cluster          up     1500   auto/1000
       e0b       Cluster      Cluster          up     1500   auto/1000
       e0c       Default      Default          up     1500   auto/1000
       e0d       Default      Default          up     1500   auto/1000
       e0e       Default      Default          up     1500   auto/1000
       e0f       Default      Default          up     1500   auto/1000
cluster01-02
       e0a       Cluster      Cluster          up     1500   auto/1000
       e0b       Cluster      Cluster          up     1500   auto/1000
       e0c       Default      Default          up     1500   auto/1000
       e0d       Default      Default          up     1500   auto/1000
       e0e       Default      Default          up     1500   auto/1000
       e0f       Default      Default          up     1500   auto/1000
```

2. Create custom IPspaces on the cluster:

   `network ipspace create -ipspace` *`ipspace`*

   The following example creates the custom IPspace `ipspace-IC1`:

   ```
   cluster01::> network ipspace create -ipspace ipspace-IC1
   ```

3. Determine which ports are available to dedicate to intercluster communication:

   `network interface show -fields home-port,curr-port`

   For complete command syntax, see the man page.

   The following example shows that ports `e0e` and `e0f` have not been assigned LIFs:

```
cluster01::> network interface show -fields home-port,curr-port
vserver lif                  home-port curr-port
------- -------------------- --------- ---------
Cluster cluster01_clus1   e0a       e0a
Cluster cluster01_clus2   e0b       e0b
Cluster cluster02_clus1   e0a       e0a
Cluster cluster02_clus2   e0b       e0b
cluster01
        cluster_mgmt         e0c       e0c
cluster01
        cluster01-01_mgmt1   e0c       e0c
cluster01
        cluster01-02_mgmt1   e0c       e0c
```

4. Remove the available ports from the default broadcast domain:

   `network port broadcast-domain remove-ports -broadcast-domain Default -ports ports`

   A port cannot be in more than one broadcast domain at a time. For complete command syntax, see the man page.

   The following example removes ports `e0e` and `e0f` from the default broadcast domain:

```
cluster01::> network port broadcast-domain remove-ports -broadcast
-domain Default -ports
cluster01-01:e0e,cluster01-01:e0f,cluster01-02:e0e,cluster01-02:e0f
```

5. Verify that the ports have been removed from the default broadcast domain:

   `network port show`

   For complete command syntax, see the man page.

   The following example shows that ports `e0e` and `e0f` have been removed from the default broadcast domain:

```
cluster01::> network port show
                                                          Speed (Mbps)
Node   Port    IPspace   Broadcast Domain Link   MTU    Admin/Oper
------ ------- --------- --------------- ----- ------- ------------
cluster01-01
       e0a     Cluster    Cluster          up    9000  auto/1000
       e0b     Cluster    Cluster          up    9000  auto/1000
       e0c     Default    Default          up    1500  auto/1000
       e0d     Default    Default          up    1500  auto/1000
       e0e     Default    -                up    1500  auto/1000
       e0f     Default    -                up    1500  auto/1000
       e0g     Default    Default          up    1500  auto/1000
cluster01-02
       e0a     Cluster    Cluster          up    9000  auto/1000
       e0b     Cluster    Cluster          up    9000  auto/1000
       e0c     Default    Default          up    1500  auto/1000
       e0d     Default    Default          up    1500  auto/1000
       e0e     Default    -                up    1500  auto/1000
       e0f     Default    -                up    1500  auto/1000
       e0g     Default    Default          up    1500  auto/1000
```

6. Create a broadcast domain in the custom IPspace:

   `network port broadcast-domain create -ipspace` *`ipspace`* `-broadcast-domain` *`broadcast_domain`* `-mtu` *`MTU`* `-ports` *`ports`*

   The following example creates the broadcast domain `ipspace-IC1-bd` in the IPspace `ipspace-IC1`:

```
cluster01::> network port broadcast-domain create -ipspace ipspace-IC1
-broadcast-domain
ipspace-IC1-bd -mtu 1500 -ports cluster01-01:e0e,cluster01-01:e0f,
cluster01-02:e0e,cluster01-02:e0f
```

7. Verify that the broadcast domain was created:

   `network port broadcast-domain show`

   For complete command syntax, see the man page.

```
cluster01::> network port broadcast-domain show
IPspace Broadcast                                       Update
Name    Domain Name    MTU  Port List                   Status Details
------- ----------- ------  ---------------------------- --------------
Cluster Cluster       9000
                            cluster01-01:e0a             complete
                            cluster01-01:e0b             complete
                            cluster01-02:e0a             complete
                            cluster01-02:e0b             complete
Default Default       1500
                            cluster01-01:e0c             complete
                            cluster01-01:e0d             complete
                            cluster01-01:e0f             complete
                            cluster01-01:e0g             complete
                            cluster01-02:e0c             complete
                            cluster01-02:e0d             complete
                            cluster01-02:e0f             complete
                            cluster01-02:e0g             complete
ipspace-IC1
        ipspace-IC1-bd
                      1500
                            cluster01-01:e0e             complete
                            cluster01-01:e0f             complete
                            cluster01-02:e0e             complete
                            cluster01-02:e0f             complete
```

8. Create intercluster LIFs on the system SVM and assign them to the broadcast domain:

Option	Description
In ONTAP 9.6 and later:	`network interface create -vserver` *`system_SVM`* `-lif` *`LIF_name`* `-service -policy default-intercluster -home -node` *`node`* `-home-port` *`port`* `-address` *`port_IP`* `-netmask` *`netmask`*
In ONTAP 9.5 and earlier:	`network interface create -vserver` *`system_SVM`* `-lif` *`LIF_name`* `-role intercluster -home-node` *`node`* `-home -port` *`port`* `-address` *`port_IP`* `-netmask` *`netmask`*

The LIF is created in the broadcast domain that the home port is assigned to. The broadcast domain has a default failover group with the same name as the broadcast domain. For complete command syntax, see the man page.

The following example creates intercluster LIFs `cluster01_icl01` and `cluster01_icl02` in the broadcast domain `ipspace-IC1-bd`:

```
cluster01::> network interface create -vserver ipspace-IC1 -lif
cluster01_icl01 -service-
policy default-intercluster -home-node cluster01-01 -home-port e0e
-address 192.168.1.201
-netmask 255.255.255.0

cluster01::> network interface create -vserver ipspace-IC1 -lif
cluster01_icl02 -service-
policy default-intercluster -home-node cluster01-02 -home-port e0e
-address 192.168.1.202
-netmask 255.255.255.0
```

9. Verify that the intercluster LIFs were created:

Option	Description
In ONTAP 9.6 and later:	`network interface show -service-policy default-intercluster`
In ONTAP 9.5 and earlier:	`network interface show -role intercluster`

For complete command syntax, see the man page.

```
cluster01::> network interface show -service-policy default-intercluster
            Logical    Status     Network            Current
Current Is
Vserver     Interface  Admin/Oper Address/Mask       Node          Port
Home
----------- ---------- ---------- ------------------ -------------
------- ----
ipspace-IC1
            cluster01_icl01
                       up/up      192.168.1.201/24   cluster01-01  e0e
true
            cluster01_icl02
                       up/up      192.168.1.202/24   cluster01-02  e0f
true
```

10. Verify that the intercluster LIFs are redundant:

Option	Description
In ONTAP 9.6 and later:	`network interface show -service-policy default-intercluster -failover`
In ONTAP 9.5 and earlier:	`network interface show -role intercluster -failover`

For complete command syntax, see the man page.

The following example shows that the intercluster LIFs `cluster01_icl01` and `cluster01_icl02` on the SVM `e0e` port fail over to the`e0f`port:

```
cluster01::> network interface show -service-policy default-intercluster
-failover
         Logical         Home                  Failover        Failover
Vserver  Interface       Node:Port             Policy          Group
-------- --------------- --------------------- --------------- --------
ipspace-IC1
         cluster01_icl01 cluster01-01:e0e   local-only
intercluster01
                            Failover Targets:  cluster01-01:e0e,
                                               cluster01-01:e0f
         cluster01_icl02 cluster01-02:e0e   local-only
intercluster01
                            Failover Targets:  cluster01-02:e0e,
                                               cluster01-02:e0f
```

Configure peer relationships

Create a cluster peer relationship

You can use the `cluster peer create` command to create a peer relationship between a local and remote cluster. After the peer relationship has been created, you can run `cluster peer create` on the remote cluster to authenticate it to the local cluster.

Before you begin

- You must have created intercluster LIFs on every node in the clusters that are being peered.
- The clusters must be running ONTAP 9.3 or later. (If the clusters are running ONTAP 9.2 or earlier, refer to the procedures in this archived document.)

Steps

1. On the destination cluster, create a peer relationship with the source cluster:

   `cluster peer create -generate-passphrase -offer-expiration` *`MM/DD/YYYY HH:MM:SS`*`|1…7days|1…168hours -peer-addrs` *`peer_LIF_IPs`* `-initial-allowed-vserver`

`-peers` *svm_name*`,..|* -ipspace` *ipspace*

If you specify both `-generate-passphrase` and `-peer-addrs`, only the cluster whose intercluster LIFs are specified in `-peer-addrs` can use the generated password.

You can ignore the `-ipspace` option if you are not using a custom IPspace. For complete command syntax, see the man page.

If you are creating the peering relationship in ONTAP 9.6 or later and you do not want cross-cluster peering communications to be encrypted, you must use the `-encryption-protocol-proposed none` option to disable encryption.

The following example creates a cluster peer relationship with an unspecified remote cluster, and pre-authorizes peer relationships with SVMs `vs1` and `vs2` on the local cluster:

```
cluster02::> cluster peer create -generate-passphrase -offer-expiration
2days -initial-allowed-vserver-peers vs1,vs2

                    Passphrase: UCa+6lRVICXeL/gq1WrK7ShR
               Expiration Time: 6/7/2017 08:16:10 EST
  Initial Allowed Vserver Peers: vs1,vs2
            Intercluster LIF IP: 192.140.112.101
              Peer Cluster Name: Clus_7ShR (temporary generated)

Warning: make a note of the passphrase - it cannot be displayed again.
```

The following example creates a cluster peer relationship with the remote cluster at intercluster LIF IP addresses 192.140.112.103 and 192.140.112.104, and pre-authorizes a peer relationship with any SVM on the local cluster:

```
cluster02::> cluster peer create -generate-passphrase -peer-addrs
192.140.112.103,192.140.112.104 -offer-expiration 2days -initial-allowed
-vserver-peers *

                    Passphrase: UCa+6lRVICXeL/gq1WrK7ShR
               Expiration Time: 6/7/2017 08:16:10 EST
  Initial Allowed Vserver Peers: vs1,vs2
            Intercluster LIF IP: 192.140.112.101,192.140.112.102
              Peer Cluster Name: Clus_7ShR (temporary generated)

Warning: make a note of the passphrase - it cannot be displayed again.
```

The following example creates a cluster peer relationship with an unspecified remote cluster, and pre-authorizes peer relationships with SVMs`vs1` and `vs2` on the local cluster:

```
cluster02::> cluster peer create -generate-passphrase -offer-expiration
2days -initial-allowed-vserver-peers vs1,vs2

                    Passphrase: UCa+6lRVICXeL/gq1WrK7ShR
              Expiration Time: 6/7/2017 08:16:10 EST
  Initial Allowed Vserver Peers: vs1,vs2
            Intercluster LIF IP: 192.140.112.101
              Peer Cluster Name: Clus_7ShR (temporary generated)

Warning: make a note of the passphrase - it cannot be displayed again.
```

2. On source cluster, authenticate the source cluster to the destination cluster:

   `cluster peer create -peer-addrs` *`peer_LIF_IPs`* `-ipspace ipspace`

   For complete command syntax, see the man page.

   The following example authenticates the local cluster to the remote cluster at intercluster LIF IP addresses 192.140.112.101 and 192.140.112.102:

```
cluster01::> cluster peer create -peer-addrs
192.140.112.101,192.140.112.102

Notice: Use a generated passphrase or choose a passphrase of 8 or more
characters.
        To ensure the authenticity of the peering relationship, use a
phrase or sequence of characters that would be hard to guess.

Enter the passphrase:
Confirm the passphrase:

Clusters cluster02 and cluster01 are peered.
```

   Enter the passphrase for the peer relationship when prompted.

3. Verify that the cluster peer relationship was created:

   `cluster peer show -instance`

```
cluster01::> cluster peer show -instance

                                Peer Cluster Name: cluster02
                    Remote Intercluster Addresses: 192.140.112.101,
192.140.112.102
               Availability of the Remote Cluster: Available
                             Remote Cluster Name: cluster2
                             Active IP Addresses: 192.140.112.101,
192.140.112.102
                           Cluster Serial Number: 1-80-123456
                  Address Family of Relationship: ipv4
             Authentication Status Administrative: no-authentication
                Authentication Status Operational: absent
                                 Last Update Time: 02/05 21:05:41
                     IPspace for the Relationship: Default
```

4. Check the connectivity and status of the nodes in the peer relationship:

   `cluster peer health show`

```
cluster01::> cluster peer health show
Node       cluster-Name                Node-Name
             Ping-Status               RDB-Health Cluster-Health  Avail…
---------- --------------------------- ---------  ---------------
--------
cluster01-01
           cluster02                   cluster02-01
             Data: interface_reachable
             ICMP: interface_reachable true       true            true
                                       cluster02-02
             Data: interface_reachable
             ICMP: interface_reachable true       true            true
cluster01-02
           cluster02                   cluster02-01
             Data: interface_reachable
             ICMP: interface_reachable true       true            true
                                       cluster02-02
             Data: interface_reachable
             ICMP: interface_reachable true       true            true
```

Other ways to do this in ONTAP

To perform these tasks with…	See this content…
The redesigned System Manager (available with ONTAP 9.7 and later)	Prepare for mirroring and vaulting
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume disaster recovery preparation overview

Create an intercluster SVM peer relationship

You can use the `vserver peer create` command to create a peer relationship between SVMs on local and remote clusters.

Before you begin

- The source and destination clusters must be peered.
- The clusters must be running ONTAP 9.3. (If the clusters are running ONTAP 9.2 or earlier, refer to the procedures in this archived document.)
- You must have "pre-authorized" peer relationships for the SVMs on the remote cluster.

  For more information, see Creating a cluster peer relationship.

About this task

Previous releases of ONTAP let you authorize a peer relationship for only one SVM at a time. You needed to run the `vserver peer accept` command each time you authorized a pending SVM peer relationship.

Beginning with ONTAP 9.3, you can "pre-authorize" peer relationships for multiple SVMs by listing the SVMs in the `-initial-allowed-vserver` option when you create a cluster peer relationship. For more information, see Creating a cluster peer relationship.

Steps

1. On the data protection destination cluster, display the SVMs that are pre-authorized for peering:

   `vserver peer permission show`

   ```
   cluster02::> vserver peer permission show
   Peer Cluster         Vserver               Applications
   -------------------  --------------------  --------------------
   cluster02            vs1,vs2               snapmirror
   ```

2. On the data protection source cluster, create a peer relationship to a pre-authorized SVM on the data protection destination cluster:

   `vserver peer create -vserver` *`local_SVM`* `-peer-vserver` *`remote_SVM`*

   For complete command syntax, see the man page.

   The following example creates a peer relationship between the local SVM `pvs1` and the pre-authorized remote SVM `vs1`:

```
cluster01::> vserver peer create -vserver pvs1 -peer-vserver vs1
```

3. Verify the SVM peer relationship:

   `vserver peer show`

```
cluster01::> vserver peer show
            Peer        Peer                           Peering
Remote
Vserver     Vserver     State        Peer Cluster      Applications
Vserver
----------- ----------- ------------ ----------------- --------------
---------
pvs1        vs1         peered       cluster02         snapmirror
vs1
```

Add an intercluster SVM peer relationship

If you create an SVM after configuring a cluster peer relationship, you will need to add a peer relationship for the SVM manually. You can use the `vserver peer create` command to create a peer relationship between SVMs. After the peer relationship has been created, you can run `vserver peer accept` on the remote cluster to authorize the peer relationship.

Before you begin

The source and destination clusters must be peered.

About this task

You can create a peer relationships between SVMs in the same cluster for local data backup. For more information, see the `vserver peer create` man page.

Administrators occasionally use the `vserver peer reject` command to reject a proposed SVM peer relationship. If the relationship between SVMs is in the `rejected` state, you must delete the relationship before you can create a new one. For more information, see the `vserver peer delete` man page.

Steps

1. On the data protection source cluster, create a peer relationship with an SVM on the data protection destination cluster:

   `vserver peer create -vserver` *`local_SVM`* `-peer-vserver` *`remote_SVM`* `-applications snapmirror|file-copy|lun-copy -peer-cluster` *`remote_cluster`*

   The following example creates a peer relationship between the local SVM`pvs1` and the remote SVM`vs1`

```
cluster01::> vserver peer create -vserver pvs1 -peer-vserver vs1
-applications snapmirror -peer-cluster cluster02
```

If the local and remote SVMs have the same names, you must use a *local name* to create the SVM peer relationship:

```
cluster01::> vserver peer create -vserver vs1 -peer-vserver
vs1 -applications snapmirror -peer-cluster cluster01
-local-name cluster1vs1LocallyUniqueName
```

2. On the data protection source cluster, verify that the peer relationship has been initiated:

   `vserver peer show-all`

   For complete command syntax, see the man page.

   The following example shows that the peer relationship between SVM`pvs1` and SVM`vs1` has been initiated:

```
cluster01::> vserver peer show-all
            Peer        Peer                        Peering
Vserver     Vserver     State      Peer Cluster     Applications
--------    --------    ---------  -------------    ------------
pvs1        vs1         initiated   Cluster02         snapmirror
```

3. On the data protection destination cluster, display the pending SVM peer relationship:

   `vserver peer show`

   For complete command syntax, see the man page.

   The following example lists the pending peer relationships for `cluster02`:

```
cluster02::> vserver peer show

                  Peer               Peer
Vserver           Vserver            State
-----------       -----------        ------------
vs1               pvs1               pending
```

4. On the data protection destination cluster, authorize the pending peer relationship:

   `vserver peer accept -vserver` *`local_SVM`* `-peer-vserver` *`remote_SVM`*

   For complete command syntax, see the man page.

The following example authorizes the peer relationship between the local SVM `vs1` and the remote SVM `pvs1`:

```
cluster02::> vserver peer accept -vserver vs1 -peer-vserver pvs1
```

5. Verify the SVM peer relationship:

   `vserver peer show`

```
cluster01::> vserver peer show
            Peer        Peer                           Peering
Remote
Vserver     Vserver     State        Peer Cluster      Applications
Vserver
----------- ----------- ------------ ----------------- --------------
---------
pvs1        vs1         peered       cluster02         snapmirror
vs1
```

Enable cluster peering encryption on an existing peer relationship

Beginning with ONTAP 9.6, cluster peering encryption is enabled by default on all newly created cluster peering relationships. Cluster peering encryption uses a pre-shared key (PSK) and the Transport Security Layer (TLS) to secure cross-cluster peering communications. This adds an additional layer of security between the peered clusters.

About this task

If you are upgrading peered clusters to ONTAP 9.6 or later, and the peering relationship was created in ONTAP 9.5 or earlier, cluster peering encryption must be enabled manually after upgrading. Both clusters in the peering relationship must be running ONTAP 9.6 or later in order to enable cluster peering encryption.

Steps

1. On the destination cluster, enable encryption for communications with the source cluster:

   `cluster peer modify` *`source_cluster`* `-auth-status-admin use-authentication -encryption-protocol-proposed tls-psk`

2. When prompted enter a passphrase.
3. On the data protection source cluster, enable encryption for communication with the data protection destination cluster:

   `cluster peer modify` *`data_protection_destination_cluster`* `-auth-status-admin use-authentication -encryption-protocol-proposed tls-psk`

4. When prompted, enter the same passphrase entered on the destination cluster.

Remove cluster peering encryption from an existing peer relationship

By default, cluster peering encryption is enabled on all peer relationships created in ONTAP 9.6 or later. If you do not want to use encryption for cross-cluster peering communications, you can disable it.

Steps

1. On the destination cluster, modify communications with the source cluster to discontinue use of cluster peering encryption :
   - To remove encryption, but maintain authentication enter:

     ```
     cluster peer modify source_cluster -auth-status-admin use-authentication
     -encryption none
     ```

   - To remove encryption and authentication, enter:

     ```
     cluster peer modify source_cluster -auth-status no-authentication
     ```

2. When prompted enter a passphrase.
3. On the source cluster, disable encryption for communication with the destination cluster:
   - To remove encryption, but maintain authentication enter:

     ```
     cluster peer modify destination_cluster -auth-status-admin use-
     authentication -encrypt none
     ```

   - To remove encryption and authentication, enter:

     ```
     cluster peer modify destination_cluster -auth-status no-authentication
     ```

4. When prompted, enter the same passphrase entered on the destination cluster.

Where to find additional information

You can learn more about tasks related to cluster and SVM peering in NetApp's extensive documentation library.

- ONTAP concepts

  Describes the concepts that inform ONTAP data management software, including data protection and transfer.

- Data protection

  Describes how to use the ONTAP CLI to perform SnapMirror replication.

- Volume disaster recovery preparation

  Describes how to use System Manager to quickly configure a destination volume for disaster recovery.

- Volume disaster recovery preparation

  Describes how to use System Manager to quickly recover a destination volume after a disaster.

- Volume backup using SnapVault

  Describes how to use System Manager to quickly configure a SnapVault relationship between volumes.

- Volume restore management using SnapVault

  Describes how to use System Manager to quickly restore files from a destination volume in a SnapVault relationship.

- Archive and compliance using SnapLock technology

  Describes how to replicate WORM files in a SnapLock volume.

Data protection with the CLI

Data protection overview with the CLI

You can use CLI commands to manage Snapshot copies on a local ONTAP system and to replicate Snapshot copies to a remote system using SnapMirror. You can replicate Snapshot copies for disaster recovery or long-term retention.

Use these procedures under the following circumstances:

- You want to understand the range of ONTAP backup and recovery capabilities.
- You want to use the command-line interface (CLI), not System Manager, an automated scripting tool, or SnapCenter Software.
- You have already created peer relationships between the source and destination clusters and the source and destination SVMs.

  Cluster and SVM peering

- You are backing up volumes or SVMs from AFF or FAS storage systems to AFF or FAS storage systems.
  - If you are replicating Element volumes to ONTAP, or ONTAP LUNs to an Element system, see the NetApp Element software documentation.

    Replication between NetApp element software and ONTAP

  - Beginning with ONTAP 9.10.1, you can create data protection relationships between S3 buckets using S3 SnapMirror. For more information, see S3 SnapMirror overview.
- You want to provide data protection using online methods, not tape.

Other ways to do this in ONTAP

To perform these tasks with…	Refer to…
The redesigned System Manager (available with ONTAP 9.7 and later)	Prepare for mirroring and vaulting
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume disaster recovery preparation overview

Manage local Snapshot copies

Manage local Snapshot copies overview

A *Snapshot copy* is a read-only, point-in-time image of a volume. The image consumes minimal storage space and incurs negligible performance overhead because it records only changes to files since the last Snapshot copy.

You can use a Snapshot copy to restore the entire contents of a volume, or to recover individual files or LUNs. Snapshot copies are stored in the directory `.snapshot` on the volume.

In ONTAP 9.3 and earlier, a volume can contain up to 255 Snapshot copies. In ONTAP 9.4 and later, a FlexVol volume can contain up to 1023 Snapshot copies.

Beginning with ONTAP 9.8, FlexGroup volumes can contain 1023 Snapshot copies. For more information, see Protect FlexGroup volumes using Snapshot copies.

Configure custom Snapshot policies

Configure custom Snapshot policies overview

A *Snapshot policy* defines how the system creates Snapshot copies. The policy specifies when to create Snapshot copies, how many copies to retain, and how to name them. For example, a system might create one Snapshot copy every day at 12:10 a.m., retain the two most recent copies, and name the copies "daily.*timestamp*."

The default policy for a volume automatically creates Snapshot copies on the following schedule, with the oldest Snapshot copies deleted to make room for newer copies:

- A maximum of six hourly Snapshot copies taken five minutes past the hour.
- A maximum of two daily Snapshot copies taken Monday through Saturday at 10 minutes after midnight.
- A maximum of two weekly Snapshot copies taken every Sunday at 15 minutes after midnight.

Unless you specify a Snapshot policy when you create a volume, the volume inherits the Snapshot policy associated with its containing storage virtual machine (SVM).

When to configure a custom Snapshot policy

If the default Snapshot policy is not appropriate for a volume, you can configure a custom policy that modifies the frequency, retention, and name of Snapshot copies. The schedule will be dictated mainly by the rate of change of the active file system.

You might back up a heavily used file system like a database every hour, while you back up rarely used files once a day. Even for a database, you will typically run a full backup once or twice a day, while backing up transaction logs every hour.

Other factors are the importance of the files to your organization, your Service Level Agreement (SLA), your Recovery Point Objective (RPO), and your Recovery Time Objective (RTO). Generally speaking, you should retain only as many Snapshot copies as necessary.

Create a Snapshot job schedule

A Snapshot policy requires at least one Snapshot copy job schedule. You can use the `job schedule cron create` command to create a job schedule.

About this task

By default, ONTAP forms the names of Snapshot copies by appending a timestamp to the job schedule name.

If you specify values for both day of the month and day of the week, the values are considered independently. For example, a cron schedule with the day specification `Friday` and the day of the month specification `13` runs every Friday and on the 13th day of each month, not just on every Friday the 13th.

Step

1. Create a job schedule:

   `job schedule cron create -name` *`job_name`* `-month month -dayofweek` *`day_of_week`* `-day` *`day_of_month`* `-hour` *`hour`* `-minute` *`minute`*

   For `-month`, `-dayofweek`, and `-hour`, you can specify `all` to run the job every month, day of the week, and hour, respectively.

   Beginning with ONTAP 9.10.1, you can include the Vserver for your job schedule:

   `job schedule cron create -name` *`job_name`* `-vserver` *`Vserver_name`* `-month` *`month`* `-dayofweek` *`day_of_week`* `-day` *`day_of_month`* `-hour` *`hour`* `-minute` *`minute`*

   The following example creates a job schedule named `myweekly` that runs on Saturdays at 3:00 a.m.:

   ```
   cluster1::> job schedule cron create -name myweekly -dayofweek
   "Saturday" -hour 3 -minute 0
   ```

   The following example creates a schedule named `myweeklymulti` that specifies multiple days, hours and minutes:

   ```
   job schedule cron create -name myweeklymulti -dayofweek
   "Monday,Wednesday,Sunday" -hour 3,9,12 -minute 0,20,50
   ```

Create a Snapshot policy

A Snapshot policy specifies when to create Snapshot copies, how many copies to retain, and how to name them. For example, a system might create one Snapshot copy every day at 12:10 a.m., retain the two most recent copies, and name them “daily.*`timestamp`*.” A Snapshot policy can contain up to five job schedules.

About this task

By default, ONTAP forms the names of Snapshot copies by appending a timestamp to the job schedule name:

```
daily.2017-05-14_0013/              hourly.2017-05-15_1106/
daily.2017-05-15_0012/              hourly.2017-05-15_1206/
hourly.2017-05-15_1006/             hourly.2017-05-15_1306/
```

You can substitute a prefix for the job schedule name if you prefer.

The `snapmirror-label` option is for SnapMirror replication. For more information, see Defining a rule for a policy.

Step

1. Create a Snapshot policy:

   `volume snapshot policy create -vserver` *`SVM`* `-policy` *`policy_name`* `-enabled true|false -schedule1` *`schedule1_name`* `-count1` *`copies_to_retain`* `-prefix1` *`snapshot_prefix`* `-snapmirror-label1` *`snapshot_label`* `… -schedule1` *`schedule5_name`* `-count5` *`copies_to_retain`*`-prefix5` *`snapshot_prefix`* `-snapmirror-label5` *`snapshot_label`*

   The following example creates a Snapshot policy named `snap_policy_daily` that runs on a `daily` schedule. The policy has a maximum of five Snapshot copies, each with the name `daily.`*`timestamp`* and the SnapMirror label `daily`:

   ```
   cluster1::> volume snapshot policy create -vserver vs0 -policy
   snap_policy_daily -schedule1 daily -count1 5 -snapmirror-label1 daily
   ```

Manage the Snapshot copy reserve

Manage the Snapshot copy reserve overview

The *Snapshot copy reserve* sets aside a percentage of disk space for Snapshot copies, five percent by default. Because Snapshot copies use space in the active file system when the Snapshot copy reserve is exhausted, you might want to increase the Snapshot copy reserve as needed. Alternatively, you can autodelete Snapshot copies when the reserve is full.

When to increase the Snapshot copy reserve

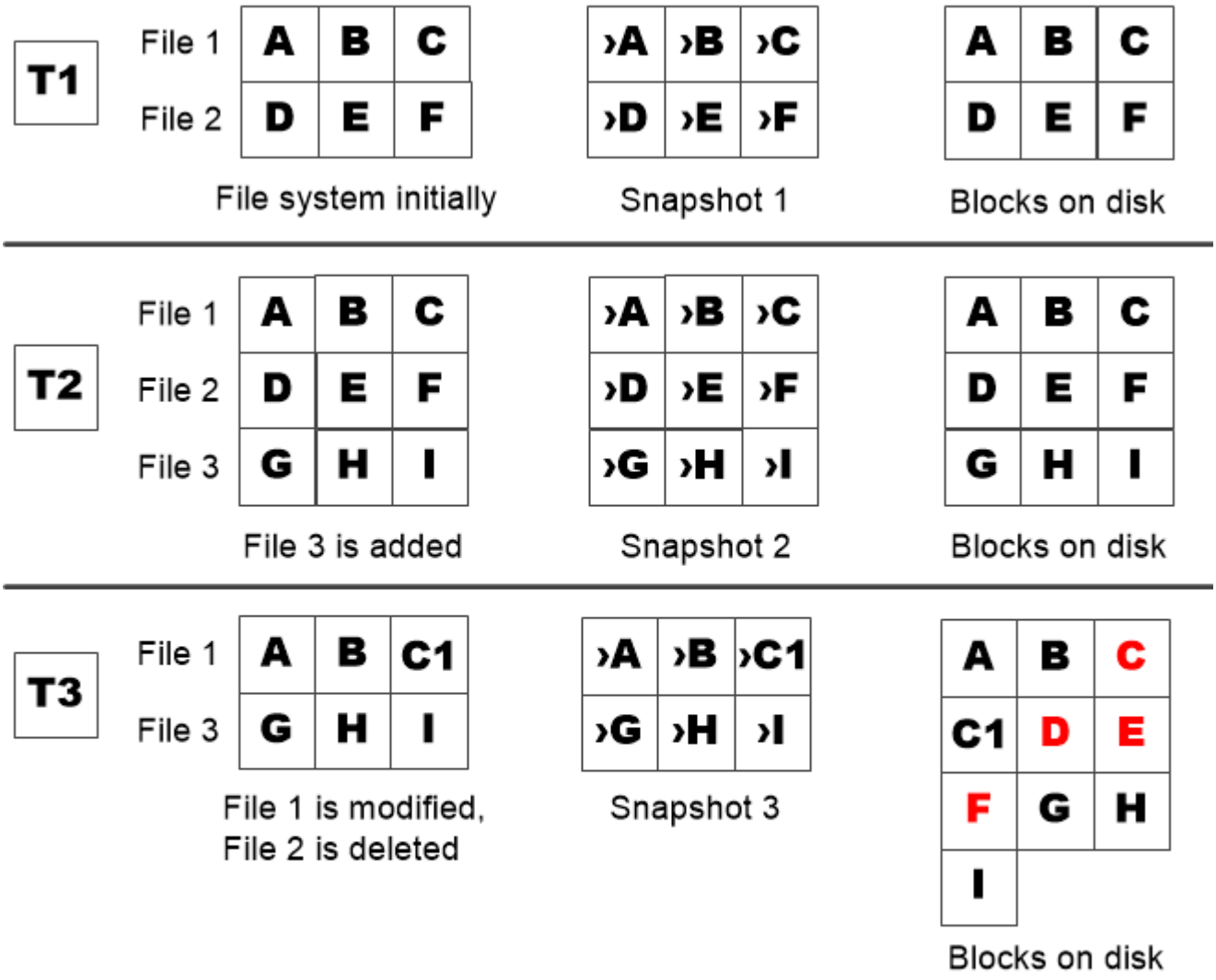
In deciding whether to increase the Snapshot reserve, it's important to remember that a Snapshot copy records only changes to files since the last Snapshot copy was made. It consumes disk space only when blocks in the active file system are modified or deleted.

This means that the rate of change of the file system is the key factor in determining the amount of disk space used by Snapshot copies. No matter how many Snapshot copies you create, they will not consume disk space if the active file system has not changed.

A FlexVol volume containing database transaction logs, for example, might have a Snapshot copy reserve as large as 20% to account for its greater rate of change. Not only will you want to create more Snapshot copies

to capture the more frequent updates to the database, you will also want to have a larger Snapshot copy reserve to handle the additional disk space the Snapshot copies consume.

A Snapshot copy consists of pointers to blocks rather than copies of blocks. You can think of a pointer as a “claim” on a block: ONTAP “holds” the block until the Snapshot copy is deleted.



A Snapshot copy consumes disk space only when blocks in the active file system are modified or deleted.

How deleting protected files can lead to less file space than expected

A Snapshot copy points to a block even after you delete the file that used the block. This explains why an exhausted Snapshot copy reserve might lead to the counter-intuitive result in which deleting an entire file system results in less space being available than the file system occupied.

Consider the following example. Before deleting any files, the `df` command output is as follows:

```
Filesystem          kbytes  used    avail  capacity
/vol/vol0/          3000000 3000000 0       100%
/vol/vol0/.snapshot 1000000 500000  500000   50%
```

After deleting the entire file system and making a Snapshot copy of the volume, the `df` command generates the following output:

```
Filesystem          kbytes  used    avail  capacity
/vol/vol0/          3000000 2500000 500000   83%
/vol/vol0/.snapshot 1000000 3500000 0       350%
```

As the output shows, the entire 3 GB formerly used by the active file system is now being used by Snapshot copies, in addition to the 0.5 GB used before the deletion.

Because the disk space used by the Snapshot copies now exceeds the Snapshot copy reserve, the overflow of 2.5 GB “spills” into the space reserved for active files, leaving you with 0.5 GB free space for files where you might reasonably have expected 3 GB.

Monitor Snapshot copy disk consumption

You can monitor Snapshot copy disk consumption using the `df` command. The command displays the amount of free space in the active file system and the Snapshot copy reserve.

Step

1. Display Snapshot copy disk consumption: `df`

   The following example shows Snapshot copy disk consumption:

   ```
   cluster1::> df
   Filesystem          kbytes  used    avail  capacity
   /vol/vol0/          3000000 3000000 0       100%
   /vol/vol0/.snapshot 1000000 500000  500000   50%
   ```

Check available Snapshot copy reserve on a volume

You might want to check how much Snapshot copy reserve is available on a volume by using the `snapshot-reserve-available` parameter with the `volume show` command.

Step

1. Check the Snapshot copy reserve available on a volume:

   ```
   vol show -vserver SVM -volume volume -fields snapshot-reserve-available
   ```

For complete command syntax, see the man page.

The following example displays the available Snapshot copy reserve for `vol1`:

```
cluster1::> vol show -vserver vs0 -volume vol1 -fields snapshot-reserve-
available

vserver volume snapshot-reserve-available
------- ------ --------------------------
vs0     vol1   4.84GB
```

Modify the Snapshot copy reserve

You might want to configure a larger Snapshot copy reserve to prevent Snapshot copies from using space reserved for the active file system. You can decrease the Snapshot copy reserve when you no longer need as much space for Snapshot copies.

Step

1. Modify the Snapshot copy reserve:

   `volume modify -vserver` *`SVM`* `-volume` *`volume`* `-percent-snapshot-space` *`snap_reserve`*

   For complete command syntax, see the man page.

   The following example sets the Snapshot copy reserve for `vol1` to 10 percent:

```
cluster1::> volume modify -vserver vs0 -volume vol1 -percent-snapshot
-space 10
```

Autodelete Snapshot copies

You can use the `volume snapshot autodelete modify` command to trigger automatic deletion of Snapshot copies when the Snapshot reserve is exceeded. By default, the oldest Snapshot copies are deleted first.

About this task

LUN and file clones are deleted when there are no more Snapshot copies to be deleted.

Step

1. Autodelete Snapshot copies:

   `volume snapshot autodelete modify -vserver` *`SVM`* `-volume` *`volume`* `-enabled true|false -trigger volume|snap_reserve`

   For complete command syntax, see the man page.

   The following example autodeletes Snapshot copies for `vol1` when the Snapshot copy reserve is

exhausted:

```
cluster1::> volume snapshot autodelete modify -vserver vs0 -volume vol1
-enabled true -trigger snap_reserve
```

Restore files from Snapshot copies

Restore a file from a Snapshot copy on an NFS or SMB client

A user on an NFS or SMB client can restore a file directly from a Snapshot copy without the intervention of a storage system administrator.

Every directory in the file system contains a subdirectory named `.snapshot` accessible to NFS and SMB users. The `.snapshot` subdirectory contains subdirectories corresponding to the Snapshot copies of the volume:

```
$ ls .snapshot
daily.2017-05-14_0013/              hourly.2017-05-15_1106/
daily.2017-05-15_0012/              hourly.2017-05-15_1206/
hourly.2017-05-15_1006/             hourly.2017-05-15_1306/
```

Each subdirectory contains the files referenced by the Snapshot copy. If users accidentally delete or overwrite a file, they can restore the file to the parent read-write directory by copying the file from the Snapshot subdirectory to the read-write directory:

```
$ ls my.txt
ls: my.txt: No such file or directory
$ ls .snapshot
daily.2017-05-14_0013/              hourly.2017-05-15_1106/
daily.2017-05-15_0012/              hourly.2017-05-15_1206/
hourly.2017-05-15_1006/             hourly.2017-05-15_1306/
$ ls .snapshot/hourly.2017-05-15_1306/my.txt
my.txt
$ cp .snapshot/hourly.2017-05-15_1306/my.txt .
$ ls my.txt
my.txt
```

Enable and disable NFS and SMB client access to Snapshot copy directory

To determine whether the Snapshot copy directory is visible to NFS and SMB clients to restore a file or LUN from a Snapshot copy, you can enable and disable access to the Snapshot copy directory using the `-snapdir-access` option of the `volume modify` command.

Steps

1. Check the Snapshot directory access status:

   `volume show -vserver SVM_name -volume vol_name -fields snapdir-access`

   Example:

   ```
   clus1::> volume show -vserver vs0 -volume vol1 -fields snapdir-access
   vserver volume snapdir-access
   ------- ------ --------------
   vs0     vol1   false
   ```

2. Enable or disable the Snapshot copy directory access:

   `volume modify -vserver SVM_name -volume vol_name -snapdir-access true|false`

   The following example enables Snapshot copy directory access on vol1:

   ```
   clus1::> volume modify -vserver vs0 -volume vol1 -snapdir-access true
   Volume modify successful on volume vol1 of Vserver vs0.
   ```

Restore a single file from a Snapshot copy

You can use the `volume snapshot restore-file` command to restore a single file or LUN from a Snapshot copy. You can restore the file to a different location in the parent read-write volume if you do not want to replace an existing file.

About this task

If you are restoring an existing LUN, a LUN clone is created and backed up in the form of a Snapshot copy. During the restore operation, you can read to and write from the LUN.

Files with streams are restored by default.

Steps

1. List the Snapshot copies in a volume:

   `volume snapshot show -vserver SVM -volume volume`

   For complete command syntax, see the man page.

   The following example shows the Snapshot copies in `vol1`:

```
clus1::> volume snapshot show -vserver vs1 -volume vol1

Vserver Volume Snapshot                State    Size  Total% Used%
------- ------ ---------- ----------- ------   -----  ------ -----
vs1  vol1   hourly.2013-01-25_0005  valid   224KB     0%    0%
               daily.2013-01-25_0010   valid   92KB      0%    0%
               hourly.2013-01-25_0105  valid   228KB     0%    0%
               hourly.2013-01-25_0205  valid   236KB     0%    0%
               hourly.2013-01-25_0305  valid   244KB     0%    0%
               hourly.2013-01-25_0405  valid   244KB     0%    0%
               hourly.2013-01-25_0505  valid   244KB     0%    0%

7 entries were displayed.
```

2. Restore a file from a Snapshot copy:

   `volume snapshot restore-file -vserver` *`SVM`* `-volume` *`volume`* `-snapshot` *`snapshot`* `-path` *`file_path`* `-restore-path` *`destination_path`*

   For complete command syntax, see the man page.

   The following example restores the file `myfile.txt`:

```
cluster1::> volume snapshot restore-file -vserver vs0 -volume vol1
-snapshot daily.2013-01-25_0010 -path /myfile.txt
```

Restore part of a file from a Snapshot copy

You can use the `volume snapshot partial-restore-file` command to restore a range of data from a Snapshot copy to a LUN or to an NFS or SMB container file, assuming you know the starting byte offset of the data and the byte count. You might use this command to restore one of the databases on a host that stores multiple databases in the same LUN.

Beginning in ONTAP 9.12.1, partial restore is available for volumes in an SM-BC relationship.

Steps

1. List the Snapshot copies in a volume:

   `volume snapshot show -vserver` *`SVM`* `-volume` *`volume`*

   For complete command syntax, see the man page.

   The following example shows the Snapshot copies in `vol1`:

```
clus1::> volume snapshot show -vserver vs1 -volume vol1

Vserver Volume Snapshot                State    Size  Total% Used%
------- ------ ---------- ----------- ------   -----  ------ -----
vs1  vol1   hourly.2013-01-25_0005  valid   224KB     0%    0%
               daily.2013-01-25_0010   valid   92KB      0%    0%
               hourly.2013-01-25_0105  valid   228KB     0%    0%
               hourly.2013-01-25_0205  valid   236KB     0%    0%
               hourly.2013-01-25_0305  valid   244KB     0%    0%
               hourly.2013-01-25_0405  valid   244KB     0%    0%
               hourly.2013-01-25_0505  valid   244KB     0%    0%

7 entries were displayed.
```

2. Restore part of a file from a Snapshot copy:

   `volume snapshot partial-restore-file -vserver` *SVM* `-volume` *volume* `-snapshot` *snapshot* `-path` *file_path* `-start-byte` *starting_byte* `-byte-count` *byte_count*

   The starting byte offset and byte count must be multiples of 4,096.

   The following example restores the first 4,096 bytes of the file `myfile.txt`:

```
cluster1::> volume snapshot partial-restore-file -vserver vs0 -volume
vol1 -snapshot daily.2013-01-25_0010 -path /myfile.txt -start-byte 0
-byte-count 4096
```

Restore the contents of a volume from a Snapshot copy

You can use the `volume snapshot restore` command to restore the contents of a volume from a Snapshot copy.

About this task

If the volume has SnapMirror relationships, manually replicate all mirror copies of the volume immediately after you restore from a Snapshot copy. Not doing so can result in unusable mirror copies that must be deleted and recreated.

1. List the Snapshot copies in a volume:

   `volume snapshot show -vserver` *SVM* `-volume` *volume*

   The following example shows the Snapshot copies in `vol1`:

```
clus1::> volume snapshot show -vserver vs1 -volume vol1

Vserver Volume Snapshot                  State    Size  Total% Used%
------- ------ ---------- ----------- ------   -----  ------ -----
vs1  vol1   hourly.2013-01-25_0005  valid   224KB     0%    0%
               daily.2013-01-25_0010   valid   92KB      0%    0%
               hourly.2013-01-25_0105  valid   228KB     0%    0%
               hourly.2013-01-25_0205  valid   236KB     0%    0%
               hourly.2013-01-25_0305  valid   244KB     0%    0%
               hourly.2013-01-25_0405  valid   244KB     0%    0%
               hourly.2013-01-25_0505  valid   244KB     0%    0%

7 entries were displayed.
```

2. Restore the contents of a volume from a Snapshot copy:

   `volume snapshot restore -vserver` *`SVM`* `-volume` *`volume`* `-snapshot` *`snapshot`*

   The following example restores the contents of `vol1`:

```
cluster1::> volume snapshot restore -vserver vs0 -volume vol1 -snapshot
daily.2013-01-25_0010
```

SnapMirror volume replication

Asynchronous SnapMirror disaster recovery basics

SnapMirror is disaster recovery technology, designed for failover from primary storage to secondary storage at a geographically remote site. As its name implies, SnapMirror creates a replica, or *mirror,* of your working data in secondary storage from which you can continue to serve data in the event of a catastrophe at the primary site.

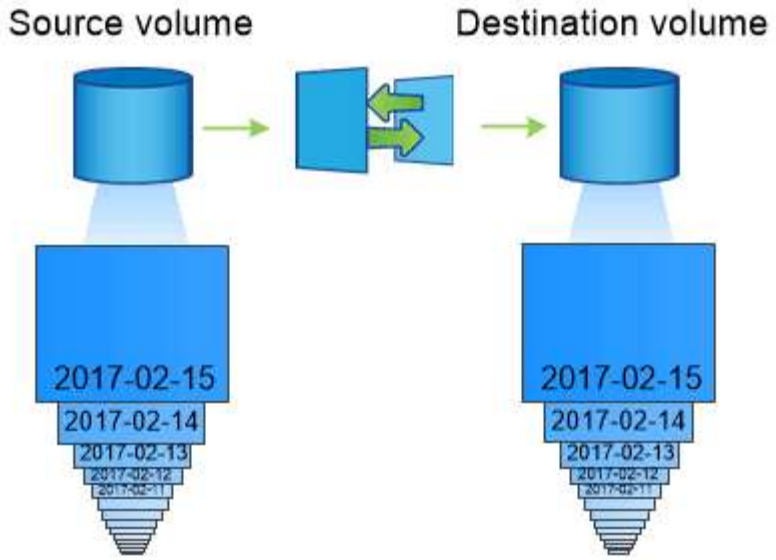
If the primary site is still available to serve data, you can simply transfer any needed data back to it, and not serve clients from the mirror at all. As the failover use case implies, the controllers on the secondary system should be equivalent or nearly equivalent to the controllers on the primary system to serve data efficiently from mirrored storage.

Data protection relationships

Data is mirrored at the volume level. The relationship between the source volume in primary storage and the destination volume in secondary storage is called a *data protection relationship.* The clusters in which the volumes reside and the SVMs that serve data from the volumes must be *peered.* A peer relationship enables clusters and SVMs to exchange data securely.

Cluster and SVM peering

The figure below illustrates SnapMirror data protection relationships.



A SnapMirror data protection relationship typically mirrors the Snapshot copies available on the source volume.

Scope of data protection relationships

You can create a data protection relationship directly between volumes or between the SVMs that own the volumes. In an *SVM data protection relationship,* all or part of the SVM configuration, from NFS exports and SMB shares to RBAC, is replicated, as well as the data in the volumes that the SVM owns.

You can also use SnapMirror for special data protection applications:

- A *load-sharing mirror* copy of the SVM root volume ensures that data remains accessible in the event of a node outage or failover.
- A data protection relationship between *SnapLock volumes* lets you replicate WORM files to secondary storage.

  Archive and compliance using SnapLock technology

- Beginning in ONTAP 9.13.1, you can use asynchronous SnapMirror to protect consistency groups

How SnapMirror data protection relationships are initialized

The first time you invoke SnapMirror, it performs a *baseline transfer* from the source volume to the destination volume. The *SnapMirror policy* for the relationship defines the contents of the baseline and any updates.

A baseline transfer under the default SnapMirror policy `MirrorAllSnapshots` involves the following steps:

- Make a Snapshot copy of the source volume.
- Transfer the Snapshot copy and all the data blocks it references to the destination volume.
- Transfer the remaining, less recent Snapshot copies on the source volume to the destination volume for use in case the “active” mirror is corrupted.

How SnapMirror data protection relationships are updated

Updates are asynchronous, following the schedule you configure. Retention mirrors the Snapshot policy on the

source.

At each update under the `MirrorAllSnapshots` policy, SnapMirror creates a Snapshot copy of the source volume and transfers that Snapshot copy and any Snapshot copies that have been made since the last update. In the following output from the `snapmirror policy show` command for the `MirrorAllSnapshots` policy, note the following:

- `Create Snapshot` is “true”, indicating that `MirrorAllSnapshots` creates a Snapshot copy when SnapMirror updates the relationship.
- `MirrorAllSnapshots` has rules “sm_created” and “all_source_snapshots”, indicating that both the Snapshot copy created by SnapMirror and any Snapshot copies that have been made since the last update are transferred when SnapMirror updates the relationship.

```
cluster_dst::> snapmirror policy show -policy MirrorAllSnapshots -instance

                     Vserver: vs0
      SnapMirror Policy Name: MirrorAllSnapshots
      SnapMirror Policy Type: async-mirror
                Policy Owner: cluster-admin
                 Tries Limit: 8
           Transfer Priority: normal
   Ignore accesstime Enabled: false
     Transfer Restartability: always
 Network Compression Enabled: false
             Create Snapshot: true
                     Comment: Asynchronous SnapMirror policy for mirroring
all snapshots
                              and the latest active file system.
       Total Number of Rules: 2
                  Total Keep: 2
                       Rules: SnapMirror Label     Keep  Preserve Warn
Schedule Prefix
                              ----------------     ----  -------- ----
-------- ------
                              sm_created              1  false       0 -
-
                              all_source_snapshots    1  false       0 -
-
```

MirrorLatest policy

The preconfigured `MirrorLatest` policy works exactly the same way as `MirrorAllSnapshots`, except that only the Snapshot copy created by SnapMirror is transferred at initialization and update.

```
                        Rules: SnapMirror Label     Keep  Preserve Warn
Schedule Prefix
                               ----------------     ----  -------- ----
-------- ------
                               sm_created              1  false       0 -
-
```

SnapMirror Synchronous disaster recovery basics

Beginning with ONTAP 9.5, SnapMirror Synchronous (SM-S) technology is supported on all FAS and AFF platforms that have at least 16 GB of memory and on all ONTAP Select platforms. SnapMirror Synchronous technology is a per-node, licensed feature that provides synchronous data replication at the volume level.

This functionality addresses the regulatory and national mandates for synchronous replication in financial, healthcare, and other regulated industries where zero data loss is required.

The limit on the number of SnapMirror Synchronous replication operations per HA pair depends on the controller model.

The following table lists the number of SnapMirror Synchronous operations that are allowed per HA pair according to platform type and ONTAP release.

Platform	Releases earlier than ONTAP 9.9.1	ONTAP 9.9.1	ONTAP 9.10.1	ONTAP 9.11.1\ONTAP 9.12.1
AFF	80	160	200	400
FAS	40	80	80	80
ONTAP Select	20	40	40	40

Supported features

ONTAP 9.12.1 supports non-disruptive SnapMirror Synchronous operations (NDO) on AFF/ASA platforms, only. Support for non-disruptive operations enables you to perform many common maintenance tasks without scheduling down time. Operations supported include takeover and giveback, and volume move, provided that a single node is surviving among each of the two clusters.

The following features are supported for SnapMirror Synchronous technology in ONTAP 9.10.1; provided all nodes in the source and destination cluster are running ONTAP 9.10.1:

- NFSv4.2
- NVMe/TCP

In ONTAP 9.5 and later, SnapMirror Synchronous technology supports the NFSv3, FC, and iSCSI protocols over all networks for which the latency does not exceed 10ms.

SnapMirror Synchronous supports source and destination volumes on FabricPool aggregates with a tiering policy of None, Snapshot, or Auto. The destination volume in a FabricPool aggregate cannot be set to All tiering policy.

The following features are supported for SnapMirror Synchronous technology in ONTAP 9.7:

- Replication of application-created Snapshot copies
  If a Snapshot copy is tagged with the appropriate label at the time of the `snapshot create` operation, using the CLI or the ONTAP API, SnapMirror Synchronous replicates the Snapshot copies, both user created or those created with external scripts, after quiescing the applications. Scheduled Snapshot copies created using a Snapshot policy are not replicated. For more information about replicating application-created Snapshot copies, see the Knowledge Base article: How to replicate application created snapshots with SnapMirror Synchronous.
- FC-NVMe
- LUN clones and NVMe namespace clones
  LUN clones backed by application-created Snapshot copies are also supported.

The following features are supported for SnapMirror Synchronous technology in ONTAP 9.6; provided all nodes in the source and destination cluster are running ONTAP 9.6:

- SVM DR
  - A SnapMirror Synchronous source can also be a SVM DR source, for example, a fan-out configuration with SM-S as one leg and SVM DR as the other.
  - A SnapMirror Synchronous source cannot be an SVM DR destination because SM-S does not support cascading a DP source.
    You must release the synchronous relationship before performing an SVM DR flip resync in the destination cluster.
  - A SnapMirror Synchronous destination cannot be an SVM DR source because SVM DR does not support replication of DP volumes.
    A flip resync of the synchronous source would result in the SVM DR excluding the DP volume in the destination cluster.
- NFSv4.0 and NFSv4.1
- SMB 2.0 or later
- Mixed protocol access (NFSv3 and SMB)
- Antivirus on the primary volume of the SnapMirror Synchronous relationship
- Hard or soft quotas on the primary volume of the SnapMirror Synchronous relationship
  The quota rules are not replicated to the destination; therefore, the quota database is not replicated to the destination.
- FPolicy on the primary volume of the SnapMirror Synchronous relationship
- SnapMirror Synchronous mirror-mirror cascade
  The relationship from the destination volume of the SnapMirror Synchronous relationship must be an asynchronous SnapMirror relationship.
- Timestamp parity between source and destination volumes for NAS
  If you have upgraded from ONTAP 9.5 to ONTAP 9.6, the timestamp is replicated only for any new and modified files in the source volume. The timestamp of existing files in the source volume is not synchronized.
- Removal of high metadata operation frequency limitation

- Security for sensitive data in-transit using TLS 1.2 encryption
- Clone autodelete

Beginning in ONTAP 9.13.1, NDMP is supported with SnapMirror Synchronous. Both the source and destination cluster must be running ONTAP 9.13.1 or later to use NDMP with SnapMirror Synchronous. For more information, see Transfer data using ndmp copy.

Unsupported features

The following features are not supported with Synchronous SnapMirror relationships:

- Tamperproof Snapshot copies
- Consistency groups
- MetroCluster configurations
- SFMoD
- SFCoD
- VVol
- Mixed SAN and NVMe access
  LUNs and NVMe namespaces are not supported on the same volume or SVM.
- SnapLock volumes
- FlexGroup volumes
- FlexCache volumes
- SnapRestore
- DP_Optimized (DPO) systems
- Tape backup or restore using dump and SMTape on the destination volume
- Tape based restore to the source volume
- Throughput floor (QoS Min) for source volumes
- In a fan-out configuration, only one relationship can be a SnapMirror Synchronous relationship; all the other relationships from the source volume must be asynchronous SnapMirror relationships.
- Global throttling

Modes of operation

SnapMirror Synchronous has two modes of operation based on the type of the SnapMirror policy used:

- **Sync mode**
  In Sync mode, application I/O operations are sent in parallel to the primary and secondary storage systems. If the write to the secondary storage is not completed for any reason, the application is allowed to continue writing to the primary storage. When the error condition is corrected, SnapMirror Synchronous technology automatically resynchronizes with the secondary storage and resumes replicating from primary storage to secondary storage in Synchronous mode.
  In Sync mode, RPO=0 and RTO is very low until a secondary replication failure occurs at which time RPO and RTO become indeterminate, but equal the time to repair the issue that caused secondary replication to fail and for the resync to complete.
- **StrictSync mode**
  SnapMirror Synchronous can optionally operate in StrictSync mode. If the write to the secondary storage is

not completed for any reason, the application I/O fails, thereby ensuring that the primary and secondary storage are identical. Application I/O to the primary resumes only after the SnapMirror relationship returns to the `InSync` status. If the primary storage fails, application I/O can be resumed on the secondary storage, after failover, with no loss of data.
In StrictSync mode RPO is always zero, and RTO is very low.

Relationship status

The status of a SnapMirror Synchronous relationship is always in the `InSync` status during normal operation. If the SnapMirror transfer fails for any reason, the destination is not in sync with the source and can go to the `OutofSync` status.

For SnapMirror Synchronous relationships, the system automatically checks the relationship status (`InSync` or `OutofSync`) at a fixed interval. If the relationship status is `OutofSync`, ONTAP automatically triggers the auto resync process to bring back the relationship to the `InSync` status. Auto resync is triggered only if the transfer fails due to any operation, such as unplanned storage failover at source or destination or a network outage. User-initiated operations such as `snapmirror quiesce` and `snapmirror break` do not trigger auto resync.

If the relationship status becomes `OutofSync` for a SnapMirror Synchronous relationship in the StrictSync mode, all I/O operations to the primary volume are stopped. The `OutofSync` state for SnapMirror Synchronous relationship in the Sync mode is not disruptive to the primary and I/O operations are allowed on the primary volume.

Related information

NetApp Technical Report 4733: SnapMirror Synchronous configration and best practices

About workloads supported by StrictSync and Sync policies

StrictSync and Sync policies support all LUN-based applications with FC, iSCSI, and FC-NVMe protocols, as well as NFSv3 and NFSv4 protocols for enterprise applications such as databases, VMWare, quota, SMB, and so on. Beginning with ONTAP 9.6, SnapMirror Synchronous can be used for enterprise file services such as electronic design automation (EDA), home directories, and software build workloads.

In ONTAP 9.5, for a Sync policy, you need to consider a few important aspects while selecting the NFSv3 or NFSv4 workloads. The amount of data read or write operations by workloads is not a consideration, as Sync policy can handle high read or write IO workloads. In ONTAP 9.5, workloads that have excessive file creation, directory creation, file permission changes, or directory permission changes may not be suitable (these are referred to as high-metadata workloads). A typical example of a high-metadata workload is a DevOps workload in which you create multiple test files, run automation, and delete the files. Another example is parallel build workload that generate multiple temporary files during compilation. The impact of a high rate of write metadata activity is that it can cause synchronization between mirrors to temporarily break which stalls the read and write IOs from the client.

Beginning with ONTAP 9.6, these limitations are removed and SnapMirror Synchronous can be used for enterprise file services workloads that include multiuser environments, such as home directories and software build workloads.

Related information

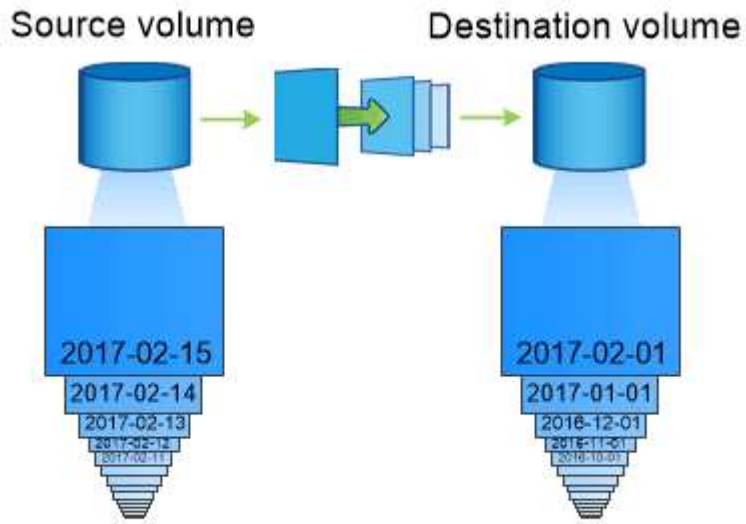
SnapMirror Synchronous Configuration and Best Practices

Vault archiving using SnapMirror technology

SnapMirror vault policies replace SnapVault technology in ONTAP 9.3 and later. You use a SnapMirror vault policy for disk-to-disk Snapshot copy replication for standards compliance and other governance-related purposes. In contrast to a SnapMirror relationship, in which the destination usually contains only the Snapshot copies currently in the source volume, a vault destination typically retains point-in-time Snapshot copies created over a much longer period.

You might want to keep monthly Snapshot copies of your data over a 20-year span, for example, to comply with government accounting regulations for your business. Since there is no requirement to serve data from vault storage, you can use slower, less expensive disks on the destination system.

The figure below illustrates SnapMirror vault data protection relationships.



A SnapVault data protection relationship typically retains point-in-time Snapshot copies created over a longer period than the Snapshot copies on the source volume.

How vault data protection relationships are initialized

The SnapMirror policy for the relationship defines the contents of the baseline and any updates.

A baseline transfer under the default vault policy `XDPDefault` makes a Snapshot copy of the source volume, then transfers that copy and the data blocks it references to the destination volume. Unlike SnapMirror relationships, a vault backup does not include older Snapshot copies in the baseline.

How vault data protection relationships are updated

Updates are asynchronous, following the schedule you configure. The rules you define in the policy for the relationship identify which new Snapshot copies to include in updates and how many copies to retain. The labels defined in the policy (“monthly,” for example) must match one or more labels defined in the Snapshot policy on the source. Otherwise, replication fails.

At each update under the `XDPDefault` policy, SnapMirror transfers Snapshot copies that have been made since the last update, provided they have labels matching the labels defined in the policy rules. In the following

output from the `snapmirror policy show` command for the `XDPDefault` policy, note the following:

- `Create Snapshot` is “false”, indicating that `XDPDefault` does not create a Snapshot copy when SnapMirror updates the relationship.
- `XDPDefault` has rules “daily” and “weekly”, indicating that all Snapshot copies with matching labels on the source are transferred when SnapMirror updates the relationship.

```
cluster_dst::> snapmirror policy show -policy XDPDefault -instance

                    Vserver: vs0
      SnapMirror Policy Name: XDPDefault
      SnapMirror Policy Type: vault
                Policy Owner: cluster-admin
                 Tries Limit: 8
           Transfer Priority: normal
   Ignore accesstime Enabled: false
     Transfer Restartability: always
 Network Compression Enabled: false
             Create Snapshot: false
                     Comment: Default policy for XDP relationships with
daily and weekly
                              rules.
       Total Number of Rules: 2
                  Total Keep: 59
                       Rules: SnapMirror Label     Keep  Preserve Warn
Schedule Prefix
                              ----------------     ----  -------- ----
-------- ------
                              daily                   7  false       0 -
-
                              weekly                 52  false       0 -
-
```

SnapMirror unified replication basics

SnapMirror *unified replication* allows you to configure disaster recovery and archiving on the same destination volume. When unified replication is appropriate, it offers benefits in reducing the amount of secondary storage you need, limiting the number of baseline transfers, and decreasing network traffic.

How unified data protection relationships are initialized

As with SnapMirror, unified data protection performs a baseline transfer the first time you invoke it. The SnapMirror policy for the relationship defines the contents of the baseline and any updates.

A baseline transfer under the default unified data protection policy `MirrorAndVault` makes a Snapshot copy of the source volume, then transfers that copy and the data blocks it references to the destination volume. Like

vault archiving, unified data protection does not include older Snapshot copies in the baseline.

How unified data protection relationships are updated

At each update under the `MirrorAndVault` policy, SnapMirror creates a Snapshot copy of the source volume and transfers that Snapshot copy and any Snapshot copies that have been made since the last update, provided they have labels matching the labels defined in the Snapshot policy rules. In the following output from the `snapmirror policy show` command for the `MirrorAndVault` policy, note the following:

- `Create Snapshot` is “true”, indicating that `MirrorAndVault` creates a Snapshot copy when SnapMirror updates the relationship.
- `MirrorAndVault` has rules “sm_created”, “daily”, and “weekly”, indicating that both the Snapshot copy created by SnapMirror and the Snapshot copies with matching labels on the source are transferred when SnapMirror updates the relationship.

```
cluster_dst::> snapmirror policy show -policy MirrorAndVault -instance

                    Vserver: vs0
      SnapMirror Policy Name: MirrorAndVault
      SnapMirror Policy Type: mirror-vault
                Policy Owner: cluster-admin
                 Tries Limit: 8
           Transfer Priority: normal
   Ignore accesstime Enabled: false
     Transfer Restartability: always
 Network Compression Enabled: false
             Create Snapshot: true
                     Comment: A unified Synchronous SnapMirror and
SnapVault policy for
                              mirroring the latest file system and daily
and weekly snapshots.
       Total Number of Rules: 3
                  Total Keep: 59
                       Rules: SnapMirror Label     Keep  Preserve Warn
Schedule Prefix
                              ----------------     ----  -------- ----
-------- ------
                              sm_created              1  false       0 -
-
                              daily                   7  false       0 -
-
                              weekly                 52  false       0 -
-
```

Unified7year policy

The preconfigured `Unified7year` policy works exactly the same way as `MirrorAndVault`, except that a

fourth rule transfers monthly Snapshot copies and retains them for seven years.

```
                       Rules: SnapMirror Label     Keep  Preserve Warn
Schedule Prefix
                              ----------------     ----  -------- ----
--------- ------
                              sm_created              1  false       0 -
-
                              daily                   7  false       0 -
-
                              weekly                 52  false       0 -
-
                              monthly                84  false       0 -
-
```

Protect against possible data corruption

Unified replication limits the contents of the baseline transfer to the Snapshot copy created by SnapMirror at initialization. At each update, SnapMirror creates another Snapshot copy of the source and transfers that Snapshot copy and any new Snapshot copies that have labels matching the labels defined in the Snapshot policy rules.

You can protect against the possibility that an updated Snapshot copy is corrupted by creating a copy of the last transferred Snapshot copy on the destination. This “local copy” is retained regardless of the retention rules on the source, so that even if the Snapshot originally transferred by SnapMirror is no longer available on the source, a copy of it will be available on the destination.

When to use unified data replication

You need to weigh the benefit of maintaining a full mirror against the advantages that unified replication offers in reducing the amount of secondary storage, limiting the number of baseline transfers, and decreasing network traffic.

The key factor in determining the appropriateness of unified replication is the rate of change of the active file system. A traditional mirror might be better suited to a volume holding hourly Snapshot copies of database transaction logs, for example.

XDP replaces DP as the SnapMirror default

Beginning with ONTAP 9.3, SnapMirror extended data protection (XDP) mode replaces SnapMirror data protection (DP) mode as the SnapMirror default.

Before upgrading to ONTAP 9.12.1, you must convert existing DP-type relationships to XDP before you can upgrade to ONTAP 9.12.1 and later releases. For more information, see Convert an existing DP-type relationship to XDP.

Until ONTAP 9.3, SnapMirror invoked in DP mode and SnapMirror invoked in XDP mode used different replication engines, with different approaches to version-dependence:

- SnapMirror invoked in DP mode used a *version-dependent* replication engine in which the ONTAP version was required to be the same on primary and secondary storage:

```
cluster_dst::>  snapmirror create -type DP -source-path ... -destination
-path ...
```

- SnapMirror invoked in XDP mode used a *version-flexible* replication engine that supported different ONTAP versions on primary and secondary storage:

```
cluster_dst::>  snapmirror create -type XDP -source-path ...
-destination-path ...
```

With improvements in performance, the significant benefits of version-flexible SnapMirror outweigh the slight advantage in replication throughput obtained with version-dependent mode. For this reason, beginning with ONTAP 9.3, XDP mode has been made the new default, and any invocations of DP mode on the command line or in new or existing scripts are automatically converted to XDP mode.

Existing relationships are not affected. If a relationship is already of type DP, it will continue to be of type DP. Beginning with ONTAP 9.5, MirrorAndVault is the new default policy when no data protection mode is specified or when XDP mode is specified as the relationship type. The table below shows the behavior you can expect.

If you specify…	**The type is…**	**The default policy (if you do not specify a policy) is…**
DP	XDP	MirrorAllSnapshots (SnapMirror DR)
Nothing	XDP	MirrorAndVault (unified replication)
XDP	XDP	MirrorAndVault (unified replication)

As the table shows, the default policies assigned to XDP in different circumstances ensure that the conversion maintains the functional equivalence of the old types. Of course, you can use different policies as needed, including policies for unified replication:

If you specify…	**And the policy is…**	**The result is…**
DP	MirrorAllSnapshots	SnapMirror DR
	XDPDefault	SnapVault
	MirrorAndVault	Unified replication
XDP	MirrorAllSnapshots	SnapMirror DR
	XDPDefault	SnapVault
	MirrorAndVault	Unified replication

The only exceptions to conversion are as follows:

- SVM data protection relationships continue to default to DP mode in ONTAP 9.3 and earlier.

  Beginning with ONTAP 9.4, SVM data protection relationships default to XDP mode.

- Root volume load-sharing data protection relationships continue to default to DP mode.
- SnapLock data protection relationships continue to default to DP mode in ONTAP 9.4 and earlier.

  Beginning with ONTAP 9.5, SnapLock data protection relationships default to XDP mode.

- Explicit invocations of DP continue to default to DP mode if you set the following cluster-wide option:

  ```
  options replication.create_data_protection_rels.enable on
  ```

  This option is ignored if you do not explicitly invoke DP.

When a destination volume grows automatically

During a data protection mirror transfer, the destination volume grows automatically in size if the source volume has grown, provided there is available space in the aggregate that contains the volume.

This behavior occurs irrespective of any automatic growth setting on the destination. You cannot limit the volume's growth or prevent ONTAP from growing it.

By default, data protection volumes are set to the `grow_shrink` autosize mode, which enables the volume to grow or shrink in response to the amount of used space. The max-autosize for data protection volumes is equal to the maximum FlexVol size and is platform dependent. For example:

- FAS2220, default DP volume max-autosize = 60TB
- FAS6220, default DP volume max-autosize = 70TB
- FAS8200, default DP volume max-autosize = 100TB

For more information, see NetApp Hardware Universe.

Fan-out and cascade data protection deployments

You can use a *fan-out* deployment to extend data protection to multiple secondary systems. You can use a *cascade* deployment to extend data protection to tertiary systems.

Both fan-out and cascade deployments support any combination of SnapMirror DR, SnapVault, or unified replication; however, SnapMirror Synchronous relationships (supported beginning with ONTAP 9.5) support only fan-out deployments with one or more asynchronous SnapMirror relationships and do not support cascade deployments. Only one relationship in the fan-out configuration can be a SnapMirror Synchronous relationship, all the other relationships from the source volume must be asynchronous SnapMirror relationships. SnapMirror Business Continuity (supported beginning with ONTAP 9.8) also supports fan-out configurations.

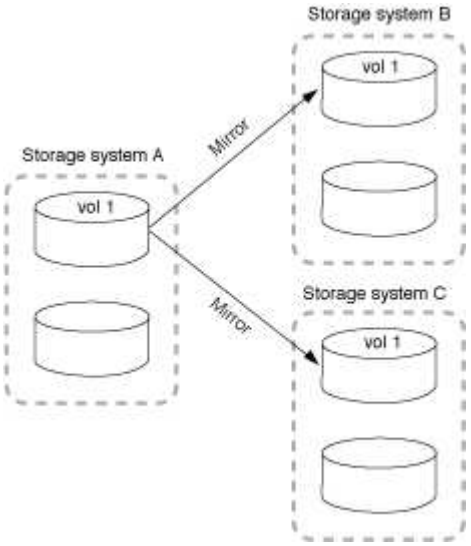
You can use a *fan-in* deployment to create data protection relationships between multiple primary systems and a single secondary system. Each relationship must use a different volume on the secondary system.

You should be aware that volumes that are part of a fan-out or cascade configuration can take longer to
resynchronize. It is not uncommon to see the SnapMirror relationship reporting
the status "preparing" for an extended time period.

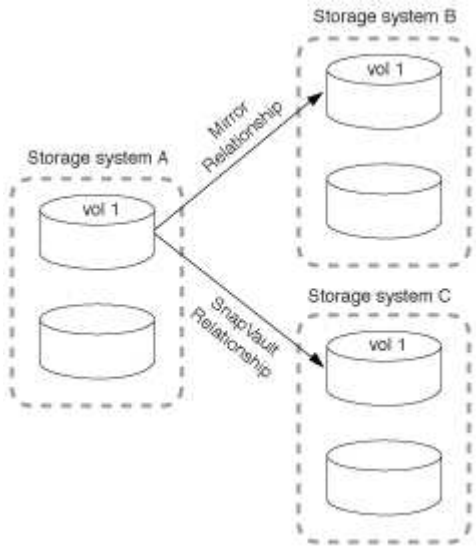
How fan-out deployments work

SnapMirror supports *multiple-mirrors* and *mirror-vault* fan-out deployments.

A multiple-mirrors fan-out deployment consists of a source volume that has a mirror relationship to multiple secondary volumes.

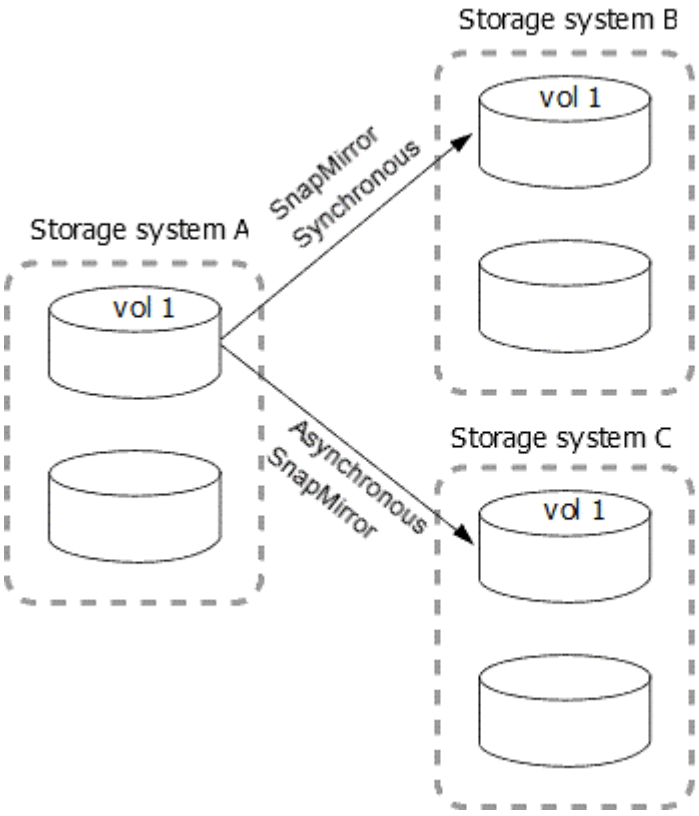


A mirror-vault fan-out deployment consists of a source volume that has a mirror relationship to a secondary volume and a SnapVault relationship to a different secondary volume.



Beginning with ONTAP 9.5, you can have fan-out deployments with SnapMirror Synchronous relationships;

however, only one relationship in the fan-out configuration can be a SnapMirror Synchronous relationship, all the other relationships from the source volume must be asynchronous SnapMirror relationships.

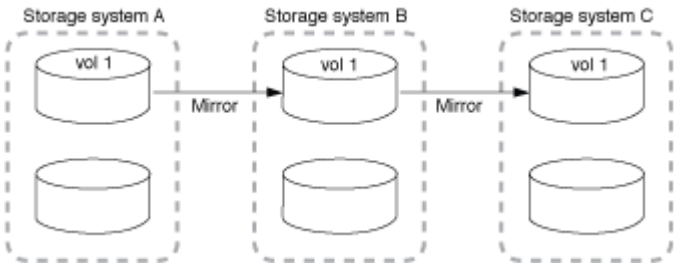


How cascade deployments work

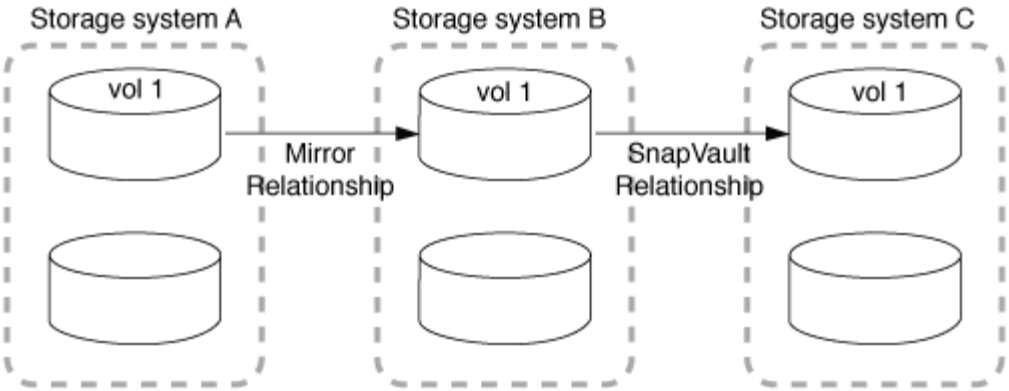
SnapMirror supports *mirror-mirror*, *mirror-vault*, *vault-mirror*, and *vault-vault* cascade deployments.

A mirror-mirror cascade deployment consists of a chain of relationships in which a source volume is mirrored to a secondary volume, and the secondary volume is mirrored to a tertiary volume. If the secondary volume becomes unavailable, you can synchronize the relationship between the primary and tertiary volumes without performing a new baseline transfer.

Beginning with ONTAP 9.6, SnapMirror Synchronous relationships are supported in a mirror-mirror cascade deployment. Only the primary and secondary volumes can be in a SnapMirror Synchronous relationship. The relationship between the secondary volumes and tertiary volumes must be asynchronous.



A mirror-vault cascade deployment consists of a chain of relationships in which a source volume is mirrored to a secondary volume, and the secondary volume is vaulted to a tertiary volume.



Vault-mirror and, beginning with ONTAP 9.2, vault-vault cascade deployments are also supported:

- A vault-mirror cascade deployment consists of a chain of relationships in which a source volume is vaulted to a secondary volume, and the secondary volume is mirrored to a tertiary volume.
- (Beginning with ONTAP 9.2) A vault-vault cascade deployment consists of a chain of relationships in which a source volume is vaulted to a secondary volume, and the secondary volume is vaulted to a tertiary volume.

Further Reading

- Resume protection in a fan-out configuration with SM-BC

SnapMirror licensing

SnapMirror licensing overview

Beginning with ONTAP 9.3, licensing has been simplified for replicating between ONTAP instances. In ONTAP 9 releases, the SnapMirror license supports both vault and mirror relationships. Users can now purchase a SnapMirror license to support ONTAP replication for both backup and disaster recovery use cases.

Prior to the ONTAP 9.3 release, two licenses were available to support different replication use cases. A SnapVault license was needed to configure *vault* relationships between ONTAP instances, where the DP instance could retain a higher number of Snapshot copies to support backup use cases where retention times are longer. A SnapMirror license was needed to configure *mirror* relationships between ONTAP instances, where each ONTAP instance would maintain the same number of snapshot copies (that is, a *mirror* image) to support disaster recovery use cases where cluster failovers would be possible. Both SnapMirror and SnapVault licenses can continue to be used and supported for ONTAP 8.x and 9.x releases.

SnapVault licenses continue to function and are supported for both ONTAP 8.x and 9.x releases, but they are no longer being sold. The SnapMirror license continues to be available and can be used in place of SnapVault and can be used for both mirror and vault configurations.

For ONTAP asynchronous replication, beginning with ONTAP 9.3 a single unified replication engine is used to configure extended data protection mode (XDP) policies, where the SnapMirror license can be configured for a mirror policy, a vault policy, or a mirror-vault policy. A SnapMirror license is required on both the source and destination clusters. A SnapVault license is not required if a SnapMirror license is already installed. The SnapMirror asynchronous perpetual license is included in the Data Protection bundle which you can purchase for your ONTAP clusters. The Data Protection bundle price is based on the raw capacity of the cluster.

Data protection configuration limits are determined using several factors, including your ONTAP version,

hardware platform, and the licenses installed. For more information, see Hardware Universe.

SnapMirror Synchronous license

Beginning with ONTAP 9.5, SnapMirror Synchronous relationships are supported. You require the following licenses for creating a SnapMirror Synchronous relationship:

- The SnapMirror Synchronous license is required on both the source cluster and the destination cluster.

  The SnapMirror Synchronous license is enabled with either the Premium bundle or the Data Protection bundle.

  If your system was purchased before June 2019 with a Premium or Flash Bundle, you can download a NetApp master key to get the required SnapMirror Synchronous license from the NetApp Support Site: Master License Keys

- The SnapMirror license is required on both the source cluster and the destination cluster.

SnapMirror Cloud license

Beginning with ONTAP 9.8, the SnapMirror Cloud license provides asynchronous replication of Snapshot copies from ONTAP instances to object storage endpoints. Replication targets can be configured using both on-premises object stores as well as S3 and S3-compatible public cloud object storage services. SnapMirror Cloud relationships are supported from ONTAP systems to pre-qualified object storage targets. ONTAP 9.8 approved object storage targets include ONTAP S3, StorageGRID, AWS S3 Standard, S3 Standard-IA, and S3 One Zone-IA, Microsoft Azure Blob Premium, Hot and Cool, and GCP Standard and Nearline storage.

SnapMirror Cloud is not available as a standalone license and is available only with purchase of the Hybrid Cloud Bundle. Hybrid Cloud Bundle is a term-based subscription license that is priced based on capacity. Only one license is needed per ONTAP cluster. Capacity is defined as the “used” capacity (not raw capacity) within any volume which is protected by SnapMirror Cloud. Users will purchase this license based on the total used capacity of volumes on the cluster being backed up by SnapMirror Cloud. As of October 2021, the Hybrid Cloud Bundle includes only a SnapMirror Cloud license (previously Hybrid Cloud Bundle included a FabricPool license, which was removed from the bundle effective October 2021). In addition to SnapMirror Cloud, the async SnapMirror license is also required and is available only with the purchase of the Data Protection Bundle.

You require the following licenses for creating a SnapMirror Cloud relationship:

- Both a SnapMirror license (purchased through Data Protection Bundle, or through Premium Bundle) and a SnapMirror Cloud license (purchased through Hybrid Cloud Bundle) are needed for replicating directly to the object store endpoint.
- When configuring a multi-policy replication workflow (for example, Disk-to-Disk-to-Cloud), a SnapMirror license is required on all ONTAP instances, while the SnapMirror Cloud license is only required for the source cluster which is replicating directly to the object storage endpoint.

SnapMirror Cloud is an end user license which can be purchased from NetApp or from an approved NetApp reseller partner. The SnapMirror Cloud license provides end user entitlement but does not enable asynchronous ONTAP to object storage replication. To invoke ONTAP APIs for SnapMirror Cloud, a unique API key from an authorized application is required. Authorized and licensed applications used to orchestrate SnapMirror Cloud replication include System Manager, and are also available from multiple third-party application providers. These authorized applications will embed the unique API key to invoke ONTAP APIs. A combination of the SnapMirror Cloud end user license and an authorized third-party backup application is required to orchestrate and enable SnapMirror Cloud replication.

Beginning with ONTAP 9.9.1, you can use System Manager for SnapMirror Cloud replication. For more information, see Back up to the cloud.

A list of authorized SnapMirror Cloud third-party applications is published on the NetApp web site.

Data Protection Optimized (DPO)

Beginning with ONTAP 9.1, new ONTAP data protection features were packaged with the FAS8200 as part of a solution called the Data Protection Bundle. This new hardware and software bundle included a new DP_Optimized (DPO) license that provided unique ONTAP features for secondary workloads. With the introduction of ONTAP 9.3 the DPO license increased the number of volumes per node from 1,000 to 1,500. Also introduced with ONTAP 9.3 were new configurations of the Data Protection Bundle based on configurations of FAS2620.

The DPO license was specifically designed for ONTAP clusters that were to be dedicated as secondary targets for SnapMirror replication. In addition to increasing the maximum volumes per node on the DPO controller, the DPO license also modified controller QoS settings to support greater replication traffic at the expense of application I/O. For this reason, the DPO license should never be installed on a cluster that supports application I/O, as application performance would be impacted. Later, Data Protection Bundles based on the FAS8200 and FAS2620 were offered as a solution and included programmatic free licenses based on the customer environment. When purchasing the solution bundles, free SnapMirror licenses would be provided for select older clusters which replicated to the DPO secondary. While the DPO license is needed on the Data Protection solution cluster, primary clusters from the following platform list would be provided free SnapMirror licenses. Primary clusters not included in this list would require purchase of SnapMirror licenses. The DPO hardware and software bundle was based on both FAS2620 and FAS8200 systems which are both EOA status and no are longer available.

- FAS2200 Series
- FAS3000 Series
- FAS6000 Series
- FAS8000 Series

Data Protection Optimized (DPO) License

Data Protection hardware and software solution bundles introduced with ONTAP 9.1 and 9.3 were based on FAS8200 and FAS2620 only. As these platforms matured and new platforms were introduced new requests to support ONTAP features for secondary replication use cases increased. As a result, a new standalone DPO license was introduced in November 2018 with the ONTAP 9.5 release.

The standalone DPO license was supported on both FAS and AFF platforms and could be purchased pre-configured with new clusters or added to deployed clusters as a software upgrade in the field. Because these new DPO licenses were not part of a hardware and software solution bundle, they carried a lower price, and free SnapMirror licenses for primary clusters were not provided. Secondary clusters configured with the a la carte DPO license must also purchase a SnapMirror license, and all primary clusters replicating to the DPO secondary cluster must purchase a SnapMirror license.

Additional ONTAP features were delivered with the DPO across multiple ONTAP releases.

Feature	9.3	9.4	9.5	9.6	9.7+
Max vols/node	1500	1500	1500	1500/2500	1500/2500

Max concurrent repl sessions	100	200	200	200	200
Workload bias*	client apps	Apps/SM	SnapMirror	SnapMirror	SnapMirror
Cross volume aggregate deduplication for HDD	No	Yes	Yes	Yes	Yes

- Details about priority for the SnapMirror backoff (workload bias) feature:
- Client: cluster I/O priority is set to client workloads (production apps), not SnapMirror traffic.
- Equality: SnapMirror replication requests have equal priority to I/O for production apps.
- SnapMirror: all SnapMirror I/O requests have higher priority that I/O for production apps.

Table 1: Max FlexVolumes per node across ONTAP releases

	9.3—9.5 Without DPO	**9.3—9.5 With DPO**	**9.6 Without DPO**	**9.6 With DPO**	**9.7—9.9.1 Without DPO**	**9.7—9..9.1 With DPO**
FAS2620	1000	1500	1000	1500	1000	1500
FAS2650	1000	1500	1000	1500	1000	1500
FAS2720	1000	1500	1000	1500	1000	1500
FAS2750	1000	1500	1000	1500	1000	1500
A200	1000	1500	1000	1500	1000	1500
A220	1000	1500	1000	1500	1000	1500
FAS8200/8300	1000	1500	1000	2500	1000	2500
A300	1000	1500	1000	2500	2500	2500
A400	1000	1500	1000	2500	2500	2500
FAS8700/9000	1000	1500	1000	2500	1000	2500
A700	1000	1500	1000	2500	2500	2500
A700s	1000	1500	1000	2500	2500	2500

A800	1000	1500	1000	2500	2500	2500

For the latest maximum FlexVol volume support for your configuration, see Hardware Universe.

Considerations for all new DPO installations

- After it is enabled, the DPO license feature cannot be disabled or undone.
- Installation of the DPO license requires a re-boot of ONTAP or failover to enable.
- The DPO solution is intended for secondary storage workloads; application workload performance on DPO clusters may be impacted
- The DPO license is supported on a select list of NetApp storage platform models.
- DPO features vary by ONTAP release. Refer to the compatibility table for reference.
- New FAS and AFF systems are not qualified with DPO. DPO licenses cannot be purchased for clusters not listed above.

Install a SnapMirror Cloud license

Beginning with ONTAP 9.8, SnapMirror Cloud provides asynchronous snapshot replication from ONTAP to object storage endpoints. SnapMirror Cloud relationships can only be configured using pre-qualified third-party backup applications. To configure ONTAP to object storage replication, both SnapMirror and SnapMirror Cloud licenses are required on the ONTAP source cluster configured for replication to the object store endpoint.

About this task

The SnapMirror Cloud license is a single-instance cluster-wide license, which means it does not need to be installed on every node in the cluster. It is a term-based license where both term and backup capacity are enforced. In addition to this end user license, SnapMirror Cloud requires an authorized and approved backup application to configure and invoke ONTAP APIs for replication. Both SnapMirror Cloud end user license and authorized app are necessary to utilize SnapMirror Cloud replication.

SnapMirror Cloud licenses are acquired through purchase of the Hybrid Cloud Bundle, which can be purchased with 1 or 3 year terms in 1 TB increments. The Hybrid Cloud Bundle includes a license for SnapMirror Cloud. Each license has a unique serial number. Purchases of the Hybrid Cloud Bundle are based on capacity, where the purchased capacity of the Hybrid Cloud Bundle is applied to the SnapMirror Cloud license.

The SnapMirror Cloud license can be installed on the cluster using the ONTAP command line or System Manager.

Steps

1. Download two NetApp License File (NLF) for SnapMirror Cloud from the NetApp Support Site.

   NetApp Support

2. Use System Manager to upload the SnapMirror Cloud NLF file to the cluster:
   a. Click **Configuration** > **Licenses**.
   b. In the **Cluster Settings** pane, click **Licenses**.

c. In the **Packages** window, click **Add**.

d. In the **Add License Packages** dialog box, click **Choose Files** to select the NLF you downloaded, and then click **Add** to upload the file to the cluster.

Related information

NetApp Software License Search

DPO systems feature enhancements

Beginning with ONTAP 9.6, the maximum number of FlexVol volumes supported increases when the DP_Optimized (DPO) license is installed. Beginning with ONTAP 9.4, systems with the DPO license support SnapMirror backoff, cross-volume background deduplication, use of Snapshot blocks as donors, and compaction.

Beginning with ONTAP 9.6, the maximum supported number of FlexVol volumes on secondary or data protection systems has increased, enabling you to scale up to 2,500 FlexVol volumes per node, or up to 5,000 in failover mode. The increase in FlexVol volumes is enabled with the DP_Optimized (DPO) license. A SnapMirror license is still required on both the source and destination nodes.

Beginning with ONTAP 9.4, the following feature enhancements are made to DPO systems:

- SnapMirror backoff: In DPO systems, replication traffic is given the same priority that client workloads are given.

  SnapMirror backoff is disabled by default on DPO systems.

- Volume background deduplication and cross-volume background deduplication: Volume background deduplication and cross-volume background deduplication are enabled in DPO systems.

  You can run the `storage aggregate efficiency cross-volume-dedupe start -aggregate` *`aggregate_name`* `-scan-old-data true` command to deduplicate the existing data. The best practice is to run the command during off-peak hours to reduce the impact on performance.

- Increased savings by using Snapshot blocks as donors: The data blocks that are not available in the active file system but are trapped in Snapshot copies are used as donors for volume deduplication.

  The new data can be deduplicated with the data that was trapped in Snapshot copies, effectively sharing the Snapshot blocks as well. The increased donor space provides more savings, especially when the volume has a large number of Snapshot copies.

- Compaction: Data compaction is enabled by default on DPO volumes.

Manage SnapMirror volume replication

SnapMirror replication workflow

SnapMirror offers three types of data protection relationship: SnapMirror DR, archive (previously known as SnapVault), and unified replication. You can follow the same basic workflow to configure each type of relationship.

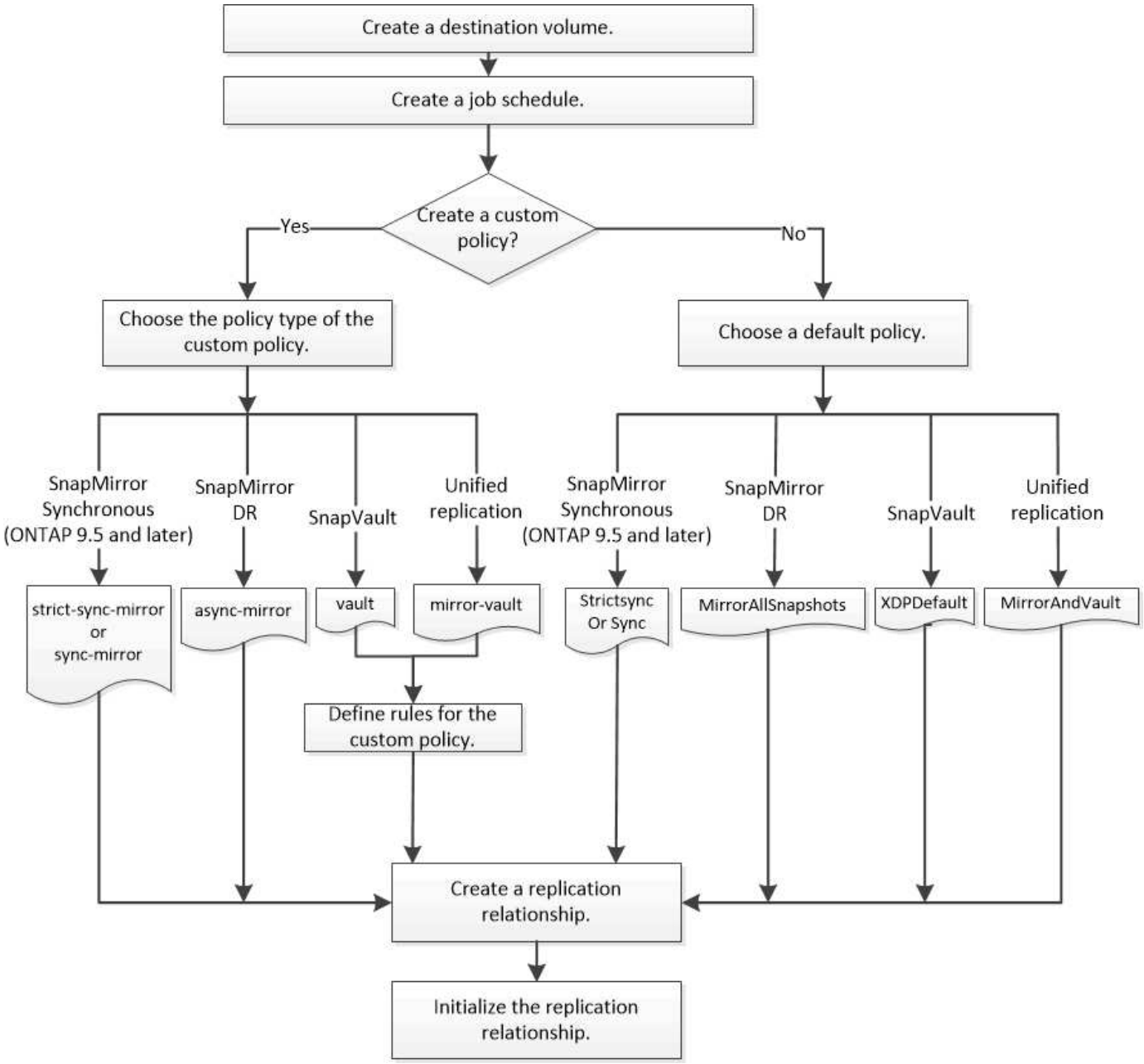
Beginning with general availability in ONTAP 9.9.1, SnapMirror Business Continuity (SM-BC) provides Zero Recovery Time Objective (Zero RTO) or Transparent Application Failover (TAF) to enable automatic failover of

business-critical applications in SAN environments. SM-BC is supported in a configuration of either two AFF clusters or two All SAN Array (ASA) clusters.

NetApp Documentation: SnapMirror Business Continuity

For each type of SnapMirror data protection relationship, the workflow is the same: create a destination volume, create a job schedule, specify a policy, create and initialize the relationship.

Beginning with ONTAP 9.3, you can use the `snapmirror protect` command to configure a data protection relationship in a single step. Even if you use `snapmirror protect`, you need to understand each step in the workflow.



Configure a replication relationship in one step

Beginning with ONTAP 9.3, you can use the `snapmirror protect` command to configure a data protection relationship in a single step. You specify a list of volumes to

be replicated, an SVM on the destination cluster, a job schedule, and a SnapMirror policy. `snapmirror protect` does the rest.

What you'll need

- The source and destination clusters and SVMs must be peered.

  Cluster and SVM peering

- The language on the destination volume must be the same as the language on the source volume.

About this task

The `snapmirror protect` command chooses an aggregate associated with the specified SVM. If no aggregate is associated with the SVM, it chooses from all the aggregates in the cluster. The choice of aggregate is based on the amount of free space and the number of volumes on the aggregate.

The `snapmirror protect` command then performs the following steps:

- Creates a destination volume with an appropriate type and amount of reserved space for each volume in the list of volumes to be replicated.
- Configures a replication relationship appropriate for the policy you specify.
- Initializes the relationship.

The name of the destination volume is of the form *`source_volume_name_dst`*. In case of a conflict with an existing name, the command appends a number to the volume name. You can specify a prefix and/or suffix in the command options. The suffix replaces the system-supplied `dst` suffix.

In ONTAP 9.3 and earlier, a destination volume can contain up to 251 Snapshot copies. In ONTAP 9.4 and later, a destination volume can contain up to 1019 Snapshot copies.

Initialization can be time-consuming. `snapmirror protect` does not wait for initialization to complete before the job finishes. For this reason, you should use the `snapmirror show` command rather than the `job show` command to determine when initialization is complete.

Beginning with ONTAP 9.5, SnapMirror Synchronous relationships can be created by using the `snapmirror protect` command.

Step

1. Create and initialize a replication relationship in one step:

   `snapmirror protect -path-list` *`SVM:volume|cluster://SVM/volume`*`, … -destination -vserver` *`destination_SVM`* `-policy` *`policy`* `-schedule` *`schedule`* `-auto-initialize true|false -destination-volume-prefix` *`prefix`* `-destination-volume-suffix` *`suffix`*

   You must run this command from the destination SVM or the destination cluster. The `-auto -initialize` option defaults to "true".

   The following example creates and initializes a SnapMirror DR relationship using the default `MirrorAllSnapshots` policy:

```
cluster_dst::> snapmirror protect -path-list svm1:volA, svm1:volB
-destination-vserver svm_backup -policy MirrorAllSnapshots -schedule
replication_daily
```

You can use a custom policy if you prefer. For more information, see Creating a custom replication policy.

The following example creates and initializes a SnapVault relationship using the default `XDPDefault` policy:

```
cluster_dst::> snapmirror protect -path-list svm1:volA, svm1:volB
-destination-vserver svm_backup -policy XDPDefault -schedule
replication_daily
```

The following example creates and initializes a unified replication relationship using the default `MirrorAndVault` policy:

```
cluster_dst::> snapmirror protect -path-list svm1:volA, svm1:volB
-destination-vserver svm_backup -policy MirrorAndVault
```

The following example creates and initializes a SnapMirror Synchronous relationship using the default `Sync` policy:

```
cluster_dst::> snapmirror protect -path-list svm1:volA, svm1:volB
-destination-vserver svm_sync -policy Sync
```

For SnapVault and unified replication policies, you might find it useful to define a schedule for creating a copy of the last transferred Snapshot copy on the destination. For more information, see Defining a schedule for creating a local copy on the destination.

After you finish

Use the `snapmirror show` command to verify that the SnapMirror relationship was created. For complete command syntax, see the man page.

Configure a replication relationship one step at a time

Create a destination volume

You can use the `volume create` command on the destination to create a destination volume. The destination volume should be the same or greater in size than the source volume.

Step

1. Create a destination volume:

   `volume create -vserver` *`SVM`* `-volume volume -aggregate` *`aggregate`* `-type DP -size` *`size`*

   For complete command syntax, see the man page.

   The following example creates a 2-GB destination volume named `volA_dst`:

   ```
   cluster_dst::> volume create -vserver SVM_backup -volume volA_dst
   -aggregate node01_aggr -type DP -size 2GB
   ```

Create a replication job schedule

You can use the `job schedule cron create` command to create a replication job schedule. The job schedule determines when SnapMirror automatically updates the data protection relationship to which the schedule is assigned.

About this task

You assign a job schedule when you create a data protection relationship. If you do not assign a job schedule, you must update the relationship manually.

Step

1. Create a job schedule:

   `job schedule cron create -name` *`job_name`* `-month` *`month`* `-dayofweek` *`day_of_week`* `-day` *`day_of_month`* `-hour` *`hour`* `-minute` *`minute`*

   For `-month`, `-dayofweek`, and `-hour`, you can specify `all` to run the job every month, day of the week, and hour, respectively.

   Beginning with ONTAP 9.10.1, you can include the Vserver for your job schedule:

   `job schedule cron create -name` *`job_name`* `-vserver` *`Vserver_name`* `-month` *`month`* `-dayofweek` *`day_of_week`* `-day` *`day_of_month`* `-hour` *`hour`* `-minute` *`minute`*

   > The minimum supported schedule (RPO) for FlexVol volumes in a volume SnapMirror relationship is 5 minutes. The minimum supported schedule (RPO) for FlexGroup volumes in a volume SnapMirror relationship is 30 minutes.

   The following example creates a job schedule named `my_weekly` that runs on Saturdays at 3:00 a.m.:

   ```
   cluster_dst::> job schedule cron create -name my_weekly -dayofweek
   "Saturday" -hour 3 -minute 0
   ```

Create a custom replication policy

You can create a custom replication policy if the default policy for a relationship is not suitable. You might want to compress data in a network transfer, for example, or modify the number of attempts SnapMirror makes to transfer Snapshot copies.

You can use a default or custom policy when you create a replication relationship. For a custom archive (formerly SnapVault) or unified replication policy, you must define one or more *rules* that determine which Snapshot copies are transferred during initialization and update.You might also want to define a schedule for creating local Snapshot copies on the destination.

The *policy type* of the replication policy determines the type of relationship it supports. The table below shows the available policy types.

Policy type	Relationship type
async-mirror	SnapMirror DR
vault	SnapVault
mirror-vault	Unified replication
strict-sync-mirror	SnapMirror Synchronous in the StrictSync mode (supported beginning with ONTAP 9.5)
sync-mirror	SnapMirror Synchronous in the Sync mode (supported beginning with ONTAP 9.5)

When you create a custom replication policy, it is a good idea to model the policy after a default policy.

Step

1. Create a custom replication policy:

   ```
   snapmirror policy create -vserver SVM -policy policy -type async-
   mirror|vault|mirror-vault|strict-sync-mirror|sync-mirror -comment comment
   -tries transfer_tries -transfer-priority low|normal -is-network-compression
   -enabled true|false
   ```

   For complete command syntax, see the man page.

   Beginning with ONTAP 9.5, you can specify the schedule for creating a common Snapshot copy schedule for SnapMirror Synchronous relationships by using the `-common-snapshot-schedule` parameter. By default, the common Snapshot copy schedule for SnapMirror Synchronous relationships is one hour. You can specify a value from 30 minutes to two hours for the Snapshot copy schedule for SnapMirror Synchronous relationships.

   The following example creates a custom replication policy for SnapMirror DR that enables network compression for data transfers:

```
cluster_dst::> snapmirror policy create -vserver svm1 -policy
DR_compressed -type async-mirror -comment "DR with network compression
enabled" -is-network-compression-enabled true
```

The following example creates a custom replication policy for SnapVault:

```
cluster_dst::> snapmirror policy create -vserver svm1 -policy
my_snapvault -type vault
```

The following example creates a custom replication policy for unified replication:

```
cluster_dst::> snapmirror policy create -vserver svm1 -policy my_unified
-type mirror-vault
```

The following example creates a custom replication policy for SnapMirror Synchronous relationship in the StrictSync mode:

```
cluster_dst::> snapmirror policy create -vserver svm1 -policy
my_strictsync -type strict-sync-mirror -common-snapshot-schedule
my_sync_schedule
```

After you finish

For "vault" and "mirror-vault" policy types, you must define rules that determine which Snapshot copies are transferred during initialization and update.

Use the `snapmirror policy show` command to verify that the SnapMirror policy was created. For complete command syntax, see the man page.

Define a rule for a policy

For custom policies with the "vault" or "mirror-vault" policy type, you must define at least one rule that determines which Snapshot copies are transferred during initialization and update. You can also define rules for default policies with the "vault" or"`mirror-vault`" policy type.

About this task

Every policy with the "vault" or "mirror-vault" policy type must have a rule that specifies which Snapshot copies to replicate. The rule "bi-monthly", for example, indicates that only Snapshot copies assigned the SnapMirror label "bi-monthly" should be replicated. You specify the SnapMirror label when you configure the Snapshot policy on the source.

Each policy type is associated with one or more system-defined rules. These rules are automatically assigned to a policy when you specify its policy type. The table below shows the system-defined rules.

System-defined rule	Used in policy types	Result
sm_created	async-mirror, mirror-vault, Sync, StrictSync	A Snapshot copy created by SnapMirror is transferred on initialization and update.
all_source_snapshots	async-mirror	New Snapshot copies on the source are transferred on initialization and update.
daily	vault,mirror-vault	New Snapshot copies on the source with the SnapMirror label “daily” are transferred on initialization and update.
weekly	vault,mirror-vault	New Snapshot copies on the source with the SnapMirror label “weekly” are transferred on initialization and update.
monthly	mirror-vault	New Snapshot copies on the source with the SnapMirror label “monthly” are transferred on initialization and update.
app_consistent	Sync, StrictSync	Snapshot copies with the SnapMirror label “app_consistent” on source are synchronously replicated to the destination. Supported Beginning with ONTAP 9.7.

Except for the “async-mirror” policy type, you can specify additional rules as needed, for default or custom policies. For example:

- For the default `MirrorAndVault` policy, you might create a rule called “bi-monthly” to match Snapshot copies on the source with the “bi-monthly” SnapMirror label.
- For a custom policy with the “mirror-vault” policy type, you might create a rule called “bi-weekly” to match Snapshot copies on the source with the “bi-weekly” SnapMirror label.

Step

1. Define a rule for a policy:

   `snapmirror policy add-rule -vserver` *`SVM`* `-policy` *`policy_for_rule`* `-snapmirror -label` *`snapmirror-label`* `-keep` *`retention_count`*

   For complete command syntax, see the man page.

   The following example adds a rule with the SnapMirror label `bi-monthly` to the default `MirrorAndVault` policy:

```
cluster_dst::> snapmirror policy add-rule -vserver svm1 -policy
MirrorAndVault -snapmirror-label bi-monthly -keep 6
```

The following example adds a rule with the SnapMirror label `bi-weekly` to the custom `my_snapvault` policy:

```
cluster_dst::> snapmirror policy add-rule -vserver svm1 -policy
my_snapvault -snapmirror-label bi-weekly -keep 26
```

The following example adds a rule with the SnapMirror label `app_consistent` to the custom `Sync` policy:

```
cluster_dst::> snapmirror policy add-rule -vserver svm1 -policy Sync
-snapmirror-label app_consistent -keep 1
```

You can then replicate Snapshot copies from the source cluster that match this SnapMirror label:

```
cluster_src::> snapshot create -vserver vs1 -volume vol1 -snapshot
snapshot1 -snapmirror-label app_consistent
```

Define a schedule for creating a local copy on the destination

For SnapVault and unified replication relationships, you can protect against the possibility that an updated Snapshot copy is corrupted by creating a copy of the last transferred Snapshot copy on the destination. This “local copy” is retained regardless of the retention rules on the source, so that even if the Snapshot originally transferred by SnapMirror is no longer available on the source, a copy of it will be available on the destination.

About this task

You specify the schedule for creating a local copy in the `-schedule` option of the `snapmirror policy add-rule` command.

Step

1. Define a schedule for creating a local copy on the destination:

   `snapmirror policy add-rule -vserver` *`SVM`* `-policy` *`policy_for_rule`* `-snapmirror -label` *`snapmirror-label`* `-schedule` *`schedule`*

   For complete command syntax, see the man page. For an example of how to create a job schedule, see Creating a replication job schedule.

   The following example adds a schedule for creating a local copy to the default `MirrorAndVault` policy:

```
cluster_dst::> snapmirror policy add-rule -vserver svm1 -policy
MirrorAndVault -snapmirror-label my_monthly -schedule my_monthly
```

The following example adds a schedule for creating a local copy to the custom `my_unified` policy:

```
cluster_dst::> snapmirror policy add-rule -vserver svm1 -policy
my_unified -snapmirror-label my_monthly -schedule my_monthly
```

Create a replication relationship

The relationship between the source volume in primary storage and the destination volume in secondary storage is called a *data protection relationship.* You can use the `snapmirror create` command to create SnapMirror DR, SnapVault, or unified replication data protection relationships.

What you'll need

- The source and destination clusters and SVMs must be peered.

  Cluster and SVM peering

- The language on the destination volume must be the same as the language on the source volume.

About this task

Until ONTAP 9.3, SnapMirror invoked in DP mode and SnapMirror invoked in XDP mode used different replication engines, with different approaches to version-dependence:

- SnapMirror invoked in DP mode used a *version-dependent* replication engine in which the ONTAP version was required to be the same on primary and secondary storage:

```
cluster_dst::>  snapmirror create -type DP -source-path ... -destination
-path ...
```

- SnapMirror invoked in XDP mode used a *version-flexible* replication engine that supported different ONTAP versions on primary and secondary storage:

```
cluster_dst::>  snapmirror create -type XDP -source-path ...
-destination-path ...
```

With improvements in performance, the significant benefits of version-flexible SnapMirror outweigh the slight advantage in replication throughput obtained with version-dependent mode. For this reason, beginning with ONTAP 9.3, XDP mode has been made the new default, and any invocations of DP mode on the command line or in new or existing scripts are automatically converted to XDP mode.

Existing relationships are not affected. If a relationship is already of type DP, it will continue to be of type DP.

The table below shows the behavior you can expect.

If you specify…	The type is…	The default policy (if you do not specify a policy) is…
DP	XDP	MirrorAllSnapshots (SnapMirror DR)
Nothing	XDP	MirrorAllSnapshots (SnapMirror DR)
XDP	XDP	XDPDefault (SnapVault)

See also the examples in the procedure below.

The only exceptions to conversion are as follows:

- SVM data protection relationships continue to default to DP mode.

  Specify XDP explicitly to obtain XDP mode with the default `MirrorAllSnapshots` policy.

- Load-sharing data protection relationships continue to default to DP mode.
- SnapLock data protection relationships continue to default to DP mode.
- Explicit invocations of DP continue to default to DP mode if you set the following cluster-wide option:

  ```
  options replication.create_data_protection_rels.enable on
  ```

  This option is ignored if you do not explicitly invoke DP.

In ONTAP 9.3 and earlier, a destination volume can contain up to 251 Snapshot copies. In ONTAP 9.4 and later, a destination volume can contain up to 1019 Snapshot copies.

Beginning with ONTAP 9.5, SnapMirror Synchronous relationships are supported.

Step

1. From the destination cluster, create a replication relationship:

   `snapmirror create -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, … -type DP|XDP -schedule` *`schedule`* `-policy` *`policy`*

   For complete command syntax, see the man page.

   > The `schedule` parameter is not applicable when creating SnapMirror Synchronous relationships.

   The following example creates a SnapMirror DR relationship using the default `MirrorLatest` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -type XDP -schedule my_daily -policy
MirrorLatest
```

The following example creates a SnapVault relationship using the default `XDPDefault` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -type XDP -schedule my_daily -policy
XDPDefault
```

The following example creates a unified replication relationship using the default `MirrorAndVault` policy:

```
cluster_dst:> snapmirror create -source-path svm1:volA -destination-path
svm_backup:volA_dst -type XDP -schedule my_daily -policy MirrorAndVault
```

The following example creates a unified replication relationship using the custom `my_unified` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -type XDP -schedule my_daily -policy
my_unified
```

The following example creates a SnapMirror Synchronous relationship using the default `Sync` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -type XDP -policy Sync
```

The following example creates a SnapMirror Synchronous relationship using the default `StrictSync` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -type XDP -policy StrictSync
```

The following example creates a SnapMirror DR relationship. With the DP type automatically converted to XDP and with no policy specified, the policy defaults to the `MirrorAllSnapshots` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -type DP -schedule my_daily
```

The following example creates a SnapMirror DR relationship. With no type or policy specified, the policy

defaults to the `MirrorAllSnapshots` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -schedule my_daily
```

The following example creates a SnapMirror DR relationship. With no policy specified, the policy defaults to the `XDPDefault` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -type XDP -schedule my_daily
```

The following example creates a SnapMirror Synchronous relationship with the predefined policy `SnapCenterSync`:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst -type XDP -policy SnapCenterSync
```

The predefined policy `SnapCenterSync` is of type `Sync`. This policy replicates any Snapshot copy that is created with the `snapmirror-label` of "app_consistent".

After you finish

Use the `snapmirror show` command to verify that the SnapMirror relationship was created. For complete command syntax, see the man page.

Other ways to do this in ONTAP

To perform these tasks with…	See this content…
The redesigned System Manager (available with ONTAP 9.7 and later)	Configure mirrors and vaults
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume backup using SnapVault overview

Initialize a replication relationship

For all relationship types, initialization performs a *baseline transfer*: it makes a Snapshot copy of the source volume, then transfers that copy and all the data blocks it references to the destination volume. Otherwise, the contents of the transfer depend on the policy.

What you'll need

The source and destination clusters and SVMs must be peered.

Cluster and SVM peering

About this task

Initialization can be time-consuming. You might want to run the baseline transfer in off-peak hours.

Beginning with ONTAP 9.5, SnapMirror Synchronous relationships are supported.

Step

1. Initialize a replication relationship:

   ```
   snapmirror initialize -source-path SVM:volume|cluster://SVM/volume, …
   -destination-path SVM:volume|cluster://SVM/volume, …
   ```

   For complete command syntax, see the man page.

   You must run this command from the destination SVM or the destination cluster.

   The following example initializes the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror initialize -source-path svm1:volA -destination
   -path svm_backup:volA_dst
   ```

Example: Configure a vault-vault cascade

An example will show in concrete terms how you can configure replication relationships one step at a time. You can use the vault-vault cascade deployment configured in the example to retain more than 251 Snapshot copies labeled “my-weekly”.

What you’ll need

- The source and destination clusters and SVMs must be peered.
- You must be running ONTAP 9.2 or later. Vault-vault cascades are not supported in earlier ONTAP releases.

About this task

The example assumes the following:

- You have configured Snapshot copies on the source cluster with the SnapMirror labels “my-daily”, “my-weekly”, and “my-monthly”.
- You have configured destination volumes named “volA” on the secondary and tertiary destination clusters.
- You have configured replication job schedules named “my_snapvault” on the secondary and tertiary destination clusters.

The example shows how to create replication relationships based on two custom policies:

- The “snapvault_secondary” policy retains 7 daily, 52 weekly, and 180 monthly Snapshot copies on the secondary destination cluster.
- The “snapvault_tertiary policy” retains 250 weekly Snapshot copies on the tertiary destination cluster.

Steps

1. On the secondary destination cluster, create the “snapvault_secondary” policy:

```
cluster_secondary::> snapmirror policy create -policy snapvault_secondary
-type vault -comment "Policy on secondary for vault to vault cascade" -vserver
svm_secondary
```

2. On the secondary destination cluster, define the “my-daily” rule for the policy:

```
cluster_secondary::> snapmirror policy add-rule -policy snapvault_secondary
-snapmirror-label my-daily -keep 7 -vserver svm_secondary
```

3. On the secondary destination cluster, define the “my-weekly” rule for the policy:

```
cluster_secondary::> snapmirror policy add-rule -policy snapvault_secondary
-snapmirror-label my-weekly -keep 52 -vserver svm_secondary
```

4. On the secondary destination cluster, define the “my-monthly” rule for the policy:

```
cluster_secondary::> snapmirror policy add-rule -policy snapvault_secondary
-snapmirror-label my-monthly -keep 180 -vserver svm_secondary
```

5. On the secondary destination cluster, verify the policy:

```
cluster_secondary::> snapmirror policy show snapvault_secondary -instance
```

```
                    Vserver: svm_secondary
      SnapMirror Policy Name: snapvault_secondary
      SnapMirror Policy Type: vault
                Policy Owner: cluster-admin
                 Tries Limit: 8
           Transfer Priority: normal
   Ignore accesstime Enabled: false
     Transfer Restartability: always
 Network Compression Enabled: false
             Create Snapshot: false
                     Comment: Policy on secondary for vault to vault
cascade
       Total Number of Rules: 3
                  Total Keep: 239
                       Rules: SnapMirror Label     Keep  Preserve Warn
Schedule Prefix
                              ----------------     ----  -------- ----
-------- ------
                              my-daily               7  false       0 -
-
                              my-weekly             52  false       0 -
-
                              my-monthly           180  false       0 -
-
```

6. On the secondary destination cluster, create the relationship with the source cluster:

```
cluster_secondary::> snapmirror create -source-path svm_primary:volA
-destination-path svm_secondary:volA -type XDP -schedule my_snapvault -policy
snapvault_secondary
```

7. On the secondary destination cluster, initialize the relationship with the source cluster:

```
cluster_secondary::> snapmirror initialize -source-path svm_primary:volA
-destination-path svm_secondary:volA
```

8. On the tertiary destination cluster, create the “snapvault_tertiary” policy:

```
cluster_tertiary::> snapmirror policy create -policy snapvault_tertiary -type
vault -comment “Policy on tertiary for vault to vault cascade” -vserver
svm_tertiary
```

9. On the tertiary destination cluster, define the “my-weekly” rule for the policy:

```
cluster_tertiary::> snapmirror policy add-rule -policy snapvault_tertiary
-snapmirror-label my-weekly -keep 250 -vserver svm_tertiary
```

10. On the tertiary destination cluster, verify the policy:

```
cluster_tertiary::> snapmirror policy show snapvault_tertiary -instance
```

```
                    Vserver: svm_tertiary
      SnapMirror Policy Name: snapvault_tertiary
      SnapMirror Policy Type: vault
                Policy Owner: cluster-admin
                 Tries Limit: 8
           Transfer Priority: normal
   Ignore accesstime Enabled: false
     Transfer Restartability: always
 Network Compression Enabled: false
             Create Snapshot: false
                     Comment: Policy on tertiary for vault to vault
cascade
       Total Number of Rules: 1
                  Total Keep: 250
                       Rules: SnapMirror Label     Keep  Preserve Warn
Schedule Prefix
                              ----------------     ----  -------- ----
-------- ------
                              my-weekly             250  false       0 -
-
```

11. On the tertiary destination cluster, create the relationship with the secondary cluster:

```
cluster_tertiary::> snapmirror create -source-path svm_secondary:volA
-destination-path svm_tertiary:volA -type XDP -schedule my_snapvault -policy
snapvault_tertiary
```

12. On the tertiary destination cluster, initialize the relationship with the secondary cluster:

```
cluster_tertiary::> snapmirror initialize -source-path svm_secondary:volA
-destination-path svm_tertiary:volA
```

Convert an existing DP-type relationship to XDP

You can easily convert an existing DP-type relationship to XDP to take advantage of version-flexible SnapMirror.

About this task

- If you are upgrading to ONTAP 9.12.1 or later, you must convert DP-type relationships to XDP before upgrading. ONTAP 9.12.1 and later does not support DP-type relationships.
- SnapMirror does not automatically convert existing DP-type relationships to XDP. To convert the relationship, you need to break and delete the existing relationship, create a new XDP relationship, and resync the relationship. For background information, see XDP replaces DP as the SnapMirror default.
- When planning your conversion, you should be aware that background preparation and the data warehousing phase of an XDP SnapMirror relationship can take a long time. It is not uncommon to see the SnapMirror relationship reporting the status "preparing" for an extended time period.

> After you convert a SnapMirror relationship type from DP to XDP, space-related settings, such as autosize and space guarantee are no longer replicated to the destination.

Steps

1. From the destination cluster, ensure that the SnapMirror relationship is type DP, that the mirror state is SnapMirrored, the relationship status is Idle, and the relationship is healthy:

   `snapmirror show -destination-path` *`SVM:volume|cluster://SVM/volume`*

   The following example shows the output from the `snapmirror show` command:

```
cluster_dst::>snapmirror show -destination-path svm_backup:volA_dst

Source Path: svm1:volA
Destination Path: svm_backup:volA_dst
Relationship Type: DP
SnapMirror Schedule: -
Tries Limit: -
Throttle (KB/sec): unlimited
Mirror State: Snapmirrored
Relationship Status: Idle
Transfer Snapshot: -
Snapshot Progress: -
Total Progress: -
Snapshot Checkpoint: -
Newest Snapshot: snapmirror.10af643c-32d1-11e3-954b-
123478563412_2147484682.2014-06-27_100026
Newest Snapshot Timestamp: 06/27 10:00:55
Exported Snapshot: snapmirror.10af643c-32d1-11e3-954b-
123478563412_2147484682.2014-06-27_100026
Exported Snapshot Timestamp: 06/27 10:00:55
Healthy: true
```

You might find it helpful to retain a copy of the `snapmirror show` command output to keep track existing of the relationship settings.

2. From the source and the destination volumes, ensure that both volumes have a common Snapshot copy:

   `volume snapshot show -vserver` *`SVM`* `-volume` *`volume`*

   The following example shows the `volume snapshot show` output for the souce and the destination volumes:

```
cluster_src:> volume snapshot show -vserver vsm1 -volume volA
---Blocks---
Vserver Volume Snapshot State Size Total% Used%
-------- ------- ------------------------------ -------- --------
------ -----
svm1 volA
weekly.2014-06-09_0736 valid 76KB 0% 28%
weekly.2014-06-16_1305 valid 80KB 0% 29%
daily.2014-06-26_0842 valid 76KB 0% 28%
hourly.2014-06-26_1205 valid 72KB 0% 27%
hourly.2014-06-26_1305 valid 72KB 0% 27%
hourly.2014-06-26_1405 valid 76KB 0% 28%
hourly.2014-06-26_1505 valid 72KB 0% 27%
hourly.2014-06-26_1605 valid 72KB 0% 27%
daily.2014-06-27_0921 valid 60KB 0% 24%
hourly.2014-06-27_0921 valid 76KB 0% 28%
snapmirror.10af643c-32d1-11e3-954b-123478563412_2147484682.2014-06-
27_100026
valid 44KB 0% 19%
11 entries were displayed.


cluster_dest:> volume snapshot show -vserver svm_backup -volume volA_dst
---Blocks---
Vserver Volume Snapshot State Size Total% Used%
-------- ------- ------------------------------ -------- --------
------ -----
svm_backup volA_dst
weekly.2014-06-09_0736 valid 76KB 0% 30%
weekly.2014-06-16_1305 valid 80KB 0% 31%
daily.2014-06-26_0842 valid 76KB 0% 30%
hourly.2014-06-26_1205 valid 72KB 0% 29%
hourly.2014-06-26_1305 valid 72KB 0% 29%
hourly.2014-06-26_1405 valid 76KB 0% 30%
hourly.2014-06-26_1505 valid 72KB 0% 29%
hourly.2014-06-26_1605 valid 72KB 0% 29%
daily.2014-06-27_0921 valid 60KB 0% 25%
hourly.2014-06-27_0921 valid 76KB 0% 30%
snapmirror.10af643c-32d1-11e3-954b-123478563412_2147484682.2014-06-
27_100026
```

3. To ensure scheduled updates will not run during the conversion, quiesce the existing DP-type relationship:

   ```
   snapmirror quiesce -source-path SVM:volume|cluster://SVM/volume, …
   -destination-path SVM:volume|cluster://SVM/volume, …
   ```

For complete command syntax, see the man page.

> You must run this command from the destination SVM or the destination cluster.

The following example quiesces the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

```
cluster_dst::> snapmirror quiesce -destination-path svm_backup:volA_dst
```

4. Break the existing DP-type relationship:

   `snapmirror break -destination-path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   > You must run this command from the destination SVM or the destination cluster.

   The following example breaks the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror break -destination-path svm_backup:volA_dst
   ```

5. If automatic deletion of Snapshot copies is enabled on the destination volume, disable it:

   `volume snapshot autodelete modify -vserver` *`SVM`* `-volume` *`volume`* `-enabled false`

   The following example disables Snapshot copy autodelete on the destination volume `volA_dst`:

   ```
   cluster_dst::> volume snapshot autodelete modify -vserver svm_backup
   -volume volA_dst -enabled false
   ```

6. Delete the existing DP-type relationship:

   `snapmirror delete -destination-path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   > You must run this command from the destination SVM or the destination cluster.

   The following example deletes the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror delete -destination-path svm_backup:volA_dst
   ```

7. You can use the output you retained from the `snapmirror show` command to create the new XDP-type

relationship:

`snapmirror create -source-path SVM:volume|cluster://SVM/volume, … -destination -path SVM:volume|cluster://SVM/volume, … -type XDP -schedule schedule -policy policy`

The new relationship must use the same source and destination volume. For complete command syntax, see the man page.

ⓘ You must run this command from the destination SVM or the destination cluster.

The following example creates a SnapMirror DR relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup` using the default `MirrorAllSnapshots` policy:

```
cluster_dst::> snapmirror create -source-path svm1:volA -destination
-path svm_backup:volA_dst
-type XDP -schedule my_daily -policy MirrorAllSnapshots
```

8. Resync the source and destination volumes:

   `snapmirror resync -source-path SVM:volume|cluster://SVM/volume, … -destination -path SVM:volume|cluster://SVM/volume, …`

   To improve resync time, you can use the `-quick-resync` option, but you should be aware that storage efficiency savings can be lost. For complete command syntax, see the man page: SnapMirror resync command.

   ⓘ You must run this command from the destination SVM or the destination cluster. Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours.

   The following example resyncs the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror resync -source-path svm1:volA -destination
   -path svm_backup:volA_dst
   ```

9. If you disabled automatic deletion of Snapshot copies, reenable it:

   `volume snapshot autodelete modify -vserver SVM -volume volume -enabled true`

After you finish

1. Use the `snapmirror show` command to verify that the SnapMirror relationship was created. For complete command syntax, see the man page.
2. Once the SnapMirror XDP destination volume begins updating Snapshot copies as defined by the SnapMirror policy, you can use the output of `snapmirror list-destinations` command from the source cluster to display the new SnapMirror XDP relationship.

Convert the type of a SnapMirror relationship

Beginning with ONTAP 9.5, SnapMirror Synchronous is supported. You can convert an asynchronous SnapMirror relationship to a SnapMirror Synchronous relationship or vice versa without performing a baseline transfer.

About this task

You cannot convert an asynchronous SnapMirror relationship to a SnapMirror Synchronous relationship or vice versa by changing the SnapMirror policy

Steps

- **Converting an asynchronous SnapMirror relationship to a SnapMirror Synchronous relationship**
  a. From the destination cluster, delete the asynchronous SnapMirror relationship:

     `snapmirror delete -destination-path` *`SVM:volume`*

     ```
     cluster2::>snapmirror delete -destination-path vs1_dr:vol1
     ```

  b. From the source cluster, release the SnapMirror relationship without deleting the common Snapshot copies:

     `snapmirror release -relationship-info-only true -destination-path` *`dest_SVM:dest_volume`*

     ```
     cluster1::>snapmirror release -relationship-info-only true
     -destination-path vs1_dr:vol1
     ```

  c. From the destination cluster, create a SnapMirror Synchronous relationship:

     `snapmirror create -source-path` *`src_SVM:src_volume`* `-destination-path` *`dest_SVM:dest_volume`* `-policy sync-mirror`

     ```
     cluster2::>snapmirror create -source-path vs1:vol1 -destination-path
     vs1_dr:vol1 -policy sync
     ```

  d. Resynchronize the SnapMirror Synchronous relationship:

     `snapmirror resync -destination-path` *`dest_SVM:dest_volume`*

     ```
     cluster2::>snapmirror resync -destination-path vs1_dr:vol1
     ```

- **Converting a SnapMirror Synchronous relationship to an asynchronous SnapMirror relationship**
  a. From the destination cluster, quiesce the existing SnapMirror Synchronous relationship:

     `snapmirror quiesce -destination-path dest_SVM:dest_volume`

```
cluster2::> snapmirror quiesce -destination-path vs1_dr:vol1
```

b. From the destination cluster, delete the asynchronous SnapMirror relationship:

`snapmirror delete -destination-path` *`SVM:volume`*

```
cluster2::>snapmirror delete -destination-path vs1_dr:vol1
```

c. From the source cluster, release the SnapMirror relationship without deleting the common Snapshot copies:

`snapmirror release -relationship-info-only true -destination-path` *`dest_SVM:dest_volume`*

```
cluster1::>snapmirror release -relationship-info-only true
-destination-path vs1_dr:vol1
```

d. From the destination cluster, create an asynchronous SnapMirror relationship:

`snapmirror create -source-path` *`src_SVM:src_volume`* `-destination-path` *`dest_SVM:dest_volume`* `-policy MirrorAllSnapshots`

```
cluster2::>snapmirror create -source-path vs1:vol1 -destination-path
vs1_dr:vol1 -policy sync
```

e. Resynchronize the SnapMirror Synchronous relationship:

`snapmirror resync -destination-path` *`dest_SVM:dest_volume`*

```
cluster2::>snapmirror resync -destination-path vs1_dr:vol1
```

Convert the mode of a SnapMirror Synchronous relationship

Beginning with ONTAP 9.5, SnapMirror Synchronous relationships are supported. You can convert the mode of a SnapMirror Synchronous relationship from StrictSync to Sync or vice versa.

About this task

You cannot modify the policy of a Snapmirror Synchronous relationship to convert its mode.

Steps

1. From the destination cluster, quiesce the existing SnapMirror Synchronous relationship:

`snapmirror quiesce -destination-path dest_SVM:dest_volume`

```
cluster2::> snapmirror quiesce -destination-path vs1_dr:vol1
```

2. From the destination cluster, delete the existing SnapMirror Synchronous relationship:

   `snapmirror delete -destination-path dest_SVM:dest_volume`

   ```
   cluster2::> snapmirror delete -destination-path vs1_dr:vol1
   ```

3. From the source cluster, release the SnapMirror relationship without deleting the common Snapshot copies:

   `snapmirror release -relationship-info-only true -destination-path dest_SVM:dest_volume`

   ```
   cluster1::> snapmirror release -relationship-info-only true -destination
   -path vs1_dr:vol1
   ```

4. From the destination cluster, create a SnapMirror Synchronous relationship by specifying the mode to which you want to convert the SnapMirror Synchronous relationship:

   `snapmirror create -source-path vs1:vol1 -destination-path dest_SVM:dest_volume -policy Sync|StrictSync`

   ```
   cluster2::> snapmirror create -source-path vs1:vol1 -destination-path
   vs1_dr:vol1 -policy Sync
   ```

5. From the destination cluster, resynchronize the SnapMirror relationship:

   `snapmirror resync -destination-path dest_SVM:dest_volume`

   ```
   cluster2::> snapmirror resync -destination-path vs1_dr:vol1
   ```

Serve data from a SnapMirror DR destination volume

Make the destination volume writeable

You need to make the destination volume writeable before you can serve data from the volume to clients. You can use the `snapmirror quiesce` command to stop scheduled transfers to the destination, the `snapmirror abort` command to stop ongoing transfers, and the `snapmirror break` command to make the destination writeable.

About this task

You must perform this task from the destination SVM or the destination cluster.

Steps

1. Stop scheduled transfers to the destination:

   `snapmirror quiesce -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination-path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   The following example stops scheduled transfers between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror quiesce -source-path svm1:volA -destination
   -path svm_backup:volA_dst
   ```

2. Stop ongoing transfers to the destination:

   `snapmirror abort -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   > This step is not required for SnapMirror Synchronous relationships (supported beginning with ONTAP 9.5).

   The following example stops ongoing transfers between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror abort -source-path svm1:volA -destination-path
   svm_backup:volA_dst
   ```

3. Break the SnapMirror DR relationship:

   `snapmirror break -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   The following example breaks the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror break -source-path svm1:volA -destination-path
   svm_backup:volA_dst
   ```

Other ways to do this in ONTAP

To perform these tasks with…	See this content…
The redesigned System Manager (available with ONTAP 9.7 and later)	Serve data from a SnapMirror destination
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume disaster recovery overview

Configure the destination volume for data access

After making the destination volume writeable, you must configure the volume for data access. NAS clients, NVMe subsystem, and SAN hosts can access the data from the destination volume until the source volume is reactivated.

NAS environment:

1. Mount the NAS volume to the namespace using the same junction path that the source volume was mounted to in the source SVM.
2. Apply the appropriate ACLs to the SMB shares at the destination volume.
3. Assign the NFS export policies to the destination volume.
4. Apply the quota rules to the destination volume.
5. Redirect clients to the destination volume.
6. Remount the NFS and SMB shares on the clients.

SAN environment:

1. Map the LUNs in the volume to the appropriate initiator group.
2. For iSCSI, create iSCSI sessions from the SAN host initiators to the SAN LIFs.
3. On the SAN client, perform a storage re-scan to detect the connected LUNs.

For information about NVMe environment, see SAN administration.

Reactivate the original source volume

You can reestablish the original data protection relationship between the source and destination volumes when you no longer need to serve data from the destination.

About this task

- The procedure below assumes that the baseline in the original source volume is intact. If the baseline is not intact, you must create and initialize the relationship between the volume you are serving data from and the original source volume before performing the procedure.
- Background preparation and the data warehousing phase of an XDP SnapMirror relationship can take a long time. It is not uncommon to see the SnapMirror relationship reporting the status "preparing" for an extended time period.

Steps

1. Delete the original data protection relationship:

`snapmirror delete -source-path SVM:volume|cluster://SVM/volume, … -destination -path SVM:volume|cluster://SVM/volume, …`

For complete command syntax, see the man page.

You must run this command from the destination SVM or the destination cluster.

The following example deletes the relationship between the original source volume, `volA` on `svm1`, and the volume you are serving data from, `volA_dst` on `svm_backup`:

```
cluster_dst::> snapmirror delete -source-path svm1:volA -destination
-path svm_backup:volA_dst
```

2. Reverse the original data protection relationship:

`snapmirror resync -source-path SVM:volume|cluster://SVM/volume, … -destination -path SVM:volume|cluster://SVM/volume, …`

For complete command syntax, see the man page.

> You must run this command from the original source SVM or the original source cluster. Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours. The command fails if a common Snapshot copy does not exist on the source and destination. Use `snapmirror initialize` to re-initialize the relationship.

The following example reverses the relationship between the original source volume, `volA` on `svm1`, and the volume you are serving data from, `volA_dst` on `svm_backup`:

```
cluster_src::> snapmirror resync -source-path svm_backup:volA_dst
-destination-path svm1:volA
```

3. When you are ready to reestablish data access to the original source, stop access to the original destination volume. One way to do this is to stop the original destination SVM:

`vserver stop -vserver SVM`

For complete command syntax, see the man page.

> You must run this command from the original destination SVM or the original destination cluster. This command stops user access to the entire original destination SVM. You may want to stop access to the original destination volume using other methods.

The following example stops the original destination SVM:

```
cluster_dst::> vserver stop svm_backup
```

4. Update the reversed relationship:

   `snapmirror update -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   You must run this command from the original source SVM or the original source cluster.

   The following example updates the relationship between the volume you are serving data from, `volA_dst` on `svm_backup`, and the original source volume, `volA` on `svm1`:

   ```
   cluster_src::> snapmirror update -source-path svm_backup:volA_dst
   -destination-path svm1:volA
   ```

5. From the original source SVM or the original source cluster, stop scheduled transfers for the reversed relationship:

   `snapmirror quiesce -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination-path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   You must run this command from the original source SVM or the original source cluster.

   The following example stops scheduled transfers between the original destination volume, `volA_dst` on `svm_backup`, and the original source volume, `volA` on `svm1`:

   ```
   cluster_src::> snapmirror quiesce -source-path svm_backup:volA_dst
   -destination-path svm1:volA
   ```

6. When the final update is complete and the relationship indicates "Quiesced" for the relationship status, run the following command from the original source SVM or the original source cluster to break the reversed relationship::

   `snapmirror break -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   You must run this command from the original source SVM or the source cluster.

   The following example breaks the relationship between the original destination volume, `volA_dst` on `svm_backup`, and the original source volume, `volA` on `svm1`:

```
cluster_scr::> snapmirror break -source-path svm_backup:volA_dst
-destination-path svm1:volA
```

7. From the original source SVM or the original source cluster, delete the reversed data protection relationship:

   `snapmirror delete -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   > You must run this command from the original source SVM or the original source cluster.

   The following example deletes the reversed relationship between the original source volume, `volA` on `svm1`, and the volume you are serving data from, `volA_dst` on `svm_backup`:

```
cluster_src::> snapmirror delete -source-path svm_backup:volA_dst
-destination-path svm1:volA
```

8. Release the reversed relationship from the original destination SVM or the original destination cluster.

   `snapmirror release -source-path` *`SVM:volume|cluster://SVM/volume`*`, …`
   `-destination-path` *`SVM:volume|cluster://SVM/volume`*`, …`

   > You must run this command from the original destination SVM or the original destination cluster.

   The following example releases the reversed relationship between the original destination volume, `volA_dst` on `svm_backup`, and the original source volume, `volA` on `svm1`:

```
cluster_dst::> snapmirror release -source-path svm_backup:volA_dst
-destination-path svm1:volA
```

1. If needed, start the original destination SVM:

   `vserver start -vserver` *`SVM`*

   For complete command syntax, see the man page.

   The following example starts the original destination SVM:

```
cluster_dst::> vserver start svm_backup
```

2. Reestablish the original data protection relationship from the original destination:

`snapmirror resync -source-path SVM:volume|cluster://SVM/volume, … -destination -path SVM:volume|cluster://SVM/volume, …`

For complete command syntax, see the man page.

The following example reestablishes the relationship between the original source volume, `volA` on `svm1`, and the original destination volume, `volA_dst` on `svm_backup`:

```
cluster_dst::> snapmirror resync -source-path svm1:volA -destination
-path svm_backup:volA_dst
```

After you finish

Use the `snapmirror show` command to verify that the SnapMirror relationship was created. For complete command syntax, see the man page.

Restore files from a SnapMirror destination volume

Restore a single file, LUN, or NVMe namespace from a SnapMirror destination

You can restore a single file, LUN, a set of files or LUNs from a Snapshot copy, or an NVMe namespace from a SnapMirror destination volume. Beginning with ONTAP 9.7, you can also restore NVMe namespaces from a SnapMirror Synchronous destination. You can restore files to the original source volume or to a different volume.

What you'll need

To restore a file or LUN from a SnapMirror Synchronous destination (supported beginning with ONTAP 9.5), you must first delete and release the relationship.

About this task

The volume to which you are restoring files or LUNs (the destination volume) must be a read-write volume:

- SnapMirror performs an *incremental restore* if the source and destination volumes have a common Snapshot copy (as is typically the case when you are restoring to the original source volume).
- Otherwise, SnapMirror performs a *baseline restore*, in which the specified Snapshot copy and all the data blocks it references are transferred to the destination volume.

Steps

1. List the Snapshot copies in the destination volume:

   `volume snapshot show -vserver SVM -volume volume`

   For complete command syntax, see the man page.

   The following example shows the Snapshot copies on the `vserverB:secondary1` destination:

```
cluster_dst::> volume snapshot show -vserver vserverB -volume secondary1

Vserver     Volume      Snapshot                State    Size  Total%
Used%
-------     ------      ---------- ----------- ------   -----  ------
-----
vserverB    secondary1  hourly.2013-01-25_0005  valid   224KB     0%
0%
                        daily.2013-01-25_0010   valid   92KB      0%
0%
                        hourly.2013-01-25_0105  valid   228KB     0%
0%
                        hourly.2013-01-25_0205  valid   236KB     0%
0%
                        hourly.2013-01-25_0305  valid   244KB     0%
0%
                        hourly.2013-01-25_0405  valid   244KB     0%
0%
                        hourly.2013-01-25_0505  valid   244KB     0%
0%

7 entries were displayed.
```

2. Restore a single file or LUN or a set of files or LUNs from a Snapshot copy in a SnapMirror destination volume:

   `snapmirror restore -source-path` *`SVM:volume|cluster://SVM/volume`*`, …` `-destination-path` *`SVM:volume|cluster://SVM/volume`*`, …` `-source-snapshot snapshot -file-list` *`source_file_path,@destination_file_path`*

   For complete command syntax, see the man page.

   > You must run this command from the destination SVM or the destination cluster.

   The following command restores the files `file1` and `file2` from the Snapshot copy `daily.2013-01-25_0010` in the original destination volume `secondary1`, to the same location in the active file system of the original source volume `primary1`:

```
cluster_dst::> snapmirror restore -source-path vserverB:secondary1
-destination-path vserverA:primary1 -source-snapshot daily.2013-01-
25_0010 -file-list /dir1/file1,/dir2/file2

[Job 3479] Job is queued: snapmirror restore for the relationship with
destination vserverA:primary1
```

The following command restores the files `file1` and `file2` from the Snapshot copy `daily.2013-01-25_0010` in the original destination volume `secondary1`, to a different location in the active file system of the original source volume `primary1`.

The destination file path begins with the @ symbol followed by the path of the file from the root of the original source volume. In this example, `file1` is restored to `/dir1/file1.new` and file2 is restored to `/dir2.new/file2` on `primary1`:

```
cluster_dst::> snapmirror restore -source-path vserverB:secondary1
-destination-path vserverA:primary1 -source-snapshot daily.2013-01-
25_0010 -file-list
/dir/file1,@/dir1/file1.new,/dir2/file2,@/dir2.new/file2

[Job 3479] Job is queued: snapmirror restore for the relationship with
destination vserverA:primary1
```

The following command restores the files `file1` and `file3` from the Snapshot copy `daily.2013-01-25_0010` in the original destination volume `secondary1`, to different locations in the active file system of the original source volume `primary1`, and restores `file2` from `snap1` to the same location in the active file system of `primary1`.

In this example, the file `file1` is restored to `/dir1/file1.new` and `file3` is restored to `/dir3.new/file3`:

```
cluster_dst::> snapmirror restore -source-path vserverB:secondary1
-destination-path vserverA:primary1 -source-snapshot daily.2013-01-
25_0010 -file-list
/dir/file1,@/dir1/file1.new,/dir2/file2,/dir3/file3,@/dir3.new/file3

[Job 3479] Job is queued: snapmirror restore for the relationship with
destination vserverA:primary1
```

Restore the contents of a volume from a SnapMirror destination

You can restore the contents of an entire volume from a Snapshot copy in a SnapMirror destination volume. You can restore the volume's contents to the original source volume or to a different volume.

About this task

The destination volume for the restore operation must be one of the following:

- A read-write volume, in which case SnapMirror performs an *incremental restore*, provided that the source and destination volumes have a common Snapshot copy (as is typically the case when you are restoring to the original source volume).

The command fails if there is not a common Snapshot copy. You cannot restore the contents of a volume to an empty read-write volume.

- An empty data protection volume, in which case SnapMirror performs a *baseline restore*, in which the specified Snapshot copy and all the data blocks it references are transferred to the source volume.

Restoring the contents of a volume is a disruptive operation. SMB traffic must not be running on the SnapVault primary volume when a restore operation is running.

If the destination volume for the restore operation has compression enabled, and the source volume does not have compression enabled, disable compression on the destination volume. You need to re-enable compression after the restore operation is complete.

Any quota rules defined for the destination volume are deactivated before the restore is performed. You can use the `volume quota modify` command to reactivate quota rules after the restore operation is complete.

Steps

1. List the Snapshot copies in the destination volume:

   `volume snapshot show -vserver` *`SVM`* `-volume` *`volume`*

   For complete command syntax, see the man page.

   The following example shows the Snapshot copies on the `vserverB:secondary1` destination:

```
cluster_dst::> volume snapshot show -vserver vserverB -volume secondary1

Vserver     Volume      Snapshot                State    Size  Total%
Used%
-------     ------      ---------- ----------- ------   -----  ------
-----
vserverB    secondary1  hourly.2013-01-25_0005  valid   224KB     0%
0%
                        daily.2013-01-25_0010   valid   92KB      0%
0%
                        hourly.2013-01-25_0105  valid   228KB     0%
0%
                        hourly.2013-01-25_0205  valid   236KB     0%
0%
                        hourly.2013-01-25_0305  valid   244KB     0%
0%
                        hourly.2013-01-25_0405  valid   244KB     0%
0%
                        hourly.2013-01-25_0505  valid   244KB     0%
0%

7 entries were displayed.
```

2. Restore the contents of a volume from a Snapshot copy in a SnapMirror destination volume:

   `snapmirror restore -source-path` *`SVM:volume|cluster://SVM/volume`*`, …`
   `-destination-path` *`SVM:volume|cluster://SVM/volume`*`, … -source-snapshot` *`snapshot`*

   For complete command syntax, see the man page.

   > You must run this command from the destination SVM or the destination cluster.

   The following command restores the contents of the original source volume `primary1` from the Snapshot copy `daily.2013-01-25_0010` in the original destination volume `secondary1`:

```
cluster_dst::> snapmirror restore -source-path vserverB:secondary1
-destination-path vserverA:primary1 -source-snapshot daily.2013-01-
25_0010

Warning: All data newer than Snapshot copy daily.2013-01-25_0010 on
volume vserverA:primary1 will be deleted.

Do you want to continue? {y|n}: y

[Job 34] Job is queued: snapmirror restore from source
vserverB:secondary1 for the snapshot daily.2013-01-25_0010.
```

3. Remount the restored volume and restart all applications that use the volume.

Other ways to do this in ONTAP

To perform these tasks with…	See this content…
The redesigned System Manager (available with ONTAP 9.7 and later)	Restore a volume from an earlier Snapshot copy
System Manager Classic (available with ONTAP 9.7 and earlier)	Volume restore using SnapVault overview

Update a replication relationship manually

You might need to update a replication relationship manually if an update fails because the source volume has been moved.

About this task

SnapMirror aborts any transfers from a moved source volume until you update the replication relationship manually.

Beginning with ONTAP 9.5, SnapMirror Synchronous relationships are supported. Although the source and destination volumes are in sync at all times in these relationships, the view from the secondary cluster is synchronized with the primary only on an hourly basis. If you want to view the point-in-time data at the destination, you should perform a manual update by running the `snapmirror update` command.

Step

1. Update a replication relationship manually:

   `snapmirror update -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   > You must run this command from the destination SVM or the destination cluster. The command fails if a common Snapshot copy does not exist on the source and destination. Use `snapmirror initialize` to re-initialize the relationship.

   The following example updates the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_src::> snapmirror update -source-path svm1:volA -destination
   -path svm_backup:volA_dst
   ```

Resynchronize a replication relationship

You need to resynchronize a replication relationship after you make a destination volume writeable, after an update fails because a common Snapshot copy does not exist on the source and destination volumes, or if you want to change the replication policy for the relationship.

About this task

- Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours.
- Volumes that are part of a fan-out or cascade configuration can take longer to resynchronize. It is not uncommon to see the SnapMirror relationship reporting the status "preparing" for an extended time period.

Step

1. Resync the source and destination volumes:

   `snapmirror resync -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, … -type DP|XDP -schedule` *`schedule`* `-policy` *`policy`*

   For complete command syntax, see the man page.

   > You must run this command from the destination SVM or the destination cluster.

   The following example resyncs the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

```
cluster_dst::> snapmirror resync -source-path svm1:volA -destination
-path svm_backup:volA_dst
```

Delete a volume replication relationship

You can use the `snapmirror delete` and `snapmirror release` commands to delete a volume replication relationship. You can then delete unneeded destination volumes manually.

About this task

The `snapmirror release` command deletes any SnapMirror-created Snapshot copies from the source. You can use the `-relationship-info-only` option to preserve the Snapshot copies.

Steps

1. Quiesce the replication relationship:

   `snapmirror quiesce -destination-path` *`SVM:volume|cluster://SVM/volume`*

   ```
   cluster_dst::> snapmirror quiesce -destination-path svm_backup:volA_dst
   ```

2. (Optional) Break the replication relationship if you require the destination volume to be a read/write volume. You can skip this step if you plan to delete the destination volume or if you don't need the volume to be read/write:

   `snapmirror break -source-path SVM:volume|cluster://SVM/volume, … -destination -path SVM:volume|cluster://SVM/volume, …`

   ```
   cluster_dst::> snapmirror break -source-path svm1:volA -destination-path
   svm_backup:volA_dst
   ```

3. Delete the replication relationship:

   `snapmirror delete -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   > You must run this command from the destination cluster or destination SVM.

   The following example deletes the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror delete -source-path svm1:volA -destination
   -path svm_backup:volA_dst
   ```

4. Release replication relationship information from the source SVM:

   `snapmirror release -source-path` *`SVM:volume|cluster://SVM/volume`*`, …`
   `-destination-path` *`SVM:volume|cluster://SVM/volume`*`, …`

   For complete command syntax, see the man page.

   > You must run this command from the source cluster or source SVM.

   The following example releases information for the specified replication relationship from the source SVM `svm1`:

   ```
   cluster_src::> snapmirror release -source-path svm1:volA -destination
   -path svm_backup:volA_dst
   ```

Manage storage efficiency

SnapMirror preserves storage efficiency on the source and destination volumes, with one exception, when postprocess data compression is enabled on the destination. In that case, all storage efficiency is lost on the destination. To correct this issue, you need to disable postprocess compression on the destination, update the relationship manually, and re-enable storage efficiency.

What you'll need

- The source and destination clusters and SVMs must be peered.

  Cluster and SVM peering

- You must disable postprocess compression on the destination.

About this task

You can use the `volume efficiency show` command to determine whether efficiency is enabled on a volume. For more information, see the man pages.

You can check if SnapMirror is maintaining storage efficiency by viewing the SnapMirror audit logs and locating the transfer description. If the transfer description displays `transfer_desc=Logical Transfer`, SnapMirror is not maintaining storage efficiency. If the transfer description displays `transfer_desc=Logical Transfer with Storage Efficiency`, SnapMirror is maintaining storage efficiency. For example:

```
Fri May 22 02:13:02 CDT 2020 ScheduledUpdate[May 22 02:12:00]:cc0fbc29-
b665-11e5-a626-00a09860c273 Operation-Uuid=39fbcf48-550a-4282-a906-
df35632c73a1 Group=none Operation-Cookie=0 action=End source=<sourcepath>
destination=<destpath> status=Success bytes_transferred=117080571
network_compression_ratio=1.0:1 transfer_desc=Logical Transfer - Optimized
Directory Mode
```

Logical Transfer with storage

Beginning with ONTAP 9.3, manual update is no longer required to re-enable storage efficiency. If SnapMirror detects that postprocess compression has been disabled, it automatically re-enables storage efficiency at the next scheduled update. Both the source and the destination must be running ONTAP 9.3.

Beginning with ONTAP 9.3, AFF systems manage storage efficiency settings differently from FAS systems after a destination volume is made writeable:

- After you make a destination volume writeable using the `snapmirror break` command, the caching policy on the volume is automatically set to “auto” (the default).

  This behavior is applicable to FlexVol volumes, only, and it does not apply to FlexGroup volumes.

- On resync, the caching policy is automatically set to “none”, and deduplication and inline compression are automatically disabled, regardless of your original settings. You must modify the settings manually as needed.

Manual updates with storage efficiency enabled can be time-consuming. You might want to run the operation in off-peak hours.

Step

1. Update a replication relationship and re-enable storage efficiency:

   `snapmirror update -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, … -enable-storage-efficiency true`

   For complete command syntax, see the man page.

   You must run this command from the destination SVM or the destination cluster. The command fails if a common Snapshot copy does not exist on the source and destination. Use `snapmirror initialize` to re-initialize the relationship.

   The following example updates the relationship between the source volume `volA` on `svm1` and the destination volume `volA_dst` on `svm_backup`, and re-enables storage efficiency:

```
cluster_dst::> snapmirror update -source-path svm1:volA -destination
-path svm_backup:volA_dst -enable-storage-efficiency true
```

Use SnapMirror global throttling

Global network throttling is available for all SnapMirror and SnapVault transfers at a per-node level.

About this task

SnapMirror global throttling restricts the bandwidth used by incoming and/or outgoing SnapMirror and SnapVault transfers. The restriction is enforced cluster wide on all nodes in the cluster.

For example, if the outgoing throttle is set to 100 MBps, each node in the cluster will have the outgoing

bandwidth set to 100 MBps. If global throttling is disabled, it is disabled on all nodes.

Although data transfer rates are often expressed in bits per second (bps), the throttle values must be entered in kilobytes per second (KBps).

> In ONTAP 9.9.1 and earlier releases, the throttle has no effect on `volume move` transfers or load-sharing mirror transfers. Beginning with ONTAP 9.10.0, you can specify an option to throttle a volume move operations. For details, see How to throttle volume move in ONTAP 9.10 and later.

Global throttling works with the per-relationship throttle feature for SnapMirror and SnapVault transfers. The per-relationship throttle is enforced until the combined bandwidth of per-relationship transfers exceeds the value of the global throttle, after which the global throttle is enforced. A throttle value `0` implies that global throttling is disabled.

> SnapMirror global throttling has no effect on SnapMirror Synchronous relationships when they are In-Sync. However, the throttle does effect SnapMirror Synchronous relationships when they perform an asynchronous transfer phase such as an initialization operation or after an Out Of Sync event. For this reason, enabling global throttling with SnapMirror Synchronous relationships is not recommended.

Steps

1. Enable global throttling:

   ```
   options -option-name replication.throttle.enable on|off
   ```

   The following example shows how to enable SnapMirror global throttling on `cluster_dst`:

   ```
   cluster_dst::> options -option-name replication.throttle.enable on
   ```

2. Specify the maximum total bandwidth used by incoming transfers on the destination cluster:

   ```
   options -option-name replication.throttle.incoming.max_kbs KBps
   ```

   The recommended minimum throttle bandwidth is 4 KBps and the maximum is up to 2 TBps. The default value for this option is `unlimited`, which means there is no limit on total bandwidth used.

   The following example shows how to set the maximum total bandwidth used by incoming transfers to 100 Mbps:

   ```
   cluster_dst::> options -option-name
   replication.throttle.incoming.max_kbs 12500
   ```

   > 100 Mbps = 12500 KBps

3. Specify the maximum total bandwidth used by outgoing transfers on the source cluster:

   ```
   options -option-name replication.throttle.outgoing.max_kbs KBps
   ```

KBps is the maximum transfer rate in kilobytes per second. Valid transfer rate values are 1 to 125000. The default value for this option is `unlimited`, which means there is no limit on total bandwidth used.

The following example shows how to set the maximum total bandwidth used by outgoing transfers to 100 Mbps:

```
cluster_src::> options -option-name
replication.throttle.outgoing.max_kbs 12500
```

About SnapMirror SVM replication

You can use SnapMirror to create a data protection relationship between SVMs. In this type of data protection relationship, all or part of the SVM's configuration, from NFS exports and SMB shares to RBAC, is replicated, as well as the data in the volumes that the SVM owns.

Supported relationship types

Only data-serving SVMs can be replicated. The following data protection relationship types are supported:

- *SnapMirror DR,* in which the destination typically contains only the Snapshot copies currently on the source.

  Beginning with ONTAP 9.9.1, this behavior changes when you are using the mirror-vault policy. Beginning with ONTAP 9.9.1, you can create different Snapshot policies on the source and destination, and the Snapshot copies on the destination are not overwritten by Snapshot copies on the source:

  - They are not overwritten from the source to the destination during normal scheduled operations, updates and resync
  - They are not deleted during break operations.
  - They are not deleted during flip-resync operations.
    When you configure an SVM DR relationship using the mirror-vault policy using ONTAP 9.9.1 and later, the policy behaves as follows:
  - User-defined Snapshot copy policies at the source are not copied to the destination.
  - System-defined Snapshot copy policies are not copied to the destination.
  - Volume association with user and system defined Snapshot policies are not copied to the destination.

    SVM.
- Beginning with ONTAP 9.2, *SnapMirror unified replication,* in which the destination is configured for both DR and long-term retention.

Details about these relationship types can be found here: Understanding SnapMirror volume replication.

The *policy type* of the replication policy determines the type of relationship it supports. The following table shows the available policy types.

Policy type	Relationship type

async-mirror	SnapMirror DR
mirror-vault	Unified replication

XDP replaces DP as the SVM replication default in ONTAP 9.4

Beginning with ONTAP 9.4, SVM data protection relationships default to XDP mode. SVM data protection relationships continue to default to DP mode in ONTAP 9.3 and earlier.

Existing relationships are not affected by the new default. If a relationship is already of type DP, it will continue to be of type DP. The following table shows the behavior you can expect.

If you specify…	The type is…	The default policy (if you do not specify a policy) is…
DP	XDP	MirrorAllSnapshots (SnapMirror DR)
Nothing	XDP	MirrorAllSnapshots (SnapMirror DR)
XDP	XDP	MirrorAndVault (Unified replication)

Details about the changes in the default can be found here: XDP replaces DP as the SnapMirror default.

Version-independence is not supported for SVM replication. In an SVM DR configuration, the destination SVM must be on a cluster running the same ONTAP version as the source SVM cluster to support failover and fail back operations.

Compatible ONTAP versions for SnapMirror relationships

How SVM configurations are replicated

The content of an SVM replication relationship is determined by the interaction of the following fields:

- The `-identity-preserve true` option of the `snapmirror create` command replicates the entire SVM configuration.

  The `-identity-preserve false` option replicates only the volumes and authentication and authorization configurations of the SVM, and the protocol and name service settings listed in Configurations replicated in SVM DR relationships.

- The `-discard-configs network` option of the `snapmirror policy create` command excludes LIFs and related network settings from SVM replication, for use in cases where the source and destination SVMs are in different subnets.
- The `-vserver-dr-protection unprotected` option of the `volume modify` command excludes the specified volume from SVM replication.

Otherwise, SVM replication is almost identical to volume replication. You can use virtually the same workflow for SVM replication as you use for volume replication.

Support details

The following table shows support details for SnapMirror SVM replication.

Resource or feature	Support details
Relationship types	• SnapMirror DR • Beginning with ONTAP 9.2, SnapMirror unified replication
Replication scope	Intercluster only. You cannot replicate SVMs in the same cluster.
Version-independence	Not supported.
Deployment types	• Single source to single destination • Beginning with ONTAP 9.4, fan-out. You can fan-out to two destinations only. By default, only one -identity-preserve true relationship is allowed per source SVM.
Autonomous Ransomware Protection	• Supported beginning with ONTAP 9.12.1. For more information, see Autonomous Ransomware Protection
Volume encryption	• Encrypted volumes on the source are encrypted on the destination. • Onboard Key Manager or KMIP servers must be configured on the destination. • New encryption keys are generated at the destination. • If the destination does not contain a node that supports volume .encryption, replication succeeds, but the destination volumes are not encrypted.
FabricPool	Beginning with ONTAP 9.6, SnapMirror SVM replication is supported with FabricPools.

MetroCluster	Beginning with ONTAP 9.11.1, both sides of a SVM DR relationship within a MetroCluster configuration can act as a source for additional SVM DR configurations. Beginning with ONTAP 9.5, SnapMirror SVM replication is supported on MetroCluster configurations. • A MetroCluster configuration cannot be the destination of an SVM DR relationship. • Only an active SVM within a MetroCluster configuration can be the source of an SVM DR relationship. A source can be a sync-source SVM before switchover or a sync-destination SVM after switchover. • When a MetroCluster configuration is in a steady state, the MetroCluster sync-destination SVM cannot be the source of an SVM DR relationship, since the volumes are not online. • When the sync-source SVM is the source of an SVM DR relationship, the source SVM DR relationship information is replicated to the MetroCluster partner. • During the switchover and switchback processes, replication to the SVM DR destination might fail. However, after the switchover or switchback process completes, the next SVM DR scheduled updates will succeed.
ONTAP S3	Not supported with SVM DR.
SnapMirror Synchronous	Not supported with SVM DR.

Configurations replicated in SVM DR relationships

The following table shows the interaction of the `snapmirror create -identity-preserve` option and the `snapmirror policy create -discard-configs network` option:

Configuration replicated		**`-identity-preserve true`**		**`-identity-preserve false`**
		Policy without `-discard-configs network` set	**Policy with `-discard-configs network` set**	

Network	NAS LIFs	Yes	No	No
	LIF Kerberos configuration	Yes	No	No
	SAN LIFs	No	No	No
	Firewall policies	Yes	Yes	No
	Routes	Yes	No	No
	Broadcast domain	No	No	No
	Subnet	No	No	No
	IPspace	No	No	No
SMB	SMB server	Yes	Yes	No
	Local groups and local user	Yes	Yes	Yes
	Privilege	Yes	Yes	Yes
	Shadow copy	Yes	Yes	Yes
	BranchCache	Yes	Yes	Yes
	Server options	Yes	Yes	Yes
	Server security	Yes	Yes	No
	Home directory, share	Yes	Yes	Yes
	Symlink	Yes	Yes	Yes
	Fpolicy policy, Fsecurity policy, and Fsecurity NTFS	Yes	Yes	Yes
	Name mapping and group mapping	Yes	Yes	Yes
	Audit information	Yes	Yes	Yes

NFS	Export policies	Yes	Yes	No
	Export policy rules	Yes	Yes	No
	NFS server	Yes	Yes	No
RBAC	Security certificates	Yes	Yes	No
	Login user, public key, role, and role configuration	Yes	Yes	Yes
	SSL	Yes	Yes	No
Name services	DNS and DNS hosts	Yes	Yes	No
	UNIX user and UNIX group	Yes	Yes	Yes
	Kerberos realm and Kerberos keyblocks	Yes	Yes	No
	LDAP and LDAP client	Yes	Yes	No
	Netgroup	Yes	Yes	No
	NIS	Yes	Yes	No
	Web and web access	Yes	Yes	No
Volume	Object	Yes	Yes	Yes
	Snapshot copies, Snapshot policy, and autodelete policy	Yes	Yes	Yes
	Efficiency policy	Yes	Yes	Yes
	Quota policy and quota policy rule	Yes	Yes	Yes
	Recovery queue	Yes	Yes	Yes

Root volume	Namespace	Yes	Yes	Yes
	User data	No	No	No
	Qtrees	No	No	No
	Quotas	No	No	No
	File-level QoS	No	No	No
	Attributes: state of the root volume, space guarantee, size, autosize, and total number of files	No	No	No
Storage QoS	QoS policy group	Yes	Yes	Yes
Fibre Channel (FC)		No	No	No
iSCSI		No	No	No
LUNs	Object	Yes	Yes	Yes
	igroups	No	No	No
	portsets	No	No	No
	Serial numbers	No	No	No
SNMP	v3 users	Yes	Yes	No

SVM DR storage limits

The following table shows the recommended maximum number of volumes and SVM DR relationships supported per storage object. You should be aware that limits are often platform dependent. Refer to the Hardware Universe to learn the limits for your specific configuration.

Storage object	Limit
SVM	300 Flexible volumes
HA pair	1,000 Flexible Volumes
Cluster	128 SVM DR relationships

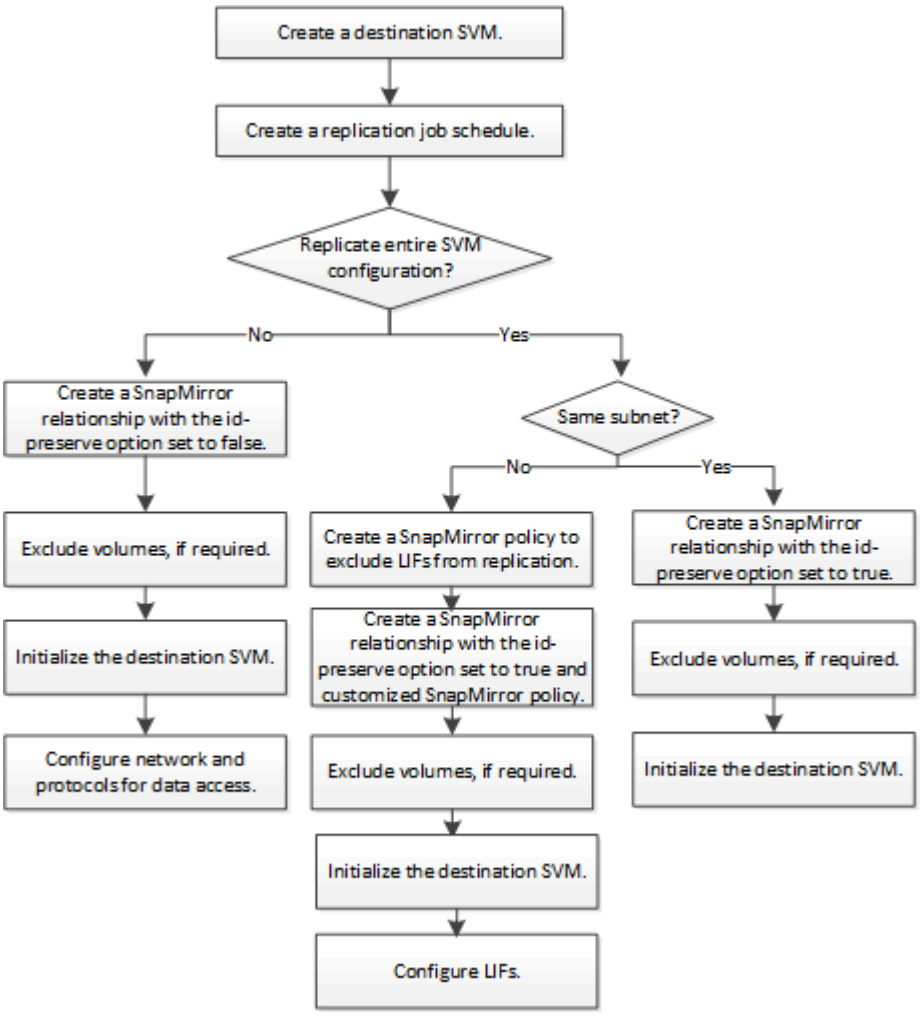
Manage SnapMirror SVM replication

Replicate SVM configurations

SnapMirror SVM replication workflow

SnapMirror SVM replication involves creating the destination SVM, creating a replication job schedule, and creating and initializing a SnapMirror relationship.

This workflow assumes that you are already using a default policy or a custom replication policy.



Criteria for placing volumes on destination SVMs

When replicating volumes from the source SVM to the destination SVM, it's important to know the criteria for selecting aggregates.

Aggregates are selected based on the following criteria:

- Volumes are always placed on non-root aggregates.
- Non-root aggregates are selected based on the available free space and the number of volumes already hosted on the aggregate.

  Aggregates with more free space and fewer volumes are given priority. The aggregate with the highest

priority is selected.

- Source volumes on FabricPool aggregates are placed on FabricPool aggregates on the destination with the same tiering-policy.
- If a volume on the source SVM is located on a Flash Pool aggregate, then the volume is placed on a Flash Pool aggregate on the destination SVM, if such an aggregate exists and has enough free space.
- If the `-space-guarantee` option of the volume that is replicated is set to `volume`, only aggregates with free space greater than the volume size are considered.
- The volume size grows automatically on the destination SVM during replication, based on the source volume size.

  If you want to pre-reserve the size on the destination SVM, you must resize the volume. The volume size does not shrink automatically on the destination SVM based on the source SVM.

If you want to move a volume from one aggregate to another, you can use the `volume move` command on the destination SVM.

Replicate an entire SVM configuration

You can use the `-identity-preserve true` option of the `snapmirror create` command to replicate an entire SVM configuration.

Before you begin

The source and destination clusters and SVMs must be peered.
For more information, see Create a cluster peer relationship and Create an SVM intercluster peer relationship.

For complete command syntax, see the man page.

About this task

This workflow assumes that you are already using a default policy or a custom replication policy.

Beginning with ONTAP 9.9.1, when you use the mirror-vault policy, you can create different Snapshot policies on the source and destination SVM, and the Snapshot copies on the destination are not overwritten by Snapshot copies on the source. For more information, see Understanding SnapMirror SVM replication.

Steps

1. Create a destination SVM:

   `vserver create -vserver` *`SVM_name`* `-subtype dp-destination`

   The SVM name must be unique across the source and destination clusters.

   The following example creates a destination SVM named `svm_backup`:

   ```
   cluster_dst:> vserver create -vserver svm_backup -subtype dp-destination
   ```

2. From the destination cluster, create an SVM peer relationship using the `vserver peer create` command.

   For more information, see Create an SVM intercluster peer relationship.

3. Create a replication job schedule:

   `job schedule cron create -name job_name -month month -dayofweek day_of_week -day day_of_month -hour hour -minute minute`

   For `-month`, `-dayofweek`, and `-hour`, you can specify `all` to run the job every month, day of the week, and hour, respectively.

   > The minimum supported schedule (RPO) for FlexVol volumes in an SVM SnapMirror relationship is 15 minutes. The minimum supported schedule (RPO) for FlexGroup volumes in an SVM SnapMirror relationship is 30 minutes.

   The following example creates a job schedule named `my_weekly` that runs on Saturdays at 3:00 a.m.:

   ```
   cluster_dst::> job schedule cron create -name my_weekly -dayofweek
   saturday -hour 3 -minute 0
   ```

4. From the destination SVM or the destination cluster, create a replication relationship:

   `snapmirror create -source-path SVM_name: -destination-path SVM_name: -type DP|XDP -schedule schedule -policy policy -identity-preserve true`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options.

   The following example creates a SnapMirror DR relationship using the default `MirrorAllSnapshots` policy:

   ```
   cluster_dst::> snapmirror create -source-path svm1: -destination-path
   svm_backup: -type XDP -schedule my_daily -policy MirrorAllSnapshots
   -identity-preserve true
   ```

   The following example creates a unified replication relationship using the default `MirrorAndVault` policy:

   ```
   cluster_dst:> snapmirror create -source-path svm1: -destination-path
   svm_backup: -type XDP -schedule my_daily -policy MirrorAndVault
   -identity-preserve true
   ```

   Assuming you have created a custom policy with the policy type `async-mirror`, the following example creates a SnapMirror DR relationship:

   ```
   cluster_dst::> snapmirror create -source-path svm1: -destination-path
   svm_backup: -type XDP -schedule my_daily -policy my_mirrored -identity
   -preserve true
   ```

Assuming you have created a custom policy with the policy type `mirror-vault`, the following example creates a unified replication relationship:

```
cluster_dst::> snapmirror create -source-path svm1: -destination-path
svm_backup: -type XDP -schedule my_daily -policy my_unified -identity
-preserve true
```

5. Stop the destination SVM:

   `vserver stop`

   `SVM name`

   The following example stops a destination SVM named dvs1:

   ```
   cluster_dst::> vserver stop -vserver dvs1
   ```

6. From the destination SVM or the destination cluster, initialize the SVM replication relationship: +

   `snapmirror initialize -source-path` *`SVM_name`*`: -destination-path` *`SVM_name`*`:`

   The following example initializes the relationship between the source SVM, `svm1`, and the destination SVM, `svm_backup`:

   ```
   cluster_dst::> snapmirror initialize -source-path svm1: -destination
   -path svm_backup:
   ```

Exclude LIFs and related network settings from SVM replication

If the source and destination SVMs are in different subnets, you can use the `-discard -configs network` option of the `snapmirror policy create` command to exclude LIFs and related network settings from SVM replication.

What you'll need

The source and destination clusters and SVMs must be peered.

For more information, see Create a cluster peer relationship and Create an SVM intercluster peer relationship.

About this task

The `-identity-preserve` option of the `snapmirror create` command must be set to `true` when you create the SVM replication relationship.

For complete command syntax, see the man page.

Steps

1. Create a destination SVM:

`vserver create -vserver SVM -subtype dp-destination`

The SVM name must be unique across the source and destination clusters.

The following example creates a destination SVM named `svm_backup`:

```
cluster_dst:> vserver create -vserver svm_backup -subtype dp-destination
```

2. From the destination cluster, create an SVM peer relationship using the `vserver peer create` command.

   For more information, see Create an SVM intercluster peer relationship.

3. Create a job schedule:

   `job schedule cron create -name job_name -month month -dayofweek day_of_week -day day_of_month -hour hour -minute minute`

   For `-month`, `-dayofweek`, and `-hour`, you can specify `all` to run the job every month, day of the week, and hour, respectively.

   > The minimum supported schedule (RPO) for FlexVol volumes in an SVM SnapMirror relationship is 15 minutes. The minimum supported schedule (RPO) for FlexGroup volumes in an SVM SnapMirror relationship is 30 minutes.

   The following example creates a job schedule named `my_weekly` that runs on Saturdays at 3:00 a.m.:

   ```
   cluster_dst::> job schedule cron create -name my_weekly -dayofweek
   "Saturday" -hour 3 -minute 0
   ```

4. Create a custom replication policy:

   `snapmirror policy create -vserver SVM -policy policy -type async-mirror|vault|mirror-vault -comment comment -tries transfer_tries -transfer -priority low|normal -is-network-compression-enabled true|false -discard -configs network`

   For complete command syntax, see the man page.

   The following example creates a custom replication policy for SnapMirror DR that excludes LIFs:

   ```
   cluster_dst::> snapmirror policy create -vserver svm1 -policy
   DR_exclude_LIFs -type async-mirror -discard-configs network
   ```

   The following example creates a custom replication policy for unified replication that excludes LIFs:

```
cluster_dst::> snapmirror policy create -vserver svm1 -policy
unified_exclude_LIFs -type mirror-vault -discard-configs network
```

5. From the destination SVM or the destination cluster, run the following command to create a replication relationship:

   `snapmirror create -source-path SVM: -destination-path SVM: -type DP|XDP -schedule schedule -policy policy -identity-preserve true|false`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the examples below.

   The following example creates a SnapMirror DR relationship that excludes LIFs:

   ```
   cluster_dst::> snapmirror create -source-path svm1: -destination-path
   svm_backup: -type XDP -schedule my_daily -policy DR_exclude_LIFs
   -identity-preserve true
   ```

   The following example creates a SnapMirror unified replication relationship that excludes LIFs:

   ```
   cluster_dst::> snapmirror create -source-path svm1: -destination-path
   svm_backup: -type XDP -schedule my_daily -policy unified_exclude_LIFs
   -identity-preserve true
   ```

6. Stop the destination SVM:

   `vserver stop`

   SVM name

   The following example stops a destination SVM named dvs1:

   ```
   cluster_dst::> vserver stop -vserver dvs1
   ```

7. From the destination SVM or the destination cluster, initialize a replication relationship:

   `snapmirror initialize -source-path SVM: -destination-path SVM:`

   For complete command syntax, see the man page.

   The following example initializes the relationship between the source, `svm1` and the destination, `svm_backup`:

```
cluster_dst::> snapmirror initialize -source-path svm1: -destination
-path svm_backup:
```

After you finish

You must configure the network and protocols on the destination SVM for data access in the event a disaster occurs.

Exclude network, name service, and other settings from SVM replication

You can use the `-identity-preserve false` option of the `snapmirror create` command to replicate only the volumes and security configurations of an SVM. Some protocol and name service settings are also preserved.

What you'll need

The source and destination clusters and SVMs must be peered.

For more information, see Create a cluster peer relationship and Create an SVM intercluster peer relationship.

About this task

For a list of preserved protocol and name service settings, see Configurations replicated in SVM DR relationships.

For complete command syntax, see the man page.

Steps

1. Create a destination SVM:

   `vserver create -vserver` *`SVM`* `-subtype dp-destination`

   The SVM name must be unique across the source and destination clusters.

   The following example creates a destination SVM named `svm_backup`:

   ```
   cluster_dst:> vserver create -vserver svm_backup -subtype dp-destination
   ```

2. From the destination cluster, create an SVM peer relationship using the `vserver peer create` command.

   For more information, see Create an SVM intercluster peer relationship.

3. Create a replication job schedule:

   `job schedule cron create -name` *`job_name`* `-month` *`month`* `-dayofweek` *`day_of_week`* `-day` *`day_of_month`* `-hour` *`hour`* `-minute` *`minute`*

   For `-month`, `-dayofweek`, and `-hour`, you can specify `all` to run the job every month, day of the week, and hour, respectively.

The minimum supported schedule (RPO) for FlexVol volumes in an SVM SnapMirror relationship is 15 minutes. The minimum supported schedule (RPO) for FlexGroup volumes in an SVM SnapMirror relationship is 30 minutes.

The following example creates a job schedule named `my_weekly` that runs on Saturdays at 3:00 a.m.:

```
cluster_dst::> job schedule cron create -name my_weekly -dayofweek
"Saturday" -hour 3 -minute 0
```

4. Create a replication relationship that excludes network, name service, and other configuration settings:

`snapmirror create -source-path` *`SVM`*`: -destination-path` *`SVM`*`: -type DP|XDP -schedule schedule -policy policy -identity-preserve false`

You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the examples below. You must run this command from the destination SVM or the destination cluster.

The following example creates a SnapMirror DR relationship using the default `MirrorAllSnapshots` policy. The relationship excludes network, name service, and other configuration settings from SVM replication:

```
cluster_dst::> snapmirror create -source-path svm1: -destination-path
svm_backup: -type XDP -schedule my_daily -policy MirrorAllSnapshots
-identity-preserve false
```

The following example creates a unified replication relationship using the default `MirrorAndVault` policy. The relationship excludes network, name service, and other configuration settings:

```
cluster_dst:> snapmirror create svm1: -destination-path svm_backup:
-type XDP -schedule my_daily -policy MirrorAndVault -identity-preserve
false
```

Assuming you have created a custom policy with the policy type `async-mirror`, the following example creates a SnapMirror DR relationship. The relationship excludes network, name service, and other configuration settings from SVM replication:

```
cluster_dst::> snapmirror create -source-path svm1: -destination-path
svm_backup: -type XDP -schedule my_daily -policy my_mirrored -identity
-preserve false
```

Assuming you have created a custom policy with the policy type `mirror-vault`, the following example creates a unified replication relationship. The relationship excludes network, name service, and other configuration settings from SVM replication:

```
cluster_dst::> snapmirror create -source-path svm1: -destination-path
svm_backup: -type XDP -schedule my_daily -policy my_unified -identity
-preserve false
```

5. Stop the destination SVM:

   `vserver stop`

   SVM name

   The following example stops a destination SVM named dvs1:

```
destination_cluster::> vserver stop -vserver dvs1
```

6. If you are using SMB, you must also configure an SMB server.

   See SMB only: Creating an SMB server.

7. From the destination SVM or the destination cluster, initialize the SVM replication relationship:

   `snapmirror initialize -source-path` *SVM_name*`: -destination-path` *SVM_name*`:`

After you finish

You must configure the network and protocols on the destination SVM for data access in the event a disaster occurs.

Specify aggregates to use for SVM DR relationships

After a disaster recovery SVM is created, you can use the `aggr-list` option with `vserver modify` command to limit which aggregates are used to host SVM DR destination volumes.

Step

1. Create a destination SVM:

   `vserver create -vserver` *SVM* `-subtype dp-destination`

2. Modify the disaster recovery SVM's aggr-list to limit the aggregates that are used to host the disaster recovery SVM's volume:

   `cluster_dest::> vserver modify -vserver` *SVM* `-aggr-list <comma-separated-list>`

SMB only: Create a SMB server

If the source SVM has an SMB configuration, and you chose to set `identity-preserve` to `false`, you must create a SMB server for the destination SVM. SMB server is required for some SMB configurations, such as shares during initialization of the

SnapMirror relationship.

Steps

1. Start the destination SVM by using the `vserver start` command.

```
destination_cluster::> vserver start -vserver dvs1
[Job 30] Job succeeded: DONE
```

2. Verify that the destination SVM is in the `running` state and subtype is `dp-destination` by using the `vserver show` command.

```
destination_cluster::> vserver show
                                  Admin      Operational Root
Vserver  Type    Subtype          State      State       Volume
Aggregate
-------- ------- ----------       ---------- ----------- ----------
----------
dvs1     data    dp-destination    running    running       -         -
```

3. Create a LIF by using the `network interface create` command.

```
destination_cluster::>network interface create -vserver dvs1 -lif NAS1
-role data -data-protocol cifs -home-node destination_cluster-01 -home
-port a0a-101  -address 192.0.2.128 -netmask 255.255.255.128
```

4. Create a route by using the `network route create` command.

```
destination_cluster::>network route create -vserver dvs1 -destination
0.0.0.0/0
-gateway 192.0.2.1
```

Network management

5. Configure DNS by using the `vserver services dns create` command.

```
destination_cluster::>vserver services dns create -domains
mydomain.example.com -vserver
dvs1 -name-servers 192.0.2.128 -state enabled
```

6. Add the preferred domain controller by using the `vserver cifs domain preferred-dc add` command.

```
destination_cluster::>vserver cifs domain preferred-dc add -vserver dvs1
-preferred-dc
192.0.2.128 -domain mydomain.example.com
```

7. Create the SMB server by using the `vserver cifs create` command.

```
destination_cluster::>vserver cifs create -vserver dvs1 -domain
mydomain.example.com
-cifs-server CIFS1
```

8. Stop the destination SVM by using the `vserver stop` command.

```
destination_cluster::> vserver stop -vserver dvs1
[Job 46] Job succeeded: DONE
```

Exclude volumes from SVM replication

By default, all RW data volumes of the source SVM are replicated. If you do not want to protect all the volumes on the source SVM, you can use the `-vserver-dr -protection unprotected` option of the `volume modify` command to exclude volumes from SVM replication.

Steps

1. Exclude a volume from SVM replication:

   `volume modify -vserver` *`SVM`* `-volume` *`volume`* `-vserver-dr-protection unprotected`

   For complete command syntax, see the man page.

   The following example excludes the volume `volA_src` from SVM replication:

```
cluster_src::> volume modify -vserver SVM1 -volume volA_src -vserver-dr
-protection unprotected
```

   If you later want to include a volume in the SVM replication that you originally excluded, run the following command:

   `volume modify -vserver` *`SVM`* `-volume` *`volume`* `-vserver-dr-protection protected`

   The following example includes the volume `volA_src` in the SVM replication:

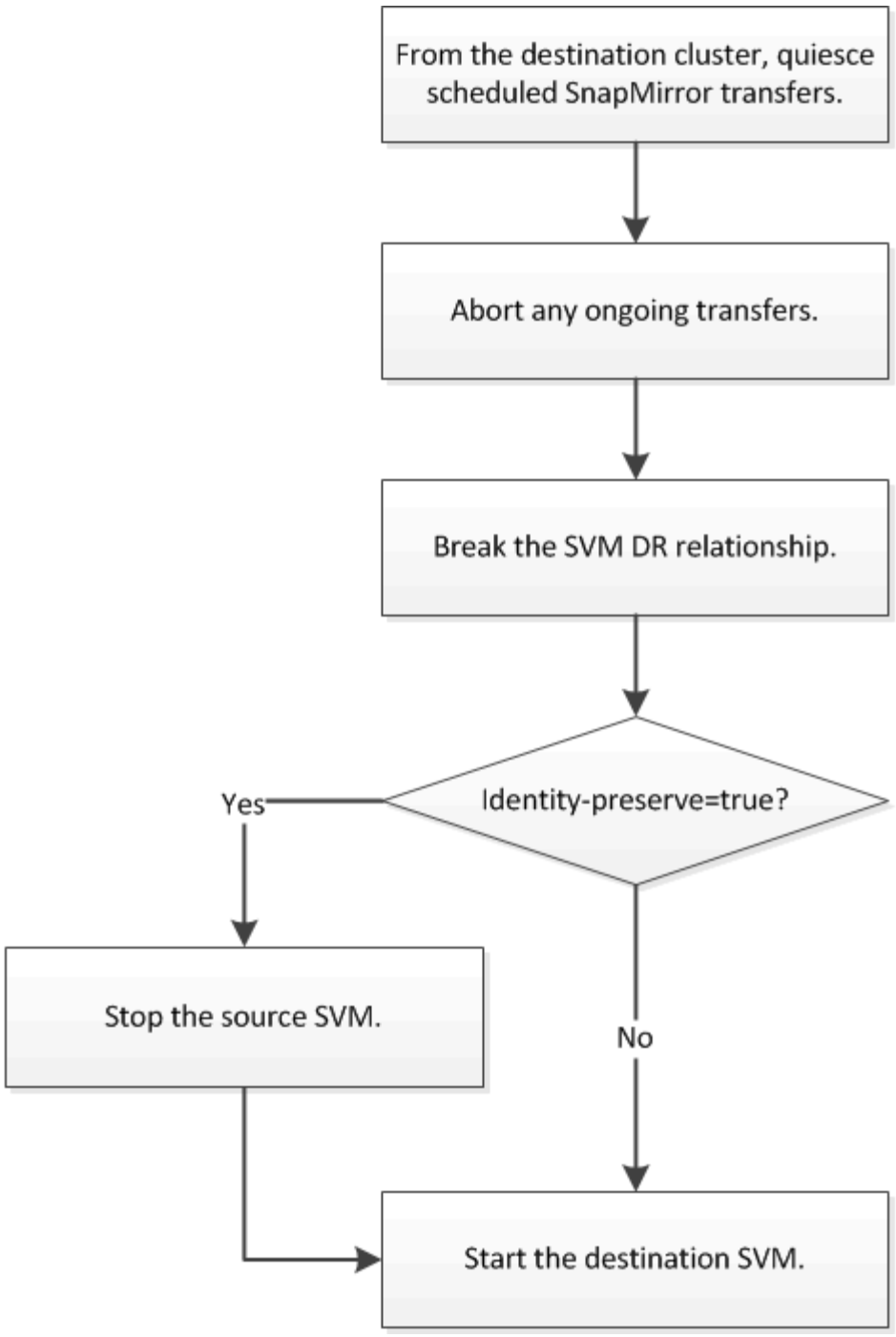
```
cluster_src::> volume modify -vserver SVM1 -volume volA_src -vserver-dr
-protection protected
```

2. Create and initialize the SVM replication relationship as described in Replicating an entire SVM configuration.

Serve data from an SVM DR destination

SVM disaster recovery workflow

To recover from a disaster and serve data from the destination SVM, you must activate the destination SVM. Activating the destination SVM involves stopping scheduled SnapMirror transfers, aborting ongoing SnapMirror transfers, breaking the replication relationship, stopping the source SVM, and starting the destination SVM.



Make SVM destination volumes writeable

You need to make SVM destination volumes writeable before you can serve data to clients. The procedure is largely identical to the procedure for volume replication, with one exception. If you set `-identity-preserve true` when you created the SVM replication relationship, you must stop the source SVM before activating the destination SVM.

About this task

For complete command syntax, see the man page.

In a disaster recovery scenario, you cannot perform a SnapMirror update from the source SVM to the disaster recovery destination SVM because your source SVM and its data will be inaccessible, and because updates since the last resync might be bad or corrupt.

Steps

1. From the destination SVM or the destination cluster, stop scheduled transfers to the destination:

   `snapmirror quiesce -source-path SVM: -destination-path SVM:`

   You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example stops scheduled transfers between the source SVM `svm1` and the destination SVM `svm_backup`:

   ```
   cluster_dst::> snapmirror quiesce -source-path svm1: -destination-path
   svm_backup:
   ```

2. From the destination SVM or the destination cluster, stop ongoing transfers to the destination:

   `snapmirror abort -source-path SVM: -destination-path SVM:`

   You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example stops ongoing transfers between the source SVM `svm1` and the destination SVM `svm_backup`:

   ```
   cluster_dst::> snapmirror abort -source-path svm1: -destination-path
   svm_backup:
   ```

3. From the destination SVM or the destination cluster, break the replication relationship:

   `snapmirror break -source-path SVM: -destination-path SVM:`

   You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example breaks the relationship between the source SVM `svm1` and the destination SVM `svm_backup`:

   ```
   cluster_dst::> snapmirror break -source-path svm1: -destination-path
   svm_backup:
   ```

4. If you set `-identity-preserve true` when you created the SVM replication relationship, stop the

source SVM:

`vserver stop -vserver SVM`

The following example stops the source SVM `svm1`:

```
cluster_src::> vserver stop svm1
```

5. Start the destination SVM:

`vserver start -vserver SVM`

The following example starts the destination SVM `svm_backup`:

```
cluster_dst::> vserver start svm_backup
```

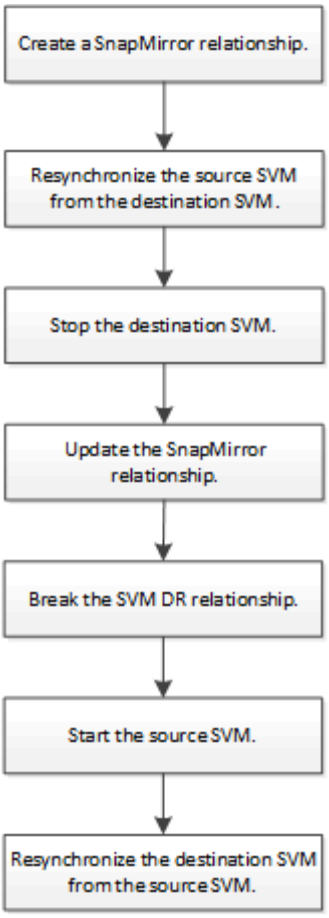
After you finish

Configure SVM destination volumes for data access, as described in Configuring the destination volume for data access.

Reactivate the source SVM

Source SVM reactivation workflow

If the source SVM exists after a disaster, you can reactivate it and protect it by recreating the SVM disaster recovery relationship.



Reactivate the original source SVM

You can reestablish the original data protection relationship between the source and destination SVM when you no longer need to serve data from the destination. The procedure is largely identical to the procedure for volume replication, with one exception. You must stop the destination SVM before reactivating the source SVM.

What you'll need

If you have increased the size of destination volume while serving data from it, before you reactivate the source volume, you should manually increase max-autosize on the original source volume to ensure it can grow sufficiently.

When a destination volume grows automatically

About this task

Beginning with ONTAP 9.11.1, you can reduce resynchronization time during a disaster recovery rehearsal by using the `-quick-resync true` option of the `snapmirror resync` command while performing a reverse resync of an SVM DR relationship. A quick resync can reduce the time it takes to return to production by bypassing the data warehouse rebuild and restore operations.

Quick resync does not preserve the storage efficiency of the destination volumes. Enabling quick resync might increase the volume space used by the destination volumes.

This procedure assumes that the baseline in the original source volume is intact. If the baseline is not intact, you must create and initialize the relationship between the volume you are serving data from and the original

source volume before performing the procedure.

For complete command syntax on commands, see the man page.

Steps

1. From the original source SVM or the original source cluster, create a reverse SVM DR relationship using the same configuration, policy, and identity-preserve setting as the original SVM DR relationship:

   `snapmirror create -source-path SVM: -destination-path SVM:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example creates a relationship between the SVM from which you are serving data, `svm_backup`, and the original source SVM, `svm1`:

   ```
   cluster_src::> snapmirror create -source-path svm_backup: -destination
   -path svm1:
   ```

2. From the original source SVM or the original source cluster, run the following command to reverse the data protection relationship:

   `snapmirror resync -source-path SVM: -destination-path SVM:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours.

   > The command fails if a common Snapshot copy does not exist on the source and destination. Use `snapmirror initialize` to reinitialize the relationship.

   The following example reverses the relationship between the original source SVM, `svm1`, and the SVM from which you are serving data, `svm_backup`:

   ```
   cluster_src::> snapmirror resync -source-path svm_backup: -destination
   -path svm1:
   ```

   Example using -quick-resync option:

   ```
   cluster_src::> snapmirror resync -source-path svm_backup: -destination
   -path svm1: -quick-resync true
   ```

3. When you are ready to reestablish data access to the original source SVM, stop the original destination SVM to disconnect any clients currently connected to the original destination SVM.

`vserver stop -vserver SVM`

The following example stops the original destination SVM which is currently serving data:

```
cluster_dst::> vserver stop svm_backup
```

4. Verify that the original destination SVM is in the stopped state by using the `vserver show` command.

```
cluster_dst::> vserver show
                                 Admin      Operational Root
Vserver        Type    Subtype   State      State       Volume
Aggregate
--------       ------- ---------- ---------- ----------- ----------
----------
svm_backup     data    default   stopped    stopped     rv
aggr1
```

5. From the original source SVM or the original source cluster, run the following command to perform the final update of the reversed relationship to transfer all changes from the original destination SVM to the original source SVM:

`snapmirror update -source-path SVM: -destination-path SVM:`

> You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

The following example updates the relationship between the original destination SVM from which you are serving data,`svm_backup`, and the original source SVM, `svm1`:

```
cluster_src::> snapmirror update -source-path svm_backup: -destination
-path svm1:
```

6. From the original source SVM or the original source cluster, run the following command to stop scheduled transfers for the reversed relationship:

`snapmirror quiesce -source-path SVM: -destination-path SVM:`

> You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

The following example stops scheduled transfers between the SVM you are serving data from, `svm_backup`, and the original SVM, `svm1`:

```
cluster_src::> snapmirror quiesce -source-path svm_backup: -destination
-path svm1:
```

7. When the final update is complete and the relationship indicates "Quiesced" for the relationship status, run the following command from the original source SVM or the original source cluster to break the reversed relationship:

   `snapmirror break -source-path SVM: -destination-path SVM:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example breaks the relationship between the original destination SVM from which you were serving data, `svm_backup`, and the original source SVM, `svm1`:

```
cluster_src::> snapmirror break -source-path svm_backup: -destination
-path svm1:
```

8. If the original source SVM was previously stopped, from the original source cluster, start the original source SVM:

   `vserver start -vserver SVM`

   The following example starts the original source SVM:

```
cluster_src::> vserver start svm1
```

9. From the original destination SVM or the original destination cluster, reestablish the original data protection relationship:

   `snapmirror resync -source-path SVM: -destination-path SVM:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example reestablishes the relationship between the original source SVM, `svm1`, and the original destination SVM, `svm_backup`:

```
cluster_dst::> snapmirror resync -source-path svm1: -destination-path
svm_backup:
```

10. From the original source SVM or the original source cluster, run the following command to delete the reversed data protection relationship:

    `snapmirror delete -source-path SVM: -destination-path SVM:`

You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

The following example deletes the reversed relationship between the original destination SVM, `svm_backup`, and the original source SVM, `svm1`:

```
cluster_src::> snapmirror delete -source-path svm_backup: -destination
-path svm1:
```

11. From the original destination SVM or the original destination cluster, release the reversed data protection relationship:

    `snapmirror release -source-path SVM: -destination-path SVM:`

    You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

    The following example releases the reversed relationship between the original destination SVM, svm_backup, and the original source SVM, `svm1`

```
cluster_dst::> snapmirror release -source-path svm_backup: -destination
-path svm1:
```

After you finish

Use the `snapmirror show` command to verify that the SnapMirror relationship was created. For complete command syntax, see the man page.

Reactivate the original source SVM (FlexGroup volumes only)

You can reestablish the original data protection relationship between the source and destination SVM when you no longer need to serve data from the destination. To reactivate the original source SVM when you are using FlexGroup volumes, you need to perform some additional steps, including deleting the original SVM DR relationship and releasing the original relationship before you reverse the relationship. You also need to release the reversed relationship and recreate the original relationship before stopping scheduled transfers.

Steps

1. From the original destination SVM or the original destination cluster, delete the original SVM DR relationship:

   `snapmirror delete -source-path SVM: -destination-path SVM:`

   You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

The following example deletes the original relationship between the original source SVM, svm1, and the original destination SVM, `svm_backup`:

```
cluster_dst::> snapmirror delete -source-path svm1: -destination-path
svm_backup:
```

2. From the original source SVM or the original source cluster, release the original relationship while keeping the Snapshot copies intact:

   `snapmirror release -source-path SVM: -destination-path SVM: -relationship-info -only true`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination -path` options. See the example below.

   The following example releases the original relationship between the original source SVM, svm1, and the original destination SVM, `svm_backup`.

   ```
   cluster_src::> snapmirror release -source-path svm1: -destination-path
   svm_backup: -relationship-info-only true
   ```

3. From the original source SVM or the original source cluster, create a reverse SVM DR relationship using the same configuration, policy, and identity-preserve setting as the original SVM DR relationship:

   `snapmirror create -source-path SVM: -destination-path SVM:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination -path` options. See the example below.

   The following example creates a relationship between the SVM from which you are serving data, `svm_backup`, and the original source SVM, `svm1`:

   ```
   cluster_src::> snapmirror create -source-path svm_backup: -destination
   -path svm1:
   ```

4. From the original source SVM or the original source cluster, run the following command to reverse the data protection relationship:

   `snapmirror resync -source-path` *`SVM`*`: -destination-path` *`SVM`*`:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination -path` options. See the example below.

   Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours.

The command fails if a common Snapshot copy does not exist on the source and destination. Use `snapmirror initialize` to reinitialize the relationship.

The following example reverses the relationship between the original source SVM, `svm1`, and the SVM from which you are serving data, `svm_backup`:

```
cluster_src::> snapmirror resync -source-path svm_backup: -destination
-path svm1:
```

5. When you are ready to reestablish data access to the original source SVM, stop the original destination SVM to disconnect any clients currently connected to the original destination SVM.

   `vserver stop -vserver` *SVM*

   The following example stops the original destination SVM which is currently serving data:

```
cluster_dst::> vserver stop svm_backup
```

6. Verify that the original destination SVM is in the stopped state by using the `vserver show` command.

```
cluster_dst::> vserver show
                                 Admin      Operational Root
Vserver        Type    Subtype   State      State       Volume
Aggregate
--------       ------- ---------- ---------- ----------- ----------
----------
svm_backup     data    default   stopped    stopped     rv
aggr1
```

7. From the original source SVM or the original source cluster, run the following command to perform the final update of the reversed relationship to transfer all changes from the original destination SVM to the original source SVM:

   `snapmirror update -source-path` *SVM*`:` `-destination-path` *SVM*`:`

   You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example updates the relationship between the original destination SVM from which you are serving data,`svm_backup`, and the original source SVM, `svm1`:

```
cluster_src::> snapmirror update -source-path svm_backup: -destination
-path svm1:
```

8. From the original source SVM or the original source cluster, run the following command to stop scheduled transfers for the reversed relationship:

   `snapmirror quiesce -source-path SVM: -destination-path SVM:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example stops scheduled transfers between the SVM you are serving data from, `svm_backup`, and the original SVM, `svm1`:

   ```
   cluster_src::> snapmirror quiesce -source-path svm_backup: -destination
   -path svm1:
   ```

9. When the final update is complete and the relationship indicates "Quiesced" for the relationship status, run the following command from the original source SVM or the original source cluster to break the reversed relationship:

   `snapmirror break -source-path SVM: -destination-path SVM:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example breaks the relationship between the original destination SVM from which you were serving data, `svm_backup`, and the original source SVM, `svm1`:

   ```
   cluster_src::> snapmirror break -source-path svm_backup: -destination
   -path svm1:
   ```

10. If the original source SVM was previously stopped, from the original source cluster, start the original source SVM:

    `vserver start -vserver SVM`

    The following example starts the original source SVM:

    ```
    cluster_src::> vserver start svm1
    ```

11. From the original source SVM or the original source cluster, delete the reversed SVM DR relationship:

    `snapmirror delete -source-path SVM: -destination-path SVM:`

    > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

    The following example deletes the reversed relationship between the original destination SVM,

svm_backup, and the original source SVM, `svm1`:

```
cluster_src::> snapmirror delete -source-path svm_backup: -destination
-path svm1:
```

12. From the original destination SVM or the original destination cluster, release the reversed relationship while keeping the Snapshot copies intact:

    `snapmirror release -source-path SVM: -destination-path SVM: -relationship-info -only true`

    > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination -path` options. See the example below.

    The following example releases the reversed relationship between the original destination SVM, svm_backup, and the original source SVM, svm1:

    ```
    cluster_dst::> snapmirror release -source-path svm_backup: -destination
    -path svm1: -relationship-info-only true
    ```

13. From the original destination SVM or the original destination cluster, recreate the original relationship. Use the same configuration, policy, and identity-preserve setting as the original SVM DR relationship:

    `snapmirror create -source-path SVM: -destination-path SVM:`

    > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination -path` options. See the example below.

    The following example creates a relationship between the original source SVM, `svm1`, and the original destination SVM, `svm_backup`:

    ```
    cluster_dst::> snapmirror create -source-path svm1: -destination-path
    svm_backup:
    ```

14. From the original destination SVM or the original destination cluster, reestablish the original data protection relationship:

    `snapmirror resync -source-path SVM: -destination-path SVM:`

    > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination -path` options. See the example below.

    The following example reestablishes the relationship between the original source SVM, `svm1`, and the original destination SVM, `svm_backup`:

```
cluster_dst::> snapmirror resync -source-path svm1: -destination-path
svm_backup:
```

Convert volume replication relationships to an SVM replication relationship

You can convert replication relationships between volumes to a replication relationship between the storage virtual machines (SVMs) that own the volumes, provided that each volume on the source (except the root volume) is being replicated, and each volume on the source (including the root volume) has the same name as the volume on the destination.

About this task

Use the `volume rename` command when the SnapMirror relationship is idle to rename destination volumes if necessary.

Steps

1. From the destination SVM or the destination cluster, run the following command to resync the source and destination volumes:

   `snapmirror resync -source-path` *`SVM:volume`* `-destination-path` *`SVM:volume`* `-type DP|XDP -schedule` *`schedule`* `-policy` *`policy`*

   For complete command syntax, see the man page.

   > Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours.

   The following example resyncs the relationship between the source volume `volA` on `svm1` and the destination volume `volA` on `svm_backup`:

   ```
   cluster_dst::> snapmirror resync -source-path svm1:volA -destination
   -path svm_backup:volA
   ```

2. Create an SVM replication relationship between the source and destination SVMs, as described in Replicating SVM configurations.

   You must use the `-identity-preserve true` option of the `snapmirror create` command when you create your replication relationship.

3. Stop the destination SVM:

   `vserver stop -vserver` *`SVM`*

   For complete command syntax, see the man page.

   The following example stops the destination SVM `svm_backup`:

```
cluster_dst::> vserver stop svm_backup
```

4. From the destination SVM or the destination cluster, run the following command to resync the source and destination SVMs:

   `snapmirror resync -source-path SVM: -destination-path SVM: -type DP|XDP -schedule schedule -policy policy`

   For complete command syntax, see the man page.

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.
   >
   > Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours.

   The following example resyncs the relationship between the source SVM `svm1` and the destination SVM `svm_backup`:

```
cluster_dst::> snapmirror resync -source-path svm1: -destination-path
svm_backup:
```

Delete an SVM replication relationship

You can use the `snapmirror delete` and `snapmirror release` commands to delete an SVM replication relationship. You can then delete unneeded destination volumes manually.

About this task

The `snapmirror release` command deletes any SnapMirror-created Snapshot copies from the source. You can use the `-relationship-info-only` option to preserve the Snapshot copies.

For complete command syntax on commands, see the man page.

Steps

1. Run the following command from the destination SVM or the destination cluster to break the replication relationship:

   `snapmirror break -source-path SVM: -destination-path SVM:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example breaks the relationship between the source SVM `svm1` and the destination SVM `svm_backup`:

```
cluster_dst::> snapmirror break -source-path svm1: -destination-path
svm_backup:
```

2. Run the following command from the destination SVM or the destination cluster to delete the replication relationship:

   `snapmirror delete -source-path` *SVM*`: -destination-path` *SVM*`:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example deletes the relationship between the source SVM `svm1` and the destination SVM `svm_backup`:

```
cluster_dst::> snapmirror delete -source-path svm1: -destination-path
svm_backup:
```

3. Run the following command from the source cluster or source SVM to release the replication relationship information from the source SVM:

   `snapmirror release -source-path` *SVM*`: -destination-path` *SVM*`:`

   > You must enter a colon (:) after the SVM name in the `-source-path` and `-destination-path` options. See the example below.

   The following example releases information for the specified replication relationship from the source SVM `svm1`:

```
cluster_src::> snapmirror release -source-path svm1: -destination-path
svm_backup:
```

Manage SnapMirror root volume replication

Manage SnapMirror root volume replication overview

Every SVM in a NAS environment has a unique namespace. The SVM *root volume,* containing operating system and related information, is the entry point to the namespace hierarchy. To ensure that data remains accessible to clients in the event of a node outage or failover, you should create a load-sharing mirror copy of the SVM root volume.

The main purpose of load-sharing mirrors for SVM root volumes is no longer for load sharing; instead, their purpose is for disaster recovery.

- If the root volume is temporarily unavailable, the load-sharing mirror automatically provides read-only access to root volume data.

- If the root volume is permanently unavailable, you can promote one of the load-sharing volumes to provide write access to root volume data.

Create and initializing load-sharing mirror relationships

You should create a load-sharing mirror (LSM) for each SVM root volume that serves NAS data in the cluster. You can create the LSM on any node other than the one containing the root volume, such as the partner node in an HA pair, or preferably in a different HA pair. For a two-node cluster, you should create the LSM on the partner of the node with the SVM root volume.

About this task

If you create an LSM on the same node, and the node is unavailable, you have a single point of failure, and you do not have a second copy to ensure the data remains accessible to clients. But when you create the LSM on a node other than the one containing the root volume, or on a different HA pair, your data is still accessible in the event of an outage.

For example, in a four-node cluster with a root volume on three nodes:

- For the root volume on HA 1 node 1, create the LSM on HA 2 node 1 or HA 2 node 2.
- For the root volume on HA 1 node 2, create the LSM on HA 2 node 1 or HA 2 node 2.
- For the root volume on HA 2 node 1, create the LSM on HA 1 node 1 or HA 1 node 2.

Steps

1. Create a destination volume for the LSM:

   `volume create -vserver` *`SVM`* `-volume volume -aggregate` *`aggregate`* `-type DP -size size`

   The destination volume should be the same or greater in size than the root volume.

   It is a best practice to name the root and destination volume with suffixes, such as `_root` and `_m1`.

   For complete command syntax, see the man page.

   The following example creates a load-sharing mirror volume for the root volume `svm1_root` in `cluster_src`:

   ```
   cluster_src:> volume create -vserver svm1 -volume svm1_m1 -aggregate
   aggr_1 -size 1gb -state online -type DP
   ```

2. Create a replication job schedule, as described in Creating a replication job schedule.
3. Create a load-sharing mirror relationship between the SVM root volume and the destination volume for the LSM:

   `snapmirror create -source-path` *`SVM:volume|cluster://SVM/volume`* `-destination -path` *`SVM:volume|cluster://SVM/volume`* `-type LS -schedule` *`schedule`*

   For complete command syntax, see the man page.

The following example creates a load-sharing mirror relationship between the root volume `svm1_root` and the load-sharing mirror volume `svm1_m1`:

```
cluster_src::> snapmirror create -source-path svm1:svm1_root
-destination-path svm1:svm1_m1 -type LS -schedule hourly
```

The type attribute of the load-sharing mirror changes from `DP` to `LS`.

4. Initialize the load-sharing mirror:

   `snapmirror initialize-ls-set -source-path` *`SVM:volume|cluster://SVM/volume`*

   Initialization can be time-consuming. You might want to run the baseline transfer in off-peak hours.

   For complete command syntax, see the man page.

   The following example initializes the load-sharing mirror for the root volume `svm1_root`:

   ```
   cluster_src::> snapmirror initialize-ls-set -source-path svm1:svm1_root
   ```

Update a load-sharing mirror relationship

Load-sharing mirror (LSM) relationships are updated automatically for SVM root volumes after a volume in the SVM is mounted or unmounted, and during `volume create` operations that include the `junction-path`option. You can manually update a LSM relationship if you want it updated before the next scheduled update.

Load-sharing mirror relationships update automatically in the following circumstances:

- It's time for a scheduled update
- A mount or unmount operation is performed on a volume in the SVM root volume
- A `volume create` command is issued that includes the `juntion-path` option

Step

1. Update a load-sharing mirror relationship manually:

   `snapmirror update-ls-set -source-path` *`SVM:volume|cluster://SVM/volume`*

   The following example updates the load-sharing mirror relationship for the root volume `svm1_root`:

   ```
   cluster_src::> snapmirror update-ls-set -source-path svm1:svm1_root
   ```

Promote a load-sharing mirror

If a root volume is permanently unavailable, you can promote the load-sharing mirror

(LSM) volume to provide write access to root volume data.

What you'll need

You must use advanced privilege level commands for this task.

Steps

1. Change to advanced privilege level:

   ```
   set -privilege advanced
   ```

2. Promote an LSM volume:

   ```
   snapmirror promote -destination-path SVM:volume|cluster://SVM/volume
   ```

   For complete command syntax, see the man page.

   The following example promotes the volume `svm1_m2` as the new SVM root volume:

   ```
   cluster_src::*> snapmirror promote -destination-path svm1:svm1_m2

   Warning: Promote will delete the offline read-write volume
            cluster_src://svm1/svm1_root and replace it with
            cluster_src://svm1/svm1_m2. Because the volume is offline,
            it is not possible to determine whether this promote will
            affect other relationships associated with this source.
   Do you want to continue? {y|n}: y
   ```

   Enter `y`. ONTAP makes the LSM volume a read/write volume, and deletes the original root volume if it is accessible.

   > The promoted root volume might not have all of the data that was in the original root volume if the last update did not occur recently.

3. Return to admin privilege level:

   ```
   set -privilege admin
   ```

4. Rename the promoted volume following the naming convention you used for the root volume:

   ```
   volume rename -vserver SVM -volume volume -newname new_name
   ```

   The following example renames the promoted volume `svm1_m2` with the name `svm1_root`:

   ```
   cluster_src::> volume rename -vserver svm11 -volume svm1_m2 -newname
   svm1_root
   ```

5. Protect the renamed root volume, as described in step 3 through step 4 in Creating and initializing load-sharing mirror relationships.

SnapMirror technical details

Use path name pattern matching

You can use pattern matching to specify the source and destination paths in `snapmirror` commands.

`snapmirror` commands use fully qualified path names in the following format: `vserver:volume`. You can abbreviate the path name by not entering the SVM name. If you do this, the `snapmirror` command assumes the local SVM context of the user.

Assuming that the SVM is called “vserver1” and the volume is called “vol1”, the fully qualified path name is `vserver1:vol1`.

You can use the asterisk (*) in paths as a wildcard to select matching, fully qualified path names. The following table provides examples of using the wildcard to select a range of volumes.

`*`	Matches all paths.
`vs*`	Matches all SVMs and volumes with SVM names beginning with `vs`.
`:*src`	Matches all SVMs with volume names containing the `src` text.
`:vol`	Matches all SVMs with volume names beginning with `vol`.

```
vs1::> snapmirror show -destination-path *:*dest*

Progress
Source              Destination  Mirror        Relationship  Total
Last
Path          Type  Path         State         Status        Progress
Healthy Updated
------------ ---- ------------ ------------- -------------- ----------
------- --------
vs1:sm_src2
              DP   vs2:sm_dest1
                                 Snapmirrored  Idle           -
true    -
```

Use extended queries to act on many SnapMirror relationships

You can use *extended queries* to perform SnapMirror operations on many SnapMirror relationships at one time. For example, you might have multiple uninitialized SnapMirror

relationships that you want to initialize using one command.

About this task

You can apply extended queries to the following SnapMirror operations:

- Initializing uninitialized relationships
- Resuming quiesced relationships
- Resynchronizing broken relationships
- Updating idle relationships
- Aborting relationship data transfers

Step

1. Perform a SnapMirror operation on many relationships:

   snapmirror command {-state state } *

   The following command initializes SnapMirror relationships that are in an `Uninitialized` state:

   ```
   vs1::> snapmirror initialize {-state Uninitialized} *
   ```

Ensure a common Snapshot copy in a mirror-vault deployment

You can use the `snapmirror snapshot-owner create` command to preserve a labeled Snapshot copy on the secondary in a mirror-vault deployment. Doing so ensures that a common Snapshot copy exists for the update of the vault relationship.

About this task

If you use a combination mirror-vault fan-out or cascade deployment, you should keep in mind that updates will fail if a common Snapshot copy does not exist on the source and destination volumes.

This is never an issue for the mirror relationship in a mirror-vault fan-out or cascade deployment, since SnapMirror always creates a Snapshot copy of the source volume before it performs the update.

It might be an issue for the vault relationship, however, since SnapMirror does not create a Snapshot copy of the source volume when it updates a vault relationship. You need to use the `snapmirror snapshot-owner create` to ensure that there is at least one common Snapshot copy on both the source and destination of the vault relationship.

Steps

1. On the source volume, assign an owner to the labeled Snapshot copy you want to preserve:

   `snapmirror snapshot-owner create -vserver` *SVM* `-volume` *volume* `-snapshot` *snapshot* `-owner` *owner*

   The following example assigns `ApplicationA` as the owner of the `snap1` Snapshot copy:

```
clust1::> snapmirror snapshot-owner create -vserver vs1 -volume vol1
-snapshot snap1 -owner ApplicationA
```

2. Update the mirror relationship, as described in Updating a replication relationship manually.

   Alternatively, you can wait for the scheduled update of the mirror relationship.

3. Transfer the labeled Snapshot copy to the vault destination:

   `snapmirror update -source-path` *`SVM:volume|cluster://SVM/volume`*`, … -destination -path` *`SVM:volume|cluster://SVM/volume`*`, … -source-snapshot snapshot`

   For complete command syntax, see the man page.

   The following example transfers the `snap1` Snapshot copy

   ```
   clust1::> snapmirror update -vserver vs1 -volume vol1
   -source-snapshot snap1
   ```

   The labeled Snapshot copy will be preserved when the vault relationship is updated.

4. On the source volume, remove the owner from the labeled Snapshot copy:

   `snapmirror snapshot-owner delete -vserver` *`SVM`* `-volume` *`volume`* `-snapshot` *`snapshot`* `-owner` *`owner`*

   The following examples removes `ApplicationA` as the owner of the `snap1` Snapshot copy:

   ```
   clust1::> snapmirror snapshot-owner delete -vserver vs1 -volume vol1
   -snapshot snap1 -owner ApplicationA
   ```

Compatible ONTAP versions for SnapMirror relationships

You should verify that the source and destination volumes are running compatible ONTAP versions before creating a SnapMirror data protection relationship.

Version-independence is not supported for SVM replication.

Unified replication relationships

For SnapMirror relationships of type “XDP”, using on premises or Cloud Volumes ONTAP releases:

Beginning with ONTAP 9.9.0:

- ONTAP 9.x.0 releases are cloud-only releases and support Cloud Volumes ONTAP (CVO) systems. The asterisk (*) after the release version indicates a cloud-only release.
- ONTAP 9.x.1 releases are general releases and support both on-premises and CVO systems.

Interoperability is bidirectional.

Interoperability for ONTAP version 9.3 and later

ONTAP version …	Interoperates with these previous ONTAP versions…																
	9.14.0*	9.13.1	9.13.0*	9.12.1	9.12.0*	9.11.1	9.11.0*	9.10.1	9.10.0*	9.9.1	9.9.0*	9.8	9.7	9.6	9.5	9.4	9.3
9.14.0*	**Yes**	**Yes**	No	**Yes**	No	**Yes**	No	**Yes**	No	**Yes**	No	**Yes**	No	No	No	No	No
9.13.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No	No	No	No
9.13.0*	No	**Yes**	**Yes**	**Yes**	No	**Yes**	No	**Yes**	No	**Yes**	No	**Yes**	No	No	No	No	No
9.12.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No	No	No
9.12.0*	No	**Yes**	No	**Yes**	**Yes**	**Yes**	No	**Yes**	No	**Yes**	No	**Yes**	**Yes**	No	No	No	No
9.11.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No	No
9.11.0*	No	**Yes**	No	**Yes**	No	**Yes**	**Yes**	**Yes**	No	**Yes**	No	**Yes**	**Yes**	**Yes**	No	No	No
9.10.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	n/a	n/a	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No
9.10.0*	No	**Yes**	No	**Yes**	No	**Yes**	No	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**	**Yes**	No	No
9.9.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No
9.9.0*	No	**Yes**	No	**Yes**	No	**Yes**	No	**Yes**	n/a	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No
9.8	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**
9.7	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**
9.6	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**
9.5	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

9.4	No	No	No	No	No	No	No	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**
9.3	No	No	No	No	No	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

SnapMirror Synchronous relationships

SnapMirror Synchronous is not supported for ONTAP cloud instances.

ONTAP version …	Interoperates with these previous ONTAP versions…								
	9.13.1	9.12.1	9.11.1	9.10.1	9.9.1	9.8	9.7	9.6	9.5
9.13.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No
9.12.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No
9.11.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No	No	No
9.10.1	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No	No
9.9.1	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	No
9.8	No	**Yes**	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No
9.7	No	**Yes**	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
9.6	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**
9.5	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**

SnapMirror SVM disaster recovery relationships

For SVM disaster recovery data and SVM protection:

SVM disaster recovery is only supported between clusters running the same version of ONTAP.

For SVM disaster recovery for SVM migration:

- Replication is supported in a single direction from an earlier version of ONTAP on the source to the same or later version of ONTAP on the destination; for example, from ONTAP 9.11.1 to ONTAP 9.12.1.
- The ONTAP version on the target cluster must be no more than 2 versions newer, as shown in the table below.
- Replication is not supported for long-term data protection use cases.

The asterisk (*) after the release version indicates a cloud-only release.

Source	Destination																
	9.3	9.4	9.5	9.6	9.7	9.8	9.9.0*	9.9.1	9.10.0*	9.10.1	9.11.0*	9.11.1	9.12.0*	9.12.1	9.13.0*	9.13.1	9.14.0*
9.3	Yes	Yes	Yes														
9.4		Yes	Yes	Yes													

9.5			Yes	Yes	Yes											
9.6				Yes	Yes	Yes										
9.7					Yes	Yes	Yes									
9.8						Yes	Yes	Yes								
9.9.0*							Yes	Yes	Yes							
9.9.1								Yes	Yes	Yes						
9.10.0*									Yes	Yes	Yes					
9.10.1										Yes	Yes	Yes				
9.11.0*											Yes	Yes	Yes			
9.11.1												Yes	Yes	Yes		
9.12.0*													Yes	Yes	Yes	
9.12.1														Yes	Yes	Yes
9.13.0*															Yes	Yes	Yes
9.13.1																Yes	Yes
9.14.0*																	Yes

SnapMirror disaster recovery relationships

For SnapMirror relationships of type “DP” and policy type “async-mirror”:

DP-type mirrors cannot be initialized beginning with ONTAP 9.11.1 and are completely deprecated in ONTAP 9.12.1. For more information, see Deprecation of data protection SnapMirror relationships.

In the following table, the column on the left indicates the ONTAP version on the source volume, and the top row indicates the ONTAP versions you can have on your destination volume.

Source	Destination											
	9.11.1	9.10.1	9.9.1	9.8	9.7	9.6	9.5	9.4	9.3	9.2	9.1	9
9.11.1	Yes	No	No	No	No	No	No	No	No	No	No	No
9.10.1	Yes	Yes	No	No	No	No	No	No	No	No	No	No

9.9.1	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
9.8	No	Yes	Yes	Yes	No	No	No	No	No	No	No	No
9.7	No	No	Yes	Yes	Yes	No	No	No	No	No	No	No
9.6	No	No	No	Yes	Yes	Yes	No	No	No	No	No	No
9.5	No	No	No	No	Yes	Yes	Yes	No	No	No	No	No
9.4	No	No	No	No	No	Yes	Yes	Yes	No	No	No	No
9.3	No	No	No	No	No	No	Yes	Yes	Yes	No	No	No
9.2	No	No	No	No	No	No	No	Yes	Yes	Yes	No	No
9.1	No	No	No	No	No	No	No	No	Yes	Yes	Yes	No
9	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes

Interoperability is not bidirectional.

SnapMirror limitations

You should be aware of basic SnapMirror limitations before creating a data protection relationship.

- A destination volume can have only one source volume.

  A source volume can have multiple destination volumes. The destination volume can be the source volume for any type of SnapMirror replication relationship.

- Depending on the array model, you can fan out a maximum of eight or sixteen destination volumes from a single source volume. See the Hardware Universe to learn details for your specific configuration.
- You cannot restore files to the destination of a SnapMirror DR relationship.
- Source or destination SnapVault volumes cannot be 32-bit.
- The source volume for a SnapVault relationship should not be a FlexClone volume.

  The relationship will work, but the efficiency offered by FlexClone volumes will not be preserved.

Archive and compliance using SnapLock technology

What SnapLock is

SnapLock is a high-performance compliance solution for organizations that use WORM storage to retain files in unmodified form for regulatory and governance purposes.

SnapLock helps to prevent deletion, change, or renaming of data to meet regulations such as SEC 17a-4, HIPAA, FINRA, CFTC, and GDPR. With SnapLock, you can create special-purpose volumes in which files can be stored and committed to a non-erasable, non-writable state either for a designated retention period or indefinitely. SnapLock allows this retention to be performed at the file level through standard open file protocols

such as CIFS and NFS. The supported open file protocols for SnapLock are NFS (versions 2, 3, and 4) and CIFS (SMB 1.0, 2.0, and 3.0).

Using SnapLock, you commit files and Snapshot copies to WORM storage, and set retention periods for WORM-protected data. SnapLock WORM storage uses NetApp Snapshot technology and can leverage SnapMirror replication, and SnapVault backups as the base technology for providing backup recovery protection for data.
Learn more about WORM storage: Compliant WORM storage using NetApp SnapLock - TR-4526.

You can use an application to commit files to WORM over NFS or CIFS, or use the SnapLock autocommit feature to commit files to WORM automatically. You can use a *WORM appendable file* to retain data that is written incrementally, like log information. For more information see Use volume append mode to create WORM appendable files.

SnapLock supports data protection methods that should satisfy most compliance requirements:

- You can use SnapLock for SnapVault to WORM-protect Snapshot copies on secondary storage. See Commit Snapshot copies to WORM.
- You can use SnapMirror to replicate WORM files to another geographic location for disaster recovery. See Mirror WORM files.

SnapLock is a license-based feature of NetApp ONTAP. A single license entitles you to use SnapLock in strict Compliance mode, to satisfy external mandates like SEC Rule 17a-4, and a looser Enterprise mode, to meet internally mandated regulations for the protection of digital assets. SnapLock licenses are part of the Security and Compliance bundle.

SnapLock is supported on all AFF and FAS systems as well as ONTAP Select. SnapLock is not a software-only solution; it is an integrated hardware and software solution. This distinction is important for strict WORM regulations such as SEC 17a-4, which requires an integrated hardware and software solution. For more information, refer to SEC Interpretation: Electronic Storage of Broker-Dealer Records.

What you can do with SnapLock

After you configure SnapLock, you can complete the following tasks:

- Commit files to WORM
- Commit Snapshot copies to WORM for secondary storage
- Mirror WORM files for disaster recovery
- Retain WORM files during litigation using Legal Hold
- Delete WORM files using the privileged delete feature
- Set the file retention period
- Move a SnapLock volume
- Lock a Snapshot copy for protection against ransomware attacks
- Review SnapLock use with the Audit Log
- Use SnapLock APIs

SnapLock Compliance and Enterprise modes

SnapLock Compliance and Enterprise modes differ mainly in the level at which each mode protects WORM files:

SnapLock mode	Protection level	WORM file deleting during retention
Compliance mode	At the file level	Cannot be deleted
Enterprise mode	At the disk level	Can be deleted by the compliance administrator using an audited “privileged delete” procedure

After the retention period has elapsed, you are responsible for deleting any files you no longer need. Once a file has been committed to WORM, whether under Compliance or Enterprise mode, it cannot be modified, even after the retention period has expired.

You cannot move a WORM file during or after the retention period. You can copy a WORM file, but the copy will not retain its WORM characteristics.

The following table shows the differences in capabilities supported by SnapLock Compliance and Enterprise modes:

Capability	SnapLock Compliance	SnapLock Enterprise
Enable and delete files using privileged delete	No	Yes
Reinitialize disks	No	Yes
Destroy SnapLock aggregates and volumes during retention period	No	Yes, with the exception of the SnapLock audit log volume
Rename aggregates or volumes	No	Yes
Use non-NetApp disks	No	Yes (with FlexArray Virtualization)
Use the SnapLock volume for audit logging	Yes	Yes, beginning with ONTAP 9.5

Supported and unsupported features with SnapLock

The following table shows the features that are supported with SnapLock Compliance mode, SnapLock Enterprise mode, or both:

Feature	Supported with SnapLock Compliance	Supported with SnapLock Enterprise
Consistency Groups	No	No
Encrypted volumes	Yes, beginning with ONTAP 9.2. Learn more about Encryption and SnapLock.	Yes, beginning with ONTAP 9.2. Learn more about Encryption and SnapLock.

FabricPools on SnapLock aggregates	No	Yes, beginning with ONTAP 9.8. Learn more about FabricPool on SnapLock Enterprise aggregates.
Flash Pool aggregates	Yes, beginning with ONTAP 9.1.	Yes, beginning with ONTAP 9.1.
FlexClone	You can clone SnapLock volumes, but you cannot clone files on a SnapLock volume.	You can clone SnapLock volumes, but you cannot clone files on a SnapLock volume.
FlexGroup volumes	Yes, beginning with ONTAP 9.11.1. Learn more about FlexGroup volumes.	Yes, beginning with ONTAP 9.11.1. Learn more about FlexGroup volumes.
LUNs	No. Learn more about LUN support with SnapLock.	No. Learn more about LUN support with SnapLock.
MetroCluster configurations	Yes, beginning with ONTAP 9.3. Learn more about MetroCluster support.	Yes, beginning with ONTAP 9.3. Learn more about MetroCluster support.
Multi-admin verification (MAV)	Yes, beginning with ONTAP 9.13.1. Learn more about MAV support.	Yes, beginning with ONTAP 9.13.1. Learn more about MAV support.
SAN	No	No
Single-file SnapRestore	No	Yes
SnapMirror Business Continuity	No	No
SnapRestore	No	Yes
SMTape	No	No
SnapMirror Synchronous	No	No
SSDs	Yes, beginning with ONTAP 9.1.	Yes, beginning with ONTAP 9.1.
Storage efficiency features	Yes, beginning with ONTAP 9.9.1. Learn more about storage efficiency support.	Yes, beginning with ONTAP 9.9.1. Learn more about storage efficiency support.

FabricPool on SnapLock Enterprise aggregates

FabricPools are supported on SnapLock Enterprise aggregates beginning with ONTAP 9.8. However, your account team needs to open a product variance request documenting that you understand that FabricPool data tiered to a public or private cloud is no longer protected by SnapLock because a cloud admin can delete that

data.

> Any data that FabricPool tiers to a public or private cloud is no longer protected by SnapLock because that data can be deleted by a cloud administrator.

FlexGroup volumes

SnapLock supports FlexGroup volumes beginning with ONTAP 9.11.1; however, the following features are not supported:

- Legal-hold
- Event-based retention
- SnapLock for SnapVault (supported beginning with ONTAP 9.12.1)

You should also be aware of the following behaviors:

- The volume compliance clock (VCC) of a FlexGroup volume is determined by the VCC of the root constituent. All non-root constituents will have their VCC closely synced to the root VCC.
- SnapLock configuration properties are set only on the FlexGroup as a whole. Individual constituents cannot have different configuration properties, such as default retention time and autocommit period.

LUN support

LUNs are supported in SnapLock volumes only in scenarios where Snapshot copies created on a non-SnapLock volume are transferred to a SnapLock volume for protection as part of SnapLock vault relationship. LUNs are not supported in read/write SnapLock volumes. Tamperproof Snapshot copies however are supported on both SnapMirror source volumes and destination volumes that contain LUNs.

MetroCluster support

SnapLock support in MetroCluster configurations differs between SnapLock Compliance mode and SnapLock Enterprise mode.

SnapLock Compliance

- Beginning with ONTAP 9.3, SnapLock Compliance is supported on unmirrored MetroCluster aggregates.
- Beginning with ONTAP 9.3, SnapLock Compliance is supported on mirrored aggregates, but only if the aggregate is used to host SnapLock audit log volumes.
- SVM-specific SnapLock configurations can be replicated to primary and secondary sites using MetroCluster.

SnapLock Enterprise

- Beginning with ONTAP 9, SnapLock Enterprise aggregates are supported.
- Beginning with ONTAP 9.3, SnapLock Enterprise aggregates with privileged delete are supported.
- SVM-specific SnapLock configurations can be replicated to both sites using MetroCluster.

MetroCluster configurations and compliance clocks

MetroCluster configurations use two compliance clock mechanisms, the Volume Compliance Clock (VCC) and the System Compliance Clock (SCC). The VCC and SCC are available to all SnapLock configurations. When you create a new volume on a node, its VCC is initialized with the current value of the SCC on that node. After the volume is created, the volume and file retention time is always tracked with the VCC.

When a volume is replicated to another site, its VCC is also replicated. When a volume switchover occurs, from Site A to Site B, for example, the VCC continues to be updated on Site B while the SCC on Site A halts when Site A goes offline.

When Site A is brought back online and the volume switchback is performed, the Site A SCC clock restarts while the VCC of the volume continues to be updated. Because the VCC is continuously updated, regardless of switchover and switchback operations, the file retention times do not depend on SCC clocks and do not stretch.

Multi-admin verification (MAV) support

Beginning with ONTAP 9.13.1, a cluster administrator can explicitly enable multi-admin verification on a cluster to require quorum approval before some SnapLock operations are executed. When MAV is enabled, SnapLock volume properties such as default-retention-time, minimum-retention-time, maximum-retention-time, volume-append-mode, autocommit-period and privileged-delete will require quorum approval. Learn more about MAV.

Storage efficiency

Beginning with ONTAP 9.9.1, SnapLock supports storage efficiency features, such as data compaction, cross-volume-deduplication, and adaptive compression for SnapLock volumes and aggregates. For more information about storage efficiency, see Logical storage management overview with the CLI.

Encryption

ONTAP offers both software- and hardware-based encryption technologies for ensuring that data at rest cannot be read if the storage medium is repurposed, returned, misplaced, or stolen.

Disclaimer: NetApp cannot guarantee that SnapLock-protected WORM files on self-encrypting drives or volumes will be retrievable if the authentication key is lost or if the number of failed authentication attempts exceeds the specified limit and results in the drive being permanently locked. You are responsible for ensuring against authentication failures.

Beginning with ONTAP 9.2, encrypted volumes are supported on SnapLock aggregates.

7-Mode Transition

You can migrate SnapLock volumes from 7-Mode to ONTAP by using the Copy-Based Transition (CBT) feature of the 7-Mode Transition Tool. The SnapLock mode of the destination volume, Compliance or Enterprise, must match the SnapLock mode of the source volume. You cannot use Copy-Free Transition (CFT) to migrate SnapLock volumes.

Configure SnapLock

Configure SnapLock

Before you use SnapLock, you need to configure SnapLock by completing various tasks such as install the SnapLock license, initialize Compliance Clock, create a SnapLock aggregate and more.

Install the license

A SnapLock license entitles you to use both SnapLock Compliance mode and SnapLock

Enterprise mode. SnapLock licenses are issued on a per-node basis. You must install a license for each node that hosts a SnapLock aggregate.

For details about Compliance mode and Enterprise mode, see What SnapLock is.

What you'll need

You must be a cluster administrator to perform this task.

About this task

You should have received the SnapLock license keys from your sales representative.

Perform this task using ONTAP System Manager or the ONTAP CLI.

System Manager

1. Navigate to **Cluster > Settings > Licenses > Add License**.
2. Click **+Add**.
3. Click **Browse** and locate the NetApp License File.
4. Click **Add**.

CLI

1. Install the SnapLock license for a node:

   `system license add -license-code` *`license_key`*

   The following command installs the license with the key `AAAAAAAAAAAAAAAAAAAAAAAAAAAA`.

   ```
   cluster1::> system license add -license-code
   AAAAAAAAAAAAAAAAAAAAAAAAAAAA
   ```

2. Repeat the previous step for each node license.

Initialize the ComplianceClock

The SnapLock ComplianceClock ensures against tampering that might alter the retention period for WORM files. You must initialize the *system ComplianceClock* on each node that hosts a SnapLock aggregate. Once you initialize the ComplianceClock on a node, you cannot initialize it again.

What you'll need

- You must be a cluster administrator to perform this task.
- The SnapLock license must be installed on the node.

About this task

The time on the system ComplianceClock is inherited by the *volume ComplianceClock*, which controls the retention period for WORM files on the volume. The volume ComplianceClock is initialized automatically when you create a new SnapLock volume.

The initial setting of the ComplianceClock is based on the current system clock. For that reason, you should verify that the system time and time zone are correct before initializing the ComplianceClock. Once you initialize the ComplianceClock on a node, you cannot initialize it again.

System Manager

Beginning with ONTAP 9.12.1, you can use System Manager to initialize the SnapLock Compliance Clock.

Steps

1. Navigate to **Cluster > Overview**.
2. In the **Nodes** section, click **Initialize SnapLock Compliance Clock**.
3. To display the Compliance Clock column and to verify that the Compliance Clock is initialized, in the **Cluster > Overview > Nodes** section, click **Show/Hide** and select **SnapLock Compliance Clock**.

CLI

1. Initialize the system ComplianceClock:

   `snaplock compliance-clock initialize -node` *`node_name`*

   The following command initializes the system ComplianceClock on `node1`:

   ```
   cluster1::> snaplock compliance-clock initialize -node node1
   ```

2. When prompted, confirm that the system clock is correct and that you want to initialize the ComplianceClock:

   ```
   Warning: You are about to initialize the secure ComplianceClock of
   the node "node1" to the current value of the node's system clock.
   This procedure can be performed only once on a given node, so you
   should ensure that the system time is set correctly before
   proceeding.

   The current node's system clock is: Mon Apr 25 06:04:10 GMT 2016

   Do you want to continue? (y|n): y
   ```

3. Repeat this procedure for each node that hosts a SnapLock aggregate.

Enable ComplianceClock resynchronization for an NTP-configured system

You can enable the SnapLock ComplianceClock time synchronization feature when an NTP server is configured.

What you'll need

- This feature is available only at the advanced privilege level.
- You must be a cluster administrator to perform this task.
- The SnapLock license must be installed on the node.
- This feature is available only for Cloud Volumes ONTAP, ONTAP Select, and VSIM platforms.

About this task

When the SnapLock secure clock daemon detects a skew beyond the threshold, ONTAP uses the system time to reset both the system and volume ComplianceClocks. A period of 24 hours is set as the skew threshold. This means that the system ComplianceClock is synchronized to the system clock only if the skew is more than a day old.

The SnapLock secure clock daemon detects a skew and changes the ComplianceClock to the system time. Any attempt at modifying the system time to force the ComplianceClock to synchronize to the system time fails, since the ComplianceClock synchronizes to the system time only if the system time is synchronized with the NTP time.

Steps

1. Enable the SnapLock ComplianceClock time synchronization feature when an NTP server is configured:

   `snaplock compliance-clock ntp`

   The following command enables the system ComplianceClock time synchronization feature:

   ```
   cluster1::*> snaplock compliance-clock ntp modify -is-sync-enabled true
   ```

2. When prompted, confirm that the configured NTP servers are trusted and that the communications channel is secure to enable the feature:
3. Check that the feature is enabled:

   `snaplock compliance-clock ntp show`

   The following command checks that the system ComplianceClock time synchronization feature is enabled:

   ```
   cluster1::*> snaplock compliance-clock ntp show

   Enable clock sync to NTP system time: true
   ```

Create a SnapLock aggregate

You use the volume `-snaplock-type` option to specify a Compliance or Enterprise SnapLock volume type. For releases earlier than ONTAP 9.10.1, you must create a separate SnapLock aggregate. Beginning with ONTAP 9.10.1, SnapLock and non-SnapLock volumes can exist on the same aggregate; therefore, you are no longer required to create a separate SnapLock aggregate if you are using ONTAP 9.10.1.

Before you begin

- You must be a cluster administrator to perform this task.
- The SnapLock license must be installed on the node.
- The ComplianceClock on the node must be initialized.
- If you have partitioned the disks as “root”, “data1”, and “data2”, you must ensure that spare disks are available.

Upgrade considerations

When upgrading to ONTAP 9.10.1, existing SnapLock and non-SnapLock aggregates are upgraded to support the existence of both SnapLock and non-SnapLock volumes; however, the existing SnapLock volume attributes are not automatically updated. For example, data-compaction, cross-volume-dedupe, and cross-volume-background-dedupe fields remain unchanged. New SnapLock volumes created on existing aggregates have the same default values as non-SnapLock volumes, and the default values for new volumes and aggregates are platform dependent.

Revert considerations

If you need to revert to an ONTAP version earlier than 9.10.1, you must move all SnapLock Compliance, SnapLock Enterprise, and SnapLock volumes to their own SnapLock aggregates.

About this task

- You cannot create Compliance aggregates for FlexArray LUNs, but SnapLock Compliance aggregates are supported with FlexArray LUNs.
- You cannot create Compliance aggregates with the SyncMirror option.
- You can create mirrored Compliance aggregates in a MetroCluster configuration only if the aggregate is used to host SnapLock audit log volumes.

> In a MetroCluster configuration, SnapLock Enterprise is supported on mirrored and unmirrored aggregates. SnapLock Compliance is supported only on unmirrored aggregates.

Steps

1. Create a SnapLock aggregate:

   `storage aggregate create -aggregate` *`aggregate_name`* `-node` *`node_name`* `-diskcount` *`number_of_disks`* `-snaplock-type compliance|enterprise`

   The man page for the command contains a complete list of options.

   The following command creates a SnapLock `Compliance` aggregate named `aggr1` with three disks on `node1`:

   ```
   cluster1::> storage aggregate create -aggregate aggr1 -node node1
   -diskcount 3 -snaplock-type compliance
   ```

Create and mount SnapLock volumes

You must create a SnapLock volume for the files or Snapshot copies that you want to commit to the WORM state. Beginning with ONTAP 9.10.1, any volume you create, regardless of the aggregate type, is created by default as a non-SnapLock volume. You

must use the `-snaplock-type` option to explicitly create a SnapLock volume by specifying either Compliance or Enterprise as the SnapLock type. By default, the SnapLock type is set to `non-snaplock`.

What you'll need

- The SnapLock aggregate must be online.
- The SnapLock license must be installed on the node.
- The ComplianceClock on the node must be initialized.

About this task

With the proper SnapLock permissions, you can destroy or rename an Enterprise volume at any time. You cannot destroy a Compliance volume until the retention period has elapsed. You can never rename a Compliance volume.

You can clone SnapLock volumes, but you cannot clone files on a SnapLock volume. The clone volume will be of the same SnapLock type as the parent volume.

LUNs are not supported in SnapLock volumes. LUNs are supported in SnapLock volumes only in scenarios where Snapshot copies created on a non-SnapLock volume are transferred to a SnapLock volume for protection as part of SnapLock vault relationship. LUNs are not supported in read/write SnapLock volumes. Tamperproof Snapshot copies however are supported on both SnapMirror source volumes and destination volumes that contain LUNs.

Perform this task using ONTAP System Manager or the ONTAP CLI.

System Manager

Beginning with ONTAP 9.12.1, you can use System Manager to create a SnapLock volume.

Steps

1. Navigate to **Storage > Volumes** and click **Add**.
2. In the **Add Volume** window, click **More Options**.
3. Enter the new volume information, including the name and size of the volume.
4. Select **Enable SnapLock** and choose the SnapLock type, either Compliance or Enterprise.
5. In the **Auto-Commit Files** section, select **Modified** and enter the amount of time a file should remain unchanged before it is automatically committed. The minimum value is 5 minutes and the maximum value is 10 years.
6. In the **Data Retention** section, select the minimum and maximum retention period.
7. Select the default retention period.
8. Click **Save**.
9. Select the new volume in the **Volumes** page to verify the SnapLock settings.

CLI

1. Create a SnapLock volume:

   `volume create -vserver` *`SVM_name`* `-volume` *`volume_name`* `-aggregate` *`aggregate_name`* `-snaplock-type compliance|enterprise`

   For a complete list of options, see the man page for the command. The following options are not available for SnapLock volumes: `-nvfail`, `-atime-update`, `-is-autobalance-eligible`, `-space-mgmt-try-first`, and `vmalign`.

   The following command creates a SnapLock `Compliance` volume named `vol1` on `aggr1` on `vs1`:

   ```
   cluster1::> volume create -vserver vs1 -volume vol1 -aggregate aggr1
   -snaplock-type compliance
   ```

Mount a SnapLock volume

You can mount a SnapLock volume to a junction path in the SVM namespace for NAS client access.

What you'll need

The SnapLock volume must be online.

About this task

- You can mount a SnapLock volume only under the root of the SVM.
- You cannot mount a regular volume under a SnapLock volume.

Steps

1. Mount a SnapLock volume:

volume mount -vserver *SVM_name* -volume *volume_name* -junction-path *path*

For a complete list of options, see the man page for the command.

The following command mounts a SnapLock volume named `vol1` to the junction path `/sales` in the `vs1` namespace:

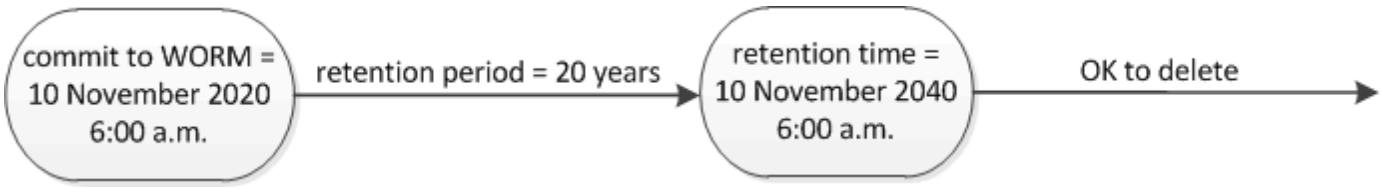
```
cluster1::> volume mount -vserver vs1 -volume vol1 -junction-path /sales
```

Set the retention time

You can set the retention time for a file explicitly, or you can use the default retention period for the volume to derive the retention time. Unless you set the retention time explicitly, SnapLock uses the default retention period to calculate the retention time. You can also set file retention after an event.

About retention period and retention time

The *retention period* for a WORM file specifies the length of time the file must be retained after it is committed to the WORM state. The *retention time* for a WORM file is the time after which the file no longer needs to be retained. A retention period of 20 years for a file committed to the WORM state on 10 November 2020 6:00 a.m., for example, would yield a retention time of 10 November 2040 6:00 a.m.



Beginning with ONTAP 9.10.1, you can set a retention time up to October 26, 3058 and a retention period up to 100 years. When you extend retention dates, older policies are converted automatically. In ONTAP 9.9.1 and earlier releases, unless you set the default retention period to infinite, the maximum supported retention time is January 19 2071 (GMT).

Important replication considerations

When establishing a SnapMirror relationship with a SnapLock source volume using a retention date later than January 19th 2071 (GMT), the destination cluster must be running ONTAP 9.10.1 or later or the SnapMirror transfer will fail.

Important revert considerations

ONTAP prevents you from reverting a cluster from ONTAP 9.10.1 to an earlier ONTAP version when there are any files with a retention period later than “January 19, 2071 8:44:07 AM”.

Understanding the default retention periods

A SnapLock Compliance or Enterprise volume has four retention periods:

- Minimum retention period (`min`), with a default of 0
- Maximum retention period (`max`), with a default of 30 years
- Default retention period, with a default equal to `min` for both Compliance mode and Enterprise mode

beginning with ONTAP 9.10.1. In ONTAP releases earlier than ONTAP 9.10.1, the default retention period depends on the mode:

  - For Compliance mode, the default is equal to `max`.
  - For Enterprise mode, the default is equal to `min`.

- Unspecified retention period.

  Beginning with ONTAP 9.8, you can set the retention period on files in a volume to `unspecified`, to enable the file to be retained until you set an absolute retention time. You can set a file with absolute retention time to unspecified retention and back to absolute retention as long as the new absolute retention time is later than the absolute time you previously set.

  Beginning with ONTAP 9.12.1, WORM files with the retention period set to `unspecified` are guaranteed to have a retention period set to the minimum retention period configured for the SnapLock volume. When you change the file retention period from `unspecified` to an absolute retention time, the new retention time specified must be greater than the minimum retention time already set on the file.

So, if you do not set the retention time explicitly before committing a Compliance-mode file to the WORM state, and you do not modify the defaults, the file will be retained for 30 years. Similarly, if you do not set the retention time explicitly before committing an Enterprise-mode file to the WORM state, and you do not modify the defaults, the file will be retained for 0 years, or, effectively, not at all.

Set the default retention period

You can use the `volume snaplock modify` command to set the default retention period for files on a SnapLock volume.

What you'll need

The SnapLock volume must be online.

About this task

The following table shows the possible values for the default retention period option:

> The default retention period must be greater than or equal to (>=) the minimum retention period and less than or equal to (<=) the maximum retention period.

Value	Unit	Notes
0 - 65535	seconds	
0 - 24	hours	
0 - 365	days	
0 - 12	months	
0 - 100	years	Beginning with ONTAP 9.10.1. For earlier ONTAP releases, the value is 0 - 70.

Value	Unit	Notes
max	-	Use the maximum retention period.
min	-	Use the minimum retention period.
infinite	-	Retain the files forever.
unspecified	-	Retain the files until an absolute retention period is set.

The values and ranges for the maximum and minimum retention periods are identical, except for `max` and `min`, which are not applicable. For more information about this task, see Set the retention time overview.

You can use the `volume snaplock show` command to view the retention period settings for the volume. For more information, see the man page for the command.

> After a file has been committed to the WORM state, you can extend but not shorten the retention period.

Steps

1. Set the default retention period for files on a SnapLock volume:

   `volume snaplock modify -vserver` *`SVM_name`* `-volume` *`volume_name`* `-default -retention-period` *`default_retention_period`* `-minimum-retention-period` *`min_retention_period`* `-maximum-retention-period` *`max_retention_period`*

   For a complete list of options, see the man page for the command.

   > The following examples assume that the minimum and maximum retention periods have not been modified previously.

   The following command sets the default retention period for a Compliance or Enterprise volume to 20 days:

   ```
   cluster1::> volume snaplock modify -vserver vs1 -volume vol1 -default
   -retention-period 20days
   ```

   The following command sets the default retention period for a Compliance volume to 70 years:

   ```
   cluster1::> volume snaplock modify -vserver vs1 -volume vol1 -maximum
   -retention-period 70years
   ```

   The following command sets the default retention period for an Enterprise volume to 10 years:

```
cluster1::> volume snaplock modify -vserver vs1 -volume vol1 -default
-retention-period max -maximum-retention-period 10years
```

The following commands set the default retention period for an Enterprise volume to 10 days:

```
cluster1::> volume snaplock modify -vserver vs1 -volume vol1 -minimum
-retention-period 10days
cluster1::> volume snaplock modify -vserver vs1 -volume vol1 -default
-retention-period min
```

The following command sets the default retention period for a Compliance volume to infinite:

```
cluster1::> volume snaplock modify -vserver vs1 -volume vol1 -default
-retention-period infinite -maximum-retention-period infinite
```

Set the retention time for a file explicitly

You can set the retention time for a file explicitly by modifying its last access time. You can use any suitable command or program over NFS or CIFS to modify the last access time.

About this task

After a file has been committed to WORM, you can extend but not shorten the retention time. The retention time is stored in the `atime` field for the file.

> You cannot explicitly set the retention time of a file to `infinite`. That value is only available when you use the default retention period to calculate the retention time.

Steps

1. Use a suitable command or program to modify the last access time for the file whose retention time you want to set.

   In a UNIX shell, use the following command to set a retention time of 21 November 2020 6:00 a.m. on a file named `document.txt`:

   ```
   touch -a -t 202011210600 document.txt
   ```

   > You can use any suitable command or program to modify the last access time in Windows.

Set the file retention period after an event

Beginning with ONTAP 9.3, you can define how long a file is retained after an event occurs by using the SnapLock *Event Based Retention (EBR)* feature.

What you'll need

- You must be a SnapLock administrator to perform this task.

  Create a SnapLock administrator account

- You must have logged in on a secure connection (SSH, console, or ZAPI).

About this task

The *event retention policy* defines the retention period for the file after the event occurs. The policy can be applied to a single file or all the files in a directory.

- If a file is not a WORM file, it will be committed to the WORM state for the retention period defined in the policy.
- If a file is a WORM file or a WORM appendable file, its retention period will be extended by the retention period defined in the policy.

You can use a Compliance-mode or Enterprise-mode volume.

EBR policies cannot be applied to files under a Legal Hold.

For advanced usage, see Compliant WORM Storage Using NetApp SnapLock.

Using EBR to extend the retention period of already existing WORM files
EBR is convenient when you want to extend the retention period of already existing WORM files. For example, it might be your firm's policy to retain employee W-4 records in unmodified form for three years after the employee changes a withholding election. Another company policy might require that W-4 records be retained for five years after the employee is terminated. In this situation, you could create an EBR policy with a five-year retention period. After the employee is terminated (the "event"), you would apply the EBR policy to the employee's W-4 record, causing its retention period to be extended. That will usually be easier than extending the retention period manually, particularly when a large number of files is involved.

Steps

1. Create an EBR policy:

   `snaplock event-retention policy create -vserver` *`SVM_name`* `-name` *`policy_name`* `-retention-period` *`retention_period`*

   The following command creates the EBR policy `employee_exit` on `vs1` with a retention period of ten years:

   ```
   cluster1::>snaplock event-retention policy create -vserver vs1 -name
   employee_exit -retention-period 10years
   ```

2. Apply an EBR policy:

   `snaplock event-retention apply -vserver` *`SVM_name`* `-name` *`policy_name`* `-volume` *`volume_name`* `-path` *`path_name`*

The following command applies the EBR policy `employee_exit` on `vs1` to all the files in the directory `d1`:

```
cluster1::>snaplock event-retention apply -vserver vs1 -name
employee_exit -volume vol1 -path /d1
```

Create an audit log

You must create a SnapLock-protected audit log before performing a privileged delete or SnapLock volume move. The audit log records the creation and deletion of SnapLock administrator accounts, modifications to the log volume, whether privileged delete is enabled, privileged delete operations, and SnapLock volume move operations.

What you'll need

You must be a cluster administrator to create a SnapLock aggregate.

About this task

You cannot delete an audit log until the log file retention period has elapsed. You cannot modify an audit log even after the retention period has elapsed. This is true for both SnapLock Compliance and Enterprise modes.

> In ONTAP 9.4 and earlier, you cannot use a SnapLock Enterprise volume for audit logging. You must use a SnapLock Compliance volume. In ONTAP 9.5 and later, you can use either a SnapLock Enterprise volume or a SnapLock Compliance volume for audit logging. In all cases, the audit log volume must be mounted at the junction path `/snaplock_audit_log`. No other volume can use this junction path.

You can find the SnapLock audit logs in the `/snaplock_log` directory under the root of the audit log volume, in subdirectories named `privdel_log` (privileged delete operations) and `system_log` (everything else). Audit log file names contain the timestamp of the first logged operation, making it easy to search for records by the approximate time that operations were executed.

- You can use the `snaplock log file show` command to view the log files on the audit log volume.
- You can use the `snaplock log file archive` command to archive the current log file and create a new one, which is useful in cases where you need to record audit log information in a separate file.

For more information, see the man pages for the commands.

> A data protection volume cannot be used as a SnapLock audit log volume.

Steps

1. Create a SnapLock aggregate.

   Create a SnapLock aggregate

2. On the SVM that you want to configure for audit logging, create a SnapLock volume.

   Create a SnapLock volume

3. Configure the SVM for audit logging:

snaplock log create -vserver *SVM_name* -volume *snaplock_volume_name* -max-file -size *size* -retention-period *default_retention_period*

> The minimum default retention period for audit log files is six months. If the retention period of an affected file is longer than the retention period of the audit log, the retention period of the log inherits the retention period of the file. So, if the retention period for a file deleted using privileged delete is 10 months, and the retention period of the audit log is 8 months, the retention period of the log is extended to 10 months. For more information about retention time and default retention period, see Set the retention time.

The following command configures `SVM1` for audit logging using the SnapLock volume `logVol`. The audit log has a maximum size of 20 GB and is retained for eight months.

```
SVM1::> snaplock log create -vserver SVM1 -volume logVol -max-file-size
20GB -retention-period 8months
```

4. On the SVM that you configured for audit logging, mount the SnapLock volume at the junction path `/snaplock_audit_log`.

   Mount a SnapLock volume

Verify SnapLock settings

You can use the `volume file fingerprint start` and `volume file fingerprint dump` commands to view key information about files and volumes, including the file type (regular, WORM, or WORM appendable), the volume expiration date, and so forth.

Steps

1. Generate a file fingerprint:

   volume file fingerprint start -vserver *SVM_name* -file *file_path*

   ```
   svm1::> volume file fingerprint start -vserver svm1 -file
   /vol/sle/vol/f1
   File fingerprint operation is queued. Run "volume file fingerprint show
   -session-id 16842791" to view the fingerprint session status.
   ```

   The command generates a session ID that you can use as input to the `volume file fingerprint dump` command.

   > You can use the `volume file fingerprint show` command with the session ID to monitor the progress of the fingerprint operation. Make sure that the operation has completed before attempting to display the fingerprint.

2. Display the fingerprint for the file:

volume file fingerprint dump -session-id *session_ID*

```
svm1::> volume file fingerprint dump -session-id 33619976
        Vserver:svm1
        Session-ID:33619976
        Volume:slc_vol
        Path:/vol/slc_vol/f1
        Data
Fingerprint:MOFJVevxNSJm3C/4Bn5oEEYH51CrudOzZYK4r5Cfy1g=Metadata

Fingerprint:8iMjqJXiNcqgXT5XuRhLiEwIrJEihDmwS0hrexnjgmc=Fingerprint
Algorithm:SHA256
        Fingerprint Scope:data-and-metadata
        Fingerprint Start Time:1460612586
        Formatted Fingerprint Start Time:Thu Apr 14 05:43:06 GMT 2016
        Fingerprint Version:3
        **SnapLock License:available**
        Vserver UUID:acf7ae64-00d6-11e6-a027-0050569c55ae
        Volume MSID:2152884007
        Volume DSID:1028
        Hostname:my_host
        Filer ID:5f18eda2-00b0-11e6-914e-6fb45e537b8d
        Volume Containing Aggregate:slc_aggr1
        Aggregate ID:c84634aa-c757-4b98-8f07-eefe32565f67
        **SnapLock System ComplianceClock:1460610635
        Formatted SnapLock System ComplianceClock:Thu Apr 14 05:10:35
GMT 2016
        Volume SnapLock Type:compliance
        Volume ComplianceClock:1460610635
        Formatted Volume ComplianceClock:Thu Apr 14 05:10:35 GMT 2016
        Volume Expiry Date:1465880998**
         Is Volume Expiry Date Wraparound:false
        Formatted Volume Expiry Date:Tue Jun 14 05:09:58 GMT 2016
        Filesystem ID:1028
        File ID:96
        File Type:worm
        File Size:1048576
        Creation Time:1460612515
        Formatted Creation Time:Thu Apr 14 05:41:55 GMT 2016
        Modification Time:1460612515
        Formatted Modification Time:Thu Apr 14 05:41:55 GMT 2016
        Changed Time:1460610598
        Is Changed Time Wraparound:false
        Formatted Changed Time:Thu Apr 14 05:09:58 GMT 2016
        Retention Time:1465880998
        Is Retention Time Wraparound:false
```

```
        Formatted Retention Time:Tue Jun 14 05:09:58 GMT 2016
        Access Time:-
        Formatted Access Time:-
        Owner ID:0
        Group ID:0
        Owner SID:-
        Fingerprint End Time:1460612586
        Formatted Fingerprint End Time:Thu Apr 14 05:43:06 GMT 2016
```

Manage WORM files

Manage WORM files

You can manage WORM files in the following ways:

- Commit files to WORM
- Commit Snapshot copies to WORM on a vault destination
- Mirror WORM files for disaster recovery
- Retain WORM files during litigation
- Delete WORM files

Commit files to WORM

You can commit files to WORM (write once, read many) either manually or by committing them automatically. You can also create WORM appendable files.

Commit files to WORM manually

You commit a file to WORM manually by making the file read-only. You can use any suitable command or program over NFS or CIFS to change the read-write attribute of a file to read-only. You might choose to manually commit files if you want to ensure an application has finished writing to a file so that the file isn't committed prematurely or if there are scaling issues for the autocommit scanner because of a high number of volumes.

What you'll need

- The file you want to commit must reside on a SnapLock volume.
- The file must be writable.

About this task

The volume ComplianceClock time is written to the `ctime` field of the file when the command or program is executed. The ComplianceClock time determines when the retention time for the file has been reached.

Steps

1. Use a suitable command or program to change the read-write attribute of a file to read-only.

   In a UNIX shell, use the following command to make a file named `document.txt` read-only:

```
chmod -w document.txt
```

In a Windows shell, use the following command to make a file named `document.txt` read-only:

```
attrib +r document.txt
```

Commit files to WORM automatically

The SnapLock autocommit feature enables you to commit files to WORM automatically. The autocommit feature commits a file to WORM state on a SnapLock volume if the file did not change for the autocommit-period
duration. The autocommit feature is disabled by default.

What you'll need

- The files you want to autocommit must reside on a SnapLock volume.
- The SnapLock volume must be online.
- The SnapLock volume must be a read-write volume.

> The SnapLock autocommit feature scans through all of the files in the volume and commits a file if it meets the autocommit requirement. There might be a time interval between when the file is ready for autocommit and when it is actually committed by the SnapLock autocommit scanner. However, the file is still protected from modifications and deletion by the file system as soon as it is eligible for autocommit.

About this task

The *autocommit period* specifies the amount of time that files must remain unchanged before they are autocommitted. Changing a file before the autocommit period has elapsed restarts the autocommit period for the file.

The following table shows the possible values for the autocommit period:

Value	Unit	Notes
none	-	The default.
5 - 5256000	minutes	-
1 - 87600	hours	-
1 - 3650	days	-
1 - 120	months	-
1 - 10	years	-

The minimum value is 5 minutes and the maximum value is 10 years.

Steps

1. Autocommit files on a SnapLock volume to WORM:

   volume snaplock modify -vserver *SVM_name* -volume *volume_name* -autocommit -period *autocommit_period*

   For a complete list of options, see the man page for the command.

   The following command autocommits the files on volume `vol1` of SVM vs1, as long as the files remain unchanged for 5 hours:

   ```
   cluster1::>volume snaplock modify -vserver vs1 -volume vol1 -autocommit
   -period 5hours
   ```

Create a WORM appendable file

A WORM appendable file retains data written incrementally, like log entries. You can use any suitable command or program to create a WORM appendable file, or you can use the SnapLock *volume append mode* feature to create WORM appendable files by default.

Use a command or program to create a WORM appendable file

You can use any suitable command or program over NFS or CIFS to create a WORM appendable file. A WORM appendable file retains data written incrementally, like log entries. Data is appended to the file in 256 KB chunks. As each chunk is written, the previous chunk becomes WORM-protected. You cannot delete the file until the retention period has elapsed.

What you'll need

The WORM appendable file must reside on a SnapLock volume.

About this task

Data does not have to be written sequentially to the active 256 KB chunk. When data is written to byte n×256KB+1 of the file, the previous 256 KB segment becomes WORM-protected.

Steps

1. Use a suitable command or program to create a zero-length file with the desired retention time.

   In a UNIX shell, use the following command to set a retention time of 21 November 2020 6:00 a.m. on a zero-length file named `document.txt`:

   ```
   touch -a -t 202011210600 document.txt
   ```

2. Use a suitable command or program to change the read-write attribute of the file to read-only.

   In a UNIX shell, use the following command to make a file named `document.txt` read-only:

```
chmod 444 document.txt
```

3. Use a suitable command or program to change the read-write attribute of the file back to writable.

   This step is not deemed a compliance risk because there is no data in the file.

   In a UNIX shell, use the following command to make a file named `document.txt` writable:

```
chmod 777 document.txt
```

4. Use a suitable command or program to start writing data to the file.

   In a UNIX shell, use the following command to write data to `document.txt`:

```
echo test data >> document.txt
```

   Change the file permissions back to read-only when you no longer need to append data to the file.

Use volume append mode to create WORM appendable files

Beginning with ONTAP 9.3, you can use the SnapLock *volume append mode* (VAM) feature to create WORM appendable files by default. A WORM appendable file retains data written incrementally, like log entries. Data is appended to the file in 256 KB chunks. As each chunk is written, the previous chunk becomes WORM-protected. You cannot delete the file until the retention period has elapsed.

What you'll need

- The WORM appendable file must reside on a SnapLock volume.
- The SnapLock volume must be unmounted and empty of Snapshot copies and user-created files.

About this task

Data does not have to be written sequentially to the active 256 KB chunk. When data is written to byte n×256KB+1 of the file, the previous 256 KB segment becomes WORM-protected.

If you specify an autocommit period for the volume, WORM appendable files that are not modified for a period greater than the autocommit period are committed to WORM.

VAM is not supported on SnapLock audit log volumes.

Steps

1. Enable VAM:

   `volume snaplock modify -vserver` *`SVM_name`* `-volume` *`volume_name`* `-is-volume-append -mode-enabled true|false`

   For a complete list of options, see the man page for the command.

The following command enables VAM on volume `vol1` of SVM`vs1`:

```
cluster1::>volume snaplock modify -vserver vs1 -volume vol1 -is-volume
-append-mode-enabled true
```

2. Use a suitable command or program to create files with write permissions.

   The files are WORM-appendable by default.

Commit Snapshot copies to WORM on a vault destination

You can use SnapLock for SnapVault to WORM-protect Snapshot copies on secondary storage. You perform all of the basic SnapLock tasks on the SnapVault destination. The destination volume is automatically mounted read-only, so there is no need to explicitly commit the Snapshot copies to WORM; therefore, creating scheduled Snapshot copies on the destination volume using SnapMirror policies is not supported.

Before you begin

- The source cluster must be running ONTAP 8.2.2 or later.
- The source and destination aggregates must be 64-bit.
- The source volume cannot be a SnapLock volume.
- The source and destination volumes must be created in peered clusters with peered SVMs.

  For more information, see Cluster Peering.

- If volume autogrow is disabled, the free space on the destination volume must be at least five percent more than the used space on the source volume.

About this task

The source volume can use NetApp or non-NetApp storage. For non-NetApp storage, you must use FlexArray Virtualization.

> You cannot rename a Snapshot copy that is committed to the WORM state.

You can clone SnapLock volumes, but you cannot clone files on a SnapLock volume.

> LUNs are not supported in SnapLock volumes. LUNs are supported in SnapLock volumes only in scenarios where Snapshot copies created on a non-SnapLock volume are transferred to a SnapLock volume for protection as part of SnapLock vault relationship. LUNs are not supported in read/write SnapLock volumes. Tamperproof Snapshot copies however are supported on both SnapMirror source volumes and destination volumes that contain LUNs.

Beginning with ONTAP 9.13.1, you can instantaneously restore a locked Snapshot copy on the destination SnapLock volume of a SnapLock for SnapVault relationship by creating a FlexClone with the `snaplock-type` option set to “non-snaplock” and specifying the Snapshot copy as the “parent-snapshot” when executing the volume clone creation operation. Learn more about creating a FlexClone volume with a SnapLock type.

For MetroCluster configurations, you should be aware of the following:

- You can create a SnapVault relationship only between sync-source SVMs, not between a sync-source SVM and a sync-destination SVM.
- You can create a SnapVault relationship from a volume on a sync-source SVM to a data-serving SVM.
- You can create a SnapVault relationship from a volume on a data-serving SVM to a DP volume on a sync-source SVM.

The following illustration shows the procedure for initializing a SnapVault relationship:

Steps

1. Identify the destination cluster.
2. On the destination cluster, install the SnapLock license, initialize the ComplianceClock, and, if you are using an ONTAP release earlier than 9.10.1, create a SnapLock aggregate, as described in SnapLock workflow.
3. On the destination cluster, create a SnapLock destination volume of type `DP` that is either the same or greater in size than the source volume:

   `volume create -vserver` *`SVM_name`* `-volume` *`volume_name`* `-aggregate` *`aggregate_name`* `-snaplock-type compliance|enterprise -type DP -size` *`size`*

   > Beginning with ONTAP 9.10.1, SnapLock and non-SnapLock volumes can exist on the same aggregate; therefore, you are no longer required to create a separate SnapLock aggregate if you are using ONTAP 9.10.1. You use the volume -snaplock-type option to specify a Compliance or Enterprise SnapLock volume type. In ONTAP releases earlier than ONTAP 9.10.1, the SnapLock mode, Compliance or Enterprise, is inherited from the aggregate. Version-flexible destination volumes are not supported. The language setting of the destination volume must match the language setting of the source volume.

   The following command creates a 2 GB SnapLock `Compliance` volume named `dstvolB` in `SVM2` on the aggregate `node01_aggr`:

   ```
   cluster2::> volume create -vserver SVM2 -volume dstvolB -aggregate
   node01_aggr -snaplock-type compliance -type DP -size 2GB
   ```

4. On the destination cluster, set the default retention period, as described in Set the default retention period.

   > A SnapLock volume that is a vault destination has a default retention period assigned to it. The value for this period is initially set to a minimum of 0 years for SnapLock Enterprise volumes and a maximum of 30 years for SnapLock Compliance volumes. Each NetApp Snapshot copy is committed with this default retention period at first. The retention period can be extended later, if needed. For more information, see Set retention time overview.

5. Create a new replication relationship between the non-SnapLock source and the new SnapLock destination you created in Step 3.

   This example creates a new SnapMirror relationship with destination SnapLock volume `dstvolB` using a policy of `XDPDefault` to vault Snapshot copies labeled daily and weekly on an hourly schedule:

```
cluster2::> snapmirror create -source-path SVM1:srcvolA -destination
-path SVM2:dstvolB -vserver SVM2 -policy XDPDefault -schedule hourly
```

Create a custom replication policy or a custom schedule if the available defaults are not suitable.

6. On the destination SVM, initialize the SnapVault relationship created in Step 5:

   `snapmirror initialize -destination-path` *`destination_path`*

   The following command initializes the relationship between the source volume `srcvolA` on `SVM1` and the destination volume `dstvolB` on `SVM2`:

   ```
   cluster2::> snapmirror initialize -destination-path SVM2:dstvolB
   ```

7. After the relationship is initialized and idle, use the `snapshot show` command on the destination to verify verify the SnapLock expiry time applied to the replicated Snapshot copies.

   This example lists the Snapshot copies on volume `dstvolB` that have the SnapMirror label and the SnapLock expiration date:

   ```
   cluster2::> snapshot show -vserver SVM2 -volume dstvolB -fields
   snapmirror-label, snaplock-expiry-time
   ```

Related information

Cluster and SVM peering

Volume backup using SnapVault

Mirror WORM files for disaster recovery

You can use SnapMirror to replicate WORM files to another geographic location for disaster recovery and other purposes. Both the source volume and destination volume must be configured for SnapLock, and both volumes must have the same SnapLock mode, Compliance or Enterprise. All key SnapLock properties of the volume and files are replicated.

Prerequisites

The source and destination volumes must be created in peered clusters with peered SVMs. For more information, see Cluster and SVM peering.

About this task

- Beginning with ONTAP 9.5, you can replicate WORM files with the XDP (extended data protection) type SnapMirror relationship rather than the DP (data protection) type relationship. XDP mode is ONTAP version-independent, and is able to differentiate files stored in the same block, making it much easier to resync replicated Compliance-mode volumes. For information on how to convert an existing DP-type

relationship to an XDP-type relationship, see Data Protection.

- A resync operation on a DP type SnapMirror relationship fails for a Compliance-mode volume if SnapLock determines that it will result in a loss of data. If a resync operation fails, you can use the `volume clone create` command to make a clone of the destination volume. You can then resync the source volume with the clone.
- A SnapMirror relationship of type XDP between SnapLock compliant volumes supports a resync after a break even if data on the destination has diverged from the source post the break.

  On a resync, when data divergence is detected between the source the destination beyond the common snapshot, a new snapshot is cut on the destination to capture this divergence. The new snapshot and the common snapshot are both locked with a retention time as follows:

  - The volume expiry time of the destination
  - If the volume expiry time is in the past or has not been set, then the snapshot is locked for a period of 30 days
  - If the destination has legal-holds, the actual volume expiry period is masked and shows up as ‘indefinite’, however the snapshot is locked for the duration of the actual volume expiry period.

If the destination volume has an expiry period that is later than the source, the destination expiry period is retained and will not be overwritten by the expiry period of the source volume post the resync.

If the destination has legal-holds placed on it that differ from the source, a resync is not allowed. The source and destination must have identical legal-holds or all legal-holds on the destination must be released before a resync is attempted.

A locked Snapshot copy on the destination volume created to capture the divergent data can be copied to the source using the CLI by running the `snapmirror update -s snapshot` command. The snapshot once copied will continue to be locked at the source as well.

- SVM data protection relationships are not supported.
- Load-sharing data protection relationships are not supported.

The following illustration shows the procedure for initializing a SnapMirror relationship:

System Manager

Beginning with ONTAP 9.12.1, you can use System Manager to set up SnapMirror replication of WORM files.

Steps

1. Navigate to **Storage > Volumes**.
2. Click **Show/Hide** and select **SnapLock Type** to display the column in the **Volumes** window.
3. Locate a SnapLock volume.
4. Click ⋮ and select **Protect**.
5. Choose the destination cluster and the destination storage VM.
6. Click **More Options**.
7. Select **Show legacy policies** and select **DPDefault (legacy)**.
8. In the **Destination Configuration details** section, select **Override transfer schedule** and select **hourly**.
9. Click **Save**.
10. To the left of the source volume name, click the arrow to expand the volume details, and on the right side of the page,review the remote SnapMirror protection details.
11. On the remote cluster, navigate to **Protection Relationships**.
12. Locate the relationship and click the destination volume name to view the relationship details.
13. Verify that the destination volume SnapLock type and other SnapLock information.

CLI

1. Identify the destination cluster.
2. On the destination cluster, install the SnapLock license, initialize the ComplianceClock, and, if you are using an ONTAP release earlier than 9.10.1, create a SnapLock aggregate.
3. On the destination cluster, create a SnapLock destination volume of type `DP` that is either the same size as or greater in size than the source volume:

   ```
   volume create -vserver SVM_name -volume volume_name -aggregate
   aggregate_name -snaplock-type compliance|enterprise -type DP -size size
   ```

   > ⓘ Beginning with ONTAP 9.10.1, SnapLock and non-SnapLock volumes can exist on the same aggregate; therefore, you are no longer required to create a separate SnapLock aggregate if you are using ONTAP 9.10.1. You use the volume -snaplock-type option to specify a Compliance or Enterprise SnapLock volume type. In ONTAP releases earlier than ONTAP 9.10.1, the SnapLock mode—Compliance or Enterprise—is inherited from the aggregate. Version-flexible destination volumes are not supported. The language setting of the destination volume must match the language setting of the source volume.

   The following command creates a 2 GB SnapLock `Compliance` volume named `dstvolB` in `SVM2` on the aggregate `node01_aggr`:

```
cluster2::> volume create -vserver SVM2 -volume dstvolB -aggregate
node01_aggr -snaplock-type compliance -type DP -size 2GB
```

4. On the destination SVM, create a SnapMirror policy:

   snapmirror policy create -vserver *SVM_name* -policy *policy_name*

   The following command creates the SVM-wide policy `SVM1-mirror`:

   ```
   SVM2::> snapmirror policy create -vserver SVM2 -policy SVM1-mirror
   ```

5. On the destination SVM, create a SnapMirror schedule:

   job schedule cron create -name *schedule_name* -dayofweek *day_of_week* -hour *hour* -minute *minute*

   The following command creates a SnapMirror schedule named `weekendcron`:

   ```
   SVM2::> job schedule cron create -name weekendcron -dayofweek
   "Saturday, Sunday" -hour 3 -minute 0
   ```

6. On the destination SVM, create a SnapMirror relationship:

   snapmirror create -source-path *source_path* -destination-path *destination_path* -type XDP|DP -policy *policy_name* -schedule *schedule_name*

   The following command creates a SnapMirror relationship between the source volume `srcvolA` on `SVM1` and the destination volume `dstvolB` on `SVM2`, and assigns the policy `SVM1-mirror` and the schedule `weekendcron`:

   ```
   SVM2::> snapmirror create -source-path SVM1:srcvolA -destination
   -path SVM2:dstvolB -type XDP -policy SVM1-mirror -schedule
   weekendcron
   ```

   The XDP type is available in ONTAP 9.5 and later. You must use the DP type in ONTAP 9.4 and earlier.

7. On the destination SVM, initialize the SnapMirror relationship:

   snapmirror initialize -destination-path *destination_path*

   The initialization process performs a *baseline transfer* to the destination volume. SnapMirror makes a Snapshot copy of the source volume, then transfers the copy and all the data blocks that it references to the destination volume. It also transfers any other Snapshot copies on the source volume to the destination volume.

The following command initializes the relationship between the source volume `srcvolA` on `SVM1` and the destination volume `dstvolB` on `SVM2`:

```
SVM2::> snapmirror initialize -destination-path SVM2:dstvolB
```

Related information

Cluster and SVM peering

Volume disaster recovery preparation

Data protection

Retain WORM files during litigation using Legal Hold

Beginning with ONTAP 9.3, you can retain Compliance-mode WORM files for the duration of a litigation by using the *Legal Hold* feature.

What you'll need

- You must be a SnapLock administrator to perform this task.

  Create a SnapLock administrator account

- You must have logged in on a secure connection (SSH, console, or ZAPI).

About this task

A file under a Legal Hold behaves like a WORM file with an indefinite retention period. It is your responsibility to specify when the Legal Hold period ends.

The number of files you can place under a Legal Hold depends on the space available on the volume.

Steps

1. Start a Legal Hold:

   `snaplock legal-hold begin -litigation-name` *`litigation_name`* `-volume` *`volume_name`* `-path` *`path_name`*

   The following command starts a Legal Hold for all the files in `vol1`:

   ```
   cluster1::>snaplock legal-hold begin -litigation-name litigation1
   -volume vol1 -path /
   ```

2. End a Legal Hold:

   `snaplock legal-hold end -litigation-name` *`litigation_name`* `-volume` *`volume_name`* `-path` *`path_name`*

   The following command ends a Legal Hold for all the files in `vol1`:

```
cluster1::>snaplock legal-hold end -litigation-name litigation1 -volume
vol1 -path /
```

Delete WORM files overview

You can delete Enterprise-mode WORM files during the retention period using the privileged delete feature.
Before you can use this feature, you must create a SnapLock administrator account and then using the account, enable the feature.

Create a SnapLock administrator account

You must have SnapLock administrator privileges to perform a privileged delete. These privileges are defined in the vsadmin-snaplock role. If you have not already been assigned that role, you can ask your cluster administrator to create an SVM administrator account with the SnapLock administrator role.

What you'll need

- You must be a cluster administrator to perform this task.
- You must have logged in on a secure connection (SSH, console, or ZAPI).

Steps

1. Create an SVM administrator account with the SnapLock administrator role:

   security login create -vserver *SVM_name* -user-or-group-name *user_or_group_name* -application *application* -authmethod *authentication_method* -role *role* -comment *comment*

   The following command enables the SVM administrator account `SnapLockAdmin` with the predefined `vsadmin-snaplock` role to access `SVM1` using a password:

   ```
   cluster1::> security login create -vserver SVM1 -user-or-group-name
   SnapLockAdmin -application ssh -authmethod password -role vsadmin-
   snaplock
   ```

Enable the privileged delete feature

You must explicitly enable the privileged delete feature on the Enterprise volume that contains the WORM files you want to delete.

About this task

The value of the `-privileged-delete` option determines whether privileged delete is enabled. Possible values are `enabled`, `disabled`, and `permanently-disabled`.

`permanently-disabled` is the terminal state. You cannot enable privileged delete on the volume after you set the state to `permanently-disabled`.

Steps

1. Enable privileged delete for a SnapLock Enterprise volume:

   volume snaplock modify -vserver *SVM_name* -volume *volume_name* -privileged -delete disabled|enabled|permanently-disabled

   The following command enables the privileged delete feature for the Enterprise volume `dataVol` on `SVM1`:

   ```
   SVM1::> volume snaplock modify -vserver SVM1 -volume dataVol -privileged
   -delete enabled
   ```

Delete Enterprise-mode WORM files

You can use the privileged delete feature to delete Enterprise-mode WORM files during the retention period.

What you'll need

- You must be a SnapLock administrator to perform this task.
- You must have created a SnapLock audit log and enabled the privileged delete feature on the Enterprise volume.

About this task

You cannot use a privileged delete operation to delete an expired WORM file. You can use the `volume file retention show` command to view the retention time of the WORM file that you want to delete. For more information, see the man page for the command.

Step

1. Delete a WORM file on an Enterprise volume:

   volume file privileged-delete -vserver *SVM_name* -file *file_path*

   The following command deletes the file `/vol/dataVol/f1` on the SVM`SVM1`:

   ```
   SVM1::> volume file privileged-delete -file /vol/dataVol/f1
   ```

Move a SnapLock volume

Beginning with ONTAP 9.8, you can move a SnapLock volume to a destination aggregate of the same type, either Enterprise to Enterprise, or Compliance to Compliance. You must be assigned the SnapLock security role to move a SnapLock volume.

Create a SnapLock security administrator account

You must have SnapLock security administrator privileges to perform a SnapLock volume move. This privilege is granted to you with the *snaplock* role, introduced in ONTAP 9.8. If you have not already been assigned that role, you can ask your cluster administrator to create a SnapLock security user with this SnapLock security role.

What you'll need

- You must be a cluster administrator to perform this task.
- You must have logged in on a secure connection (SSH, console, or ZAPI).

About this task

The snaplock role is associated with the admin SVM, unlike the vsadmin-snaplock role, which is associated with the data SVM.

Step

1. Create an SVM administrator account with the SnapLock administrator role:

   security login create -vserver *SVM_name* -user-or-group-name *user_or_group_name* -application *application* -authmethod *authentication_method* -role *role* -comment *comment*

   The following command enables the SVM administrator account `SnapLockAdmin` with the predefined `snaplock` role to access admin SVM `cluster1` using a password:

   ```
   cluster1::> security login create -vserver cluster1 -user-or-group-name
   SnapLockAdmin -application ssh -authmethod password -role snaplock
   ```

Move a SnapLock volume

You can use the `volume move` command to move a SnapLock volume to a destination aggregate.

What you'll need

- You must have created a SnapLock-protected audit log before performing SnapLock volume move.

  Create an audit log.

- If you are using a version of ONTAP earlier than ONTAP 9.10.1, the destination aggregate must be the same SnapLock type as the SnapLock volume you want to move; either Compliance to Compliance or Enterprise to Enterprise. Beginning with ONTAP 9.10.1, this restriction is removed and an aggregate can include both Compliance and Enterprise SnapLock volumes, as well as non-SnapLock volumes.
- You must be a user with the SnapLock security role.

Steps

1. Using a secure connection, log in to the ONTAP cluster management LIF:

   ssh snaplock_user@cluster_mgmt_ip

2. Move a SnapLock volume:

   volume move start -vserver *SVM_name* -volume *SnapLock_volume_name* -destination -aggregate *destination_aggregate_name*

3. Check the status of the volume move operation:

   volume move show -volume *SnapLock_volume_name* -vserver *SVM_name* -fields volume,phase,vserver

Lock a Snapshot copy for protection against ransomware attacks

Beginning with ONTAP 9.12.1, you can lock a Snapshot copy on a non-SnapLock volume to provide protection from ransomware attacks. Locking Snapshot copies ensures that they can't be deleted accidentally or maliciously.

You use the SnapLock compliance clock feature to lock Snapshot copies for a specified period so that they cannot be deleted until the expiration time is reached. Locking Snapshot copies makes them tamperproof, protecting them from ransomware threats. You can use locked Snapshot copies to recover data if a volume is compromised by a ransomware attack.

Tamperproof Snapshot copy requirements and considerations

- If you are using the ONTAP CLI, all nodes in the cluster must be running ONTAP 9.12.1 or later. If you are using System Manager, all nodes must be running ONTAP 9.13.1 or later.
- The SnapLock license must be installed on the cluster.

  For details, see Installing the SnapLock license.

- The compliance clock on the cluster must be initialized.

  For details, see Initialize the Compliance Clock.

- When Snapshot locking is enabled on a volume, you can upgrade the clusters to a version of ONTAP later than ONTAP 9.12.1; however, you cannot revert to an earlier version of ONTAP until all locked Snapshot copies have reached their expiration date and are deleted and Snapshot copy locking is disabled.
- When a Snapshot is locked, the volume expiry time is set to the expiry time of the Snapshot copy. If more than one Snapshot copy is locked, the volume expiry time reflects the largest expiry time among all Snapshot copies.
- The retention period for locked Snapshot copies takes precedence over the Snapshot copy keep count, which means the keep count limit is not honored if the Snapshot copy retention period for locked Snapshot copies has not expired.
- In a SnapMirror relationship, you can set a retention period on a mirror-vault policy rule, and the retention period is applied for Snapshot copies replicated to the destination if the destination volume has Snapshot copy locking enabled. The retention period takes precedence over keep count; for example, Snapshot copies that have not passed their expiry will be retained even if the keep count is exceeded.
- You can rename a Snapshot copy on a non-SnapLock volume. Snapshot rename operations on the primary volume of a SnapMirror relationship are reflected on the secondary volume only if the policy is MirrorAllSnapshots. For other policy types, the renamed Snapshot copy is not propagated during updates.
- If you are using the ONTAP CLI, you can restore a locked Snapshot copy with the `volume snapshot restore` command only if the locked Snapshot copy is the most recent. If there are any unexpired Snapshot copies later than the one being restored, the Snapshot copy restore operation fails.

Features supported with tamperproof Snapshot copies

- FlexGroup volumes

  Snapshot copy locking is supported on FlexGroup volumes. Snapshot locking occurs only on the root constituent Snapshot copy. Deleting the FlexGroup volume is allowed only if the root constituent expiration time has passed.

- FlexVol to FlexGroup conversion

You can convert a FlexVol volume with locked Snapshot copies to a FlexGroup volume. Snapshot copies remain locked after the conversion.

- Volume clone and file clone

  You can create volume clones and file clones from a locked Snapshot copy.

Unsupported features

The following features currently are not supported with tamperproof Snapshot copies:

- Consistency groups
- FabricPool
- FlexCache volumes
- SMtape
- SnapCenter
- SnapMirror Business Continuity (SM-BC)
- SnapMirror Synchronous
- SVM data mobility

Enable Snapshot copy locking when creating a volume

Beginning with ONTAP 9.12.1, you can enable Snapshot copy locking when you create a new volume or when you modify an existing volume by using the `-snapshot-locking-enabled` option with the `volume create` and `volume modify` commands in the CLI. Beginning with ONTAP 9.13.1, you can use System Manager to enable Snapshot copy locking.

System Manager

1. Navigate to **Storage > Volumes** and select **Add**.
2. In the **Add Volume** window, choose **More Options**.
3. Enter the volume name, size, export policy and share name.
4. Select **Enable Snapshot locking**. This selection is not displayed if the SnapLock license is not installed.
5. If it is not already enabled, select **Initialize SnapLock Compliance Clock**.
6. Save your changes.
7. In the **Volumes** window, select the volume you updated and choose **Overview**.
8. Verify that **SnapLock Snapshot Copy Locking** displays as **Enabled**.

CLI

1. To create a new volume and enable Snapshot copy locking, enter the following command:

   ```
   volume create -vserver vserver_name -volume volume_name -snapshot-locking
   -enabled true
   ```

   The following command enables Snapshot copy locking on a new volume named vol1:

   ```
   > volume create -volume vol1 -aggregate aggr1 -size 100m -snapshot
   -locking-enabled true
   Warning: Snapshot copy locking is being enabled on volume "vol1" in
   Vserver "vs1". It cannot be disabled until all locked Snapshot
   copies are past their expiry time. A volume with unexpired locked
   Snapshot copies cannot be deleted.
   Do you want to continue: {yes|no}: y
   [Job 32] Job succeeded: Successful
   ```

Enable Snapshot copy locking on an existing volume

Beginning with ONTAP 9.12.1, you can enable Snapshot copy locking on an existing volume using the ONTAP CLI. Beginning with ONTAP 9.13.1, you can use System Manager to enable Snapshot copy locking on an existing volume.

System Manager

1. Navigate to **Storage > Volumes**.
2. Select ⋮ and choose **Edit > Volume**.
3. In the **Edit Volume** window, locate the Snapshot Copies (Local) Settings section and select **Enable Snapshot locking**.

   This selection is not displayed if the SnapLock license is not installed.
4. If it is not already enabled, select **Initialize SnapLock Compliance Clock**.
5. Save your changes.
6. In the **Volumes** window, select the volume you updated and choose **Overview**.
7. Verify that **SnapLock Snapshot Copy Locking** displays as **Enabled**.

CLI

1. To modify an existing volume to enable Snapshot copy locking, enter the following command:

   ```
   volume modify -vserver vserver_name -volume volume_name -snapshot-locking
   -enabled true
   ```

Create a locked Snapshot copy policy and apply retention

Beginning with ONTAP 9.12.1, you can create Snapshot copy policies to apply a Snapshot copy retention period and apply the policy to a volume to lock Snapshot copies for the specified period. You can also lock a Snapshot copy by manually setting a retention period. Beginning with ONTAP 9.13.1, you can use System Manager to create Snapshot copy locking policies and apply them to a volume.

Create a Snapshot copy locking policy

System Manager

1. Navigate to **Storage > Storage VMs** and select a storage VM.
2. Select **Settings**.
3. Locate **Snapshot Policies** and select →.
4. In the **Add Snapshot Policy** window, enter the policy name.
5. Select + Add .
6. Provide the Snapshot copy schedule details, including the schedule name, maximum Snapshot copies to keep, and SnapLock retention period.
7. In the **SnapLock Retention Period** column, enter the number of hours, days, months or years to retain the Snapshot copies. For example, a Snapshot copy policy with a retention period of 5 days locks a Snapshot copy for 5 days from the time it is created, and it cannot be deleted during that time. The following retention period ranges are supported:
   - Years: 0 - 100
   - Months: 0 - 1200
   - Days: 0 - 36500
   - Hours: 0 - 24
8. Save your changes.

CLI

1. To create a Snapshot copy policy, enter the following command:

   `volume snapshot policy create -policy policy_name -enabled true -schedule1 schedule1_name -count1 maximum_Snapshot_copies -retention-period1 _retention_period`

   The following command creates a Snapshot copy locking policy:

   ```
   cluster1> volume snapshot policy create -policy policy_name -enabled
   true -schedule1 hourly -count1 24 -retention-period1 "1 days"
   ```

   A Snapshot copy is not replaced if it is under active retention; that is, the retention count will not be honored if there are locked Snapshot copies that have not yet expired.

Apply a locking policy to a volume

System Manager

1. Navigate to **Storage > Volumes**.
2. Select ⋮ and choose **Edit > Volume**.
3. In the **Edit Volume** window, select **Schedule Snapshot copies**.
4. Select the locking Snapshot copy policy from the list.
5. If Snapshot copy locking is not already enabled, select **Enable Snapshot locking**.
6. Save your changes.

CLI

1. To apply a Snapshot copy locking policy to an existing volume, enter the following command:

   ```
   volume modify -volume volume_name -vserver vserver_name -snapshot-policy
   policy_name
   ```

Apply retention period during manual Snapshot copy creation

You can apply a Snapshot copy retention period when you manually create a Snapshot copy. Snapshot copy locking must be enabled on the volume, otherwise, the retention period setting is ignored.

System Manager

1. Navigate to **Storage > Volumes** and select a volume.
2. In the volume details page, select the **Snapshot copies** tab.
3. Select + Add .
4. Enter the Snapshot copy name and the SnapLock expiration time. You can select the calendar to choose the retention expiration date and time.
5. Save your changes.
6. In the **Volumes > Snapshot Copies** page, select **Show/Hide** and choose **SnapLock Expiration Time** to display the **SnapLock Expiration Time** column and verify that the retention time is set.

CLI

1. To create a Snapshot copy manually and apply a locking retention period, enter the following command:

   ```
   volume snapshot create -volume volume_name -snapshot snapshot_copy_name
   -snaplock-expiry-time expiration_date_time
   ```

   The following command creates a new Snapshot copy and sets the retention period:

   ```
   cluster1> volume snapshot create -vserver vs1 -volume vol1 -snapshot
   snap1 -snaplock-expiry-time "11/10/2022 09:00:00"
   ```

Apply retention period to an existing Snapshot copy

System Manager

1. Navigate to **Storage > Volumes** and select a volume.
2. In the volume details page, select the **Snapshot copies** tab.
3. Select the Snapshot copy, select ⋮, and choose **Modify SnapLock Expiration Time**. You can select the calendar to choose the retention expiration date and time.
4. Save your changes.
5. In the **Volumes > Snapshot Copies** page, select **Show/Hide** and choose **SnapLock Expiration Time** to display the **SnapLock Expiration Time** column and verify that the retention time is set.

CLI

1. To manually apply a retention period to an existing Snapshot copy, enter the following command:

   `volume snapshot modify-snaplock-expiry-time -volume` *`volume_name`* `-snapshot` *`snapshot_copy_name`* `-expiry-time` *`expiration_date_time`*

   The following example applies a retention period to an existing Snapshot copy:

   ```
   cluster1> volume snapshot modify-snaplock-expiry-time -volume vol1
   -snapshot snap2 -expiry-time "11/10/2022 09:00:00"
   ```

SnapLock APIs

You can use Zephyr APIs to integrate with SnapLock functionality in scripts or workflow automation. The APIs use XML messaging over HTTP, HTTPS, and Windows DCE/RPC. For more information, see ONTAP Automation documentation.

file-fingerprint-abort

Abort a file fingerprint operation.

file-fingerprint-dump

Display file fingerprint information.

file-fingerprint-get-iter

Display the status of file fingerprint operations.

file-fingerprint-start

Generate a file fingerprint.

snaplock-archive-vserver-log

Archive the active audit log file.

snaplock-create-vserver-log

Create an audit log configuration for an SVM.

snaplock-delete-vserver-log

Delete an audit log configuration for an SVM.

snaplock-file-privileged-delete

Execute a privileged delete operation.

snaplock-get-file-retention

Get the retention period of a file.

snaplock-get-node-compliance-clock

Get the node ComplianceClock date and time.

snaplock-get-vserver-active-log-files-iter

Display the status of active log files.

snaplock-get-vserver-log-iter

Display the audit log configuration.

snaplock-modify-vserver-log

Modify the audit log configuration for an SVM.

snaplock-set-file-retention

Set the retention time for a file.

snaplock-set-node-compliance-clock

Set the node ComplianceClock date and time.

snaplock-volume-set-privileged-delete

Set the privileged-delete option on a SnapLock Enterprise volume.

volume-get-snaplock-attrs

Get the attributes of a SnapLock volume.

volume-set-snaplock-attrs

Set the attributes of a SnapLock volume.

Consistency groups management

Consistency groups overview

A consistency group is a collection of volumes that are managed as a single unit. In ONTAP, consistency groups provide easy management and a protection guarantee for an application workload spanning multiple volumes.

You can use consistency groups to simplify your storage management. Imagine you have an important database spanning twenty LUNs. You could manage the LUNs on an individual basis or treat the LUNs as a solitary dataset, organizing them into a single consistency group.

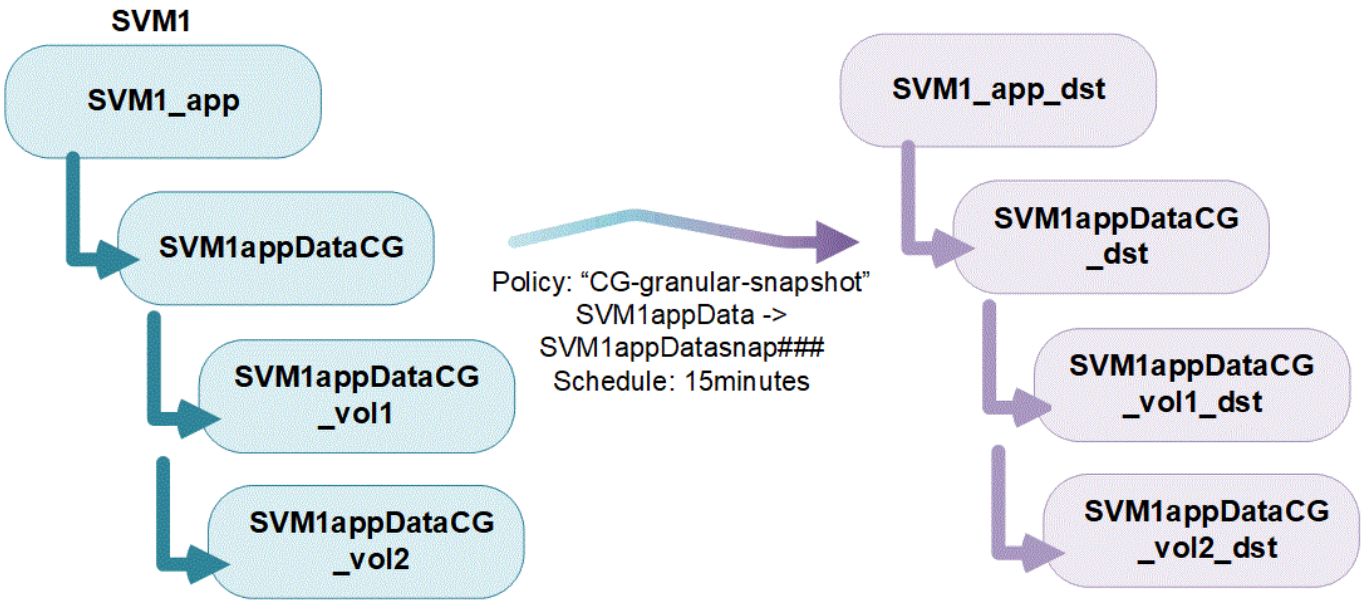
Consistency groups facilitate application workload management, providing easily configured local and remote protection policies and simultaneous crash-consistent or application-consistent Snapshot copies of a collection of volumes at a point in time. Snapshots in consistency groups enable an entire application workload to be restored.

Understand consistency groups

Consistency groups support any FlexVol volume regardless of protocol (NAS, SAN, or NVMe) and can be managed through the ONTAP REST API or in System Manager under the **Storage > Consistency Groups** menu item.

Consistency groups can exist as individual entities—as a collection of volumes—or in a hierarchical relationship, which consists of other consistency groups. Individual volumes can have their own volume-granular snapshot policy. In addition, there can be a consistency group-wide snapshot policy. The consistency group can only have one SnapMirror Business Continuity (SM-BC) relationship and shared SM-BC policy, which can be used to recover the entire consistency group.

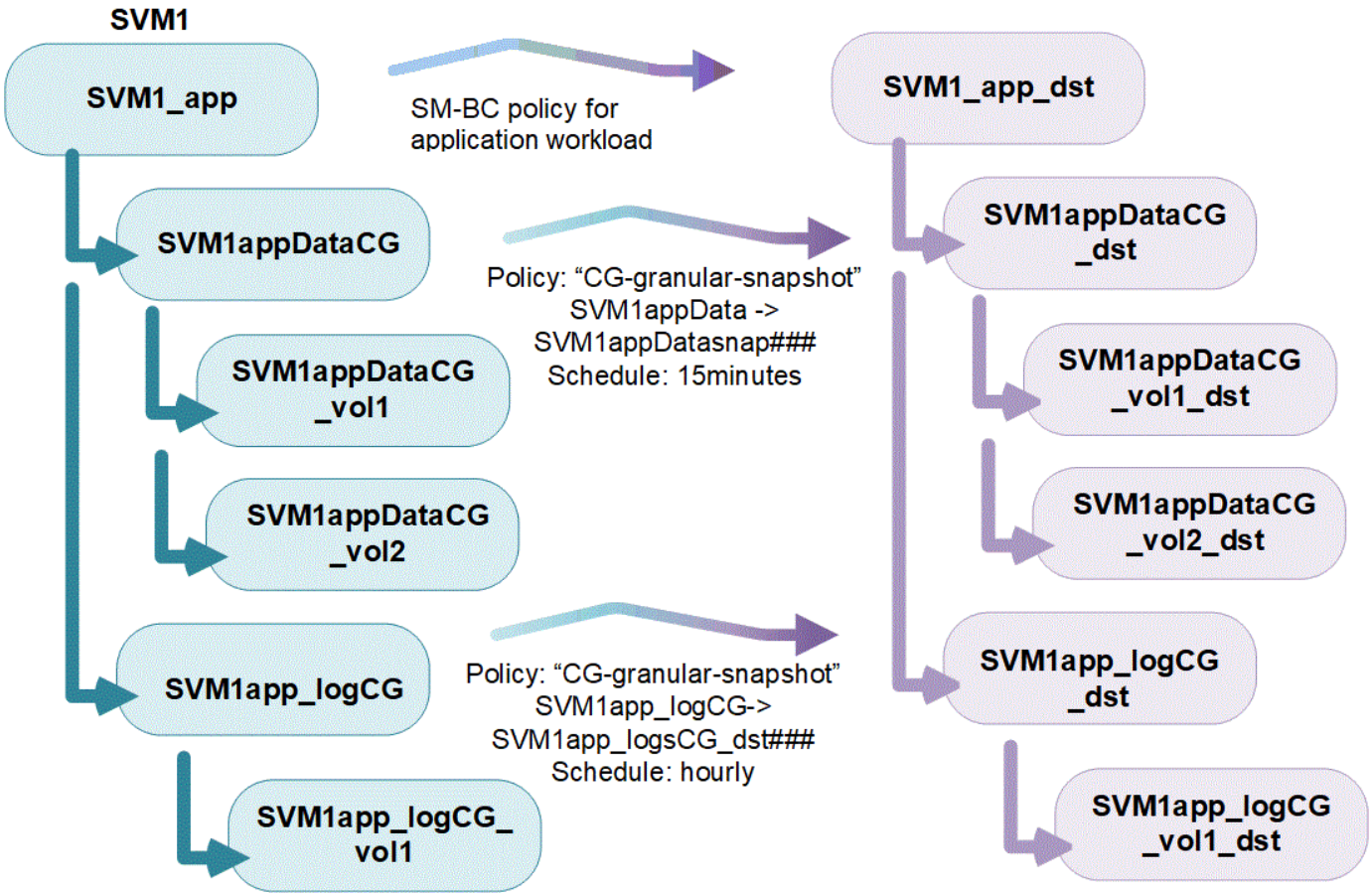
The following diagram illustrates how you might use an individual consistency group. The data for an application hosted on `SVM1` spans two volumes: `vol1` and `vol2`. A Snapshot policy on the consistency group captures snapshots of the data every 15 minutes.



Larger application workloads might require multiple consistency groups. In these situations, you can create

hierarchical consistency groups, where a single consistency group becomes the child components of a parent consistency group. The parent consistency group can include up to five child consistency groups. Like in individual consistency groups, a remote SM-BC protection policy can be applied to the entire configuration of consistency groups (parent and children) to recover the application workload.

In the following example, an application is hosted on `SVM1`. The administrator has created a parent consistency group, `SVM1_app`, which includes two child consistency groups: `SVM1appDataCG` for the data and `SVM1app_logCG` for the logs. Each child consistency group has its own snapshot policy. Snapshots of the volumes in `SVM1appDataCG` are taken every 15 minutes. Snapshots of `SVM1app_logCG` are taken hourly. The parent consistency group `SVM1_app` has an SM-BC policy which replicates the data to ensure continued service in the event of a disaster.



Beginning with ONTAP 9.12.1, consistency groups support cloning and modifying the members of the consistency by adding or removing volumes in both System Manager and the ONTAP REST API. Beginning in ONTAP 9.12.1, the ONTAP REST API also supports:

- Creating consistency groups with new NFS or SMB volumes or NVMe namespaces.
- Adding new or existing NFS or SMB volumes or NVMe namespaces to existing consistency groups.

For more information about the ONTAP REST API, refer to ONTAP REST API reference documentation.

Monitor consistency groups

Beginning in ONTAP 9.13.1, consistency groups offer real-time and historical capacity and performance monitoring, offering insights about the performance of applications and individual consistency groups.

Consistency group monitoring data is maintained for up to one year. You can track metrics for:

- Performance: IOPS, latency, and throughput
- Capacity: Size, available capacity, used capacity

> You can retrieve historical metrics only with the REST API. Historical metrics are not viewable in System Manager.

Protect consistency groups

Consistency groups offer protection through:

- Snapshot policies
- SnapMirror Business Continuity (SM-BC)
- MetroCluster support (beginning 9.11.1)
- Asynchronous SnapMirror (beginning 9.13.1)

Creating a consistency group does not automatically enable protection. Local and remote protection policies can be set when creating or after creating a consistency group.

To configure protection on a consistency group, see Protect a consistency group.

In order to utilize remote protection, you must meet the requirements for SnapMirror Business Continuity deployments.

> SM-BC relationships cannot be established on volumes mounted for NAS access.

Application and component tags

Beginning in ONTAP 9.12.1, consistency groups support component and application tagging. Application and component tags are a management tool, enabling you to filter and identify different workloads in your consistency groups.

There are two types of tags:

- **Application tags**: these apply to individual and parent consistency groups. Application tags provide labeling for workloads such as MongoDB, Oracle, or SQL Server. The default application tag for consistency groups is Other.
- **Component tags**: Children in hierarchal consistency groups have component tags instead of application tags. The options for component tags are "data", "logs", or "other". The default value is Other.

You can apply tags when creating consistency groups or after the consistency groups have been created. If the consistency group has an SM-BC relationship, you must use **Other** as the application or component tag.

Consistency groups in MetroCluster configurations

Beginning with ONTAP 9.11.1, you can provision consistency groups with new volumes on a cluster within a MetroCluster configuration. These volumes are provisioned on mirrored aggregates.

After they are provisioned, you can move volumes associated with consistency groups between mirrored and unmirrored aggregates. Therefore, volumes associated with consistency groups can be located on mirrored aggregates, unmirrored aggregates, or both. You can modify mirrored aggregates containing volumes associated with consistency groups to become unmirrored. Similarly, you can modify unmirrored aggregates

containing volumes associated with consistency groups to enable mirroring.

Volumes associated and Snapshots associated with consistency groups placed on mirrored aggregates are replicated to the remote site (site B). The contents of the volumes on site B provide a write-order guarantee for the consistency group, allowing you to recover from site B in the event of a disaster. You can access replicated consistency group Snapshots using consistency group Snapshot REST API and System Manager on clusters running ONTAP 9.11.1 or later.

If some or all the volumes associated with a consistency group are located on unmirrored aggregates that are not currently accessible, GET or DELETE operations on the consistency group behave as if the local volumes or hosting aggregates are offline.

Consistency group configurations for replication

If site B is running ONTAP 9.10.1 or earlier, only the volumes associated with the consistency groups located on mirrored aggregates are replicated to site B. The consistency group configurations are only replicated to site B, if both sites are running ONTAP 9.11.1 or later. After site B is upgraded to ONTAP 9.11.1, data for consistency groups on site A that have all their associated volumes placed on mirrored aggregates are replicated to site B.

> It's recommended you maintain at least 20% free space for mirrored aggregates for optimal storage performance and availability. Although the recommendation is 10% for non-mirrored aggregates, the additional 10% of space may be used by the filesystem to absorb incremental changes. Incremental changes increase space utilization for mirrored aggregates due to ONTAP's copy-on-write Snapshot-based architecture. Failure to adhere to these best practices may have a negative impact on performance.

Upgrade considerations

Consistency groups created with SM-BC in ONTAP 9.8 and 9.9.1 will automatically be upgraded and become manageable under **Storage > Consistency Groups** in System Manager or the ONTAP REST API when upgrading to ONTAP 9.10.1 or later. For more information about upgrading from ONTAP 9.8 or 9.9.1, see SM-BC upgrade and revert considerations.

Consistency group snapshots created in the REST API can be managed through System Manager's Consistency Group interface and through consistency group REST API endpoints.

> Snapshots created with the ONTAPI commands `cg-start` and `cg-commit` will not be recognized as consistency group Snapshots and thus cannot be managed through System Manager's consistency group interface or the consistency group endpoints in the ONTAP REST API.

Supported features by release

	ONTAP 9.13.1	ONTAP 9.12.1	ONTAP 9.11.1	ONTAP 9.10.1
Hierarchical consistency groups	X	X	X	X
Local Snapshot protection	X	X	X	X
SnapMirror Business Continuity	X	X	X	X
MetroCluster support	X	X	X	
Two-phase commits (REST API only)	X	X	X	

	ONTAP 9.13.1	ONTAP 9.12.1	ONTAP 9.11.1	ONTAP 9.10.1
Application and component tags	X	X		
Clone consistency groups	X	X		
Add and remove volumes	X	X		
Create CGs with new NAS volumes	X	REST API only		
Create CGs with new NVMe Namespaces	X	REST API only		
Move volumes between child consistency groups	X			
Modify consistency group geometry	X			
Monitoring	X			
Async SnapMirror (single consistency groups only)	X			

Learn more about consistency groups

More information

- ONTAP Automation documentation
- SnapMirror Business Continuity
- Asynchronous SnapMirror disaster recovery basics
- MetroCluster documentation

Consistency group limits

When planning and managing your consistency groups, account for object limits at the scope of both the cluster and the parent or child consistency group.

If you are using SnapMirror Business Continuity, refer to SM-BC restrictions and limitations for limits.

Limit	Scope	Minimum	Maximum
Number of consistency groups	Cluster	0	Same as maximum volume count in cluster
Number of parent consistency groups	Cluster	0	Same as maximum volume count in cluster
Number of individual and parent consistency groups	Cluster	0	Same as maximum volume count in cluster
Number of volumes in a consistency group	Single consistency group	1 volume	80 volumes
Number of volumes in the child of a parent consistency group	Parent consistency group	1 volume	80 volumes
Number of volumes in a child consistency group	Child consistency group	1 volume	80 volumes
Number of child consistency groups in a parent consistency group	Parent consistency group	1 consistency group	5 consistency groups

Configure a single consistency group

Consistency groups can be created with existing volumes or new LUNs or volumes (depending on the version of ONTAP). A volume or LUN can only be associated with one consistency group at a time.

Before you begin

- In ONTAP 9.10.1 through 9.11.1, modifying the member volumes of a consistency group after it is created is not supported.

  Beginning in ONTAP 9.12.1, you can modify the member volumes of a consistency group. For more information on this process, refer to Modify a consistency group.

Create a consistency group with new LUNs or volumes

In ONTAP 9.10.1 through 9.12.1, you can create a consistency group using new LUNs. Beginning in ONTAP 9.13.1, System Manager also supports creating a consistency group with new NVMe namespaces or new NAS volumes. (This is also supported in the ONTAP REST API beginning with ONTAP 9.12.1.)

Steps

1. Select **Storage > Consistency groups**.

2. Select **+Add** then select the protocol for your storage object.

   In ONTAP 9.10.1 through 9.12.1, the only option for a new storage object is **Using new LUNs**. Beginning in ONTAP 9.13.1, System Manager supports creating consistency groups with new NVMe namespaces and new NAS volumes.

3. Name the consistency group. Designate the number of volumes or LUNs and the capacity per volume or LUN.
   a. **Application Type**: If you are using ONTAP 9.12.1 or later, select an application type. If no value is selected, the consistency group will be assigned the type of **Other** by default. Learn more about tagging consistency in Application and component tags. If you plan to create a consistency group with a remote protection policy, you must use **Other**.
   b. For **New LUNs**: Select the host operating system and LUN format. Enter the host initiator information.
   c. For **New NAS volumes**: choose the appropriate export option (NFS or SMB/CIFS) based on the NAS configuration of your SVM.
   d. For **New NVMe namespaces**: Select the host operating system and NVMe subsystem.
4. To configure protection policies, add a child consistency group, or access permissions, select **More options**.
5. Select **Save**.
6. Confirm your consistency group has been created by returning to the main consistency group menu where it will appear once the job completes. If you set a protection policy, you will know it has been applied when you see a green shield under look under the appropriate policy, remote or local.

Create a consistency group with existing volumes

You can use existing volumes to create a consistency group.

Steps

1. Select **Storage > Consistency groups**.
2. Select **+Add** then **Using existing volumes**.
3. Name the consistency group and select the storage VM.
   a. **Application Type**: If you are using ONTAP 9.12.1 or later, select an application type. If no value is selected, the consistency group will be assigned the type of **Other** by default. Learn more about tagging consistency in Application and component tags. If the consistency group has an SM-BC relationship, you must use **Other**.
4. Select the existing volumes to include. Only volumes that are not already part of a consistency group will be available for selection.

   If creating a consistency group with existing volumes, the consistency group supports FlexVol volumes. Volumes with Asynchronous or Synchronous SnapMirror relationships can be added to consistency groups, but they are not consistency group-aware. Consistency groups do not support S3 buckets, or storage VMs with SVMDR relationships.

5. Select **Save**.
6. Confirm your consistency group has been created by returning to the main consistency group menu where it will appear once the ONTAP job completes. If you have chosen a protection policy, confirm it was properly set by selecting your consistency group from the menu. If you set a protection policy, you will know it has been applied when you see a green shield under look under the appropriate policy, remote or local.

Next steps

- Protect a consistency group
- Modify a consistency group
- Clone a consistency group

Configure a hierarchical consistency group

Hierarchical consistency groups enable you to manage large workloads spanning multiple volumes, creating a parent consistency group that serves as an umbrella for child consistency groups.

Hierarchical consistency groups have a parent that can include up to five individual consistency groups. Hierarchical consistency groups can support different local Snapshot policies across consistency groups or individual volumes. If you use a remote protection policy, that will apply for the entire hierarchical consistency group (parent and children).

Beginning in ONTAP 9.13.1, you can modify the geometry of your consistency groups and move volumes between child consistency groups.

For object limits on consistency groups, see Object limits for consistency groups.

Create a hierarchical consistency group with new LUNs or volumes

When creating a hierarchical consistency group, you can populate it with new LUNs. Beginning in ONTAP 9.13.1, you can also use new NVMe namespaces and NAS volumes.

Steps

1. Select **Storage > Consistency groups**.
2. Select **+Add** then select the protocol for your storage object.

   In ONTAP 9.10.1 through 9.12.1, the only option for a new storage object is **Using new LUNs**. Beginning in ONTAP 9.13.1, System Manager supports creating consistency groups with new NVMe namespaces and new NAS volumes.

3. Name the consistency group. Designate the number of volumes or LUNs and the capacity per volume or LUN.
   a. **Application Type**: If you are using ONTAP 9.12.1 or later, select an application type. If no value is selected, the consistency group will be assigned the type of **Other** by default. Learn more about tagging consistency in Application and component tags. If you plan to use a remote protection policy, you must choose **Other**.
4. Select the host operating system and LUN format. Enter the host initiator information.
   a. For **New LUNs**: Select the host operating system and LUN format. Enter the host initiator information.
   b. For **New NAS volumes**: choose the appropriate export option (NFS or SMB/CIFS) based on the NAS configuration of your SVM.
   c. For **New NVMe namespaces**: Select the host operating system and NVMe subsystem.
5. To add a child consistency group, select **More options** then **+Add child consistency group**.
6. Select the performance level, the number of LUNs or volumes, and capacity per LUN or volume. Designate the appropriate export configurations or operating system information based on the protocol you are using.

7. Optionally, select a local snapshot policy and set the access permissions.
8. Repeat for up to five child consistency groups.
9. Select **Save**.
10. Confirm your consistency group has been created by returning to the main consistency group menu where it will appear once the ONTAP job completes. If you set a protection policy, look under the appropriate policy, remote or local, which should display a green shield with a checkmark in it.

Create a hierarchical consistency group with existing volumes

You can organize existing volumes into a hierarchical consistency group.

Steps

1. Select **Storage > Consistency groups**.
2. Select **+Add** then **Using existing volumes**.
3. Select the storage VM.
4. Select the existing volumes to include. Only volumes that are not already part of a consistency group will be available for selection.
5. To add a child consistency group, select **+Add Child Consistency Group**. Create the necessary consistency groups, which will be named automatically.
   a. **Component Type**: If you are using ONTAP 9.12.1 or later, select a component type of "data", "logs", or "other". If no value is selected, the consistency group will be assigned the type of **Other** by default. Learn more about tagging consistency in Application and component tags. If you plan to use a remote protection policy, you must use **Other**.
6. Assign existing volumes to each consistency group.
7. Optionally, select a local Snapshot policy.
8. Repeat for up to five child consistency groups.
9. Select **Save**.
10. Confirm your consistency group has been created by returning to the main consistency group menu where it will appear once the ONTAP job completes. If you have chosen a protection policy, confirm it was properly set by selecting your consistency group from the menu; under the appropriate policy type, you will see a green shield with a checkmark inside of it.

Next steps

- Modify the geometry of a consistency groups
- Modify a consistency group
- Protect a consistency group

Protect a consistency group

Consistency groups offer easily managed local and remote protection for SAN, NAS, and NVMe applications that span multiple volumes.

Creating a consistency group does not automatically enable protection. Protection policies can be set at the time of creation or after creating your consistency group. You can protect consistency groups using:

- Local Snapshot policies

- SnapMirror Business Continuity (SM-BC)
- Asynchronous SnapMirror (beginning 9.13.1)

If you are utilizing nested consistency groups, you can set different protection policies for the parent and child consistency groups.

Beginning in ONTAP 9.11.1, consistency groups offer two-phase consistency group Snapshot creation. The two-phase Snapshot executes a precheck, ensuring the Snapshot will be captured successfully.

Recovery can occur for an entire consistency group, a single consistency group in a hierarchical configuration, or for individual volumes within the consistency group. Recovery can be achieved by selecting the consistency group you want to recover from, selecting the Snapshot copy type, and then identifying the Snapshot copy to base the restoration on. For more information about this process, see Restore a volume from an earlier Snapshot copy.

Set a local Snapshot protection policy

Setting a local snapshot protection policy allows you to create a policy spanning all volumes in a consistency group.

Steps

1. Select **Storage > Consistency groups**.
2. Select the consistency group you have created from the Consistency group menu.
3. At the top right of the overview page for the consistency group, select **Edit**.
4. Check the box next to **Schedule Snapshot copies (local)**.
5. Select a Snapshot policy. To configure a new, custom policy, refer to Create a custom data protection policy.
6. Select **Save**.
7. Return to the consistency group overview menu. In the left column under **Snapshot Copies (Local)**, the status will say protected next to  .

Create two-phase consistency group snapshots

Beginning in ONTAP 9.11.1, consistency groups support two-phase commits for consistency group (CG) Snapshot creation, which execute a precheck before committing the Snapshot. This feature is only available with the ONTAP REST API.

Two-phase CG Snapshot creation is only available for Snapshot creation, not provisioning consistency groups or restoring consistency groups.

A two-phase CG Snapshot creation breaks the Snapshot creation process invoked with a POST request to the `/application/consistency-groups/{consistency_group_uuid}/snapshots` endpoint into a sequence of two phases:

1. In the first phase initiated with a POST request, the API executes prechecks, triggers Snapshot creation, and starts a timer for designated interval.
2. If the POST request in phase one completes with a 201 status code, you can invoke the second phase within the designated interval from the first phase, committing the Snapshot to the appropriate endpoint.

For more information about the ONTAP REST API, refer to the API reference or visit the ONTAP REST API

page at the NetApp Developer Network for a complete list of API endpoints.

Before you begin

- To use two-phase CG Snapshot creation, all nodes in the cluster must be running ONTAP 9.11.1 or later.
- Only one active invocation of a consistency group Snapshot creation operation is supported on a consistency group instance at a time, whether it be a one-phase or two-phase. Attempting to invoke a Snapshot creation while another one is in progress will result in a failure.
- The two-phase consistency group Snapshot creation can be invoked with the `action=start` parameter.

  You can additionally use the `action_timeout` parameter to specify the maximum number of seconds that the Snapshot creation process can take.
  The `action_timeout` parameter can be set equal to an integer between 5 and 120. The default value of `action_timeout` is 7.

Steps

1. Invoke the Snapshot creation. Send a POST request to the consistency group endpoint using the `action=start` parameter.

```
curl -k -X POST 'https://<IP_address>/application/consistency-
groups/<cg-uuid>/snapshots?action=start&action_timeout=7' -H "accept:
application/hal+json" -H "content-type: application/json" -d '
{
  "name": "<snapshot_name>",
  "consistency_type": "crash",
  "comment": "<comment>",
  "snapmirror_label": "<SnapMirror_label>"
}'
```

2. If the POST request succeeds, your output will include a snapshot uuid. Using that uuid, submit a PATCH request to commit the Snapshot.

```
curl -k -X PATCH 'https://<IP_address>/application/consistency-
groups/<cg_uuid>/snapshots/<snapshot_id>?action=commit' -H "accept:
application/hal+json" -H "content-type: application/json"
```

Set remote protection for a consistency group

Consistency groups offer remote protection through SM-BC and, beginning in ONTAP 9.13.1, asynchronous SnapMirror.

Configure protection with SM-BC

You can utilize SM-BC to ensure Snapshot copies of consistency groups created on your consistency group are copied to the destination. To learn more about SM-BC, refer to Configure protection for business continuity.

Before you begin

- SM-BC relationships cannot be established on volumes mounted for NAS access.
- The policy labels in the source and destination cluster must match.
- SM-BC will not replicate Snapshot copies by default unless a rule with a SnapMirror label is added to the predefined `AutomatedFailOver` policy and the Snapshot copies are created with that label.

  To learn more about this process, refer to Configure protection for business continuity.

- Beginning in ONTAP 9.13.1, you can non-disruptively add volumes to a consistency group with an active SM-BC relationship. Any other changes to a consistency group require you to break the SM-BC relationship, modify the consistency group, then reestablish and resynchronize the relationship.

Steps

1. Ensure you have met the prerequisites for using SM-BC.
2. Select **Storage > Consistency groups**.
3. Select the consistency group you have created from the Consistency group menu.
4. At the top right of the overview page, select **More** then **Protect**.
5. System Manager auto-fills source-side information. Select the appropriate cluster and storage VM for the destination. Select a protection policy. Ensure that **Initialize relationship** is checked.
6. Select **Save**.
7. The consistency group needs to initialize and synchronize. Confirm synchronization has completed successfully by returning to the **Consistency group** menu. The **SnapMirror (Remote)** status displays `Protected` next to  .

Configure asynchronous SnapMirror protection

Beginning in ONTAP 9.13.1, you can configure asynchronous SnapMirror protection for a single consistency group.

Before you begin

- Asynchronous SnapMirror protection is only available for single consistency groups. It is not supported for hierarchical consistency groups. To convert a hierarchical consistency group into a single consistency group, see modify consistency group architecture.
- Cascade deployments are not supported with SM-BC.
- The policy labels in the source and destination cluster must match.
- You can non-disruptively add volumes to a consistency group with an active asynchronous SnapMirror relationship. Any other changes to a consistency group require you to break the SnapMirror relationship, modify the consistency group, then reestablish and resynchronize the relationship.
- If you have configured an asynchronous SnapMirror protection relationship for multiple individual volumes, you can convert those volumes into a consistency group while retaining the existing Snapshots. To convert volumes successfully:
- There must be a common Snapshot copy of the volumes.
- You must break the existing SnapMirror relationship, add the volumes to a single consistency group, then resynchronize the relationship using the following workflow.

Steps

1. From the destination cluster, select **Storage > Consistency groups**.

2. Select the consistency group you have created from the Consistency group menu.
3. At the top right of the overview page, select **More** then **Protect**.
4. System Manager auto-fills source-side information. Select the appropriate cluster and storage VM for the destination. Select a protection policy. Ensure that **Initialize relationship** is checked.

   When selecting an asynchronous policy, you have the option to **Override Transfer Schedule**.

   The minimum supported schedule (recovery point objective, or RPO) for consistency groups with asynchronous SnapMirror is 30 minutes.

5. Select **Save**.
6. The consistency group needs to initialize and synchronize. Confirm synchronization has completed successfully by returning to the **Consistency group** menu. The **SnapMirror (Remote)** status displays `Protected` next to  .

Visualize relationships

System Manager visualizes LUN maps under the **Protection > Relationships** menu. When you select a source relationship, System Manager displays a visualization of the source relationships. By selecting a volume, you can delve deeper into these relationships to see a list of the contained LUNs and the initiator group relationships. This information can be downloaded as an Excel workbook from the individual volume view; the download operation will run in the background.

Related information

- Clone a consistency group
- Configure Snapshot copies
- Create custom data protection policies
- Recover from Snapshot copies
- Restore a volume from an earlier Snapshot copy
- SM-BC overview
- ONTAP Automation documentation
- Asynchronous SnapMirror disaster recovery basics

Modify member volumes in a consistency group

Beginning in ONTAP 9.12.1, you can modify a consistency group by removing volumes or adding existing volumes (expanding the consistency group). Beginning in ONTAP 9.13.1, you can move volumes between child consistency groups if they share a common parent.

Add volumes to a consistency group

Beginning in ONTAP 9.12.1, you can non-disruptively add volumes to a consistency group.

Before you begin

- You cannot add volumes associated with another consistency group.
- Consistency groups support NAS, SAN, and NVMe protocols.

- You can add up to 16 volumes at a time to a consistency group if the adjustments are within the overall consistency group limits.
- Beginning in ONTAP 9.13.1, you can non-disruptively add volumes to a consistency group with an active SnapMirror Business Continuity (SM-BC) or asynchronous SnapMirror protection policy.
- When you add volumes to a consistency group protected by SM-BC, the status of the SM-BC relationship status will change to "Expanding" until mirroring and protection are configured for the new volume. If a disaster occurs on the primary cluster before this process completes, the consistency group reverts back to its original composition as part of the failover operation.
- In ONTAP 9.12.1, you *cannot* add volumes to a consistency group in an SM-BC relationship. You must first break the SM-BC relationship, modify the consistency group, then restore protection with SM-BC.
- Beginning in ONTAP 9.12.1, the ONTAP REST API supports adding *new* or existing volumes to a consistency group. For more information about the ONTAP REST API, refer to ONTAP REST API reference documentation.

  Beginning in ONTAP 9.13.1, this functionality is supported in System Manager.
- When expanding a consistency group, Snapshot copies of the consistency group captured before the modification will be considered partial. Any restore operation based on that Snapshot copy will reflect the consistency group at the point-in-time of the snapshot.
- If you are using ONTAP 9.10.1 through 9.11.1, you cannot modify a consistency group. To change the configuration of a consistency group in ONTAP 9.10.1 or 9.11.1, you must delete the consistency group, then create a new consistency group with the volumes you want to include.

Steps

1. Select **Storage > Consistency groups**.
2. Select the consistency group that you want to modify.
3. If you are modifying a single consistency group, at the top of the **Volumes** menu, select **More** and then **Expand** to add a volume.

   If you are modifying a child consistency group, identify the parent consistency group you want to modify. Select the **>** button to view the child consistency groups, then select ⋮ next to the name of the child consistency group you want to modify. From that menu, select **Expand**.
4. Select up to 16 volumes to add to the consistency group.
5. Select **Save**. When the operation completes, view the newly added volumes in the consistency group's **Volumes** menu.

Remove volumes from a consistency group

Volumes removed from a consistency group are not deleted. They remain active in the cluster.

Before you begin

- You cannot remove volumes from a consistency group in a SnapMirror Business Continuity (SM-BC) relationship. You must first break the SM-BC relationship to modify the consistency group and then reestablish the relationship.
- If a consistency group has no volumes in it following the remove operation, the consistency group will be deleted.
- When a volume is removed from a consistency group, existing Snapshots of the consistency group remain but are considered invalid. The existing Snapshots cannot be used to restore the contents of the consistency group. Volume-granular Snapshots remain valid.

- If you delete a volume from the cluster, it is automatically removed from the consistency group.
- To change the configuration of a consistency group in ONTAP 9.10.1 or 9.11.1, you must delete the consistency group then create a new consistency group with the desired member volumes.
- Deleting a volume from the cluster will automatically remove it the consistency group.

Steps

1. Select **Storage > Consistency groups**.
2. Select the single or child consistency group that you want to modify.
3. In the **Volumes** menu, select the checkboxes next to the individual volumes you want to remove from the consistency group.
4. Select **Remove volumes from the consistency group**.
5. Confirm that you understand removing the volumes will cause all Snapshot copies of the consistency group to become invalid and select **Remove**.

Move volumes between consistency groups

Beginning in ONTAP 9.13.1, you can move volumes between child consistency groups that share a parent.

Before you begin

- You can only move volumes between consistency groups nested under the same parent consistency group.
- Existing consistency group Snapshots become invalid and no longer accessible as consistency group snapshots. Individual volume Snapshots remain valid.
- Snapshot copies of the parent consistency group remain valid.
- If you move all volumes out of a child consistency group, that consistency group will be deleted.
- Modifications to a consistency group must abide by consistency group limits.

Steps

1. Select **Storage > Consistency groups**.
2. Select the parent consistency group that contains the volumes you want to move. Find the child consistency group and then expand the **Volumes** menu. Select the volumes you want to move.
3. Select **Move**.
4. Choose whether you want to move the volumes to a new consistency group or an existing group.
   a. To move to an existing consistency group, select **Existing child consistency group** then choose the consistency group's name from the dropdown menu.
   b. To move to a new consistency group, select **New child consistency group**. Enter a name for the new child consistency group and select a component type.
5. Select **Move**.

Related information

- Consistency group limits
- Clone a consistency group

Modify consistency group geometry

Beginning in ONTAP 9.13.1, you can modify the geometry of a consistency group. Modifying the geometry of a consistency group enables you to alter the configuration of child or parent consistency groups without disruption to ongoing IO operations.

Modifying consistency group geometry will have an impact on existing snapshot copies.

> ⓘ You cannot modify the geometry of a consistency group that is configured with a remote protection policy. You must first break the protection relationship, modify the geometry, then restore remote protection.

Add a new child consistency group

Beginning in ONTAP 9.13.1, you can add a new child consistency group to an existing parent consistency group.

Before you begin

- A parent consistency group can contain a maximum of five child consistency groups. See consistency group limits for other limits.
- You cannot add a child consistency group to a single consistency group. You must first promote the consistency group, then you can add a child consistency group.
- Existing Snapshot copies of the consistency group captured before the expand operation will be considered partial. Any restore operation based on that snapshot copy will reflect the consistency group at the point-in-time of the Snapshot copy.

Steps

1. Select **Storage > Consistency groups**.
2. Select the parent consistency group you want to which you want to add a child consistency group.
3. Next to the parent consistency group's name, select **More** then **Add new child consistency group**.
4. Enter a name for your consistency group.
5. Choose whether you would like to add new or existing volumes.
    a. If you are adding existing volumes, select **Existing volumes** then choose the volumes from the dropdown menu.
    b. If you are adding new volumes, select **New volumes** then designate the number of volumes and their size.
6. Select **Add**.

Detach a child consistency group

Beginning in ONTAP 9.13.1, you can remove a child consistency group from its parent, converting it into an individual consistency group.

Before you begin

- Detaching a child consistency group causes the parent consistency group's snapshots to become invalid and inaccessible. Volume granular snapshots remain valid.
- Existing Snapshot copies of the individual consistency group remain valid.

Steps

1. Select **Storage > Consistency groups**.
2. Select the parent consistency group that contains the child you want to detach.
3. Next to the child consistency group you want to detach, select **More** then **Detach from parent**.
4. Optionally, rename the consistency group and select an application type.
5. Select **Detach**.

Move a single consistency group under a parent consistency group

Beginning in ONTAP 9.13.1, you can convert an existing single consistency group to a child consistency group. You can either move the consistency group under an existing parent consistency group or create a new parent consistency group during the move operation.

Before you begin

- The parent consistency group must have four or fewer children. A parent consistency group can contain a maximum of five child consistency groups. See consistency group limits for other limits.
- Existing snapshot copies of the *parent* consistency group captured before this operation will be considered partial. Any restore operation based on one of those Snapshot copies will reflect the consistency group at the point-in-time of the Snapshot copy.
- Existing consistency group snapshots of the single consistency group remain valid.

Steps

1. Select **Storage > Consistency groups**.
2. Select the consistency group you want to convert.
3. Select **More** then **Move under different consistency group**.
4. Optionally, enter a new name for the consistency group and select a component type. By default, the component type will be Other.
5. Choose if you want to migrate to an existing parent consistency group or create a new parent consistency group:
   a. To migrate to an existing parent consistency group, select **Existing consistency group** then choose the consistency group from the dropdown menu.
   b. To create a new parent consistency group, select **New consistency group** then provide a name for the new consistency group.
6. Select **Move**.

Promote a child consistency group

Beginning in ONTAP 9.13.1, you can promote a single consistency group to a parent consistency group. When you promote the single consistency group to a parent, you also create a new child consistency group that inherits all of the volumes in the original, single consistency group.

Before you begin

- If you want to convert a child consistency group to a parent consistency group, you must first detach the child consistency group then follow this procedure.
- Existing Snapshot copies of the consistency group remain valid after you promote the consistency group.

Steps

1. Select **Storage > Consistency groups**.
2. Select the consistency group you want to promote.
3. Select **More** then **Promote to parent consistency group**.
4. Enter a **Name** and select a **Component type** for the child consistency group.
5. Select **Promote**.

Demote a parent to a single consistency group

Beginning in ONTAP 9.13.1, you can demote a parent consistency group to a single consistency group. Demoting the parent flattens the hierarchy of the consistency group, removing all associated child consistency groups. All volumes in the consistency group will remain under the new, single consistency group.

Before you begin

- Existing Snapshot copies of the parent consistency group remain valid after you demote it to a single consistency. Existing Snapshot copies of any of the associated child consistency groups of that parent will become invalid, but the individual volume snapshots within them continue to be accessible as volume-granular Snapshots.

Steps

1. Select **Storage > Consistency groups**.
2. Select the parent consistency group you want to demote.
3. Select **More** then **Demote to single consistency group**.
4. A warning will advise you that all associated child consistency groups will be deleted and their volumes will be moved under the new, single consistency group. Select **Demote** to confirm you understand the impact.

Clone a consistency group

Beginning in ONTAP 9.12.1, you can clone a consistency group to create a copy of a consistency group and its contents. Cloning a consistency group creates a copy of the consistency group configuration, its metadata such as application type, and all the volumes and its contents such as files, directories, LUNs or NVMe namespaces.

When cloning a consistency group, you can clone it with its current configuration, but with volume contents as they are or based on an existing consistency group Snapshot.

Cloning a consistency group is supported only for the entire consistency group. You cannot clone an individual child consistency group in a hierarchical relationship: only the complete consistency group configuration can be cloned.

When you clone a consistency group, the following components are not cloned:

- iGroups
- LUN maps
- NVMe subsystems
- NVMe namespace subsystem maps

Before you begin

- When you clone a consistency group, ONTAP will not create SMB shares for the cloned volumes if a share

name is not specified. * Cloned consistency groups are not mounted if a junction path is not specified.

- If you attempt to clone a consistency group based on a Snapshot that does not reflect the consistency group's current configuration, the operation will fail.
- After you clone a consistency group, you need to perform the appropriate mapping operation.

  Refer to Map igroups to multiple LUNs or Map an NVMe namespace to a subsystem for more information.

- Cloning a consistency group is not supported for a consistency group in a SnapMirror Business Continuity relationship or with any associated DP volumes.

Steps

1. Select **Storage > Consistency groups**.
2. Select the consistency group you want to clone from the **Consistency Group** menu.
3. At the top right of the overview page for the consistency group, select **Clone**.
4. Enter a name for the new, cloned consistency group or accept the default name.
   a. Choose if you want to enable **Thin Provisioning**.
   b. Choose **Split Clone** if you want to dissociate the consistency group from its source and allocate additional disk space for the cloned consistency group.
5. To clone the consistency group in its current state, choose **Add a new Snapshot copy**.

   To clone the consistency group based on a snapshot, choose **Use an existing Snapshot copy**. Selecting this option will open a new sub-menu. Choose the Snapshot that you want to use as the basis for the clone operation.

6. Select **Clone**.
7. Return to the **Consistency Group** menu to confirm your consistency group has been cloned.

Next steps

- Map igroups to multiple LUNs
- Map an NVMe namespace to a subsystem

Delete a consistency group

If you decide that you no longer need a consistency group, you can delete it.

Deleting a consistency group deletes the instance of the consistency group and does **not** impact the constituent volumes or LUNs. Deleting a consistency group does not result in deletion of the Snapshots present on each volume, but they will no longer be accessible as consistency group Snapshots. They can, however, continue to be managed as ordinary volume granular snapshots.

Consistency groups will be deleted if all of the volumes in the consistency group are deleted.

If you are using a version of ONTAP between 9.10.1 to 9.12.0, volumes can only be removed from a consistency group if the volume itself is deleted, in which case the volume is automatically removed from the consistency group. Beginning in ONTAP 9.12.1, you can remove volumes from a consistency group without deleting. For more information on this process, refer to Modify a consistency group.

Steps

1. Select **Storage > Consistency groups**.

2. Select the consistency group you would like to delete.
3. Next to the name of the consistency group, select ⋮ and then **Delete**.

SnapMirror Business Continuity

SnapMirror Business Continuity overview

SnapMirror Business Continuity (SM-BC) enables business services to continue operating even through a complete site failure, supporting applications to fail over transparently using a secondary copy. Neither manual intervention nor additional scripting is required to trigger a failover with SM-BC.

SM-BC is available beginning with ONTAP 9.8. SM-BC is supported on AFF clusters or All SAN Array (ASA) clusters, where the primary and secondary clusters can be either AFF or ASA. SM-BC protects applications with iSCSI or FCP LUNs.

Benefits

SM-BC provides the following benefits:

- Continuous availability for business-critical applications
- Ability to host critical applications alternately from primary and secondary site
- Simplified application management using consistency groups for dependent write-order consistency
- The ability to test failover for each application
- Instantaneous creation of mirror clones without impacting application availability
- Beginning in ONTAP 9.11.1, SM-BC supports single-file SnapRestore.

Use cases

Application deployment for zero recovery time object (RTO)

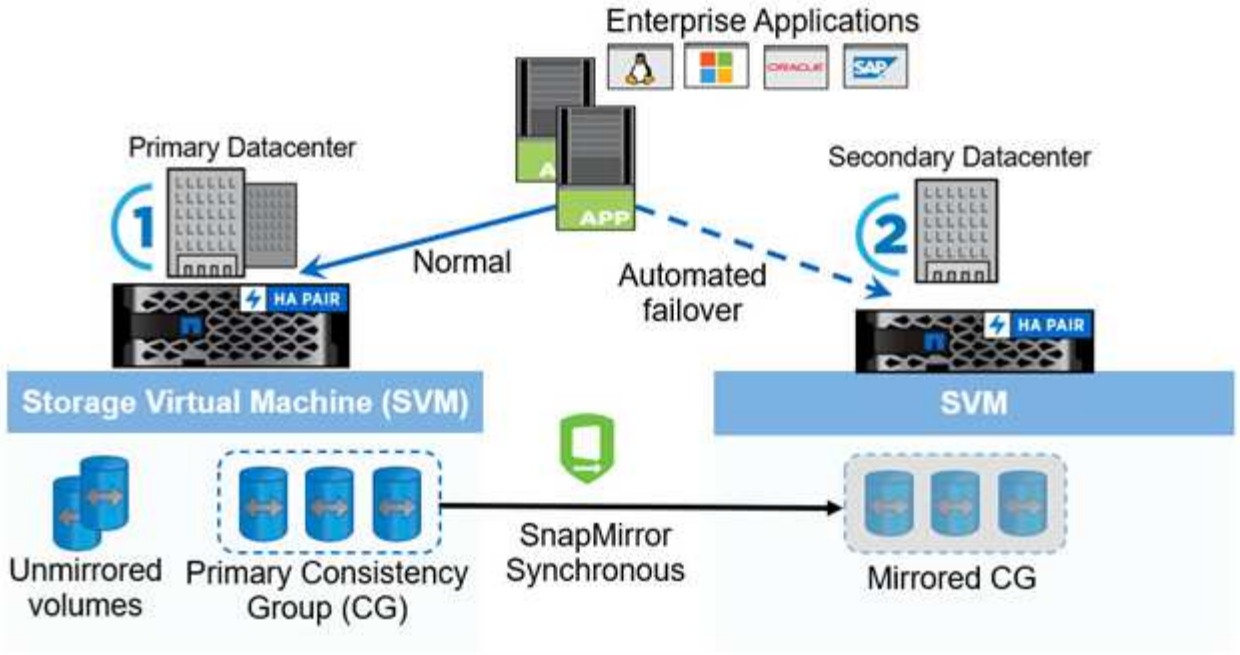
In an SM-BC deployment, you will have a primary and secondary cluster. A LUN in the primary cluster (`1LP`) will have a mirror (`L1s`) on the secondary; both LUNs share the same serial ID and are reported as read-write LUNs to the host. Read and write operations, however, are only serviced to the primary LUN, `1LP`. Any writes to the mirror `L1S` are served by proxy.

Disaster scenario

With SM-BC, you can synchronously replicate multiple volumes for an application between sites at geographically dispersed locations. You can automatically failover to the secondary copy in case of disruption of the primary, thus enabling business continuity for tier one applications.

Architecture

The following figure illustrates the operation of the SnapMirror Business Continuity feature at a high level.



In section one of the diagram, an application is deployed on a SVM in the primary data center. The volumes that have been added to the primary consistency group are protected with SM-BC and are mirrored to secondary consistency group at a secondary data center. The volumes in the primary consistency group will failover to the mirrored consistency group in the event of a disruption. Volumes not in a mirrored consistency group are not served in the event of a failover.

Further information

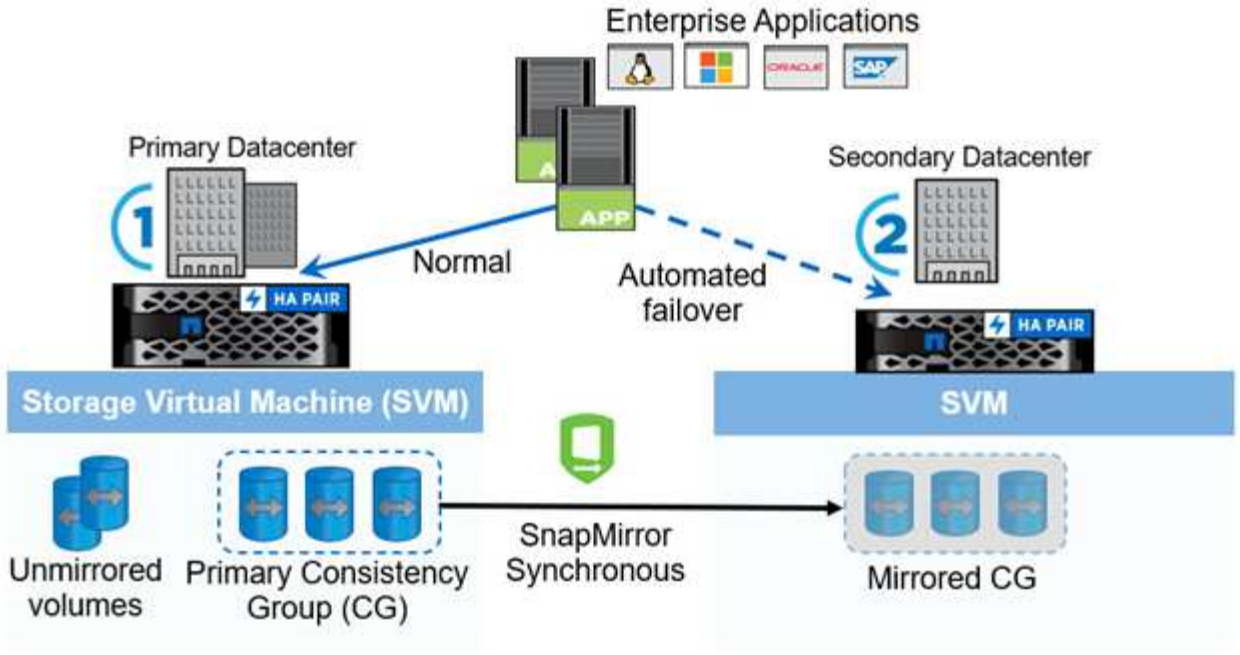
- TR-4878: SnapMirror Business Continuity

Key concepts

SnapMirror Business Continuity (SM-BC) utilizes features such as consistency groups and the ONTAP Mediator to ensure your data is replicated and served even in the event of a disaster scenario. When planning your SM-BC deployment, it is important to understand the essential concepts in SM-BC and its architecture.

Architecture

The following figure illustrates a high-level overview of an SM-BC deployment.



The diagram shows an enterprise application that is hosted on an storage VM (SVM) at the primary data center. The SVM contains five volumes, three of which are part of a consistency group. The three volumes in the consistency group are mirrored to a secondary data center. In normal circumstances, all write operations are performed to the primary data center; in effect, this data center serves as the source for I/O operations, while the secondary data center serves as a destination.

In the event of a disaster scenario at the primary data center, the ONTAP Mediator will direct the secondary data center to act as the primary, serving all I/O operations. Only the volumes that are mirrored in the consistency group will be served. Any operations pertaining to the other two volumes on the SVM will be affected by the disaster event.

Essential concepts

Understanding the following terms will help you deploy SM-BC.

Consistency group

A consistency group is a collection of volumes or LUNs that provide a write-order consistency guarantee for the application workload that needs to be protected for business continuity. A consistency group ensures all volumes of this data set are quiesced and then snapped at the same point in time, providing a data-consistent restore point across volumes for that data set.

In SM-BC, you will create a primary and secondary consistency group for replication and data protection. The secondary consistency group will serve your data in the event of a disruption.

To learn more about consistency groups, see Consistency groups overview.

Constituent

An individual volume or LUN that is part of a consistency group, which is protected by the SM-BC relationship.

ONTAP Mediator

The ONTAP Mediators monitors the two ONTAP clusters and orchestrates failover in case your primary storage system fails. With the ONTAP Mediator, your application automatically reconnects to the resources in the secondary storage system.

With the ONTAP Mediator's health information, clusters can differentiate between intercluster LIF failure and site failure. When the site goes down, ONTAP Mediator passes on the health information to the peer cluster on demand, facilitating the peer cluster to failover.

Learn more about the ONTAP Mediator.

Planned failover

A manual operation to change the roles of copies in a SM-BC relationship. The primary sites becomes the secondary, and the secondary becomes the primary.

Automatic unplanned failover (AUFO)

An automatic operation to perform a failover to the mirror copy. The operation requires assistance from Mediator to detect that the primary copy is unavailable.

Out of Sync (OOS)

When the application I/O is not replicating to the secondary storage system, it will be reported as **out of sync**. An out of sync status means the secondary volumes are not synchronized with the primary (source) and that SnapMirror replication is not occurring.

If the mirror state is `Snapmirrored`, this indicates a transfer failure or failure due to an unsupported operation.

Zero RPO

RPO stands for recovery point objective, which is the amount of data loss deemed acceptable during a given time period. Zero RPO signifies that no data loss is acceptable.

Zero RTO

RTO stands for recovery time objective, which is the amount of time that is deemed acceptable for an application to return to normal operations following an outage, failure, or other data loss event. Zero RTO signifies that no amount of downtime is acceptable.

Plan

Prerequisites

When planning your SnapMirror Business Continuity deployment, ensure you have met the various hardware, software, and system configuration requirements.

Hardware

- Only two-node HA clusters are supported
- Both clusters must be either AFF (including AFF C-Series) or ASA (no mixing)

Software

- ONTAP 9.8 or later
- ONTAP Mediator 1.2 or later
- A Linux server or virtual machine for the ONTAP Mediator running one of the following:

ONTAP Mediator version	Supported Linux versions

1.6	• Red Hat Enterprise Linux: 8.4, 8.5, 8.6, 8.7, 8.8, 9.0, 9.1, 9.2 • Rocky Linux 8 and 9
1.5	• Red Hat Enterprise Linux: 7.6, 7.7, 7.8, 7.9, 8.1, 8.2, 8.3, 8.4, 8.5 • CentOS: 7.6, 7.7, 7.8, 7.9
1.4	• Red Hat Enterprise Linux: 7.6, 7.7, 7.8, 7.9, 8.1, 8.2, 8.3, 8.4, 8.5 • CentOS: 7.6, 7.7, 7.8, 7.9
1.3	• Red Hat Enterprise Linux: 7.6, 7.7, 7.8, 7.9, 8.1, 8.2, 8.3 • CentOS: 7.6, 7.7, 7.8, 7.9
1.2	• Red Hat Enterprise Linux: 7.6, 7.7, 7.8, 8.1 • CentOS: 7.6, 7.7, 7.8

Licensing

- SnapMirror synchronous (SM-S) license must be applied on both clusters
- SnapMirror license must be applied on both clusters

If your ONTAP storage systems were purchased before June 2019, see NetApp ONTAP Master License Keys to get the required SM-S license.

Networking environment

- Inter-cluster latency round trip time (RTT) must be less than 10 milliseconds.
- SCSI-3 persistent reservations are **not** supported with SM-BC .

Supported protocols

- Only SAN protocols are supported (not NFS/SMB).
- Only Fibre Channel and iSCSI protocols are supported.
- The default IPspace is required by SM-BC for cluster peer relationships. Custom IPspace is not supported.

NTFS Security Style

NTFS security style is **not** supported on SM-BC volumes.

ONTAP Mediator

- The ONTAP Mediator be provisioned externally and attached to ONTAP for transparent application failover.
- To be fully functional and to enable automatic unplanned failover, the external ONTAP mediator should be provisioned and configured with ONTAP clusters.
- The ONTAP Mediator must be installed in a third failure domain, separate from the two ONTAP clusters.
- When installing the ONTAP Mediator, you should replace the self-signed certificate with a valid certificate

signed by a mainstream reliable CA.

- For more information about the ONTAP Mediator, see Prepare to install the ONTAP Mediator service.

Read-write destination volumes

- SM-BC relationships are not supported on read-write destination volumes. Before you can use a read-write volume, you must convert it to a DP volume by creating a volume-level SnapMirror relationship and then deleting the relationship. For details, see Converting existing relationships to SM-BC relationships

Large LUNs and large volumes

Support for large LUNs and large volumes (greater than 100 TB) depends on the version of ONTAP you are using and your platform.

ONTAP 9.12.1P2 and later

- For ONTAP 9.12.1 P2 and later, SMBC supports Large LUNs and large volumes greater than 100TB on ASA and AFF (including C-Series).

> For ONTAP Releases 9.12.1P2 and later, You must ensure that both the primary and secondary clusters are either All SAN Arrays or All Flash Array, and that they both have ONTAP 9.12.1 P2 or later installed. If the secondary cluster is running a version earlier than ONTAP 9.12.1P2 or if the array type is not the same as primary cluster, the synchronous relationship can go out of sync if the primary volume grows larger than 100 TB.

ONTAP 9.8 - 9.12.1P1

- For ONTAP releases between ONTAP 9.8 and 9.12.1 P1 (inclusive), Large LUNs and large volumes greater than 100TB are supported only on All SAN Arrays.

> For ONTAP releases between ONTAP 9.8 and 9.12.1 P2, You must ensure that both the primary and secondary clusters are All SAN Arrays, and that they both have ONTAP 9.8 or later installed. If the secondary cluster is running a version earlier than ONTAP 9.8 or if it is not an All SAN Array, the synchronous relationship can go out of sync if the primary volume grows larger than 100 TB.

Further information

- Hardware Universe
- ONTAP Mediator overview

Supported configurations and features

SnapMirror Business Continuity is compatible with numerous operating systems and other features in ONTAP. Learn about details and recommended configurations.

Supported configurations

SM-BC is supported with numerous operating systems, including:

- AIX (beginning ONTAP 9.11.1)

- HP-UX (beginning ONTAP 9.10.1)
- Solaris 11.4 (beginning ONTAP 9.10.1)

AIX

Beginning with ONTAP 9.11.1, AIX is supported with SM-BC. With an AIX configuration, the primary cluster is the "active" cluster.

In an AIX configuration, failovers are disruptive. With each failover, you will need to perform a re-scan on the host for I/O operations to resume.

To configure for AIX host with SM-BC, refer to the Knowledge Base article How to configure an AIX host for SnapMirror Business Continuity (SM-BC).

HP-UX

Beginning in ONTAP 9.10.1, SM-BC for HP-UX is supported.

Limitations with HP-UX

If an automatic unplanned failover (AUFO) event occurs on the isolated master cluster in the SM-BC configuration, it might take more than 120 seconds for I/O to resume on the HP-UX host. Depending on the applications that are running, this might not lead to any I/O disruption or error messages. If an AUFO event on the isolated master cluster occurs, you must restart applications on the HP-UX host that have a disruption tolerance of less than 120 seconds.

An AUFO event on the isolated master cluster might cause dual event failure when the connection between the primary and the secondary cluster is lost and the connection between the primary cluster and the mediator is also lost. This is considered a rare event, unlike other AUFO events.

Solaris Host setting recommendation

Beginning with ONTAP 9.10.1, SM-BC supports Solaris 11.4.

To ensure the Solaris client applications are non-disruptive when an unplanned site failover switchover occurs in an SM-BC environment, modify the default Solaris OS settings. To configure Solaris with the recommended settings, see the Knowledge Base article Solaris Host support recommended settings in SnapMirror Business Continuity (SM-BC) configuration.

ONTAP integrations

SM-BC offers support for other features in ONTAP, including:

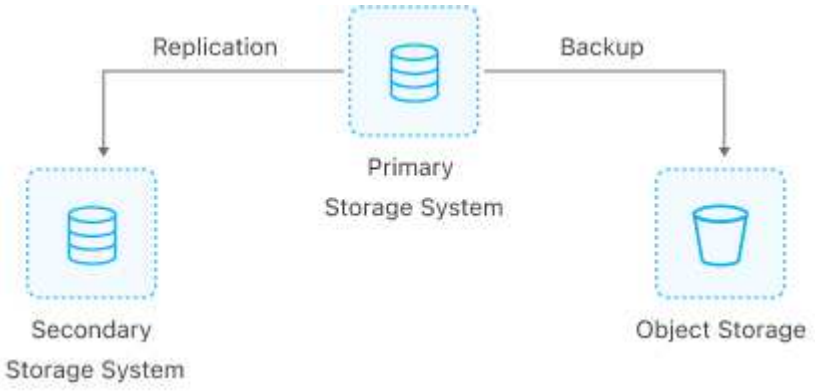
- Fan-out configurations
- NDMP copy (beginning ONTAP 9.13.1)
- Partial file restore (beginning ONTAP 9.12.1)

FabricPool

SM-BC supports source and destination volumes on FabricPool aggregates with the tiering policy of None, Snapshot or Auto. SM-S SM-BC does not support FabricPool aggregates using a tiering policy of All.

Fan-out configurations

In a fan-out configurations, your source volume can be mirrored to an SM-BC destination endpoint and to one or more asynchronous SnapMirror relationships.



SM-BC supports fan-out configurations with the `MirrorAllSnapshots` policy and, beginning in ONTAP 9.11.1, the `MirrorAndVault` policy. Fan-out configurations are not supported in SM-BC with the `XDPDefault` policy.

If you experience a failover on the SM-BC destination in a fan-out configuration, you will have to manually resume protection in the fan-out configuration.

NDMP restore

Beginning in ONTAP 9.13.1, you can use NDMP to copy and restore data with SM-BC. Using NDMP allows you to move data onto the SM-BC source to complete a restore without pausing protection. This is particularly useful in fan-out configurations.

To learn more about this process, see Transfer data using ndmp copy.

Partial file restore

Beginning in ONTAP 9.12.1, partial LUN restore is supported for SM-BC volumes. For information on this process, refer to Restore part of a file from a Snapshot copy.

Object limits for SnapMirror Business Continuity

When preparing to use and managing SnapMirror Business Continuity, be aware of the following limitations.

Consistency groups in a cluster

Consistency group limits for a cluster with SM-BC are calculated based on relationships and depend on the version of ONTAP used. Limits are platform-independent.

ONTAP version	Maximum number of relationships
ONTAP 9.8-9.9.1	5
ONTAP 9.10.1	20
ONTAP 9.11.1 and later	50

Volumes per consistency group

The maximum number of volumes per consistency group with SM-BC is platform independent.

ONTAP version	Maximum number of volumes supported in a consistency group relationship
ONTAP 9.8-9.9.1	12
ONTAP 9.10.1 and later	16

Volumes

Volume limits in SM-BC are calculated based on the number of endpoints, not the number of relationships. A consistency group with 12 volumes contributes 12 endpoints on both the primary and secondary cluster. Both SM-BC and SnapMirror Synchronous relationships contribute to the total number of endpoints.

The maximum endpoints per platform are included in the following table.

S. No	Platform	Endpoints per HA for SM-BC			Overall sync and SM-BC endpoints per HA		
		ONTAP 9.8-9.9.1	ONTAP 9.10.1	ONTAP 9.11.1 and later	ONTAP 9.8-9.9.1	ONTAP 9.10.1	ONTAP 9.11.1 and later
1	AFF	60	200	400	80	200	400
2	ASA	60	200	400	80	200	400

SAN object limits

SAN object limits are included in the following table. The limits apply regardless of the platform.

Object in an SM-BC relationship	Count
LUNs per volume	256
LUN maps per node	2048
LUN maps per cluster	4096
LIFs per SVM (with at least one volume in an SM-BC relationship)	256
Inter-cluster LIFs per node	4
Inter-cluster LIFs per cluster	8

Related information

- Hardware Universe
- Consistency group limits

Install and set up

Configure the ONTAP Mediator and clusters for SnapMirror Business Continuity

SnapMirror Business Continuity (SM-BC) utilizes peered clusters to ensure your data is available in the event of a failover scenario. The ONTAP Mediator is a key resource ensuring business continuity, monitoring the health of each cluster. To configure SM-BC, you must first install the ONTAP Mediator and ensure you primary and secondary clusters are configured properly.

Once you have installed the ONTAP Mediator and configured your clusters, you must Initialize the ONTAP mediator for SM-BC the ONTAP Mediator for use with SM-BC. You must then Create, initialize, and map the consistency group for SM-BC

ONTAP Mediator

The ONTAP Mediator establishes a quorum for the ONTAP clusters in an SM-BC relationship. It coordinates automated failover when a failure is detected, determining which cluster acts as the primary and ensuring data is served to and from the correct destination.

Prerequisites for the ONTAP Mediator

- The ONTAP Mediator includes its own set of prerequisites. You must meet these prerequisites before installing the mediator.

  For more information, see Prepare to install the ONTAP Mediator service.

- By default, the ONTAP Mediator provides service through TCP port 31784. You should make sure that port 31784 is open and available between the ONTAP clusters and the mediator.

Install the ONTAP Mediator and confirm cluster configuration

Proceed through each of the following steps. For each step, you should confirm that the specific configuration has been performed. Use the link included after each step to get more information as needed.

Steps

1. Install the ONTAP Mediator service before you ensure that your source and destination clusters are configured properly.

   Prepare to install or upgrade the ONTAP Mediator service

2. Confirm that a cluster peering relationship exists between the clusters.

   > The default IPspace is required by SM-BC for cluster peer relationships. A custom IPspace is not supported.

   Configure peer relationships

3. Confirm that the Storage VMs are created on each cluster.

   Creating an SVM

4. Confirm that a peer relationship exists between the Storage VMs on each cluster.

   Creating an SVM peering relationship

5. Confirm that the volumes exist for your LUNs.

   Creating a volume

6. Confirm that at least one SAN LIF is created on each node in the cluster.

   Considerations for LIFs in a cluster SAN environment

   Creating a LIF

7. Confirm that the necessary LUNs are created and mapped to an igroup, which is used to map LUNs to the initiator on the application host.

   Create LUNs and map igroups

8. Rescan the application host to discover any new LUNs.

Initialize the ONTAP mediator for SM-BC

Once you have installed the ONTAP Mediator and confirmed you cluster configuration, you must initialize the ONTAP Mediator for cluster monitoring. You can initialize the ONTAP Mediator using System Manager or the ONTAP CLI.

System Manager

With System Manager, you can configure the ONTAP Mediator server for automated failover. You can also replace the self-signed SSL and CA with the third party validated SSL Certificate and CA if you have not already done so.

Steps

1. Navigate to **Protection > Overview > Mediator > Configure**.
2. Select **Add**, and enter the following ONTAP Mediator server information:
   - IPv4 address
   - Username
   - Password
   - Certificate

CLI

You can initialize the ONTAP Mediator from either the primary or secondary cluster using the ONTAP CLI. When you issue the `mediator add` command on one cluster, the ONTAP Mediator is automatically added on the other cluster.

Steps

1. Initialize Mediator on one of the clusters:

   ```
   snapmirror mediator add -mediator-address IP_Address -peer-cluster
   cluster_name -username user_name
   ```

   Example

   ```
   cluster1::> snapmirror mediator add -mediator-address 192.168.10.1
   -peer-cluster cluster2 -username mediatoradmin
   Notice: Enter the mediator password.

   Enter the password: ******
   Enter the password again: ******
   ```

2. Check the status of the Mediator configuration:

   ```
   snapmirror mediator show
   ```

   ```
   Mediator Address Peer Cluster     Connection Status Quorum Status
   ---------------- ---------------- ----------------- -------------
   192.168.10.1     cluster-2        connected         true
   ```

   `Quorum Status` indicates whether the SnapMirror consistency group relationships are synchronized with the mediator; a status of `true` indicates successful synchronization.

Establish protection with SnapMirror Business Continuity

Configuring protection using SnapMirror Business Continuity involves selecting LUNs on the ONTAP source cluster and adding them to a consistency group.

Before you begin

- You must have a SnapMirror Synchronous license.
- You must be a cluster or storage VM administrator.
- All constituent volumes in a consistency group must be in a single storage VM (SVM).
  - LUNs can reside on different volumes.
- The source and destination cluster cannot be the same.
- You cannot establish SM-BC consistency group relationships across ASA clusters and non-ASA clusters.
- The default IPspace is required by SM-BC for cluster peer relationships. Custom IPspace is not supported.
- The name of the consistency group must be unique.
- The volumes on the secondary (destination) cluster must be type DP.
- The primary and the secondary SVMs must be in a peered relationship.

Steps

You can configure a consistency group using the ONTAP CLI or System Manager.

Beginning in ONTAP 9.10.1, ONTAP offers a consistency group endpoint and menu in System Manager, offering additional management utilities. If you are using ONTAP 9.10.1 or later, see Configure a consistency group then configure protection to create an SM-BC relationship.

System Manager

1. On the primary cluster, navigate to **Protection > Overview > Protect for Business Continuity > Protect LUNs**.
2. Select the LUNs you want to protect and add them to a protection group.
3. Select the destination cluster and SVM.
4. **Initialize relationship** is selected by default. Click **Save** to begin protection.
5. Go to **Dashboard > Performance** to verify IOPS activity for the LUNs.
6. On the destination cluster, use System Manager to verify that the protection for business continuity relationship is in sync: **Protection > Relationships**.

CLI

1. Create a consistency group relationship from the destination cluster.
   `destination::> snapmirror create -source-path *source-path* -destination-path *destination-path* -cg-item -mappings *volume-paths* -policy *policy-name*

   You can map up to 12 constituent volumes using the `cg-item-mappings` parameter on the `snapmirror create` command.

   The following example creates two consistency groups: `cg_src_ on the source with `vol1` and `vol2` and a mirrored destination consistency group, `cg_dst`.

   ```
   destination::> snapmirror create -source-path vs1_src:/cg/cg_src
   -destination-path vs1_dst:/cg/cg_dst -cg-item-mappings
   vol_src1:@vol_dst1,vol_src2:@vol_dst2 -policy AutomatedFailOver
   ```

2. From the destination cluster, initialize the consistency group.

   ```
   destination::>snapmirror initialize -destination-path destination-
   consistency-group
   ```

3. Confirm that the initialization operation completed successfully. The status should be `InSync`.

   ```
   snapmirror show
   ```

4. On each cluster, create an igroup so you can map LUNs to the initiator on the application host.
   `lun igroup create -igroup *name* -protocol *fcp|iscsi* -ostype *os* -initiator *initiator_name*`
5. On each cluster, map LUNs to the igroup:

   ```
   lun map -path path_name -igroup igroup_name
   ```

6. Verify the LUN mapping completed successfully with the `lun map` command. Then, you can discover the new LUNs on the application host.

Manage SM-BC and protect data

Create a common Snapshot copy

In addition to the regularly scheduled Snapshot copy operations, you can manually create a common Snapshot copy between the volumes in the primary SnapMirror consistency group and the volumes in the secondary SnapMirror consistency group.

About this task

- In ONTAP 9.8, the scheduled snapshot creation interval is one hour.

  Beginning with ONTAP 9.9.1, that interval is 12 hours.

Before you begin

- The SnapMirror group relationship must be in sync.

Steps

1. Create a common Snapshot copy:

   ```
   destination::>snapmirror update -destination-path vs1_dst:/cg/cg_dst
   ```

2. Monitor the progress of the update:

   ```
   destination::>snapmirror show -fields -newest-snapshot
   ```

Perform a planned failover

In a planned failover, you switch the roles of the primary and secondary clusters, so that the secondary cluster takes over from the primary cluster. During a failover, what is normally the secondary cluster processes input and output requests locally without disrupting client operations.

You may want to perform a planned failover to test the health of your disaster recovery configuration or to perform maintenance on the primary cluster.

About this task

A planned failover is initiated by the administrator of the secondary cluster. The operation requires switching the primary and secondary roles so that the secondary cluster takes over from the primary. The new primary cluster can then begin processing input and output requests locally without disrupting client operations.

Before you begin

- The SM-BC relationship must be in sync.
- You cannot initiate a planned failover when a nondisruptive operation is in process. Nondisruptive operations include volume moves, aggregrate relocations, and storage failovers.
- The ONTAP Mediator must be configured, connected, and in quorum.

Steps

You can perform a planned failover using the ONTAP CLI or System Manager.

ONTAP CLI

1. From the destination cluster, initiate the failover operation:

   ```
   destination::>snapmirror failover start -destination-path
   vs1_dst:/cg/cg_dst
   ```

2. Monitor the progress of the failover:

   ```
   destination::>snapmirror failover show
   ```

3. When the failover operation is complete, you can monitor the Synchronous SnapMirror protection relationship status from the destination:

   ```
   destination::>snapmirror show
   ```

System Manager

1. In System Manager, select **Protection > Overview > Relationships**.
2. Identify the SM-BC relationship you want to failover. Next to its name, select the … next to the relationship's name, then select **Failover**.
3. To monitor the status of the failover, use the `snapmirror failover show` in the ONTAP CLI.

Recover from automatic unplanned failover operations

An automatic unplanned failover (AUFO) operation occurs when the primary cluster is down or isolated. The ONTAP Mediator detects when a failover occurs and, and executes an automatic unplanned failover to the the secondary cluster. The secondary cluster is converted to the primary and begins serving clients. This operation is performed only with assistance from the ONTAP Mediator.

> After the automatic unplanned failover, it is important to rescan the host LUN I/O paths so that there is no loss of I/O paths.

Reestablish the protection relationship after an unplanned failover

You can reestablish the protection relationship using System Manager or the ONTAP CLI.

System Manager

Steps

1. Navigate to **Protection > Relationships** and wait for the relationship state to show “InSync.”
2. To resume operations on the original source cluster, click ⋮ and select **Failover**.

CLI

You can monitor the status of the automatic unplanned failover using the `snapmirror failover show` command.

For example:

```
ClusterB::> snapmirror failover show -instance
Start Time: 9/23/2020 22:03:29
         Source Path: vs1:/cg/scg3
    Destination Path: vs3:/cg/dcg3
     Failover Status: completed
        Error Reason:
            End Time: 9/23/2020 22:03:30
Primary Data Cluster: cluster-2
Last Progress Update: -
       Failover Type: unplanned
  Error Reason codes: -
```

Refer to the EMS reference to learn about event messages and about corrective actions.

Resume protection in a fan-out configuration after failover

If you experience a failover on the secondary cluster in the SM-BC relationship, the asynchronous SnapMirror destination will become unhealthy, and you must manually restore protection by deleting and recreating the relationship with the asynchronous SnapMirror endpoint.

Steps

1. Verify the failover has completed successfully:
   `snapmirror failover show`
2. On the asynchronous Snapmirror endpoint, delete the fan-out endpoint:
   `snapmirror delete -destination-path` *`destination_path`*
3. On the third site, create an asynchronous SnapMirror relationships between the new SM-BC primary volume and the async fan-out destination volume:
   `snapmirror create -source-path` *`source_path`* `-destination-path` *`destination_path`* `-policy MirrorAllSnapshots -schedule` *`schedule`*
4. Resynchronize the relationship:
   `snapmirror resync -destination-path` *`destination_path`*
5. Verify the relationship status and heath:
   `snapmirror show`

Monitor SnapMirror Business Continuity operations

You can monitor the following SnapMirror Business Continuity (SM-BC) operations to ensure the health of your SM-BC configuration:

- ONTAP Mediator
- Planned failover operations
- Automatic unplanned failover operations
- SM-BC availability

ONTAP Mediator

During normal operations, the ONTAP Mediator state should be connected. If it is in any other state, this might indicate an error condition. You can review the Event Management System (EMS) messages to determine the error and appropriate corrective actions.

Planned failover operations

You can monitor status and progress of a planned failover operation using the `snapmirror failover show` command. For example:

```
ClusterB::> snapmirror failover start -destination-path vs1:/cg/dcg1
```

Once the failover operation is complete, you can monitor the Synchronous SnapMirror protection status from the new destination cluster. For example:

```
ClusterA::> snapmirror show
```

Refer to the EMS reference to learn about event messages and corrective actions.

Automatic unplanned failover operations

During an unplanned automatic failover, you can monitor the status of the operation using the `snapmirror failover show` command.

```
ClusterB::> snapmirror failover show -instance
Start Time: 9/23/2020 22:03:29
         Source Path: vs1:/cg/scg3
    Destination Path: vs3:/cg/dcg3
     Failover Status: completed
        Error Reason:
            End Time: 9/23/2020 22:03:30
Primary Data Cluster: cluster-2
Last Progress Update: -
       Failover Type: unplanned
  Error Reason codes: -
```

Refer to the EMS reference to learn about event messages and about corrective actions.

SM-BC availability

You can check the availability of the SM-BC relationship using a series of commands, either on the primary cluster, the secondary cluster, or both.

Commands you use include the `snapmirror mediator show` command on both the primary and secondary cluster to check the connection and quorum status, the `snapmirror show` command, and the `volume show` command. For example:

```
SMBC_A::*> snapmirror mediator show
Mediator Address Peer Cluster     Connection Status Quorum Status
---------------- ---------------- ----------------- -------------
10.236.172.86    SMBC_B           connected         true

SMBC_B::*> snapmirror mediator show
Mediator Address Peer Cluster     Connection Status Quorum Status
---------------- ---------------- ----------------- -------------
10.236.172.86    SMBC_A           connected         true

SMBC_B::*> snapmirror show -expand

Progress
Source            Destination Mirror  Relationship   Total
Last
Path        Type  Path        State   Status         Progress  Healthy
Updated
----------- ---- ------------ ------- -------------- --------- -------
--------
vs0:/cg/cg1 XDP  vs1:/cg/cg1_dp Snapmirrored InSync  -         true    -
vs0:vol1    XDP  vs1:vol1_dp  Snapmirrored InSync    -         true    -
2 entries were displayed.

SMBC_A::*> volume show -fields is-smbc-master,smbc-consensus,is-smbc-
failover-capable -volume vol1
vserver volume is-smbc-master is-smbc-failover-capable smbc-consensus
------- ------ -------------- ------------------------ --------------
vs0     vol1   true           false                      Consensus

SMBC_B::*> volume show -fields is-smbc-master,smbc-consensus,is-smbc-
failover-capable -volume vol1_dp
vserver volume  is-smbc-master is-smbc-failover-capable smbc-consensus
------- ------- -------------- ------------------------ --------------
vs1     vol1_dp false           true                      No-consensus
```

Add or remove volumes to a consistency group

As your application workload requirements change, you may need to add or remove volumes from a consistency group to ensure business continuity. The process of adding and removing volumes in an an active SM-BC relationship depends on the version of ONTAP you are using.

In most instances, this is a disruptive process requiring you to break the SnapMirror relationship, modify the consistency group, then resume protection. Beginning with ONTAP 9.13.1, adding volumes to a consistency group with an active SM-BC relationship is a non-disruptive operation.

About this task

- In ONTAP 9.8 through 9.9.1, you can add or remove volumes to a consistency group using the ONTAP CLI.
- Beginning with ONTAP 9.10.1, it is recommended that you manage consistency groups through System Manager or with the ONTAP REST API.

  If you want to change the composition of the consistency group by adding or removing a volume, you must first delete the original relationship and then create the consistency group again with the new composition.

- Beginning in ONTAP 9.13.1, you can non-disruptively add volumes to a consistency group with an active SM-BC relationship from the source or destination.

  Removing volumes is a disruptive operation. You must break the SnapMirror relationship before proceeding removing volumes.

ONTAP 9.8-9.13.0

Before you begin

- You cannot begin to modify the consistency group while it is in the `InSync` state.
- The destination volume should be of type DP.
- The new volume you add to expand the consistency group must have a pair of common Snapshot copies between the source and destination volumes.

Steps

The examples shown in two volume mappings: `vol_src1` ←→ `vol_dst1` and `vol_src2` ←→ `vol_dst2`, in a consistency group relationship between the end points `vs1_src:/cg/cg_src` and `vs1_dst:/cg/cg_dst`.

1. On the source and destination clusters, verify there is a common Snapshot between the source and destination clusters with the command `snapshot show -vserver` *`svm_name`* `-volume` *`volume_name`* `-snapshot` *`snapmirror`*

   ```
   source::>snapshot show -vserver vs1_src -volume vol_src3 -snapshot
   snapmirror*

   destination::>snapshot show -vserver vs1_dst -volume vol_dst3 -snapshot
   snapmirror*
   ```

2. If no common Snapshot copy exists, create and initialize a FlexVol SnapMirror relationship:

   ```
   destination::>snapmirror initialize -source-path vs1_src:vol_src3
   -destination-path vs1_dst:vol_dst3
   ```

3. Delete the consistency group relationship:

   ```
   destination::>snapmirror delete -destination-path vs1_dst:vol_dst3
   ```

4. Release the source SnapMirror relationship and retain the common Snapshot copies:

   ```
   source::>snapmirror release -relationship-info-only true -destination-path
   vs1_dst:vol_dst3
   ```

5. Unmap the LUNs and delete the existing consistency group relationship:

   ```
   destination::>lun mapping delete -vserver vs1_dst -path <lun_path> -igroup
   <igroup_name>
   ```

   > The destination LUNs are unmapped, while the LUNs on the primary copy continue to serve the host I/O.

   ```
   destination::>snapmirror delete -destination-path vs1_dst:/cg/cg_dst

   source::>snapmirror release -destination-path vs1_dst:/cg/cg_dst
   -relationship-info-only true
   ```

6. **If you are using ONTAP 9.10.1 through 9.13.0,** delete and recreate and the consistency group on

the source with the correct composition. Follow the steps in Delete a consistency group and then Configure a single consistency group. In ONTAP 9.10.1 and later, you must perform the delete and create operations in System Manager or with the ONTAP REST API; there is no CLI procedure.

If you are using ONTAP 9.8, 9.0, or 9.9.1, skip to the next step.

7. Create the new consistency group on the destination with the new composition:

```
destination::>snapmirror create -source-path vs1_src:/cg/cg_src
-destination-path vs1_dst:/cg/cg_dst -cg-item-mappings vol_src1:@vol_dst1,
vol_src2:@vol_dst2, vol_src3:@vol_dst3
```

8. Resynchronize the zero RTO consistency group relationship to ensure it is in sync:

```
destination::>snapmirror resync -destination-path vs1_dst:/cg/cg_dst
```

9. Remap the LUNs that you unmapped in Step 5:

```
destination::> lun map -vserver vs1_dst -path lun_path -igroup igroup_name
```

10. Rescan host LUN I/O paths to restore all paths to the LUNs.

ONTAP 9.13.1 and later

Beginning in ONTAP 9.13.1, you can non-disruptively add volumes to a consistency group with an active SM-BC relationship. SM-BC supports adding volumes from both the source or destination.

For details on adding volumes from the source consistency group, see Modify a consistency group.

Add a volume from the destination cluster

1. On the destination cluster, select **Protection** > **Relationships**.
2. Find the SM-BC relationship you want to add volumes to. Select ⋮ then **Expand**.
3. Select the volume relationships whose volumes are to be added to consistency group
4. Select **Expand**.

Convert existing relationships to SM-BC relationships

If you have an existing Synchronous SnapMirror relationship between a source and destination cluster, you can convert it to an SM-BC relationship. This allows you to associate the mirrored volumes with a consistency group, ensuring zero RPO across a multi-volume workload. Additionally, you can retain existing SnapMirror snapshots if you need to revert to a point in time prior to establishing the SM-BC relationship.

Before you begin

- A zero RPO Synchronous SnapMirror relationship must exist between the primary and secondary cluster.
- All LUNs on the destination volume must be unmapped before the zero RTO SnapMirror relationship can be created.
- SM-BC only supports SAN protocols (not NFS/CIFS). Ensure no constituent of the consistency group is mounted for NAS access.

About this task

- You must be a cluster and SVM administrator on the primary and secondary clusters.
- You cannot convert zero RPO to zero RTO sync by changing the SnapMirror policy.
- You must ensure the LUNs are unmapped before issuing the `snapmirror create` command.

  If existing LUNs on the secondary volume are mapped and the `AutomatedFailover` policy is configured, the `snapmirror create` will trigger an error.

Steps

1. From the secondary cluster, perform a SnapMirror update on the existing relationship:

   ```
   destination::>snapmirror update -destination-path vs1_dst:vol1
   ```

2. Verify that the SnapMirror update completed successfully:

   ```
   destination::>snapmirror show
   ```

3. Quiesce each of the zero RPO synchronous relationships:

   ```
   destination::>snapmirror quiesce -destination-path vs1_dst:vol1

   destination::>snapmirror quiesce -destination-path vs1_dst:vol2
   ```

4. Delete each of the zero RPO synchronous relationships:

   ```
   destination::>snapmirror delete -destination-path vs1_dst:vol1

   destination::>snapmirror delete -destination-path vs1_dst:vol2
   ```

5. Release the source SnapMirror relationship but retain the common Snapshot copies:

   ```
   source::>snapmirror release -relationship-info-only true -destination-path
   vs1_dst:vol1

   source::>snapmirror release -relationship-info-only true -destination-path
   vs1_dst:vol2
   ```

6. Create a group zero RTO Synchronous Snapmirror relationship:

   ```
   destination::> snapmirror create -source-path vs1_src:/cg/cg_src -destination
   -path vs1_dst:/cg/cg_dst -cg-item-mappings vol1:@vol1,vol2:@vol2 -policy
   AutomatedFailover
   ```

7. Resynchronize the consistency group:

   ```
   destination::> snapmirror resync -destination-path vs1_dst:/cg/cg_dst
   ```

8. Rescan host LUN I/O paths to restore all paths to the LUNs.

Upgrade and revert ONTAP with SM-BC

SnapMirror Business Continuity (SM-BC) is supported beginning with ONTAP 9.8.

Upgrading and reverting your ONTAP cluster has implications on your SM-BC relationships depending on the ONTAP version to which you are upgrading or reverting.

Upgrade ONTAP

Before you can configure and use SM-BC, you must upgrade all nodes on the source and destination clusters to ONTAP 9.8 or later.
xref:./smbc/Upgrade software on ONTAP clusters

> The `snapmirror quiesce` and `snampirror resume` commands are not supported with SM-BC.

When you upgrade clusters from 9.8 or 9.9.1 to 9.10.1, ONTAP creates new consistency groups on both source and destination for SM-BC relationships. These can be managed in System Manager under the **Consistency Groups** option or using the ONTAP REST API with the consistency groups endpoint.

Revert to ONTAP 9.9.1 from ONTAP 9.10.1

To revert relationships from 9.10.1 to 9.9.1, SM-BC relationships must be deleted, followed by the 9.10.1 consistency group instance. Consistency groups with an active SM-BC relationship cannot be deleted. Any FlexVol volumes that were upgraded to 9.10.1 previously associated with another Smart Container or Enterprise App in 9.9.1 or earlier will no longer be associated on revert. Deleting consistency groups does not delete the constituent volumes or volume granular snapshots. Refer to Delete a consistency group for more information on this task in ONTAP 9.10.1 and later.

Revert to ONTAP 9.7 from ONTAP 9.8

> SM-BC is not supported with mixed ONTAP 9.7 and ONTAP 9.8 clusters.

When you revert from ONTAP 9.8 to ONTAP 9.7, you must be aware of the following:

- If the cluster host an SM-BC destination, reverting to ONTAP 9.7 is not allowed until the relationship is broken and deleted.
- If the cluster hosts an SM-BC source, reverting to ONTAP 9.7 is not allowed until the relationship is released.
- All user-created custom SM-BC SnapMirror policies must be deleted before reverting to ONTAP 9.7.

To meet these requirements, see Remove an SM-BC configuration.

Steps

1. Perform a revert check from one of the clusters in the SM-BC relationship:

   ```
   cluster::*> system node revert-to -version 9.7 -check-only
   ```

   Example:

   ```
   cluster::*> system node revert-to -version 9.7 -check-only
   Error: command failed: The revert check phase failed. The following
   issues must be resolved before revert can be completed. Bring the data
   LIFs down on running vservers. Command to list the running vservers:
   vserver show -admin-state running Command to list the data LIFs that are
   ```

```
up: network interface show -role data -status-admin up Command to bring
all data LIFs down: network interface modify {-role data} -status-admin
down
Disable snapshot policies.
    Command to list snapshot policies: "snapshot policy show".
    Command to disable snapshot policies: "snapshot policy modify
-vserver
   * -enabled false"

   Break off the initialized online data-protection (DP) volumes and
delete
   Uninitialized online data-protection (DP) volumes present on the
local
   node.
    Command to list all online data-protection volumes on the local
node:
   volume show -type DP -state online -node <local-node-name>
    Before breaking off the initialized online data-protection volumes,
   quiesce and abort transfers on associated SnapMirror relationships
and
   wait for the Relationship Status to be Quiesced.
    Command to quiesce a SnapMirror relationship: snapmirror quiesce
    Command to abort transfers on a SnapMirror relationship: snapmirror
   abort
    Command to see if the Relationship Status of a SnapMirror
relationship
   is Quiesced: snapmirror show
    Command to break off a data-protection volume: snapmirror break
    Command to break off a data-protection volume which is the
destination
   of a SnapMirror relationship with a policy of type "vault":
snapmirror
   break -delete-snapshots
    Uninitialized data-protection volumes are reported by the
"snapmirror
   break" command when applied on a DP volume.
    Command to delete volume: volume delete

   Delete current version snapshots in advanced privilege level.
    Command to list snapshots: "snapshot show -fs-version 9.8"
    Command to delete snapshots: "snapshot prepare-for-revert -node
   <nodename>"

   Delete all user-created policies of the type active-strict-sync-
mirror
   and active-sync-mirror.
```

```
   The command to see all active-strict-sync-mirror and active-sync-
mirror
   type policies is:
    snapmirror policy show -type
   active-strict-sync-mirror,active-sync-mirror
   The command to delete a policy is :
    snapmirror policy delete -vserver <SVM-name> -policy <policy-name>
```

For information on reverting clusters, see Revert ONTAP.

Remove an SM-BC configuration

If you no longer require zero RTO Syncronous SnapMirror protection, you can delete your SM-BC relationship.

About this task

- Before you delete the SM-BC relationship, all LUNs in the destination cluster must be unmapped.
- After the LUNs are unmapped and the host is rescanned, the SCSI target notifies the hosts that the LUN inventory has changed. The existing LUNs on the zero RTO secondary volumes change to reflect a new identity after the zero RTO relationship is deleted. Hosts discover the secondary volume LUNs as new LUNs that have no relationship to the source volume LUNs.
- The secondary volumes remain DP volumes after the relationship is deleted. You can issue the `snapmirror break` command to convert them to read/write.
- Deleting the relationship is not allowed in the failed-over state when the relationship is not reversed.

Steps

1. From the secondary cluster, remove the SM-BC consistency group relationship between the source endpoint and destination endpoint:

   ```
   destination::>snapmirror delete -destination-path vs1_dst:/cg/cg_dst
   ```

2. From the primary cluster, release the consistency group relationship and the Snapshot copies created for the relationship:

   ```
   source::>snapmirror release -destination-path vs1_dst:/cg/cg_dst
   ```

3. Perform a host rescan to update the LUN inventory.
4. Beginning with ONTAP 9.10.1, deleting the SnapMirror relationship does not delete the consistency group. If you want to delete the consistency group, you must use System Manager or the ONTAP REST API. See Delete a consistency group for more information.

Remove ONTAP Mediator

If you want to remove an existing ONTAP Mediator configuration from your ONTAP clusters, you can do so by using the `snapmirror mediator remove` command.

Steps

1. Remove ONTAP Mediator:

```
snapmirror mediator remove -mediator-address 12.345.678.90 -peer-cluster
cluster_xyz
```

Troubleshoot

SnapMirror delete operation fails in takover state

Issue:

When ONTAP 9.9.1 is installed on a cluster, executing the `snapmirror delete` command fails when an SM-BC consistency group relationship is in takeover state.

Example:

```
C2_cluster::> snapmirror delete  vs1:/cg/dd

Error: command failed: RPC: Couldn't make connection
```

Solution

When the nodes in an SM-BC relationship are in takeover state, perform the SnapMirror delete and release operation with the "-force" option set to true.

Example:

```
C2_cluster::> snapmirror delete  vs1:/cg/dd -force true

Warning: The relationship between source "vs0:/cg/ss" and destination
         "vs1:/cg/dd" will be deleted, however the items of the
destination
         Consistency Group might not be made writable, deletable, or
modifiable
         after the operation. Manual recovery might be required.
Do you want to continue? {y|n}: y
Operation succeeded: snapmirror delete for the relationship with
destination "vs1:/cg/dd".
```

Failure creating a SnapMirror relationship and initializing consistency group

Issue:

Creation of SnapMirror relationship and consistency group initialization fails.

Solution:

Ensure that you have not exceeded the limit of consistency groups per cluster. Consistency group limits in SM-BC are platform independent and differ based on the version of ONTAP. See Additional restrictions and limitations for limitations based on ONTAP version.

Error:

If the consistency group is stuck initializing, check the status of your consistency group initializations with the

ONTAP REST API, System Manager or the command `sn show -expand`.

Solution:

If consistency groups fail to initialize, remove the SM-BC relationship, delete the consistency group, then recreate the relationship and initialize it. This workflow differs depending on the version of ONTAP you are using.

If you are using ONTAP 9.8-9.9.1	If you are using ONTAP 9.10.1 or later
1. Remove the SM-BC configuration 2. Create a consistency group relationship 3. Initialize the consistency group relationship	1. Under **Protection > Relationships**, find the SM-BC relationship on the consistency group. Select ⋮, then **Delete** to remove the SM-BC relationship. 2. Delete the consistency group 3. Configure the consistency group

Planned failover unsuccessful

Issue:

After executing the `snapmirror failover start` command, the output for the `snapmirror failover show` command displays a message indicates that a nondisruptive operation is in progress.

Example:

```
Cluster1::> snapmirror failover show
Source Destination Error
Path Path Type Status start-time end-time Reason
-------- ----------- -------- --------- ---------- ---------- ----------
vs1:/cg/cg vs0:/cg/cg planned failed 10/1/2020 10/1/2020 SnapMirror
Failover cannot start because a volume move is running. Retry the command
once volume move has finished.
                                                              08:35:04
08:35:04
```

Cause:

A planned failover cannot begin when a nondisruptive operation is in progress, including volume move, aggregate relocation, and storage failover.

Solution:

Wait for the nondisruptive operation to complete and try the failover operation again.

ONTAP Mediator not reachable or Mediator quorum status is false

Issue:

After executing the `snapmirror failover start` command, the output for the `snapmirror failover show` command displays a message indicating that Mediator is not configured.

See Initialize the ONTAP Mediator.

Example:

```
Cluster1::> snapmirror failover show
Source Destination Error
Path Path Type Status start-time end-time Reason
-------- ---------- -------- --------- ---------- ---------- ----------
vs0:/cg/cg vs1:/cg/cg planned failed 10/1/2020 10/1/2020 SnapMirror
failover cannot start because the source-side precheck failed. reason:
Mediator not configured.
05:50:42 05:50:43
```

Cause:

Mediator is not configured or there are network connectivity issues.

Solution:

If the ONTAP Mediator is not configured, you must configure the ONTAP Mediator before you can establish an SM-BC relationship. Fix any network connectivity issues. Make sure Mediator is connected and quorum status is true on both the source and destination site using the snapmirror mediator show command. For more information, see Configure the ONTAP Mediator.

Example:

```
cluster::> snapmirror mediator show
Mediator Address Peer Cluster     Connection Status Quorum Status
---------------- ---------------- ----------------- -------------
10.234.10.143    cluster2         connected         true
```

Automatic unplanned failover not triggered on Site B

Issue:

A failure on Site A does not trigger an unplanned failover on Site B.

Possible cause #1:

The ONTAP Mediator is not configured. To determine if this is the cause, issue the `snapmirror mediator show` command on the Site B cluster.

Example:

```
Cluster2::*> snapmirror mediator show
This table is currently empty.
```

This example indicates that ONTAP Mediator is not configured on Site B.

Solution:

Ensure that ONTAP Mediator is configured on both clusters, that the status is connected, and quorum is set to True.

Possible cause #2:

SnapMirror consistency group is out of sync. To determine if this is the cause, view the event log to view if the consistency group was in sync during the time at which the Site A failure occurred.

Example:

```
cluster::*> event log show -event *out.of.sync*

Time                Node             Severity      Event
------------------- ---------------- -------------
---------------------------
10/1/2020 23:26:12  sti42-vsim-ucs511w ERROR       sms.status.out.of.sync:
Source volume "vs0:zrto_cg_556844_511u_RW1" and destination volume
"vs1:zrto_cg_556881_511w_DP1" with relationship UUID "55ab7942-03e5-11eb-
ba5a-005056a7dc14" is in "out-of-sync" status due to the following reason:
"Transfer failed."
```

Solution:

Complete the following steps to perform a forced failover on Site B.

1. Unmap all LUNs belonging to the consistency group from Site B.
2. Delete the SnapMirror consistency group relationship using the `force` option.
3. Enter the `snapmirror break` command on the consistency group constituent volumes to convert volumes from DP to R/W, to enable I/O from Site B.
4. Boot up the Site A nodes to create a zero RTO relationship from Site B to Site A.
5. Release the consistency group with `relationship-info-only` on Site A to retain common Snapshot copy and unmap the LUNs belonging to the consistency group.
6. Convert volumes on Site A from R/W to DP by setting up a volume level relationship using either the Sync policy or Async policy.
7. Issue the `snapmirror resync` to synchronize the relationships.
8. Delete the SnapMirror relationships with the Sync policy on Site A.
9. Release the SnapMirror relationships with Sync policy using `relationship-info-only true` on Site B.
10. Create a consistency group relationship from Site B to Site A.
11. Perform a consistency group resync from Site A, and then verify that the consistency group is in sync.
12. Rescan host LUN I/O paths to restore all paths to the LUNs.

Link between Site B and mediator down and Site A down

To check on the connection of the ONTAP Mediator, use the `snapmirror mediator show` command. If the connection status is unreachable and Site B is unable to reach Site B, you will have an output similar to the one below. Follow the steps in the solution to restore connection

Example:

```
cluster::*> snapmirror mediator show
Mediator Address Peer Cluster     Connection Status Quorum Status
---------------- ---------------- ----------------- -------------
10.237.86.17     C1_cluster       unreachable       true
SnapMirror consistency group relationship status is out of sync.

C2_cluster::*> snapmirror show -expand
Source            Destination Mirror  Relationship   Total
Last
Path        Type  Path        State   Status         Progress  Healthy
Updated
----------- ---- ------------ ------- -------------- --------- -------
--------
vs0:/cg/src_cg_1 XDP vs1:/cg/dst_cg_1 Snapmirrored OutOfSync - false   -
vs0:zrto_cg_655724_188a_RW1 XDP vs1:zrto_cg_655755_188c_DP1 Snapmirrored
OutOfSync - false -
vs0:zrto_cg_655733_188a_RW2 XDP vs1:zrto_cg_655762_188c_DP2 Snapmirrored
OutOfSync - false -
vs0:zrto_cg_655739_188b_RW1 XDP vs1:zrto_cg_655768_188d_DP1 Snapmirrored
OutOfSync - false -
vs0:zrto_cg_655748_188b_RW2 XDP vs1:zrto_cg_655776_188d_DP2 Snapmirrored
OutOfSync - false -
5 entries were displayed.

Site B cluster is unable to reach Site A.
C2_cluster::*> cluster peer show
Peer Cluster Name         Cluster Serial Number Availability
Authentication
------------------------- --------------------- --------------
--------------
C1_cluster            1-80-000011           Unavailable    ok
```

Solution

Force a failover to enable I/O from Site B and then establish a zero RTO relationship from Site B to Site A.

Complete the following steps to perform a forced failover on Site B.

1. Unmap all LUNs belonging to the consistency group from Site B.
2. Delete the SnapMirror consistency group relationship using the force option.
3. Enter the snapmirror break command on the consistency group constituent volumes to convert volumes from DP to RW, to enable I/O from Site B.
4. Boot up the Site A nodes to create a zero RTO relationship from Site B to Site A.
5. Release the consistency group with relationship-info-only on Site A to retain common Snapshot copy and unmap the LUNs belonging to the consistency group.

6. Convert volumes on Site A from RW to DP by setting up a volume level relationship using either Sync policy or Async policy.
7. Issue the snapmirror resync to synchronize the relationships.
8. Delete the SnapMirror relationships with Sync policy on Site A.
9. Release the SnapMirror relationships with Sync policy using relationship-info-only true on Site B.
10. Create a consistency group relationship from Site B to Site A.
11. Perform a consistency group resync from Site A, and then verify that the consistency group is in sync.
12. Rescan host LUN I/O paths to restore all paths to the LUNs.

Link between Site A and mediator down and Site B down

When using SM-BC, you may lose connectivity between the mediator or your peered clusters. You can diagnose the issue by checking the connection, availability, and consensus status of the different parts of the SM-BC relationship and then forcefully resuming connection.

Table 1. Determining the cause

What to check	CLI command	Indicator
Mediator from Site A	`snapmirror mediator show`	The connection status will be `unreachable`
Site B connectivity	`cluster peer show`	Availability will be `unavailable`
Consensus status of the SM-BC volume	`volume show` *`volume_name`* `-fields smbc-consensus`	The `sm-bc consensus` field will read `Awaiting-consensus`

For additional information about diagnosing and resolving this issue, refer to the Knowledge Base article Link between Site A and Mediator down and Site B down when using SM-BC.

SM-BC SnapMirror delete operation fails when fence is set on destination volume

Issue:

SnapMirror delete operation fails when any of the destination volumes have redirection fence set.

Solution

Performing the following operations to retry the redirection and remove the fence from the destination volume.

- SnapMirror resync
- SnapMirror update

Volume move operation stuck when primary is down

Issue:

A volume move operation is stuck indefinitely in cutover deferred state when the primary site is down in an SM-BC relationship.
When the primary site is down, the secondary site performs an automatic unplanned

failover (AUFO). When a volume move operation is in progress when the AUFO is triggered the volume move becomes stuck.

Solution:

Abort the volume move instance that is stuck and restart the volume move operation.

SnapMirror release fails when unable to delete Snapshot copy

Issue:

The SnapMirror release operation fails when the Snapshot copy cannot be deleted.

Solution:

The Snapshot copy contains a transient tag. Use the `snapshot delete` command with the `-ignore -owners` option to remove the transient Snapshot copy.

```
snapshot delete -volume <volume_name> -snapshot <snapshot_name> -ignore-owners true -force true
```

Retry the `snapmirror release` command.

Volume move reference Snapshot copy shows as the newest

Issue:

After performing a volume move operation on a consistency group volume, the volume move reference Snapshot copy might display as the newest for the SnapMirror relationship.

You can view the newest Snapshot copy with the following command:

```
snapmirror show -fields newest-snapshot status -expand
```

Solution:

Manually perform a `snapmirror resync` or wait for the next automatic resync operation after the volume move operation completes.

Mediator service for MetroCluster and SnapMirror Business Continuity

ONTAP Mediator overview

The ONTAP Mediator provides several functions for ONTAP features:

- Provides a persistent and fenced store for HA metadata.
- Serves as a ping proxy for controller liveliness.
- Provides synchronous node health query functionality to aid in quorum determination.

The ONTAP Mediator provides two additional systemctl services:

- **`ontap_mediator.service`**

Maintains the REST APIs server for managing the ONAP relationships.

- **`mediator-scst.service`**

  Controls the startup and shutdown of the iSCSI module (SCST).

Tools provided for the system administrator

Tools provided for the system administrator:

- **`/usr/local/bin/mediator_change_password`**

  Sets a new API password when the current API username and password are provided.

- **`/usr/local/bin/mediator_change_user`**

  Sets a new API username when the current API username and password are provided.

- **`/usr/local/bin/mediator_generate_support_bundle`**

  Generates a local tgz file containing all useful support information needed for communication with NetApp customer support. This includes application configuration, logs, and some system information. The bundles are generated on the local disk and can be transferred manually, as needed. Storage location: /opt/netapp/data/support_bundles/

- **`/usr/local/bin/uninstall_ontap_mediator`**

  Removes the ONTAP Mediator package and the SCST kernel module. This includes all configuration, logs, and mailbox data.

- **`/usr/local/bin/mediator_unlock_user`**

  Releases a lock-out on the API user account if the authentication retry limit was reached. This feature is used to prevent brute force password derivation. It prompts the user for the correct username and password.

- **`/usr/local/bin/mediator_add_user`**

  (Support only) Used to add the API user upon installation.

Special Notes

ONTAP Mediator relies on SCST to provide iSCSI (See http://scst.sourceforge.net/index.html). This package is a kernel module that is compiled during installation specifically for the kernel. Any updates to the kernel might require SCST to be re-installed. Alternatively, uninstall then re-install the ONTAP Mediator, then reconfigure the ONTAP relationship.

Any updates to the server OS kernel should be coordinated with a maintenance window in ONTAP.

What's new with the ONTAP Mediator

New enhancements to the ONTAP Mediator are provided with each release. Here's what's new.

Enhancements

ONTAP Mediator version	Enhancements
1.6	• Python 3.9 updates. • Support for RHEL 8.4-8.8, 9.0-9.2, Rocky Linux 8 and 9. • Discontinued support for RHEL 7.x / CentOS all releases.
1.5	• Optimizes speed for larger scale SMBC systems. • Cryptographic code-signature added to the installer. • Includes deprecation warnings for RHEL 7.x / CentOS 7.x.
1.4	• Support for RHEL 8.4 and 8.5. • Includes SCST version 3.6.0. • Added support for UFEI-based firmware's Secure Boot (SB).
1.3	• Support for RHEL/CentOS 8.2 and 8.3. • Includes SCST version 3.5.0.
1.2	• Support for HTTPs mailboxes. • For use with ONTAP 9.8+ MCC-IP AUSO and SM-BC ZRTO. • Includes SCST version 3.4.0.
1.1	• Support for RHEL/CentOS 7.6, 7.7, 8.0, and 8.1. • Eliminates Perl dependencies. • Includes SCST version 3.4.0.
1.0	• Support for iSCSI mailboxes. • For use with ONTAP 9.7+ MCC-IP AUSO. • Support for RHEL/CentOS 7.6.

OS support matrix

OS for ONTAP Mediator	1.6	1.5	1.4	1.3	1.2	1.1	1.0
7.6	Obsolete	Yes	Yes	Yes	Yes	Yes	Yes (RHEL only)

7.7	Obsolete	Yes	Yes	Yes	Yes	No	No
7.8	Obsolete	Yes	Yes	Yes	Yes	No	No
7.9	Obsolete	Yes	Yes	Yes	Implied	No	No
RHEL 8.0	Obsolete	Yes	Yes	Yes	Yes	Yes	No
RHEL 8.1	Obsolete	Yes	Yes	Yes	Yes	No	No
RHEL 8.2	Obsolete	Yes	Yes	Yes	No	No	No
RHEL 8.3	Obsolete	Yes	Yes	Yes	No	No	No
RHEL 8.4	Yes	Yes	Yes	No	No	No	No
RHEL 8.5	Yes	Yes	Yes	No	No	No	No
RHEL 8.6	Yes	No	No	No	No	No	No
RHEL 8.7	Yes	No	No	No	No	No	No
RHEL 8.8	Yes	No	No	No	No	No	No
RHEL 9.0	Yes	No	No	No	No	No	No
RHEL 9.1	Yes	No	No	No	No	No	No
RHEL 9.2	Yes	No	No	No	No	No	No
CentOS 8 and stream	No	No	No	No	N/A	N/A	N/A
Rocky Linux 8	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Rocky Linux 9	Yes	N/A	N/A	N/A	N/A	N/A	N/A

- OS refers to both RedHat and CentOS releases unless otherwise specified.
- "Implied" means that the OS was released after the ONTAP Mediator was shipped, but support has been confirmed.
- "No" means that the OS and ONTAP Mediator are not compatible.
- Centos 8 was removed for all releases due to its rebranching. Centos Stream was deemed as not a suitable production target OS. No support is planned.
- ONTAP Mediator 1.5 was the last supported release for RHEL 7.x branch operating systems.

- ONTAP Mediator 1.6 adds support for Rocky Linux 8 and 9.

Resolved issues

Date of change	Change ID	Description
10 Jan 2023	6567145	The following changes were made: • Added support for additional operating systems for ONTAP Mediator: RHEL 9.6, 8.7, 9.0, and 9.1. • Added new SCST version 3.7.0 to unblock issues for newly supported operating systems. • Added support for Rocky Linux: Rocky 8 and 9.
24 Jan 2023	6621319	Allowed pre-installed SCST library for ONTAP Mediator installations.
27 Feb 2023	6623764	Implemented changes to always load the scst_disk kernel module when the mediator-scst service restarts. These changes ensure the service will always be ready to create new iSCSI targets using the standard logic.
28 Feb 2023	6625194	Added a new option to the ONTAP Mediator installer: `--skip -yum-dependencies`
24 Mar 2023	6652840	Updated the ONTAP Mediator installer so that it is able to reinstall or repair the SCST installation.
27 Mar 2023	6655179	Fixed a parsing issue that occurred when the support bundle collection with a complex password was triggered.
28 Mar 2023	6656739	Changed the SCST comparison logic so that is will install the right version when ONTAP Mediator is upgraded.

Install or upgrade

Prepare to install or upgrade the ONTAP Mediator service

To install the ONTAP Mediator service, you must ensure all prerequisites are met, fetch the installation package and run the installer on the host. This procedure is used for an installation or an upgrade of an existing installation.

About this task

- Beginning with ONTAP 9.7, you can use any version of ONTAP Mediator to monitor a MetroCluster IP configuration.
- Beginning with ONTAP 9.8, you can use any version of ONTAP Mediator to monitor an SM-BC relationship.

Before you begin

You must meet the following prerequisites.

ONTAP Mediator version	Supported Linux versions
1.6	• Red Hat Enterprise Linux: 8.4, 8.5, 8.6, 8.7, 8.8, 9.0, 9.1, 9.2 • Rocky Linux 8 and 9
1.5	• Red Hat Enterprise Linux: 7.6, 7.7, 7.8, 7.9, 8.1, 8.2, 8.3, 8.4, 8.5 • CentOS: 7.6, 7.7, 7.8, 7.9
1.4	• Red Hat Enterprise Linux: 7.6, 7.7, 7.8, 7.9, 8.1, 8.2, 8.3, 8.4, 8.5 • CentOS: 7.6, 7.7, 7.8, 7.9
1.3	• Red Hat Enterprise Linux: 7.6, 7.7, 7.8, 7.9, 8.1, 8.2, 8.3 • CentOS: 7.6, 7.7, 7.8, 7.9
1.2	• Red Hat Enterprise Linux: 7.6, 7.7, 7.8, 8.1 • CentOS: 7.6, 7.7, 7.8

The kernel version must match the operating system version.

- 64-bit physical installation or virtual machine
- 8 GB RAM
- User: Root access

Any library packages except the kernel can safely be updated but might require a reboot to take affect within the ONTAP Mediator application. A service window is recommended when a reboot is required.

If you install the `yum-utils` package, you can use the `needs-restarting` command.

The kernel core can be updated if it is being updated to a version that is still supported by the ONTAP Mediator version matrix. A reboot will be mandatory, so a service window is required.

The SCST kernel module must be uninstalled prior to the reboot, then re-installed after the reboot.

Upgrading to a kernel beyond the supported OS release for the specific ONTAP Mediator release is not support. (This likely indicates that the tested SCST module won't compile).

Upgrade the host operating system and then the ONTAP Mediator

To upgrade the host OS for ONTAP Mediator to a later version, you must first uninstall ONTAP Mediator.

Before you begin

The best practices for installing Red Hat Enterprise Linux or CentOS and the associated repositories on your system are listed below. Systems installed or configured differently might require additional steps.

- You must install Red Hat Enterprise Linux or CentOS according to Red Hat best practices. Due to end-of-life support for CentOS 8.x versions, compatible versions of CentOS 8.x are not recommended.
- While installing the ONTAP Mediator service on Red Hat Enterprise Linux or CentOS, the system must have access to the appropriate repository so that the installation program can access and install all the required software dependencies.
- For the yum installer to find dependent software in the Red Hat Enterprise Linux repositories, you must have registered the system during the Red Hat Enterprise Linux installation or afterwards by using a valid Red Hat subscription.

  See the Red Hat documentation for information about the Red Hat Subscription Manager.
- The following ports must be unused and available for the Mediator:
  - 31784
  - 3260
- If using a third-party firewall: refer to Firewall requirements for ONTAP Mediator
- If the Linux host is in a location without access to the internet, you must ensure that the required packages are available in a local repository.

  If you are using Link Aggregation Control Protocol (LACP) in a Linux environment, you must correctly configure the kernel and make sure the `sysctl net.ipv4.conf.all.arp_ignore` is set to "2".

What you'll need

The following packages are required by the ONTAP Mediator service:

All RHEL/CentOS versions	Additional packages for RHEL 8.x / Rocky Linux 8	Additional packages for RHEL 9.x / Rocky Linux 9
• openssl • openssl-devel • kernel-devel-$ (uname -r) • gcc • make • libselinux-utils • patch • bzip2 • perl-Data-Dumper • perl-ExtUtils-MakeMaker • efibootmgr • mokutil	• python3-pip • elfutils-libelf-devel • policycoreutils-python-utils • redhat-lsb-core • python39 • python39-devel	• python3-pip • elfutils-libelf-devel • policycoreutils-python-utils • python3 • python3-devel

The Mediator installation package is a self-extracting compressed tar file that includes:

- An RPM file containing all dependencies that cannot be obtained from the supported release's repository.
- An install script.

A valid SSL certification is recommended.

About this task

When you upgrade the host OS for ONTAP Mediator to a later major version (for example, from 7.x to 8.x) using the leapp-upgrade tool, you must uninstall ONTAP Mediator because the tool tries to detect new versions of any RPMs that are installed in the repositories that are registered with the system.

Because an .rpm file was installed as part of the ONTAP Mediator installer, it is included in that search. However, because that .rpm file was unpacked as part of the installer and not downloaded from a registered repository, an upgrade cannot be found. In this case, the leapp-upgrade tool uninstalls the package.

In order to preserve the log files, which will be used to triage support cases, you should back up the files prior to doing an OS upgrade and restore them after a reinstall of the ONTAP Mediator package. Because the ONTAP Mediator is being reinstalled, any ONTAP Clusters that are connected to it will need to be reconnected after the new installation.

The following steps should be performed in order. Immediately after you reinstall ONTAP Mediator, you should stop the ontap_mediator service, replace the log files, and restart the service. This will ensure logs will not be lost.

Steps

1. Back up the log files.

```
[rootmediator-host ~]# tar -czf ontap_mediator_file_backup.tgz -C
/opt/netapp/lib/ontap_mediator ./log
./ontap_mediator/server_config/ontap_mediator.user_config.yaml
[rootmediator-host ~]# tar -tf ontap_mediator_file_backup.tgz
./log/
./log/ontap_mediator.log
./log/scstadmin.log
./log/ontap_mediator_stdout.log
./log/ontap_mediator_requests.log
./log/install_20230419134611.log
./log/scst.log
./log/ontap_mediator_syslog.log
./ontap_mediator/server_config/ontap_mediator.user_config.yaml
[rootmediator-host ~]#
```

2. Perform upgrade with leapp-upgrade tool.

```
[rootmediator-host ~]# leapp preupgrade --target 8.4
  ..<snip upgrade checks>..
  ..<fix issues found>..
[rootmediator-host ~]# leapp upgrade --target 8.4
  ..<snip upgrade>..
[rootmediator-host ~]# cat /etc/os-release | head -2
NAME="Red Hat Enterprise Linux"
VERSION="8.4 (Ootpa)"
[rootmediator-host ~]#
```

3. Reinstall ONTAP Mediator.

> Perform the rest of the steps immediately after reinstalling ONTAP Mediator to prevent a loss of log files.

```
[rootmediator-host ~]# ontap-mediator-1.6.0/ontap-mediator-1.6.0

ONTAP Mediator: Self Extracting Installer

  ..<snip installation>..
[rootmediator-host ~]#
```

4. Stop the ontap_mediator service.

```
[rootmediator-host ~]# systemctl stop ontap_mediator
[rootmediator-host ~]#
```

5. Replace the log files.

```
[rootmediator-host ~]# tar -xf ontap_mediator_log_backup.tgz -C
/opt/netapp/lib/ontap_mediator
[rootmediator-host ~]#
```

6. Start the ontap_mediator service.

```
[rootmediator-host ~]# systemctl start ontap_mediator
[rootmediator-host ~]#
```

7. Reconnect all ONTAP clusters to the upgraded ONTAP Mediator

Procedure for MetroCluster over IP

```
siteA::> metrocluster configuration-settings mediator show
Mediator IP     Port    Node                    Configuration
Connection
                                                Status        Status
--------------- ------- ---------------------- -------------
-----------
172.31.40.122
                31784   siteA-node2             true          false
                        siteA-node1             true          false
                        siteB-node2             true          false
                        siteB-node2             true          false
siteA::> metrocluster configuration-settings mediator remove
Removing the mediator and disabling Automatic Unplanned Switchover.
It may take a few minutes to complete.
Please enter the username for the mediator: mediatoradmin
Please enter the password for the mediator:
Confirm the mediator password:
Automatic Unplanned Switchover is disabled for all nodes...
Removing mediator mailboxes...
Successfully removed the mediator.

siteA::> metrocluster configuration-settings mediator add -mediator
-address 172.31.40.122
Adding the mediator and enabling Automatic Unplanned Switchover. It
may take a few minutes to complete.
Please enter the username for the mediator: mediatoradmin
Please enter the password for the mediator:
Confirm the mediator password:
Successfully added the mediator.

siteA::> metrocluster configuration-settings mediator show
Mediator IP     Port    Node                    Configuration
Connection
                                                Status        Status
--------------- ------- ---------------------- -------------
-----------
172.31.40.122
                31784   siteA-node2             true          true
                        siteA-node1             true          true
                        siteB-node2             true          true
                        siteB-node2             true          true
siteA::>
```

Procedure for SnapMirror Business Continuity

For SnapMirror Business Continuity, if you installed your TLS certificate outside of the /opt/netapp directory, then you will not need to reinstall it. If you were using the default generated self-signed certificate or put your custom certificate in the /opt/netapp directory, then you should back it up and restore it.

```
peer1::> snapmirror mediator show
Mediator Address Peer Cluster     Connection Status Quorum Status
---------------- ---------------- ----------------- -------------
172.31.49.237    peer2            unreachable       true

peer1::> snapmirror mediator remove -mediator-address 172.31.49.237
-peer-cluster peer2

Info: [Job 39] 'mediator remove' job queued

peer1::> job show -id 39
                            Owning
Job ID Name                 Vserver    Node           State
------ -------------------- ---------- -------------- ----------
39     mediator remove      peer1      peer1-node1    Success
     Description: Removing entry in mediator

peer1::> security certificate show -common-name ONTAPMediatorCA
Vserver    Serial Number   Certificate Name
Type
---------- --------------- ------------------------------------
------------
peer1
        4A790360081F41145E14C5D7CE721DC6C210007F
                        ONTAPMediatorCA
server-ca
    Certificate Authority: ONTAP Mediator CA
        Expiration Date: Mon Apr 17 10:27:54 2073

peer1::> security certificate delete -common-name ONTAPMediatorCA *
1 entry was deleted.

 peer1::> security certificate install -type server-ca -vserver
peer1

Please enter Certificate: Press <Enter> when done
  ..<snip ONTAP Mediator CA public key>..

You should keep a copy of the CA-signed digital certificate for
future reference.
```

```
The installed certificate's CA and serial number for reference:
CA: ONTAP Mediator CA
serial: 44786524464C5113D5EC966779D3002135EA4254

The certificate's generated name for reference: ONTAPMediatorCA

peer2::> security certificate delete -common-name ONTAPMediatorCA *
1 entry was deleted.

peer2::> security certificate install -type server-ca -vserver peer2

 Please enter Certificate: Press <Enter> when done
..<snip ONTAP Mediator CA public key>..


You should keep a copy of the CA-signed digital certificate for
future reference.

The installed certificate's CA and serial number for reference:
CA: ONTAP Mediator CA
serial: 44786524464C5113D5EC966779D3002135EA4254

The certificate's generated name for reference: ONTAPMediatorCA

peer1::> snapmirror mediator add -mediator-address 172.31.49.237
-peer-cluster peer2 -username mediatoradmin

Notice: Enter the mediator password.

Enter the password:
Enter the password again:

Info: [Job: 43] 'mediator add' job queued

peer1::> job show -id 43
                            Owning
Job ID Name                 Vserver    Node           State
------ -------------------- ---------- -------------- ----------
43     mediator add         peer1      peer1-node2    Success
    Description: Creating a mediator entry

peer1::> snapmirror mediator show
Mediator Address Peer Cluster     Connection Status Quorum Status
---------------- ---------------- ----------------- -------------
172.31.49.237    peer2            connected         true
```

```
peer1::>
```

Enable access to the repositories

You should enable access to repositories so ONTAP Mediator can access the required packages during the installation process

Steps

1. Determine which repositories must be accessed, as shown in the following table:

If your operating system is…	You must provide access to these repositories…
RHEL 7.x	• rhel-7-server-optional-rpms
RHEL 8.x	• rhel-8-for-x86_64-baseos-rpms • rhel-8-for-x86_64-appstream-rpms
RHEL 9.x	• rhel-9-for-x86_64-baseos-rpms • rhel-9-for-x86_64-appstream-rpms
CentOS 7.x	• C7.6.1810 - Base repository
Rocky Linux 8	• appstream • baseos
Rocky Linux 9	• appstream • baseos

2. Use one of the following procedures to enable access to the repositories listed above so ONTAP Mediator can access the required packages during the installation process.

Procedure for RHEL 7.x operating system

Use this procedure if your operating system is **RHEL 7.x** to enable access to repositories:

Steps

1. Subscribe to the required repository:

   ```
   subscription-manager repos --enable rhel-7-server-optional-rpms
   ```

   The following example shows the execution of this command:

   ```
   [root@localhost ~]# subscription-manager repos --enable rhel-7-
   server-optional-rpms
   Repository 'rhel-7-server-optional-rpms' is enabled for this system.
   ```

2. Run the `yum repolist` command.

   The following example shows the execution of this command. The "rhel-7-server-optional-rpms" repository should appear in the list.

   ```
   [root@localhost ~]# yum repolist
   Loaded plugins: product-id, search-disabled-repos, subscription-
   manager
   rhel-7-server-optional-rpms | 3.2 kB  00:00:00
   rhel-7-server-rpms | 3.5 kB  00:00:00
   (1/3): rhel-7-server-optional-rpms/7Server/x86_64/group
   |  26 kB  00:00:00
   (2/3): rhel-7-server-optional-rpms/7Server/x86_64/updateinfo
   | 2.5 MB  00:00:00
   (3/3): rhel-7-server-optional-rpms/7Server/x86_64/primary_db
   | 8.3 MB  00:00:01
   repo id                                    repo name
   status
   rhel-7-server-optional-rpms/7Server/x86_64   Red Hat Enterprise
   Linux 7 Server - Optional (RPMs)   19,447
   rhel-7-server-rpms/7Server/x86_64            Red Hat Enterprise
   Linux 7 Server (RPMs)              26,758
   repolist: 46,205
   [root@localhost ~]#
   ```

Procedure for RHEL 8.x operating system

Use this procedure if your operating system is **RHEL 8.x** to enable access to repositories:

Steps

1. Subscribe to the required repository:

   ```
   subscription-manager repos --enable rhel-8-for-x86_64-baseos-rpms

   subscription-manager repos --enable rhel-8-for-x86_64-appstream-rpms
   ```

   The following example shows the execution of this command:

   ```
   [root@localhost ~]# subscription-manager repos --enable rhel-8-for-
   x86_64-baseos-rpms
   Repository 'rhel-8-for-x86_64-baseos-rpms' is enabled for this
   system.
   [root@localhost ~]# subscription-manager repos --enable rhel-8-for-
   x86_64-appstream-rpms
   Repository 'rhel-8-for-x86_64-appstream-rpms' is enabled for this
   system.
   ```

2. Run the `yum repolist` command.

   The newly subscribed repositories should appear in the list.

Procedure for RHEL 9.x operating system

Use this procedure if your operating system is **RHEL 9.x** to enable access to repositories:

Steps

1. Subscribe to the required repository:

   ```
   subscription-manager repos --enable rhel-9-for-x86_64-baseos-rpms

   subscription-manager repos --enable rhel-9-for-x86_64-appstream-rpms
   ```

   The following example shows the execution of this command:

   ```
   [root@localhost ~]# subscription-manager repos --enable rhel-9-for-
   x86_64-baseos-rpms
   Repository 'rhel-9-for-x86_64-baseos-rpms' is enabled for this
   system.
   [root@localhost ~]# subscription-manager repos --enable rhel-9-for-
   x86_64-appstream-rpms
   Repository 'rhel-9-for-x86_64-appstream-rpms' is enabled for this
   system.
   ```

2. Run the `yum repolist` command.

   The newly subscribed repositories should appear in the list.

Procedure for CentOS 7.x operating system

Use this procedure if your operating system is **CentOS 7.x** to enable access to repositories:

> The following examples are showing a repository for CentOS 7.6 and might not work for other CentOS versions. Use the base repository for your version of CentOS.

Steps

1. Add the C7.6.1810 - Base repository. The C7.6.1810 - Base vault repository contains the "kernel-devel" package needed for ONTAP Mediator.
2. Add the following lines to /etc/yum.repos.d/CentOS-Vault.repo.

```
[C7.6.1810-base]
name=CentOS-7.6.1810 - Base
baseurl=http://vault.centos.org/7.6.1810/os/$basearch/
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-7
enabled=1
```

3. Run the `yum repolist` command.

   The following example shows the execution of this command. The CentOS-7.6.1810 - Base repository should appear in the list.

```
Loaded plugins: fastestmirror
Loading mirror speeds from cached hostfile
 * base: distro.ibiblio.org
 * extras: distro.ibiblio.org
 * updates: ewr.edge.kernel.org
C7.6.1810-base                                | 3.6 kB  00:00:00
(1/2): C7.6.1810-base/x86_64/group_gz         | 166 kB  00:00:00
(2/2): C7.6.1810-base/x86_64/primary_db       | 6.0 MB  00:00:04
repo id                    repo name                status
C7.6.1810-base/x86_64      CentOS-7.6.1810 - Base   10,019
base/7/x86_64              CentOS-7 - Base          10,097
extras/7/x86_64            CentOS-7 - Extras        307
updates/7/x86_64           CentOS-7 - Updates       1,010
repolist: 21,433
[root@localhost ~]#
```

Procedure for Rocky Linux 8 or 9 operating systems

Use this procedure if your operating system is **Rocky Linux 8** or **Rocky Linux 9** to enable access to repositories:

Steps

1. Subscribe to the required repositories:

   ```
   dnf config-manager --set-enabled baseos

   dnf config-manager --set-enabled appstream
   ```

2. Perform a `clean` operation:

   ```
   dnf clean all
   ```

3. Verify the list of repositories:

   ```
   dnf repolist
   ```

Example for Rocky Linux 8

```
[root@localhost ~]# dnf config-manager --set-enabled baseos
[root@localhost ~]# dnf config-manager --set-enabled appstream
[root@localhost ~]# dnf clean all
[root@localhost ~]# dnf repolist
repo id                         repo name
appstream                       Rocky Linux 8 - AppStream
baseos                          Rocky Linux 8 - BaseOS
[root@localhost ~]#
```

Example for Rocky Linux 9

```
[root@localhost ~]# dnf config-manager --set-enabled baseos
[root@localhost ~]# dnf config-manager --set-enabled appstream
[root@localhost ~]# dnf clean all
[root@localhost ~]# dnf repolist
repo id                         repo name
appstream                       Rocky Linux 9 - AppStream
baseos                          Rocky Linux 9 - BaseOS
[root@localhost ~]#
```

Download the Mediator installation package

Download the Mediator installation package as part of the installation process.

Steps

1. Download the Mediator installation package from the ONTAP Mediator page.

   ONTAP Mediator download page

2. Confirm that the Mediator installation package is in the current working directory:

   `ls`

   ```
   [root@mediator-host ~]#ls
   ontap-mediator-1.6.0.tgz
   ```

   For ONTAP Mediator versions 1.4 and earlier, the installer is named `ontap-mediator`.

   If you are at a location without access to the internet, you must ensure that the installer has access to the required packages.

3. If necessary, move the Mediator installation package from the download directory to the installation directory on the Linux Mediator host.
4. Unzip the installer package:

   `tar xvfz ontap-mediator-1.6.0.tgz`

   ```
   [root@scs000099753 ~]# tar xvfz ontap-mediator-1.6.0.tgz
   ontap-mediator-1.6.0/
   ontap-mediator-1.6.0/ONTAP-Mediator-production.pub
   ontap-mediator-1.6.0/tsa-prod-chain-ONTAP-Mediator.pem
   ontap-mediator-1.6.0/tsa-prod-ONTAP-Mediator.pem
   ontap-mediator-1.6.0/csc-prod-ONTAP-Mediator.pem
   ontap-mediator-1.6.0/csc-prod-chain-ONTAP-Mediator.pem
   ontap-mediator-1.6.0/ontap-mediator-1.6.0
   ontap-mediator-1.6.0/ontap-mediator-1.6.0.sig.tsr
   ontap-mediator-1.6.0/ontap-mediator-1.6.0.tsr
   ontap-mediator-1.6.0/ontap-mediator-1.6.0.sig
   ```

Verify the ONTAP Mediator code signature

You should verify the ONTAP Mediator code signature before installing the Mediator installation package.

Before you begin

Before verifying the Mediator code signature, your system must meet the following requirements.

- openssl versions 1.0.2 to 3.0 for basic verification
- openssl version 1.1.0 or later for Time Stamping Authority (TSA) operations
- Public internet access for OCSP verification

The following files are included in the download package:

File	Description
`ONTAP-Mediator-development.pub`	The public key used to verify the signature
`csc-prod-chain-ONTAP-Mediator.pem`	The public certification CA chain of trust
`csc-prod-ONTAP-Mediator.pem`	The certificate used to generate the key
`ontap-mediator-1.6.0`	The product installation executable for version 1.6.0
`ontap-mediator-1.6.0.sig`	The SHA-256 hashed, then RSA-signed using the csc-prod key, signature for the installer
`ontap-mediator-1.6.0.sig.tsr`	The revocation request for use by OCSCP for the installer's signature
`tsa-prod-ONTAP-Mediator.pem`	The public certificate for the TSR
`tsa-prod-chain-ONTAP-Mediator.pem`	The public certificate CA Chain for the TSR

Steps

1. Perform the revocation check on `csc-prod-ONTAP-Mediator.pem` by using Online Certificate Status Protocol (OCSP).
   a. Find the OCSP URL used to register the certificate because developer certificates might not provide a uri.

```
openssl x509 -noout -ocsp_uri -in csc-prod-chain-ONTAP-Mediator.pem
```

   b. Generate an OCSP request for the certificate.

```
openssl ocsp -issuer csc-prod-chain-ONTAP-Mediator.pem -CAfile csc-
prod-chain-ONTAP-Mediator.pem -cert csc-prod-ONTAP-Mediator.pem
-reqout req.der
```

   c. Connect to the OCSP Manager to send the OCSP request:

```
openssl ocsp -issuer csc-prod-chain-ONTAP-Mediator.pem -CAfile csc-
prod-chain-ONTAP-Mediator.pem -cert csc-prod-ONTAP-Mediator.pem  -url
${ocsp_uri} -resp_text -respout resp.der -verify_other csc-prod-
chain-ONTAP-Mediator.pem
```

2. Verify the trust chain of the CSC and expiration dates against the local host:

`openssl verify`

> The `openssl` version from the PATH must have a valid `cert.pem` (not self-signed).

```
openssl verify -untrusted csc-prod-chain-ONTAP-Mediator.pem -CApath
${OPENSSLDIR} csc-prod-ONTAP-Mediator.pem  # Failure action: The Code-
Signature-Check certificate has expired or is invalid. Download a newer
version of the ONTAP Mediator.
openssl verify -untrusted tsa-prod-chain-ONTAP-Mediator.pem -CApath
${OPENSSLDIR} tsa-prod-ONTAP-Mediator.pem  # Failure action: The Time-
Stamp certificate has expired or is invalid. Download a newer version of
the ONTAP Mediator.
```

3. Verify the `ontap-mediator-1.5.0.sig.tsr` and `ontap-mediator-1.6.0.tsr` files using the associated certificates:

`openssl ts -verify`

> `.tsr` files contain the time stamp response associated with the installer and the code signature. Processing confirms that the time stamp has a valid signature from TSA and that your input file has not changed.
> The verification is performed locally on your machine. Independently, there is no need to access TSA servers.

```
openssl ts -verify -data ontap-mediator-1.6.0.sig -in ontap-mediator-
1.6.0.sig.tsr -CAfile tsa-prod-chain-ONTAP-Mediator.pem -untrusted tsa-
prod-ONTAP-Mediator.pem
openssl ts -verify -data ontap-mediator-1.6.0 -in ontap-mediator-
1.6.0.tsr -CAfile tsa-prod-chain-ONTAP-Mediator.pem -untrusted tsa-prod-
ONTAP-Mediator.pem
```

4. Verify signatures against the key:

`openssl -dgst -verify`

```
openssl dgst -sha256 -verify ONTAP-Mediator-production.pub -signature
ontap-mediator-1.6.0.sig ontap-mediator-1.6.0
```

Example of Verifying the ONTAP Mediator code signature (console output)

```
[root@scspa2695423001 ontap-mediator-1.6.0]# pwd
/root/ontap-mediator-1.6.0
[root@scspa2695423001 ontap-mediator-1.6.0]# ls -l
total 63660
-r--r--r-- 1 root root     8582 Feb 19 15:02 csc-prod-chain-ONTAP-
Mediator.pem
-r--r--r-- 1 root root     2373 Feb 19 15:02 csc-prod-ONTAP-
Mediator.pem
-r-xr-xr-- 1 root root 65132818 Feb 20 15:17 ontap-mediator-1.6.0
-rw-r--r-- 1 root root      384 Feb 20 15:17 ontap-mediator-1.6.0.sig
-rw-r--r-- 1 root root     5437 Feb 20 15:17 ontap-mediator-
1.6.0.sig.tsr
-rw-r--r-- 1 root root     5436 Feb 20 15:17 ontap-mediator-1.6.0.tsr
-r--r--r-- 1 root root      625 Feb 19 15:02 ONTAP-Mediator-
production.pub
-r--r--r-- 1 root root     3323 Feb 19 15:02 tsa-prod-chain-ONTAP-
Mediator.pem
-r--r--r-- 1 root root     1740 Feb 19 15:02 tsa-prod-ONTAP-
Mediator.pem
[root@scspa2695423001 ontap-mediator-1.6.0]#
[root@scspa2695423001 ontap-mediator-1.6.0]#
/root/verify_ontap_mediator_signatures.sh
++ openssl version -d
++ cut -d '"' -f2
+ OPENSSLDIR=/etc/pki/tls
+ openssl version
OpenSSL 1.1.1k  FIPS 25 Mar 2021
++ openssl x509 -noout -ocsp_uri -in csc-prod-chain-ONTAP-Mediator.pem
+ ocsp_uri=http://ocsp.entrust.net
+ echo http://ocsp.entrust.net
http://ocsp.entrust.net
+ openssl ocsp -issuer csc-prod-chain-ONTAP-Mediator.pem -CAfile csc-
prod-chain-ONTAP-Mediator.pem -cert csc-prod-ONTAP-Mediator.pem -reqout
req.der
+ openssl ocsp -issuer csc-prod-chain-ONTAP-Mediator.pem -CAfile csc-
prod-chain-ONTAP-Mediator.pem -cert csc-prod-ONTAP-Mediator.pem -url
http://ocsp.entrust.net -resp_text -respout resp.der -verify_other csc-
prod-chain-ONTAP-Mediator.pem
OCSP Response Data:
    OCSP Response Status: successful (0x0)
    Response Type: Basic OCSP Response
    Version: 1 (0x0)
    Responder Id: C = US, O = "Entrust, Inc.", CN = Entrust Extended
Validation Code Signing CA - EVCS2
```

```
    Produced At: Feb 28 05:01:00 2023 GMT
    Responses:
    Certificate ID:
      Hash Algorithm: sha1
      Issuer Name Hash: 69FA640329AB84E27220FE0927647B8194B91F2A
      Issuer Key Hash: CE894F8251AA15A28462CA312361D261FBF8FE78
      Serial Number: 511A542B57522AEB7295A640DC6200E5
    Cert Status: good
    This Update: Feb 28 05:00:00 2023 GMT
    Next Update: Mar  4 04:59:59 2023 GMT

    Signature Algorithm: sha512WithRSAEncryption
         3c:1d:49:b0:93:62:37:3e:c7:38:e3:9f:9f:62:82:73:ed:f4:
         ea:00:6b:f1:01:cd:79:57:92:f1:9d:5d:85:9b:60:59:f8:6c:
         e6:f4:50:51:f3:4c:8a:51:dd:50:68:16:8f:20:24:7e:39:b0:
         44:94:8d:b0:61:da:b9:08:36:74:2d:44:55:62:fb:92:be:4a:
         e7:6c:8c:49:dd:0c:fd:d8:ce:20:08:0d:0f:5a:29:a3:19:03:
         9f:d3:df:41:f4:89:0f:73:18:3f:ac:bb:a7:a3:96:7d:c5:70:
         4c:57:cd:17:17:c6:8a:60:d1:37:c9:2d:81:07:2a:d7:a6:02:
         ee:ce:88:16:22:db:e3:43:64:1e:9b:0d:4d:31:66:fa:ab:a5:
         52:99:94:4a:4a:d0:52:c5:34:f5:18:c7:15:5b:ce:74:c2:fc:
         61:ea:55:aa:f1:2f:82:a3:6a:95:8d:7e:2b:38:49:4f:bf:b1:
         68:7b:1b:24:8b:1f:4d:c5:77:f0:71:af:9c:34:c8:7a:82:50:
         09:a2:19:6e:c6:30:4f:da:a2:79:08:f9:d0:ff:85:d9:2a:84:
         cf:0c:aa:75:8f:72:c9:a7:a2:83:e8:8b:cf:ed:0c:69:75:b6:
         2a:7b:6b:58:99:01:d8:34:ad:e1:89:25:27:1b:fa:d9:6d:32:
         97:3a:0b:0a:8e:a3:9e:e3:f4:e0:d6:1a:c9:b5:14:8c:3e:54:
         3b:37:17:1a:93:44:84:8b:4a:87:97:1e:76:43:3e:d3:ec:8b:
         7e:56:4a:3f:01:31:c0:e5:58:fb:50:ce:6f:b1:e7:35:f9:b7:
         a3:ef:6b:3b:21:95:37:a6:5b:8f:f0:15:18:36:65:89:a1:9c:
         9b:69:00:b4:b1:65:6a:bc:11:2d:d4:9b:b4:97:cc:cb:7a:0c:
         16:11:c1:75:58:7e:13:ab:56:3c:3f:93:5b:95:24:c6:54:52:
         1f:86:a9:16:ce:d9:ea:8b:3a:f3:4f:c4:8f:ad:de:e8:3e:3c:
         d2:51:51:ad:33:7f:d8:c5:33:24:26:f1:2d:9d:0e:9f:55:d0:
         68:bf:af:bd:68:4a:40:08:bc:92:a0:62:54:7d:16:7b:36:29:
         15:b1:cd:58:8e:fb:4a:f2:3e:94:8b:fe:56:95:cc:24:32:af:
         5f:71:99:18:ed:0c:64:94:f7:54:48:87:48:d0:6d:b3:42:04:
         96:03:73:a2:8e:8a:6a:b2:af:ee:56:19:a1:c6:35:12:59:ad:
         19:6a:fe:e0:f1:27:cc:96:4e:f0:4f:fb:6a:bd:ce:05:2c:aa:
         79:7c:df:02:5c:ca:53:7d:60:12:88:7c:ce:15:c7:d4:02:27:
         c1:ab:cf:71:30:1e:14:ba
WARNING: no nonce in response
Response verify OK
csc-prod-ONTAP-Mediator.pem: good
        This Update: Feb 28 05:00:00 2023 GMT
        Next Update: Mar  4 04:59:59 2023 GMT
```

```
+ openssl verify -untrusted csc-prod-chain-ONTAP-Mediator.pem -CApath
/etc/pki/tls csc-prod-ONTAP-Mediator.pem
csc-prod-ONTAP-Mediator.pem: OK
+ openssl verify -untrusted tsa-prod-chain-ONTAP-Mediator.pem -CApath
/etc/pki/tls tsa-prod-ONTAP-Mediator.pem
tsa-prod-ONTAP-Mediator.pem: OK
+ openssl ts -verify -data ontap-mediator-1.6.0.sig -in ontap-mediator-
1.6.0.sig.tsr -CAfile tsa-prod-chain-ONTAP-Mediator.pem -untrusted tsa-
prod-ONTAP-Mediator.pem
Using configuration from /etc/pki/tls/openssl.cnf
Verification: OK
+ openssl ts -verify -data ontap-mediator-1.6.0 -in ontap-mediator-
1.6.0.tsr -CAfile tsa-prod-chain-ONTAP-Mediator.pem -untrusted tsa-
prod-ONTAP-Mediator.pem
Using configuration from /etc/pki/tls/openssl.cnf
Verification: OK
+ openssl dgst -sha256 -verify ONTAP-Mediator-production.pub -signature
ontap-mediator-1.6.0.sig ontap-mediator-1.6.0
Verified OK
[root@scspa2695423001 ontap-mediator-1.6.0]#
```

Install the ONTAP Mediator installation package

To install the ONTAP Mediator service, you must get the installation package and run the installer on the host.

Steps

1. Run the installer and respond to the prompts as required:

   `./ontap-mediator-1.6.0/ontap-mediator-1.6.0 -y`

   ```
   [root@scs000099753 ~]# ./ontap-mediator-1.5.0/ontap-mediator-1.6.0 -y
   ```

   The installation process proceeds to create the required accounts and install required packages. If you have a previous version of Mediator installed on the host, you will be prompted to confirm that you want to upgrade.

2. Beginning with ONTAP Mediator 1.4, the Secure Boot mechanism is enabled on UEFI systems. When Secure Boot is enabled, you must take additional steps to register the security key after installation:

   - Follow instructions in the README file to sign the SCST kernel module.:

     `/opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys/README.module-signing`

   - Locate the required keys:

```
/opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys
```

After installation, the README files and key location are also provided in the system output.

Example of ONTAP Mediator 1.5 installation (console output)

```
[root@scs000099753 ~]# ./ontap-mediator-1.6.0/ontap-mediator-1.6.0 -y
ONTAP Mediator: Self Extracting Installer


+ Extracting the ONTAP Mediator installation/upgrade archive
+ Performing the ONTAP Mediator run-time code signature check
   Using openssl from the path: /usr/bin/openssl configured for
CApath:/etc/pki/tls

+ Unpacking the ONTAP Mediator installer
ONTAP Mediator requires two user accounts. One for the service
(netapp), and one for use by ONTAP to the mediator API (mediatoradmin).
Using default account names: netapp + mediatoradmin

Enter ONTAP Mediator user account (mediatoradmin) password:

Re-Enter ONTAP Mediator user account (mediatoradmin) password:

+ Checking if SELinux is in enforcing mode


+ Checking for default Linux firewall
success
success
success


################################################################
Preparing for installation of ONTAP Mediator packages.


+ Installing required packages.


Last metadata expiration check: 0:25:24 ago on Fri 21 Oct 2022 04:00:13
PM EDT.
Package openssl-1:1.1.1k-4.el8.x86_64 is already installed.
Package gcc-8.4.1-1.el8.x86_64 is already installed.
Package python36-3.6.8-2.module+el8.1.0+3334+5cb623d7.x86_64 is already
installed.
Package libselinux-utils-2.9-5.el8.x86_64 is already installed.
Package perl-Data-Dumper-2.167-399.el8.x86_64 is already installed.
Package efibootmgr-16-1.el8.x86_64 is already installed.
Package mokutil-1:0.3.0-11.el8.x86_64 is already installed.
```

```
Package python3-pip-9.0.3-19.el8.noarch is already installed.
Package policycoreutils-python-utils-2.9-14.el8.noarch is already
installed.
Dependencies resolved.
================================================================================
================================================================================
 Package                                    Architecture
Version                                                 Repository
Size
================================================================================
================================================================================
Installing:
 bzip2                                      x86_64
1.0.6-26.el8                                            rhel-8-for-
x86_64-baseos-rpms                          60 k
 elfutils-libelf-devel                      x86_64
0.186-1.el8                                             rhel-8-for-
x86_64-baseos-rpms                          60 k
 kernel-devel                               x86_64
4.18.0-348.el8                                          rhel-8-for-
x86_64-baseos-rpms                          20 M
 make                                       x86_64
1:4.2.1-11.el8                                          rhel-8-for-
x86_64-baseos-rpms                         498 k
 openssl-devel                              x86_64
1:1.1.1k-7.el8_6                                        rhel-8-for-
x86_64-baseos-rpms                         2.3 M
 patch                                      x86_64
2.7.6-11.el8                                            rhel-8-for-
x86_64-baseos-rpms                         138 k
 perl-ExtUtils-MakeMaker                    noarch
1:7.34-1.el8                                            rhel-8-for-
x86_64-appstream-rpms                      301 k
 python36-devel                             x86_64
3.6.8-38.module+el8.5.0+12207+5c5719bc                  rhel-8-for-
x86_64-appstream-rpms                       17 k
 redhat-lsb-core                            x86_64
4.1-47.el8                                              rhel-8-for-
x86_64-appstream-rpms                       45 k
Upgrading:
 cpp                                        x86_64
8.5.0-10.1.el8_6                                        rhel-8-for-
x86_64-appstream-rpms                       10 M
 elfutils-libelf                            x86_64
```

```
0.186-1.el8                                                  rhel-8-for-
x86_64-baseos-rpms                      229 k
 elfutils-libs                               x86_64
0.186-1.el8                                                  rhel-8-for-
x86_64-baseos-rpms                      295 k
 gcc                                         x86_64
8.5.0-10.1.el8_6                                             rhel-8-for-
x86_64-appstream-rpms                    23 M
 libgcc                                      x86_64
8.5.0-10.1.el8_6                                             rhel-8-for-
x86_64-baseos-rpms                       80 k
 libgomp                                     x86_64
8.5.0-10.1.el8_6                                             rhel-8-for-
x86_64-baseos-rpms                      207 k
 libsemanage                                 x86_64
2.9-8.el8                                                    rhel-8-for-
x86_64-baseos-rpms                      168 k
 mokutil                                     x86_64
1:0.3.0-11.el8_6.1                                           rhel-8-for-
x86_64-baseos-rpms                       46 k
 openssl                                     x86_64
1:1.1.1k-7.el8_6                                             rhel-8-for-
x86_64-baseos-rpms                      709 k
 openssl-libs                                x86_64
1:1.1.1k-7.el8_6                                             rhel-8-for-
x86_64-baseos-rpms                      1.5 M
 platform-python-pip                         noarch
9.0.3-22.el8                                                 rhel-8-for-
x86_64-baseos-rpms                      1.6 M
 policycoreutils                             x86_64
2.9-19.el8                                                   rhel-8-for-
x86_64-baseos-rpms                      374 k
 policycoreutils-python-utils                noarch
2.9-19.el8                                                   rhel-8-for-
x86_64-baseos-rpms                      253 k
 python3-libsemanage                         x86_64
2.9-8.el8                                                    rhel-8-for-
x86_64-baseos-rpms                      128 k
 python3-pip                                 noarch
9.0.3-22.el8                                                 rhel-8-for-
x86_64-appstream-rpms                    20 k
 python3-policycoreutils                     noarch
2.9-19.el8                                                   rhel-8-for-
x86_64-baseos-rpms                      2.2 M
 python36                                    x86_64
3.6.8-38.module+el8.5.0+12207+5c5719bc                       rhel-8-for-
```

```
x86_64-appstream-rpms                    19 k
Installing dependencies:
 annobin                                 x86_64
10.29-3.el8                                        rhel-8-for-
x86_64-appstream-rpms                   117 k
 at                                      x86_64
3.1.20-11.el8                                      rhel-8-for-
x86_64-baseos-rpms                       81 k
 bc                                      x86_64
1.07.1-5.el8                                       rhel-8-for-
x86_64-baseos-rpms                      129 k
 cups-client                             x86_64
1:2.2.6-38.el8                                     rhel-8-for-
x86_64-appstream-rpms                   169 k
 dwz                                     x86_64
0.12-10.el8                                        rhel-8-for-
x86_64-appstream-rpms                   109 k
 ed                                      x86_64
1.14.2-4.el8                                       rhel-8-for-
x86_64-baseos-rpms                       82 k
 efi-srpm-macros                         noarch
3-3.el8                                            rhel-8-for-
x86_64-appstream-rpms                    22 k
 esmtp                                   x86_64
1.2-15.el8                                         EPEL-8
57 k
 ghc-srpm-macros                         noarch
1.4.2-7.el8                                        rhel-8-for-
x86_64-appstream-rpms                   9.4 k
 go-srpm-macros                          noarch
2-17.el8                                           rhel-8-for-
x86_64-appstream-rpms                    13 k
 keyutils-libs-devel                     x86_64
1.5.10-6.el8                                       rhel-8-for-
x86_64-baseos-rpms                       48 k
 krb5-devel                              x86_64
1.18.2-14.el8                                      rhel-8-for-
x86_64-baseos-rpms                      560 k
 libcom_err-devel                        x86_64
1.45.6-2.el8                                       rhel-8-for-
x86_64-baseos-rpms                       38 k
 libesmtp                                x86_64
1.0.6-18.el8                                       EPEL-8
70 k
 libkadm5                                x86_64
1.18.2-14.el8                                      rhel-8-for-
```

```
x86_64-baseos-rpms                      187 k
 liblockfile                                    x86_64
1.14-1.el8                                              rhel-8-for-
x86_64-appstream-rpms                    32 k
 libselinux-devel                               x86_64
2.9-5.el8                                               rhel-8-for-
x86_64-baseos-rpms                      200 k
 libsepol-devel                                 x86_64
2.9-3.el8                                               rhel-8-for-
x86_64-baseos-rpms                       87 k
 libverto-devel                                 x86_64
0.3.0-5.el8                                             rhel-8-for-
x86_64-baseos-rpms                       18 k
 m4                                             x86_64
1.4.18-7.el8                                            rhel-8-for-
x86_64-baseos-rpms                      223 k
 mailx                                          x86_64
12.5-29.el8                                             rhel-8-for-
x86_64-baseos-rpms                      257 k
 ncurses-compat-libs                            x86_64
6.1-9.20180224.el8                                      rhel-8-for-
x86_64-baseos-rpms                      328 k
 ocaml-srpm-macros                              noarch
5-4.el8                                                 rhel-8-for-
x86_64-appstream-rpms                   9.5 k
 openblas-srpm-macros                           noarch
2-2.el8                                                 rhel-8-for-
x86_64-appstream-rpms                   8.0 k
 pcre2-devel                                    x86_64
10.32-2.el8                                             rhel-8-for-
x86_64-baseos-rpms                      605 k
 pcre2-utf16                                    x86_64
10.32-2.el8                                             rhel-8-for-
x86_64-baseos-rpms                      229 k
 pcre2-utf32                                    x86_64
10.32-2.el8                                             rhel-8-for-
x86_64-baseos-rpms                      220 k
 perl-CPAN-Meta-YAML                            noarch
0.018-397.el8                                           rhel-8-for-
x86_64-appstream-rpms                    34 k
 perl-ExtUtils-Command                          noarch
1:7.34-1.el8                                            rhel-8-for-
x86_64-appstream-rpms                    19 k
 perl-ExtUtils-Install                          noarch
2.14-4.el8                                              rhel-8-for-
x86_64-appstream-rpms                    46 k
```

```
 perl-ExtUtils-Manifest                          noarch
1.70-395.el8                                             rhel-8-for-
x86_64-appstream-rpms                    37 k
 perl-ExtUtils-ParseXS                           noarch
1:3.35-2.el8                                             rhel-8-for-
x86_64-appstream-rpms                    83 k
 perl-JSON-PP                                    noarch
1:2.97.001-3.el8                                         rhel-8-for-
x86_64-appstream-rpms                    68 k
 perl-Math-BigInt                                noarch
1:1.9998.11-7.el8                                        rhel-8-for-
x86_64-baseos-rpms                      196 k
 perl-Math-Complex                               noarch
1.59-421.el8                                             rhel-8-for-
x86_64-baseos-rpms                      109 k
 perl-Test-Harness                               noarch
1:3.42-1.el8                                             rhel-8-for-
x86_64-appstream-rpms                   279 k
 perl-devel                                      x86_64
4:5.26.3-419.el8_4.1                                     rhel-8-for-
x86_64-appstream-rpms                   599 k
 perl-srpm-macros                                noarch
1-25.el8                                                 rhel-8-for-
x86_64-appstream-rpms                    11 k
 perl-version                                    x86_64
6:0.99.24-1.el8                                          rhel-8-for-
x86_64-appstream-rpms                    67 k
 platform-python-devel                           x86_64
3.6.8-41.el8                                             rhel-8-for-
x86_64-appstream-rpms                   249 k
 python-rpm-macros                               noarch
3-41.el8                                                 rhel-8-for-
x86_64-appstream-rpms                    15 k
 python-srpm-macros                              noarch
3-41.el8                                                 rhel-8-for-
x86_64-appstream-rpms                    15 k
 python3-pyparsing                               noarch
2.1.10-7.el8                                             rhel-8-for-
x86_64-baseos-rpms                      142 k
 python3-rpm-generators                          noarch
5-7.el8                                                  rhel-8-for-
x86_64-appstream-rpms                    25 k
 python3-rpm-macros                              noarch
3-41.el8                                                 rhel-8-for-
x86_64-appstream-rpms                    14 k
 qt5-srpm-macros                                 noarch
```

```
5.15.2-1.el8                                                    rhel-8-for-
x86_64-appstream-rpms                    11 k
 redhat-lsb-submod-security                     x86_64
4.1-47.el8                                                      rhel-8-for-
x86_64-appstream-rpms                    22 k
 redhat-rpm-config                              noarch
125-1.el8                                                       rhel-8-for-
x86_64-appstream-rpms                    87 k
 rust-srpm-macros                               noarch
5-2.el8                                                         rhel-8-for-
x86_64-appstream-rpms                   9.3 k
 spax                                           x86_64
1.5.3-13.el8                                                    rhel-8-for-
x86_64-baseos-rpms                      217 k
 systemtap-sdt-devel                            x86_64
4.6-4.el8                                                       rhel-8-for-
x86_64-appstream-rpms                    86 k
 time                                           x86_64
1.9-3.el8                                                       rhel-8-for-
x86_64-baseos-rpms                       54 k
 unzip                                          x86_64
6.0-46.el8                                                      rhel-8-for-
x86_64-baseos-rpms                      196 k
 util-linux-user                                x86_64
2.32.1-28.el8                                                   rhel-8-for-
x86_64-baseos-rpms                      100 k
 zip                                            x86_64
3.0-23.el8                                                      rhel-8-for-
x86_64-baseos-rpms                      270 k
 zlib-devel                                     x86_64
1.2.11-17.el8                                                   rhel-8-for-
x86_64-baseos-rpms                       58 k
Installing weak dependencies:
 perl-CPAN-Meta                                 noarch
2.150010-396.el8                                                rhel-8-for-
x86_64-appstream-rpms                   191 k
 perl-CPAN-Meta-Requirements                    noarch
2.140-396.el8                                                   rhel-8-for-
x86_64-appstream-rpms                    37 k
 perl-Encode-Locale                             noarch
1.05-10.module+el8.3.0+6498+9eecfe51                            rhel-8-for-
x86_64-appstream-rpms                    22 k
 perl-Time-HiRes                                x86_64
4:1.9758-2.el8                                                  rhel-8-for-
x86_64-appstream-rpms                    61 k
```

```
Transaction Summary
================================================================================
================================================================================
=========================================
Install  69 Packages
Upgrade  17 Packages

Total download size: 72 M
Is this ok [y/N]: y
Downloading Packages:
(1/86): perl-ExtUtils-Install-2.14-4.el8.noarch.rpm
735 kB/s |  46 kB     00:00
(2/86): libesmtp-1.0.6-18.el8.x86_64.rpm
1.0 MB/s |  70 kB     00:00
(3/86): esmtp-1.2-15.el8.x86_64.rpm
747 kB/s |  57 kB     00:00
(4/86): rust-srpm-macros-5-2.el8.noarch.rpm
308 kB/s | 9.3 kB     00:00
(5/86): perl-ExtUtils-Manifest-1.70-395.el8.noarch.rpm
781 kB/s |  37 kB     00:00
(6/86): perl-CPAN-Meta-2.150010-396.el8.noarch.rpm
2.7 MB/s | 191 kB     00:00
(7/86): ocaml-srpm-macros-5-4.el8.noarch.rpm
214 kB/s | 9.5 kB     00:00
(8/86): perl-JSON-PP-2.97.001-3.el8.noarch.rpm
1.2 MB/s |  68 kB     00:00
(9/86): perl-ExtUtils-MakeMaker-7.34-1.el8.noarch.rpm
5.8 MB/s | 301 kB     00:00
(10/86): ghc-srpm-macros-1.4.2-7.el8.noarch.rpm
317 kB/s | 9.4 kB     00:00
(11/86): perl-Test-Harness-3.42-1.el8.noarch.rpm
4.5 MB/s | 279 kB     00:00
(12/86): perl-ExtUtils-Command-7.34-1.el8.noarch.rpm
520 kB/s |  19 kB     00:00

...

15 MB/s | 1.5 MB     00:00
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
-----------------------------------------
Total
35 MB/s |  72 MB     00:02
Running transaction check
Transaction check succeeded.
Running transaction test
```

```
Transaction test succeeded.
Running transaction
  Preparing        :
1/1
  Running scriptlet: openssl-libs-1:1.1.1k-7.el8_6.x86_64
1/1
  Upgrading        : openssl-libs-1:1.1.1k-7.el8_6.x86_64
1/103
  Running scriptlet: openssl-libs-1:1.1.1k-7.el8_6.x86_64
1/103
  Upgrading        : libgcc-8.5.0-10.1.el8_6.x86_64
2/103
  Running scriptlet: libgcc-8.5.0-10.1.el8_6.x86_64
2/103
  Upgrading        : elfutils-libelf-0.186-1.el8.x86_64
3/103
  Installing       : perl-version-6:0.99.24-1.el8.x86_64
4/103
  Installing       : perl-CPAN-Meta-Requirements-2.140-396.el8.noarch
5/103
  Upgrading        : libsemanage-2.9-8.el8.x86_64
6/103
  Installing       : zlib-devel-1.2.11-17.el8.x86_64
7/103
  Installing       : python-srpm-macros-3-41.el8.noarch
8/103
  Installing       : python-rpm-macros-3-41.el8.noarch
9/103
  Installing       : python3-rpm-macros-3-41.el8.noarch
10/103
  Installing       : perl-Time-HiRes-4:1.9758-2.el8.x86_64
11/103
  Installing       : perl-ExtUtils-ParseXS-1:3.35-2.el8.noarch
12/103
  Installing       : perl-Test-Harness-1:3.42-1.el8.noarch
13/103
  Upgrading        : python3-libsemanage-2.9-8.el8.x86_64
14/103
  Upgrading        : policycoreutils-2.9-19.el8.x86_64
15/103
  Running scriptlet: policycoreutils-2.9-19.el8.x86_64
15/103
  Upgrading        : python3-policycoreutils-2.9-19.el8.noarch
16/103
  Installing       : dwz-0.12-10.el8.x86_64
17/103
```

```
  Installing       : ncurses-compat-libs-6.1-9.20180224.el8.x86_64
18/103
  Installing       : libesmtp-1.0.6-18.el8.x86_64
19/103
  Installing       : mailx-12.5-29.el8.x86_64
20/103
  Installing       : libkadm5-1.18.2-14.el8.x86_64
21/103
  Upgrading        : libgomp-8.5.0-10.1.el8_6.x86_64
22/103
  Running scriptlet: libgomp-8.5.0-10.1.el8_6.x86_64
22/103
  Upgrading        : platform-python-pip-9.0.3-22.el8.noarch
23/103
  Upgrading        : python3-pip-9.0.3-22.el8.noarch
24/103
  Upgrading        : python36-3.6.8-
38.module+el8.5.0+12207+5c5719bc.x86_64
25/103
  Running scriptlet: python36-3.6.8-
38.module+el8.5.0+12207+5c5719bc.x86_64
25/103
  Upgrading        : cpp-8.5.0-10.1.el8_6.x86_64
26/103
  Running scriptlet: cpp-8.5.0-10.1.el8_6.x86_64
26/103
  Upgrading        : gcc-8.5.0-10.1.el8_6.x86_64
27/103
  Running scriptlet: gcc-8.5.0-10.1.el8_6.x86_64
27/103
  Installing       : annobin-10.29-3.el8.x86_64
28/103
  Installing       : unzip-6.0-46.el8.x86_64
29/103
  Installing       : zip-3.0-23.el8.x86_64
30/103
  Installing       : perl-Math-Complex-1.59-421.el8.noarch
31/103
  Installing       : perl-Math-BigInt-1:1.9998.11-7.el8.noarch
32/103
  Installing       : perl-JSON-PP-1:2.97.001-3.el8.noarch
33/103
  Installing       : make-1:4.2.1-11.el8.x86_64
34/103
  Running scriptlet: make-1:4.2.1-11.el8.x86_64
34/103
```

```
  Installing       : libcom_err-devel-1.45.6-2.el8.x86_64
35/103
  Installing       : util-linux-user-2.32.1-28.el8.x86_64
36/103
  Installing       : libsepol-devel-2.9-3.el8.x86_64
37/103
  Installing       : pcre2-utf32-10.32-2.el8.x86_64
38/103
  Installing       : pcre2-utf16-10.32-2.el8.x86_64
39/103
  Installing       : pcre2-devel-10.32-2.el8.x86_64
40/103
  Installing       : libselinux-devel-2.9-5.el8.x86_64
41/103
  Installing       : patch-2.7.6-11.el8.x86_64
42/103
  Installing       : python3-pyparsing-2.1.10-7.el8.noarch
43/103
  Installing       : systemtap-sdt-devel-4.6-4.el8.x86_64
44/103
  Installing       : spax-1.5.3-13.el8.x86_64
45/103
  Running scriptlet: spax-1.5.3-13.el8.x86_64
45/103
  Installing       : m4-1.4.18-7.el8.x86_64
46/103
  Running scriptlet: m4-1.4.18-7.el8.x86_64
46/103
  Installing       : libverto-devel-0.3.0-5.el8.x86_64
47/103
  Installing       : bc-1.07.1-5.el8.x86_64
48/103
  Running scriptlet: bc-1.07.1-5.el8.x86_64
48/103
  Installing       : at-3.1.20-11.el8.x86_64
49/103
  Running scriptlet: at-3.1.20-11.el8.x86_64
49/103
  Installing       : keyutils-libs-devel-1.5.10-6.el8.x86_64
50/103
  Installing       : krb5-devel-1.18.2-14.el8.x86_64
51/103
  Installing       : time-1.9-3.el8.x86_64
52/103
  Running scriptlet: time-1.9-3.el8.x86_64
52/103
```

```
  Upgrading        : policycoreutils-python-utils-2.9-19.el8.noarch
80/103
  Installing       : elfutils-libelf-devel-0.186-1.el8.x86_64
81/103
  Upgrading        : elfutils-libs-0.186-1.el8.x86_64
82/103
  Upgrading        : mokutil-1:0.3.0-11.el8_6.1.x86_64
83/103
  Upgrading        : openssl-1:1.1.1k-7.el8_6.x86_64
84/103
  Installing       : kernel-devel-4.18.0-348.el8.x86_64
85/103
  Running scriptlet: kernel-devel-4.18.0-348.el8.x86_64

  ...

85/103
  Installing       : bzip2-1.0.6-26.el8.x86_64
86/103
  Cleanup          : policycoreutils-python-utils-2.9-14.el8.noarch
87/103
  Cleanup          : python3-policycoreutils-2.9-14.el8.noarch
88/103
  Cleanup          : python36-3.6.8-
2.module+el8.1.0+3334+5cb623d7.x86_64
89/103
  Running scriptlet: python36-3.6.8-
2.module+el8.1.0+3334+5cb623d7.x86_64
89/103
  Cleanup          : elfutils-libs-0.185-1.el8.x86_64
90/103
  Cleanup          : openssl-1:1.1.1k-4.el8.x86_64
91/103
  Cleanup          : python3-libsemanage-2.9-6.el8.x86_64
92/103
  Running scriptlet: gcc-8.4.1-1.el8.x86_64
93/103
  Cleanup          : gcc-8.4.1-1.el8.x86_64
93/103
  Running scriptlet: policycoreutils-2.9-14.el8.x86_64
94/103
  Cleanup          : policycoreutils-2.9-14.el8.x86_64
94/103
  Cleanup          : mokutil-1:0.3.0-11.el8.x86_64
95/103
```

```
  Cleanup          : python3-pip-9.0.3-19.el8.noarch
96/103
  Cleanup          : platform-python-pip-9.0.3-19.el8.noarch
97/103
  Cleanup          : openssl-libs-1:1.1.1k-4.el8.x86_64
98/103
  Running scriptlet: openssl-libs-1:1.1.1k-4.el8.x86_64
98/103
  Cleanup          : libsemanage-2.9-6.el8.x86_64
99/103
  Running scriptlet: cpp-8.4.1-1.el8.x86_64
100/103
  Cleanup          : cpp-8.4.1-1.el8.x86_64
100/103
  Cleanup          : libgcc-8.5.0-3.el8.x86_64
101/103
  Running scriptlet: libgcc-8.5.0-3.el8.x86_64
101/103
  Running scriptlet: libgomp-8.4.1-1.el8.x86_64
102/103
  Cleanup          : libgomp-8.4.1-1.el8.x86_64
102/103
  Running scriptlet: libgomp-8.4.1-1.el8.x86_64
102/103
  Cleanup          : elfutils-libelf-0.185-1.el8.x86_64
103/103
  Running scriptlet: elfutils-libelf-0.185-1.el8.x86_64
103/103
  Verifying        : esmtp-1.2-15.el8.x86_64
1/103
  Verifying        : libesmtp-1.0.6-18.el8.x86_64

  ...

Upgraded:
  cpp-8.5.0-10.1.el8_6.x86_64                              elfutils-
libelf-0.186-1.el8.x86_64     elfutils-libs-0.186-1.el8.x86_64
gcc-8.5.0-10.1.el8_6.x86_64
  libgcc-8.5.0-10.1.el8_6.x86_64                           libgomp-
8.5.0-10.1.el8_6.x86_64        libsemanage-2.9-8.el8.x86_64
mokutil-1:0.3.0-11.el8_6.1.x86_64
  openssl-1:1.1.1k-7.el8_6.x86_64                          openssl-
libs-1:1.1.1k-7.el8_6.x86_64   platform-python-pip-9.0.3-22.el8.noarch
policycoreutils-2.9-19.el8.x86_64
  policycoreutils-python-utils-2.9-19.el8.noarch           python3-
libsemanage-2.9-8.el8.x86_64   python3-pip-9.0.3-22.el8.noarch
```

```
python3-policycoreutils-2.9-19.el8.noarch
  python36-3.6.8-38.module+el8.5.0+12207+5c5719bc.x86_64
Installed:
  annobin-10.29-3.el8.x86_64                                    at-
3.1.20-11.el8.x86_64                          bc-1.07.1-5.el8.x86_64
  bzip2-1.0.6-26.el8.x86_64
cups-client-1:2.2.6-38.el8.x86_64                dwz-0.12-
10.el8.x86_64
  ed-1.14.2-4.el8.x86_64
efi-srpm-macros-3-3.el8.noarch                   elfutils-libelf-
devel-0.186-1.el8.x86_64
  esmtp-1.2-15.el8.x86_64
ghc-srpm-macros-1.4.2-7.el8.noarch               go-srpm-macros-2-
17.el8.noarch
  kernel-devel-4.18.0-348.el8.x86_64
keyutils-libs-devel-1.5.10-6.el8.x86_64          krb5-devel-1.18.2-
14.el8.x86_64
  libcom_err-devel-1.45.6-2.el8.x86_64
libesmtp-1.0.6-18.el8.x86_64                     libkadm5-1.18.2-
14.el8.x86_64
  liblockfile-1.14-1.el8.x86_64
libselinux-devel-2.9-5.el8.x86_64                libsepol-devel-2.9-
3.el8.x86_64
  libverto-devel-0.3.0-5.el8.x86_64                             m4-
1.4.18-7.el8.x86_64                           mailx-12.5-
29.el8.x86_64
  make-1:4.2.1-11.el8.x86_64
ncurses-compat-libs-6.1-9.20180224.el8.x86_64    ocaml-srpm-macros-
5-4.el8.noarch
  openblas-srpm-macros-2-2.el8.noarch
openssl-devel-1:1.1.1k-7.el8_6.x86_64            patch-2.7.6-
11.el8.x86_64
  pcre2-devel-10.32-2.el8.x86_64
pcre2-utf16-10.32-2.el8.x86_64                   pcre2-utf32-10.32-
2.el8.x86_64
  perl-CPAN-Meta-2.150010-396.el8.noarch
perl-CPAN-Meta-Requirements-2.140-396.el8.noarch  perl-CPAN-Meta-
YAML-0.018-397.el8.noarch
  perl-Encode-Locale-1.05-10.module+el8.3.0+6498+9eecfe51.noarch
perl-ExtUtils-Command-1:7.34-1.el8.noarch        perl-ExtUtils-
Install-2.14-4.el8.noarch
  perl-ExtUtils-MakeMaker-1:7.34-1.el8.noarch
perl-ExtUtils-Manifest-1.70-395.el8.noarch       perl-ExtUtils-
ParseXS-1:3.35-2.el8.noarch
  perl-JSON-PP-1:2.97.001-3.el8.noarch
perl-Math-BigInt-1:1.9998.11-7.el8.noarch        perl-Math-Complex-
```

```
1.59-421.el8.noarch
  perl-Test-Harness-1:3.42-1.el8.noarch
perl-Time-HiRes-4:1.9758-2.el8.x86_64              perl-devel-
4:5.26.3-419.el8_4.1.x86_64
  perl-srpm-macros-1-25.el8.noarch
perl-version-6:0.99.24-1.el8.x86_64                platform-python-
devel-3.6.8-41.el8.x86_64
  python-rpm-macros-3-41.el8.noarch
python-srpm-macros-3-41.el8.noarch                 python3-pyparsing-
2.1.10-7.el8.noarch
  python3-rpm-generators-5-7.el8.noarch
python3-rpm-macros-3-41.el8.noarch                 python36-devel-
3.6.8-38.module+el8.5.0+12207+5c5719bc.x86_64
  qt5-srpm-macros-5.15.2-1.el8.noarch
redhat-lsb-core-4.1-47.el8.x86_64                  redhat-lsb-submod-
security-4.1-47.el8.x86_64
  redhat-rpm-config-125-1.el8.noarch
rust-srpm-macros-5-2.el8.noarch                    spax-1.5.3-
13.el8.x86_64
  systemtap-sdt-devel-4.6-4.el8.x86_64
time-1.9-3.el8.x86_64                              unzip-6.0-
46.el8.x86_64
  util-linux-user-2.32.1-28.el8.x86_64
zip-3.0-23.el8.x86_64                              zlib-devel-1.2.11-
17.el8.x86_64

Complete!
OS package installations finished
+ Installing ONTAP Mediator. (Log: /tmp/ontap_mediator.JixKGP/ontap-
mediator-1.6.0/ontap-mediator-1.6.0/install_20221021155929.log)
    This step will take several minutes. Use the log file to view
progress.
    Sudoer config verified
    ONTAP Mediator rsyslog and logging rotation enabled
+ Install successful. (Moving log to
/opt/netapp/lib/ontap_mediator/log/install_20221021155929.log)
+ WARNING: This system supports UEFI
           Secure Boot (SB) is currently disabled on this system.
           If SB is enabled in the future, SCST will not work unless
the following action is taken:
           Using the keys in
/opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys follow
           instructions in
/opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys/README.modu
le-signing
           to sign the SCST kernel module. Note that reboot will be
```

```
needed.
     SCST will not start automatically when Secure Boot is enabled and
not configured properly.
+ Note: ONTAP Mediator uses a kernel module compiled specifically for
the current
        OS. Using 'yum update' to upgrade the kernel might cause
service interruption.
    For more information, see /opt/netapp/lib/ontap_mediator/README
[root@scs000099753 ~]# cat /etc/redhat-release
Red Hat Enterprise Linux release 8.5 (Ootpa)
[root@scs000099753 ~]#
```

Verify the installation

After the ONTAP Mediator has been installed, you should verify that the ONTAP Mediator services are running.

Steps

1. View the status of the ONTAP Mediator services:
   a. `systemctl status ontap_mediator`

```
[root@scspr1915530002 ~]# systemctl status ontap_mediator

 ontap_mediator.service - ONTAP Mediator
Loaded: loaded (/etc/systemd/system/ontap_mediator.service; enabled;
vendor preset: disabled)
Active: active (running) since Mon 2022-04-18 10:41:49 EDT; 1 weeks 0
days ago
Process: 286710 ExecStop=/bin/kill -s INT $MAINPID (code=exited,
status=0/SUCCESS)
Main PID: 286712 (uwsgi)
Status: "uWSGI is ready"
Tasks: 3 (limit: 49473)
Memory: 139.2M
CGroup: /system.slice/ontap_mediator.service
      ├─286712 /opt/netapp/lib/ontap_mediator/pyenv/bin/uwsgi --ini
/opt/netapp/lib/ontap_mediator/uwsgi/ontap_mediator.ini
      ├─286716 /opt/netapp/lib/ontap_mediator/pyenv/bin/uwsgi --ini
/opt/netapp/lib/ontap_mediator/uwsgi/ontap_mediator.ini
      └─286717 /opt/netapp/lib/ontap_mediator/pyenv/bin/uwsgi --ini
/opt/netapp/lib/ontap_mediator/uwsgi/ontap_mediator.ini

[root@scspr1915530002 ~]#
```

b. `systemctl status mediator-scst`

```
[root@scspr1915530002 ~]# systemctl status mediator-scst
   Loaded: loaded (/etc/systemd/system/mediator-scst.service;
enabled; vendor preset: disabled)
   Active: active (running) since Mon 2022-04-18 10:41:47 EDT; 1
weeks 0 days ago
  Process: 286595 ExecStart=/etc/init.d/scst start (code=exited,
status=0/SUCCESS)
 Main PID: 286662 (iscsi-scstd)
    Tasks: 1 (limit: 49473)
   Memory: 1.2M
   CGroup: /system.slice/mediator-scst.service
           └─286662 /usr/local/sbin/iscsi-scstd

[root@scspr1915530002 ~]#
```

2. Confirm the ports that are used by the ONTAP Mediator service:

`netstat`

```
[root@scspr1905507001 ~]# netstat -anlt | grep -E '3260|31784'

         tcp   0   0 0.0.0.0:31784   0.0.0.0:*      LISTEN

         tcp   0   0 0.0.0.0:3260    0.0.0.0:*      LISTEN

         tcp6  0   0 :::3260         :::*           LISTEN
```

Post-installation configuration

After the ONTAP Mediator service is installed and running, additional configuration tasks must be performed in the ONTAP storage system to use the Mediator features:

- To use the ONTAP Mediator service in a MetroCluster IP configuration, see Configuring the ONTAP Mediator service from a MetroCluster IP configuration.
- To use SnapMirror Business Continuity, see Install ONTAP Mediator Service and confirm the ONTAP cluster configuration.

Configure ONTAP Mediator security policies

The ONTAP Mediator server supports several configurable security settings. The default values for all settings are provide in a low_space_threshold_mib: 10read-only file:

`/opt/netapp/lib/ontap_mediator/server_config/ontap_mediator.user_config.yaml`

All values that are placed in the `ontap_mediator.user_config.yaml` will override the default values and be maintained across all ONTAP Mediator upgrades.

After you modify `ontap_mediator.user_config.yaml`, restart the ONTAP Mediator service:

```
systemctl restart ontap_mediator
```

The following attributes can be configured:
NOTE: Other default values in the `ontap_mediator.config.yaml` should not be modified.

- **Settings used to install third-party SSL certificates as replacements for the default self-signed certificates**

```
cert_path:
'/opt/netapp/lib/ontap_mediator/ontap_mediator/server_config/ontap_media
tor_server.crt'
key_path:
'/opt/netapp/lib/ontap_mediator/ontap_mediator/server_config/ontap_media
tor_server.key'
ca_cert_path:
'/opt/netapp/lib/ontap_mediator/ontap_mediator/server_config/ca.crt'
ca_key_path:
'/opt/netapp/lib/ontap_mediator/ontap_mediator/server_config/ca.key'
ca_serial_path:
'/opt/netapp/lib/ontap_mediator/ontap_mediator/server_config/ca.srl'
cert_valid_days: '1095'                  # Used to set the expiration
on client certs to 3 years
x509_passin_pwd: 'pass:ontap'            # passphrase for the signed
client cert
```

- **Settings that provide protections against brute-force password guessing attacks**

  To enable the feature, set a value for the `window_seconds` and the `retry_limit`

  Examples:

  - Provide a 5-minute window for guesses, and then reset the count to zero failures:

    ```
    authentication_lock_window_seconds: 300
    ```

  - Lock the account if five failures occur within the window timeframe:

    ```
    authentication_retry_limit: 5
    ```

  - Reduce the impact of brute-force password guessing attacks by setting a delay that occurs prior to rejecting each attempt, which slows the attacks.

    ```
    authentication_failure_delay_seconds: 5
    ```

```
authentication_failure_delay_seconds: 0   # seconds (float) to delay
failed auth attempts prior to response, 0 = no delay
authentication_lock_window_seconds: null  # seconds (int) since the
oldest failure before resetting the retry counter, null = no window
authentication_retry_limit: null          # number of retries to
allow before locking API access, null = unlimited
```

- **Fields that control the password complexity rules of the ONTAP Mediator API user account**

```
password_min_length: 8

password_max_length: 64

password_uppercase_chars: 0    # min. uppercase characters

password_lowercase_chars: 1    # min. lowercase character

password_special_chars: 1      # min. non-letter, non-digit

password_nonletter_chars: 2    # min. non-letter characters (digits,
specials, anything)
```

- **Setting that controls the required free space on the `/opt/netapp/lib/ontap_mediator` disk.**

  If the space is lower than the set threshold, the service will issue a warning event.

```
low_space_threshold_mib: 10
```

Manage the ONTAP mediator service

After you have installed ONTAP Mediator service, you might want to change the user name or password. You can also uninstall the ONTAP Mediator Service.

Change the user name

About these tasks

These task is performed on the Linux host on which the ONTAP Mediator service is installed.

If you are unable to reach this command, you might need to run the command using the full path as shown in the following example:

```
/usr/local/bin/mediator_username
```

Procedure

Change the username by choosing one of the following options:

- Run the command mediator_change_user and respond to the prompts as shown in the following example:

```
[root@mediator-host ~]# mediator_change_user
Modify the Mediator API username by entering the following values:
    Mediator API User Name: mediatoradmin
                  Password:
New Mediator API User Name: mediator
The account username has been modified successfully.
[root@mediator-host ~]#
```

- Run the following command:

```
MEDIATOR_USERNAME=mediator MEDIATOR_PASSWORD=mediator2
MEDIATOR_NEW_USERNAME=mediatoradmin mediator_change_user
```

```
 [root@mediator-host ~]# MEDIATOR_USERNAME= mediator
MEDIATOR_PASSWORD='mediator2' MEDIATOR_NEW_USERNAME= mediatoradmin
mediator_change_user
 The account username has been modified successfully.
 [root@mediator-host ~]#
```

Change the password

About this task

This task is performed on the Linux host on which the ONTAP Mediator service is installed.

If you are unable to reach this command, you might need to run the command using the full path as shown in the following example:

```
/usr/local/bin/mediator_change_password
```

Procedure

Change the password by choosing one of the following options:

- Run the `mediator_change_password` command and respond to the prompts as shown in the following example:

```
[root@mediator-host ~]# mediator_change_password
Change the Mediator API password by entering the following values:
   Mediator API User Name: mediatoradmin
              Old Password:
              New Password:
          Confirm Password:
The password has been updated successfully.
[root@mediator-host ~]#
```

- Run the following command:

```
MEDIATOR_USERNAME= mediatoradmin MEDIATOR_PASSWORD=mediator1
MEDIATOR_NEW_PASSWORD=mediator2 mediator_change_password
```

The example shows that the password is changed from "mediator1" to "mediator2".

```
 [root@mediator-host ~]# MEDIATOR_USERNAME=mediatoradmin
MEDIATOR_PASSWORD=mediator1 MEDIATOR_NEW_PASSWORD=mediator2
mediator_change_password
 The password has been updated successfully.
 [root@mediator-host ~]#
```

Stop the ONTAP Mediator service

To stop the ONTAP Mediator service, perform the following steps:

Steps

1. Stop the ONTAP Mediator.

```
systemctl stop ontap_mediator
```

2. Stop SCST.

```
systemctl stop mediator-scst
```

3. Disable the ONTAP Mediator and SCST.

```
systemctl diable ontap_mediator mediator-scst
```

Re-enable the ONTAP Mediator service

To re-enable the ONTAP Mediator service, perform the following steps:

Steps

1. Enable the ONTAP Mediator and SCST.

```
systemctl enable ontap_mediator mediator-scst
```

2. Start SCST.

```
systemctl start mediator-scst
```

3. Start ONTAP Mediator.

```
systemctl start ontap_mediator
```

Verify the ONTAP Mediator is healthy

After the ONTAP Mediator has been installed, you should verify that the ONTAP Mediator services are running.

Steps

1. View the status of the ONTAP Mediator services:
   a. `systemctl status ontap_mediator`

```
[root@scspr1915530002 ~]# systemctl status ontap_mediator

 ontap_mediator.service - ONTAP Mediator
Loaded: loaded (/etc/systemd/system/ontap_mediator.service; enabled;
vendor preset: disabled)
Active: active (running) since Mon 2022-04-18 10:41:49 EDT; 1 weeks 0
days ago
Process: 286710 ExecStop=/bin/kill -s INT $MAINPID (code=exited,
status=0/SUCCESS)
Main PID: 286712 (uwsgi)
Status: "uWSGI is ready"
Tasks: 3 (limit: 49473)
Memory: 139.2M
CGroup: /system.slice/ontap_mediator.service
      ├─286712 /opt/netapp/lib/ontap_mediator/pyenv/bin/uwsgi --ini
/opt/netapp/lib/ontap_mediator/uwsgi/ontap_mediator.ini
      ├─286716 /opt/netapp/lib/ontap_mediator/pyenv/bin/uwsgi --ini
/opt/netapp/lib/ontap_mediator/uwsgi/ontap_mediator.ini
      └─286717 /opt/netapp/lib/ontap_mediator/pyenv/bin/uwsgi --ini
/opt/netapp/lib/ontap_mediator/uwsgi/ontap_mediator.ini

[root@scspr1915530002 ~]#
```

   b. `systemctl status mediator-scst`

```
[root@scspr1915530002 ~]# systemctl status mediator-scst
   Loaded: loaded (/etc/systemd/system/mediator-scst.service;
enabled; vendor preset: disabled)
   Active: active (running) since Mon 2022-04-18 10:41:47 EDT; 1
weeks 0 days ago
  Process: 286595 ExecStart=/etc/init.d/scst start (code=exited,
status=0/SUCCESS)
 Main PID: 286662 (iscsi-scstd)
    Tasks: 1 (limit: 49473)
   Memory: 1.2M
   CGroup: /system.slice/mediator-scst.service
           └─286662 /usr/local/sbin/iscsi-scstd

[root@scspr1915530002 ~]#
```

2. Confirm the ports that are used by the ONTAP Mediator service:

   `netstat`

```
[root@scspr1905507001 ~]# netstat -anlt | grep -E '3260|31784'

         tcp   0   0 0.0.0.0:31784   0.0.0.0:*      LISTEN

         tcp   0   0 0.0.0.0:3260    0.0.0.0:*      LISTEN

         tcp6  0   0 :::3260         :::*           LISTEN
```

Manually uninstall SCST to perform host maintenance

To uninstall SCST, you need the SCST tar bundle that is used for the installed version of ONTAP Mediator.

Steps

1. Download the appropriate SCST bundle (as shown in the following table) and untar it.

For this version …	Use this tar bundle…
ONTAP Mediator 1.6	scst-3.7.0.tar.bz2
ONTAP Mediator 1.5	scst-3.6.0.tar.bz2
ONTAP Mediator 1.4	scst-3.6.0.tar.bz2
ONTAP Mediator 1.3	scst-3.5.0.tar.bz2

ONTAP Mediator 1.1	scst-3.4.0.tar.bz2
ONTAP Mediator 1.0	scst-3.3.0.tar.bz2

2. Issue the following commands in the "scst" directory:
   a. `systemctl stop mediator-scst`
   b. `make scstadm_uninstall`
   c. `make iscsi_uninstall`
   d. `make usr_uninstall`
   e. `make scst_uninstall`
   f. `depmod`

Manually install SCST to perform host maintenance

To manually install SCST, you need the SCST tar bundle that is used for the installed version of ONTAP Mediator (see the table above).

1. Issue the following commands in the "scst" directory:
   a. `make 2release`
   b. `make scst_install`
   c. `make usr_install`
   d. `make iscsi_install`
   e. `make scstadm_install`
   f. `depmod`
   g. `cp scst/src/certs/scst_module_key.der /opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys/.`
   h. `cp scst/src/certs/scst_module_key.der /opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys/.`
   i. `patch /etc/init.d/scst < /opt/netapp/lib/ontap_mediator/systemd/scst.patch`
2. (Optional) If Secure Boot is enabled, before you reboot, perform the following steps:
   a. Determine each file name for "scst_vdisk", "scst", and "iscsi_scst" modules.

```
[root@localhost ~]# modinfo -n scst_vdisk
[root@localhost ~]# modinfo -n scst
[root@localhost ~]# modinfo -n iscst_scst
```

   b. Determine the kernel release.

```
[root@localhost ~]# uname -r
```

c. Sign each file with the kernel.

```
[root@localhost ~]# /usr/src/kernels/<KERNEL-RELEASE>/scripts/sign-
file \sha256 \
/opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys/scst_modu
le_key.priv \
/opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys/scst_modu
le_key.der \
_module-filename_
```

d. Install the correct key with the UEFI firmware.

Instructions for installing the UEFI key are located at:

```
/opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys/README.module-
signing
```

The generated UEFI key is located at:

```
/opt/netapp/lib/ontap_mediator/ontap_mediator/SCST_mod_keys/scst_module_key.
der
```

3. Perform a reboot.

```
reboot
```

Uninstall the ONTAP Mediator service

Before you begin

If necessary, you can remove the ONTAP Mediator service. The Mediator must be disconnected from ONTAP before you remove the Mediator service.

About this task

This task is performed on the Linux host on which the ONTAP Mediator service is installed.

If you are unable to reach this command, you might need to run the command using the full path as shown in the following example:

```
/usr/local/bin/uninstall_ontap_mediator
```

Step

1. Uninstall the ONTAP Mediator service:

```
uninstall_ontap_mediator
```

```
 [root@mediator-host ~]# uninstall_ontap_mediator

 ONTAP Mediator: Self Extracting Uninstaller

 + Removing ONTAP Mediator. (Log:
/tmp/ontap_mediator.GmRGdA/uninstall_ontap_mediator/remove.log)
 + Remove successful.
 [root@mediator-host ~]#
```

Maintain OS host for ONTAP Mediator

For optimal performance, you should maintain the host OS for ONTAP Mediator on a regular basis.

Reboot the host

Reboot the host when the clusters are healthy. While the ONTAP Mediator is offline, the clusters are at risk of not being able to react properly to failures. A service window is recommended if a reboot is required.

ONTAP Mediator will automatically resume during a reboot and will re-enter the relationships that were previously configured with ONTAP clusters.

Host package updates

Any library or yum packages (except the kernel) can be safely updated but might require a reboot to take effect. A service window is recommended if a reboot is required.

If you install the `yum-utils` package, use the `needs-restarting` command to detect if any package changes require a reboot.

You should reboot if any of the ONTAP Mediator dependencies are updated because they will not take immediate effect on running processes.

Host OS minor kernel upgrades

SCST must be compiled for the kernel that is being used. To update the OS, a maintenance window is required.

Steps

Perform the following steps to upgrade the host OS kernel.

1. Stop the ONTAP Mediator
2. Uninstall the SCST package. (SCST doesn’t provide an upgrade mechanism.)
3. Upgrade the OS, and reboot.
4. Re-install the SCST package.
5. Re-enable the ONTAP Mediator services.

Manage MetroCluster sites with System Manager

MetroCluster site management overview with System Manager

Beginning with ONTAP 9.8, you can use System Manager as a simplified interface for managing a configuration of a MetroCluster setup.

A MetroCluster configuration allows two clusters to mirror data to each other so if one cluster goes down, the data isn't lost.

Typically, an organization sets up the clusters in two separate geographical locations. An administrator at each location sets up a cluster and configures it. Then one of the administrators can set up the peering between the clusters so that they can share data.

The organization can also install an ONTAP Mediator in a third location. The ONTAP Mediator service monitors the status of each cluster. When one of the clusters detects that it cannot communicate with the partner cluster, it queries the monitor to determine if the error is a problem with the cluster system or with the network connection.

If the problem is with the network connection, the system administrator performs troubleshooting methods to correct the error and reconnect. If the partner cluster is down, the other cluster initiates a switchover process to control the data I/O for both clusters.

You can also perform a switchover to bring down one of the cluster systems for planned maintenance. The partner cluster handles all data I/O operations for both clusters until you bring up the cluster on which you performed maintenance and perform a switchback operation.

You can manage the following operations:

- Set up an IP MetroCluster site
- Set up IP MetroCluster peering
- Configure an IP MetroCluster site
- Perform IP MetroCluster switchover and switchback
- Troubleshoot problems with IP MetroCluster configurations
- Upgrade ONTAP on MetroCluster clusters

Set up an IP MetroCluster site

Beginning with ONTAP 9.8, you can use System Manager to set up an IP configuration of a MetroCluster site.

A MetroCluster site consists of two clusters. Typically, the clusters are located in different geographical locations.

Before you start

- Your system should already be installed and cabled according to the Installation and Setup Instructions that came with the system.
- Cluster network interfaces should be configured on each node of each cluster for intra-cluster communication.

Assign a node-management IP address

Windows System

You should connect your Windows computer to the same subnet as the controllers. This will automatically assign a node-management IP address to your system.

Steps

1. From the Windows system, open the **Network** drive to discover the nodes.
2. Double-click the node to launch the cluster setup wizard.

Other systems

You should configure the node-management IP address for one of the nodes in your cluster. You can use this node-management IP address to launch the cluster set up wizard.

See Creating the cluster on the first node for information about assigning a node-management IP address.

Initialize and configure the cluster

You initialize the cluster by setting an administrative password for the cluster and setting up the cluster management and node management networks. You can also configure services like a DNS server to resolve host names and an NTP server to synchronize time.

Steps

1. On a web browser, enter the node-management IP address that you have configured: "https://node-management-IP"

   System Manager automatically discovers the remaining nodes in the cluster.

2. In the **Initialize Storage System** window, perform the following:
   a. Enter cluster management network configuration data.
   b. Enter Node management IP addresses for all the nodes.
   c. Provide domain name servers (DNS) details.
   d. In the **Other** section, select the check box labeled **Use time service (NTP)** to add the time servers.

When you click **Submit**, wait for the cluster to be created and configured. Then, a validation process occurs.

What's Next?

After both clusters have been set up, initialized, and configured, perform the following procedure:

- Set up IP MetroCluster peering

Configure ONTAP on a new cluster video

Set up IP MetroCluster peering

Beginning with ONTAP 9.8, you can manage an IP configuration of a MetroCluster operation with System Manager. After setting up two clusters, you set up peering between them.

Before you start

You should have completed the following procedure to set up two clusters:

- Set up an IP MetroCluster site

Certain steps of this process are performed by different system administrators located at the geographical sites of each cluster. For the purposes of explaining this process, the clusters are called "Site A cluster" and "Site B cluster".

Performing the peering process from Site A

This process is performed by a system administrator at Site A.

Steps

1. Log in to Site A cluster.
2. In System Manager, select **Dashboard** from the left navigation column to display the cluster overview.

   The dashboard shows the details for this cluster (Site A). In the **MetroCluster** section, Site A cluster is shown on the left.

3. Click **Attach Partner Cluster**.
4. Enter the details of the network interfaces that allow the nodes in Site A cluster to communicate with the nodes in Site B cluster.

5. Click **Save and Continue**.
6. On the **Attach Partner Cluster** window, select **I do not have a passphrase**, which lets you generate a passphrase.
7. Copy the generated passphrase and share it with the system administrator at Site B.
8. Select **Close**.

Performing the peering process from Site B

This process is performed by a system administrator at Site B.

Steps

1. Log in to Site B cluster.
2. In System Manager, select **Dashboard** to display the cluster overview.

   The dashboard shows the details for this cluster (Site B). In the MetroCluster section, Site B cluster is shown on the left.

3. Click **Attach Partner Cluster** to start the peering process.
4. Enter the details of the network interfaces that allow the nodes in Site B cluster to communicate with the nodes in Site A cluster.
5. Click **Save and Continue**.
6. On the **Attach Partner Cluster** window, select **I have a passphrase**, which lets you enter the passphrase that you received from the system administrator at Site A.
7. Select **Peer** to complete the peering process.

What's next?

After the peering process is successfully completed, you configure the clusters. See Configure an IP MetroCluster site.

Configure an IP MetroCluster site

Beginning with ONTAP 9.8, you can manage an IP configuration of a MetroCluster operation with System Manager. After setting up two clusters and peering them, you configure each cluster.

Before you start

You should have completed the following procedures:

- Set up an IP MetroCluster site
- Set up IP MetroCluster peering

Configure the connection between clusters

Steps

1. Log in to System Manager on one of the sites, and select **Dashboard**.

   In the **MetroCluster** section, the graphic shows the two clusters that you set up and peered for the MetroCluster sites. The cluster you are working from (local cluster) is shown on the left.

2. Click **Configure MetroCluster**. From this window, you can perform the following tasks:
   a. The nodes for each cluster in the MetroCluster configuration are shown. Use the drop-down lists to select which nodes in the local cluster will be disaster recovery partners with which nodes in the remote cluster.
   b. Click the check box if you want to configure an ONTAP Mediator service. See Configure the ONTAP Mediator service.
   c. If both clusters have a license to enable encryption, the **Encryption** section is displayed.

      To enable encryption, enter a passphrase.

   d. Click the check box if you want to configure MetroCluster with shared layer 3 network.

      The HA partner nodes and network switches connecting to the nodes must have a matching configuration.

3. Click **Save** to configure the MetroCluster sites.

   On the **Dashboard**, in the **MetroCluster** section, the graphic shows a check mark on the link between the two clusters, indicating a healthy connection.

Configure the ONTAP Mediator service

The ONTAP Mediator service is typically installed at a geographic location separate from either location of the clusters. The clusters communicate regularly with the service to indicate that they are up and running. If one of the clusters in the MetroCluster configuration detects that the communication with its partner cluster is down, it checks with the ONTAP Mediator to determine if the partner cluster itself is down.

Before you start

Both clusters at the MetroCluster sites should be up and peered.

Steps

1. In System Manager in ONTAP 9.8, select **Cluster > Settings**.
2. In the **Mediator** section, click .
3. On the **Configure Mediator** window, click **Add+**.
4. Enter the configuration details for the ONTAP Mediator.

Perform IP MetroCluster switchover and switchback

You can switch over control from one IP MetroCluster site to the other to perform maintenance or recover from an issue.

Switchover and switchback procedures are supported only for IP MetroCluster configurations.

Overview of switchover and switchback

A switchover can occur in two instances:

- **A planned switchover**

This switchover is initiated by a system administrator using System Manager. The planned switchover allows a system administrator of a local cluster to switch control so that the data services of the remote cluster are handled by the local cluster. Then, a system administrator at the remote cluster location can perform maintenance on the remote cluster.

- **An unplanned switchover**

  In some cases, when a MetroCluster cluster goes down or the connections between the clusters are down, ONTAP will automatically initiate a switchover procedure so that the cluster that is still running handles the data handling responsibilities of the down cluster.

  At other times, when ONTAP cannot determine the status of one of the clusters, the system administrator of the site that is working initiates the switchover procedure to take control of the data handling responsibilities of the other site.

For any type of switchover procedure, the data servicing capability is returned to the cluster by using a *switchback* process.

You perform different switchover and switchback processes for ONTAP 9.7 and 9.8:

- Use System Manager in ONTAP 9.7 for switchover and switchback
- Use System Manager in ONTAP 9.8 for switchover and switchback

Use System Manager in ONTAP 9.7 for switchover and switchback

Steps

1. Log in to System Manager in ONTAP 9.7.
2. Click **(Return to classic version)**.
3. Click **Configuration > MetroCluster**.

   System Manager verifies whether a negotiated switchover is possible.

4. Perform one of the following substeps when the validation process has completed:
   a. If validation fails, but Site B is up, then an error has occurred. For example, there might be a problem with a subsystem, or NVRAM mirroring might not be synchronized.
      i. Fix the issue that is causing the error, click **Close**, and then start again at Step 2.
      ii. Halt the Site B nodes, click **Close**, and then perform the steps in Performing an unplanned switchover.
   b. If validation fails, and Site B is down, then most likely there is a connection problem. Verify that Site B is really down, then perform the steps in Performing an unplanned switchover.
5. Click **Switchover from Site B to Site A** to initiate the switchover process.
6. Click **Switch to the new experience**.

Use System Manager in ONTAP 9.8 for switchover and switchback

Perform a planned switchover (ONTAP 9.8)

Steps

1. Log in to System Manager in ONTAP 9.8.

2. Select **Dashboard**. In the **MetroCluster** section, the two clusters are shown with a connection.
3. In the local cluster (shown on the left), click ⋮, and select **Switchover remote data services to the local site**.

   After the switchover request is validated, control is transferred from the remote site to the local site, which performs data service requests for both clusters.

   The remote cluster reboots, but the storage components are not active, and the cluster does not service data requests. It is now available for planned maintenance.

ⓘ The remote cluster should not be used for data servicing until you perform a switchback.

Perform an unplanned switchover (ONTAP 9.8)

An unplanned switchover might be initiated automatically by ONTAP. If ONTAP cannot determine if a switchback is needed, the system administrator of the MetroCluster site that is still running initiates the switchover with the following steps:

Steps

1. Log in to System Manager in ONTAP 9.8.
2. Select **Dashboard**.

   In the **MetroCluster** section, the connection between the two clusters is shown with an "X" on it, meaning a connection cannot be detected. Either the connections or the cluster is down.

3. In the local cluster (shown on the left), click ⋮, and select **Switchover remote data services to the local site**.

   If the switchover fails with an error, click on the "View details" link in the error message and confirm the unplanned switchover.

   After the switchover request is validated, control is transferred from the remote site to the local site, which performs data service requests for both clusters.

   The cluster must be repaired before it is brought online again.

ⓘ After the remote cluster is brought online again, it should not be used for data servicing until you perform a switchback.

Perform a switchback (ONTAP 9.8)

Before you start

Whether the remote cluster was down due to planned maintenance or due to a disaster, it should now be up and running and waiting for the switchback.

Steps

1. On the local cluster, log in to System Manager in ONTAP 9.8.
2. Select **Dashboard**.

   In the **MetroCluster** section, the two clusters are shown.

3. In the local cluster (shown on the left), click ⋮, and select **Take back control**.

   The data is *healed* first, to ensure data is synchronized and mirrored between both clusters.

4. When the data healing is complete, click ⋮, and select **Initiate switchback**.

   When the switchback is complete, both clusters are active and servicing data requests. Also, the data is being mirrored and synchronized between the clusters.

Modify address, netmask, and gateway in a MetroCluster IP

Beginning with ONTAP 9.10.1, you can change the following properties of a MetroCluster IP interface: IP address and mask, and gateway. You can use any combination of parameters to update.

You might need to update these properties, for example, if a duplicate IP address is detected or if a gateway needs to change in the case of a layer 3 network due to router configuration changes. You can only change one interface at a time. There will be traffic disruption on that interface until the other interfaces are updated and connections are reestablished.

> ⓘ You must make the changes on each port. Similarly, network switches also need to update their configuration. For example, if the gateway is updated, ideally it is changed on both nodes of an HA pair, since they are same. Plus the switch connected to those nodes also needs to update its gateway.

Step

Update the IP address, netmask, and gateway for a each node and interface.

Troubleshoot problems with IP MetroCluster configurations

Beginning with ONTAP 9.8, System Manager monitors the health of IP MetroCluster configurations and helps you identify and correct problems that might occur.

Overview of the MetroCluster Health Check

System Manager periodically checks the health of your IP MetroCluster configuration. When you view the MetroCluster section in the Dashboard, usually the message is "MetroCluster systems are healthy."

However, when a problem occurs, the message will show the number of events. You can click on that message and view the results of the health check for the following components:

- Node
- Network Interface
- Tier (Storage)
- Cluster
- Connection
- Volume
- Configuration Replication

The **Status** column identifies which components have problems, and the **Details** column suggests how to correct the problem.

MetroCluster troubleshooting

Steps

1. In System Manager, select **Dashboard**.
2. In the **MetroCluster** section, notice the message.
   a. If the message indicates that your MetroCluster configuration is healthy, and the connections between the clusters and the ONTAP Mediator are healthy (shown with check marks), then you have no problems to correct.
   b. If the message lists the number of events, or the connections have gone down (shown with an "X"), then continue to the next step.
3. Click the message that shows the number of events.

   The MetroCluster Health Report displays.
4. Troubleshoot the problems that appear in the report using the suggestions in the **Details** column.
5. When all the problems have been corrected, click **Check MetroCluster Health**.

   The MetroCluster Health Check uses an intensive amount of resources, so it is recommended that you perform all your troubleshooting tasks before running the check.

   The MetroCluster Health Check runs in the background. You can work on other tasks while you wait for it to finish.

Data protection using tape backup

Tape backup of FlexVol volumes overview

ONTAP supports tape backup and restore through Network Data Management Protocol (NDMP). NDMP allows you to back up data in storage systems directly to tape, resulting in efficient use of network bandwidth. ONTAP supports both dump and SMTape engines for tape backup.

You can perform a dump or SMTape backup or restore by using NDMP-compliant backup applications. Only NDMP version 4 is supported.

Tape backup using dump

Dump is a Snapshot copy based backup in which your file system data is backed up to tape. The ONTAP dump engine backs up files, directories, and the applicable access control list (ACL) information to tape. You can back up an entire volume, an entire qtree, or a subtree that is not an entire volume or an entire qtree. Dump supports baseline, differential, and incremental backups.

Tape backup using SMTape

SMTape is a Snapshot copy based disaster recovery solution from ONTAP that backs up blocks of data to tape. You can use SMTape to perform volume backups to tapes. However, you cannot perform a backup at the

qtree or subtree level. SMTape supports baseline, differential, and incremental backups.

Beginning in ONTAP 9.13.1, Tape backup using SMTape is supporting with SnapMirror Business Continuity.

Tape backup and restore workflow

You can perform tape backup and restore operations by using an NDMP-enabled backup application.

About this task

The tape backup and restore workflow provides an overview of the tasks that are involved in performing tape backup and restore operations. For detailed information about performing a backup and restore operation, see the backup application documentation.

Steps

1. Set up a tape library configuration by choosing an NDMP-supported tape topology.
2. Enable NDMP services on your storage system.

   You can enable the NDMP services either at the node level or at the storage virtual machine (SVM) level. This depends on the NDMP mode in which you choose to perform the tape backup and restore operation.

3. Use NDMP options to manage NDMP on your storage system.

   You can use NDMP options either at the node level or at the SVM level. This depends on the NDMP mode in which you choose to perform the tape backup and restore operation.

   You can modify the NDMP options at the node level by using the `system services ndmp modify` command and at the SVM level by using the `vserver services ndmp modify` command. For more information about these commands, see the man pages.

4. Perform a tape backup or restore operation by using an NDMP-enabled backup application.

   ONTAP supports both dump and SMTape engines for tape backup and restore.

   For more information about using the backup application (also called *Data Management Applications* or *DMAs*) to perform backup or restore operations, see your backup application documentation.

Related information

Common NDMP tape backup topologies

Understanding dump engine for FlexVol volumes

Use cases for choosing a tape backup engine

ONTAP supports two backup engines: SMTape and dump. You should be aware of the use cases for the SMTape and dump backup engines to help you choose the backup engine to perform tape backup and restore operations.

Dump can be used in the following cases:

- Direct Access Recovery (DAR) of files and directories

- Backup of a subset of subdirectories or files in a specific path
- Excluding specific files and directories during backups
- Preserving backup for long durations

SMTape can be used in the following cases:

- Disaster recovery solution
- Preserving deduplication savings and deduplication settings on the backed up data during a restore operation
- Backup of large volumes

Manage tape drives

Manage tape drives overview

You can verify tape library connections and view tape drive information before performing a tape backup or restore operation. You can use a nonqualified tape drive by emulating this to a qualified tape drive. You can also assign and remove tape aliases in addition to viewing existing aliases.

When you back up data to tape, the data is stored in tape files. File marks separate the tape files, and the files have no names. You specify a tape file by its position on the tape. You write a tape file by using a tape device. When you read the tape file, you must specify a device that has the same compression type that you used to write that tape file.

Commands for managing tape drives, media changers, and tape drive operations

There are commands for viewing information about tape drives and media changers in a cluster, bringing a tape drive online and taking it offline, modifying the tape drive cartridge position, setting and clearing tape drive alias name, and resetting a tape drive. You can also view and reset tape drive statistics.

If you want to…	Use this command…
Bring a tape drive online	`storage tape online`
Clear an alias name for tape drive or media changer	`storage tape alias clear`
Enable or disable a tape trace operation for a tape drive	`storage tape trace`
Modify the tape drive cartridge position	`storage tape position`
Reset a tape drive	`storage tape reset` This command is available only at the advanced privilege level.

If you want to…	Use this command…
Set an alias name for tape drive or media changer	`storage tape alias set`
Take a tape drive offline	`storage tape offline`
View information about all tape drives and media changers	`storage tape show`
View information about tape drives attached to the cluster	• `storage tape show-tape-drive` • `system node hardware tape drive show`
View information about media changers attached to the cluster	`storage tape show-media-changer`
View error information about tape drives attached to the cluster	`storage tape show-errors`
View all ONTAP qualified and supported tape drives attached to each node in the cluster	`storage tape show-supported-status`
View aliases of all tape drives and media changers attached to each node in the cluster	`storage tape alias show`
Reset the statistics reading of a tape drive to zero	`storage stats tape zero tape_name` You must use this command at the nodeshell.
View tape drives supported by ONTAP	`storage show tape supported [-v]` You must use this command at the nodeshell. You can use the `-v` option to view more details about each tape drive.
View tape device statistics to understand tape performance and check usage pattern	`storage stats tape tape_name` You must use this command at the nodeshell.

For more information about these commands, see the man pages.

Use a nonqualified tape drive

You can use a nonqualified tape drive on a storage system if it can emulate a qualified tape drive. It is then treated like a qualified tape drive. To use a nonqualified tape drive, you must first determine whether it emulates any of the qualified tape drives.

About this task

A nonqualified tape drive is one that is attached to the storage system, but not supported or recognized by ONTAP.

Steps

1. View the nonqualified tape drives attached to a storage system by using the `storage tape show-supported-status` command.

   The following command displays tape drives attached to the storage system and the support and qualification status of each tape drive. The nonqualified tape drives are also listed. `tape_drive_vendor_name` is a nonqualified tape drive attached to the storage system, but not supported by ONTAP.

```
cluster1::> storage tape show-supported-status -node Node1

          Node: Node1
                                    Is
          Tape Drive                Supported  Support Status
          --------------------      ---------  --------------
          "tape_drive_vendor_name"  false      Nonqualified tape drive
          Hewlett-Packard C1533A    true       Qualified
          Hewlett-Packard C1553A    true       Qualified
          Hewlett-Packard Ultrium 1 true       Qualified
          Sony SDX-300C             true       Qualified
          Sony SDX-500C             true       Qualified
          StorageTek T9840C         true       Dynamically Qualified
          StorageTek T9840D         true       Dynamically Qualified
          Tandberg LTO-2 HH         true       Dynamically Qualified
```

2. Emulate the qualified tape drive.

   NetApp Downloads: Tape Device Configuration Files

Related information

What qualified tape drives are

Assign tape aliases

For easy device identification, you can assign tape aliases to a tape drive or medium changer. Aliases provide a correspondence between the logical names of backup devices and a name permanently assigned to the tape drive or medium changer.

Steps

1. Assign an alias to a tape drive or medium changer by using the `storage tape alias set` command.

   For more information about this command, see the man pages.

   You can view the serial number (SN) information about the tape drives by using the `system node hardware tape drive show` command and about tape libraries by using the `system node`

`hardware tape library show` commands.

The following command sets an alias name to a tape drive with serial number SN[123456]L4 attached to the node, cluster1-01:

```
cluster-01::> storage tape alias set  -node cluster-01 -name st3
-mapping SN[123456]L4
```

The following command sets an alias name to a media changer with serial number SN[65432] attached to the node, cluster1-01:

```
cluster-01::> storage tape alias set  -node cluster-01 -name mc1
-mapping SN[65432]
```

Related information

What tape aliasing is

Removing tape aliases

Remove tape aliases

You can remove aliases by using the `storage tape alias clear` command when persistent aliases are no longer required for a tape drive or medium changer.

Steps

1. Remove an alias from a tape drive or medium changer by using the `storage tape alias clear` command.

   For more information about this command, see the man pages.

   The following command removes the aliases of all tape drives by specifying the scope of the alias clear operation to `tape`:

   ```
   cluster-01::>storage tape alias clear -node cluster-01 -clear-scope tape
   ```

After you finish

If you are performing a tape backup or restore operation using NDMP, then after you remove an alias from a tape drive or medium changer, you must assign a new alias name to the tape drive or medium changer to continue access to the tape device.

Related information

What tape aliasing is

Assigning tape aliases

Enabling or disabling tape reservations

You can control how ONTAP manages tape device reservations by using the `tape.reservations` option. By default, tape reservation is turned off.

About this task

Enabling the tape reservations option can cause problems if tape drives, medium changers, bridges, or libraries do not work properly. If tape commands report that the device is reserved when no other storage systems are using the device, this option should be disabled.

Steps

1. To use either the SCSI Reserve/Release mechanism or SCSI Persistent Reservationsor to disable tape reservations, enter the following commandat the clustershell:

   `options -option-name tape.reservations -option-value {scsi | persistent | off}`

   `scsi` selects the SCSI Reserve/Release mechanism.

   `persistent` selects SCSI Persistent Reservations.

   `off` disables tape reservations.

Related information

What tape reservations are

Commands for verifying tape library connections

You can view information about the connection path between a storage system and a tape library configuration attached to the storage system. You can use this information to verify the connection path to the tape library configuration or for troubleshooting issues related to the connection paths.

You can view the following tape library details to verify the tape library connections after adding or creating a new tape library, or after restoring a failed path in a single-path or multipath access to a tape library. You can also use this information while troubleshooting path-related errors or if access to a tape library fails.

- Node to which the tape library is attached
- Device ID
- NDMP path
- Tape library name
- Target port and initiator port IDs
- Single-path or multipath access to a tape library for every target or FC initiator port
- Path-related data integrity details, such as “Path Errors” and “Path Qual”
- LUN groups and LUN counts

If you want to…	Use this command…
View information about a tape library in a cluster	`system node hardware tape library show`
View path information for a tape library	`storage tape library path show`
View path information for a tape library for every initiator port	`storage tape library path show-by-initiator`
View connectivity information between a storage tape library and cluster	`storage tape library config show`

For more information about these commands, see the man pages.

About tape drives

Qualified tape drives overview

You must use a qualified tape drive that has been tested and found to work properly on a storage system. You can follow tape aliasing and also enable tape reservations to ensure that only one storage system accesses a tape drive at any particular time.

A qualified tape drive is a tape drive that has been tested and found to work properly on storage systems. You can qualify tape drives for existing ONTAP releases by using the tape configuration file.

Format of the tape configuration file

The tape configuration file format consists of fields such as vendor ID, product ID, and details of compression types for a tape drive. This file also consists of optional fields for enabling the autoload feature of a tape drive and changing the command timeout values of a tape drive.

The following table displays the format of the tape configuration file:

Item	Size	Description
`vendor_id` (string)	up to 8 bytes	The vendor ID as reported by the `SCSI Inquiry` command.
`product_id`(string)	up to 16 bytes	The product ID as reported by the `SCSI Inquiry` command.
`id_match_size`(number)		The number of bytes of the product ID to be used for matching to detect the tape drive to be identified, beginning with the first character of the product ID in the Inquiry data.

Item	Size	Description
`vendor_pretty` (string)	up to 16 bytes	If this parameter is present, it is specified by the string displayed by the command, `storage tape show -device-names`; otherwise, INQ_VENDOR_ID is displayed.
`product_pretty`(string)	up to 16 bytes	If this parameter is present, it is specified by the string displayed by the command, `storage tape show -device-names`; otherwise, INQ_PRODUCT_ID is displayed.

The `vendor_pretty` and `product_pretty` fields are optional, but if one of these fields has a value, the other must also have a value.

The following table explains the description, density code, and compression algorithm for the various compression types, such as `l`, `m`, `h`, and `a`:

Item	Size	Description
`{l | m | h | a}_description=(string)`	up to 24 bytes	The string to print for the nodeshell command, `sysconfig -t`, that describes characteristics of the particular density setting.
`{l | m | h | a}_density=(hex codes)`		The density code to be set in the SCSI mode page block descriptor corresponding to the desired density code for l, m, h, or a.
`{l | m | h | a}_algorithm=(hex codes)`		The compression algorithm to be set in the SCSI Compression Mode Page corresponding to the density code and the desired density characteristic.

The following table describes the optional fields available in the tape configuration file:

Field	Description
`autoload=(Boolean yes/no)`	This field is set to `yes` if the tape drive has an automatic loading feature; that is, after tape cartridge is inserted, the tape drive becomes ready without the need to execute a `SCSI load` (start/stop unit) command. The default for this field is `no`.

Field	Description
`cmd_timeout_0x`	Individual timeout value. You must use this field only if you want to specify a different timeout value from the one being used as a default by the tape driver. The sample file lists the default SCSI command timeout values used by the tape drive. The timeout value can be expressed in minutes (m), seconds (s), or milliseconds (ms). You should not change this field.

You can download and view the tape configuration file from the NetApp Support Site.

Example of a tape configuration file format

The tape configuration file format for the HP LTO5 ULTRIUM tape drive is as follows:

```
vendor_id="HP"

product_id="Ultrium 5-SCSI"

id_match_size=9

vendor_pretty="Hewlett-Packard"

product_pretty="LTO-5"

l_description="LTO-3(ro)/4 4/800GB"

l_density=0x00

l_algorithm=0x00

m_description="LTO-3(ro)/4 8/1600GB cmp"

m_density=0x00

m_algorithm=0x01

h_description="LTO-5 1600GB"

h_density=0x58

h_algorithm=0x00

a_description="LTO-5 3200GB cmp"

a_density=0x58

a_algorithm=0x01
```

`autoload`="yes"

Related information

NetApp Tools: Tape Device Configuration Files

How the storage system qualifies a new tape drive dynamically

The storage system qualifies a tape drive dynamically by matching its vendor ID and product ID with the information contained in the tape qualification table.

When you connect a tape drive to the storage system, it looks for a vendor ID and product ID match between the information obtained during tape discovery and the information in the internal tape qualification table. If the storage system discovers a match, it marks the tape drive as qualified and can access the tape drive. If the storage system cannot find a match, the tape drive remains in the unqualified state and is not accessed.

Tape devices overview

Tape devices overview

A tape device is a representation of a tape drive. It is a specific combination of rewind type and compression capability of a tape drive.

A tape device is created for each combination of rewind type and compression capability. Therefore, a tape drive or tape library can have several tape devices associated with it. You must specify a tape device to move, write, or read tapes.

When you install a tape drive or tape library on a storage system, ONTAP creates tape devices associated with the tape drive or tape library.

ONTAP detects tape drives and tape libraries and assigns logical numbers and tape devices to them. ONTAP detects the Fibre Channel, SAS, and parallel SCSI tape drives and libraries when they are connected to the interface ports. ONTAP detects these drives when their interfaces are enabled.

Tape device name format

Each tape device has an associated name that appears in a defined format. The format includes information about the type of device, rewind type, alias, and compression type.

The format of a tape device name is as follows:

`rewind_type st alias_number compression_type`

`rewind_type` is the rewind type.

The following list describes the various rewind type values:

- **r**

  ONTAP rewinds the tape after it finishes writing the tape file.

- **nr**

  ONTAP does not rewind the tape after it finishes writing the tape file. You must use this rewind type when

you want to write multiple tape files on the same tape.

- **ur**

  This is the unload/reload rewind type. When you use this rewind type, the tape library unloads the tape when it reaches the end of a tape file, and then loads the next tape, if there is one.

  You must use this rewind type only under the following circumstances:

  - The tape drive associated with this device is in a tape library or is in a medium changer that is in the library mode.
  - The tape drive associated with this device is attached to a storage system.
  - Sufficient tapes for the operation that you are performing are available in the library tape sequence defined for this tape drive.

If you record a tape using a no-rewind device, you must rewind the tape before you read it.

`st` is the standard designation for a tape drive.

`alias_number` is the alias that ONTAP assigns to the tape drive. When ONTAP detects a new tape drive, ONTAP assigns an alias to the tape drive.

`compression_type` is a drive-specific code for the density of data on the tape and the type of compression.

The following list describes the various values for `compression_type`:

- **a**

  Highest compression

- **h**

  High compression

- **m**

  Medium compression

- **l**

  Low compression

Examples

`nrst0a` specifies a no-rewind device on tape drive 0 using the highest compression.

Example of a listing of tape devices

The following example shows the tape devices associated with HP Ultrium 2-SCSI:

```
        Tape drive (fc202_6:2.126L1)  HP      Ultrium 2-SCSI
rst0l   -  rewind device,         format is: HP (200GB)
nrst0l  -  no rewind device,      format is: HP (200GB)
urst0l  -  unload/reload device,  format is: HP (200GB)
rst0m   -  rewind device,         format is: HP (200GB)
nrst0m  -  no rewind device,      format is: HP (200GB)
urst0m  -  unload/reload device,  format is: HP (200GB)
rst0h   -  rewind device,         format is: HP (200GB)
nrst0h  -  no rewind device,      format is: HP (200GB)
urst0h  -  unload/reload device,  format is: HP (200GB)
rst0a   -  rewind device,         format is: HP (400GB w/comp)
nrst0a  -  no rewind device,      format is: HP (400GB w/comp)
urst0a  -  unload/reload device,  format is: HP (400GB w/comp)
```

The following list describes the abbreviations in the preceding example:

- GB—Gigabytes; this is the capacity of the tape.
- w/comp—With compression; this shows the tape capacity with compression.

Supported number of simultaneous tape devices

ONTAP supports a maximum of 64 simultaneous tape drive connections, 16 medium changers, and 16 bridge or router devices for each storage system (per node) in any mix of Fibre Channel, SCSI, or SAS attachments.

Tape drives or medium changers can be devices in physical or virtual tape libraries or stand-alone devices.

> Although a storage system can detect 64 tape drive connections, the maximum number of backup and restore sessions that can be performed simultaneously depends upon the scalability limits of the backup engine.

Related information

Scalability limits for dump backup and restore sessions

Tape aliasing

Tape aliasing overview

Aliasing simplifies the process of device identification. Aliasing binds a physical path name (PPN) or a serial number (SN) of a tape or a medium changer to a persistent, but modifiable alias name.

The following table describes how tape aliasing enables you to ensure that a tape drive (or tape library or medium changer) is always associated with a single alias name:

Scenario	Reassigning of the alias
When the system reboots	The tape drive is automatically reassigned its previous alias.
When a tape device moves to another port	The alias can be adjusted to point to the new address.
When more than one system uses a particular tape device	The user can set the alias to be the same for all the systems.

When you upgrade from Data ONTAP 8.1.x to Data ONTAP 8.2.x, the tape alias feature of Data ONTAP 8.2.x modifies the existing tape alias names. In such a case you might have to update the tape alias names in the backup application.

Assigning tape aliases provides a correspondence between the logical names of backup devices (for example, st0 or mc1) and a name permanently assigned to a port, a tape drive, or a medium changer.

st0 and st00 are different logical names.

Logical names and serial numbers are used only to access a device. After the device is accessed, it returns all error messages by using the physical path name.

There are two types of names available for aliasing: physical path name and serial number.

What physical path names are

Physical path names (PPNs) are the numerical address sequences that ONTAP assigns to tape drives and tape libraries based on the SCSI-2/3 adapter or switch (specific location) they are connected to the storage system. PPNs are also known as electrical names.

PPNs of direct-attached devices use the following format: `host_adapter. device_id_lun`

The LUN value is displayed only for tape and medium changer devices whose LUN values are not zero; that is, if the LUN value is zero the `lun` part of the PPN is not displayed.

For example, the PPN 8.6 indicates that the host adapter number is 8, the device ID is 6, and the logical unit number (LUN) is 0.

SAS tape devices are also direct-attached devices. For example, the PPN 5c.4 indicates that in a storage system, the SAS HBA is connected in slot 5, SAS tape is connected to port C of the SAS HBA, and the device ID is 4.

PPNs of Fibre Channel switch-attached devices use the following format: `switch:port_id. device_id_lun`

For example, the PPN MY_SWITCH:5.3L2 indicates that the tape drive connected to port 5 of a switch called MY_SWITCH is set with device ID 3 and has the LUN 2.

The LUN (logical unit number) is determined by the drive. Fibre Channel, SCSI tape drives and libraries, and

disks have PPNs.

PPNs of tape drives and libraries do not change unless the name of the switch changes, the tape drive or library moves, or the tape drive or library is reconfigured. PPNs remain unchanged after reboot. For example, if a tape drive named MY_SWITCH:5.3L2 is removed and a new tape drive with the same device ID and LUN is connected to port 5 of the switch MY_SWITCH, the new tape drive would be accessible by using MY_SWITCH:5.3L2.

What serial numbers are

A serial number (SN) is a unique identifier for a tape drive or a medium changer. ONTAP generates aliases based on SN instead of the WWN.

Since the SN is a unique identifier for a tape drive or a medium changer, the alias remains the same regardless of the multiple connection paths to the tape drive or medium changer. This helps storage systems to track the same tape drive or medium changer in a tape library configuration.

The SN of a tape drive or a medium changer does not change even if you rename the Fibre Channel switch to which the tape drive or medium changer is connected. However, in a tape library if you replace an existing tape drive with a new one, then ONTAP generates new aliases because the SN of the tape drive changes. Also, if you move an existing tape drive to a new slot in a tape library or remap the tape drive's LUN, ONTAP generates a new alias for that tape drive.

You must update the backup applications with the newly generated aliases.

The SN of a tape device uses the following format: `SN[xxxxxxxxxx]L[X]`

`x` is an alphanumeric character and L`X` is the LUN of the tape device. If the LUN is 0, the L`X` part of the string is not displayed.

Each SN consists of up to 32 characters; the format for the SN is not case-sensitive.

Considerations when configuring multipath tape access

You can configure two paths from the storage system to access the tape drives in a tape library. If one path fails, the storage system can use the other paths to access the tape drives without having to immediately repair the failed path. This ensures that tape operations can be restarted.

You must consider the following when configuring multipath tape access from your storage system:

- In tape libraries that support LUN mapping, for multipath access to a LUN group, LUN mapping must be symmetrical on each path.

  Tape drives and media changers are assigned to LUN groups (set of LUNs that share the same initiator path set) in a tape library. All tape drives of a LUN group must be available for backup and restore operations on all multiple paths.

- A maximum of two paths can be configured from the storage system to access the tape drives in a tape library.
- Multipath tape access supports load balancing. Load balancing is disabled by default.

In the following example, the storage system accesses LUN group 0 through two initiator paths: 0b and 0d. In

both these paths, the LUN group has the same LUN number, 0, and LUN count, 5. The storage system accesses LUN group 1 through only one initiator path, 3d.

```
STSW-3070-2_cluster::> storage tape library config show

Node                    LUN Group   LUN Count  Library Name  Library
Target Port  Initiator
----------------------- ----------- ---------- -------------
-------------------- -----
STSW-3070-2_cluster-01        0      5         IBM 3573-TL_1
510a09800000412d     0b

0d
                              1      2         IBM 3573-TL_2
50050763124b4d6f     3d

3 entries were displayed
```

For more information, see the man pages.

How you add tape drives and libraries to storage systems

You can add tape drives and libraries to storage system dynamically (without taking the storage system offline).

When you add a new medium changer, the storage system detects its presence and adds it to the configuration. If the medium changer is already referenced in the alias information, no new logical names are created. If the library is not referenced, the storage system creates a new alias for the medium changer.

In a tape library configuration, you must configure a tape drive or medium changer on LUN 0 of a target port for ONTAP to discover all medium changers and tape drives on that target port.

What tape reservations are

Multiple storage systems can share access to tape drives, medium changers, bridges, or tape libraries. Tape reservations ensure that only one storage system accesses a device at any particular time by enabling either the SCSI Reserve/Release mechanism or SCSI Persistent Reservations for all tape drives, medium changers, bridges, and tape libraries.

> All the systems that share devices in a library, whether switches are involved or not, must use the same reservation method.

The SCSI Reserve/Release mechanism for reserving devices works well under normal conditions. However, during interface error recovery procedures, reservations can be lost. If this occurs, initiators other than the reserved owner can access the device.

Reservations made with SCSI Persistent Reservations are not affected by error recovery mechanisms, such as loop reset or target reset; however, not all devices implement SCSI Persistent Reservations correctly.

Transfer data using ndmpcopy

Transfer data using ndmpcopy overview

The `ndmpcopy` nodeshell command transfers data between storage systems that support NDMP v4. You can perform both full and incremental data transfers. You can transfer full or partial volumes, qtrees, directories, or individual files.

About this task

Using ONTAP 8.x and earlier releases, incremental transfers are limited to a maximum of two levels (one full and up to two incremental backups).

Beginning with ONTAP 9.0 and later releases, incremental transfers are limited to a maximum of nine levels (one full and up to nine incremental backups).

You can run `ndmpcopy` at the nodeshell command line of the source and destination storage systems, or a storage system that is neither the source nor the destination of the data transfer. You can also run `ndmpcopy` on a single storage system that is both the source and the destination of the data transfer.

You can use IPv4 or IPv6 addresses of the source and destination storage systems in the `ndmpcopy` command. The path format is `/vserver_name/volume_name \[path\]`.

Steps

1. Enable NDMP service on the source and destination storage systems:

If you are performing data transfer at the source or destination in…	Use the following command…
SVM-scoped NDMP mode	`vserver services ndmp on` For NDMP authentication in the admin SVM, the user account is `admin` and the user role is `admin` or `backup`. In the data SVM, the user account is `vsadmin` and the user role is `vsadmin` or `vsadmin-backup` role.
Node-scoped NDMP mode	`system services ndmp on`

2. Transfer data within a storage system or between storage systems using the `ndmpcopy` command at the nodeshell:

```
::> system node run -node <node_name> < ndmpcopy [options]
source_IP:source_path destination_IP:destination_path [-mcs {inet|inet6}] [-
mcd {inet|inet6}] [-md {inet|inet6}]
```

DNS names are not supported in ndmpcopy. You must provide the IP address of the source and the destination. The loopback address (127.0.0.1) is not supported for the source IP address or the destination IP address.

- The `ndmpcopy` command determines the address mode for control connections as follows:
  - The address mode for control connection corresponds to the IP address provided.
  - You can override these rules by using the `-mcs` and `-mcd` options.
- If the source or the destination is the ONTAP system, then depending on the NDMP mode (node-scoped or SVM-scoped), use an IP address that allows access to the target volume.
- `source_path` and `destination_path` are the absolute path names till the granular level of volume, qtree, directory or file.
- `-mcs` specifies the preferred addressing mode for the control connection to the source storage system.

  `inet` indicates an IPv4 address mode and `inet6` indicates an IPv6 address mode.
- `-mcd` specifies the preferred addressing mode for the control connection to the destination storage system.

  `inet` indicates an IPv4 address mode and `inet6` indicates an IPv6 address mode.
- `-md` specifies the preferred addressing mode for data transfers between the source and the destination storage systems.

  `inet` indicates an IPv4 address mode and `inet6` indicates an IPv6 address mode.

  If you do not use the `-md` option in the `ndmpcopy` command, the addressing mode for the data connection is determined as follows:
  - If either of the addresses specified for the control connections is an IPv6 address, the address mode for the data connection is IPv6.
  - If both the addresses specified for the control connections are IPv4 addresses, the `ndmpcopy` command first attempts an IPv6 address mode for the data connection.

    If that fails, the command uses an IPv4 address mode.

    An IPv6 address, if specified, must be enclosed within square brackets.

    This sample command migrates data from a source path (`source_path`) to a destination path (`destination_path`).

    ```
    > ndmpcopy -sa admin:<ndmp_password> -da admin:<ndmp_password>
     -st md5 -dt md5 192.0.2.129:/<src_svm>/<src_vol>
    192.0.2.131:/<dst_svm>/<dst_vol>
    ```

    This sample command explicitly sets the control connections and the data connection to use IPv6 address mode:

```
> ndmpcopy -sa admin:<ndmp_password> -da admin:<ndmp_password> -st
md5 -dt md5 -mcs inet6 -mcd inet6 -md
 inet6 [2001:0db8:1:1:209:6bff:feae:6d67]:/<src_svm>/<src_vol>
[2001:0ec9:1:1:200:7cgg:gfdf:7e78]:/<dst_svm>/<dst_vol>
```

Options for the ndmpcopy command

You should understand the options available for the `ndmpcopy` nodeshell command to successfully transfer data.

The following table lists the available options. For more information, see the `ndmpcopy` man pages available through the nodeshell.

Option	Description
`-sa username:[password]`	This option sets the source authentication user name and password for connecting to the source storage system. This is a mandatory option. For a user without admin privilege, you must specify the user's system-generated NDMP-specific password. The system-generated password is mandatory for both admin and non-admin users.
`-da username:[password]`	This option sets the destination authentication user name and password for connecting to the destination storage system. This is a mandatory option.
`-st {md5|text}`	This option sets the source authentication type to be used when connecting to the source storage system.This is a mandatory option and therefore the user should provide either the `text` or `md5` option.
`-dt {md5|text}`	This option sets the destination authentication type to be used when connecting to the destination storage system.
`-l`	This option sets the dump level used for the transfer to the specified value of level.Valid values are `0`, `1`, to `9`, where `0` indicates a full transfer and `1` to `9` specifies an incremental transfer. The default is `0`.
`-d`	This option enables generation of ndmpcopy debug log messages. The ndmpcopy debug log files are located in the `/mroot/etc/log` root volume. The ndmpcopy debug log file names are in the `ndmpcopy.yyyymmdd` format.

Option	Description
`-f`	This option enables the forced mode. This mode enables system files to be overwritten in the `/etc` directory on the root of the 7-Mode volume.
`-h`	This option prints the help message.
`-p`	This option prompts you to enter the password for source and destination authorization. This password overrides the password specified for `-sa` and `-da` options. You can use this option only when the command is running in an interactive console.
`-exclude`	This option excludes specified files or directories from the path specified for data transfer. The value can be a comma-separated list of directory or file names such as **`.pst`** `or .txt`.

NDMP for FlexVol volumes

About NDMP for FlexVol volumes

The Network Data Management Protocol (NDMP) is a standardized protocol for controlling backup, recovery, and other types of data transfer between primary and secondary storage devices, such as storage systems and tape libraries.

By enabling NDMP support on a storage system, you enable that storage system to communicate with NDMP-enabled network-attached backup applications (also called *Data Management Applications* or *DMAs*), data servers, and tape servers participating in backup or recovery operations. All network communications occur over TCPIP or TCP/IPv6 network. NDMP also provides low-level control of tape drives and medium changers.

You can perform tape backup and restore operations in either node-scoped NDMP mode or storage virtual machine (SVM) scoped NDMP mode.

You must be aware of the considerations that you have to take into account while using NDMP, list of environment variables, and supported NDMP tape backup topologies. You can also enable or disable the enhanced DAR functionality. The two authentication methods supported by ONTAP for authenticating NDMP access to a storage system are: plaintext and challenge.

Related information

Environment variables supported by ONTAP

About NDMP modes of operation

You can choose to perform tape backup and restore operations either at the node level as you have been doing until now or at the storage virtual machine (SVM) level. To perform

these operations successfully at the SVM level, NDMP service must be enabled on the SVM.

If you upgrade from Data ONTAP 8.2 to Data ONTAP 8.3, the NDMP mode of operation used in 8.2 will continue to be retained post the upgrade from 8.2 to 8.3.

If you install a new cluster with Data ONTAP 8.2 or later, NDMP is in the SVM-scoped NDMP mode by default. To perform tape backup and restore operations in the node-scoped NDMP mode, you must explicitly enable the node-scoped NDMP mode.

Related information

Commands for managing node-scoped NDMP mode

Managing node-scoped NDMP mode for FlexVol volumes

Managing SVM-scoped NDMP mode for FlexVol volumes

What node-scoped NDMP mode is

In the node-scoped NDMP mode, you can perform tape backup and restore operations at the node level. The NDMP mode of operation used in Data ONTAP 8.2 will continue to be retained post the upgrade from 8.2 to 8.3.

In the node-scoped NDMP mode, you can perform tape backup and restore operations on a node that owns the volume. To perform these operations, you must establish NDMP control connections on a LIF hosted on the node that owns the volume or tape devices.

This mode is deprecated and will be removed in a future major release.

Related information

Managing node-scoped NDMP mode for FlexVol volumes

What SVM-scoped NDMP mode is

You can perform tape backup and restore operations at the storage virtual machine (SVM) level successfully if the NDMP service is enabled on the SVM. You can back up and restore all volumes hosted across different nodes in the SVM of a cluster if the backup application supports the CAB extension.

An NDMP control connection can be established on different LIF types. In the SVM-scoped NDMP mode, these LIFs belong to either the data SVM or admin SVM. The connection can be established on a LIF only if the NDMP service is enabled on the SVM that owns this LIF.

A data LIF belongs to the data SVM and the intercluster LIF, node-management LIF, and cluster-management LIF belong to the admin SVM.

In the SVM-scoped NDMP mode, the availability of volumes and tape devices for backup and restore operations depends on the LIF type on which the NDMP control connection is established and the status of the CAB extension. If your backup application supports the CAB extension and a volume and the tape device share the same affinity, then the backup application can perform a local backup or restore operation, instead of a three-way backup or restore operation.

Related information

Managing SVM-scoped NDMP mode for FlexVol volumes

Considerations when using NDMP

You must take into account a number of considerations when starting the NDMP service on your storage system.

- Each node supports a maximum of 16 concurrent backups, restores, or combination of the two using connected tape drives.
- NDMP services can generate file history data at the request of NDMP backup applications.

  File history is used by backup applications to enable optimized recovery of selected subsets of data from a backup image. File history generation and processing might be time-consuming and CPU-intensive for both the storage system and the backup application.

  SMTape does not support file history.

  If your data protection is configured for disaster recovery—where the entire backup image will be recovered—you can disable file history generation to reduce backup time. See your backup application documentation to determine whether it is possible to disable NDMP file history generation.

- Firewall policy for NDMP is enabled by default on all LIF types.
- In node-scoped NDMP mode, backing up a FlexVol volume requires that you use the backup application to initiate a backup on a node that owns the volume.

  However, you cannot back up a node root volume.

- You can perform NDMP backup from any LIF as permitted by the firewall policies.

  If you use a data LIF, you must select a LIF that is not configured for failover. If a data LIF fails over during an NDMP operation, the NDMP operation fails and must be run again.

- In node-scoped NDMP mode and storage virtual machine (SVM) scoped NDMP mode with no CAB extension support, the NDMP data connection uses the same LIF as the NDMP control connection.
- During LIF migration, ongoing backup and restore operations are disrupted.

  You must initiate the backup and restore operations after the LIF migration.

- The NDMP backup path is of the format */vserver_name/volume_name/path_name*.

  path_name is optional, and specifies the path of the directory, file, or Snapshot copy.

- When a SnapMirror destination is backed up to tape by using the dump engine, only the data in the volume is backed up.

  However, if a SnapMirror destination is backed up to tape using SMTape, then the metadata is also backed up. The SnapMirror relationships and the associated metadata are not backed up to tape. Therefore, during restore, only the data on that volume is restored, but the associated SnapMirror relationships are not restored.

Related information

What Cluster Aware Backup extension does

ONTAP concepts

System administration

Environment variable

Environment variables overview

Environment variables are used to communicate information about a backup or restore operation between an NDMP-enabled backup application and a storage system.

For example, if a user specifies that a backup application should back up `/vserver1/vol1/dir1`, the backup application sets the FILESYSTEM environment variable to `/vserver1/vol1/dir1`. Similarly, if a user specifies that a backup should be a level 1 backup, the backup application sets the LEVEL environment variable to 1 (one).

The setting and examining of environment variables are typically transparent to backup administrators; that is, the backup application sets them automatically.

A backup administrator rarely specifies environment variables; however, you might want to change the value of an environment variable from that set by the backup application to characterize or work around a functional or performance problem. For example, an administrator might want to temporarily disable file history generation to determine if the backup application's processing of file history information is contributing to performance issues or functional problems.

Many backup applications provide a means to override or modify environment variables or to specify additional environment variables. For information, see your backup application documentation.

Environment variables supported by ONTAP

Environment variables are used to communicate information about a backup or restore operation between an NDMP-enabled backup application and a storage system. ONTAP supports environment variables, which have an associated default value. However, you can manually modify these default values.

If you manually modify the values set by the backup application, the application might behave unpredictably. This is because the backup or restore operations might not be doing what the backup application expected them to do. But in some cases, judicious modification might help in identifying or working around problems.

The following tables list the environment variables whose behavior is common to dump and SMTape and those variables that are supported only for dump and SMTape. These tables also contain descriptions of how the environment variables that are supported by ONTAP work if they are used:

In most cases, variables that have the value, `Y` also accept `T` and `N` also accept `F`.

Environment variables supported for dump and SMTape

Environment variable	Valid values	Default	Description
DEBUG	`Y` or `N`	`N`	Specifies that debugging information is printed.
FILESYSTEM	`string`	`none`	Specifies the path name of the root of the data that is being backed up.
NDMP_VERSION	`return_only`	`none`	You should not modify the NDMP_VERSION variable. Created by the backup operation, the NDMP_VERSION variable returns the NDMP version. ONTAP sets the NDMP_VERSION variable during a backup for internal use and to pass to a backup application for informational purposes. The NDMP version of an NDMP session is not set with this variable.
PATHNAME_SEPARATOR	`return_value`	`none`	Specifies the path name separator character. This character depends on the file system being backed up. For ONTAP, the character “/” is assigned to this variable. The NDMP server sets this variable before starting a tape backup operation.
TYPE	`dump` or `smtape`	`dump`	Specifies the type of backup supported to perform tape backup and restore operations.
VERBOSE	`Y` or `N`	`N`	Increases the log messages while performing a tape backup or restore operation.

Environment variables supported for dump

Environment variable	Valid values	Default	Description
ACL_START	`return_only`	`none`	Created by the backup operation, the ACL_START variable is an offset value used by a direct access restore or restartable NDMP backup operation. The offset value is the byte offset in the dump file where the ACL data (Pass V) begins and is returned at the end of a backup. For a direct access restore operation to correctly restore backed-up data, the ACL_START value must be passed to the restore operation when it begins. An NDMP restartable backup operation uses the ACL_START value to communicate to the backup application where the nonrestartable portion of the backup stream begins.

Environment variable	Valid values	Default	Description
BASE_DATE	`0`, `-1`, or `DUMP_DATE` value	`-1`	Specifies the start date for incremental backups. When set to `-1`, the BASE_DATE incremental specifier is disabled. When set to `0` on a level 0 backup, incremental backups are enabled. After the initial backup, the value of the DUMP_DATE variable from the previous incremental backup is assigned to the BASE_DATE variable. These variables are an alternative to the LEVEL/UPDATE based incremental backups.
DIRECT	`Y` or `N`	`N`	Specifies that a restore should fast-forward directly to the location on the tape where the file data resides instead of scanning the entire tape. For direct access recovery to work, the backup application must provide positioning information. If this variable is set to `Y`, the backup application specifies the file or directory names and the positioning information.
DMP_NAME	`string`	`none`	Specifies the name for a multiple subtree backup. This variable is mandatory for multiple subtree backups.

Environment variable	Valid values	Default	Description
DUMP_DATE	`return_value`	`none`	You do not change this variable directly. It is created by the backup if the BASE_DATE variable is set to a value other than `-1`. The DUMP_DATE variable is derived by prepending the 32-bit level value to a 32-bit time value computed by the dump software. The level is incremented from the last level value passed into the BASE_DATE variable. The resulting value is used as the BASE_DATE value on a subsequent incremental backup.

Environment variable	Valid values	Default	Description
ENHANCED_DAR_ENABLED	`Y` or `N`	`N`	Specifies whether enhanced DAR functionality is enabled. Enhanced DAR functionality supports directory DAR and DAR of files with NT Streams. It provides performance improvements. Enhanced DAR during restore is possible only if the following conditions are met: • ONTAP supports enhanced DAR. • File history is enabled (HIST=Y) during the backup. • The `ndmpd.offset_map.enable` option is set to `on`. • ENHANCED_DAR_ENABLED variable is set to `Y` during restore.

Environment variable	Valid values	Default	Description
EXCLUDE	`pattern_string`	`none`	Specifies files or directories that are excluded when backing up data. The exclude list is a comma-separated list of file or directory names. If the name of a file or directory matches one of the names in the list, it is excluded from the backup. The following rules apply while specifying names in the exclude list: • The exact name of the file or directory must be used. • The asterisk (*), a wildcard character, must be either the first or the last character of the string. Each string can have up to two asterisks. • A comma in a file or directory name must be preceded with a backslash. • The exclude list can contain up to 32 names. Files or directories specified to be excluded for backup are not excluded if you set NON_QUOTA_TREE to `Y` simultaneously.

Environment variable	Valid values	Default	Description
EXTRACT	`Y`, `N`, or `E`	`N`	Specifies that subtrees of a backed-up data set are to be restored. The backup application specifies the names of the subtrees to be extracted. If a file specified matches a directory whose contents were backed up, the directory is recursively extracted. To rename a file, directory, or qtree during restore without using DAR, you must set the EXTRACT environment variable to `E`.
EXTRACT_ACL	`Y` or `N`	`Y`	Specifies that ACLs from the backed up file are restored on a restore operation. The default is to restore ACLs when restoring data, except for DARs (DIRECT=Y).

Environment variable	Valid values	Default	Description
FORCE	`Y` or `N`	`N`	Determines if the restore operation must check for volume space and inode availability on the destination volume. Setting this variable to `Y` causes the restore operation to skip checks for volume space and inode availability on the destination path. If enough volume space or inodes are not available on the destination volume, the restore operation recovers as much data allowed by the destination volume space and inode availability. The restore operation stops when volume space or inodes are not available.
HIST	`Y` or `N`	`N`	Specifies that file history information is sent to the backup application. Most commercial backup applications set the HIST variable to `Y`. If you want to increase the speed of a backup operation, or you want to troubleshoot a problem with the file history collection, you can set this variable to `N`. You should not set the HIST variable to `Y` if the backup application does not support file history.

Environment variable	Valid values	Default	Description
IGNORE_CTIME	`Y` or `N`	`N`	Specifies that a file is not incrementally backed up if only its ctime value has changed since the previous incremental backup. Some applications, such as virus scanning software, change the ctime value of a file within the inode, even though the file or its attributes have not changed. As a result, an incremental backup might back up files that have not changed. The `IGNORE_CTIME` variable should be specified only if incremental backups are taking an unacceptable amount of time or space because the ctime value was modified. The `NDMP dump` command sets `IGNORE_CTIME` to `false` by default. Setting it to `true` can result in the following data loss: 1. If `IGNORE_CTIME` is set to true with a volume level incremental `ndmpcopy`, it results in the deleting

Environment variable	Valid values	Default	Description
IGNORE_QTREES	`Y` or `N`	`N`	Specifies that the restore operation does not restore qtree information from backed-up qtrees.
LEVEL	`0-31`	`0`	Specifies the backup level. Level 0 copies the entire data set. Incremental backup levels, specified by values above 0, copy all files (new or modified) since the last incremental backup. For example, a level 1 backs up new or modified files since the level 0 backup, a level 2 backs up new or modified files since the level 1 backup, and so on.
LIST	`Y` or `N`	`N`	Lists the backed-up file names and inode numbers without actually restoring the data.
LIST_QTREES	`Y` or `N`	`N`	Lists the backed-up qtrees without actually restoring the data.
MULTI_SUBTREE_ NAMES	`string`	`none`	Specifies that the backup is a multiple subtree backup. Multiple subtrees are specified in the string, which is a newline-separated, null-terminated list of subtree names. Subtrees are specified by path names relative to their common root directory, which must be specified as the last element of the list. If you use this variable, you must also use the DMP_NAME variable.

Environment variable	Valid values	Default	Description
NDMP_UNICODE_ FH	`Y` or `N`	`N`	Specifies that a Unicode name is included in addition to the NFS name of the file in the file history information. This option is not used by most backup applications and should not be set unless the backup application is designed to receive these additional file names. The HIST variable must also be set.
NO_ACLS	`Y` or `N`	`N`	Specifies that ACLs must not be copied when backing up data.

Environment variable	Valid values	Default	Description
NON_QUOTA_TREE	`Y` or `N`	`N`	Specifies that files and directories in qtrees must be ignored when backing up data. When set to `Y`, items in qtrees in the data set specified by the FILESYSTEM variable are not backed up. This variable has an effect only if the FILESYSTEM variable specifies an entire volume. The NON_QUOTA_TREE variable only works on a level 0 backup and does not work if the MULTI_SUBTREE_NAMES variable is specified. Files or directories specified to be excluded for backup are not excluded if you set NON_QUOTA_TREE to `Y` simultaneously.
NOWRITE	`Y` or `N`	`N`	Specifies that the restore operation must not write data to the disk. This variable is used for debugging.

Environment variable	Valid values	Default	Description
RECURSIVE	`Y` or `N`	`Y`	Specifies that directory entries during a DAR restore be expanded. The DIRECT and ENHANCED_DAR_ENABLED environment variables must be enabled (set to `Y`) as well. If the RECURSIVE variable is disabled (set to `N`), only the permissions and ACLs for all the directories in the original source path are restored from tape, not the contents of the directories. If the RECURSIVE variable is set to `N` or the RECOVER_FULL_PATHS variable is set to `Y`, the recovery path must end with the original path. If the RECURSIVE variable is disabled and if there is more than one recovery path, all of the recovery paths must be contained within the longest of the recovery paths. Otherwise, an error message is displayed. For example, the following are valid recovery paths because all of the recovery paths are within `foo/dir1/deepdir/myfile`:

Environment variable	Valid values	Default	Description
RECOVER_FULL_PATHS	`Y` or `N`	`N`	Specifies that the full recovery path will have their permissions and ACLs restored after the DAR. DIRECT and ENHANCED_DAR_ENABLED must be enabled (set to `Y`) as well. If RECOVER_FULL_PATHS is set to `Y`, the recovery path must end with the original path. If directories already exist on the destination volume, their permissions and ACLs will not be restored from tape.
UPDATE	`Y` or `N`	`Y`	Updates the metadata information to enable LEVEL based incremental backup.

Environment variables supported for SMTape

Environment variable	Valid values	Default	Description
BASE_DATE	`DUMP_DATE`	`-1`	Specifies the start date for incremental backups. `BASE_DATE` is a string representation of the reference Snapshot identifiers. Using the `BASE_DATE` string, SMTape locates the reference Snapshot copy. `BASE_DATE` is not required for baseline backups. For an incremental backup, the value of the `DUMP_DATE` variable from the previous baseline or incremental backup is assigned to the `BASE_DATE` variable. The backup application assigns the `DUMP_DATE` value from a previous SMTape baseline or incremental backup.
DUMP_DATE	`return_value`	`none`	At the end of an SMTape backup, DUMP_DATE contains a string identifier that identifies the Snapshot copy used for that backup. This Snapshot copy could be used as the reference Snapshot copy for a subsequent incremental backup. The resulting value of DUMP_DATE is used as the BASE_DATE value for subsequent incremental backups.

Environment variable	Valid values	Default	Description
SMTAPE_BACKUP_SET_ID	`string`	`none`	Identifies the sequence of incremental backups associated with the baseline backup. Backup set ID is a 128-bit unique ID that is generated during a baseline backup. The backup application assigns this ID as the input to the `SMTAPE_BACKUP_SET_ID` variable during an incremental backup.
SMTAPE_SNAPSHOT_NAME	Any valid Snapshot copy that is available in the volume	`Invalid`	When the SMTAPE_SNAPSHOT_NAME variable is set to a Snapshot copy, that Snapshot copy and its older Snapshot copies are backed up to tape. For incremental backup, this variable specifies incremental Snapshot copy. The BASE_DATE variable provides the baseline Snapshot copy.
SMTAPE_DELETE_SNAPSHOT	`Y` or `N`	`N`	For a Snapshot copy created automatically by SMTape, when the SMTAPE_DELETE_SNAPSHOT variable is set to `Y`, then after the backup operation is complete, SMTape deletes this Snapshot copy. However, a Snapshot copy created by the backup application will not be deleted.
SMTAPE_BREAK_MIRROR	`Y` or `N`	`N`	When the SMTAPE_BREAK_MIRROR variable is set to `Y`, the volume of type `DP` is changed to a `RW` volume after a successful restore.

Common NDMP tape backup topologies

NDMP supports a number of topologies and configurations between backup applications and storage systems or other NDMP servers providing data (file systems) and tape services.

Storage system-to-local-tape

In the simplest configuration, a backup application backs up data from a storage system to a tape subsystem attached to the storage system. The NDMP control connection exists across the network boundary. The NDMP data connection that exists within the storage system between the data and tape services is called an NDMP local configuration.

Storage system-to-tape attached to another storage system

A backup application can also back up data from a storage system to a tape library (a medium changer with one or more tape drives) attached to another storage system. In this case, the NDMP data connection between the data and tape services is provided by a TCP or TCP/IPv6 network connection. This is called an NDMP three-way storage system-to-storage system configuration.

Storage system-to-network-attached tape library

NDMP-enabled tape libraries provide a variation of the three-way configuration. In this case, the tape library attaches directly to the TCP/IP network and communicates with the backup application and the storage system through an internal NDMP server.

Storage system-to-data server-to-tape or data server-to-storage system-to-tape

NDMP also supports storage system-to-data-server and data-server-to-storage system three-way configurations, although these variants are less widely deployed. Storage system-to-server allows storage system data to be backed up to a tape library attached to the backup application host or to another data server system. The server-to-storage system configuration allows server data to be backed up to a storage system-attached tape library.

Supported NDMP authentication methods

You can specify an authentication method to allow NDMP connection requests. ONTAP supports two methods for authenticating NDMP access to a storage system: plaintext and challenge.

In node-scoped NDMP mode, both challenge and plaintext are enabled by default. However, you cannot disable challenge. You can enable and disable plaintext. In the plaintext authentication method, the login password is transmitted as clear text.

In the storage virtual machine (SVM)-scoped NDMP mode, by default the authentication method is challenge. Unlike the node-scoped NDMP mode, in this mode you can enable and disable both plaintext and challenge authentication methods.

Related information

User authentication in a node-scoped NDMP mode

User authentication in the SVM-scoped NDMP mode

NDMP extensions supported by ONTAP

NDMP v4 provides a mechanism for creating NDMP v4 protocol extensions without modifying the core NDMP v4 protocol. You should be aware of the NDMP v4 extensions that are supported by ONTAP.

The following NDMP v4 extensions are supported by ONTAP:

- Cluster Aware Backup (CAB)

  This extension is supported only in the SVM-scoped NDMP mode.

- Connection Address Extension (CAE) for IPv6 support
- Extension class 0x2050

  This extension supports restartable backup operations and Snapshot Management Extensions.

  The `NDMP_SNAP_RECOVER` message, which is part of the Snapshot Management Extensions, is used to initiate a recovery operation and to transfer the recovered data from a local Snapshot copy to a local file system location. In ONTAP, this message allows the recovery of volumes and regular files only.

  The `NDMP_SNAP_DIR_LIST` message enables you to browse through the Snapshot copies of a volume. If a nondisruptive operation takes place while a browsing operation is in progress, the backup application must reinitiate the browsing operation.

NDMP restartable backup extension for a dump supported by ONTAP

You can use the NDMP restartable backup extension (RBE) functionality to restart a backup from a known checkpoint in the data stream before the failure.

What enhanced DAR functionality is

You can use the enhanced direct access recovery (DAR) functionality for directory DAR and DAR of files and NT streams. By default, enhanced DAR functionality is enabled.

Enabling enhanced DAR functionality might impact the backup performance because an offset map has to be created and written onto tape. You can enable or disable enhanced DAR in both the node-scoped and storage virtual machine (SVM)-scoped NDMP modes.

Scalability limits for NDMP sessions

You must be aware of the maximum number of NDMP sessions that can be established simultaneously on storage systems of different system memory capacities. This maximum number depends on the system memory of a storage system.

The limits mentioned in the following table are for the NDMP server. The limits mentioned in the section “Scalability limits for dump backup and restore sessions” are for the dump and restore session.

Scalability limits for dump backup and restore sessions

System memory of a storage system	Maximum number of NDMP sessions
Less than 16 GB	8
Greater than or equal to 16 GB but less than 24 GB	20
Greater than or equal to 24 GB	36

You can obtain the system memory of your storage system by using the `sysconfig -a` command (available through the nodeshell). For more information about using this command, see the man pages.

About NDMP for FlexGroup volumes

Beginning with ONTAP 9.7, NDMP is supported on FlexGroup volumes.

Beginning with ONTAP 9.7, the ndmpcopy command is supported for data transfer between FlexVol and FlexGroup volumes.

If you revert from ONTAP 9.7 to an earlier version, the incremental transfer information of the previous transfers is not retained and therefore, you must perform a baseline copy after reverting.

Beginning with ONTAP 9.8, the following NDMP features are supported on FlexGroup volumes:

- The NDMP_SNAP_RECOVER message in the extension class 0x2050 can be used for recovering individual files in a FlexGroup volume.
- NDMP restartable backup extension (RBE) is supported for FlexGroup volumes.
- Environment variables EXCLUDE and MULTI_SUBTREE_NAMES are supported for FlexGroup volumes.

About NDMP with SnapLock volumes

Creating multiple copies of regulated data provides you with redundant recovery scenarios, and by using NDMP dump and restore, it's possible to preserve the write once, read many (WORM) characteristics of source files on a SnapLock volume.

WORM attributes on the files in a SnapLock volume are preserved when backing up, restoring and copying data; however, WORM attributes are enforced only when restoring to a SnapLock volume. If a backup from a SnapLock volume is restored to a volume other than a SnapLock volume, the WORM attributes are preserved but are ignored and are not enforced by ONTAP.

Manage node-scoped NDMP mode for FlexVol volumes

Manage node-scoped NDMP mode for FlexVol volumes overview

You can manage NDMP at the node level by using NDMP options and commands. You can modify the NDMP options by using the `options` command. You must use NDMP-specific credentials to access a storage system to perform tape backup and restore operations.

For more information about the `options` command, see the man pages.

Related information

Commands for managing node-scoped NDMP mode

What node-scoped NDMP mode is

Commands for managing node-scoped NDMP mode

You can use the `system services ndmp` commands to manage NDMP at a node level. Some of these commands are deprecated and will be removed in a future major release.

You can use the following NDMP commands only at the advanced privilege level:

- `system services ndmp service terminate`
- `system services ndmp service start`
- `system services ndmp service stop`
- `system services ndmp log start`
- `system services ndmp log stop`

If you want to…	Use this command…
Enable NDMP service	`system services ndmp on*`
Disable NDMP service	`system services ndmp off*`
Display NDMP configuration	`system services ndmp show*`
Modify NDMP configuration	`system services ndmp modify*`
Display the default NDMP version	`system services ndmp version*`
Display NDMP service configuration	`system services ndmp service show`
Modify NDMP service configuration	`system services ndmp service modify`
Display all NDMP sessions	`system services ndmp status`
Display detailed information about all NDMP sessions	`system services ndmp probe`
Terminate the specified NDMP session	`system services ndmp kill`
Terminate all NDMP sessions	`system services ndmp kill-all`
Change the NDMP password	`system services ndmp password*`

If you want to…	Use this command…
Enable node-scoped NDMP mode	`system services ndmp node-scope-mode on*`
Disable node-scoped NDMP mode	`system services ndmp node-scope-mode off*`
Display the node-scoped NDMP mode status	`system services ndmp node-scope-mode status*`
Forcefully terminate all NDMP sessions	`system services ndmp service terminate`
Start the NDMP service daemon	`system services ndmp service start`
Stop the NDMP service daemon	`system services ndmp service stop`
Start logging for the specified NDMP session	`system services ndmp log start*`
Stop logging for the specified NDMP session	`system services ndmp log stop*`

- These commands are deprecated and will be removed in a future major release.

For more information about these commands, see the man pages for the `system services ndmp` commands.

User authentication in a node-scoped NDMP mode

In the node-scoped NDMP mode, you must use NDMP specific credentials to access a storage system in order to perform tape backup and restore operations.

The default user ID is “root”. Before using NDMP on a node, you must ensure that you change the default NDMP password associated with the NDMP user. You can also change the default NDMP user ID.

Related information

Commands for managing node-scoped NDMP mode

Manage SVM-scoped NDMP mode for FlexVol volumes

Manage SVM-scoped NDMP mode for FlexVol volumes overview

You can manage NDMP on a per SVM basis by using the NDMP options and commands. You can modify the NDMP options by using the `vserver services ndmp modify` command. In the SVM-scoped NDMP mode, user authentication is integrated with the role-based access control mechanism.

You can add NDMP in the allowed or disallowed protocols list by using the `vserver modify` command. By default, NDMP is in the allowed protocols list. If NDMP is added to the disallowed protocols list, NDMP

sessions cannot be established.

You can control the LIF type on which an NDMP data connection is established by using the `-preferred -interface-role` option. During an NDMP data connection establishment, NDMP chooses an IP address that belongs to the LIF type as specified by this option. If the IP addresses do not belong to any of these LIF types, then the NDMP data connection cannot be established. For more information about the `-preferred -interface-role` option, see the man pages.

For more information about the `vserver services ndmp modify` command, see the man pages.

Related information

Commands for managing SVM-scoped NDMP mode

What Cluster Aware Backup extension does

ONTAP concepts

What SVM-scoped NDMP mode is

System administration

Commands for managing SVM-scoped NDMP mode

You can use the `vserver services ndmp` commands to manage NDMP on each storage virtual machine (SVM, formerly known as Vserver).

If you want to…	Use this command…
Enable NDMP service	`vserver services ndmp on` NDMP service must always be enabled on all nodes in a cluster. You can enable NDMP service on a node by using the `system services ndmp on` command. By default, NDMP service is always enabled on a node.
Disable NDMP service	`vserver services ndmp off`
Display NDMP configuration	`vserver services ndmp show`
Modify NDMP configuration	`vserver services ndmp modify`
Display default NDMP version	`vserver services ndmp version`
Display all NDMP sessions	`vserver services ndmp status`
Display detailed information about all NDMP sessions	`vserver services ndmp probe`

If you want to…	Use this command…
Terminate a specified NDMP session	`vserver services ndmp kill`
Terminate all NDMP sessions	`vserver services ndmp kill-all`
Generate the NDMP password	`vserver services ndmp generate-password`
Display NDMP extension status	`vserver services ndmp extensions show` This command is available at the advanced privilege level.
Modify (enable or disable) NDMP extension status	`vserver services ndmp extensions modify` This command is available at the advanced privilege level.
Start logging for the specified NDMP session	`vserver services ndmp log start` This command is available at the advanced privilege level.
Stop logging for the specified NDMP session	`vserver services ndmp log stop` This command is available at the advanced privilege level.

For more information about these commands, see the man pages for the `vserver services ndmp` commands.

What Cluster Aware Backup extension does

CAB (Cluster Aware Backup) is an NDMP v4 protocol extension. This extension enables the NDMP server to establish a data connection on a node that owns a volume. This also enables the backup application to determine if volumes and tape devices are located on the same node in a cluster.

To enable the NDMP server to identify the node that owns a volume and to establish a data connection on such a node, the backup application must support the CAB extension. CAB extension requires the backup application to inform the NDMP server about the volume to be backed up or restored prior to establishing the data connection. This allows the NDMP server to determine the node that hosts the volume and appropriately establish the data connection.

With the CAB extension supported by the backup application, the NDMP server provides affinity information about volumes and tape devices. Using this affinity information, the backup application can perform a local backup instead of a three-way backup if a volume and tape device are located on the same node in a cluster.

Availability of volumes and tape devices for backup and restore on different LIF types

You can configure a backup application to establish an NDMP control connection on any of the LIF types in a cluster. In the storage virtual machine (SVM)-scoped NDMP mode, you can determine the availability of volumes and tape devices for backup and restore operations depending upon these LIF types and the status of the CAB extension.

The following tables show the availability of volumes and tape devices for NDMP control connection LIF types and the status of the CAB extension:

Availability of volumes and tape devices when CAB extension is not supported by the backup application

NDMP control connection LIF type	Volumes available for backup or restore	Tape devices available for backup or restore
Node-management LIF	All volumes hosted by a node	Tape devices connected to the node hosting the node-management LIF
Data LIF	Only volumes that belong to the SVM hosted by a node that hosts the data LIF	None
Cluster-management LIF	All volumes hosted by a node that hosts the cluster-management LIF	None
Intercluster LIF	All volumes hosted by a node that hosts the intercluster LIF	Tape devices connected to the node hosting the intercluster LIF

Availability of volumes and tape devices when CAB extension is supported by the backup application

NDMP control connection LIF type	Volumes available for backup or restore	Tape devices available for backup or restore
Node-management LIF	All volumes hosted by a node	Tape devices connected to the node hosting the node-management LIF
Data LIF	All volumes that belong to the SVM that hosts the data LIF	None
Cluster-management LIF	All volumes in the cluster	All tape devices in the cluster
Intercluster LIF	All volumes in the cluster	All tape devices in the cluster

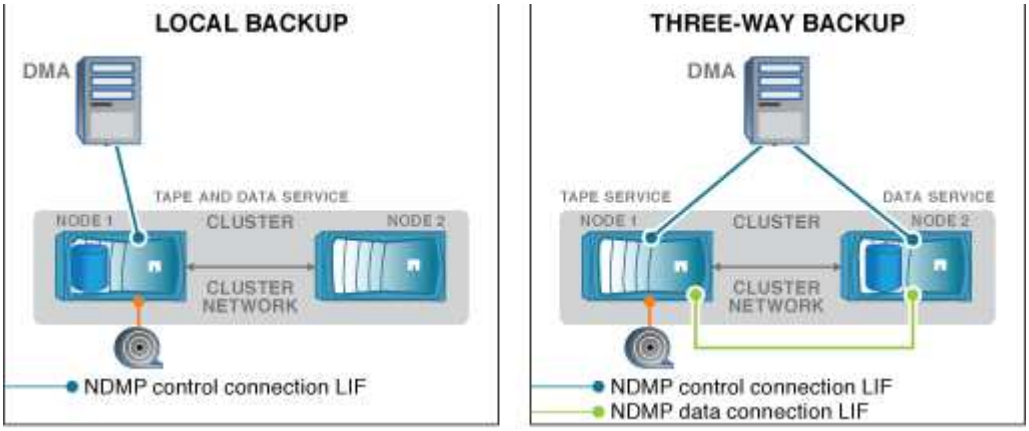
What affinity information is

With the backup application being CAB aware, the NDMP server provides unique location information about volumes and tape devices. Using this affinity information, the backup

application can perform a local backup instead of a three-way backup if a volume and a tape device share the same affinity.

If the NDMP control connection is established on a node management LIF, cluster management LIF, or an intercluster LIF, the backup application can use the affinity information to determine if a volume and tape device are located on the same node and then perform either a local or a three-way backup or restore operation. If the NDMP control connection is established on a data LIF, then the backup application always performs a three-way backup.

Local NDMP backup and Three-way NDMP backup



Using the affinity information about volumes and tape devices, the DMA (backup application) performs a local NDMP backup on the volume and tape device located on Node 1 in the cluster. If the volume moves from Node 1 to Node 2, affinity information about the volume and tape device changes. Hence, for a subsequent backup the DMA performs a three-way NDMP backup operation. This ensures continuity of the backup policy for the volume irrespective of the node to which the volume is moved to.

Related information

What Cluster Aware Backup extension does

NDMP server supports secure control connections in SVM-scoped mode

A secure control connection can be established between the Data Management Application (DMA) and NDMP server by using secure sockets (SSL/TLS) as the communication mechanism. This SSL communication is based on the server certificates. The NDMP server listens on port 30000 (assigned by IANA for “ndmps” service).

After establishing the connection from the client on this port, the standard SSL handshake ensues where the server presents the certificate to the client. When the client accepts the certificate, the SSL handshake is complete. After this process is complete, all of the communication between the client and the server is encrypted. The NDMP protocol workflow remains exactly as before. The secure NDMP connection requires server- side certificate authentication only. A DMA can choose to establish a connection either by connecting to the secure NDMP service or the standard NDMP service.

By default, secure NDMP service is disabled for a storage virtual machine (SVM). You can enable or disable the secure NDMP service on a given SVM by using the `vserver services ndmp modify -vserver vserver -is-secure-control-connection-enabled [true|false]` command.

NDMP data connection types

In the storage virtual machine (SVM)-scoped NDMP mode, the supported NDMP data connection types depend on the NDMP control connection LIF type and the status of the CAB extension. This NDMP data connection type indicates whether you can perform a local or a three-way NDMP backup or restore operation.

You can perform a three-way NDMP backup or restore operation over a TCP or TCP/IPv6 network. The following tables show the NDMP data connection types based on the NDMP control connection LIF type and the status of the CAB extension.

NDMP data connection type when CAB extension is supported by the backup application

NDMP control connection LIF type	NDMP data connection type
Node-management LIF	LOCAL, TCP, TCP/IPv6
Data LIF	TCP, TCP/IPv6
Cluster-management LIF	LOCAL, TCP, TCP/IPv6
Intercluster LIF	LOCAL, TCP, TCP/IPv6

NDMP data connection type when CAB extension is not supported by the backup application

NDMP control connection LIF type	NDMP data connection type
Node-management LIF	LOCAL, TCP, TCP/IPv6
Data LIF	TCP, TCP/IPv6
Cluster-management LIF	TCP, TCP/IPv6
Intercluster LIF	LOCAL, TCP, TCP/IPv6

Related information

What Cluster Aware Backup extension does

Network management

User authentication in the SVM-scoped NDMP mode

In the storage virtual machine (SVM)-scoped NDMP mode, NDMP user authentication is integrated with role-based access control. In the SVM context, the NDMP user must have either the “vsadmin” or “vsadmin-backup” role. In a cluster context, the NDMP user must have either the “admin” or “backup” role.

Apart from these pre-defined roles, a user account associated with a custom role can also be used for NDMP authentication provided that the custom role has the “vserver services ndmp” folder in its command directory

and the access level of the folder is not “none”. In this mode, you must generate an NDMP password for a given user account, which is created through role-based access control. Cluster users in an admin or backup role can access a node-management LIF, a cluster-management LIF, or an intercluster LIF. Users in a vsadmin-backup or vsadmin role can access only the data LIF for that SVM. Therefore, depending on the role of a user, the availability of volumes and tape devices for backup and restore operations vary.

This mode also supports user authentication for NIS and LDAP users. Therefore, NIS and LDAP users can access multiple SVMs with a common user ID and password. However, NDMP authentication does not support Active Directory users.

In this mode, a user account must be associated with the SSH application and the “User password” authentication method.

Related information

Commands for managing SVM-scoped NDMP mode

System administration

ONTAP concepts

Generate an NDMP-specific password for NDMP users

In the storage virtual machine (SVM)-scoped NDMP mode, you must generate a password for a specific user ID. The generated password is based on the actual login password for the NDMP user. If the actual login password changes, you must generate the NDMP-specific password again.

Steps

1. Use the `vserver services ndmp generate-password` command to generate an NDMP-specific password.

   You can use this password in any current or future NDMP operation that requires password input.

   > From the storage virtual machine (SVM, formerly known as Vserver) context, you can generate NDMP passwords for users belonging only to that SVM.

   The following example shows how to generate an NDMP-specific password for a user ID user1:

   ```
   cluster1::vserver services ndmp> generate-password -vserver vs1 -user
   user1

   Vserver: vs1
   User: user1
   Password: jWZiNt57huPOoD8d
   ```

2. If you change the password to your regular storage system account, repeat this procedure to obtain your new NDMP-specific password.

How tape backup and restore operations are affected during disaster recovery in MetroCluster configuration

You can perform tape backup and restore operations simultaneously during disaster recovery in a MetroCluster configuration. You must understand how these operations are affected during disaster recovery.

If tape backup and restore operations are performed on a volume of anSVM in a disaster recovery relationship, then you can continue performing incremental tape backup and restore operations after a switchover and switchback.

About dump engine for FlexVol volumes

About dump engine for FlexVol volumes

Dump is a Snapshot copy based backup and recovery solution from ONTAP that helps you to back up files and directories from a Snapshot copy to a tape device and restore the backed up data to a storage system.

You can back up your file system data, such as directories, files, and their associated security settings, to a tape device by using the dump backup. You can back up an entire volume, an entire qtree, or a subtree that is neither an entire volume nor an entire qtree.

You can perform a dump backup or restore by using NDMP-compliant backup applications.

When you perform a dump backup, you can specify the Snapshot copy to be used for a backup. If you do not specify a Snapshot copy for the backup, the dump engine creates a Snapshot copy for the backup. After the backup operation is completed, the dump engine deletes this Snapshot copy.

You can perform level-0, incremental, or differential backups to tape by using the dump engine.

After reverting to a release earlier than Data ONTAP 8.3, you must perform a baseline backup operation before performing an incremental backup operation.

Related information

Upgrade, revert, or downgrade

How a dump backup works

A dump backup writes file system data from disk to tape using a predefined process. You can back up a volume, a qtree, or a subtree that is neither an entire volume nor an entire qtree.

The following table describes the process that ONTAP uses to back up the object indicated by the dump path:

Stage	Action
1	For less than full volume or full qtree backups, ONTAP traverses directories to identify the files to be backed up. If you are backing up an entire volume or qtree, ONTAP combines this stage with Stage 2.

Stage	Action
2	For a full volume or full qtree backup, ONTAP identifies the directories in the volumes or qtrees to be backed up.
3	ONTAP writes the directories to tape.
4	ONTAP writes the files to tape.
5	ONTAP writes the ACL information (if applicable) to tape.

The dump backup uses a Snapshot copy of your data for the backup. Therefore, you do not have to take the volume offline before initiating the backup.

The dump backup names each Snapshot copy it creates as `snapshot_for_backup.n`, where `n` is an integer starting at 0. Each time the dump backup creates a Snapshot copy, it increments the integer by 1. The integer is reset to 0 after the storage system is rebooted. After the backup operation is completed, the dump engine deletes this Snapshot copy.

When ONTAP performs multiple dump backups simultaneously, the dump engine creates multiple Snapshot copies. For example, if ONTAP is running two dump backups simultaneously, you find the following Snapshot copies in the volumes from which data is being backed up: `snapshot_for_backup.0` and `snapshot_for_backup.1`.

When you are backing up from a Snapshot copy, the dump engine does not create an additional Snapshot copy.

Types of data that the dump engine backs up

The dump engine enables you to back up data to tape to guard against disasters or controller disruptions. In addition to backing up data objects such as a files, directories, qtrees, or entire volumes, the dump engine can back up many types of information about each file. Knowing the types of data that the dump engine can back up and the restrictions to take into consideration can help you plan your approach to disaster recovery.

In addition to backing up data in files, the dump engine can back up the following information about each file, as applicable:

- UNIX GID, owner UID, and file permissions
- UNIX access, creation, and modification time
- File type
- File size
- DOS name, DOS attributes, and creation time
- Access control lists (ACLs) with 1,024 access control entries (ACEs)
- Qtree information
- Junction paths

Junction paths are backed up as symbolic links.

- LUN and LUN clones

  You can back up an entire LUN object; however, you cannot back up a single file within the LUN object. Similarly, you can restore an entire LUN object but not a single file within the LUN.

  > The dump engine backs up LUN clones as independent LUNs.

- VM-aligned files

  Backup of VM-aligned files is not supported in releases earlier than Data ONTAP 8.1.2.

> When a snapshot-backed LUN clone is transitioned from Data ONTAP operating in 7-Mode to ONTAP, it becomes an inconsistent LUN. The dump engine does not back up inconsistent LUNs.

When you restore data to a volume, client I/O is restricted on the LUNs being restored. The LUN restriction is removed only when the dump restore operation is complete. Similarly, during a SnapMirror single file or LUN restore operation, client I/O is restricted on both files and LUNs being restored. This restriction is removed only when the single file or LUN restore operation is complete. If a dump backup is performed on a volume on which a dump restore or SnapMirror single file or LUN restore operation is being performed, then the files or LUNs that have client I/O restriction are not included in the backup. These files or LUNs are included in a subsequent backup operation if the client I/O restriction is removed.

> A LUN running on Data ONTAP 8.3 that is backed up to tape can be restored only to 8.3 and later releases and not to an earlier release. If the LUN is restored to an earlier release, then the LUN is restored as a file.

When you back up a SnapVault secondary volume or a volume SnapMirror destination to tape, only the data on the volume is backed up. The associated metadata is not backed up. Therefore, when you try to restore the volume, only the data on that volume is restored. Information about the volume SnapMirror relationships is not available in the backup and therefore is not restored.

If you dump a file that has only Windows NT permissions and restore it to a UNIX-style qtree or volume, the file gets the default UNIX permissions for that qtree or volume.

If you dump a file that has only UNIX permissions and restore it to an NTFS-style qtree or volume, the file gets the default Windows permissions for that qtree or volume.

Other dumps and restores preserve permissions.

You can back up VM-aligned files and the `vm-align-sector` option. For more information about VM-aligned files, see Logical storage management.

What increment chains are

An increment chain is a series of incremental backups of the same path. Because you can specify any level of backup at any time, you must understand increment chains to be able to perform backups and restores effectively. You can perform 31 levels of incremental backup operations.

There are two types of increment chains:

- A consecutive increment chain, which is a sequence of incremental backups that starts with level 0 and is raised by 1 at each subsequent backup.
- A nonconsecutive increment chain, where incremental backups skip levels or have levels that are out of sequence, such as 0, 2, 3, 1, 4, or more commonly 0, 1, 1, 1 or 0, 1, 2, 1, 2.

Incremental backups are based on the most recent lower-level backup. For example, the sequence of backup levels 0, 2, 3, 1, 4 provides two increment chains: 0, 2, 3 and 0, 1, 4. The following table explains the bases of the incremental backups:

Backup order	Increment level	Increment chain	Base	Files backed up
1	0	Both	Files on the storage system	All files in the backup path
2	2	0, 2, 3	Level-0 backup	Files in the backup path created since the level-0 backup
3	3	0, 2, 3	Level-2 backup	Files in the backup path created since the level-2 backup
4	1	0, 1, 4	Level-0 backup, because this is the most recent level that is lower than the level-1 backup	Files in the backup path created since the level-0 backup, including files that are in the level-2 and level-3 backups
5	4	0, 1, 4	The level-1 backup, because it is a lower level and is more recent than the level-0, level-2, or level-3 backups	Files created since the level-1 backup

What the blocking factor is

A tape block is 1,024 bytes of data. During a tape backup or restore, you can specify the number of tape blocks that are transferred in each read/write operation. This number is called the *blocking factor*.

You can use a blocking factor from 4 to 256. If you plan to restore a backup to a system other than the system that did the backup, the restore system must support the blocking factor that you used for the backup. For example, if you use a blocking factor of 128, the system on which you restore that backup must support a blocking factor of 128.

During an NDMP backup, the MOVER_RECORD_SIZE determines the blocking factor. ONTAP allows a maximum value of 256 KB for MOVER_RECORD_SIZE.

When to restart a dump backup

A dump backup sometimes does not finish because of internal or external errors, such as tape write errors, power outages, accidental user interruptions, or internal inconsistency on the storage system. If your backup fails for one of these reasons, you can restart it.

You can choose to interrupt and restart a backup to avoid periods of heavy traffic on the storage system or to avoid competition for other limited resources on the storage system, such as a tape drive. You can interrupt a long backup and restart it later if a more urgent restore (or backup) requires the same tape drive. Restartable backups persist across reboots. You can restart an aborted backup to tape only if the following conditions are true:

- The aborted backup is in phase IV.
- All of the associated Snapshot copies that were locked by the dump command are available.
- The file history must be enabled.

When such a dump operation is aborted and left in a restartable state, the associated Snapshot copies are locked. These Snapshot copies are released after the backup context is deleted. You can view the list of backup contexts by using the `vserver services ndmp restartable backup show` command.

```
cluster::> vserver services ndmpd restartable-backup show
Vserver     Context Identifier                    Is Cleanup Pending?
----------- ------------------------------------ -------------------
vserver1 330e6739-0179-11e6-a299-005056bb4bc9 false
vserver1 481025c1-0179-11e6-a299-005056bb4bc9 false
vserver2 5cf10132-0179-11e6-a299-005056bb4bc9 false
3 entries were displayed.

cluster::> vserver services ndmpd restartable-backup show -vserver
vserver1 -context-id 330e6739-0179-11e6-a299-005056bb4bc9

                      Vserver: vserver1
            Context Identifier: 330e6739-0179-11e6-a299-005056bb4bc9
                   Volume Name: /vserver1/vol1
           Is Cleanup Pending?: false
            Backup Engine Type: dump
Is Snapshot Copy Auto-created?: true
                     Dump Path: /vol/vol1
   Incremental Backup Level ID: 0
                     Dump Name: /vserver1/vol1
     Context Last Updated Time: 1460624875
               Has Offset Map?: true
                 Offset Verify: true
       Is Context Restartable?: true
              Is Context Busy?: false
                  Restart Pass: 4
              Status of Backup: 2
            Snapshot Copy Name: snapshot_for_backup.1
          State of the Context: 7

cluster::>"
```

How a dump restore works

A dump restore writes file system data from tape to disk using a predefined process.

The process in the following table shows how the dump restore works:

Stage	Action
1	ONTAP catalogs the files that need to be extracted from the tape.
2	ONTAP creates directories and empty files.

Stage	Action
3	ONTAP reads a file from tape, writes it to disk, and sets the permissions (including ACLs) on it.
4	ONTAP repeats stages 2 and 3 until all the specified files are copied from the tape.

Types of data that the dump engine restores

When a disaster or controller disruption occurs, the dump engine provides multiple methods for you to recover all of the data that you backed up, from single files, to file attributes, to entire directories. Knowing the types of data that dump engine can restore and when to use which method of recovery can help minimize downtime.

You can restore data to an online mapped LUN. However, host applications cannot access this LUN until the restore operation is complete. After the restore operation is complete, the host cache of the LUN data should be flushed to provide coherency with the restored data.

The dump engine can recover the following data:

- Contents of files and directories
- UNIX file permissions
- ACLs

  If you restore a file that has only UNIX file permissions to an NTFS qtree or volume, the file has no Windows NT ACLs. The storage system uses only the UNIX file permissions on this file until you create a Windows NT ACL on it.

  > If you restore ACLs backed up from storage systems running Data ONTAP 8.2 to storage systems running Data ONTAP 8.1.x and earlier that have an ACE limit lower than 1,024, a default ACL is restored.

- Qtree information

  Qtree information is used only if a qtree is restored to the root of a volume. Qtree information is not used if a qtree is restored to a lower directory, such as `/vs1/vol1/subdir/lowerdir`, and it ceases to be a qtree.

- All other file and directory attributes
- Windows NT streams
- LUNs
  - A LUN must be restored to a volume level or a qtree level for it to remain as a LUN.

    If it is restored to a directory, it is restored as a file because it does not contain any valid metadata.

  - A 7-Mode LUN is restored as a LUN on an ONTAP volume.
- A 7-Mode volume can be restored to an ONTAP volume.
- VM-aligned files restored to a destination volume inherit the VM-align properties of the destination volume.

- The destination volume for a restore operation might have files with mandatory or advisory locks.

  While performing restore operation to such a destination volume, the dump engine ignores these locks.

Considerations before restoring data

You can restore backed-up data to its original path or to a different destination. If you are restoring backed-up data to a different destination, you must prepare the destination for the restore operation.

Before restoring data either to its original path or to a different destination, you must have the following information and meet the following requirements:

- The level of the restore
- The path to which you are restoring the data
- The blocking factor used during the backup
- If you are doing an incremental restore, all tapes must be in the backup chain
- A tape drive that is available and compatible with the tape to be restored from

Before restoring data to a different destination, you must perform the following operations:

- If you are restoring a volume, you must create a new volume.
- If you are restoring a qtree or a directory, you must rename or move files that are likely to have the same names as files you are restoring.

> In ONTAP 9, qtree names support the Unicode format. The earlier releases of ONTAP do not support this format. If a qtree with Unicode names in ONTAP 9 is copied to an earlier release of ONTAP using the `ndmpcopy` command or through restoration from a backup image in a tape, the qtree is restored as a regular directory and not as a qtree with Unicode format.

> If a restored file has the same name as an existing file, the existing file is overwritten by the restored file. However, the directories are not overwritten.

To rename a file, directory, or qtree during restore without using DAR, you must set the EXTRACT environment variable to `E`.

Required space on the destination storage system

You require about 100 MB more space on the destination storage system than the amount of data to be restored.

> The restore operation checks for volume space and inode availability on the destination volume when the restore operation starts. Setting the FORCE environment variable to `Y` causes the restore operation to skip the checks for volume space and inode availability on the destination path. If there is not enough volume space or inodes available on the destination volume, the restore operation recovers as much data allowed by the destination volume space and inode availability. The restore operation stops when there is no more volume space or inodes left.

Scalability limits for dump backup and restore sessions

You must be aware of the maximum number of dump backup and restore sessions that can be performed simultaneously on storage systems of different system memory capacities. This maximum number depends on the system memory of a storage system.

The limits mentioned in the following table are for the dump or restore engine. The limits mentioned in the scalability limits for NDMP sessions are for the NDMP server, which are higher than the engine limits.

System memory of a storage system	Total number of dump backup and restore sessions
Less than 16 GB	4
Greater than or equal to 16 GB but less than 24 GB	16
Greater than or equal to 24 GB	32

If you use `ndmpcopy` command to copy data within storage systems, two NDMP sessions are established, one for dump backup and the other for dump restore.

You can obtain the system memory of your storage system by using the `sysconfig -a` command (available through the nodeshell). For more information about using this command, see the man pages.

Related information

Scalability limits for NDMP sessions

Tape backup and restore support between Data ONTAP operating in 7-Mode and ONTAP

You can restore data backed up from a storage system operating in 7-Mode or running ONTAP to a storage system either operating in 7-Mode or running ONTAP.

The following tape backup and restore operations are supported between Data ONTAP operating in 7-Mode and ONTAP:

- Backing up a 7-Mode volume to a tape drive connected to a storage system running ONTAP
- Backing up an ONTAP volume to a tape drive connected to a 7-Mode system
- Restoring backed-up data of a 7-Mode volume from a tape drive connected to a storage system running ONTAP
- Restoring backed-up data of an ONTAP volume from a tape drive connected to a 7-Mode system
- Restoring a 7-Mode volume to an ONTAP volume

```
-   A 7-Mode LUN is restored as a LUN on an ONTAP volume.
-   You should retain the ONTAP LUN identifiers when
restoring a 7-Mode LUN to an existing ONTAP LUN.
```

- Restoring an ONTAP volume to a 7-Mode volume

  An ONTAP LUN is restored as a regular file on a 7-Mode volume.

Delete restartable contexts

If you want to start a backup instead of restarting a context, you can delete the context.

About this task

You can delete a restartable context using the `vserver services ndmp restartable-backup delete` command by providing the SVM name and the context ID.

Steps

1. Delete a restartable context:

   `vserver services ndmp restartable-backup delete -vserver *vserver-name* -context -id *context_identifier*`.

```
cluster::> vserver services ndmpd restartable-backup show
Vserver     Context Identifier                  Is Cleanup Pending?
----------- ----------------------------------- -------------------
vserver1    330e6739-0179-11e6-a299-005056bb4bc9 false
vserver1    481025c1-0179-11e6-a299-005056bb4bc9 false
vserver2    5cf10132-0179-11e6-a299-005056bb4bc9 false
3 entries were displayed.

cluster::>
cluster::> vserver services ndmp restartable-backup delete -vserver
vserver1 -context-id 481025c1-0179-11e6-a299-005056bb4bc9

cluster::> vserver services ndmpd restartable-backup show
Vserver     Context Identifier                  Is Cleanup Pending?
----------- ----------------------------------- -------------------
vserver1    330e6739-0179-11e6-a299-005056bb4bc9 false
vserver2    5cf10132-0179-11e6-a299-005056bb4bc9 false
3 entries were displayed.

cluster::>"
```

How dump works on a SnapVault secondary volume

You can perform tape backup operations on data that is mirrored on the SnapVault secondary volume. You can back up only the data that is mirrored on the SnapVault secondary volume to tape, and not the SnapVault relationship metadata.

When you break the data protection mirror relationship (`snapmirror break`) or when a SnapMirror

resynchronization occurs, you must always perform a baseline backup.

How dump works with storage failover and ARL operations

Before you perform dump backup or restore operations, you should understand how these operations work with storage failover (takeover and giveback) or aggregate relocation (ARL) operations. The `-override-vetoes` option determines the behavior of dump engine during a storage failover or ARL operation.

When a dump backup or restore operation is running and the `-override-vetoes` option is set to `false`, a user-initiated storage failover or ARL operation is stopped. However, if the `-override-vetoes` option is set to `true`, then the storage failover or ARL operation is continued and the dump backup or restore operation is aborted. When a storage failover or ARL operation is automatically initiated by the storage system, an active dump backup or restore operation is always aborted. You cannot restart dump backup and restore operations even after storage failover or ARL operations complete.

Dump operations when CAB extension is supported

If the backup application supports CAB extension, you can continue performing incremental dump backup and restore operations without reconfiguring backup policies after a storage failover or ARL operation.

Dump operations when CAB extension is not supported

If the backup application does not support CAB extension, you can continue performing incremental dump backup and restore operations if you migrate the LIF configured in the backup policy to the node that hosts the destination aggregate. Otherwise, after the storage failover and ARL operation, you must perform a baseline backup prior to performing the incremental backup operation.

> For storage failover operations, the LIF configured in the backup policy must be migrated to the partner node.

Related information

ONTAP concepts

High Availability

How dump works with volume move

Tape backup and restore operations and volume move can run in parallel until the final cutover phase is attempted by the storage system. After this phase, new tape backup and restore operations are not allowed on the volume that is being moved. However, the current operations continue to run until completion.

The following table describes the behavior of tape backup and restore operations after the volume move operation:

If you are performing tape backup and restore operations in the…	Then…
storage virtual machine (SVM) scoped NDMP mode when CAB extension is supported by the backup application	You can continue performing incremental tape backup and restore operations on read/write and read-only volumes without reconfiguring backup policies.
SVM-scoped NDMP mode when CAB extension is not supported by the backup application	You can continue performing incremental tape backup and restore operations on read/write and read-only volumes if you migrate the LIF configured in the backup policy to the node that hosts the destination aggregate. Otherwise, after the volume move, you must perform a baseline backup before performing the incremental backup operation.

When a volume move occurs, if the volume belonging to a different SVM on the destination node has the same name as that of the moved volume, then you cannot perform incremental backup operations of the moved volume.

Related information

ONTAP concepts

How dump works when a FlexVol volume is full

Before performing an incremental dump backup operation, you must ensure that there is sufficient free space in the FlexVol volume.

If the operation fails, you must increase the free space in the Flex Vol volume either by increasing its size or by deleting the Snapshot copies. Then perform the incremental backup operation again.

How dump works when volume access type changes

When a SnapMirror destination volume or a SnapVault secondary volume changes state from read/write to read-only or from read-only to read/write, you must perform a baseline tape backup or restore operation.

SnapMirror destination and SnapVault secondary volumes are read-only volumes. If you perform tape backup and restore operations on such volumes, you must perform a baseline backup or restore operation whenever the volume changes state from read-only to read/write or from read/write to read-only.

Related information

ONTAP concepts

How dump works with SnapMirror single file or LUN restore

Before you perform dump backup or restore operations on a volume to which a single file or LUN is restored by using SnapMirror technology, you must understand how dump operations work with a single file or LUN restore operation.

During a SnapMirror single file or LUN restore operation, client I/O is restricted on the file or LUN being

restored. When the single file or LUN restore operation finishes, the I/O restriction on the file or LUN is removed. If a dump backup is performed on a volume to which a single file or LUN is restored, then the file or LUN that has client I/O restriction is not included in the dump backup. In a subsequent backup operation, this file or LUN is backed up to tape after the I/O restriction is removed.

You cannot perform a dump restore and a SnapMirror single file or LUN restore operation simultaneously on the same volume.

How dump backup and restore operations are affected in MetroCluster configurations

Before you perform dump backup and restore operations in a MetroCluster configuration, you must understand how dump operations are affected when a switchover or switchback operation occurs.

Dump backup or restore operation followed by switchover

Consider two clusters: cluster 1 and cluster 2. During a dump backup or restore operation on cluster 1, if a switchover is initiated from cluster 1 to cluster 2, then the following occurs:

- If the value of the `override-vetoes` option is `false`, then the switchover is aborted and the backup or restore operation continues.
- If the value of the option is `true`, then the dump backup or restore operation is aborted and the switchover continues.

Dump backup or restore operation followed by switchback

A switchover is performed from cluster 1 to cluster 2 and a dump backup or restore operation is initiated on cluster 2. The dump operation backs up or restores a volume that is located on cluster 2. At this point, if a switchback is initiated from cluster 2 to cluster 1, then the following occurs:

- If the value of the `override-vetoes` option is `false`, then the switchback is cancelled and the backup or restore operation continues.
- If the value of the option is `true`, then the backup or restore operation is aborted and the switchback continues.

Dump backup or restore operation initiated during a switchover or switchback

During a switchover from cluster 1 to cluster 2, if a dump backup or restore operation is initiated on cluster 1, then the backup or restore operation fails and the switchover continues.

During a switchback from cluster 2 to cluster 1, if a dump backup or restore operation is initiated from cluster 2, then the backup or restore operation fails and the switchback continues.

About SMTape engine for FlexVol volumes

About SMTape engine for FlexVol volumes

SMTape is a disaster recovery solution from ONTAP that backs up blocks of data to tape. You can use SMTape to perform volume backups to tapes. However, you cannot perform a backup at the qtree or subtree level. SMTape supports baseline, differential, and incremental backups. SMTape does not require a license.

You can perform an SMTape backup and restore operation by using an NDMP-compliant backup application. You can choose SMTape to perform backup and restore operations only in the storage virtual machine (SVM) scoped NDMP mode.

> Reversion process is not supported when an SMTape backup or restore session is in progress. You must wait until the session finishes or you must abort the NDMP session.

Using SMTape, you can back up 255 Snapshot copies. For subsequent baseline, incremental, or differential backups, you must delete older backed-up Snapshot copies.

Before performing a baseline restore, the volume to which data is being restored must be of type `DP` and this volume must be in the restricted state. After a successful restore, this volume is automatically online. You can perform subsequent incremental or differential restores on this volume in the order in which the backups were performed.

Use Snapshot copies during SMTape backup

You should understand how Snapshot copies are used during an SMTape baseline backup and an incremental backup. There are also considerations to keep in mind while performing a backup using SMTape.

Baseline backup

While performing a baseline backup, you can specify the name of the Snapshot copy to be backed up to tape. If no Snapshot copy is specified, then depending on the access type of the volume (read/write or read-only), either a Snapshot copy is created automatically or existing Snapshot copies are used. When you specify a Snapshot copy for the backup, all the Snapshot copies older than the specified Snapshot copy are also backed up to tape.

If you do not specify a Snapshot copy for the backup, the following occurs:

- For a read/write volume, a Snapshot copy is created automatically.

  The newly created Snapshot copy and all the older Snapshot copies are backed up to tape.

- For a read-only volume, all the Snapshot copies, including the latest Snapshot copy, are backed up to tape.

  Any new Snapshot copies created after the backup is started are not backed up.

Incremental backup

For SMTape incremental or differential backup operations, the NDMP-compliant backup applications create and manage the Snapshot copies.

You must always specify a Snapshot copy while performing an incremental backup operation. For a successful incremental backup operation, the Snapshot copy backed up during the previous backup operation (baseline or incremental) must be on the volume from which the backup is performed. To ensure that you use this backed-up Snapshot copy, you must consider the Snapshot policy assigned on this volume while configuring the backup policy.

Considerations on SMTape backups on SnapMirror destinations

- A data protection mirror relationship creates temporary Snapshot copies on the destination volume for replication.

You should not use these Snapshot copies for SMTape backup.

- If a SnapMirror update occurs on a destination volume in a data protection mirror relationship during an SMTape backup operation on the same volume, then the Snapshot copy that is backed up by SMTape must not be deleted on the source volume.

  During the backup operation, SMTape locks the Snapshot copy on the destination volume and if the corresponding Snapshot copy is deleted on the source volume, then the subsequent SnapMirror update operation fails.

- You should not use these Snapshot copies during incremental backup.

SMTape capabilities

SMTape capabilities such as backup of Snapshot copies, incremental and differential backups, preservation of deduplication and compression features on restored volumes, and tape seeding help you optimize your tape backup and restore operations.

SMTape provides the following capabilities:

- Provides a disaster recovery solution
- Enables incremental and differential backups
- Backs up Snapshot copies
- Enables backup and restore of deduplicated volumes and preserves deduplication on the restored volumes
- Backs up compressed volumes and preserves compression on the restored volumes
- Enables tape seeding

SMTape supports the blocking factor in multiples of 4 KB, in the range of 4 KB through 256 KB.

> You can restore data to volumes created across up to two major consecutive ONTAP releases only.

Features not supported in SMTape

SMTape does not support restartable backups and verification of backed-up files.

Scalability limits for SMTape backup and restore sessions

While performing SMTape backup and restore operations through NDMP or CLI (tape seeding), you must be aware of the maximum number of SMTape backup and restore sessions that can be performed simultaneously on storage systems with different system memory capacities. This maximum number depends on the system memory of a storage system.

> SMTape backup and restore sessions scalability limits are different from NDMP session limits and dump session limits.

System memory of the storage system	Total number of SMTape backup and restore sessions
Less than 16 GB	6
Greater than or equal to 16 GB but less than 24 GB	16
Greater than or equal to 24 GB	32

You can obtain the system memory of your storage system by using the `sysconfig -a` command (available through the nodeshell). For more information about using this command, see the man pages.

Related information

Scalability limits for NDMP sessions

Scalability limits for dump backup and restore sessions

What tape seeding is

Tape seeding is an SMTape functionality that helps you initialize a destination FlexVol volume in a data protection mirror relationship.

Tape seeding enables you to establish a data protection mirror relationship between a source system and a destination system over a low-bandwidth connection.

Incremental mirroring of Snapshot copies from the source to the destination is feasible over a low bandwidth connection. However, an initial mirroring of the base Snapshot copy takes a long time over a low-bandwidth connection. In such cases, you can perform an SMTape backup of the source volume to a tape and use the tape to transfer the initial base Snapshot copy to the destination. You can then set up incremental SnapMirror updates to the destination system using the low-bandwidth connection.

Related information

ONTAP concepts

How SMTape works with storage failover and ARL operations

Before you perform SMTape backup or restore operations, you should understand how these operations work with storage failover (takeover and giveback) or aggregate relocation (ARL) operation. The `-override-vetoes` option determines the behavior of SMTape engine during a storage failover or ARL operation.

When an SMTape backup or restore operation is running and the `-override-vetoes` option is set to `false`, a user-initiated storage failover or ARL operation is stopped and the backup or restore operation complete. If the backup application supports CAB extension, then you can continue performing incremental SMTape backup and restore operations without reconfiguring backup policies. However, if the `-override-vetoes` option is set to `true`, then the storage failover or ARL operation is continued and the SMTape backup or restore operation is aborted.

Related information

Network management

How SMTape works with volume move

SMTape backup operations and volume move operations can run in parallel until the storage system attempts the final cutover phase. After this phase, new SMTape backup operations cannot run on the volume that is being moved. However, the current operations continue to run until completion.

Before the cutover phase for a volume is started, the volume move operation checks for active SMTape backup operations on the same volume. If there are active SMTape backup operations, then the volume move operation moves into a cutover deferred state and allows the SMTape backup operations to complete. After these backup operations are completed, you must manually restart the volume move operation.

If the backup application supports CAB extension, you can continue performing incremental tape backup and restore operations on read/write and read-only volumes without reconfiguring backup policies.

Baseline restore and volume move operations cannot be performed simultaneously; however, incremental restore can run in parallel with volume move operations, with the behavior similar to that of SMTape backup operations during volume move operations.

Related information

ONTAP concepts

How SMTape works with volume rehost operations

SMTape operations cannot commence when a volume rehost operation is in progress on a volume. When a volume is involved in a volume rehost operation, SMTape sessions should not be started on that volume.

If any volume rehost operation is in progress, then SMTape backup or restore fails. If an SMTape backup or restore is in progress, then volume rehost operations fail with an appropriate error message. This condition applies to both NDMP-based and CLI-based backup or restore operations.

How NDMP backup policy are affected during ADB

When the automatic data balancer (ADB) is enabled, the balancer analyzes the usage statistics of aggregates to identify the aggregate that has exceeded the configured high-threshold usage percentage.

After identifying the aggregate that has exceeded the threshold, the balancer identifies a volume that can be moved to aggregates residing in another node in the cluster and attempts to move that volume. This situation affects the backup policy configured for this volume because if the data management application (DMA) is not CAB aware, then the user has to reconfigure the backup policy and run the baseline backup operation.

If the DMA is CAB aware and the backup policy has been configured using specific interface, then the ADB is not affected.

How SMTape backup and restore operations are affected in MetroCluster configurations

Before you perform SMTape backup and restore operations in a MetroCluster

configuration, you must understand how SMTape operations are affected when a switchover or switchback operation occurs.

SMTape backup or restore operation followed by switchover

Consider two clusters: cluster 1 and cluster 2. During an SMTape backup or restore operation on cluster 1, if a switchover is initiated from cluster 1 to cluster 2, then the following occurs:

- If the value of the `-override-vetoes` option is `false`, then the switchover process is aborted and the backup or restore operation continues.
- If the value of the option is `true`, then the SMTape backup or restore operation is aborted and the switchover process continues.

SMTape backup or restore operation followed by switchback

A switchover is performed from cluster 1 to cluster 2 and an SMTape backup or restore operation is initiated on cluster 2. The SMTape operation backs up or restores a volume that is located on cluster 2. At this point, if a switchback is initiated from cluster 2 to cluster 1, then the following occurs:

- If the value of the `-override-vetoes` option is `false`, then the switchback process is aborted and the backup or restore operation continues.
- If the value of the option is `true`, then the backup or restore operation is aborted and the switchback process continues.

SMTape backup or restore operation initiated during a switchover or switchback

During a switchover process from cluster 1 to cluster 2, if an SMTape backup or restore operation is initiated on cluster 1, then the backup or restore operation fails and the switchover continues.

During a switchback process from cluster 2 to cluster 1, if an SMTape backup or restore operation is initiated from cluster 2, then the backup or restore operation fails and the switchback continues.

Monitor tape backup and restore operations for FlexVol volumes

Monitor tape backup and restore operations for FlexVol volumes overview

You can view the event log files to monitor the tape backup and restore operations. ONTAP automatically logs significant backup and restore events and the time at which they occur in a log file named `backup` in the controller's `/etc/log/` directory. By default, event logging is set to `on`.

You might want to view event log files for the following reasons:

- Checking whether a nightly backup was successful
- Gathering statistics on backup operations
- For using the information in past event log files to help diagnose problems with backup and restore operations

Once every week, the event log files are rotated. The `/etc/log/backup` file is renamed to `/etc/log/backup.0`, the `/etc/log/backup.0` file is renamed to `/etc/log/backup.1`, and so on. The system saves the log files for up to six weeks; therefore, you can have up to seven message files

(`/etc/log/backup.[0-5]` and the current `/etc/log/backup` file).

Access the event log files

You can access the event log files for tape backup and restore operations in the `/etc/log/` directory by using the `rdfile` command at the nodeshell. You can view these event log files to monitor tape backup and restore operations.

About this task

With additional configurations, such as an access-control role with access to the `spi` web service or a user account set up with the `http` access method, you can also use a web browser to access these log files.

Steps

1. To access the nodeshell, enter the following command:

   `node run -node` *`node_name`*

   `node_name` is the name of the node.

2. To access the event log files for tape backup and restore operations, enter the following command:

   `rdfile /etc/log/backup`

Related information

System administration

ONTAP concepts

What the dump and restore event log message format is

Dump and restore event log message format overview

For each dump and restore event, a message is written to the backup log file.

The format of the dump and restore event log message is as follows:

`type timestamp identifier event (event_info)`

The following list describes the fields in the event log message format:

- Each log message begins with one of the type indicators described in the following table:

Type	Description
log	Logging event
dmp	Dump event
rst	Restore event

- `timestamp` shows the date and time of the event.
- The `identifier` field for a dump event includes the dump path and the unique ID for the dump. The `identifier` field for a restore event uses only the restore destination path name as a unique identifier. Logging-related event messages do not include an `identifier` field.

What logging events are

The event field of a message that begins with a log specifies the beginning of a logging or the end of a logging.

It contains one of the events shown in the following table:

Event	Description
Start_Logging	Indicates the beginning of logging or that logging has been turned back on after being disabled.
Stop_Logging	Indicates that logging has been turned off.

What dump events are

The event field for a dump event contains an event type followed by event-specific information within parentheses.

The following table describes the events, their descriptions, and the related event information that might be recorded for a dump operation:

Event	Description	Event information
Start	NDMP dump is started	Dump level and the type of dump
End	Dumps completed successfully	Amount of data processed
Abort	The operation is cancelled	Amount of data processed
Options	Specified options are listed	All options and their associated values, including NDMP options
Tape_open	The tape is open for read/write	The new tape device name
Tape_close	The tape is closed for read/write	The tape device name
Phase-change	A dump is entering a new processing phase	The new phase name
Error	A dump has encountered an unexpected event	Error message

Event	Description	Event information
Snapshot	A Snapshot copy is created or located	The name and time of the Snapshot copy
Base_dump	A base dump entry in the internal metafile has been located	The level and time of the base dump (for incremental dumps only)

What restore events are

The event field for a restore event contains an event type followed by event-specific information in parentheses.

The following table provides information about the events, their descriptions, and the related event information that can be recorded for a restore operation:

Event	Description	Event information
Start	NDMP restore is started	Restore level and the type of restore
End	Restores completed successfully	Number of files and amount of data processed
Abort	The operation is cancelled	Number of files and amount of data processed
Options	Specified options are listed	All options and their associated values, including NDMP options
Tape_open	The tape is open for read/write	The new tape device name
Tape_close	The tape is closed for read/write	The tape device name
Phase-change	Restore is entering a new processing phase	The new phase name
Error	Restore encounters an unexpected event	Error message

Enabling or disabling event logging

You can turn the event logging on or off.

Steps

1. To enable or disable event logging, enter the following command at the clustershell:

```
options -option_name backup.log.enable -option-value {on | off}
```

`on` turns event logging on.

`off` turns event logging off.

Event logging is turned on by default.

Error messages for tape backup and restore of FlexVol volumes

Backup and restore error messages

Resource limitation: no available thread

- **Message**

  `Resource limitation: no available thread`

- **Cause**

  The maximum number of active local tape I/O threads is currently in use. You can have a maximum of 16 active local tape drives.

- **Corrective action**

  Wait for some tape jobs to finish before starting a new backup or restore job.

Tape reservation preempted

- **Message**

  `Tape reservation preempted`

- **Cause**

  The tape drive is in use by another operation or the tape has been closed prematurely.

- **Corrective action**

  Ensure that the tape drive is not in use by another operation and that the DMA application has not aborted the job and then retry.

Could not initialize media

- **Message**

  `Could not initialize media`

- **Cause**

  You might get this error for one of the following reasons:

  - The tape drive used for the backup is corrupt or damaged.
  - The tape does not contain the complete backup or is corrupt.

- The maximum number of active local tape I/O threads is currently in use.

  You can have a maximum of 16 active local tape drives.

- **Corrective action**
  - If the tape drive is corrupt or damaged, retry the operation with a valid tape drive.
  - If the tape does not contain the complete backup or is corrupt, you cannot perform the restore operation.
  - If tape resources are not available, wait for some of the backup or restore jobs to finish and then retry the operation.

Maximum number of allowed dumps or restores (maximum session limit) in progress

- **Message**

  `Maximum number of allowed dumps or restores` *`(maximum session limit)`* `in progress`

- **Cause**

  The maximum number of backup or restore jobs is already running.

- **Corrective action**

  Retry the operation after some of the currently running jobs have finished.

Media error on tape write

- **Message**

  `Media error on tape write`

- **Cause**

  The tape used for the backup is corrupted.

- **Corrective action**

  Replace the tape and retry the backup job.

Tape write failed

- **Message**

  `Tape write failed`

- **Cause**

  The tape used for the backup is corrupted.

- **Corrective action**

  Replace the tape and retry the backup job.

Tape write failed - new tape encountered media error

- **Message**

  ```
  Tape write failed - new tape encountered media error
  ```

- **Cause**

  The tape used for the backup is corrupted.

- **Corrective action**

  Replace the tape and retry the backup.

Tape write failed - new tape is broken or write protected

- **Message**

  ```
  Tape write failed - new tape is broken or write protected
  ```

- **Cause**

  The tape used for the backup is corrupted or write-protected.

- **Corrective action**

  Replace the tape and retry the backup.

Tape write failed - new tape is already at the end of media

- **Message**

  ```
  Tape write failed - new tape is already at the end of media
  ```

- **Cause**

  There is not enough space on the tape to complete the backup.

- **Corrective action**

  Replace the tape and retry the backup.

Tape write error

- **Message**

  ```
  Tape write error - The previous tape had less than the required minimum
  capacity, size MB, for this tape operation, The operation should be restarted
  from the beginning
  ```

- **Cause**

  The tape capacity is insufficient to contain the backup data.

- **Corrective action**

  Use tapes with larger capacity and retry the backup job.

Media error on tape read

- **Message**

  ```
  Media error on tape read
  ```

- **Cause**

  The tape from which data is being restored is corrupted and might not contain the complete backup data.

- **Corrective action**

  If you are sure that the tape has the complete backup, retry the restore operation. If the tape does not contain the complete backup, you cannot perform the restore operation.

Tape read error

- **Message**

  ```
  Tape read error
  ```

- **Cause**

  The tape drive is damaged or the tape does not contain the complete backup.

- **Corrective action**

  If the tape drive is damaged, use another tape drive. If the tape does not contain the complete backup, you cannot restore the data.

Already at the end of tape

- **Message**

  ```
  Already at the end of tape
  ```

- **Cause**

  The tape does not contain any data or must be rewound.

- **Corrective action**

  If the tape does not contain data, use the tape that contains the backup and retry the restore job. Otherwise, rewind the tape and retry the restore job.

Tape record size is too small. Try a larger size.

- **Message**

`Tape record size is too small. Try a larger size.`

- **Cause**

  The blocking factor specified for the restore operation is smaller than the blocking factor that was used during the backup.

- **Corrective action**

  Use the same blocking factor that was specified during the backup.

Tape record size should be block_size1 and not block_size2

- **Message**

  `Tape record size should be block_size1 and not block_size2`

- **Cause**

  The blocking factor specified for the local restore is incorrect.

- **Corrective action**

  Retry the restore job with `block_size1` as the blocking factor.

Tape record size must be in the range between 4KB and 256KB

- **Message**

  `Tape record size must be in the range between 4KB and 256KB`

- **Cause**

  The blocking factor specified for the backup or restore operation is not within the permitted range.

- **Corrective action**

  Specify a blocking factor in the range of 4 KB to 256 KB.

NDMP error messages

Network communication error

- **Message**

  `Network communication error`

- **Cause**

  Communication to a remote tape in an NDMP three-way connection has failed.

- **Corrective action**

  Check the network connection to the remote mover.

Message from Read Socket: error_string

- **Message**

  `Message from Read Socket: error_string`

- **Cause**

  Restore communication from the remote tape in NDMP 3-way connection has errors.

- **Corrective action**

  Check the network connection to the remote mover.

Message from Write Dirnet: error_string

- **Message**

  `Message from Write Dirnet: error_string`

- **Cause**

  Backup communication to a remote tape in an NDMP three-way connection has an error.

- **Corrective action**

  Check the network connection to the remote mover.

Read Socket received EOF

- **Message**

  `Read Socket received EOF`

- **Cause**

  Attempt to communicate with a remote tape in an NDMP three-way connection has reached the End Of File mark. You might be attempting a three-way restore from a backup image with a larger block size.

- **Corrective action**

  Specify the correct block size and retry the restore operation.

ndmpd invalid version number: version_number ``

- **Message**

  `ndmpd invalid version number: version_number`

- **Cause**

  The NDMP version specified is not supported by the storage system.

- **Corrective action**

Specify NDMP version 4.

ndmpd session session_ID not active

- **Message**

  `ndmpd session session_ID not active`

- **Cause**

  The NDMP session might not exist.

- **Corrective action**

  Use the `ndmpd status` command to view the active NDMP sessions.

Could not obtain vol ref for Volume volume_name

- **Message**

  `Could not obtain vol ref for Volume vol_name`

- **Cause**

  The volume reference could not be obtained because the volume might be in use by other operations.

- **Corrective action**

  Retry the operation later.

Data connection type ["NDMP4_ADDR_TCP"|"NDMP4_ADDR_TCP_IPv6"] not supported for ["IPv6"|"IPv4"] control connections

- **Message**

  `Data connection type ["NDMP4_ADDR_TCP"|"NDMP4_ADDR_TCP_IPv6"] not supported for ["IPv6"|"IPv4"] control connections`

- **Cause**

  In node-scoped NDMP mode, the NDMP data connection established must be of the same network address type (IPv4 or IPv6) as the NDMP control connection.

- **Corrective action**

  Contact your backup application vendor.

DATA LISTEN: CAB data connection prepare precondition error

- **Message**

  `DATA LISTEN: CAB data connection prepare precondition error`

- **Cause**

  NDMP data listen fails when the backup application has negotiated the CAB extension with the NDMP server and there is a mismatch in the specified NDMP data connection address type between the NDMP_CAB_DATA_CONN_PREPARE and the NDMP_DATA_LISTEN messages.

- **Corrective action**

  Contact your backup application vendor.

DATA CONNECT: CAB data connection prepare precondition error

- **Message**

  ```
  DATA CONNECT: CAB data connection prepare precondition error
  ```

- **Cause**

  NDMP data connect fails when the backup application has negotiated the CAB extension with the NDMP server and there is a mismatch in the specified NDMP data connection address type between the NDMP_CAB_DATA_CONN_PREPARE and the NDMP_DATA_CONNECT messages.

- **Corrective action**

  Contact your backup application vendor.

Error:show failed: Cannot get password for user '<username>'

- **Message**

  ```
  Error: show failed: Cannot get password for user '<username>'
  ```

- **Cause**

  Incomplete user account configuration for NDMP

- **Corrective action**

  Ensure that the user account is associated with the SSH access method and the authentication method is user password.

Dump error messages

Destination volume is read-only

- **Message**

  ```
  Destination volume is read-only
  ```

- **Cause**

  The path to which the restore operation is attempted to is read-only.

- **Corrective action**

Try restoring the data to a different location.

Destination qtree is read-only

- **Message**

  `Destination qtree is read-only`

- **Cause**

  The qtree to which the restore is attempted to is read-only.

- **Corrective action**

  Try restoring the data to a different location.

Dumps temporarily disabled on volume, try again

- **Message**

  `Dumps temporarily disabled on volume, try again`

- **Cause**

  NDMP dump backup is attempted on a SnapMirror destination volume that is part of either a `snapmirror break` or a `snapmirror resync` operation.

- **Corrective action**

  Wait for the `snapmirror break` or `snapmirror resync` operation to finish and then perform the dump operation.

  Whenever the state of a SnapMirror destination volume changes from read/write to read-only or from read-only to read/write, you must perform a baseline backup.

NFS labels not recognized

- **Message**

  `Error: Aborting: dump encountered NFS security labels in the file system`

- **Cause**

  NFS security labels are supported Beginning with ONTAP 9.9.1 when NFSv4.2 is enabled. However, NFS security labels are not currently recognized by the dump engine. If it encounters any NFS security labels on the files, directories, or any special files in any format of dump, the dump fails.

- **Corrective action**

  Verify that no files or directories have NFS security labels.

No files were created

- **Message**

  ```
  No files were created
  ```

- **Cause**

  A directory DAR was attempted without enabling the enhanced DAR functionality.

- **Corrective action**

  Enable the enhanced DAR functionality and retry the DAR.

Restore of the file <file name> failed

- **Message**

  ```
  Restore of the file file name failed
  ```

- **Cause**

  When a DAR (Direct Access Recovery) of a file whose file name is the same as that of a LUN on the destination volume is performed, then the DAR fails.

- **Corrective action**

  Retry DAR of the file.

Truncation failed for src inode <inode number>…

- **Message**

  ```
  Truncation failed for src inode <inode number>. Error <error number>. Skipping
  inode.
  ```

- **Cause**

  Inode of a file is deleted when the file is being restored.

- **Corrective action**

  Wait for the restore operation on a volume to complete before using that volume.

Unable to lock a snapshot needed by dump

- **Message**

  ```
  Unable to lock a snapshot needed by dump
  ```

- **Cause**

  The Snapshot copy specified for the backup is not available.

- **Corrective action**

  Retry the backup with a different Snapshot copy.

  Use the `snap list` command to see the list of available Snapshot copies.

Unable to locate bitmap files

- **Message**

  `Unable to locate bitmap files`

- **Cause**

  The bitmap files required for the backup operation might have been deleted. In this case, the backup cannot be restarted.

- **Corrective action**

  Perform the backup again.

Volume is temporarily in a transitional state

- **Message**

  `Volume is temporarily in a transitional state`

- **Cause**

  The volume being backed up is temporarily in an unmounted state.

- **Corrective action**

  Wait for some time and perform the backup again.

SMTape error messages

Chunks out of order

- **Message**

  `Chunks out of order`

- **Cause**

  The backup tapes are not being restored in the correct sequence.

- **Corrective action**

  Retry the restore operation and load the tapes in the correct sequence.

Chunk format not supported

- **Message**

  ```
  Chunk format not supported
  ```

- **Cause**

  The backup image is not of SMTape.

- **Corrective action**

  If the backup image is not of SMTape, retry the operation with a tape that has the SMTape backup.

Failed to allocate memory

- **Message**

  ```
  Failed to allocate memory
  ```

- **Cause**

  The system has run out of memory.

- **Corrective action**

  Retry the job later when the system is not too busy.

Failed to get data buffer

- **Message**

  ```
  Failed to get data buffer
  ```

- **Cause**

  The storage system ran out of buffers.

- **Corrective action**

  Wait for some storage system operations to finish and then retry the job.

Failed to find snapshot

- **Message**

  ```
  Failed to find snapshot
  ```

- **Cause**

  The Snapshot copy specified for the backup is unavailable.

- **Corrective action**

Check if the specified Snapshot copy is available. If not, retry with the correct Snapshot copy.

Failed to create snapshot

- **Message**

  `Failed to create snapshot`

- **Cause**

  The volume already contains the maximum number of Snapshot copies.

- **Corrective action**

  Delete some Snapshot copies and then retry the backup operation.

Failed to lock snapshot

- **Message**

  `Failed to lock snapshot`

- **Cause**

  The Snapshot copy is either in use or has been deleted.

- **Corrective action**

  If the Snapshot copy is in use by another operation, wait for that operation to finish and then retry the backup. If the Snapshot copy has been deleted, you cannot perform the backup.

Failed to delete snapshot

- **Message**

  `Failed to delete snapshot`

- **Cause**

  The auto Snapshot copy could not be deleted because it is in use by other operations.

- **Corrective action**

  Use the `snap` command to determine the status of the Snapshot copy. If the Snapshot copy is not required, delete it manually.

Failed to get latest snapshot

- **Message**

  `Failed to get latest snapshot`

- **Cause**

The latest Snapshot copy might not exist because the volume is being initialized by SnapMirror.

- **Corrective action**

  Retry after initialization is complete.

Failed to load new tape

- **Message**

  ```
  Failed to load new tape
  ```

- **Cause**

  Error in tape drive or media.

- **Corrective action**

  Replace the tape and retry the operation.

Failed to initialize tape

- **Message**

  ```
  Failed to initialize tape
  ```

- **Cause**

  You might get this error message for one of the following reasons:

  - The backup image is not of SMTape.
  - The tape blocking factor specified is incorrect.
  - The tape is corrupt or damaged.
  - The wrong tape is loaded for restore.

- **Corrective action**
  - If the backup image is not of SMTape, retry the operation with a tape that has SMTape backup.
  - If the blocking factor is incorrect, specify the correct blocking factor and retry the operation.
  - If the tape is corrupt, you cannot perform the restore operation.
  - If the wrong tape is loaded, retry the operation with the correct tape.

Failed to initialize restore stream

- **Message**

  ```
  Failed to initialize restore stream
  ```

- **Cause**

  You might get this error message for one of the following reasons:

  - The backup image is not of SMTape.

- The tape blocking factor specified is incorrect.
- The tape is corrupt or damaged.
- The wrong tape is loaded for restore.

- **Corrective action**
  - If the backup image is not of SMTape, retry the operation with a tape that has the SMTape backup.
  - If the blocking factor is incorrect, specify the correct blocking factor and retry the operation.
  - If the tape is corrupt, you cannot perform the restore operation.
  - If the wrong tape is loaded, retry the operation with the correct tape.

Failed to read backup image

- **Message**

  `Failed to read backup image`

- **Cause**

  The tape is corrupt.

- **Corrective action**

  If the tape is corrupt, you cannot perform the restore operation.

Image header missing or corrupted

- **Message**

  `Image header missing or corrupted`

- **Cause**

  The tape does not contain a valid SMTape backup.

- **Corrective action**

  Retry with a tape containing a valid backup.

Internal assertion

- **Message**

  `Internal assertion`

- **Cause**

  There is an internal SMTape error.

- **Corrective action**

  Report the error and send the `etc/log/backup` file to technical support.

Invalid backup image magic number

- **Message**

  ```
  Invalid backup image magic number
  ```

- **Cause**

  The backup image is not of SMTape.

- **Corrective action**

  If the backup image is not of SMTape, retry the operation with a tape that has the SMTape backup.

Invalid backup image checksum

- **Message**

  ```
  Invalid backup image checksum
  ```

- **Cause**

  The tape is corrupt.

- **Corrective action**

  If the tape is corrupt, you cannot perform the restore operation.

Invalid input tape

- **Message**

  ```
  Invalid input tape
  ```

- **Cause**

  The signature of the backup image is not valid in the tape header. The tape has corrupted data or does not contain a valid backup image.

- **Corrective action**

  Retry the restore job with a valid backup image.

Invalid volume path

- **Message**

  ```
  Invalid volume path
  ```

- **Cause**

  The specified volume for the backup or restore operation is not found.

- **Corrective action**

Retry the job with a valid volume path and volume name.

Mismatch in backup set ID

- **Message**

  `Mismatch in backup set ID`

- **Cause**

  The tape loaded during a tape change is not a part of the backup set.

- **Corrective action**

  Load the correct tape and retry the job.

Mismatch in backup time stamp

- **Message**

  `Mismatch in backup time stamp`

- **Cause**

  The tape loaded during a tape change is not a part of the backup set.

- **Corrective action**

  Use the `smtape restore -h` command to verify the header information of a tape.

Job aborted due to shutdown

- **Message**

  `Job aborted due to shutdown`

- **Cause**

  The storage system is being rebooted.

- **Corrective action**

  Retry the job after the storage system reboots.

Job aborted due to Snapshot autodelete

- **Message**

  `Job aborted due to Snapshot autodelete`

- **Cause**

  The volume does not have enough space and has triggered the automatic deletion of Snapshot copies.

- **Corrective action**

  Free up space in the volume and retry the job.

Tape is currently in use by other operations

- **Message**

  `Tape is currently in use by other operations`

- **Cause**

  The tape drive is in use by another job.

- **Corrective action**

  Retry the backup after the currently active job is finished.

Tapes out of order

- **Message**

  `Tapes out of order`

- **Cause**

  The first tape of the tape sequence for the restore operation does not have the image header.

- **Corrective action**

  Load the tape with the image header and retry the job.

Transfer failed (Aborted due to MetroCluster operation)

- **Message**

  `Transfer failed (Aborted due to MetroCluster operation)`

- **Cause**

  The SMTape operation is aborted because of a switchover or switchback operation.

- **Corrective action**

  Perform the SMTape operation after the switchover or switchback operation finishes.

Transfer failed (ARL initiated abort)

- **Message**

  `Transfer failed (ARL initiated abort)`

- **Cause**

While an SMTape operation is in progress if an aggregate relocation is initiated, then the SMTape operation is aborted.

- **Corrective action**

  Perform the SMTape operation after the aggregate relocation operation finishes.

Transfer failed (CFO initiated abort)

- **Message**

  `Transfer failed (CFO initiated abort)`

- **Cause**

  The SMTape operation is aborted because of a storage failover (takeover and giveback) operation of a CFO aggregate.

- **Corrective action**

  Perform the SMTape operation after the storage failover of the CFO aggregate finishes.

Transfer failed (SFO initiated abort)

- **Message**

  `Transfer failed (SFO initiated abort)`

- **Cause**

  The SMTape operation is aborted because of a storage failover (takeover and giveback) operation.

- **Corrective action**

  Perform the SMTape operation after the storage failover (takeover and giveback) operation finishes.

Underlying aggregate under migration

- **Message**

  `Underlying aggregate under migration`

- **Cause**

  If an SMTape operation is initiated on an aggregate that is under migration (storage failover or aggregate relocation), then the SMTape operation fails.

- **Corrective action**

  Perform the SMTape operation after the aggregate migration finishes.

Volume is currently under migration

- **Message**

  ```
  Volume is currently under migration
  ```

- **Cause**

  Volume migration and SMTape backup cannot run simultaneously.

- **Corrective action**

  Retry the backup job after the volume migration is complete.

Volume offline

- **Message**

  ```
  Volume offline
  ```

- **Cause**

  The volume being backed up is offline.

- **Corrective action**

  Bring the volume online and retry the backup.

Volume not restricted

- **Message**

  ```
  Volume not restricted
  ```

- **Cause**

  The destination volume to which data is being restored is not restricted.

- **Corrective action**

  Restrict the volume and retry the restore operation.

NDMP configuration

NDMP configuration overview

You can quickly configure an ONTAP 9 cluster to use the Network Data Management Protocol (NDMP) to back up data directly to tape using a third-party backup application.

If the backup application supports Cluster Aware Backup (CAB), you can configure NDMP as *SVM-scoped* or *node-scoped*:

- SVM-scoped at the cluster (admin SVM) level enables you to back up all volumes hosted across different

nodes of the cluster. SVM-scoped NDMP is recommended where possible.

- Node-scoped NDMP enables you to back up all the volumes hosted on that node.

If the backup application does not support CAB, you must use node-scoped NDMP.

SVM-scoped and node-scoped NDMP are mutually exclusive; they cannot be configured on the same cluster.

Node-scoped NDMP is deprecated in ONTAP 9.

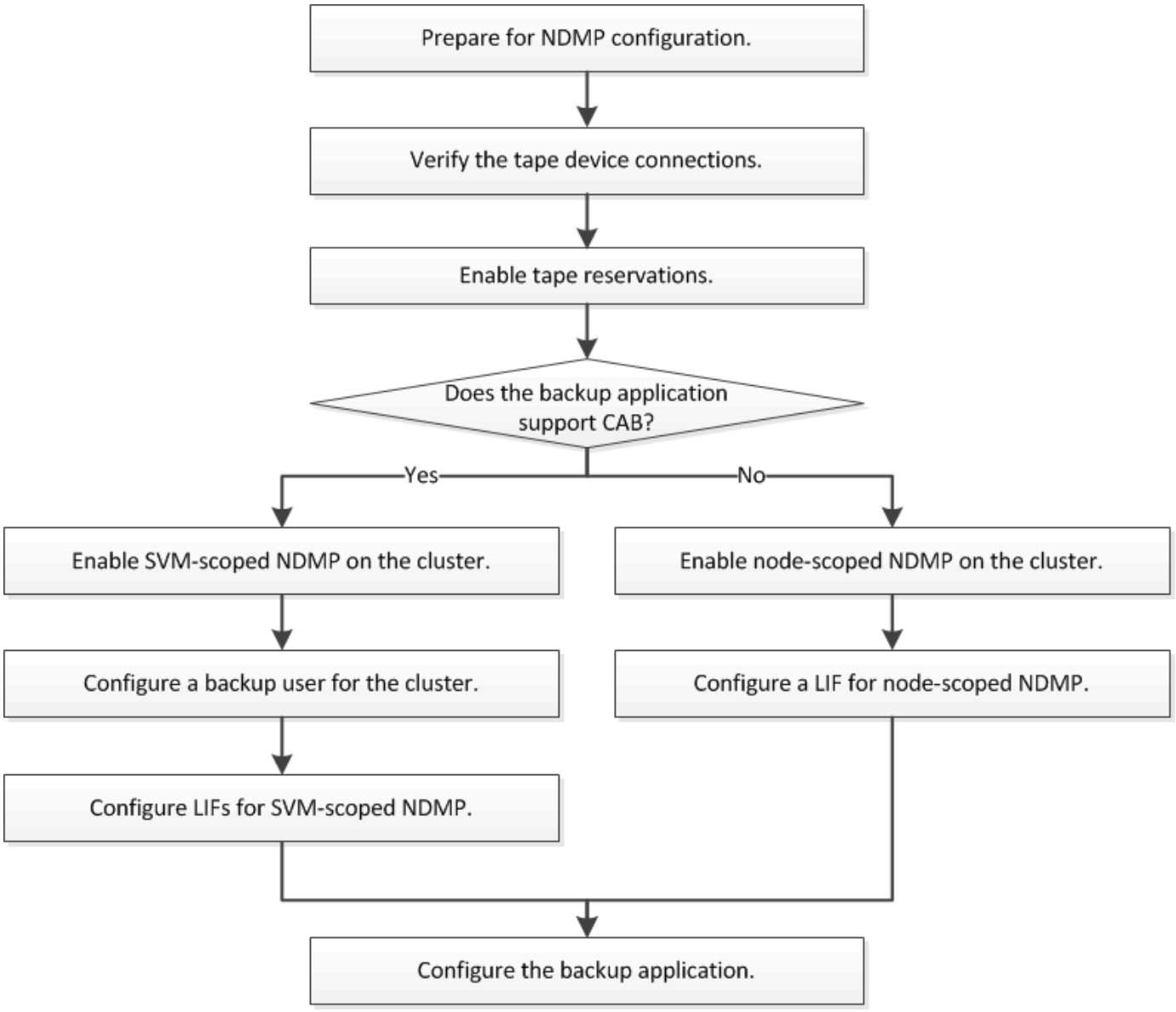
Learn more about Cluster Aware Backup (CAB).

Before configuring NDMP, verify the following:

- You have a third-party backup application (also called a Data Management Application or DMA).
- You are a cluster administrator.
- Tape devices and an optional media server are installed.
- Tape devices are connected to the cluster through a Fibre Channel (FC) switch and not directly attached.
- At least one tape device has a logical unit number (LUN) of 0.

NDMP configuration workflow

Setting up tape backup over NDMP involves preparing for NDMP configuration, verifying the tape device connections, enabling tape reservations, configuring NDMP at the SVM or node level, enabling NDMP on the cluster, configuring a backup user, configuring LIFs, and configuring the backup application.



Prepare for NDMP configuration

Before you configure tape backup access over Network Data Management Protocol (NDMP), you must verify that the planned configuration is supported, verify that your tape drives are listed as qualified drives on each node, verify that all nodes have intercluster LIFs, and identify whether the backup application supports the Cluster Aware Backup (CAB) extension.

Steps

1. Refer to your backup application provider's compatibility matrix for ONTAP support (NetApp does not qualify third-party backup applications with ONTAP or NDMP).

   You should verify that the following NetApp components are compatible:

   - The version of ONTAP 9 that is running on the cluster.
   - The backup application vendor and version: for example, Veritas NetBackup 8.2 or CommVault.

- The tape devices details, such as the manufacturer, model, and interface of the tape drives: for example, IBM Ultrium 8 or HPe StoreEver Ultrium 30750 LTO-8.
- The platforms of the nodes in the cluster: for example, FAS8700 or A400.

> You can find legacy ONTAP compatibility support matrices for backup applications in the NetApp Interoperability Matrix Tool.

2. Verify that your tape drives are listed as qualified drives in each node's built-in tape configuration file:
   a. On the command line-interface, view the built-in tape configuration file by using the `storage tape show-supported-status` command.

```
cluster1::> storage tape show-supported-status

Node: cluster1-1
                                 Is
Tape Drives                      Supported  Support Status
-------------------------------  ---------
-------------------------------
Certance Ultrium 2               true       Dynamically Qualified
Certance Ultrium 3               true       Dynamically Qualified
Digital DLT2000                  true       Qualified
```

   b. Compare your tape drives to the list of qualified drives in the output.

> The names of the tape devices in the output might vary slightly from the names on the device label or in the Interoperability Matrix. For example, Digital DLT2000 can also be known as DLT2k. You can ignore these minor naming differences.

   c. If a device is not listed as qualified in the output even though the device is qualified according to the Interoperability Matrix, download and install an updated configuration file for the device using the instructions on the NetApp Support Site.

      NetApp Downloads: Tape Device Configuration Files

      A qualified device might not be listed in the built-in tape configuration file if the tape device was qualified after the node was shipped.

3. Verify that every node in the cluster has an intercluster LIF:
   a. View the intercluster LIFs on the nodes by using the `network interface show -role intercluster` command.

```
cluster1::> network interface show -role intercluster

            Logical    Status     Network            Current
Current Is
Vserver     Interface  Admin/Oper Address/Mask       Node
Port    Home
----------- ---------- ---------- ------------------ -------------
------- ----
cluster1    IC1        up/up      192.0.2.65/24      cluster1-1
e0a     true
```

b. If an intercluster LIF does not exist on any node, create an intercluster LIF by using the `network interface create` command.

```
cluster1::> network interface create -vserver cluster1 -lif IC2 -role
intercluster
-home-node cluster1-2 -home-port e0b -address 192.0.2.68 -netmask
255.255.255.0
-status-admin up -failover-policy local-only -firewall-policy
intercluster

cluster1::> network interface show -role intercluster

            Logical    Status     Network            Current
Current Is
Vserver     Interface  Admin/Oper Address/Mask       Node
Port    Home
----------- ---------- ---------- ------------------ -------------
------- ----
cluster1    IC1        up/up      192.0.2.65/24      cluster1-1
e0a     true
cluster1    IC2        up/up      192.0.2.68/24      cluster1-2
e0b     true
```

Network management

4. Identify whether the backup application supports Cluster Aware Backup (CAB) by using the documentation provided with the backup application.

   CAB support is a key factor in determining the type of backup you can perform.

Verify tape device connections

You must ensure that all drives and media changers are visible in ONTAP as devices.

Steps

1. View information about all drives and media changers by using the `storage tape show` command.

```
cluster1::> storage tape show

Node: cluster1-01
Device ID               Device Type     Description
Status
----------------------  -------------  ------------------------------
--------
sw4:10.11               tape drive      HP LTO-3
normal
0b.125L1                media changer   HP MSL G3 Series
normal
0d.4                    tape drive      IBM LTO 5 ULT3580
normal
0d.4L1                  media changer   IBM 3573-TL
normal
...
```

2. If a tape drive is not displayed, troubleshoot the problem.
3. If a media changer is not displayed, view information about media changers by using the `storage tape show-media-changer` command, and then troubleshoot the problem.

```
cluster1::> storage tape show-media-changer

Media Changer: sw4:10.11L1
  Description: PX70-TL
         WWNN: 2:00a:000e11:10b919
         WWPN: 2:00b:000e11:10b919
Serial Number: 00FRU7800000_LL1

       Errors: -

Paths:
Node                      Initiator  Alias    Device State
Status
------------------------  ---------  -------  ------------------------
--------
cluster1-01               2b         mc0      in-use
normal
...
```

Enable tape reservations

You must ensure that tape drives are reserved for use by backup applications for NDMP backup operations.

About this task

The reservation settings vary in different backup applications, and these settings must match the backup application and the nodes or servers using the same drives. See the vendor documentation of the backup application for the correct reservation settings.

Steps

1. Enable reservations by using the `options -option-name tape.reservations -option-value persistent` command.

   The following command enables reservations with the `persistent` value:

   ```
   cluster1::> options -option-name tape.reservations -option-value
   persistent
   2 entries were modified.
   ```

2. Verify that reservations are enabled on all nodes by using the `options tape.reservations` command, and then review the output.

   ```
   cluster1::> options tape.reservations

   cluster1-1
       tape.reservations                persistent

   cluster1-2
       tape.reservations                persistent
   2 entries were displayed.
   ```

Configure SVM-scoped NDMP

Enable SVM-scoped NDMP on the cluster

If the DMA supports the Cluster Aware Backup (CAB) extension, you can back up all the volumes hosted across different nodes in a cluster by enabling SVM-scoped NDMP, enabling NDMP service on the cluster (admin SVM), and configuring LIFs for data and control connection.

What you'll need

The CAB extension must be supported by the DMA.

About this task

Turning off node-scoped NDMP mode enables SVM-scoped NDMP mode on the cluster.

Steps

1. Enable SVM-scoped NDMP mode by using the `system services ndmp` command with the `node-scope-mode` parameter.

```
cluster1::> system services ndmp node-scope-mode off
NDMP node-scope-mode is disabled.
```

2. Enable NDMP service on the admin SVM by using the `vserver services ndmp on` command.

```
cluster1::> vserver services ndmp on -vserver cluster1
```

The authentication type is set to `challenge` by default and plaintext authentication is disabled.

For secure communication, you should keep plaintext authentication disabled.

3. Verify that NDMP service is enabled by using the `vserver services ndmp show` command.

```
cluster1::> vserver services ndmp show

Vserver       Enabled   Authentication type
------------- --------- -------------------
cluster1      true      challenge
vs1           false     challenge
```

Enable a backup user for NDMP authentication

To authenticate SVM-scoped NDMP from the backup application, there must be an administrative user with sufficient privileges and an NDMP password.

About this task

You must generate an NDMP password for backup admin users. You can enable backup admin users at the cluster or SVM level, and if necessary, you can create a new user. By default, the users with the following roles can authenticate for NDMP backup:

- Cluster-wide: `admin` or `backup`
- Individual SVMs: `vsadmin` or `vsadmin-backup`

If you are using an NIS or LDAP user, the user must exist on the respective server. You cannot use an Active Directory user.

Steps

1. Display the current admin users and permissions:

```
security login show
```

2. If needed, create a new NDMP backup user with the `security login create` command and the appropriate role for cluster-wide or individual SVM privileges.

   You can specify a local backup user name or an NIS or LDAP user name for the `-user-or-group-name` parameter.

   The following command creates the backup user `backup_admin1` with the `backup` role for the entire cluster:

   ```
   cluster1::> security login create -user-or-group-name backup_admin1
   -application ssh -authmethod password -role backup
   ```

   The following command creates the backup user `vsbackup_admin1` with the `vsadmin-backup` role for an individual SVM:

   ```
   cluster1::> security login create -user-or-group-name vsbackup_admin1
   -application ssh -authmethod password -role vsadmin-backup
   ```

   Enter a password for the new user and confirm.

3. Generate a password for the admin SVM by using the `vserver services ndmp generate password` command.

   The generated password must be used to authenticate the NDMP connection by the backup application.

   ```
   cluster1::> vserver services ndmp generate-password -vserver cluster1
   -user backup_admin1

    Vserver: cluster1
       User: backup_admin1
   Password: qG5CqQHYxw7tE57g
   ```

Configure LIFs

You must identify the LIFs that will be used for establishing a data connection between the data and tape resources, and for control connection between the admin SVM and the backup application. After identifying the LIFs, you must verify that firewall and failover policies are set for the LIFs, and specify the preferred interface role.

Beginning with ONTAP 9.10.1, firewall policies are deprecated and wholly replaced with LIF service policies. For more information, see LIFs and service policies in ONTAP 9.6 and later.

Steps

1. Identify the intercluster, cluster-management, and node-management LIFs by using the `network interface show` command with the `-role` parameter.

   The following command displays the intercluster LIFs:

```
cluster1::> network interface show -role intercluster

            Logical           Status     Network            Current
Current Is
Vserver     Interface         Admin/Oper Address/Mask       Node
Port    Home
----------- ----------        ---------- ------------------
------------- ------- ----
cluster1    IC1               up/up      192.0.2.65/24      cluster1-1
e0a     true
cluster1    IC2               up/up      192.0.2.68/24      cluster1-2
e0b     true
```

The following command displays the cluster-management LIF:

```
cluster1::> network interface show -role cluster-mgmt

            Logical           Status     Network            Current
Current Is
Vserver     Interface         Admin/Oper Address/Mask       Node
Port    Home
----------- ----------        ---------- ------------------
------------- ------- ----
cluster1    cluster_mgmt      up/up      192.0.2.60/24      cluster1-2
e0M     true
```

The following command displays the node-management LIFs:

```
cluster1::> network interface show -role node-mgmt

            Logical           Status     Network            Current
Current Is
Vserver     Interface         Admin/Oper Address/Mask       Node
Port    Home
----------- ----------        ---------- ------------------ ------------
------  ------
cluster1    cluster1-1_mgmt1  up/up      192.0.2.69/24      cluster1-1
e0M     true
            cluster1-2_mgmt1  up/up      192.0.2.70/24      cluster1-2
e0M     true
```

2. Ensure that the firewall policy is enabled for NDMP on the intercluster, cluster-management (cluster-mgmt), and node-management (node-mgmt) LIFs:

a. Verify that the firewall policy is enabled for NDMP by using the `system services firewall policy show` command.

The following command displays the firewall policy for the cluster-management LIF:

```
cluster1::> system services firewall policy show -policy cluster

Vserver     Policy       Service    Allowed
-------     ------------ ---------- -----------------
cluster     cluster      dns        0.0.0.0/0
                         http       0.0.0.0/0
                         https      0.0.0.0/0
                        ** ndmp       0.0.0.0/0**
                         ndmps      0.0.0.0/0
                         ntp        0.0.0.0/0
                         rsh        0.0.0.0/0
                         snmp       0.0.0.0/0
                         ssh        0.0.0.0/0
                         telnet     0.0.0.0/0
10 entries were displayed.
```

The following command displays the firewall policy for the intercluster LIF:

```
cluster1::> system services firewall policy show -policy intercluster

Vserver     Policy       Service    Allowed
-------     ------------ ---------- -------------------
cluster1    intercluster dns        -
                         http       -
                         https      -
                         **ndmp       0.0.0.0/0, ::/0**
                         ndmps      -
                         ntp        -
                         rsh        -
                         ssh        -
                         telnet     -
9 entries were displayed.
```

The following command displays the firewall policy for the node-management LIF:

```
cluster1::> system services firewall policy show -policy mgmt

Vserver     Policy       Service    Allowed
-------     ------------ ---------- -------------------
cluster1-1  mgmt         dns        0.0.0.0/0, ::/0
                         http       0.0.0.0/0, ::/0
                         https      0.0.0.0/0, ::/0
                         **ndmp       0.0.0.0/0, ::/0**
                         ndmps      0.0.0.0/0, ::/0
                         ntp        0.0.0.0/0, ::/0
                         rsh        -
                         snmp       0.0.0.0/0, ::/0
                         ssh        0.0.0.0/0, ::/0
                         telnet     -
10 entries were displayed.
```

b. If the firewall policy is not enabled, enable the firewall policy by using the `system services firewall policy modify` command with the `-service` parameter.

   The following command enables firewall policy for the intercluster LIF:

```
cluster1::> system services firewall policy modify -vserver cluster1
-policy intercluster -service ndmp 0.0.0.0/0
```

3. Ensure that the failover policy is set appropriately for all the LIFs:

   a. Verify that the failover policy for the cluster-management LIF is set to `broadcast-domain-wide`, and the policy for the intercluster and node-management LIFs is set to `local-only` by using the `network interface show -failover` command.

      The following command displays the failover policy for the cluster-management, intercluster, and node-management LIFs:

```
cluster1::> network interface show -failover

           Logical            Home               Failover
Failover
Vserver    Interface          Node:Port          Policy
Group
---------- -----------------  ----------------- --------------------
--------
cluster    cluster1_clus1     cluster1-1:e0a    local-only
cluster
                                                    Failover
Targets:
                                                    .......

**cluster1   cluster_mgmt       cluster1-1:e0m    broadcast-domain-
wide Default**
                                                    Failover
Targets:
                                                    .......
           **IC1                cluster1-1:e0a    local-only
Default**
                                                    Failover
Targets:
           **IC2                cluster1-1:e0b    local-only
Default**
                                                    Failover
Targets:
                                                    .......
**cluster1-1 cluster1-1_mgmt1   cluster1-1:e0m    local-only
Default**
                                                    Failover
Targets:
                                                    ......
**cluster1-2 cluster1-2_mgmt1   cluster1-2:e0m    local-only
Default**
                                                    Failover
Targets:
                                                    ......
```

b. If the failover policies are not set appropriately, modify the failover policy by using the `network interface modify` command with the `-failover-policy` parameter.

```
cluster1::> network interface modify -vserver cluster1 -lif IC1
-failover-policy local-only
```

4. Specify the LIFs that are required for data connection by using the `vserver services ndmp modify` command with the `preferred-interface-role` parameter.

```
cluster1::> vserver services ndmp modify -vserver cluster1 -preferred
-interface-role intercluster,cluster-mgmt,node-mgmt
```

5. Verify that the preferred interface role is set for the cluster by using the `vserver services ndmp show` command.

```
cluster1::> vserver services ndmp show -vserver cluster1

                            Vserver: cluster1
                       NDMP Version: 4
                       .......
                       .......
             Preferred Interface Role: intercluster, cluster-mgmt, node-
mgmt
```

Configure node-scoped NDMP

Enable node-scoped NDMP on the cluster

You can back up volumes hosted on a single node by enabling node-scoped NDMP, enabling the NDMP service, and configuring a LIF for data and control connection. This can be done for all nodes of the cluster.

Node-scoped NDMP is deprecated in ONTAP 9.

About this task

When using NDMP in node-scope mode, authentication must be configured on a per-node basis. For more information, see the Knowledge Base article "How to configure NDMP authentication in the 'node-scope' mode".

Steps

1. Enable node-scoped NDMP mode by using the `system services ndmp` command with the `node-scope-mode` parameter.

```
cluster1::> system services ndmp node-scope-mode on
NDMP node-scope-mode is enabled.
```

2. Enable NDMP service on all nodes in the cluster by using the `system services ndmp on` command.

   Using the wildcard "*" enables NDMP service on all nodes at the same time.

   You must specify a password for authentication of the NDMP connection by the backup application.

```
cluster1::> system services ndmp on -node *

Please enter password:
Confirm password:
2 entries were modified.
```

3. Disable the `-clear-text` option for secure communication of the NDMP password by using the `system services ndmp modify` command.

   Using the wildcard "*" disables the `-clear-text` option on all nodes at the same time.

```
cluster1::> system services ndmp modify -node * -clear-text false
2 entries were modified.
```

4. Verify that NDMP service is enabled and the `-clear-text` option is disabled by using the `system services ndmp show` command.

```
cluster1::> system services ndmp show
Node                  Enabled   Clear text  User Id
--------------------- --------- ----------- ---------
cluster1-1            true      false        root
cluster1-2            true      false        root
2 entries were displayed.
```

Configure a LIF

You must identify a LIF that will be used for establishing a data connection and control connection between the node and the backup application. After identifying the LIF, you must verify that firewall and failover policies are set for the LIF.

Beginning with ONTAP 9.10.1, firewall policies are deprecated and wholly replaced with LIF service policies. For more information, see Configure firewall policies for LIFs.

Steps

1. Identify the intercluster LIF hosted on the nodes by using the `network interface show` command with the `-role` parameter.

```
cluster1::> network interface show -role intercluster

            Logical    Status     Network            Current
Current Is
Vserver     Interface  Admin/Oper Address/Mask       Node          Port
Home
----------- ---------- ---------- ------------------ -------------
------- ----
cluster1    IC1        up/up      192.0.2.65/24      cluster1-1    e0a
true
cluster1    IC2        up/up      192.0.2.68/24      cluster1-2    e0b
true
```

2. Ensure that the firewall policy is enabled for NDMP on the intercluster LIFs:
   a. Verify that the firewall policy is enabled for NDMP by using the `system services firewall policy show` command.

      The following command displays the firewall policy for the intercluster LIF:

      ```
      cluster1::> system services firewall policy show -policy intercluster

      Vserver     Policy       Service    Allowed
      -------     ------------ ---------- -------------------
      cluster1    intercluster dns        -
                               http       -
                               https      -
                               **ndmp       0.0.0.0/0, ::/0**
                               ndmps      -
                               ntp        -
                               rsh        -
                               ssh        -
                               telnet     -
      9 entries were displayed.
      ```

   b. If the firewall policy is not enabled, enable the firewall policy by using the `system services firewall policy modify` command with the `-service` parameter.

      The following command enables firewall policy for the intercluster LIF:

      ```
      cluster1::> system services firewall policy modify -vserver cluster1
      -policy intercluster -service ndmp 0.0.0.0/0
      ```

3. Ensure that the failover policy is set appropriately for the intercluster LIFs:

a. Verify that the failover policy for the intercluster LIFs is set to `local-only` by using the `network interface show -failover` command.

```
cluster1::> network interface show -failover
            Logical          Home               Failover     Failover
Vserver     Interface        Node:Port          Policy       Group
--------    ---------------  -----------------  -----------  --------
cluster1    **IC1               cluster1-1:e0a    local-only
Default**
                                                    Failover Targets:
                                                    .......
            **IC2               cluster1-2:e0b    local-only
Default**
                                                    Failover Targets:
                                                    .......
cluster1-1  cluster1-1_mgmt1 cluster1-1:e0m    local-only    Default
                                                    Failover Targets:
                                                    .......
```

b. If the failover policy is not set appropriately, modify the failover policy by using the `network interface modify` command with the `-failover-policy` parameter.

```
cluster1::> network interface modify -vserver cluster1 -lif IC1
-failover-policy local-only
```

Configure the backup application

After the cluster is configured for NDMP access, you must gather information from the cluster configuration and then configure the rest of the backup process in the backup application.

Steps

1. Gather the following information that you configured earlier in ONTAP:
   - The user name and password that the backup application requires to create the NDMP connection
   - The IP addresses of the intercluster LIFs that the backup application requires to connect to the cluster
2. In ONTAP, display the aliases that ONTAP assigned to each device by using the `storage tape alias show` command.

   The aliases are often useful in configuring the backup application.

```
cluster1::> storage tape show -alias

  Device ID: 2a.0
Device Type: tape drive
Description: Hewlett-Packard LTO-5

Node                          Alias     Mapping
----------------------------- --------- ------------------------------
stsw-3220-4a-4b-02            st2       SN[HU19497WVR]
...
```

3. In the backup application, configure the rest of the backup process by using the backup application's documentation.

After you finish

If a data mobility event occurs, such as a volume move or LIF migration, you must be prepared to reinitialize any interrupted backup operations.

Replication between NetApp Element software and ONTAP

Replication between NetApp Element software and ONTAP overview

You can ensure business continuity on an Element system by using SnapMirror to replicate Snapshot copies of an Element volume to an ONTAP destination. In the event of a disaster at the Element site, you can serve data to clients from the ONTAP system, and then reactivate the Element system when service is restored.

Beginning with ONTAP 9.4, you can replicate Snapshot copies of a LUN created on an ONTAP node back to an Element system. You might have created a LUN during an outage at the Element site, or you might be using a LUN to migrate data from ONTAP to Element software.

You should work with Element to ONTAP backup if the following apply:

- You want to use best practices, not explore every available option.
- You want to use the ONTAP command-line interface (CLI), not System Manager or an automated scripting tool.
- You are using iSCSI to serve data to clients.

If you require additional configuration or conceptual information, see the following documentation:

- Element configuration

  NetApp Element software documentation

- SnapMirror concepts and configuration

  Data protection overview

About replication between Element and ONTAP

Beginning with ONTAP 9.3, you can use SnapMirror to replicate Snapshot copies of an Element volume to an ONTAP destination. In the event of a disaster at the Element site, you can serve data to clients from the ONTAP system, then reactivate the Element source volume when service is restored.

Beginning with ONTAP 9.4, you can replicate Snapshot copies of a LUN created on an ONTAP node back to an Element system. You might have created a LUN during an outage at the Element site, or you might be using a LUN to migrate data from ONTAP to Element software.

Types of data protection relationship

SnapMirror offers two types of data protection relationship. For each type, SnapMirror creates a Snapshot copy of the Element source volume before initializing or updating the relationship:

- In a *disaster recovery (DR)* data protection relationship, the destination volume contains only the Snapshot copy created by SnapMirror, from which you can continue to serve data in the event of a catastrophe at the primary site.
- In a *long-term retention* data protection relationship, the destination volume contains point-in-time Snapshot copies created by Element software, as well as the Snapshot copy created by SnapMirror. You might want to retain monthly Snapshot copies created over a 20-year span, for example.

Default policies

The first time you invoke SnapMirror, it performs a *baseline transfer* from the source volume to the destination volume. The *SnapMirror policy* defines the contents of the baseline and any updates.

You can use a default or custom policy when you create a data protection relationship. The *policy type* determines which Snapshot copies to include and how many copies to retain.

The table below shows the default policies. Use the `MirrorLatest` policy to create a traditional DR relationship. Use the `MirrorAndVault` or `Unified7year` policy to create a unified replication relationship, in which DR and long-term retention are configured on the same destination volume.

Policy	Policy Type	Update behavior
MirrorLatest	async-mirror	Transfer the Snapshot copy created by SnapMirror.
MirrorAndVault	mirror-vault	Transfer the Snapshot copy created by SnapMirror and any less recent Snapshot copies made since the last update, provided they have SnapMirror labels “daily” or “weekly”.
Unified7year	mirror-vault	Transfer the Snapshot copy created by SnapMirror and any less recent Snapshot copies made since the last update, provided they have SnapMirror labels “daily”, “weekly”, or “monthly”.

For complete background information on SnapMirror policies, including guidance on which policy to use, see Data Protection.

Understanding SnapMirror labels

Every policy with the “mirror-vault” policy type must have a rule that specifies which Snapshot copies to replicate. The rule “daily”, for example, indicates that only Snapshot copies assigned the SnapMirror label “daily” should be replicated. You assign the SnapMirror label when you configure Element Snapshot copies.

Replication from an Element source cluster to an ONTAP destination cluster

You can use SnapMirror to replicate Snapshot copies of an Element volume to an ONTAP destination system. In the event of a disaster at the Element site, you can serve data to clients from the ONTAP system, then reactivate the Element source volume when service is restored.

An Element volume is roughly equivalent to an ONTAP LUN. SnapMirror creates a LUN with the name of the Element volume when a data protection relationship between Element software and ONTAP is initialized. SnapMirror replicates data to an existing LUN if the LUN meets the requirements for Element to ONTAP replication.

Replication rules are as follows:

- An ONTAP volume can contain data from one Element volume only.
- You cannot replicate data from an ONTAP volume to multiple Element volumes.

Replication from an ONTAP source cluster to an Element destination cluster

Beginning with ONTAP 9.4, you can replicate Snapshot copies of a LUN created on an ONTAP system back to an Element volume:

- If a SnapMirror relationship already exists between an Element source and an ONTAP destination, a LUN created while you are serving data from the destination is automatically replicated when the source is reactivated.
- Otherwise, you must create and initialize a SnapMirror relationship between the ONTAP source cluster and the Element destination cluster.

Replication rules are as follows:

- The replication relationship must have a policy of type “async-mirror”.

  Policies of type “mirror-vault” are not supported.

- Only iSCSI LUNs are supported.
- You cannot replicate more than one LUN from an ONTAP volume to an Element volume.
- You cannot replicate a LUN from an ONTAP volume to multiple Element volumes.

Prerequisites

You must have completed the following tasks before configuring a data protection relationship between Element and ONTAP:

- The Element cluster must be running NetApp Element software version 10.1 or later.
- The ONTAP cluster must be running ONTAP 9.3 or later.
- SnapMirror must have been licensed on the ONTAP cluster.
- You must have configured volumes on the Element and ONTAP clusters that are large enough to handle

anticipated data transfers.

- If you are using the “mirror-vault” policy type, a SnapMirror label must have been configured for the Element Snapshot copies to be replicated.

> You can perform this task in the Element software web UI only. For more information, see the NetApp Element software documentation

- You must have ensured that port 5010 is available.
- If you foresee that you might need to move a destination volume, you must have ensured that full-mesh connectivity exists between the source and destination. Every node on the Element source cluster must be able to communicate with every node on the ONTAP destination cluster.

Support details

The following table shows support details for Element to ONTAP backup.

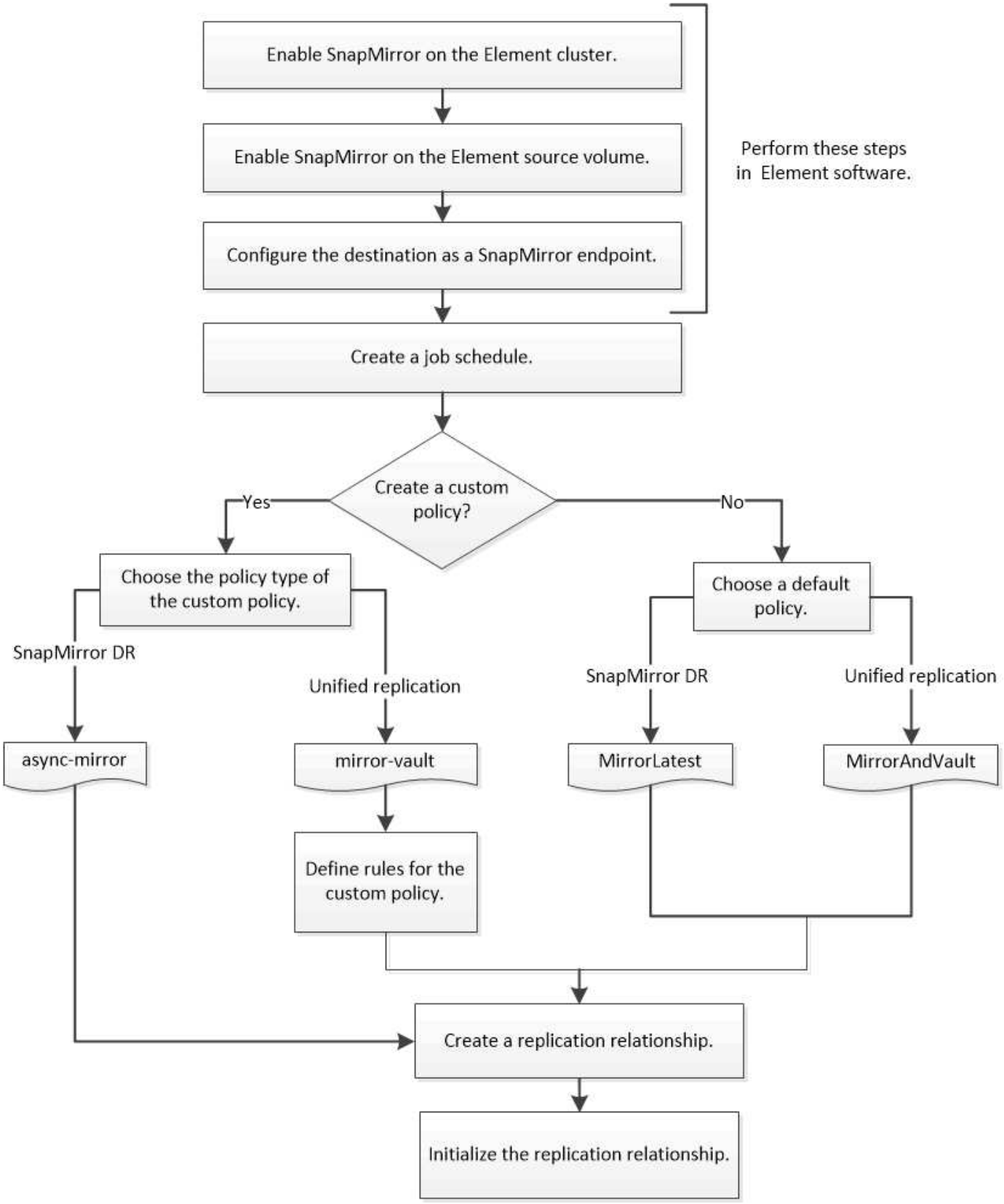
Resource or feature	Support details
SnapMirror	• The SnapMirror restore feature is not supported. • The `MirrorAllSnapshots` and `XDPDefault` policies are not supported. • The “vault” policy type is not supported. • The system-defined rule “all_source_snapshots” is not supported. • The “mirror-vault” policy type is supported only for replication from Element software to ONTAP. Use “async-mirror” for replication from ONTAP to Element software. • The `-schedule` and `-prefix` options for `snapmirror policy add-rule` are not supported. • The `-preserve` and `-quick-resync` options for `snapmirror resync` are not supported. • Storage efficiency is not preserved. • Fan-out and cascade data protection deployments are not supported.
ONTAP	• ONTAP Select is supported beginning with ONTAP 9.4 and Element 10.3. • Cloud Volumes ONTAP is supported beginning with ONTAP 9.5 and Element 11.0.
Element	• Volume size limit is 8 TiB. • Volume block size must be 512 bytes. A 4K byte block size is not supported. • Volume size must be a multiple of 1 MiB. • Volume attributes are not preserved. • Maximum number of Snapshot copies to be replicated is 30.

Network	• A single TCP connection is allowed per transfer. • The Element node must be specified as an IP address. DNS hostname lookup is not supported. • IPspaces are not supported.
SnapLock	SnapLock volumes are not supported.
FlexGroup	FlexGroup volumes are not supported.
SVM DR	ONTAP volumes in an SVM DR configuration are not supported.
MetroCluster	ONTAP volumes in a MetroCluster configuration are not supported.

Workflow for replication between Element and ONTAP

Whether you are replicating data from Element to ONTAP or from ONTAP to Element, you need to configure a job schedule, specify a policy, and create and initialize the relationship. You can use a default or custom policy.

The workflow assumes that you have completed the prerequisite tasks listed in Prerequisites. For complete background information on SnapMirror policies, including guidance on which policy to use, see Data protection.



Enable SnapMirror in Element software

Enable SnapMirror on the Element cluster

You must enable SnapMirror on the Element cluster before you can create a replication

relationship. You can perform this task in the Element software web UI only.

Before you begin

- The Element cluster must be running NetApp Element software version 10.1 or later.
- SnapMirror can only be enabled for Element clusters used with NetApp ONTAP volumes.

About this task

The Element system comes with SnapMirror disabled by default. SnapMirror is not automatically enabled as part of a new installation or upgrade.

> Once enabled, SnapMirror cannot be disabled. You can only disable the SnapMirror feature and restore the default settings by returning the cluster to the factory image.

Steps

1. Click **Clusters** > **Settings**.
2. Find the cluster-specific settings for SnapMirror.
3. Click **Enable SnapMirror**.

Enable SnapMirror on the Element source volume

You must enable SnapMirror on the Element source volume before you can create a replication relationship. You can perform this task in the Element software web UI only.

Before you begin

- You must have enabled SnapMirror on the Element cluster.
- The volume block size must be 512 bytes.
- The volume must not be participating in Element remote replication.
- The volume access type must not be “Replication Target”.

About this task

The procedure below assumes the volume already exists. You can also enable SnapMirror when you create or clone a volume.

Steps

1. Select **Management** > **Volumes**.
2. Select the ⚙ button for the volume.
3. In the drop-down menu, select **Edit**.
4. In the **Edit Volume** dialog, select **Enable SnapMirror**.
5. Select **Save Changes**.

Create a SnapMirror endpoint

You must create a SnapMirror endpoint before you can create a replication relationship. You can perform this task in the Element software web UI only.

Before you begin

You must have enabled SnapMirror on the Element cluster.

Steps

1. Click **Data Protection** > **SnapMirror Endpoints**.
2. Click **Create Endpoint**.
3. In the **Create a New Endpoint** dialog, enter the ONTAP cluster management IP address.
4. Enter the user ID and password of the ONTAP cluster administrator.
5. Click **Create Endpoint**.

Configure a replication relationship

Create a replication job schedule

Whether you are replicating data from Element to ONTAP or from ONTAP to Element, you need to configure a job schedule, specify a policy, and create and initialize the relationship. You can use a default or custom policy.

You can use the `job schedule cron create` command to create a replication job schedule. The job schedule determines when SnapMirror automatically updates the data protection relationship to which the schedule is assigned.

About this task

You assign a job schedule when you create a data protection relationship. If you do not assign a job schedule, you must update the relationship manually.

Step

1. Create a job schedule:

   `job schedule cron create -name` *`job_name`* `-month` *`month`* `-dayofweek` *`day_of_week`* `-day` *`day_of_month`* `-hour` *`hour`* `-minute` *`minute`*

   For `-month`, `-dayofweek`, and `-hour`, you can specify `all` to run the job every month, day of the week, and hour, respectively.

   Beginning with ONTAP 9.10.1, you can include the Vserver for your job schedule:

   `job schedule cron create -name` *`job_name`* `-vserver` *`Vserver_name`* `-month` *`month`* `-dayofweek` *`day_of_week`* `-day` *`day_of_month`* `-hour` *`hour`* `-minute` *`minute`*

   The following example creates a job schedule named `my_weekly` that runs on Saturdays at 3:00 a.m.:

   ```
   cluster_dst::> job schedule cron create -name my_weekly -dayofweek
   "Saturday" -hour 3 -minute 0
   ```

Customize a replication policy

Create a custom replication policy

You can use a default or custom policy when you create a replication relationship. For a custom unified replication policy, you must define one or more *rules* that determine which

Snapshot copies are transferred during initialization and update.

You can create a custom replication policy if the default policy for a relationship is not suitable. You might want to compress data in a network transfer, for example, or modify the number of attempts SnapMirror makes to transfer Snapshot copies.

About this task

The *policy type* of the replication policy determines the type of relationship it supports. The table below shows the available policy types.

Policy type	Relationship type
async-mirror	SnapMirror DR
mirror-vault	Unified replication

Step

1. Create a custom replication policy:

   `snapmirror policy create -vserver` *`SVM`* `-policy policy -type async-mirror|mirror-vault -comment` *`comment`* `-tries` *`transfer_tries`* `-transfer-priority low|normal -is-network-compression-enabled true|false`

   For complete command syntax, see the man page.

   Beginning with ONTAP 9.5, you can specify the schedule for creating a common Snapshot copy schedule for SnapMirror Synchronous relationships by using the `-common-snapshot-schedule` parameter. By default, the common Snapshot copy schedule for SnapMirror Synchronous relationships is one hour. You can specify a value from 30 minutes to two hours for the Snapshot copy schedule for SnapMirror Synchronous relationships.

   The following example creates a custom replication policy for SnapMirror DR that enables network compression for data transfers:

   ```
   cluster_dst::> snapmirror policy create -vserver svm1 -policy
   DR_compressed -type async-mirror -comment "DR with network compression
   enabled" -is-network-compression-enabled true
   ```

   The following example creates a custom replication policy for unified replication:

   ```
   cluster_dst::> snapmirror policy create -vserver svm1 -policy my_unified
   -type mirror-vault
   ```

After you finish

For "mirror-vault" policy types, you must define rules that determine which Snapshot copies are transferred during initialization and update.

Use the `snapmirror policy show` command to verify that the SnapMirror policy was created. For complete

command syntax, see the man page.

Define a rule for a policy

For custom policies with the “mirror-vault” policy type, you must define at least one rule that determines which Snapshot copies are transferred during initialization and update. You can also define rules for default policies with the “mirror-vault” policy type.

About this task

Every policy with the “mirror-vault” policy type must have a rule that specifies which Snapshot copies to replicate. The rule “bi-monthly”, for example, indicates that only Snapshot copies assigned the SnapMirror label “bi-monthly” should be replicated. You assign the SnapMirror label when you configure Element Snapshot copies.

Each policy type is associated with one or more system-defined rules. These rules are automatically assigned to a policy when you specify its policy type. The table below shows the system-defined rules.

System-defined rule	Used in policy types	Result
sm_created	async-mirror, mirror-vault	A Snapshot copy created by SnapMirror is transferred on initialization and update.
daily	mirror-vault	New Snapshot copies on the source with the SnapMirror label “daily” are transferred on initialization and update.
weekly	mirror-vault	New Snapshot copies on the source with the SnapMirror label “weekly” are transferred on initialization and update.
monthly	mirror-vault	New Snapshot copies on the source with the SnapMirror label “monthly” are transferred on initialization and update.

You can specify additional rules as needed, for default or custom policies. For example:

- For the default `MirrorAndVault` policy, you might create a rule called “bi-monthly” to match Snapshot copies on the source with the “bi-monthly” SnapMirror label.
- For a custom policy with the “mirror-vault” policy type, you might create a rule called “bi-weekly” to match Snapshot copies on the source with the “bi-weekly” SnapMirror label.

Step

1. Define a rule for a policy:

   ```
   snapmirror policy add-rule -vserver SVM -policy policy_for_rule -snapmirror
   -label snapmirror-label -keep retention_count
   ```

For complete command syntax, see the man page.

The following example adds a rule with the SnapMirror label `bi-monthly` to the default `MirrorAndVault` policy:

```
cluster_dst::> snapmirror policy add-rule -vserver svm1 -policy
MirrorAndVault -snapmirror-label bi-monthly -keep 6
```

The following example adds a rule with the SnapMirror label `bi-weekly` to the custom `my_snapvault` policy:

```
cluster_dst::> snapmirror policy add-rule -vserver svm1 -policy
my_snapvault -snapmirror-label bi-weekly -keep 26
```

The following example adds a rule with the SnapMirror label `app_consistent` to the custom `Sync` policy:

```
cluster_dst::> snapmirror policy add-rule -vserver svm1 -policy Sync
-snapmirror-label app_consistent -keep 1
```

You can then replicate Snapshot copies from the source cluster that match this SnapMirror label:

```
cluster_src::> snapshot create -vserver vs1 -volume vol1 -snapshot
snapshot1 -snapmirror-label app_consistent
```

Create a replication relationship

Create a relationship from an Element source to an ONTAP destination

The relationship between the source volume in primary storage and the destination volume in secondary storage is called a *data protection relationship*. You can use the `snapmirror create` command to create a data protection relationship from an Element source to an ONTAP destination, or from an ONTAP source to an Element destination.

You can use SnapMirror to replicate Snapshot copies of an Element volume to an ONTAP destination system. In the event of a disaster at the Element site, you can serve data to clients from the ONTAP system, then reactivate the Element source volume when service is restored.

Before you begin

- The Element node containing the volume to be replicated must have been made accessible to ONTAP.
- The Element volume must have been enabled for SnapMirror replication.
- If you are using the “mirror-vault” policy type, a SnapMirror label must have been configured for the Element Snapshot copies to be replicated.

You can perform this task in the Element software web UI only. For more information, see the Element documentation.

About this task

You must specify the Element source path in the form *hostip:*/lun/*name*, where “lun” is the actual string “lun” and `name` is the name of the Element volume.

An Element volume is roughly equivalent to an ONTAP LUN. SnapMirror creates a LUN with the name of the Element volume when a data protection relationship between Element software and ONTAP is initialized. SnapMirror replicates data to an existing LUN if the LUN meets the requirements for replicating from Element software to ONTAP.

Replication rules are as follows:

- An ONTAP volume can contain data from one Element volume only.
- You cannot replicate data from an ONTAP volume to multiple Element volumes.

In ONTAP 9.3 and earlier, a destination volume can contain up to 251 Snapshot copies. In ONTAP 9.4 and later, a destination volume can contain up to 1019 Snapshot copies.

Step

1. From the destination cluster, create a replication relationship from an Element source to an ONTAP destination:

   `snapmirror create -source-path` *`hostip:`*`/lun/name -destination-path` *`SVM:volume`*
   `|`*`cluster://SVM/volume`* `-type XDP -schedule schedule -policy` *`policy`*

   For complete command syntax, see the man page.

   The following example creates a SnapMirror DR relationship using the default `MirrorLatest` policy:

   ```
   cluster_dst::> snapmirror create -source-path 10.0.0.11:/lun/0005
   -destination-path svm_backup:volA_dst -type XDP -schedule my_daily
   -policy MirrorLatest
   ```

   The following example creates a unified replication relationship using the default `MirrorAndVault` policy:

   ```
   cluster_dst:> snapmirror create -source-path 10.0.0.11:/lun/0005
   -destination-path svm_backup:volA_dst -type XDP -schedule my_daily
   -policy MirrorAndVault
   ```

   The following example creates a unified replication relationship using the `Unified7year` policy:

   ```
   cluster_dst::> snapmirror create -source-path 10.0.0.11:/lun/0005
   -destination-path svm_backup:volA_dst -type XDP -schedule my_daily
   -policy Unified7year
   ```

The following example creates a unified replication relationship using the custom `my_unified` policy:

```
cluster_dst::> snapmirror create -source-path 10.0.0.11:/lun/0005
-destination-path svm_backup:volA_dst -type XDP -schedule my_daily
-policy my_unified
```

After you finish

Use the `snapmirror show` command to verify that the SnapMirror relationship was created. For complete command syntax, see the man page.

Create a relationship from an ONTAP source to an Element destination

Beginning with ONTAP 9.4, you can use SnapMirror to replicate Snapshot copies of a LUN created on an ONTAP source back to an Element destination. You might be using the LUN to migrate data from ONTAP to Element software.

Before you begin

- The Element destination node must have been made accessible to ONTAP.
- The Element volume must have been enabled for SnapMirror replication.

About this task

You must specify the Element destination path in the form *`hostip:`*`/lun/`*`name`*, where “lun” is the actual string “lun” and `name` is the name of the Element volume.

Replication rules are as follows:

- The replication relationship must have a policy of type “async-mirror”.

  You can use a default or custom policy.

- Only iSCSI LUNs are supported.
- You cannot replicate more than one LUN from an ONTAP volume to an Element volume.
- You cannot replicate a LUN from an ONTAP volume to multiple Element volumes.

Step

1. Create a replication relationship from an ONTAP source to an Element destination:

   `snapmirror create -source-path` *`SVM:volume|cluster://SVM/volume`* `-destination -path` *`hostip:`*`/lun/`*`name` `-type XDP -schedule schedule -policy` *`policy`*

   For complete command syntax, see the man page.

   The following example creates a SnapMirror DR relationship using the default `MirrorLatest` policy:

```
cluster_dst::> snapmirror create -source-path svm_1:volA_dst
-destination-path 10.0.0.11:/lun/0005 -type XDP -schedule my_daily
-policy MirrorLatest
```

The following example creates a SnapMirror DR relationship using the custom `my_mirror` policy:

```
cluster_dst::> snapmirror create -source-path svm_1:volA_dst
-destination-path 10.0.0.11:/lun/0005 -type XDP -schedule my_daily
-policy my_mirror
```

After you finish

Use the `snapmirror show` command to verify that the SnapMirror relationship was created. For complete command syntax, see the man page.

Initialize a replication relationship

For all relationship types, initialization performs a *baseline transfer*: it makes a Snapshot copy of the source volume, then transfers that copy and all the data blocks it references to the destination volume.

Before you begin

- The Element node containing the volume to be replicated must have been made accessible to ONTAP.
- The Element volume must have been enabled for SnapMirror replication.
- If you are using the “mirror-vault” policy type, a SnapMirror label must have been configured for the Element Snapshot copies to be replicated.

About this task

You must specify the Element source path in the form *`hostip:`*`/lun/`*`name`*, where “lun” is the actual string “lun” and *`name`* is the name of the Element volume.

Initialization can be time-consuming. You might want to run the baseline transfer in off-peak hours.

> If initialization of a relationship from an ONTAP source to an Element destination fails for any reason, it will continue to fail even after you have corrected the problem (an invalid LUN name, for example). The workaround is as follows:
>
> 1. Delete the relationship.
> 2. Delete the Element destination volume.
> 3. Create a new Element destination volume.
> 4. Create and initialize a new relationship from the ONTAP source to the Element destination volume.

Step

1. Initialize a replication relationship:

`snapmirror initialize -source-path hostip:/lun/name -destination-path SVM:volume|cluster://SVM/volume`

For complete command syntax, see the man page.

The following example initializes the relationship between the source volume `0005` at IP address 10.0.0.11 and the destination volume `volA_dst` on `svm_backup`:

```
cluster_dst::> snapmirror initialize -source-path 10.0.0.11:/lun/0005
-destination-path svm_backup:volA_dst
```

Serve data from a SnapMirror DR destination volume

Make the destination volume writeable

When disaster disables the primary site for a SnapMirror DR relationship, you can serve data from the destination volume with minimal disruption. You can reactivate the source volume when service is restored at the primary site.

You need to make the destination volume writeable before you can serve data from the volume to clients. You can use the `snapmirror quiesce` command to stop scheduled transfers to the destination, the `snapmirror abort` command to stop ongoing transfers, and the `snapmirror break` command to make the destination writeable.

About this task

You must specify the Element source path in the form *`hostip:`*`/lun/`*`name`*, where “lun” is the actual string “lun” and `name` is the name of the Element volume.

Steps

1. Stop scheduled transfers to the destination:

   `snapmirror quiesce -source-path hostip:/lun/name -destination-path SVM:volume|cluster://SVM/volume`

   For complete command syntax, see the man page.

   The following example stops scheduled transfers between the source volume `0005` at IP address 10.0.0.11 and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror quiesce -source-path 10.0.0.11:/lun/0005
   -destination-path svm_backup:volA_dst
   ```

2. Stop ongoing transfers to the destination:

   `snapmirror abort -source-path hostip:/lun/name -destination-path SVM:volume|cluster://SVM/volume`

   For complete command syntax, see the man page.

The following example stops ongoing transfers between the source volume `0005` at IP address 10.0.0.11 and the destination volume `volA_dst` on `svm_backup`:

```
cluster_dst::> snapmirror abort -source-path 10.0.0.11:/lun/0005
-destination-path svm_backup:volA_dst
```

3. Break the SnapMirror DR relationship:

   `snapmirror break -source-path` *`hostip:`*`/lun/`*`name`* `-destination-path` *`SVM:volume`*
   `|`*`cluster://SVM/volume`*

   For complete command syntax, see the man page.

   The following example breaks the relationship between the source volume `0005` at IP address 10.0.0.11 and the destination volume `volA_dst` on `svm_backup` and the destination volume `volA_dst` on `svm_backup`:

```
cluster_dst::> snapmirror break -source-path 10.0.0.11:/lun/0005
-destination-path svm_backup:volA_dst
```

Configure the destination volume for data access

After making the destination volume writeable, you must configure the volume for data access. SAN hosts can access the data from the destination volume until the source volume is reactivated.

1. Map the Element LUN to the appropriate initiator group.
2. Create iSCSI sessions from the SAN host initiators to the SAN LIFs.
3. On the SAN client, perform a storage re-scan to detect the connected LUN.

Reactivate the original source volume

You can reestablish the original data protection relationship between the source and destination volumes when you no longer need to serve data from the destination.

About this task

The procedure below assumes that the baseline in the original source volume is intact. If the baseline is not intact, you must create and initialize the relationship between the volume you are serving data from and the original source volume before performing the procedure.

You must specify the Element source path in the form *`hostip:`*`/lun/`*`name`*, where “lun” is the actual string “lun” and `name` is the name of the Element volume.

Beginning with ONTAP 9.4, Snapshot copies of a LUN created while you are serving data from the ONTAP destination are automatically replicated when the Element source is reactivated.

Replication rules are as follows:

- Only iSCSI LUNs are supported.
- You cannot replicate more than one LUN from an ONTAP volume to an Element volume.
- You cannot replicate a LUN from an ONTAP volume to multiple Element volumes.

Steps

1. Delete the original data protection relationship:

   `snapmirror delete -source-path` *`SVM:volume|cluster://SVM/volume`* `-destination -path` *`hostip:`*`/lun/`*`name`* `-policy` *`policy`*

   For complete command syntax, see the man page.

   The following example deletes the relationship between the original source volume, `0005` at IP address 10.0.0.11, and the volume you are serving data from, `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror delete -source-path 10.0.0.11:/lun/0005
   -policy MirrorLatest -destination-path svm_backup:volA_dst
   ```

2. Reverse the original data protection relationship:

   `snapmirror resync -source-path` *`SVM:volume|cluster://SVM/volume`* `-destination -path` *`hostip:`*`/lun/`*`name`* `-policy` *`policy`*

   For complete command syntax, see the man page.

   Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours.

   The following example reverses the relationship between the original source volume, `0005` at IP address 10.0.0.11, and the volume you are serving data from, `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror resync -source-path svm_backup:volA_dst
   -destination-path 10.0.0.11:/lun/0005 -policy MirrorLatest
   ```

3. Update the reversed relationship:

   `snapmirror update -source-path` *`SVM:volume|cluster://SVM/volume`* `-destination -path` *`hostip:`*`/lun/`*`name`*

   For complete command syntax, see the man page.

   > The command fails if a common Snapshot copy does not exist on the source and destination. Use `snapmirror initialize` to re-initialize the relationship.

   The following example updates the relationship between the volume you are serving data from, `volA_dst` on `svm_backup`, and the original source volume, `0005` at IP address 10.0.0.11:

```
cluster_dst::> snapmirror update -source-path svm_backup:volA_dst
-destination-path 10.0.0.11:/lun/0005
```

4. Stop scheduled transfers for the reversed relationship:

   `snapmirror quiesce -source-path` *`SVM:volume`*|*`cluster://SVM/volume`* `-destination -path` *`hostip:`*`/lun/`*`name`*

   For complete command syntax, see the man page.

   The following example stops scheduled transfers between the volume you are serving data from, `volA_dst` on `svm_backup`, and the original source volume, `0005` at IP address 10.0.0.11:

   ```
   cluster_dst::> snapmirror quiesce -source-path svm_backup:volA_dst
   -destination-path 10.0.0.11:/lun/0005
   ```

5. Stop ongoing transfers for the reversed relationship:

   `snapmirror abort -source-path` *`SVM:volume`*|*`cluster://SVM/volume`* `-destination -path` *`hostip:`*`/lun/`*`name`*

   For complete command syntax, see the man page.

   The following example stops ongoing transfers between the volume you are serving data from, `volA_dst` on `svm_backup`, and the original source volume, `0005` at IP address 10.0.0.11:

   ```
   cluster_dst::> snapmirror abort -source-path svm_backup:volA_dst
   -destination-path 10.0.0.11:/lun/0005
   ```

6. Break the reversed relationship:

   `snapmirror break -source-path` *`SVM:volume`*|*`cluster://SVM/volume`* `-destination -path` *`hostip:`*`/lun/`*`name`*

   For complete command syntax, see the man page.

   The following example breaks the relationship between the volume you are serving data from, `volA_dst` on `svm_backup`, and the original source volume, `0005` at IP address 10.0.0.11:

   ```
   cluster_dst::> snapmirror break -source-path svm_backup:volA_dst
   -destination-path 10.0.0.11:/lun/0005
   ```

7. Delete the reversed data protection relationship:

   `snapmirror delete -source-path` *`SVM:volume`*|*`cluster://SVM/volume`* `-destination -path` *`hostip`*`:/lun/`*`name`* `-policy` *`policy`*

For complete command syntax, see the man page.

The following example deletes the reversed relationship between the original source volume, `0005` at IP address 10.0.0.11, and the volume you are serving data from, `volA_dst` on `svm_backup`:

```
cluster_src::> snapmirror delete -source-path svm_backup:volA_dst
-destination-path 10.0.0.11:/lun/0005 -policy MirrorLatest
```

8. Reestablish the original data protection relationship:

   `snapmirror resync -source-path` *`hostip`*`:/lun/`*`name`* `-destination-path` *`SVM:volume`*`|`*`cluster://SVM/volume`*

   For complete command syntax, see the man page.

   The following example reestablishes the relationship between the original source volume, `0005` at IP address 10.0.0.11, and the original destination volume, `volA_dst` on `svm_backup`:

```
cluster_dst::> snapmirror resync -source-path 10.0.0.11:/lun/0005
-destination-path svm_backup:volA_dst
```

After you finish

Use the `snapmirror show` command to verify that the SnapMirror relationship was created. For complete command syntax, see the man page.

Update a replication relationship manually

You might need to update a replication relationship manually if an update fails because of a network error.

About this task

You must specify the Element source path in the form *`hostip:`*`/lun/`*`name`*, where “lun” is the actual string “lun” and `name` is the name of the Element volume.

Steps

1. Update a replication relationship manually:

   `snapmirror update -source-path` *`hostip:`*`/lun/`*`name`* `-destination-path` *`SVM:volume`*`|`*`cluster://SVM/volume`*

   For complete command syntax, see the man page.

   > The command fails if a common Snapshot copy does not exist on the source and destination. Use `snapmirror initialize` to re-initialize the relationship.

   The following example updates the relationship between the source volume `0005` at IP address 10.0.0.11 and the destination volume `volA_dst` on `svm_backup`:

```
cluster_src::> snapmirror update -source-path 10.0.0.11:/lun/0005
-destination-path svm_backup:volA_dst
```

Resynchronize a replication relationship

You need to resynchronize a replication relationship after you make a destination volume writeable, after an update fails because a common Snapshot copy does not exist on the source and destination volumes, or if you want to change the replication policy for the relationship.

About this task

Although resync does not require a baseline transfer, it can be time-consuming. You might want to run the resync in off-peak hours.

You must specify the Element source path in the form *hostip:*/lun/*name*, where “lun” is the actual string “lun” and `name` is the name of the Element volume.

Step

1. Resync the source and destination volumes:

   `snapmirror resync -source-path` *`hostip:`*`/lun/`*`name`* `-destination-path` *`SVM:volume`*
   `|`*`cluster://SVM/volume`* `-type XDP -schedule` *`schedule`* `-policy` *`policy`*

   For complete command syntax, see the man page.

   The following example resyncs the relationship between the source volume `0005` at IP address 10.0.0.11 and the destination volume `volA_dst` on `svm_backup`:

   ```
   cluster_dst::> snapmirror resync -source-path 10.0.0.11:/lun/0005
   -policy MirrorLatest -destination-path svm_backup:volA_dst
   ```