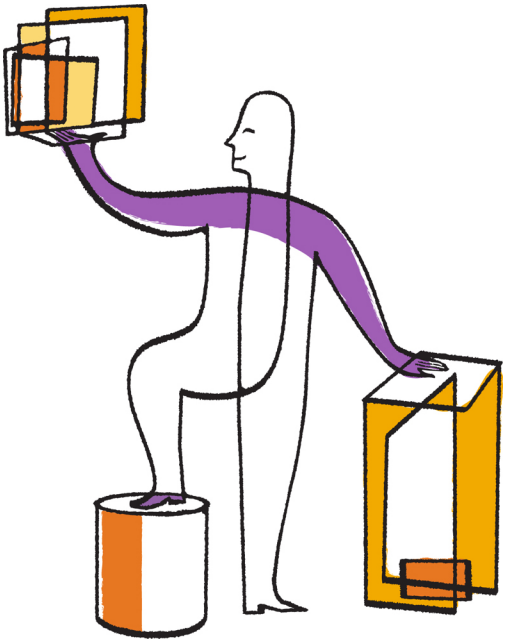
Data ONTAP® 8.2

Archive and Compliance Management Guide

For 7-Mode



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Contents

What SnapLock is

SnapLock is an alternative to the traditional optical "write once, read many" (WORM) data. SnapLock is used for the storage of read-only WORM data.

SnapLock is a license-based, disk-based, open-protocol feature that works with application software to administer non-rewritable storage of data. The primary objective of this Data ONTAP feature is to provide storage-enforced WORM and retention functionality by using open file protocols such as CIFS and NFS. SnapLock can be deployed for protecting data in strict regulatory environments in such a way that even the storage administrator is considered an untrusted party.

SnapLock provides special purpose volumes in which files can be stored and committed to a non-erasable, non-rewritable state either forever or for a designated retention period. SnapLock allows this retention to be performed at the granularity of individual files through standard open file protocols such as CIFS and NFS.

How SnapLock works

The WORM data on SnapLock volumes is administered in the same way as data on regular (non-WORM) volumes. SnapLock volumes operate in WORM mode and support standard file system semantics. You can create data on a SnapLock volume and commit it to the WORM state by transitioning the file from a writable state to a read-only state.

Marking an active writable file as read-only on a SnapLock volume commits the data to WORM. When a file is committed to WORM, it cannot be altered or deleted by applications, users, or administrators until the file retention date is reached. The exception is in SnapLock Enterprise volumes, where you can delete a file before it reaches the retention date by using the privileged delete feature.

The data that is committed to the WORM state on a SnapLock volume cannot be changed or deleted before its retention date. However, you can change or delete the empty directories and files that are not committed to a WORM state. Directories do not behave any differently than they would on regular volumes, with the exception that they cannot be renamed or moved once created. It is a requirement for regulatory compliance that WORM data be not only non-erasable and non-rewritable, but it must also be locked down in the same location at which it was created. In the case of WORM implementation, this means that the directory path to WORM files must be locked down and should never change.

In Data ONTAP 7.0 and later, WORM files can be deleted after their retention dates have been reached. The retention date on a WORM file is set when the file is committed to the WORM state, but it can be extended at any time. The retention period can never be shortened for any WORM file.

Hardware platforms supported for SnapLock

SnapLock is exclusively a licensed feature of Data ONTAP and is supported on almost all NetApp hardware platforms. V-Series supports SnapLock Enterprise on both native and third-party storage, however, SnapLock Compliance is supported only on native disks.

Licensing SnapLock functionality

You must license SnapLock Compliance, SnapLock Enterprise, or both before you can use the SnapLock feature. After installing the license, you need to enable them.

Before you begin

- You must ensure that Storage Encryption functionality is not enabled on the storage system. Storage Encryption is not supported with SnapLock. If Storage Encryption is enabled on a storage system, you cannot use the SnapLock functionality. If a SnapLock license is installed on the storage system, Storage Encryption functionality will be unavailable.

About this task

SnapLock does not support solid-state drive (SSD) aggregates.

Steps

1. Check if the SnapLock licenses exist on the storage system by entering the following command:

   `license`

2. Install a license for SnapLock Compliance, SnapLock Enterprise, or both by using the `license add` command.
   - To use the SnapLock Compliance feature, enter the following command:

     `license add` ***`snaplock_license`***
   - To install the SnapLock Enterprise feature, enter the following command:

     `license add` ***`snaplock_enterprise`***

After you finish

Enable the SnapLock license.

Related tasks

Enabling the SnapLock functionality on page 11

Enabling the SnapLock functionality

After installing the SnapLock license, you must also enable the functionality.

Before you begin

You must have licensed the SnapLock Compliance, SnapLock Enterprise or both the functionalities.

About this task

Note: If your storage system contains SnapLock license and you upgrade to Data ONTAP 8.2, the SnapLock functionality will be enabled by default.

Steps

1. Depending on your requirement, complete one of the following steps:

If you want to...	Enter the following command...
Enable the SnapLock Enterprise functionality	`options licensed_feature.snaplock_enterprise.enable on`
Disable the SnapLock Enterprise functionality	`options licensed_feature.snaplock_enterprise.enable off`

2. Depending on your requirement, complete one of the following steps:

If you want to...	Enter the following command...
Enable the SnapLock Compliance functionality	`options licensed_feature.snaplock.enable on`
Disable the SnapLock Compliance functionality	`options licensed_feature.snaplock.enable off`

After you finish

Initialize the system ComplianceClock.

SnapLock and AutoSupport messages

If you enable the AutoSupport feature, the storage system sends AutoSupport messages to technical support. AutoSupport messages include event, log-level descriptions, SnapLock volume state and options.

The AutoSupport messages also contain the system ComplianceClock time, the volume ComplianceClock time of all the SnapLock volumes, and the expiry date of all volumes on the storage system.

Note: AutoSupport messages do not include options such as a privileged delete setting.

To know more about the AutoSupport messages, see the *Data ONTAP System Administration Guide for 7-Mode*.

What ComplianceClock is

ComplianceClock is a secure time base that prevents compliant data from being tampered with. ComplianceClock makes it impossible to prematurely modify or delete data by altering system clock.

Starting with Data ONTAP 8.1, there are two types of ComplianceClock—volume ComplianceClock and system ComplianceClock. These two types of ComplianceClock minimize the ComplianceClock lag and enable the expiry of WORM files with extended retention.

Related concepts

What the extended date range mechanism is on page 112

What system ComplianceClock is

A system ComplianceClock is a secure time base for each storage system. The system ComplianceClock provides the initial value for volume ComplianceClock when a new SnapLock volume is created.

The system ComplianceClock configuration is used as a reference time for updating the volume ComplianceClock.

What volume ComplianceClock is

The volume ComplianceClock is a time-based security feature for each volume. The volume ComplianceClock is used to determine the expiry date of WORM files and Snapshot copies in a SnapLock volume.

The volume ComplianceClock is initialized automatically during the creation of a new SnapLock volume. When a new SnapLock volume is created, the volume ComplianceClock gets its initial time from the system ComplianceClock time.

Since, each SnapLock volume maintains its own volume ComplianceClock value; therefore, a change in the ComplianceClock value of one volume does not affect the ComplianceClock of any other volume.

How volume ComplianceClock interacts with the system ComplianceClock

The volume ComplianceClock obtains its starting value from the system ComplianceClock time when a new volume is created. Therefore, a continuous association is maintained between the volume ComplianceClock and system ComplianceClock. This association minimizes the instances of ComplianceClock lag.

Initializing the system ComplianceClock

You must initialize the system ComplianceClock to create SnapLock volumes. During initialization, the system ComplianceClock value is initialized to the current value of the system clock.

Before you begin

You must have licensed and enabled the SnapLock Compliance, SnapLock Enterprise, or both.

Step

1. Initialize the system ComplianceClock by entering the following command:

   `snaplock clock initialize`

   Note: You can initialize system ComplianceClock only once.

Example:

The following command initializes the ComplianceClock on the storage system 'System1':

```
System 1> snaplock clock initialize
*** WARNING: YOU ARE INITIALIZING THE SECURE COMPLIANCE CLOCK ***

You are about to initialize the secure Compliance Clock of this
system to the current value of the system clock. This procedure
can be performed ONLY ONCE on this system so you should ensure
that the system time is set correctly before proceeding.

The current local system time is: Mon Jun 20 13:13:49 GMT 2011

Is the current local system time correct? yes
Are you REALLY sure you want initialize the Compliance Clock?yes
```

Related tasks

Enabling the SnapLock functionality on page 11

Viewing the system ComplianceClock and volume ComplianceClock time

You can view the system ComplianceClock time before creating a SnapLock volume. You can view the volume ComplianceClock time for calculating the retention time before committing a file to

WORM state in a SnapLock volume. You can view the system ComplianceClock and the volume ComplianceClock time by using the `status` command.

Step

1. To view the system ComplianceClock and volume ComplianceClock time, enter the following command:

   `snaplock clock status [`*`vol_name`*`]`

   `vol_name` is the name of the SnapLock volume for which you want to view the ComplianceClock time.

   If no volume name is specified, the system ComplianceClock time and volume ComplianceClock time of all the SnapLock volumes are displayed.

Example

The following command displays the system ComplianceClock and volume ComplianceClock time of all the SnapLock volumes:

```
System A> snaplock clock status
System ComplianceClock: Wed Dec 22 06:35:58 GMT 2010

Volume          ComplianceClock
--------------- --------------------
wormvol          Wed Dec 22 06:35:58 GMT 2010
wormvol1        Wed Dec 22 06:35:58 GMT 2010
```

The following command displays the system ComplianceClock and volume ComplianceClock time of SnapLock volume "wormvol":

```
System A>  snaplock clock status wormvol
System ComplianceClock: Wed Dec 22 06:37:27 GMT 2010

Volume          ComplianceClock
--------------- --------------------
Wormvol       Wed Dec 22 06:37:27 GMT 2010
```

Upgrade considerations for ComplianceClock

You should be aware of certain considerations for the ComplianceClock time when upgrading the storage system from an earlier release that supports SnapLock to Data ONTAP 8.1.

- System ComplianceClock is initialized to system clock.
- The ComplianceClock value of an already existing SnapLock volume is used to initialize its volume ComplianceClock.
- The chances of ComplianceClock to lag behind the system clock is minimal, therefore; the ComplianceClock no longer aligns itself to the system clock.

How the volume ComplianceClock impacts SnapLock operations

You can use the volume ComplianceClock for calculating the retention period for performing various SnapLock operations such as committing a file to WORM state, checking the expiry date and so on.

The volume ComplianceClock impacts the following SnapLock operations:

- Creating a SnapLock volume
  You must initialize the system ComplianceClock before creating a SnapLock Compliance volume. The volume ComplianceClock gets initialized automatically. The volume ComplianceClock is used for calculating the retention period of a file.
- Committing a file to WORM state
  When you commit a file to WORM state, volume ComplianceClock time is written to the `ctime` field of the file. The volume ComplianceClock is used for calculating the retention period of a file.

  Note: The `ctime` value is different from the `atime` value that is used as the retention date of the file.
- Checking the expiry status of a WORM file
  To check whether a WORM file has expired, you compare the retention time of the file with the volume ComplianceClock time. If the volume ComplianceClock value is lesser than the retention time of the file, it indicates that the file has not expired.
- Destroying a SnapLock Compliance volume
  To check whether a SnapLock Compliance volume can be destroyed, you compare its destroy time (equivalent to retention time) with volume ComplianceClock time. If the volume ComplianceClock time is less than the volume's destroy time, you cannot destroy the volume.

Operations that might affect volume ComplianceClock time

When the source and destination storage systems are running the same or different Data ONTAP versions, operations such as Volume SnapMirror, aggr copy, or vol copy might affect the volume ComplianceClock time.

Source and destination storage system running different Data ONTAP versions

You should be aware of the following points when performing volume SnapMirror, aggr copy or vol copy operations on the source storage system running Data ONTAP 7.3 and the destination storage system running Data ONTAP 8.1:

- If the source and destination are SnapLock volumes, the destination volume ComplianceClock time is updated as per the source ComplianceClock time.

- If the source is a non-SnapLock volume or aggregate and destination is a SnapLock volume or aggregate, the destination volume ComplianceClock time is updated as per the source ComplianceClock value when the SnapMirror relationship is broken.

Source and destination storage system running the same Data ONTAP version

You should be aware of the following points when performing Volume SnapMirror or vol copy operations on a source and destination storage system running Data ONTAP 8.1:

- If the source and the destination is SnapLock volume, the volume ComplianceClock time of the destination volume is updated as per the source volume.
- If the source is a non-SnapLock volume and the destination is SnapLock volume, the volume ComplianceClock time of the destination volume is re-initialized according to the destination system ComplianceClock.

Creating SnapLock volumes

You can create SnapLock traditional volumes or SnapLock FlexVol volumes. Before you create a SnapLock FlexVol volume, however, you must create an aggregate with SnapLock as an attribute of that aggregate.

Creating SnapLock traditional volumes

You can create SnapLock traditional volumes to retain compliance or archival data.

Before you begin

- You must have licensed and enabled the SnapLock Compliance, SnapLock Enterprise, or both.
- You must have initialized system ComplianceClock.

  Note: If you do not initialize the system ComplianceClock, the volume creation will fail with following message:
  `use "snaplock clock initialize" to set Compliance Clock before creating a SnapLock Enterprise volume.`

Steps

1. Create a SnapLock traditional volume by entering the following command:

   `vol create` ***`trad_vol`*** **`-L`** ***`snaplock_type ndisks`*****`[@`*****`disksize`*****`]`**

   `trad_vol` is the new traditional volume name.

   `ndisks` is the number of disks.

   `disksize` is the size of the disk.

   `snaplock_type` can be `compliance` or `enterprise`.

Note: The volume ComplianceClock gets initialized automatically when you create a SnapLock volume.

2. Verify that the newly created SnapLock volume exists by entering the following command:

   `vol status`

   Example

```
sys1> vol status
          Volume     State      Status          Options
          vol0       online     raid_dp, flex   root       32-bit
          wormvol    online     raid_dp, trad   no_atime_update=on,
                                                snaplock_compliance
```

Related concepts

What ComplianceClock is on page 12

Related tasks

Initializing the system ComplianceClock on page 13

Creating SnapLock aggregates and their flexible volumes

If you are using the FlexVol feature of Data ONTAP, you can create SnapLock aggregates and flexible volumes to retain compliance or archival data.

Before you begin

- You must have licensed and enabled the SnapLock Compliance, SnapLock Enterprise, or both.
- You must have initialized system ComplianceClock.

  Note: If you do not initialize the system ComplianceClock, the aggregate creation fails with following message:
  `use "snaplock clock initialize" to set Compliance Clock before creating a SnapLock Enterprise aggregate.`

About this task

SnapLock is an attribute of the aggregate; therefore, the volume contained in that aggregate inherits the aggregate's SnapLock attributes.

Steps

1. Create a SnapLock aggregate by entering the following command:

   `aggr create` ***`aggrname`*** **`-L`** ***`snaplock_type ndisks`*****`[@`*****`disksize`****`]`**

   `aggrname` is the new SnapLock aggregate name.

snaplock_type can be Compliance or Enterprise.

ndisks is the number of disks.

disksize is the size of the disk, for example, 72 GB.

2. Verify that the newly created SnapLock aggregate exists by entering the following command:

   aggr status

   Example

```
aggr status aggr1
      Aggr State      Status           Options
      aggr1 online  raid_dp, aggr      snaplock_enterprise
      Volumes: vol1
```

3. Create a SnapLock FlexVol volume by entering the following command:

   vol create *wormvol aggrname size*[k|m|g|t]

SnapLock Compliance write verification option

You can use the SnapLock Compliance write verification option when each write operation to the disk media must be immediately read back and verified for integrity.

This feature adds a level of data integrity checking to the already robust data protection and resiliency features in Data ONTAP. Although SnapLock write verification can affect performance, the performance impact should not affect archival throughput.

SnapLock write verification is applicable only for SnapLock Compliance volumes. The SnapLock write verification option provides limited benefit beyond the advanced, high-performance data protection and integrity features already provided by nonvolatile RAM (NVRAM), checksums, RAID scrubs, media scans, and double-parity RAID.

Using the SnapLock Compliance write verification option

You enable the SnapLock write verification option by using the `snaplock.compliance.write_verify` option.

Step

1. To enable SnapLock write verification, enter the following command:

   options snaplock.compliance.write_verify on

What a WORM file is

The abbreviation WORM stands for "write once, read many." A WORM file has the property that data can be written only once to any area of the file and can never be overwritten or erased before the retention period expires.

After a file on a SnapLock volume is committed to the WORM state, there is only one attribute that can be modified—the retention date of the file can be extended. The retention period can never be shortened.

How to manage WORM data

After creating SnapLock volumes, you can transition only the regular files in the volume to the WORM state. You can set the retention date on the file, determine whether a file is in the WORM state, or extend the retention date of a WORM file.

Note: In Data ONTAP 8.1, you cannot commit a non-regular file (such as LUNs and Symbolic links) to WORM state. However, the non-regular files that were committed to WORM state in earlier releases continue to be in WORM state even after upgrading to Data ONTAP 8.1.

Transitioning data to the WORM state

You must transition a file from the writable to read-only state in the SnapLock volume for the file to be committed to a WORM state. You can transition data to the WORM state manually or automatically and set the retention date for the file.

About this task

When you commit a file to WORM state, volume ComplianceClock time is written to the `ctime` field of the file. The volume ComplianceClock is used for calculating the retention period of a file.

Note: The ctime value is different from the `atime` value that is used as the retention date of the file.

Steps

1. Set the retention date using the command or program available to the file access protocol (CIFS, NFS, and so on) and client operating system you are using.

   #### Example

   In a UNIX shell, use the following command to set the `document.txt` file with a retention date of 21 November 2020:

   ```
   touch -a -t 202011210600 document.txt
   ```

2. Commit the `document.txt` file to the WORM state by using the following command:

   ```
   chmod -w document.txt
   ```

   Note: The last accessed timestamp of the file at the time it is committed to the WORM state becomes its retention date unless it is limited by the minimum or maximum retention period of the SnapLock volume. If no retention date was set for the file, the default retention period of the SnapLock volume is used. The file's retention date is stored in the `atime` field. The option

`no_atime_update` is always set to `on` for SnapLock volumes. Therefore, `atime` is not updated when files are accessed.

Related concepts

Committing files to WORM state automatically on page 31

Determining the WORM status of a file

You can check whether the files placed in a SnapLock volume are committed to the WORM state by using the `file fingerprint` command. If a file is transitioned from a writable state to a read-only state in a SnapLock volume, the file is in the WORM state.

Step

1. You can check the WORM state by using the fingerprint of the file:

   `file fingerprint -x` *`pathname`*

   A file has WORM protection if the `file-type` is `worm` and the volume is a SnapLock volume. The file's expiry date is present in the `retention-time` and `formatted-retention-time` fields. You should check this date against the volume ComplianceClock time (specified in the `snaplock-volume-compliance-clock` and `formatted-snaplock-volume-compliance-clock` fields) to determine whether the file has expired.

Examples of file committed to WORM state by using the file fingerprint command

The following example shows a file with read-only permission with the `file-type` changed to `worm`:

```
file fingerprint -x /vol/test_slc_vol/sample_file.0

<fingerprint><fingerprint-info><fingerprint-algorithm>sha-256</
fingerprint-algorithm><fingerprint-start-time>1306404712</
fingerprint-start-time><formatted-fingerprint-start-time>Thu May 26
10:11:52 GMT 2011</formatted-fingerprint-start-time><fingerprint-
scope>data_and_metadata</fingerprint-scope><fingerprint-version>2</
fingerprint-version><fingerprint-input-path>/vol/test_slc_vol/
sample_file.0</fingerprint-input-path><filer-id>118069060</filer-
id><filer-name>f3070-230-70</filer-name><snaplock-
license>compliance and enterprise</snaplock-license><snaplock-
system-compliance-clock>1306404710</snaplock-system-compliance-
clock><formatted-snaplock-system-compliance-clock>Thu May 26
10:11:50 GMT 2011</formatted-snaplock-system-compliance-
clock><volume-name>test_slc_vol</volume-name><volume-
uuid>43cf0d50-8780-11e0-a7ee-123478563412</volume-uuid><volume-
type>flexible</volume-type><volume-containing-aggregate>slc</volume-
containing-aggregate><aggregate-uuid>a235e9e7-8531-11e0-
a7ee-123478563412</aggregate-uuid><volume-snaplock-type>compliance</
```

```
volume-snaplock-type><snaplock-volume-compliance-clock>1306404710</
snaplock-volume-compliance-clock><formatted-snaplock-volume-
compliance-clock>Thu May 26 10:11:50 GMT 2011</formatted-snaplock-
volume-compliance-clock><volume-expiry-date>1306491101</volume-
expiry-date><is-volume-expiry-date-wraparound>false</is-volume-
expiry-date-wraparound><formatted-volume-expiry-date>Fri May 27
10:11:41 GMT 2011</formatted-volume-expiry-date><metadata-
files><file-fingerprint-info><path>/vol/test_slc_vol/sample_file.0</
path><fsid>773461395</fsid><fileid>96</fileid><file-type>worm</file-
type><file-size>2048</file-size><creation-time>1306404660</creation-
time><formatted-creation-time>Thu May 26 10:11:00 GMT 2011</
formatted-creation-time><modified-time>1306404660</modified-
time><formatted-modified-time>Thu May 26 10:11:00 GMT 2011</
formatted-modified-time><changed-time>1306404701</changed-time><is-
changed-time-wraparound>false</is-changed-time-
wraparound><formatted-changed-time>Thu May 26 10:11:41 GMT 2011</
formatted-changed-time><retention-time>1306491101</retention-
time><is-wraparound>false</is-wraparound><formatted-retention-
time>Fri May 27 10:11:41 GMT 2011</formatted-retention-time><owner-
id>0</owner-id><group-id>0</group-id><data-
fingerprint>5aAKqZkayKXuMQmETYSlVYO9IFcq0//NQnkvPDaxg60=</data-
fingerprint><metadata-fingerprint>aUe0DQjT73ncAwp9tWP
+XdvgaU6mMJcnzsSlF5zb9CA=</metadata-fingerprint></file-fingerprint-
info></metadata-files><fingerprint-end-time>1306404712</fingerprint-
end-time><formatted-fingerprint-end-time>Thu May 26 10:11:52 GMT
2011</formatted-fingerprint-end-time></fingerprint-info></
fingerprint>
```

Related concepts

How SnapLock uses fingerprints on page 52

Extending the retention date of a WORM file

A WORM file can remain in WORM state longer than the current retention date if you extend the retention date of the WORM file beyond that of the current retention date.

About this task

For extending the retention date, you can use the command or program available to the file access protocol (CIFS, NFS, and so on) and client operating system you are using. You can extend the retention date interactively or programmatically.

Note: The SnapLock volume maximum or minimum retention period restrictions are not applied when the retention date of a WORM file is being extended.

Steps

1. To extend the retention date, use the command or program available to you.

Example

In a UNIX shell, you can use the following command to extend the `document.txt` file to a WORM state with a retention date of 15 December 2020:

```
touch -a -t 202012150600 document.txt
```

Note: The retention date of a WORM file can never be changed to earlier than its current setting.

2. To check the retention date on a file, enter the following command and note the value of the access time:

   `stat document.txt`

Related concepts

How the SnapLock volume retention period works on page 26

What the WORM append file is

You can append data to a WORM append file. The WORM operations are done in 256-KB segments, so that when byte 256KB+1 is written, the previous segment automatically becomes immutable.

It is sometimes useful to have a SnapLock file that accepts appended data. An example would be a log file that you must retain. Rather than filling a log and copying it to a SnapLock file, you can create the file as a SnapLock file, append data to it, and then lock the file in place.

Note: You cannot reduce the size of WORM appendable files. Therefore, though you can modify the content of the last partial chunk (256k), you cannot reduce the size.

Creating a WORM append file

The WORM append file works with chunks of 256 KB. As each chunk is filled, it is locked. The file must be made read-only for it to be locked in its entirety.

Steps

1. To create a WORM file that can be appended, create a zero length file with the desired retention date inside a WORM volume by entering the following command:

   `touch -a -t 202012150600 file`

2. Make the file read-only by entering the following command:

   `chmod 444 file`

3. Make the file writable again by entering the following command:

```
chmod 644 file
```

Note: This step is not deemed a compliance risk because there is no data in the file.

4. Start writing data to the file by entering the following command:

```
echo test data >> file
```

Note: Data is committed to WORM state in 256-KB chunks. Data does not have to be written sequentially to the active 256-KB chunk. When the data is written to byte n×256KB+1 of the file, the previous 256-KB segment becomes WORM and cannot be rewritten.

As each chunk is filled, it is locked. At this stage, you have a WORM appendable file.

5. When you have finished entering data into the file, make the file read-only again by entering the following command:

```
chmod 444 file
```

The entire file is now in the WORM state and therefore is immutable.

What retention period is

A retention period is the time period after which Data ONTAP permits the deletion of a write once, read many (WORM) file on a SnapLock volume. It is the duration for which a file is retained in WORM state.

Regulatory environments require that records be retained for a long period. Every record committed to the WORM state on a SnapLock volume can have an individual retention period associated with it. Data ONTAP enforces retention of these records until the retention period ends. After the retention period is over, the records can be deleted but not modified. Data ONTAP does not automatically delete any record. All records must be deleted using an application or manually.

The retention period is calculated by using the volume ComplianceClock. You can extend the retention period of an existing WORM file to infinite, however, you cannot shorten the retention period.

How the SnapLock volume retention period works

After creating the SnapLock volume, you can set the volume retention period. The SnapLock volume retention period can be specified in seconds, hours, days, months, or years.

Data ONTAP applies the retention period in a calendar-correct method. For example, if a WORM file or Snapshot copy created on 1 February has a retention period of one month, the retention period will expire on 1 March.

A SnapLock Compliance or Enterprise volume has three retention period values:

- Minimum retention period
- Maximum retention period
- Default retention period

The storage system checks for the minimum and maximum values when a file is committed to the WORM state. You can extend the retention date beyond the date set by the volume's maximum retention period value after the file has been locked initially.

The following table shows the default maximum and minimum retention periods for SnapLock Enterprise and SnapLock Compliance volumes:

Option	**SnapLock Enterprise default**	**SnapLock Compliance default**
`snaplock_minimum_period`	0	0
`snaplock_maximum_period`	30 years	30 years
`snaplock_default_period`	min (equal to snaplock_minimum_period)	max (equal to snaplock_maximum_period)

Viewing the retention period of a volume

You can view the retention period of a volume to know if the volume can be deleted. You can delete a SnapLock volume when the retention period is over. You can view the maximum retention period of WORM files in SnapLock volume by using the `vol status` command.

Step

1. To view the retention period of a SnapLock volume, enter the following command:

   `vol status -w`

Example

In the following example, the command output displays the expiry date of SnapLock volumes in a storage system:

```
system_a> vol status -w
Volume                      Expiry Date                   Compliance Clock
-------------------------   ---------------------------   ---------------------------
vol0                        -                             -
slcv_32_1                   Sun Dec 16 22:13:39 GMT 2012   Tue Feb  5 19:15:30 GMT 2013
slcv_32_3                   Sat Nov 16 22:37:02 GMT 2019   Tue Feb  5 19:15:30 GMT 2013
slcv_32_5                   Mon Sep 16 22:13:32 GMT 2013   Tue Feb  5 19:15:30 GMT 2013
```

If the SnapLock volume does not have any retention time set, the command displays the expiry date as none.

```
system_a> vol status -w
Volume                      Expiry Date                   Compliance Clock
-------------------------   ---------------------------   ---------------------------
vol0                        -                             -
sle_vol                     none                          Thu Jan 10 07:58:27 GMT 2013
reg_vol                     -                             -
slc_vol                     none                          Thu Jan 10 07:58:27 GMT 2013
```

Note: In a SnapLock Enterprise volume, the volume expiry time might be inconsistent, for example, date with a longer retention than that of the oldest file on the volume and so on. This is because certain operations, such as privileged delete and Single File SnapRestore (SFSR), might not update the volume's expiry date. However, you can destroy a SnapLock Enterprise volume, irrespective of the volume's expiry date.

What the minimum retention period is

The minimum retention period is the shortest amount of time that a WORM file can be retained in a SnapLock volume. If the application sets the retention period shorter than the minimum retention period, Data ONTAP adjusts the retention period of the file to the volume's minimum retention period.

The minimum retention period has the following characteristics:

- The existing files that are already in the WORM state are not affected by changes in this volume retention period.
- The minimum retention period takes precedence over a default period or over a retention date that was explicitly set by the application.
- Until you explicitly reconfigure the retention period, the minimum retention period is 0.

Setting the minimum retention period

You can set the SnapLock volume minimum retention period to ensure that applications or users do not assign retention period that do not conform to the minimum retention period requirement.

Step

1. To set the SnapLock volume minimum retention period, enter the following command:

   vol options *vol_name* snaplock_minimum_period {*count*{s|h|d|m|y}}|infinite

   vol_name is the SnapLock volume name.

   count is the retention period specified by a numeral, followed by seconds (s), hours (h), days (d), months (m), or years (y). Alternatively, you can specify `infinite`, which means that only files that get committed to WORM state in the volume are retained forever. To learn about retention period values, see the na_vol(1) man page.

   Note: To set the minimum retention period to `infinite`, you must set the default and maximum retention period also as `infinite`. For details, see the na_vol(1) man page.

Example

The following command sets a minimum retention period of six months:

vol options wormvol1 snaplock_minimum_period 6m

What the maximum retention period is

The maximum retention period is the longest retention period a file can have at the time it is committed to WORM. After a file is committed to WORM, its retention period can be extended beyond this limit.

The maximum retention period has the following characteristics:

- The existing files that are already in the WORM state are not affected by changes in this volume retention period.
- The maximum retention period takes precedence over a default period or over a retention date that was explicitly set by the application.
- The maximum allowed retention period is 70 years. However if the retention time corresponding to 70 years exceeds 19 Jan 2071(GMT), the file is committed to the maximum allowed retention time, which is 19 Jan 2071(GMT).
- Until you explicitly reconfigure the retention period, the maximum retention period is 30 years.

Setting the maximum retention period

You can set the SnapLock volume maximum retention period to ensure that applications or users do not assign excessive retention period that do not conform to the required maximum retention period values. You can also set the maximum retention period to infinite.

Step

1. To set the SnapLock volume maximum retention period, enter the following command:

   vol options *vol_name* snaplock_maximum_period {*count*{s|h|d|m|y}}|infinite

   vol_name is the SnapLock volume name.

   count is the retention period specified by a numeral, followed by seconds (s), hours (h), days (d), months (m), or years (y). Alternatively, you can specify infinite, which means that all files that get committed to WORM in the volume are retained forever.

   See the na_vol(1) man page for details.

   ### Example

   The following command sets a maximum retention period of three years:

   vol options wormvol1 snaplock_maximum_period 3y

What the default retention period is

The default retention period is assigned to a WORM file on a SnapLock volume if the file was not explicitly assigned a retention period.

The initial value of the default retention period is equal to the maximum retention period on SnapLock Compliance volumes and the minimum retention period on SnapLock Enterprise volumes. Any changes in these values change the default retention period.

You cannot explicitly assign an infinite retention period to the file. You can set infinite retention for a file by setting the default retention period of the SnapLock volume to infinite. However, you can extend the retention period of a WORM file to infinite.

Note: Any attempt to explicitly set the retention date of the file before committing it to the WORM state will cause the file to be retained for that specified period. The file will not be retained for an infinite period.

In a scenario, where the volume ComplianceClock lags behind the system time, if the retention time specified for a file (atime) is less than the ctime of the file, the file gets committed to WORM for the default retention period of the volume.

Setting the default retention period

You can reset the default retention period of a SnapLock volume. You might want to do this to ensure that a retention period is assigned to all the WORM files on the volume even if users or the application failed to assign a retention period.

Step

1. To reset the SnapLock volume default retention period, enter the following command:

   vol options *vol_name* snaplock_default_period {*count*{s|h|d|m|y}}|min|max|infinite

   vol_name is the SnapLock volume name.

   count is the retention period specified by a numeral, followed by seconds (s), hours (h),days (d), months (m), or years (y). Alternatively, you can specify infinite, which means that the files are committed to WORM state and retained forever. For details, see the na_vol(1) man page.

   min is the retention period specified by the snaplock_minimum_period option.

   max is the retention period specified by the snaplock_maximum_period option.

   Note: The value of the SnapLock default period must be greater than or equal to the value of the SnapLock minimum retention period and less than or equal to the value of the SnapLock maximum retention period.

Example

The following command sets the default retention period equal to the minimum retention period:

vol options wormvol1 snaplock_default_period min

Committing files to WORM state automatically

If you want to automatically commit all the files in a SnapLock volume to the WORM state, you can use the autocommit feature of SnapLock. The SnapLock autocommit feature commits files to the WORM state if the file does not change during a specified autocommit period.

Beginning with Data ONTAP 8.1, the autocommit period is set at the volume level. The autocommit feature uses the system time to convert regular files to WORM state and the volume ComplianceClock time to set the retention period of the files in a SnapLock volume.

The autocommit feature depends on the status of the SnapLock volume. If a SnapLock volume with the autocommit feature enabled goes offline or is in restricted state, the autocommit feature gets disabled on that volume. The autocommit feature is enabled again automatically when the volume becomes online.

How SnapLock autocommit feature works

The SnapLock autocommit feature enables you to commit all the files in a SnapLock volume to the WORM state automatically. In a new SnapLock volume, the autocommit feature is disabled by default. You can enable the autocommit feature on a SnapLock volume by using the `vol options` command.

You can set the autocommit period of a SnapLock volume in hours, days, months, or years. The minimum autocommit period that can be specified to commit the files to WORM state is two hours. However, the autocommit operation does not take place immediately when the autocommit period ends; instead, the specified period is the minimum amount of time for which the files that are not modified become eligible for locking. The autocommit operation might not follow the autocommit period instantly because of the additional processing needed to commit multiple files to the WORM state.

When you use the autocommit feature to commit a file to WORM, the value (file's `ctime` value plus volume autocommit period) is compared with the value of the system clock. If the system clock value is greater, the file is committed to WORM state.

Note: A file that is automatically committed to the WORM state gets a retention period equal to the volume's default retention period. However, if you explicitly change the `atime` value of the file before it is automatically committed, the file's retention date will be the `atime` value set by you.

Setting the autocommit period

To commit the files in a SnapLock volume to WORM state automatically, you must set the autocommit period. The autocommit period determines how long a file in that volume must remain

unchanged before it is committed to the WORM state. You can set the autocommit period by using the `vol options` command.

Step

1. To set the autocommit period, enter the following command:

   `vol options` ***`vol_name`*** **`snaplock_autocommit_period {none|`*** ***`count`*** **`{h|d|m|y}}`**

   `autocommit_period` is the time in hours, days, months, or years.

   #### Example

   In the following example, the autocommit period is set to 24 days on the volume sle_vol.

   `vol options sle_vol snaplock_autocommit_period 24d`

   Note: You can disable the autocommit feature by setting the autocommit period to `none`.

   After the SnapLock retention period has elapsed, no changes can be made to the file. If you want to delete the file, you must manually change permissions to read-write after the retention period has expired.

Examples of file access before and after an autocommit operation

The following example shows a file fingerprint output of a file before and after the autocommit operation:

```
file fingerprint -x /vol/test_slc_vol/sample_file.0

<fingerprint><fingerprint-info><fingerprint-algorithm>sha-256</
fingerprint-algorithm><fingerprint-start-time>1306404682</
fingerprint-start-time><formatted-fingerprint-start-time>Thu May 26
10:11:22 GMT 2011</formatted-fingerprint-start-time><fingerprint-
scope>data_and_metadata</fingerprint-scope><fingerprint-version>2</
fingerprint-version><fingerprint-input-path>/vol/test_slc_vol/
sample_file.0</fingerprint-input-path><filer-id>118069060</filer-
id><filer-name>f3070-230-70</filer-name><snaplock-
license>compliance and enterprise</snaplock-license><snaplock-
system-compliance-clock>1306404680</snaplock-system-compliance-
clock><formatted-snaplock-system-compliance-clock>Thu May 26
10:11:20 GMT 2011</formatted-snaplock-system-compliance-
clock><volume-name>test_slc_vol</volume-name><volume-
uuid>43cf0d50-8780-11e0-a7ee-123478563412</volume-uuid><volume-
type>flexible</volume-type><volume-containing-aggregate>slc</volume-
containing-aggregate><aggregate-uuid>a235e9e7-8531-11e0-
a7ee-123478563412</aggregate-uuid><volume-snaplock-type>compliance</
volume-snaplock-type><snaplock-volume-compliance-clock>1306404680</
snaplock-volume-compliance-clock><formatted-snaplock-volume-
compliance-clock>Thu May 26 10:11:20 GMT 2011</formatted-snaplock-
volume-compliance-clock><formatted-volume-expiry-
date>no_expiry_date</formatted-volume-expiry-date><metadata-
files><file-fingerprint-info><path>/vol/test_slc_vol/sample_file.0</
path><fsid>773461395</fsid><fileid>96</fileid><file-type>regular</
```

```
file-type><file-size>2048</file-size><creation-time>1306404660</
creation-time><formatted-creation-time>Thu May 26 10:11:00 GMT
2011</formatted-creation-time><modified-time>1306404660</modified-
time><formatted-modified-time>Thu May 26 10:11:00 GMT 2011</
formatted-modified-time><changed-time>1306404660</changed-
time><formatted-changed-time>Thu May 26 10:11:00 GMT 2011</
formatted-changed-time><access-time>1306404660</access-
time><formatted-access-time>Thu May 26 10:11:00 GMT 2011</formatted-
access-time><owner-id>0</owner-id><group-id>0</group-id><data-
fingerprint>5aAKqZkayKXuMQmETYSlVYO9IFcq0//NQnkvPDaxg60=</data-
fingerprint><metadata-fingerprint>iGAAuCvXpKnbrCOHI8AF/
vzNKVesrw8wEV10p8LfeyU=</metadata-fingerprint></file-fingerprint-
info></metadata-files><fingerprint-end-time>1306404682</fingerprint-
end-time><formatted-fingerprint-end-time>Thu May 26 10:11:22 GMT
2011</formatted-fingerprint-end-time></fingerprint-info></
fingerprint>
```

The following example shows the same file with the `file-type` changed to `worm` after the autocommit period has elapsed:

```
file fingerprint -x /vol/test_slc_vol/sample_file.0

<fingerprint><fingerprint-info><fingerprint-algorithm>sha-256</
fingerprint-algorithm><fingerprint-start-time>1306404712</
fingerprint-start-time><formatted-fingerprint-start-time>Thu May 26
10:11:52 GMT 2011</formatted-fingerprint-start-time><fingerprint-
scope>data_and_metadata</fingerprint-scope><fingerprint-version>2</
fingerprint-version><fingerprint-input-path>/vol/test_slc_vol/
sample_file.0</fingerprint-input-path><filer-id>118069060</filer-
id><filer-name>f3070-230-70</filer-name><snaplock-
license>compliance and enterprise</snaplock-license><snaplock-
system-compliance-clock>1306404710</snaplock-system-compliance-
clock><formatted-snaplock-system-compliance-clock>Thu May 26
10:11:50 GMT 2011</formatted-snaplock-system-compliance-
clock><volume-name>test_slc_vol</volume-name><volume-
uuid>43cf0d50-8780-11e0-a7ee-123478563412</volume-uuid><volume-
type>flexible</volume-type><volume-containing-aggregate>slc</volume-
containing-aggregate><aggregate-uuid>a235e9e7-8531-11e0-
a7ee-123478563412</aggregate-uuid><volume-snaplock-type>compliance</
volume-snaplock-type><snaplock-volume-compliance-clock>1306404710</
snaplock-volume-compliance-clock><formatted-snaplock-volume-
compliance-clock>Thu May 26 10:11:50 GMT 2011</formatted-snaplock-
volume-compliance-clock><volume-expiry-date>1306491101</volume-
expiry-date><is-volume-expiry-date-wraparound>false</is-volume-
expiry-date-wraparound><formatted-volume-expiry-date>Fri May 27
10:11:41 GMT 2011</formatted-volume-expiry-date><metadata-
files><file-fingerprint-info><path>/vol/test_slc_vol/sample_file.0</
path><fsid>773461395</fsid><fileid>96</fileid><file-type>worm</file-
type><file-size>2048</file-size><creation-time>1306404660</creation-
time><formatted-creation-time>Thu May 26 10:11:00 GMT 2011</
formatted-creation-time><modified-time>1306404660</modified-
time><formatted-modified-time>Thu May 26 10:11:00 GMT 2011</
formatted-modified-time><changed-time>1306404701</changed-time><is-
changed-time-wraparound>false</is-changed-time-
```

```
wraparound><formatted-changed-time>Thu May 26 10:11:41 GMT 2011</
formatted-changed-time><retention-time>1306491101</retention-
time><is-wraparound>false</is-wraparound><formatted-retention-
time>Fri May 27 10:11:41 GMT 2011</formatted-retention-time><owner-
id>0</owner-id><group-id>0</group-id><data-
fingerprint>5aAKqZkayKXuMQmETYSlVYO9IFcq0//NQnkvPDaxg60=</data-
fingerprint><metadata-fingerprint>aUe0DQjT73ncAwp9tWP
+XdvgaU6mMJcnzsSlF5zb9CA=</metadata-fingerprint></file-fingerprint-
info></metadata-files><fingerprint-end-time>1306404712</fingerprint-
end-time><formatted-fingerprint-end-time>Thu May 26 10:11:52 GMT
2011</formatted-fingerprint-end-time></fingerprint-info></
fingerprint>
```

Displaying the autocommit period of a SnapLock volume

You can view the autocommit period of a SnapLock volume by using the `vol options` command or `vol status` command.

Step

1. To view the autocommit period of a SnapLock volume, enter one of the following commands:
   - **`vol options`** ***`vol_name`***
   - **`vol status -v`** ***`vol_name`***

   `vol_name` is the name of the SnapLock volume for which you want to view the autocommit period.

   `-v` is an option required to display the autocommit period of a volume.

What the privileged delete feature is

The privileged delete feature of SnapLock allows a privileged user to delete a file that is otherwise immutable because of a retention policy. A privileged user should be part of the "Compliance Administrators" group. On a SnapLock Enterprise volume, a privileged user can delete an unexpired WORM file irrespective of its retention period.

The privileged delete feature is available only on a SnapLock Enterprise volume; it is not available on a SnapLock Compliance volume. The delete operation is recorded in the SnapLock log file. All the privileged delete operations are logged in the SnapLock log file in a volume. Therefore, the privileged delete feature is also known as *Auditable Delete*.

When a privileged user deletes a WORM file, the event needs to be logged for auditing. The following SnapLock operations are logged in the SnapLock log volume:

- Privileged delete of a retained WORM file
- Changes to privileged delete state of the SnapLock Enterprise volume
- Changes to the SnapLock log volume
- Addition of a user to and removal of a user from the Compliance Administrators group.

In the SnapLock log file, you can find details related to the privileged deletion of a WORM file, such as whether a file was deleted, when it was deleted, and who deleted the file.

The privileged delete feature enables the compliance administrator to delete a WORM file that is retained on a SnapLock Enterprise volume. The delete operation deletes only the specified file. You can also use the privileged delete feature on a WORM file that has infinite retention.

Note: You cannot use a privileged delete operation to delete an expired WORM file that has exceeded its retention period.

How privileged delete works

By default, a newly created SnapLock Enterprise volume does not allow privileged delete operations. The initial state of the privileged delete feature in a SnapLock Enterprise volume is `off`. Therefore, to use privileged delete, you need to enable the privileged delete option in the SnapLock Enterprise volume.

Each SnapLock Enterprise volume has one of the following options for the privileged delete functionality:

- `on`—The privileged delete feature is turned on and deletions are allowed on that SnapLock Enterprise volume.
- `off`—The feature is turned off and no privileged delete operations are allowed on that SnapLock Enterprise volume.

- `disallowed`—The feature is disabled for this volume and can never be turned on for this volume. If this option is set, you cannot delete any files from the volume before the expiry date.

You can transition the volume option between the three values. However, you cannot enable the privileged delete functionality on a volume for which the option is `disallowed`.

The SnapLock log captures any change made to the privileged delete configuration, along with the delete events. Therefore, before transitioning between the privileged delete options on the volume, you must assign a SnapLock log volume in the system. In certain scenarios, where the volume option for the privileged delete feature is set to `on`, the privileged delete operations might fail. This happens because the SnapLock log file is unavailable. For example, it can happen when the SnapLock log volume is offline.

The privileged delete state of the SnapLock Enterprise volume is a property of the data contained in the SnapLock Enterprise volume. For SnapLock Enterprise volumes, the initial state of the privileged delete feature is `off`; for SnapLock Compliance volumes, the initial state of the privileged delete feature is `disallowed`. In addition, when you upgrade a SnapLock Enterprise volume to Data ONTAP 7.3 for the first time, the initial state of the privileged delete feature is `off`. You can transition the privileged delete state of a SnapLock Enterprise volume to `on`, `off`, or `disallowed` by using the `snaplock options` command.

Note: When you transition a SnapLock Enterprise volume to `disallowed` privileged delete state, you cannot use the `snaplock options` command to change the state again.

In the case of a volume SnapMirror relationship, the state of the privileged delete option on the source volume is transparently transferred to the destination volume. If a SnapLock Enterprise volume in `disallowed` state is a volume SnapMirror destination and you use a `vsm transfer`, `vol copy`, or `aggr copy` command to transfer data from the source volume, the SnapLock Enterprise volume can transition out of the `disallowed` privileged delete state to the privileged delete state of the source.

The SnapLock privileged delete functionality was introduced in the Data ONTAP 7.3 release family starting with release Data ONTAP 7.3.1; it was not available in earlier releases. If you revert to any release earlier than Data ONTAP 7.3, the privileged delete state of the SnapLock Enterprise volume is maintained. When the system is upgraded again to a Data ONTAP 7.3 or later, the saved privileged delete state of the SnapLock Enterprise volume is restored from the earlier saved volume metadata.

Limitations of the privileged delete functionality

Privileged delete functionality has certain limitations such as you cannot delete a file that has exceeded the retention period, cannot use this feature in a SnapLock Compliance volume and so on.

- The privileged delete functionality is not available for SnapLock Compliance volumes.
- You cannot use the privileged delete functionality to delete a file that has exceeded its retention period.
- You cannot perform the privileged delete operation on alternate data streams because you cannot commit the alternate data streams to the WORM state.

- Privileged delete functionality is not available for use through standard protocols such as NFS or CIFS. It is available only through proprietary command-line interface.
- The vFiler units do not support privileged delete operations. Privileged delete is allowed only for the volumes owned by the default vFiler unit (vfiler0).
- If the privileged delete feature is set to `on` for a SnapLock Enterprise volume, you cannot move the volume from the default vFiler unit to any other vFiler unit.

Ensuring secure connection to the storage system

Before you start working with privileged delete, you must ensure that the session is secure and that the SSH and Telnet sessions are distinct sessions.

Step

1. To ensure that the SSH or Telnet sessions are kept separate from other sessions, perform the following steps:
   a) If the `telnet.distinct.enable` option is set to `off` at the time of logging in, set this option to `on`.

      Example

      ```
      options telnet.distinct.enable on
      ```

   b) Log out and log in again.

      This enables the `telnet.distinct.enable` option to take effect.

Enabling privileged delete functionality

To use the privileged delete functionality, you need to enable it in the SnapLock Enterprise volume.

Before you begin

You must configure the SnapLock log volume before you enable the privileged delete functionality in the volume.

Steps

1. To configure the SnapLock log volume, enter the following command:

   ```
   snaplock log volume volume_name
   ```

   The log volume should be a SnapLock Compliance volume.

2. To enable the privileged delete functionality in a SnapLock Enterprise volume, enter the following command:

   ```
   snaplock options volume_name privdel on
   ```

Disabling or disallowing privileged delete functionality

You can disable (turn off) or disallow (permanently remove) the privileged delete feature in a volume. To disallow the privileged delete feature, you must first disable the privileged delete feature in the volume.

Step

1. Depending upon whether you want to disable or disallow the privileged delete feature in a SnapLock volume, perform the appropriate action:

If you want to...	Then...
Disable the privileged delete feature	Enter the following command: **`snaplock options -f volume-name privdel off`**
Disallow privileged delete functionality in a volume	Disable the privileged delete feature, and then enter the following command: **`snaplock options -f volume-name -f privdel disallowed`** **Attention:** The `disallowed` option deletes the privileged delete functionality from the volume. Therefore, when you change the privileged delete state of a volume to `disallowed`, you can never perform a privileged delete operation on that volume.

Deleting a WORM file using privileged delete

You can use the privileged delete feature to delete a WORM file in a SnapLock Enterprise volume before the expiry date of the file is reached. This functionality is supported only for SnapLock Enterprise volumes.

Steps

1. Configure a SnapLock log volume by using the following command:

   `snaplock log volume volume-name`

   where *`volume-name`* is the name of the SnapLock Compliance volume that you want to use for SnapLock logging.

2. In the SnapLock Enterprise volume, create a file with a retention period of, for example, 30 years by using the following command:

   `touch -a -t [[CC]YY]MMDDhhmm[.ss] filename`

Example

```
touch -a -t 203811210600 document.txt
```

The retention period of the `document.txt` file is set to 30 years.

3. Enable privileged delete functionality on the SnapLock Enterprise volume by using the following command:

   snaplock options *volume-name* privdel on

4. Create a user with compliance capabilities by using the following command:

   useradmin user add *user_name* -g "Compliance Administrators"

   user_name is the user name for the new user.

   Note: To assign a user to the Compliance Administrators group, ensure that the `telnet.distinct.enable` option is set to `on`.

5. Log in to SSH session and delete the file by using the following command:

   snaplock privdel [-f] *path*

   The `-f` flag allows the command to proceed without interactive confirmation from the user.

   Note: Only a privileged user can perform the privileged delete operation. The user should be part of the "Compliance Administrators" group.

6. Check the log entry for this delete operation.

How privileged delete affects mirroring interactions

Using SnapMirror, you can replicate a SnapLock Enterprise volume to a non-WORM or another SnapLock Enterprise volume.

If privileged delete is enabled on a SnapLock Enterprise source volume, and the destination is also a SnapLock Enterprise volume, the transfer of the privileged delete state depends on the type of mirroring used. To use the privileged delete functionality at the destination, you need to break the SnapMirror relationship and make the destination volume writable.

In the case of a volume SnapMirror relationship, the privileged delete state of the source volume is transparently transferred to the volume SnapMirror destination volume irrespective of the type of the source and destination volumes. For a SnapLock Enterprise volume and a regular volume, the initial state is `uninitialized`; for a SnapLock Compliance volume the initial state is `disallowed`. In this type of mirroring, the state of the privileged delete feature on the final destination is the same as that on the source volume.

In the case of a qtree SnapMirror relationship, the privileged delete state of the source is not transferred to the destination.

Note: You must separately replicate the log volume to the SnapMirror destination for maintaining complete information about all the privileged delete activity associated with the replicated SnapLock Enterprise volume.

Considerations when using the privileged delete feature

You can perform privileged delete operations over RLM, console, and secure shell (SSH) connections. However, there are certain issues to consider.

Keep in mind the following considerations while using RLM and the console:

- You cannot perform privileged delete operations if both the RLM and console sessions are active.
- You cannot perform privileged delete operations if you had a shared login session previously for the RLM and console sessions.

What SnapLock logging is

SnapLock logging is an infrastructure for logging SnapLock events. The SnapLock events are recorded in the SnapLock log file.

Following are the properties of SnapLock log files:

- The log files are protected from tampering. They are not writable by any external applications.
- SnapLock log files are WORM files that reside on a SnapLock Compliance volume.

In SnapLock logging, you cannot delete the log files until their retention period expires. The retention period of the SnapLock log file is derived from the events that are logged in. The minimum and default retention period of the log file is six months. You can determine the default retention period by using the option `snaplock.log.default_retention`.

When a new record is added in the log file, the retention period of the log file is modified. The retention period of the log file is compared with the retention period of the new event logged in the file. If the retention period of the logged event is longer, the retention period of the log file is made equal to the retention period of the logged event.

In the case of the privileged delete record, the retention period is derived from the file that is deleted. For other events (addition or deletion of compliance users, enabling or disabling of the privileged delete feature, and changes to the log volume), the retention period is equal to the value obtained from the `snaplock.log.default_retention` option.

You can use SnapLock logging for any audits or log. SnapLock logging is also useful for privileged delete operations.

Related concepts

What the privileged delete feature is on page 35

Types of SnapLock log files

SnapLock log files are of two types, `system_log` and `priv_delete`.

The `system_log` file logs system-related SnapLock events such as the addition of a compliance user and changes to the SnapLock log volume.

The `priv_delete` log file logs the privileged delete operations performed on a SnapLock file.

The SnapLock log file name contains the following parameters:

- Base name (`system_log` or `priv_delete`)
- Starting date and time (date and time when the SnapLock log file was created)
- End date and time (present only when the SnapLock log file is archived)

The log file that is being used for logging is called the active log file. An active log file name does not have the end date and time specified in it. It contains only the start date and time. Also, you cannot delete an active log file even after its expiry date.

For example, a `priv_delete` log file could have the following name: `priv_delete.20080825_161858_GMT-20080826_121346_GMT`.

A `system_log` file could have the following name: `system_log.20080825_161858_GMT-20080826_121346_GMT`.

An active `system_log` file could have the following name: `system_log.20080909_131521_GMT-present`.

What the SnapLock log file contains

When an unexpired SnapLock file is deleted, an entry is made in the log file. The log file captures all information about the SnapLock file.

This log record is helpful during an audit because the log entry serves as an evidence for the deleted file. If the expiry time of the deleted SnapLock file exceeds the expiry time of the SnapLock log file, the expiry time of the log file is automatically extended to be the same as the expiry time of the deleted SnapLock file. This ensures that the log record for file deletion is retained at least until the expiry date of the deleted file. The SnapLock Compliance volume contains the SnapLock log files.

The SnapLock log file logs the following events:

- snaplock.log.volume.changed
- snaplock.pre.privileged.delete
- snaplock.post.privileged.delete
- snaplock.pre.option.privileged.delete
- snaplock.post.option.privileged.delete
- snaplock.user.added.deleted

The following log entries will be logged for all the events:

- `LogEntry date` (System Date)
- `SCCdate` (system ComplianceClock date)
- `VCCdate` (volume ComplianceClock date)
- `node` (name of the system)
- `vFilerName`
- `vFilerUUID`
- `LogVersion`

When you use the privileged delete feature, the `snaplock.pre.privileged.delete` log entry is logged immediately before the file is deleted, and the `snaplock.post.privileged.delete` log

entry is logged immediately after the file is deleted. The following table lists the fields that are logged for `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete` events in the SnapLock log file with the base name `priv_delete`:

Field	Events	Description
sequence_number	Logged for `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete`	The sequence number maps the `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete` log entries.
file_pathname	Logged for both `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete`	The complete path of the file on which the privileged delete operation is performed.
file_expires	Logged for both `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete`	Expiry date of the file.
file_fingerprint	Logged for both `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete`	XML-formatted fingerprint using a secure hash of the file's metadata and contents.
client_user	Logged for both `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete`	User name of the client who performs the operation.
client_ip_address	Logged for both `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete`	The IP address of the client who performs the delete operation. **Note:** This field is not valid if client_transport is CONSOLE.

Field	Events	Description
client_transport	Logged for both `snaplock.pre.privileged.delete` and `snaplock.post.privileged.delete`	Transport used by client request. It can have the following values: • SSH • HTTPS • CONSOLE **Note:** The client_ip_address field is not valid if this field has value 'CONSOLE'.
result	Logged only for `snaplock.post.privileged.delete`	Describes the success or failure of the delete operation.

The `snaplock.pre.option.privileged.delete` log entry is logged immediately before the privileged delete option is modified on the volume, and the `snaplock.post.option.privileged.delete` log entry is logged immediately after the privileged delete option is modified on the volume. The following table lists the fields that are logged for `snaplock.pre.option.privileged.delete` and `snaplock.post.option.privileged.delete` events in the SnapLock log file with the base name `priv_delete`:

Field	Events	Description
sequence_number	Logged for both `snaplock.pre.option.privileged.delete` and `snaplock.post.option.privileged.delete`	The sequence number maps the `snaplock.pre.option.privileged.delete` and `snaplock.post.option.privileged.delete` log entries.
volume	Logged for both `snaplock.pre.option.privileged.delete` and `snaplock.post.option.privileged.delete`	The name of the SnapLock volume.

Field	Events	Description
changed_from	Logged for both `snaplock.pre.option.privileged.delete` and `snaplock.post.option.privileged.delete`	The starting value for the option.
changed_to	Logged for both `snaplock.pre.option.privileged.delete` and `snaplock.post.option.privileged.delete`	The ending value for the option.
result	Logged for `snaplock.post.option.privileged.delete`	Describes the success or failure of the option change operation.

The following table lists the fields that are logged for the `snaplock.user.added.deleted` event in the SnapLock log file with the base name `system_log`:

Field	Description
whodidit	The name of the user who modified the compliance group.
username	The name of the user who was added or deleted in a group.
action	Describes if a user is added or deleted to compliance group. This can be one of the following values: "added" or "deleted."

The following table lists the fields that are logged for the `snaplock.log.volume.changed` event in the SnapLock log file with the base name `system_log`:

Field	Description
old_log_volume	The name of the previous log volume.
new_log_volume	The name of the new log volume.

Advantages of SnapLock logging

SnapLock logging has several advantages.

- SnapLock logging logs all the privileged delete operations that affect a WORM file.

- The SnapLock log resides in the SnapLock Compliance volume. Therefore, you cannot delete the log file until the retention period expires. You can extend the retention period of a log file, but you cannot shorten it.
- The log files are protected from tampering. SnapLock files are not writable by any external applications.
- The SnapLock log file contains the version number; therefore, it is possible to check the compatibility between the log files and log records in different Data ONTAP releases.
- SnapLock log files can be parsed by an XML parser.

Limitations of SnapLock logging

SnapLock logging has certain limitations.

- SnapLock logging fails if there is not enough space in the logging volume.
- SnapLock logging fails if the required licenses are not installed and enabled.
  The log volume is a SnapLock Compliance volume; therefore, you need to install and enable the SnapLock Compliance license.
- SnapLock logging fails if the volume used for logging is not available (is offline or does not exist).
- You cannot move a SnapLock log volume from the default vFiler unit to any other vFiler unit.
- If you want to use NTFS or a mixed security style for SnapLock logging, you must upgrade the storage system to Data ONTAP 7.3.2 or later.
  In such a case, you must upgrade both the nodes in an HA pair to Data ONTAP 7.3.2 or later. This ensures that the SnapLock logging operation works correctly during a takeover.

Assigning a SnapLock log volume

You can assign a SnapLock Compliance volume as the log volume to log the SnapLock events.

Before you begin

- You must have licensed and enabled the SnapLock Compliance functionality.
- You must have a SnapLock Compliance volume.

Steps

1. To check the existing volume, enter the following command:
   `vol status`
   This command lists all the volumes. You need to select a SnapLock Compliance volume.
2. To list the SnapLock log volumes in a system, enter the following command:
   `snaplock log volume`
   This command gets the name of the current SnapLock log volume.

3. To set the SnapLock log volume to another volume, enter the following command:

   snaplock log volume -f *worm_log_volume*

   worm_log_volume is the name of the log volume. You can assign any SnapLock Compliance volume on a storage system as the log volume.

   Example

   snaplock log volume -f *logvol*

   logvol is the name of the SnapLock log volume that you want to set.

   Note: The `-f` option force-changes the SnapLock log volume.

4. To check the log status of all the active log files on a volume, enter the following command:

   snaplock log status *worm_log_volume*

   Example

   snaplock log status *logvol*

   logvol is the name of the SnapLock log volume.

How archiving a log file works

You can archive a log file automatically or manually. The logs are archived automatically when the size of the log file exceeds the size that is specified in the `snaplock.log.maximum_size` option.

You can also archive the log files manually. Manual archiving is required in scenarios where you want to keep the privileged delete log records of certain files separately. You can use the `snaplock log archive` command to create a new log file, perform privileged delete, and then again archive the log file.

Archiving log files

You can archive a single active log file or all active log files on a volume.

Steps

1. To get the maximum permissible size of the log file, enter the following command:

   options snaplock.log.maximum_size

2. To archive the file, enter the following command:

   snaplock log archive *vol* [*basename*]

   vol is the name of the SnapLock volume that contains the active SnapLock log files.

basename is the base name of the log file that needs to be archived. Currently, there are only two log files—`system_log` and `priv_delete`. If you do not specify the base name, all active log files in the SnapLock volume are archived.

Note: If the archiving operation fails, the `snaplock log status` command displays the following error message:

```
Log files on volume are inconsistent. Use snaplock log archive
command or change the log volume.
```

Finding the status of the SnapLock log file

You can get the status of either a single active SnapLock log file or all log files in a volume.

Step

1. To get the status of a SnapLock log file, enter the following command:

   `snaplock log status` *`vol`* `[`*`basename`*`]`

   vol is the name of the SnapLock volume that contains the active SnapLock files.

   basename is the base name of the log file for which you want the status.

Result

The `snaplock log status` command displays the following information:

- Log volume name
- Total log files: The command displays the number of active SnapLock log files in a volume. For each active SnapLock log file, it displays the following information:
  - Base name
  - Complete path
  - Expiry date
  - Size
  - SnapLock error

Following is an example of the output of the `snaplock log status` command:

```
system_a> snaplock log status vol_slc
Log Volume Name : vol_slc, Total active logfiles in volume : 2
-----------------------------------------------------------------
Basename: system_log
Complete_path: /vol/vol_slc/system_log.20090330_152241_GMT-present
Expiry: Wed Sep 30 15:22:41 GMT 2009
Size: 503
```

```
Basename: priv_delete
Complete_path: /vol/vol_slc/priv_delete.20090330_152915_GMT-present
Expiry: Wed Sep 30 15:29:15 GMT 2009
Size: 104KB
```

Upgrade and revert considerations for SnapLock logging

If you upgrade to Data ONTAP 7.3.1 or later with support for the SnapLock logging feature, you will have access to the new configurable options and commands required for this feature.

If you revert to a release that does not support the SnapLock logging feature, all the active SnapLock log files will be archived. The SnapLock log file is committed to the WORM state and acts as a simple WORM file. You will lose all the state information about the active log file, for example, the sequence number. The SnapLock log files that already exist are protected against any modification and deletion. All the existing WORM files will be retained until the expiry date of the file.

How Data ONTAP tracks the files on SnapLock volumes

Data ONTAP constantly tracks the retention status of WORM files on SnapLock Compliance volumes. It allows you to destroy a SnapLock Compliance volume depending on the status of the WORM files on the volume. You can destroy a SnapLock Compliance volume if the volume does not contain any unexpired WORM files.

Note: An administrator can destroy SnapLock Enterprise volumes at any time.

Destroying a SnapLock volume

You must check the status of the SnapLock volume and the WORM files before attempting to destroy the volume.

Before you begin

You must have SnapLock volume that contains expired WORM files. If the SnapLock volume contains unexpired WORM files, Data ONTAP will not allow you to destroy that volume. It returns a message stating that the `vol destroy` command cannot destroy the volume.

Steps

1. Take the volume offline by entering the following command:

   `vol offline` *`vol_name`*

2. To destroy the SnapLock volume, enter the following command:

   `vol destroy` *`vol_name`*

   If a SnapLock Compliance volume cannot be destroyed, it remains offline. You should immediately bring it online by using the `vol online` *`vol_name`* command.

Destroying aggregates

An aggregate must be taken offline for destroying. You can take SnapLock aggregates offline only when they do not contain flexible volumes. You must destroy the flexible volumes contained in an

aggregate before you can destroy the aggregate. This applies to all flexible volumes within SnapLock aggregates.

Steps

1. Destroy all flexible volumes contained within the aggregate you want to destroy, by using the `vol destroy` command.
2. To take the aggregate offline, enter the following command:

   `aggr offline` ***`aggr_name`***

   `aggr_name` is the name of the aggregate that you intend to destroy and whose disks you are converting to hot spares.
3. Destroy the aggregate by entering the following command:

   `aggr destroy` ***`aggr_name`***

   `aggr_name` is the name of the aggregate that you are destroying and whose disks you are converting to hot spares.

How SnapLock uses fingerprints

A fingerprint is useful for checking data integrity. The fingerprint operation allows you to generate a fingerprint on a per-file basis by using either of the following hashing algorithms—MD5 or SHA-256.

The fingerprint accounts for data set in place before migration and compares the data before and after migration. In addition, fingerprinting enables log tracking, thus extending the logging functionality.

For example, the privileged delete feature needs the ability to disambiguate (in a crash situation) between a file that was not deleted and a file that is deleted and replaced with a new file with the same name or contents.

You can create fingerprints for both WORM and non-WORM data files. You can generate fingerprints in XML format that can be viewed using any XML browser.

The SnapLock fingerprint operation supports the following algorithms:

- MD5
- SHA-256

By default, SnapLock uses the SHA-256 algorithm.

How a fingerprint is calculated

A fingerprint is calculated based on the file data and metadata.

- File data: Contents of the file
- File metadata:
  - File type
  - File flags
  - File size
  - File user ID
  - File group ID
  - File change time (the time when the inode was changed)
  - File modification time
  - File creation time
  - File retention time

Input parameters for the fingerprint operation

You need to provide the input parameters for the fingerprint operation, including path, algorithm, and scope of the fingerprint operation.

The following table describes the input parameters:

Input parameter	Description
Path	The path of the file for which the fingerprint is calculated.
Fingerprint scope	The scope of fingerprint calculation. It can have the following values: • Data: to be calculated on the data of a file only. • Metadata: to be calculated on the metadata only. • Data and metadata: to be calculated on the data and metadata of a file.
Fingerprint algorithm	The following algorithms are used for fingerprint calculation: • MD5 (hashing algorithm) • SHA-256 (hashing algorithm)

Calculating the fingerprint of a file

You can create a fingerprint for a file by using the `file fingerprint` command.

Step

1. To perform the fingerprint operation, enter the following command:
   `file fingerprint [-a {MD5|SHA-256}] [-m] [-d] [-x]` ***`path`***

   `-a` specifies the algorithm for fingerprint calculation. It can be either MD5 or SHA-256. By default, file fingerprinting uses the SHA-256 algorithm.

   `-m` specifies the metadata fingerprint calculation.

   `-d` specifies the data fingerprint calculation. By default, the fingerprint is calculated for both data and metadata.

   `-x` displays the output in XML format.

   `path` is the path of the file for which the fingerprint operation is required.

Example:

To display the regular output, enter the following command:

```
file fingerprint -a MD5 -m -d /vol/vol_worm/myfile
```

To display the XML output, include `-x` in the command:

```
file fingerprint -a MD5 -m -d -x /vol/vol_worm/myfile
```

Output parameters for the fingerprint operation

The fingerprint operation provides the output parameters of a file, such as general information about the fingerprint operation, volume information, file information, and system information.

General information about the fingerprint operation

- Fingerprint algorithm: the algorithm used for the fingerprint operation.
- File fingerprint scope: the scope provided for the input parameter. It can be data, metadata, or both (data and metadata).
- File fingerprint version: the version of the file fingerprint. Currently, Data ONTAP uses version 2.
- File fingerprint start and stop time: the start and stop time of the file fingerprint calculation.
- Readable format of the fingerprint start and stop times.
- Path: the path of the file on which the file fingerprint calculation was performed.

System information

- FilerID: the NVRAM ID of the storage system.
- Filer-name: the name of the storage system.
- SnapLock license: the type of SnapLock license enabled on your system(SnapLock Compliance or SnapLock Enterprise).
- snaplock-system-compliance-clock: The system ComplianceClock time.
- Readable format of system ComplianceClock time.

Volume information

- Volume name: the name of the volume to which a file belongs.
- Volume-uuid: the universal unique identifier for the volume.
- Volume type: the type of volume (traditional or flexible).
- volume-containing-aggregate: the name of the containing aggregate if it is a flexible volume.
- Aggregate uuid: the universal unique identifier for the aggregate if the volume is a flexible volume.
- SnapLock-volume-type: the type of SnapLock volume. This information is present for SnapLock volumes only. Possible values are-`compliance` or `enterprise`.
- snaplock-volume-compliance-clock: the volume ComplianceClock time.

- Volume expiry date: the expiry date of the volume.
- Fsid: the file system ID for the file.
- is-volume-expiry-date-wraparound: `volume-expiry-date` is a wraparound format. The wraparound format indicates that dates after 19 January 2038 are mapped from 01/01/1970 - 12/31/2002 to 01/19/2038 - 01/19/2071. This field is included only if `volume-expiry-date` is part of file-fingerprint output. It is present only for SnapLock volumes.
- formatted-volume-expiry-date: the expiry date of the SnapLock volume is in the format day month date hour: minutes: second year in the GMT time zone. A value of `infinite` indicates that the volume has an infinite expiry date. A value of `scan_is_pending_or_in_progress` indicates that the expiry date is not displayed because a WORM scan is in progress or pending on the volume. A value of `no_expiry_date` indicates that the expiry date is not displayed because the SnapLock volume has no WORM files and WORM .This field is not included if the volume is offline or the volume is a non-SnapLock volume.

File information

- Path: the path of the file on which the fingerprint operation was performed.
- Fileid: the unique ID of the file within the file system.
- File type: the file type, for example, WORM, WORM appendable, WORM log, or non-SnapLock file.
- File size: the size of the file in bytes.
- creation time: creation time of the file in seconds in standard UNIX format. Time is taken from system clock at the time of file creation.
- Formatted-creation-time: creation time of the file formatted in human-readable format day month date hour: minutes:seconds year in GMT time zone.
- Modified time: last modification time of file in seconds in the standard UNIX format. Time is taken from system clock at the last time the file was modified.
- Formatted-modified-time: last modification time of the file formatted in human-readable format *day month date hour: minutes: seconds year* in GMT time zone.
- Changed-time: last changed time of the file attributes in seconds in standard UNIX format. For WORM files, the last change time for file attributes occurs when file is committed to WORM state. The time is taken from volume ComplianceClock when committing it to WORM.
- is-changed-time-wraparound: this parameter is displayed `True` if the date represented in "changed-time" is in wraparound format. The wraparound format indicates that dates from 1/19/2038-01/19/2071 are mapped to 01/01/1970-12/31/2002
- Formatted change time: last changed time of the file in human-readable format day month date hour: minutes: seconds year in GMT time zone.
- Retention time: retention time of the file in seconds in standard UNIX format. This field is not displayed for regular files, files on non-SnapLock volumes and

files with infinite retention. The flag `is-wraparound` indicates that retention is in the wraparound format. The time is computed with volume ComplianceClock as the reference time.

- is-wraparound: is displayed `True` if the date represented in retention-time is in wraparound format. The wraparound format indicates that dates from 1/19/2038-01/19/2071 are mapped to 01/01/1970-12/31/2002.
- Formatted-retention-time: expiry date of the WORM file formatted in a human-readable format. This takes care of wraparound dates and prints the expiry date of a file in the format day month date hour: minutes: seconds year in GMT time zone. A value as `infinite` indicates that the file has infinite retention time. This field is not included for regular files and files on a non-SnapLock volumes.
- Owner ID: the ID of the owner for the file.
- Group ID: the group ID for the file.
- Data fingerprint: the string format of the fingerprint calculated for the file data. Valid if the scope selected is for data or for both data and metadata.
- Metadata fingerprint: the string format for the fingerprint for the file metadata. Not valid if the scope selected is only data.
- The output parameter also indicates the retention time and wraparound information. This field is valid only for WORM files.

Note:

- You cannot compute a fingerprint on the symbolic link of the file.
- Currently, fingerprint operation is supported only on one file.

SnapLock interaction with a vFiler unit

SnapLock disallows vFiler unit creation if the root of the vFiler unit is on a SnapLock volume.

In releases earlier than Data ONTAP 7.3.1, the vFiler units can be created with the root on a SnapLock volume. After you upgrade to Data ONTAP 7.3.1 or later, these vFiler units continue to operate. However, an error message is raised when the vFiler units are started. The intention of the error message is to warn about the unsupported configuration.

In Data ONTAP 7.3.1 and later, SnapVault is vFiler unit enabled. Because the SnapLock for SnapVault feature is a SnapVault configuration with SnapVault secondary on the SnapLock volume, the following SnapVault options are also available on the vFiler unit:

- `snapvault.access`
- `snapvault.enable`

Creating the root of a vFiler unit from a SnapLock volume to a non-SnapLock volume

You cannot move a vFiler unit from a SnapLock volume to a non-SnapLock volume. You can only re-create a vFiler unit (with the same configuration as in the SnapLock volume) in the non-SnapLock volume. Therefore, to recover from a situation where the root of a vFiler unit is in a SnapLock volume, you need to re-create the root of the vFiler unit in the non-SnapLock volume.

Step

1. To re-create a vFiler unit in a non-SnapLock volume, enter the following command:

   `vfiler create` ***`vfilername`*** **`-r path`**

   where *`vfilername`* is the vFiler unit with the root on the non-SnapLock volume.

Re-creating the vFiler unit in a non-SnapLock volume

The following example shows how to re-create the vFiler unit (with the same configuration as in the SnapLock volume) in a non-SnapLock volume:

1. Consider a vFiler unit, `vfiler1`, having its root in the SnapLock volume `sle0` (at `/vol/sle0/etc`). Copy `/etc` from `sle0` to `vfvol0`, where `vfvol0` is a non-SnapLock volume.
2. Rename SnapLock volume `sle0` to `sle0_temp` and non-SnapLock volume `vfvol0` to `sle0`.
3. Enter the following command:

   `vfiler create vfiler1 -r /vol/sle0`

This command re-creates the vFiler unit with its root on `/vol/sle0/etc` (which is actually the non-SnapLock volume).

4. Rename `sle0` to `vfvol0` in the non-SnapLock volume and `temp_sle0` to `sle0` in the SnapLock volume.
   The vFiler unit, `vfiler1`, is created with its root directory switched from `/vol/sle0/etc/` in the SnapLock volume to `/vol/vfvol0/etc/` in the non-SnapLock volume.

Limitations of vFiler units on SnapLock volumes

There are certain limitations of vFiler units on SnapLock volumes:

- You cannot create new vFiler units on a SnapLock volume.
- The SnapLock commands with exception to the `snaplock clock status` command work only for the volumes that are owned by the root vFiler unit.
- The SnapLock log volume must be completely owned by the default vFiler unit (vfiler0).
- The SnapLock log volume cannot be moved to a nondefault vFiler unit.
- Privileged delete operations cannot be performed on a volume that is not completely owned by the default vFiler unit.
- If a SnapLock Enterprise volume has the `privdel` option set to `on`, you must disable the option before moving the volume to a nondefault vFiler unit.

SnapLock interaction with HA configuration

In an HA configuration, both the nodes should be running the same Data ONTAP version.

In Data ONTAP 8.1, the two nodes in an HA configuration maintain their own system ComplianceClock metadata. However, during the takeover mode, the surviving node maintains the system ComplianceClock metadata of the disaster node. The surviving node updates the system ComplianceClock metadata of both the nodes.

After the disaster node recovers, during the giveback mode, the system ComplianceClock value is returned to the disaster node. After the giveback, both the nodes update their respective system ComplianceClock value.

SnapLock interaction with MetroCluster

As with any volume on a mirrored aggregate, MetroCluster enables SnapLock volumes to be mirrored from one site to another while retaining the SnapLock characteristics, assuming that the sites have been properly configured.

However, if you are planning to use both SnapLock and MetroCluster together, see the *MetroClusters and SnapLock volumes* section of the *Data ONTAP High Availability and MetroCluster Configuration Guide for 7-Mode*.

SnapLock interaction with FlexClone volumes

If the parent volume is a SnapLock Compliance or Enterprise volume, the FlexClone volume inherits the SnapLock specific values of the volume options, volume ComplianceClock, and expiration date of the parent volume. You cannot delete the FlexClone volume before its expiration date.

You can create the FlexClone volume of SnapLock volume by using the `vol clone create` command. However, you must use the `-f` option to create a FlexClone volume of a SnapLock Compliance volume. See the *Data ONTAP Storage Management Guide for 7-Mode* for more information about creating the FlexClone volumes.

Protecting your SnapLock volumes with SnapMirror

You can protect backups on SnapLock volumes by using the SnapMirror relationship.

If you want to protect backups on SnapLock Enterprise volumes with SnapMirror, you can use the same procedures that you use for non-SnapLock volumes.

However, if you are protecting backups on SnapLock Compliance volumes with SnapMirror, some operations, such as the `snapmirror resync` command, cannot be used. This is because a resynchronization operation might alter data and, by definition, compliance data must not be altered. To learn how to set up a SnapMirror relationship, see the *Data ONTAP Data Protection Online Backup and Recovery Guide for 7-Mode*.

In a qtree SnapMirror relationship, the resynchronization of qtree SnapMirror (using the `snapmirror resync` command) and resynchronization of SnapVault (using the `snapvault start -r` command) to SnapLock Compliance volumes is allowed. This is because Data ONTAP provides a mechanism to store the data altered by a resynchronization for subsequent retrieval.

The following table is a quick reference for which SnapLock volumes you can use the `resync` option on:

	SnapLock Compliance destination volume	**SnapLock Enterprise destination volume**
Qtree SnapMirror resynchronization	Yes	Yes
Volume SnapMirror resynchronization	No	Yes

SnapLock qtree SnapMirror resynchronization restrictions

Beginning with Data ONTAP 7.2.5.1, qtree SnapMirror resynchronization is not supported for mirroring volumes from a less strict qtree to a SnapLock Compliance qtree. When the source is a non-SnapLock qtree or a SnapLock Enterprise qtree, and the destination is a SnapLock Compliance qtree, resynchronization is not allowed.

The following table shows all the possible combinations and whether resynchronization is allowed:

SnapMirror resync source	**SnapMirror resync destination**	**Resynchronization**
SnapLock Compliance volume	Non-SnapLock volume	Allowed
SnapLock Enterprise volume	Non-SnapLock volume	Allowed

SnapMirror resync source	SnapMirror resync destination	Resynchronization
Non-SnapLock volume	Non-SnapLock volume	Allowed
SnapLock Compliance volume	SnapLock Enterprise volume	Allowed
SnapLock Enterprise volume	SnapLock Enterprise volume	Allowed
Non-SnapLock volume	SnapLock Enterprise volume	Allowed
SnapLock Compliance volume	SnapLock Compliance volume	Allowed
SnapLock Enterprise volume	SnapLock Compliance volume	Not allowed
Non-SnapLock volume	SnapLock Compliance volume	Not allowed

In addition, to allow a qtree SnapMirror resynchronization between SnapLock Compliance qtrees, you must make at least one transfer from the SnapLock Compliance qtree source to the SnapLock Compliance qtree destination after you upgrade to Data ONTAP 7.2.5.1 or a later release and before you break the relationship. If you do not make the transfer after the upgrade, the resynchronization is disallowed.

What the dump file is

The dump file is created when a `snapmirror resync` is initiated to synchronize the SnapLock destination volume with the SnapLock source volume.

The dump file contains the files changed or added on the SnapLock destination volume after the SnapMirror relationship was broken. The data is written to the dump file in the BSD dump format.

Extracting files from the dump file after a qtree SnapMirror resynchronization

After the qtree SnapMirror resynchronization between the SnapLock Compliance source and destination volume pairs, any new data created on the destination qtree will be archived in a dump file. These files are stored in the following directory on the destination SnapLock Compliance volume:`/etc/logs/snapmirror_resync_archive/volname_UUID_qtree`.The image and log files are named `dump_image_YYMMDD_HHMMSS` and `dump_log_YYMMDD_HHMMSS`, respectively.

Steps

1. Create a directory with the name `temp` in the SnapLock volume.
2. Copy the dump file into this directory and provide the new name `dumpfile` to the file.
3. To view the files contained in the dump file, run the following command:

   `restore -tf /vol/volume_name/temp/dumpfile`

4. To restore the files contained in the dump file to their original location, enter the following command:

   `restore -rfQ /vol/volume_name/temp/dumpfile`

5. To restore the files contained in the dump file to a different location, enter the following command:

   `restore -rfQD /vol/volume_name/temp/dumpfile /vol/volume_name/temp`
   The files extracted will be in their original SnapLock state irrespective of the approach used.

How to set an end-to-end SnapLock Compliance volume SnapMirror relationship

To create an end-to-end relationship between SnapLock Compliance volumes by using SnapMirror, you need to create both the source and the destination volumes as SnapLock Compliance volumes and then initialize the mirroring relationship by using the `snapmirror initialize` command. The other commands you use differ depending on whether you are creating a volume SnapMirror relationship for a traditional volume or a FlexVol volume.

Note: In a volume SnapMirror relationship between two SnapLock Compliance volumes, the exact status of the SnapLock log volume on the source is transferred to the destination volume. The active log files remain active on the destination. The WORM log metafile is also replicated to the destination, and it points to the active WORM log files on the destination. Therefore, you can use the WORM log file from the same state as it was at the source, before the migration.

Limitations of the SnapMirror relationship

The SnapMirror relationship in SnapLock has certain limitations.

- The SnapMirror relationship is not allowed if the source is a non-WORM volume and the destination is a SnapLock Compliance volume.
- The SnapMirror relationship is not allowed if the source is a SnapLock Enterprise volume and the destination is a SnapLock Compliance volume.
- A volume SnapMirror relationship is not allowed between two SnapLock Compliance volumes if the destination volume has unexpired files.
- Deletion of a Snapshot copy on a SnapLock Compliance volume is not allowed if the volume is part of a SnapMirror relationship and the Snapshot copy is locked by SnapMirror. This protects you from accidentally deleting the base Snapshot copy of a volume SnapMirror relationship on a SnapLock Compliance volume.
- On a SnapLock Compliance volume, if a volume SnapMirror relationship is broken, it can never be reestablished.
- In a SnapMirror or vol copy operation from a regular volume to a SnapLock volume, all SnapLock related volume options are cleared out and the `no_atime_update` volume option is set to `on` in the SnapLock volume.

Creating a volume SnapMirror relationship for a FlexVol volume

You can create a volume SnapMirror relationship for a FlexVol volume.

Steps

1. To create a SnapLock Compliance aggregate source, enter the following command:

   aggr create *aggr_name* [-L [*compliance*|*enterprise*]] *ndisks[@disksize]*

   `-L` is specified to create a SnapLock aggregate. The aggregate can either be a SnapLock Compliance aggregate or a SnapLock Enterprise aggregate.

   Example

   aggr create wormaggrsrc -L compliance 3

2. To create a volume in that aggregate, enter the following command:

   vol create *vol_name aggr_name size[k|m|g|t]*

   Example

   vol create src wormaggrsrc 20g

3. To create a SnapLock Compliance aggregate destination, enter the following command:

   aggr create *aggr_name* [-L [*compliance*|*enterprise*]] *ndisks[@disksize]*

   `-L` is specified to create a SnapLock aggregate. The aggregate can either be a SnapLock Compliance aggregate or a SnapLock Enterprise aggregate.

   Example

   aggr create wormaggrdst -L compliance 3

4. To create a volume in that aggregate, enter the following command:

   vol create *vol_name aggr-name size[k|m|g|t]*

   Example

   vol create dst wormaggrdst 20g

5. On the destination system, restrict the volume by using the `vol restrict` command.

   vol restrict *vol_name*

   Example

   vol restrict dst

6. To initialize the SnapMirror relationship between the source and the destination, enter the following command:

   snapmirror initialize -S *src_system:src_vol dst_system:dst_vol*

   src_system is the name of the source system.

   src_vol is the volume you want to copy.

   dst_system is the name of the destination system.

   dst_vol is the destination volume.

   Example

   snapmirror initialize -S src dst

   The `snapmirror initialize` command initializes the SnapMirror relationship between the source volume *src* and destination volume *dst*.

Creating a volume SnapMirror relationship for a traditional volume

You can create a volume SnapMirror relationship for a traditional volume.

Steps

1. To create a SnapLock Compliance volume, enter the following command:

   vol create *vol_name* [-L [*compliance*|*enterprise*]] *ndisks[@disk-size]*

   Example

   vol create src_vol -L compliance 3

2. To create a SnapLock Compliance destination volume, enter the following command:

   vol create *vol_name* [-L [*compliance*|*enterprise*]] *ndisks[@disk-size]*

   Example

   vol create dst_vol -L compliance 3

3. On the destination system, to mark the destination volume as restricted, enter the following command:

   vol restrict *vol_name*

   Example

   vol restrict dst_vol

4. To initialize the SnapMirror relationship between the source and the destination, enter the following command:

   snapmirror initialize -S *src_system:src_vol dst_system:dst_vol*

   src_system is the name of the source system.

   src_vol is the volume you want to copy.

   dst_system is the name of the destination system.

   dst_vol is the destination volume.

   Example

   snapmirror initialize -S src_vol dst_vol

   The `snapmirror initialize` command initializes the SnapMirror relationship between the source volume *src* and destination volume *dst*.

The SnapLock for SnapVault feature—secure SnapVault destination

You can use the SnapLock for SnapVault feature to back up data to SnapLock volumes. The SnapLock for SnapVault feature of Data ONTAP uses SnapVault to back up data, whether it is WORM data or not, to SnapLock Compliance or Enterprise volumes. To keep data on the SnapLock volume compliant, you put the log files on a separate log volume for the SnapLock for SnapVault feature.

Before using the SnapLock for SnapVault feature, you need to ensure that the log volume for the SnapLock for SnapVault feature is configured. To configure the log volume for the SnapLock for SnapVault feature, you use the `snapvault.lockvault.log_volume` option. For added data protection, create a copy of the log volume for the SnapLock for SnapVault feature by using SnapMirror.

The process of using the SnapLock for SnapVault feature to back up data to SnapLock volumes is similar to the process of backing up data to non-SnapLock volumes.

- You can back up the primary system data using the SnapLock for SnapVault feature.
- For additional protection, if you want a copy of the backup of the SnapLock for SnapVault feature, copy the destination volume of the SnapLock for SnapVault feature by using SnapMirror.

In the SnapLock for SnapVault relationship, you cannot have both the source and the destination as SnapLock Compliance volumes.

Note: Open Systems SnapVault 2.1 and later support the SnapLock for SnapVault feature.

Guidelines for using the SnapLock for SnapVault feature

You should follow certain guidelines to back up data to SnapLock volumes by using the SnapLock for SnapVault feature.

These guidelines cover the following areas:

- Capacity planning
- Management of WORM Snapshot copies from SnapVault
- Management of SnapVault log files

Aspects of capacity planning

You should plan the capacity of your storage system and the secondary storage system before performing the backup.

The following are the aspects of capacity planning:

- SnapVault secondary storage system volume size
- The SnapLock for SnapVault Log volume size
- Number of qtrees backed up to each volume
- SnapVault schedule

Guidelines for estimating SnapVault secondary storage system volume size

There are guidelines you can follow to estimate the size of SnapVault secondary storage system volumes for growth over one year, depending on how often you back up data.

- Three percent (3%) growth every day
- Five percent (5%) growth every week
- Ten percent (10%) growth every month
- Seven percent (7%) monthly growth rate, compounded to 100 percent growth every year

The following is an example of how to estimate the daily backup:

Example: Estimating daily backup

Assume a starting baseline transfer of 1 GB and 100 percent growth of new data for the year (1 GB). The changed size due to daily growth if changes are made every weeknight is as follows:

- Calculate daily backup by using the following equation: Size due to daily growth = (number of days x .03) - (new data)
  For example, size due to daily growth = (250 x .03) - 1 GB = 7.5 GB - 1 GB = 6.5 GB of change
  Therefore, for 1 GB of source data, you need 1 GB baseline + 1 GB new data + 6.5 GB of changed data = 8.5 GB secondary system volume. In other words, you must be able to scale the secondary system volume to about 8 times the current data set size within one year.

Estimating the log volume size

You can use simple equations to estimate the size of the log data associated with each SnapLock volume and create a log volume equal to the total of the combined estimated sizes.

Steps

1. Calculate the baseline transfer as follows:

   ```
   Baseline transfer = number of inodes per volume x 256 bytes
   ```

   where 256 bytes is an estimated size of the log entry.

2. Calculate the incremental transfers as follows:

   ```
   Incremental transfers = number of inodes x .03 x 250 snapshot copies x
   256 bytes
   ```

   where .03 represents the rate of change.

   Note: If the estimate is too low, you can add disks to the volume; alternatively, you can allocate a second log volume if the first becomes full and configure the system to use the new log volume.

How to set up SnapVault backups

To set up SnapVault backups, you must prepare the primary storage system and SnapVault secondary storage system to perform backup tasks. These tasks are similar to those for non-SnapLock volumes. To use SnapVault backup, you must have separate SnapVault licenses for the primary and the secondary storage systems.

- On the primary storage system, use console commands to activate the SnapVault primary license and specify the SnapVault secondary storage host.
- On the SnapVault secondary storage system, use console commands to license and enable SnapVault, initialize system ComplianceClock, configure the log volume for the SnapLock for SnapVault feature, specify the primary storage system that are to be backed up, and start the process of initial Snapshot copy backup.
- On the primary storage system, schedule the time for local SnapVault Snapshot copies to occur. On the SnapVault secondary storage system, schedule the time for the Snapshot copies from the primary storage system to be backed up to secondary storage system.

Configuring a primary storage system for SnapVault

To back up a primary storage system to the SnapVault secondary storage system, you need to log in to the primary system's console and enable SnapVault.

Steps

1. Set up the SnapVault primary license on each primary storage system to be backed up. In the console, enter the following command:

   license add *sv_primary_license*

2. Enable SnapVault on each primary storage system to be backed up. In the console, enter the following command:

   options snapvault.enable on

3. Specify the name of the SnapVault secondary storage system. To do this, enter the following command:

   options snapvault.access host=*snapvault_secondary*

   The system must be able to resolve the host name (*snapvault_secondary*) to an IP address in the `/etc/hosts` file or else the system needs to be running DNS or NIS. You can also enter the IP address instead of the host name. For details, see the na_protocolaccess(8) man page. For more information about the `options` command, see the na_options(1) man page.

Configuring a SnapVault secondary storage system

To configure a SnapVault secondary storage system, you need to log in to the secondary system's console and enable the SnapVault license.

Steps

1. Set up the SnapVault secondary license by entering the following command in the console of the SnapVault secondary system:

   license add *sv_secondary_license*

2. Enable SnapVault by entering the following command:

   options snapvault.enable on

3. Initialize system ComplianceClock if you have not already done so by entering the following command:

   snaplock clock initialize

   The system prompts you to confirm the current local time and that you want to initialize system ComplianceClock.

4. Create the log volume for the SnapLock for SnapVault feature. The log volume should be a SnapLock volume that contains Operations log files and Files-transferred log files.

5. Configure the log volume for the SnapLock for SnapVault feature by entering the following command:

   options snapvault.lockvault_log_volume *volume_name*

   volume_name is the log volume for the SnapLock for SnapVault feature.

   Note: You must use the name of a previously created SnapLock volume for this command to succeed.

6. To specify the names of the primary storage system that you want to back up and restore, enter the following command:

   options snapvault.access host=*snapvault_primary1,snapvault_primary2 ...*

7. For each qtree on the primary storage system to be backed up, execute an initial baseline copy of the qtree from the primary to the secondary storage system.

   On each command line, specify the primary storage system, volume, qtree, and the secondary storage host, SnapLock volume, and qtree. You need to use the `-S` prefix to indicate the source qtree path.

Example

To start a baseline copy of qtrees `tree_a` , `tree_b`, and `tree_c` to a SnapLock Compliance volume called `sv_vol`, use the following commands:

```
snapvault start -S system_a:/vol/vol1/tree_a sv_systemb:/vol/sv_vol/
tree_a

snapvault start -S system_a:/vol/vol1/tree_b sv_systemb:/vol/sv_vol/
tree_b

snapvault start -S system_a:/vol/vol1/tree_c sv_systemb:/vol/sv_vol/
tree_c
```

Note: Enter each command on a single line.

Scheduling SnapVault update backups on the primary storage system

You can configure a schedule for Snapshot copies on both the primary and the SnapVault secondary storage systems. You can set the schedules to an hourly, weekly, or nightly basis.

Step

1. On each primary storage system that contains qtrees to be backed up to a SnapVault secondary storage system, schedule the Snapshot copies on each volume that contains the backed-up qtrees by using the following command:

   snapvault snap sched *volume_name snap_name schedule_spec*

   For each set of Snapshot copies, specify the volume name, Snapshot copy base name (for example, “sv_hourly” or “sv_nightly”), number of SnapVault Snapshot copies to store locally, and the days and hours to execute the Snapshot copies.

Examples of scheduling the Snapshot copies

Some of the specific examples of the command follow:

```
snapvault snap sched vol1 sv_weekly 1@sat@19

snapvault snap sched vol1 sv_nightly 2@mon-fri@19

snapvault snap sched vol1 sv_hourly 11@mon-fri@7-18
```

Note: When specifying the SnapVault Snapshot copy base name, avoid using “hourly,” “nightly,” or “weekly.” Such naming conflicts with the non-SnapVault `snap sched` Snapshot copies.

Scheduling SnapVault update backups on the SnapVault secondary storage system

For each SnapVault volume Snapshot copy set that you scheduled on your primary storage system , you can schedule a set of transfers and the subsequent Snapshot copies of the SnapVault secondary storage system.

Step

1. Enter the following command:

   snapvault snap sched -x *sec_vol snap_name count* [@*day_list*][@*hour_list*]

   Note: Before scheduling SnapVault Snapshot copies, ensure that the SnapLock default retention period is set correctly or that you explicitly set the retention period when you schedule SnapVault Snapshot copies.

   The `-x` parameter causes SnapVault to copy new or modified data from the primary qtrees to their associated qtrees on the secondary storage system. After all the secondary qtrees on the specified volume have been updated, SnapVault creates a Snapshot copy of this volume for archiving.

   count is the number of Snapshot copies you want to retain for this set. If the value is 0, no Snapshot copies are taken. If the value is not 0, Snapshot copies are taken and no Snapshot copies are automatically deleted.

   @day_list is a comma-separated list that specifies the days on which a new Snapshot copy is created for this set.

   @hour_list specifies the hours at which a new Snapshot copy is created for this set.

   Snapshot copy base names on the primary and secondary systems must match, but Snapshot copy times and number of stored Snapshot copies can differ.

Scheduling SnapVault update backups on the SnapVault primary and secondary storage system schedules

If SnapVault is scheduled to perform Snapshot copy management at the same time as the default `snapshot sched` activity, the Snapshot copy management operations scheduled using the `snap sched` command might fail with syslog messages.

About this task

The Snapshot copy management operations scheduled using the `snap sched` command might fail with the syslog messages “Skipping creation of hourly snapshot” or “Snapshot already exists." To

avoid this condition, you should disable the conflicting times using `snap sched`, and use the `snapvault snap sched` command to configure equivalent schedules.

Step

1. To turn off the regular schedule of Snapshot copies, enter the following command:

   ```
   snap sched volume 0 0 0
   ```

Guidelines for scheduling SnapVault transfers

The only guideline for scheduling SnapVault transfers is not to overload the primary storage system or the network. You must consider the overall load and time to complete all transfers.

Management of WORM Snapshot copies by using SnapVault

You can manage WORM Snapshot copies by using SnapVault.

How retention of Snapshot copies works on SnapLock volumes

SnapVault uses the `count` field of the SnapVault schedule on the secondary storage system to determine the number of Snapshot copies that are retained.

When the maximum count of Snapshot copies to be retained is reached, the oldest retained Snapshot copies are deleted when new Snapshot copies are added. For SnapLock volumes, older WORM Snapshot copies cannot be deleted until their retention period has expired.

WORM Snapshot copies are not deleted automatically. You must delete WORM Snapshot copies when they expire.

How Snapshot copies are named on SnapLock volumes

Snapshot copies created by SnapVault on SnapLock volumes use a different naming scheme from that used by Snapshot copies for regular volumes.

The Snapshot copy name contains the system clock time and date as a suffix. The following is the format of the Snapshot copy name: *snapname*`.`*yyyymmdd_hhmmss_zzz*.

snapname is the Snapshot copy name specified in the schedule.

yyyymmdd is the year, month, and day.

hhmmss is the hour, minute, and second.

zzz is the current time zone setting.

Example

```
%/used %/total date name
---------- ---------- ------------ --------
2% ( 2%) 0% ( 0%) Feb 04 02:20 svhourly.20040104_120502_GMT
9% ( 3%) 1% ( 0%) Feb 04 02:15 svhourly.20040104_180601_GMT
```

Retention period for WORM Snapshot copies created by SnapVault

You can configure the schedules on the SnapVault secondary storage system to create WORM Snapshot copies and specify a retention period.

For WORM Snapshot copy creation, the volume must exist on the secondary storage system and it must be a SnapLock volume.

Note: If you change the retention period in the schedule, WORM Snapshot copies created under the previous schedule retain their retention period, and WORM Snapshot copies created under the changed schedule use the new retention period.

Default SnapVault settings for the WORM Snapshot copies retention period

When you configure a SnapVault Snapshot copy schedule for a SnapLock volume on the secondary storage system, the Snapshot copies created for that volume are WORM Snapshot copies. By default, SnapVault uses the retention period set by the `snaplock_default_period vol` option as the retention period for the WORM Snapshot copies.

You should ensure that the retention periods you configured when creating a SnapLock Compliance volume are correct.

Note: The default retention period for volumes of the SnapLock for SnapVault feature is 30 years if the volume is a SnapLock Compliance volume. If the volume is a SnapLock Enterprise volume, the default retention period is 0 years. Unless you want all the SnapVault WORM Snapshot copies created in a SnapLock Compliance volume to have a 30-year retention period, be sure to reset the default retention period.

Specifying retention period for WORM Snapshot copies

You can specify retention period for different WORM Snapshot copies created in a SnapLock volume.

Step

1. To specify the retention period for WORM Snapshot copies, enter the following command:

   `snapvault snap sched -x -o retention_period=`*`period sec_vol snapname count@day_list@hour_list`*

   `period` is the retention period specified by a numeral followed by days (d), months (m), or years (y).

   `sec_vol` is the name of the volume where the Snapshot copy resides.

   `snapname` is the name of the Snapshot copy.

count is the number of Snapshot copies you want to retain for this set, although this value is ignored.

@day_list is a comma-separated list that specifies the days on which a new Snapshot copy is created for this set.

@hour_list specifies the hours at which a new Snapshot copy is created for this set.

Example

WORM Snapshot copies created on the secondary storage system in the sv_proj SnapLock volume have retention period of 360 days from the time of their creation. Snapshot copies are created at noon and 8:00 p.m. every day.

```
snapvault snap sched -x -o retention_period=360d sv_proj sv_hourly
1@12,20
```

Extending the retention period of WORM Snapshot copies

You can extend the retention period of a WORM Snapshot copy.

Step

1. To extend the retention period of a WORM Snapshot copy, enter the following command:

   snapvault snap retain *volumesnapshot period*

   volume is the name of the WORM volume.

   snapshot is the name of the Snapshot copy.

   period is the retention period specified by a numeral followed by days (d), months (m), or years (y).

Example

The following command extends the shown *sv_hourly* Snapshot copy in the *wormvol* volume to two years:

```
snapvault snap retain wormvol sv_hourly.20050513_195442_GMT 2y

***WARNING: YOU ARE REQUESTING SNAPLOCK RETENTION OF A SNAPSHOT***

This operation will enforce the retention of the snapshot by
SnapLock for the specified retention period. You will NOT be able
to delete the retained snapshot until this retention period has
been satisfied. The relevant information for confirmation of this
operation is as follows:

      Volume: wormvol
    Snapshot: sv_hourly.20050513_195442_GMT
Retain until: Fri Feb 17 00:00:27 GMT 2006
```

```
Are you REALLY sure you want to retain this snapshot? Y
```

Listing Snapshot copies on the WORM volume

WORM Snapshot copies are identified by the word `snaplock` at the end of each Snapshot copy entry.

Step

1. To list all Snapshot copies, including WORM Snapshot copies, enter the following command:

   snap list *sec_vol*

   sec_vol is the name of the WORM volume.

Example

The following output lists Snapshot copies on the *wormvol* volume:

```
system> snap list wormvol
Volume wormvol
working...


%/used    %/total    date name
--------  ---------- ------------ --------
0% ( 0%)  0% ( 0%)   May 13 19:56 sv_hourly.20050513_195442_GMT
(snaplock)
3% ( 2%)  1% ( 0%)   May 13 19:51 sv_hourly.20050513_195006_GMT
(snaplock)
5% ( 2%)  1% ( 0%)   May 13 19:12 sv_hourly.20050513_191043_GMT
(snaplock)
```

Listing Snapshot copies and retention dates

You can list Snapshot copies and retention dates.

Step

1. To list Snapshot copies and retention dates, enter the following command:

   snap list -l *volume*

   volume is the name of the WORM volume.

Example

The following output lists Snapshot copies and retention dates:

```
system> snap list -l wormvol
Volume wormvol
working...


snapshot date              retention date name
-------------------------- ------------------------- --------
May 13 19:56:50 2005 +0000 May 13 19:59:42 2005 +0000
sv_hourly.20050513_195442_GMT
May 13 19:51:07 2005 +0000 May 13 19:55:08 2005 +0000
sv_hourly.20050513_195006_GMT
May 13 19:12:06 2005 +0000 May 13 19:15:43 2005 +0000
sv_hourly.20050513_191043_GMT
```

Snapshot copies with a dash (-) in the retention date column are not WORM Snapshot copies; therefore, they do not have retention periods.

Deleting expired WORM Snapshot copies

You can delete WORM Snapshot copies that are retained beyond their retention period. WORM Snapshot copies are not deleted automatically. You must delete them when they expire. The expiry of snapshot copies is based on comparing the retention time of the snapshot copies with the volume ComplianceClock of the SnapLock volume.

Step

1. To delete an expired WORM Snapshot copy, enter the following command:

   snap delete *volume snapshot*

   volume is the name of the WORM volume.

   snapshot is the name of the Snapshot copy.

   Note: You cannot delete unexpired WORM Snapshot copies.

Example

```
system> snap delete wormvol slminutely.20040104_122040_GMT
Illegal operation on snapshot locked by SnapLock.
```

How to retain more than 255 SnapVault Snapshot copies

The limit imposed by Data ONTAP for retaining Snapshot copies is 255. However, if you need to retain more than 255 Snapshot copies, you can do so by creating a new volume.

The practical limit for WORM Snapshot copies is approximately 250 for the following reasons:

- A few non-WORM base Snapshot copies and temporary Snapshot copies are used by SnapVault.
- Snapshot copies are needed for managing SnapMirror relationships if you have SnapVault secondary volumes that are protected by SnapMirror.

If you need to retain more than 250 Snapshot copies, you can do so by creating a new volume. As subsequent volumes reach the limit, you can create additional new volumes. In this manner, you can use multiple volumes to retain a larger number of Snapshot copies.

How to create a new volume to retain more Snapshot copies

If you need to create a new volume to retain more Snapshot copies than the maximum allowed, you can do so in one of the two ways—by creating a volume clone or by copying a Snapshot copy.

Choices

- Create a clone of the volume and continue running SnapVault updates to the new volume.
- Copy one Snapshot copy in the volume to a new volume and continue running SnapVault updates to the new volume.

  Note: If you are using a version of Open Systems SnapVault prior to version 2.2, you cannot retain more than 255 SnapVault Snapshot copies without a new baseline. Open Systems SnapVault versions prior to 2.2 do not support the `snapvault start -r` command, which is needed to restart SnapVault relationships on the new volume. This command is supported on Open Systems SnapVault 2.2 and later.

Advantages of cloning Snapshot copies

Using the cloning approach for creating a new volume to retain more than the 255 Snapshot copies has many advantages.

- Less disk space is used: Initially, the new clone volume does not occupy any disk space. Only changes are recorded on the new volume.
- Speed: Volume cloning is almost instantaneous. Copying data from a Snapshot copy takes time.
- Breaking the relationship is easy: If you want to break the relationship between the original volume and the clone, you can do so by using the `vol clone split` command.

Note: At the time of the split, additional disk space will likely be used.

Advantages of copying Snapshot copies

Using the copying approach for creating a new volume to retain more than the 255 Snapshot copies has certain advantages.

- Each volume is completely independent. You need not keep the old volumes online. If the old volumes are damaged or destroyed, your more recent volumes can still be used.
- SnapVault relationships can be migrated to another machine with volume copying.

Creating a new volume for retaining Snapshot copies

You need to create a new volume to retain more than 250 Snapshot copies.

Steps

1. Ensure that everything on the old volume is in an appropriate state.
2. Remove the SnapVault schedules for the old volume.
3. Create a new volume by doing one of the following steps:
   - Create a volume clone to a new volume.
   - Copy the appropriate Snapshot copy to a new volume.
4. Check or set the retention period on the new volume.
5. Check volume options on the new volume.
6. Restart all SnapVault relationships in the new volume.
7. Reconfigure the SnapVault schedules in the new volume.
8. Ensure that everything was migrated successfully. To do this, run a few Snapshot copy targets in the new volume.
9. Stop all SnapVault relationships in the old volume.

   Note: Free Snapshot copies might be required to complete some operations. If you get an error message stating that the system has reached the Snapshot copy limit per volume, you need to find unnecessary Snapshot copies and delete them.

Verifying the state of the old volume

Before creating a new volume for Snapshot copy retention, you need to ensure that all the files in the old volume are in the `Idle` and the `snapvaulted` state.

Steps

1. Check that all relationships for the volume that you will clone or copy are in the `Idle` and `snapvaulted` state by entering the following command:

   `snapvault status`

If...	Then...
The volume is in this state	Go to Step 3.
The volume is not in this state, but transfers are proceeding normally	Wait for the transfers to finish and then repeat this step.
Transfers are not proceeding or completed	Go to Step 2.

2. To check and correct the configuration information, enter the following command:

   `snapvault status -c`

   You need to perform this step because occasionally, the `snapvault status` command might show a relationship for which there is no permanent configuration information.

   a) Compare the output from the `snapvault status -c` command to the output from the `snapvault status` command.

      You should see a one-to-one correspondence. If any relationships are missing, make the output from the two commands consistent.

   b) Create the configuration entry for the missing relationship using the `snapvault start` command or, if the relationship is not needed, use the `snapvault stop` command.

      The `snapvault stop` command destroys the relationship.

3. Ensure that all qtrees with SnapVault relationships are at the same base Snapshot copy by entering the following command:

   `snapvault status -l`

   Check the base Snapshot copy listed for each qtree in the destination volume to ensure that they refer to the same Snapshot copy.

If...	Then...
They refer to the same Snapshot copy	You are finished.
They do not refer to the same Snapshot copy	Go to Step 4.

4. To create a new base Snapshot copy for all qtrees in the volume, enter the following command:

   `snapvault snap create -w *sec_vol* ""`

   `sec_vol` is the current secondary volume.

   " " specifies that no `snapvault snap sched` Snapshot copy is created.

   Note: All qtrees should be in the `snapvaulted` state after the transfers initiated by the `snapvault snap create` command.

5. Go back to Step 1 and ensure that everything is in an appropriate state.

Removing the SnapVault schedules for the old volume

Before you remove the schedules, make a note of the schedule configuration, including retention period. Doing so enables you to set up the schedule in the same way on the new secondary volume.

Steps

1. View the existing schedules by entering the following command:

   snapvault snap sched *sec_vol*

2. Remove the schedules by entering the following command:

   snapvault snap unsched *sec_vol*

   Note: If transfers to the secondary volume are currently in process, the `snapvault snap unsched` command fails. Wait for the transfers to finish and then repeat the command.

3. Verify that the files in the volume are either in the `idle` or `snapvaulted` state.

Creating a volume clone to a new volume

You can create a volume clone from a base Snapshot copy.

Steps

1. Ensure that you have licensed the volume cloning feature (flex_clone license) by entering the following command:

   license

2. To create a volume clone, enter the following command:

   vol clone create *altvol* -b *sec_vol base_snapshot*

   altvol is the new secondary volume.

   sec_vol is the old secondary volume.

   base_snapshot is the Snapshot copy that you get by using the `snapvault status -l` command.

   When you clone a SnapLock Compliance volume, you get the following error message:

   ```
   Error: vol clone create: The source volume is a strict worm volume.
   If you create a clone of this volume, you will not be able to delete
   it until all of the WORM files on this new clone have expired. Use
   force option to create clones of worm volumes. If you use force
   option, the destroy time of the clone volume would be: dd mm yy.
   ```

   Note: Clone volumes are in the same aggregate as the parent volume.

   When you create a volume clone, you can ignore the messages appearing on the console.

Examples of possible messages

```
Reverting volume altvol to a previous snapshot.

Breaking snapmirrored qtree 1 in volume
altvol:
basesnapshot no longer exists.
Use snapmirror resync or initialize to re-establish the snapmirror.

Breaking snapmirrored qtree 2 in volume
altvol:
WAFL_check broke all snapmirrors in volume
wormclone1.Use snapmirror resync or
initialize to re-establish the snapmirror.
```

Copying the appropriate Snapshot copy to a new volume

When you are creating a copy of a volume, the copy must be of the same type (flexible or traditional) and same compliance type (SnapLock Compliance or SnapLock Enterprise) as the old volume.

About this task

Note: If the volume you are copying is a FlexVol volume, the copy does not have to be in the same aggregate as the old volume, nor does it have to be on the same storage system as the old volume.

Steps

1. To create a copy of the old volume, create the new volume by entering the following command:

   vol create *altvol*

   altvol is the new volume.

   Note: Include the appropriate volume type and sizing information.

2. Put the new volume in a restricted state by entering the following command:

   vol restrict *altvol*

3. Copy the base Snapshot copy from the old volume to the new volume by entering the following command:

   vol copy start -s *base_snapshot secsystem*:*secvol altvol*

   Note: The command assumes that the volume copy is initiated from the system that contains *altvol*.

4. Put the new volume online by entering the following command:

   vol online *altvol*

When you create a volume copy, you can ignore the messages appearing on the console.

Examples of possible messages

```
Breaking snapmirrored qtree 1 in volume altvol: base snapshot no
longer exists. Use snapmirror resync or initialize to re-establish
the snapmirror.

Breaking snapmirrored qtree 2 in volume
altvol: WAFL_check broke all snapmirrors in volume wormclone1.Use
snapmirror resync or initialize to re-establish the snapmirror.
```

Checking or setting the retention period on the new volume

Clone volumes and volume copies automatically inherit the retention period from their parent volumes. You can change the retention period for the new volume.

Steps

1. To see the retention period on the old volume, enter the following command:

   vol options *sec_vol*

2. To see the retention period on the new volume, enter the same command for the new volume:

   vol options *altvol*

3. Compare the output from the two volumes to ensure that they are the same.
4. If you want to change the retention period, enter one or more of the following commands:

   vol options *altvol* snaplock_default_period *period*

   vol options *altvol* snaplock_maximum_period *period*

   vol options *altvol* snaplock_miniumum_period *period*

   where *period* is the retention period.

   To learn about retention period values, see the na_vol(1) man page.

Checking volume options on the new volume

Clone volumes and volume copies automatically inherit all options from their parent volumes. Before starting any SnapVault activity on the new volume, you should check the volume options on the new volume against the volume options on the old volume.

Steps

1. To see all volume options for both volumes, enter the following commands:

   vol status -v *sec_vol*

vol options *sec_vol*

vol status -v *altvol*

vol options *altvol*

where *sec_vol* is the name of the old volume and *altvol* is the name of new volume.

2. Compare the output to ensure that all options, except for size-related options, are set to the same values.

   Note: It is especially important that the language settings be the same.

Restarting all SnapVault relationships in the new volume

The qtrees on the new volume are in the normal state, not the `snapvaulted` state (as you can see by using the `qtree status` command). You must restart the SnapVault relationships in the new volume.

About this task

Note: To support data integrity in a restrictive SnapLock Compliance environment, the `snapvault start -r` operation saves all data that was written after the common Snapshot copy to a directory on the volume; however, you typically cannot write data after the common Snapshot copy in this situation.

Steps

1. To see the SnapVault relationships in the old volume, enter the following command:

   snapvault status

   You can see the SnapVault relationships for all volumes. You can use the listed relationships to generate the relationships in the new volume.

2. To restart SnapVault relationships, enter the following command for each secondary qtree:

   snapvault start -r -S *pri_system*:/vol/*pri_vol*/*pri_qtree* /vol/*altvol*/*dest_qtree*

   For details about the `snapvault start` command, see the na_snapvault(1) man page.

   Note: If you omit the `-r` option from the `snapvault start` command, the restart will fail.

Reconfiguring the SnapVault schedules in the new volume

If you are not changing the SnapVault Snapshot schedule on the primary storage system, you can use the same names and schedule for Snapshot copies.

Step

1. To reconfigure the SnapVault schedules, enter the following command:

```
snapvault snap sched -x -o retention_period=period
altvolsnapname sched_spec
```

To learn more about the `snapvault snap sched` command, see the na_snapvault man page.

Note: Specifying the retention period is optional. If a retention period is not specified, the default retention period for the volume is used.

Ensuring the migration of Snapshot copies

You should run a few Snapshot copy targets in the new volume to ensure that everything was migrated successfully. Then, after the first scheduled Snapshot copy and transfer have occurred, look at the entries in the new volume.

Steps

1. To view the entries, enter the following commands:

   ```
   snapvault status
   ```

   ```
   snapvault status -c
   ```

2. Verify all the entries of Snapshot copies in the new volume.

Stopping all SnapVault relationships in the old volume

After verifying the migration of the Snapshot copy, you can delete the old SnapVault relationships.

Steps

1. From the system that contains the old volume, enter the following command for all the qtrees in the old volume:

   ```
   snapvault stop -f /vol/sec_vol/dest_qtree
   ```

2. From the primary storage system, enter the following command for all the qtrees backed up to the old volume:

   ```
   snapvault release /vol/pri_vol/pri_qtree sec_system:/vol/sec_vol/
   dest_qtree
   ```

   For details about the `snapvault release` command, see the na_snapvault(1) man page.

   The `snapvault stop` command deletes the qtree from the active file system on the old volume. Backup copies of the qtree are in the Snapshot copies on the old volume. You can access them if you want to browse the old backups or restore data from the old backups. The active image of the backup data is moved to the new volume when you restart the SnapVault relationship by using the `snapvault start -r` command.

Backup of the log volumes created by the SnapLock for SnapVault feature

Along with backing up SnapLock Compliance secondary storage volumes, you can provide additional protection for log volumes created by the SnapLock for SnapVault feature.

Protecting a log volume of the SnapLock for SnapVault feature

You can protect a log volume of the SnapLock for SnapVault feature. You do this by creating a SnapMirror backup with the same update schedule that you have for other SnapMirror relationships between the SnapVault secondary storage system and the SnapMirror destination.

Step

1. Create a SnapMirror relationship between the SnapLock for SnapVault log volume and a new SnapLock for SnapVault log volume on the new standby system.

   For more information about setting up a basic SnapMirror operation, see the *Data ONTAP Data Protection Online Backup and Recovery Guide for 7-Mode*.

Failing over to the standby system

If you convert the standby system to a SnapVault secondary system, you need to configure the log volume for the SnapLock for SnapVault feature to continue with collecting log information.

Steps

1. Quiesce the SnapMirror relationship to the SnapLock for SnapVault log volume on the converted standby system by using the following command:

   snapmirror quiesce *volume_name*

2. Break the SnapMirror relationship to the SnapLock for SnapVault log volume on the converted standby system by using the following command:

   snapmirror break *volume_name*

3. Configure the SnapLock for SnapVault log volume on the converted standby system by using the following command:

   options snapvault.lockvault_log_volume *volume_name*

Reestablishing standby protection

If you reestablish standby protection for new SnapVault secondary volumes, you should also reestablish new standby protection for the log volume of the SnapLock for SnapVault feature. As is

the case with reestablishing standby protection for SnapVault secondary volumes, you need a new volume for the new standby log volume of the SnapLock for SnapVault feature.

Step

1. Create a SnapMirror relationship between the SnapLock for SnapVault log volume and a new SnapLock for SnapVault log volume on the new standby system.

How to resynchronize a broken SnapVault relationship

You can use the `snapvault start -r` command to reestablish a broken SnapVault relationship without a lengthy baseline transfer.

Typically, this command locates the most recent common Snapshot copy, discards any data written to the destination after that Snapshot copy, and begins to resynchronize content using the common Snapshot copy.

To support data integrity in a restrictive SnapLock Compliance environment, the `snapvault start -r` operation saves all data that was written after the common Snapshot copy to an image and log file in a directory on the volume. These files are then stored in the following directory on the SnapLock Compliance volume: `/etc/logs/snapmirror_resync_archive/volname_UUID_qtree`.

The image and log files are named `dump_image_`*`YYMMDD_HHMMSS`* and `dump_log_`*`YYMMDD_HHMMSS`*, respectively.

Note: The retention period for image and log files is equal to the longest retention period of any data file in the data set. This ensures that the image and log files are not deleted before the retention period has passed.

If the save operation fails for any reason, the `snapvault start -r` transfer operation does not proceed.

Turning SnapVault off

You might want to turn SnapVault off because the files are no longer important or current or have been moved to another location.

Step

1. On both the primary storage system and the secondary storage system, enter the following command:

   `options snapvault.enable off`

   This option persists across reboots.

Management of SnapVault log files

You can manage SnapVault log files for compliance.

Regulatory compliance and SnapVault log files

SnapVault creates log files that meet the requirements for regulatory compliance.

Following are the requirements for regulatory compliance:

- You cannot delete a log file.
- You cannot delete or overwrite the contents of log files.
- The log files must accurately record the exact series of events that occur during a time frame.

How SnapVault maintains compliance

SnapVault uses a SnapLock volume in which the log files are kept. This volume, called SnapLock for SnapVault log volume, is a standard WORM volume. SnapVault uses an append-only write operation to write to the log files. This allows accurate record keeping but does not allow previous events to be overwritten.

SnapVault uses two types of log files to record events:

- SnapVault operations log files
- SnapVault files-transferred log files

Operations log file

Operations log files have a weekly rotation policy; SnapVault creates a new log file every Sunday morning at midnight. Any SnapVault operations that are active when the new log file is created are recorded in the new log file.

The following is the format for an operations log file name:

snapvault.*yyyymmdd_zzz*

yyyy is the year.

mm is the month (01 to 12).

dd is the date (01 to 31).

zzz is the current time zone setting.

The timestamp denotes when the log file is created. The timestamp is generated using the system clock.

Files-transferred log files

SnapVault creates a new files-transferred log file at the beginning of each SnapVault transfer.

Files-transferred log files are kept in the following directory structure in the log volume created by the SnapLock for SnapVault feature : `/etc/logs/`*`snapvault secondary vol/secondary qtree name/month/log file`*.

The `snapVault secondary vol` directories are the SnapLock volume names on the secondary storage system. The following is the format of the directory name: *`secondary volume name_volume id`*. The volume UUID uniquely identifies a volume globally.

The secondary qtree name directories are the qtrees within a SnapVault secondary vol directory. The following is the format of the secondary qtree directory name: *`secondary qtree name_treeid_inodenum_gennum`*. The `tree ID`, inode number, and generation number uniquely identify the qtrees within a volume.

The month directory denotes the month in which log files for a qtree were generated. The format for the month directory is as follows: *`yyyymm`*. The year (*`yyyy`*) and month (*`mm`*) are generated using the system clock.

The log file name uniquely identifies each transfer log file. The following is the format of the transfer log file name: `snapvault_filelog.`*`yyyymmdd_hhmmss_zzz`*.

The year (`yyyy`), month (`mm`), day (`dd`), hour (`hh`), minute (`mm`), second (`ss`), and time zone (`zzz`) are generated using the system clock.

Example

The following is a sample path for a transfer log file named `snapvault_filelog.20040123_000500_PST`:

```
/etc/log/vault_ ed0ad520-5f40-11d8-91ca-00a09800dcba/
users_19_1435628_1286197/200401/snapvault_filelog.20040123_000500_PST
```

Configuring the log volumes of the SnapLock for SnapVault feature

A log volume for the SnapLock for SnapVault feature must be a SnapLock volume. The SnapLock volume can be a traditional volume or a flexible volume. All SnapVault log entries are created in the log volume. This is a system-wide option; therefore, a SnapVault operation on any SnapLock volume

is logged to the log volume. However, you need to set this option for SnapVault transfers to SnapLock volumes to succeed.

Before you begin

You must create a log volume for the SnapLock for SnapVault feature before starting an initial (level 0) SnapVault transfer.

Step

1. To configure the log volume, enter the following command:

   `options snapvault.lockvault_log_volume` ***`volume_name`***

   `volume_name` is a SnapLock volume.

   Note: You must use the name of a previously created SnapLock volume, and this volume should not be used for any other purpose.

Where the log files are kept

All SnapVault log files are kept in the log directory of the SnapLock for SnapVault log volume that you created and configured.

The SnapVault log files are kept in the `/etc/log` directory of the SnapLock for SnapVault log volume. Log files in this directory inherit the default retention period of the log volume. Log files cannot be deleted from the volume until their retention periods have expired. SnapVault does not remove expired log files automatically; you must delete them manually.

Note: Ensure that you set the default retention period on the log volume appropriately. The initial default retention period is 30 years for SnapLock Compliance volumes.

What files-transferred log files contain

A transfer log contains a header that describes the transfer and zero or more entries that describe the contents of the transfer.

A log file contains only a header and zero entries in two instances: when no data on the primary storage system has changed since the last SnapVault update or for a rollback transfer.

The header at the beginning of each log file contains the following information:

- Transfer type
- Source system and source path
- Destination system and destination path
- Date and time of the start of the transfer

- Date and time of the source system Snapshot copy

  Note: Date and time of the source system Snapshot copy is interpreted according to the time zone settings on the secondary system, not the primary system.

Example

```
# Transfer type: Base Start
# From: sourcesystem:/vol/compat_data/myqtree1
# To: destinationsystem:/vol/logs/mult1
# Start time: Tue Mar 30 22:43:09 GMT 2004
# Source snapshot timestamp: Wed Mar 31 23:41:01 EST 2004
```

Types of log entries recorded

All create, delete, modify, and rename operations are recorded in the transfer log files.

- Create file (regular, special, or stream)
- Delete file (regular, special, or stream)
- Create directory
- Delete directory
- Rename from (regular file or directory)
- Rename to (regular file or directory)
- Modify file (regular, special, or stream file, but not directory)
- Modify attributes (regular, special, stream file, or directory)

Log entry format

The log entry format is as follows:

`date_and_time action_taken base_path_length`:*`stream_name_length  path_name`*

`date_and_time` is the `mtime` or `ctime` value from the primary storage system, not the secondary storage system.

Note: The `mtime` value is used to create file and directory types, delete file and directory types, and modify file types because these entry types modify data. The `ctime` value is used to rename file and directory types and modify attribute types because these types modify the container for the data, not the data itself.

action_taken is one of the types of log entries.

base_path_length:*stream_name_length* is the length of the base path followed by a colon and the stream name in single byte characters. Only the base path length is shown if the file is not a stream file.

path_name is the file path relative to the base of the tree that is mirrored, not the absolute path name. The relative path name is the same on the primary and secondary storage system.

Example

The following are examples of log entries:

```
Fri Mar 26 23:08:33 GMT 2004 Create Dir    7   ./mydir
Mon Oct  9 17:36:14 GMT 2000 Create File  14   ./mydir/myfile
Mon Jun 12 22:21:11 GMT 2000 Create File  14:8 ./mydir/myfile:strm
```

How log entries are created

Certain actions cause SnapVault to create a log entry type. The following table lists actions that cause SnapVault to create a log entry, the type of log entry created, and possibly a note about the action.

Action	Entry type	Note
The initial transfer of all files and directories.	Create File	
	Create Directory	
The data in a file was modified.	Modify File	A Modify Attributes entry is not created if a Modify File entry was.
The attributes of a directory, such as permissions, were changed or any entries in the directory were added or deleted.	Modify Attributes (directory)	
An access control list (ACL) for a file or directory was created, deleted, or changed.	Modify Attributes (any file or directory associated with the ACL)	ACL creation, deletion, or modification is not explicitly logged.
A file or directory with only one link was renamed.	Rename From	Renaming creates two entries that appear together in the log.
	Rename To	

Action	Entry type	Note
A file was renamed.	Modify Attributes or Modify File in addition to Rename From and Rename To	A Modify Attributes entry is created if no data was modified. A Modify file entry is created if data was modified.
A directory was renamed.	Modify Attributes in addition to Rename From and Rename To	
A hard link was added to an existing file.	Create File	
A hard link to a file was removed and the file still has one or more hard links.	Delete File	
A hard link was added to a file, but no content was changed.	Modify Attributes for all links to the file except the new link	
A hard link was added to a file and content was changed.	Modify File for all links to the file except the new link	
A hard link was deleted from a file, but no content was changed.	Modify Attributes for all links to the file except the deleted link	
A file with one or more hard links to it was created between the previous transfer and the current transfer.	Create File	No Modify File or Modify Attributes entry for the file.
A file and all its hard links were deleted between the previous transfer and the current transfer.	Delete File	No Modify File or Modify Attributes entry for any links.
A file with multiple hard links was renamed.	Create File	A file with hard links is renamed by adding one link to the file and deleting one link from the file.
	Delete File	
	Modify Attributes or Modify File	

Action	Entry type	Note
Data or attributes of a file were modified.	Modify File or Modify Attributes, respectively	A Modify File or Modify Attributes entry is created for each link to the file except links that were added or deleted by the transfer.

How to provide backup and standby protection using SnapMirror

By setting up a SnapMirror relationship between the SnapVault secondary storage system and a SnapMirror destination or NearStore system, you can provide backup and standby protection for the SnapVault secondary storage system data.

The following is the process for backup and standby protection for the secondary storage system data:

- Use the SnapMirror destination device as a standby device to be activated as an alternative SnapVault secondary storage if the original secondary storage device goes down.

  Note: The SnapMirror destination systems cannot take advantage of the disk-space-saving benefits of volume cloning. If you used volume cloning on the original SnapVault secondary volume to store more than 255 Snapshot copies, which is the limit imposed on volumes by Data ONTAP, the SnapMirror destination volumes might need to be larger than the SnapVault secondary volumes if they are going to store the same amount of data.

- Reestablishing backup and standby protection using this procedure, you have your original SnapMirror destination volumes as your SnapVault secondary volumes, and new volumes as your SnapMirror destination volumes.

  Note: You could use the original SnapVault secondary volumes when they become available after the retention period of Snapshot copies and files on the volumes expire, but retention period are usually long enough that the volumes are not likely to be available.

- An optional step, but one that you should avoid performing, is to return to the original backup and standby configuration. After you reestablish the backup and standby configuration, your SnapVault secondary volumes are protected with a SnapMirror replication, but the two backup systems are reversed (the system that was your standby is now your secondary and the system that was your secondary is now your standby). Instead of returning to the original configuration, it is better that the storage system you use for your SnapVault secondaries and their associated SnapMirror standbys have the same configuration such that their roles can be reversed, if necessary.

Setting up backup and standby protection for SnapVault

You can set up the SnapMirror backup and standby protection for the SnapVault secondary storage system and fail over to the standby system, if needed.

Steps

1. To confirm that the SnapVault secondary storage device has both SnapVault secondary storage and SnapMirror features licensed, enter the following command:

   `license`

2. To confirm that the SnapMirror destination device has both the SnapVault secondary storage and SnapMirror features licensed, enter the following command:

   `license`

3. Set up SnapMirror replication from the active SnapVault secondary storage system to a disk-based destination device (another storage or NearStore system).

   For more information about setting up a SnapMirror relationship with a disk-based destination device, see the *Data ONTAP Data Protection Online Backup and Recovery Guide for 7-Mode*.

4. If the active SnapVault secondary storage system is damaged or destroyed, convert the SnapMirror destination device to an alternate SnapVault secondary system to carry on the task of backing up data from the primary storage system.

   For details on converting a SnapMirror destination to a writable volume, see the *Data ONTAP Data Protection Online Backup and Recovery Guide for 7-Mode*.

5. Activate the SnapVault license on the new SnapVault systems, and use the `snapvault start` and `snapvault snap sched` commands to complete configuration of the new SnapVault secondary storage system.

6. Optional: You can return the storage system to their original configuration.

Reestablishing backup and standby protection for SnapVault

To reestablish SnapMirror backup and standby protection for the new SnapVault secondary storage system, you need to perform an initial SnapMirror transfer from the SnapVault secondary to a new volume.

Step

1. To perform an initial SnapMirror transfer from the new SnapVault secondary volume to the new volume, enter the following command:

   `snapmirror initialize`

Attention: Using the `snapmirror initialize` command destroys all existing data on the new volumes. For more information about setting up a basic SnapMirror operation, see the *Data ONTAP Data Protection Online Backup and Recovery Guide for 7-Mode*.

If you are able to use your original SnapVault secondary volumes as the new SnapMirror destinations and you used volume cloning to go beyond 255 Snapshot copies, which is the limit imposed on a volume by Data ONTAP, the original SnapVault secondary volumes might not be large enough to accommodate the replication. If this is the case, you can add disk space to the original SnapVault secondary volumes.

Returning to the original backup and standby configuration

You can return to the original backup and standby configuration.

Steps

1. Break the SnapMirror relationship.
2. If the active SnapVault secondary storage system is damaged or destroyed, convert the SnapMirror destination device to an alternative SnapVault secondary system to carry on the task of backing up data from the primary storage system.

   For details on converting a SnapMirror destination to a writable volume, see the *Data ONTAP Data Protection Online Backup and Recovery Guide for 7-Mode*.
3. Activate the SnapVault license on the new SnapVault system, and use the `snapvault start` and `snapvault snap sched` commands to complete configuration of the new SnapVault secondary storage system.
4. Perform an initial SnapMirror transfer from the new SnapVault secondary volume to the new volume using the following command:

   `snapmirror initialize`

   Attention: Using the `snapmirror initialize` command will destroy all existing data on the new volumes. For details on converting a SnapMirror destination to a writable volume or qtree, see the *Data ONTAP Data Protection Online Backup and Recovery Guide for 7-Mode*.

   If you are able to use your original SnapVault secondary volumes as the new SnapMirror destinations and you used volume cloning to go beyond 255 Snapshot copies, which is the limit imposed on a volume by Data ONTAP, the original SnapVault secondary volumes might not be large enough to accommodate the replication. If this is the case, you can add disk space to the original SnapVault secondary volumes.

Limitations to compliance backup and standby service

There are limitations to the backup and standby service.

- After you have failed over to the standby device and have begun to take backups, you cannot reuse the original SnapVault secondary storage disks for protecting the new SnapVault secondary volumes until the retention period for all Snapshot copies and data on the original SnapVault secondary storage disks have expired.

For all practical purposes, the original SnapVault secondary storage disks cannot be used to protect the new SnapVault secondary volumes and cannot be used to resume their original role as SnapVault secondary storage because typical retention period are on the order of months to years.

- You cannot restore backup data to a SnapVault secondary storage if the secondary storage uses SnapLock Compliance volumes, because of the constraints put on SnapLock Compliance volumes to eliminate the possibility of losing compliance data.

  Note: Failing over to a standby device is complex, has the limitations mentioned above, and is costly in terms of time and disk space. Failing over should be done only in the event of a permanent loss of the original SnapVault secondary storage when the quick resumption of backups is critical enough to warrant the cost of reestablishing the original configuration.

How to manage SnapLock through Data ONTAP APIs

An application can integrate seamlessly with SnapLock using Data ONTAP APIs. SnapLock is an open solution that uses standard protocols to enable seamless integration with ISV archival applications as well as custom applications. This integration with specific vertical applications allows data immutability to become a part of your data workflow, thereby eliminating the need to separately manage WORM locking and the eventual deletion of data to meet regulations.

You can leverage the SnapLock features through the command line interface (CLI) or programmatically by using Data ONTAP APIs.

You can use the following two options to integrate with SnapLock:

- Data ONTAP APIs
- The native API available in the programming language that the application is written in

What ONTAPI is

You can use ONTAPI (also known as Data ONTAP APIs) to access and manage the storage system. Data ONTAP APIs are invoked in the form of XML. You can use the HTTP, HTTPS, and Windows DCE/RPC protocols to query Data ONTAP APIs.

Data ONTAP APIs can manage the following features of Data ONTAP:

- Setup and management of storage objects
- Quota/user management
- Device configuration
- Discovery of devices, aggregates, volumes
- Monitoring the health of the storage system, disk/volume capacity, performance
- Alerts/notifications
- License management
- Security
- Block protocols
- Data backup and recovery
- Data replication
- Archival and compliance of data
- File access protocols

The complete ONTAPI lists are available in the `doc/ontapi` directory of NetApp Manageability SDK (software development kit) installations, with subdirectories for each release. The ONTAPI versions pertaining to each major release of Data ONTAP are available in the Version Matrix provided with NetApp Manageability SDK.

You can invoke Data ONTAP APIs by using NetApp Manageability SDK. NetApp Manageability SDK contains sample code that demonstrates the use of ONTAPI in C/C++, Java, C#, VB.Net, Powershell, and Perl. To use the Data ONTAP APIs to create applications, see NetApp Manageability SDK.

Related information

NetApp Manageability SDK Introduction and Download Information

Setting up a client to use ONTAPI calls

Certain steps are involved in setting up a client to use ONTAPI calls.

About this task

Note: All the examples in this topic are shown in C/C++.

Steps

1. Use a client program to initialize the server context.

   In Perl and Java, initializing the server context occurs automatically apart from declaring the libraries and as part of creating a server object. In Perl, declaring the use of `NaElement` is optional because `NaServer` already does that as part of its own initialization.

   #### Example

   ```
   char    err[256];
   if (!na_startup(err, sizeof(err))) {
       fprintf(stderr, "Error: %s\n", err);
       exit(-1);
   }
   ```

2. Identify which server (storage system) you want to communicate with, and the version of the ONTAPI library you expect.

   This setup gives you a pointer to an na_server_t* value (C/C++) or an object (Perl/Java) that is a server context used for subsequent ONTAPI invocations.

   #### Example

   ```
   na_server_t*    s;

   /*
    * server to talk to, and
    * ONTAPI version, in this case 1.3 or higher
    */
   ```

```
s = na_server_open("jetfighter",1,3);
```

3. Set the transport parameters.

   If you are writing a Windows application in C, you normally use Windows DCE/RPC, which furnishes native Windows authentication and authorization. On the other hand, if you must use HTTP (which you must always do with Perl and Java), you must furnish a user name and password for use by the server context, or have the server context authenticate against the `/etc/hosts.equiv` file on the storage system. This file consists of either host names, in which case everyone coming from that host is allowed in as root, or host name/user name pairs, in which case the named users are allowed in as root when they connect from the named host. The *Data ONTAP System Administration Guide for 7-Mode* has more details on the `/etc/hosts.equiv` file. When using `HOSTSEQUIV` login style, you must set the `httpd.admin.hostsequiv.enable` option on the storage system to `on`.

   Example

```
bool          use_rpc = 1;
bool          use_hosts_equiv = 0;

if (use_rpc) {
    na_server_set_style(s, NA_STYLE_RPC);
}
else if (use_hosts_equiv) {
    na_server_set_style(s,
                    NA_STYLE_HOSTSEQUIV);
}
else {
    na_server_set_style(s,
                    NA_STYLE_LOGIN_PASSWORD);
    na_server_set_admin_user(s,
                    "root", "F18fan");
}
```

4. Check for the ONTAPI library version before invoking an ONTAPI library.

   Use `system-get-ontapi-version` to obtain the ONTAPI version of a storage system.

   Example

```
na_elem_t*      out;

/*

 * Make sure version is available

 */

out = na_server_invoke(s,
```

```
          "system-get-version", NULL);
if (na_results_status(out) != NA_OK) {
    printf("Version 1.3 is unsupported: %s\n",
           na_results_reason(out));
}

na_free(out);
```

5. Close the server context to free memory and resources. (The Perl bindings take care of this when the context goes out of scope.)

Example

```
na_server_close(s);
```

Setting up the client is complete.

Benefits of using the Data ONTAP API suite

The Data ONTAP API suite is a framework of methods that you can use from external applications to perform all the functions on a storage system running Data ONTAP.

The following are some of the advantages of using the Data ONTAP API suite:

- Access to Data ONTAP features through APIs
- Support for multiple platforms such as Windows, Linux, Solaris, VMware ESX, and so on
- Support for multiple languages such as C, C++, Java, Perl, and so on
- Support for multiple transport protocols such as HTTP, HTTPS, and Windows RPCs
- Support for different authentication mechanisms such as login/password, Windows RPC authentication, and so on
- Support for multithreading

List of SnapLock APIs

An application can use SnapLock–related Data ONTAP APIs to integrate with the SnapLock functionality.

The following is the list of SnapLock-related Data ONTAP APIs:

- volume-create
- volume-set-options
- volume-options-list-info
- file-get-snaplock-retention-time
- file-get-snaplock-retention-time-list-info-max
- file-set-snaplock-retention-time
- file-snaplock-retention-time-list-info
- snaplock-get-log-volume
- snaplock-get-options
- snaplock-log-archive
- snaplock-log-status-list-info
- snaplock-privileged-delete-file
- snaplock-set-log-volume
- snaplock-set-options
- file-get-fingerprint
- snaplock-set-compliance-clock
- snaplock-get-system-compliance-clock
- snaplock-get-volume-compliance-clock

Note: Starting with Data ONTAP 8.1, the SnapLock API `snaplock-get-compliance-clock` is deprecated. You must use the APIs; `snaplock-get-system-compliance-clock` to get the system ComplianceClock time and `snaplock-get-volume-compliance-clock` to get the volume ComplianceClock time.

For more information about the Data ONTAP APIs, see the *NetApp Manageability SDK*.

Related information

NetApp Support Site: support.netapp.com

volume-create

The `volume-create` API creates a new flexible, traditional, or sparse volume with the given name and characteristics. Newly created traditional volumes may not be operational immediately after the

API returns. You can use the `volume-list-info` API to query the status of the newly-created volume in order to determine when it is fully operational.

file-get-snaplock-retention-time

The `file-get-snaplock-retention-time` API gets the SnapLock retention attributes of a file.

file-get-snaplock-retention-time-list-info-max

The `file-get-snaplock-retention-time-list-info-max` API gets the maximum number of entries that can be processed and returned in one call to the `file-snaplock-retention-time-list-info` API.

file-set-snaplock-retention-time

The `file-set-snaplock-retention-time` API sets the SnapLock retention attributes of a file.

You can use this API to extend the retention period of an existing WORM file in a SnapLock volume.

file-snaplock-retention-time-list-info

The `file-snaplock-retention-time-list-info` API gets the SnapLock retention attributes for a list of files.

snaplock-get-log-volume

The `snaplock-get-log-volume` API gets the active SnapLock log volume configuration.

snaplock-get-options

The `snaplock-get-options` API gets the value of a given SnapLock option on a volume.

snaplock-log-archive

The `snaplock-log-archive` API archives the active SnapLock log file. This API closes the current log file for further updates and opens a new log file to write future log updates.

snaplock-log-status-list-info

The `snaplock-log-status-list-info` API provides the status of the active WORM log file.

snaplock-privileged-delete-file

The `snaplock-privileged-delete-file` API executes a privileged delete on a SnapLock file.

snaplock-set-log-volume

The `snaplock-set-log-volume` API sets the active log volume configuration.

snaplock-set-options

The `snaplock-set-options` API sets the SnapLock options on a volume.

file-get-fingerprint

The `file-get-fingerprint` API gets the fingerprint or digest of the file. The fingerprint is calculated using MD5 or SHA-256 digest algorithm. The fingerprint is calculated over the file data or metadata or on both data and metadata depending on the scope that you have selected. The fingerprints are base64 encoded.

Data fingerprint is calculated over file contents and the metadata fingerprint is calculated over the selected attributes of the file. The following attributes are used for metadata fingerprint calculations:

- file type (file-type)
- file size (file-size)
- file crtime (creation-time)
- file mtime (modified-time)
- file ctime (changed-time)
- file retention time (retention-time, is-wraparound)
- file uid (owner-id)

- file gid (group-id)

Note: The file retention time is applicable only to WORM protected files.

snaplock-get-system-compliance-clock

The new SnapLock API `snaplock-get-system-compliance-clock` gets the system ComplianceClock time.

snaplock-get-volume-compliance-clock

The new SnapLock API `snaplock-get-volume-compliance-clock` gets the volume ComplianceClock time.

What the extended date range mechanism is

Data ONTAP denotes time as a signed 32-bit integer that is interpreted as the number of seconds since 1 January 1970, 00 hours 00 minutes 00 seconds (GMT). This interpretation imposes an upper limit of 03 hours 14 minutes 07 seconds on 19 January 2038 (GMT). The extended date range mechanism remaps the dates in the range 2038 to 2071 to the date range 1970 to 2003.

To support an extended range for record retention dates, SnapLock provides a mechanism by which applications can specify retention dates up to 19 January 2071 (GMT). This is accomplished by defining a new epoch for the last access time of 1 January 2003 00 hours 00 minutes 00 seconds (GMT). Instead of setting off the entire time range, the last access times before 1 January 2003 (GMT) are interpreted as dates in the future, using a wraparound technique. Therefore, all retention dates between 1 January 2003 and 19 January 2003 remain identical to the regular format. However, the dates between 1 January 2038 and 19 January 2071 are encoded as past dates.

For example, a file with a record retention date of 1 January 2040 displays the retention date as 1 January 1972 in the CIFS or NFS clients.

Setting files to WORM state from an application

An application can be integrated with SnapLock to the extent that it manages individual files, is able to set or extend the retention period of the files, and is able to commit the files to WORM state by transitioning them from writable to read-only state.

Before you begin

- You must have installed and enabled the SnapLock license.
- You must have initialized the system ComplianceClock initialized.
- You must have created SnapLock volume.
- You must have files in the SnapLock volume in the writable state.

About this task

An application can set the retention period on a file by altering the atime parameter when using NFS and the Date Accessed parameter when using CIFS.

Steps

1. Create a storage system connection.
2. Set the retention period of a file in seconds or by dates.

   Note: If you must provide the retention period in seconds, it should be in UNIX time_t format.

If you want to calculate the retention period...	Then...
In seconds	**a.** Get the volume ComplianceClock time by using the `snaplock-get-volume-compliance-clock` API. **b.** Check whether the range of the retention period needs to be extended: • If the seconds <= (0x7FFFFFFF - volume ComplianceClock time), use the normal range (retention_period = seconds + ComplianceClock time). • If the seconds >= (0x7FFFFFFF - volume ComplianceClock time), use the extended range (retention_period = seconds + volume ComplianceClock time +1-0x7FFFFFFF).

If you want to calculate the retention period...	Then...
By dates	**a.** Convert the date to UNIX time_t format (number of seconds since 1 January 1970). This date is the retention period. **b.** Verify if the range of this retention period needs an extension: • If the retention period > 0x7FFFFFFF, use the extended range (retention_period= retention_period + 1 - 0x7FFFFFFF).

3. Set the file to WORM state by using the retention period calculated in Step 2.
4. Optional: Close the storage system connection, if required.

Result

The file is set to WORM state.

Related concepts

What the extended date range mechanism is on page 112

Using SnapLock volume defaults to set retention period

If you want to set the same retention period on all or majority of files in a SnapLock volume, you can use the `volume-set-option` API to set the SnapLock volume defaults—minimum retention period, maximum retention period, and default retention period.

Before you begin

- You must have installed and enabled the SnapLock license.
- You must have initialized the system ComplianceClock.
- You must have created a SnapLock volume.

Steps

1. Create a storage system connection.
2. Set the default period for the volume by using the `volume-set-option` API and providing the following values for the corresponding input elements:
   - `volume`: the SnapLock volume name.
   - `option-name`: snaplock_default _period.
   - `option-value`: the default period value in seconds, hours, days, months or years.

   Note: You can also use the `volume-set-option` to set the minimum and maximum retention period of the files.
3. Optional: Close the storage system connection, if required.

After you finish

You must convert the files to WORM state to get a retention period equal to the `snaplock_default_period`.

By setting the SnapLock volume options, you need not specify a retention period for a file unless you want the retention period to be different than the time specified in `snaplock_default_period`.

Related concepts

How the SnapLock volume retention period works on page 26

Using the SnapLock autocommit feature from an application

You can use the autocommit feature of SnapLock to automatically commit files in SnapLock volumes to WORM state.

Before you begin

- You must have installed and enabled the SnapLock license.
- You must have initialized the system ComplianceClock.
- You must have created a SnapLock volume.

About this task

- The autocommit feature is a volume-level option.
  Once enabled, it affects every file in that SnapLock volume.
- A file that is automatically committed to WORM state gets a retention period equal to the SnapLock volume's default retention period.
  However, if you explicitly change the `atime` value of the file before it is automatically committed, the file's retention date will be the `atime` value set by you.

Steps

1. Create a storage system connection.
2. Set the autocommit period by using the `volume-set-option` API and providing the following values for the corresponding input elements:
   - `volume`: volume name
   - `option_name`: snaplock_autocommit_period
   - `option-value`: autocommit period in [h|d|m|y] (hours, days, months or years) format.
3. Get the current value of the autocommit period of SnapLock volume by using the `volume-options-list-info` API and providing the following values for the corresponding input elements:
   - `volume`: volume name
4. Optional: Close the storage system connection, if required.

Related concepts

How SnapLock autocommit feature works on page 31

How to implement SnapLock features through Data ONTAP APIs

Applications can leverage the SnapLock features privileged delete and WORM append files by using Data ONTAP APIs. Applications can take advantage of these SnapLock features to further enhance your overall solution.

Using the SnapLock privileged delete feature from an application

You can set your application to perform privileged delete operations on a SnapLock Enterprise volume by using the Data ONTAP API suite. It allows a privileged user (part of Compliance Administrator group) to delete a file that is otherwise immutable because of a retention policy.

Before you begin

- You must have installed and enabled the SnapLock license.
- You must have initialized the system ComplianceClock.
- You must have created a SnapLock volume.

Steps

1. Create a privileged user who is part of the Compliance Administrators group.

   You can use the `useradmin-user-add` Data ONTAP API to specify the new user information and membership to the Compliance Administrators group through the input parameters.

2. Enable a compliance log volume.

   The log volume must be of type SnapLock Compliance. You can use the `volume-create` Data ONTAP API from an application and specify that the volume is a SnapLock Compliance volume.

3. Set the newly created volume as the compliance log volume by using the `snaplock-set-log-volume` Data ONTAP API and specify the newly created volume name through the input parameters.

4. Enable the privileged delete functionality on the SnapLock Enterprise volume from the CLI.

   You can use the `snaplock-set-options` Data ONTAP API and specify the option as `privdel` and the option value as `on`.

5. Log in over SSH.

   You must ensure that SSH or Telnet sessions are kept separate from other sessions.

6. Delete a file on the SnapLock Enterprise volume.

   You can use the `snaplock-privileged-delete-file` Data ONTAP API and specify the `do it` flag as `true` and the file path.

Related concepts

What the privileged delete feature is on page 35

Using the SnapLock logging feature from an application

The SnapLock logging feature enables logging of SnapLock events. The log files reside in a SnapLock Compliance volume as WORM files. Events are logged whenever there is a privileged delete activity.

Before you begin

- You must have installed and enabled the SnapLock Compliance license.
- You must have initialized the system ComplianceClock.
- You must have created a SnapLock volume.

Steps

1. Assign a log volume.

   You can use the `snaplock-set-log-volume` Data ONTAP API and specify the name of the log volume through the input parameters.

2. Archive the log file.

   Archiving, in this context, means committing a log file to WORM state. You can use the `snaplock-log-archive` Data ONTAP API and specify the log name and log volume through the input parameters.

3. View the status of the log file.

   You can use the `snaplock-log-status-list-info` Data ONTAP API and specify the log name and log volume through the input parameters.

Related concepts

What SnapLock logging is on page 41

What event-based retention is

Event-based retention refers to retaining a record based on the occurrence of an event. A record should be deleted either when the event occurs or a certain number of years after the event occurs.

For example: If the retention period of an insurance contract is set for Date of the Insured's Death plus 10 years, the event is triggered when the insured dies on 5 March 2010. Therefore, based on the event, the contract must be retained until 4 March 2020 and can be deleted on or after 5 March 2020.

Note: While SnapLock does not have a native event-based retention capability, it is possible to implement this capability by using the native features of SnapLock.

Related tasks

Implementing event-based retention and legal hold on page 123

What legal hold is

Legal hold refers to retaining a record because a hold order is in place, probably because an inquiry is being conducted. The record must be retained until the hold expires. Legal hold supersedes event-based retention.

For example: If the retention period of an insurance contract is set for Date of the Insured's Death plus 10 years, and the insured dies on 5 March 2010, triggering the event, the contract must be retained until 4 March 2020. The record can only be deleted on or after 5 March 2020. If a legal hold is put on the contract on 15 August 2016 and the hold is still valid on 5 March 2020, you cannot delete the contract. The contract can be deleted only after the legal hold is removed.

Note: While SnapLock does not have native legal hold capability, it is possible to implement this capability by using the native features of SnapLock.

Related tasks

Implementing event-based retention and legal hold on page 123

Implementation of event-based retention and the legal hold feature using SnapLock

SnapLock does not have native event-based retention and legal hold capability; however, it is possible to implement these capabilities by using the native features of SnapLock.

You can use the SnapLock Enterprise volumes and assign a retention period of `infinite`, so that all files that are committed to the WORM state on the volume have a retention period of infinity and can never be deleted. Based on the workflow resulting from event-based retention, legal hold requirements, and actual events, you can delete files that require deletion using the privileged delete feature.

For example: If the retention period of the contract is set for Date of the Insured's Death plus 10 years and the insured dies on 5 March 2010, the event is captured and examined by the application. The application infers that the contract needs to be retained for 10 years and flags the contract to be deleted, using privileged delete, on 5 March 2020. If nothing occurs until 5 March 2020, the application deletes the contract on 5 March 2020. However if a legal hold is put on the contract on 15 August 2016, the application captures this information and infers that the contract should not be deleted on 4 March 2020 but rather it should be deleted when the legal hold is removed. The legal hold is removed on 11 January 2021, and the application simply deletes the contract using the privileged delete feature.

Note: The application references time from the SnapLock volume ComplianceClock.

Related concepts

What the privileged delete feature is on page 35
What legal hold is on page 121
What event-based retention is on page 120

Implementing event-based retention and legal hold

You can capture an event, examine it, and take the necessary action on that event. Depending on the event, you can flag the record as DELETE or DONT_DELETE. You can delete the files that are marked as DELETE by using the SnapLock privileged delete feature.

Before you begin

- You must have the privileged delete feature enabled.
- You must have the files in WORM state.
- You must have files stored in SnapLock Enterprise volume.
- You must have initialized the system ComplianceClock.
- You must have set the default retention period of the SnapLock Enterprise volume to infinite.
- You must have an internal database that is used by the application for implementing the event-based retention or legal hold functionality in place.

Steps

1. Examine the event and get the record for which the event was triggered.
2. Choose the event:

If the event is...	Then...
An event-based retention event occurs (for example, the insured dies)	**a.** Determine the retention period after which the file needs to be deleted. For example, if the retention period of a contract is set for Date of Insured's death plus 10 years and the insured dies on 5 March 2010, the application infers that the contract needs to be retained for 10 years. **b.** Calculate the deletion date based on the following formula: Deletion date = volume ComplianceClock date + retention period. **c.** Add a row to the database corresponding to this file and deletion date (record), and delete the file on the deletion date.
Legal hold	**a.** Find the record in the database. **b.** Edit the record to specify the path and deletion date and flag the record as DONT_DELETE.
Legal hold withdrawn	**a.** Find the record in the database. **b.** Edit the record to specify the path and deletion date and flag the record as DELETE.

3. Scan the database for all files that are marked as DELETE.

4. Delete the files using the privileged delete feature.

Deleting a record using the privileged delete feature

Based on the event triggered, you can delete a record that is marked as DELETE by using the SnapLock privileged delete feature.

Before you begin

- You must have files stored in a SnapLock Enterprise volume.
- You must have enabled privileged delete feature on that volume.
- You must have set the default retention period of the volume to infinite.

Steps

1. Scan the database for all files that are marked as DELETE.
2. Delete the files using the privileged delete feature.

Related tasks

Deleting a WORM file using privileged delete on page 38

Examples for setting a file to WORM state using an application

You can set up an application to set a file to WORM state by using Data ONTAP APIs.

Example for setting the retention period

Using C#

```
using System;
using System.Text;
using NetApp.Manage;

void set_to_worm_with_retention_period(string serverip,
string serverusername, string serverpasswd, string path, long
seconds)
{
    NaElement xi;
    NaElement xo;
    NaServer s;
    long complianceclocktime;
    long retentionperiod;

    try
    {
        //Initialize connection to server, and
        //request version 1.3 of the API set
        s = new NaServer(serverip, 1, 3);
        s.Style = NaServer.AUTH_STYLE.LOGIN_PASSWORD;
        s.SetAdminUser(serverusername, serverpasswd);
        //get the ComplianceClock time
        xi = new NaElement("snaplock-get-volume-compliance-clock" );
        //Invoke ONTAP API
        xo = s.InvokeElem(xi);
complianceclocktime = Convert.ToInt64(xo.GetChildContent("snaplock-
volume-compliance-clock"));//long is of .NET framework type
System.Int64
                                //check if retention period falls
within the normal range or
                                //requires the use of the extended
range
        if (seconds <= 0x7FFFFFFF - complianceclocktime)
        {
            //use of normal range
            retentionperiod = seconds + complianceclocktime;
        }
        else
        {
            //use of extended range
                                                retentionperiod =
seconds + complianceclocktime + 1 -   0x7FFFFFFF;
```

```
        }
        // set file to WORM state with this retention period
        xi = new NaElement("file-set-snaplock-retention-time");
        xi.AddNewChild("path", path);
        xi.AddNewChild("retention-time",
retentionperiod.ToString());
        //Invoke ONTAP API
        xo = s.InvokeElem(xi);
    }
    catch (Exception e)
    {
        Console.Error.WriteLine(e.Message);
    }
}
```

Example for setting the retention date

Using C#

```
void set_to_worm_with_retention_date(string serverip,
string serverusername, string serverpasswd, string path, DateTime
date)
{
    NaElement xi;
    NaElement xo;
    NaServer s;
    long retentionperiod;

    try
    {
        //Initialize connection to server, and
        //request version 1.3 of the API set
        s = new NaServer(serverip, 1, 3);
        s.Style = NaServer.AUTH_STYLE.LOGIN_PASSWORD;
        s.SetAdminUser(serverusername, serverpasswd);
        //convert date to UTC
                                    retentionperiod =
(date.ToUniversalTime().Ticks - new
                                    DateTime(1970,1,1,0,0,0,0).Ticks)/
10000000;
                                    // if the retention period is not
in the normal date range,
                                    //then use of the extended range
will be necessary
        if (retentionperiod > 0x7FFFFFF)
            //use of extended date range
            retentionperiod = retentionperiod + 1-
0x7FFFFFF;
        // set file to WORM state with this retention period
        xi = new NaElement("file-set-snaplock-retention-time");
        xi.AddNewChild("path", path);
        xi.AddNewChild("retention-time",
retentionperiod.ToString());
```

```
        //Invoke ONTAP API
        xo = s.InvokeElem(xi);
    }
    catch (Exception e)
    {
        Console.Error.WriteLine(e.Message);
    }
}
```

Examples for setting the SnapLock volume defaults

You can set up an application to set the SnapLock default period by using Data ONTAP APIs.

Using C#

```
using System;
using System.Text;
using NetApp.Manage;

void set_snaplock_default_period(string serverip,
string serverusername, string serverpasswd, string volume, long
numberofdays)
{
    NaElement xi;
    NaElement xo;
    NaServer s;

    try
    {
        //Initialize connection to server, and
        //request version 1.3 of the API set
        s = new NaServer(serverip, 1, 3);
        s.Style = NaServer.AUTH_STYLE.LOGIN_PASSWORD;
        s.SetAdminUser(serverusername, serverpasswd);
        //set option snaplock_default_period to numberofdays
        xi = new NaElement("volume-set-option");
        xi.AddNewChild("option-name", "snaplock_default_period");
        xi.AddNewChild("option-value", numberofdays.ToString()+"d");
        xi.AddNewChild("volume", volume);
        //Invoke ONTAP API
        xo = s.InvokeElem(xi);
    }
    catch (Exception e)
    {
        Console.Error.WriteLine(e.Message);
    }
}
```

Examples for setting the autocommit feature and time intervals

You can set up an application to set the SnapLock autocommit feature and time intervals by using Data ONTAP APIs.

Using C#

```
using System;
using System.Text;
using NetApp.Manage;

void set_snaplock_autocommit_period(string volume_name, serverip,
string serverusername, string serverpasswd, int autocommitperiodhrs)
{
    NaElement xi;
    NaElement xo;
    NaServer s;

    try
    {
        //Initialize connection to server, and
        //request version 1.3 of the API set
        s = new NaServer(serverip, 1, 3);
        s.Style = NaServer.AUTH_STYLE.LOGIN_PASSWORD;
        s.SetAdminUser(serverusername, serverpasswd);
        //set volume-level snaplock_autocommit_period to
autocommitperiodhrs
        xi = new NaElement("volume-set-options");
        xi.AddNewChild("volume", "volume_name");
        xi.AddNewChild("option_name", "snaplock_autocommit_period");
        xi.AddNewChild("option_value",
autocommitperiodhrs.ToString()+"h");
        //Invoke ONTAP API
        xo = s.InvokeElem(xi);
    }
    catch (Exception e)
    {
        Console.Error.WriteLine(e.Message);
    }
}
```

Examples for creating a compliance administrator

You can create a compliance administrator by using Data ONTAP APIs.

Using C#

```
using System;
using System.Text;
using System.Collections.Generic;
using NetApp.Manage;

void create_compliance_user(string serverip, string serverusername,
string serverpasswd, string username, string passwd)
{
    NaElement xi;
    NaElement xo;
    NaElement user;
    NaElement userinfo;
    NaElement group;
    NaElement groupinfo;
    NaServer  s;

    try
    {
        //Initialize connection to server, and
        //request version 1.3 of the API set
        s = new NaServer(serverip, 1, 3);
        s.Style = NaServer.AUTH_STYLE.LOGIN_PASSWORD;
        s.SetAdminUser(serverusername,
serverpasswd);
        //The ComplianceUser is part of group
'Compliance
        //Administrators'
        //Create useradmin-user-add ONTAPI API
        xi = new NaElement("useradmin-user-add");
        //Create useradmin-user structure
        user = new NaElement("useradmin-user");
        //Create useradmin-user-info structure
        userinfo = new NaElement("useradmin-user-info");
        //Add username
        userinfo.AddNewChild("name", username);
        //Create useradmin-groups structure
        group = new NaElement("useradmin-groups");
        //Create useradmin-group-info structure
        groupinfo = new NaElement("useradmin-group-info");
        //Add groupname "Compliance Administrators"
        groupinfo.AddNewChild("name", "Compliance Administrators");
        group.AddChildElement(groupinfo);
        userinfo.AddChildElement(group);
        user.AddChildElement(userinfo);
        //Add useradmin-user and password
        xi.AddChildElement(user);
```

```
xi.AddNewChild("password",passwd);
        //Invoke useradmin-user-list ONTAP API
        xo = s.InvokeElem(xi);
    }
    catch (Exception e)
    {
        Console.Error.WriteLine(e.Message);
    }
}
```

Examples for setting a SnapLock log volume

You can set up an application to set a SnapLock log volume by using Data ONTAP APIs.

Using C#

```
void set_snaplock_log_volume(string serverip, string
serverusername, string serverpasswd, string
snaplockcompliancevolume)
{
    NaElement xi;
    NaElement xo;
    NaServer  s;

    try
    {
        //Initialize connection to server, and
        //request version 1.3 of the API set
        s = new NaServer(serverip, 1, 3);
        s.Style = NaServer.AUTH_STYLE.LOGIN_PASSWORD;
        s.SetAdminUser(serverusername, serverpasswd);
        //Check to see if log volume has already been set
        //If not set, set the log volume, otherwise just return
        //Create snaplock-get-log-volume ONTAPI API
        xi = new NaElement("snaplock-get-log-volume");
        //Invoke snaplock-get-log-volume ONTAP API
        xo = s.InvokeElem(xi);
        if (string.Compare(xo.GetChildContent("log-volume"),"Not
configured")!=0)
            //Log volume already setup
            return;
        else
        {
            //Setup log volume
            xi = new NaElement("snaplock-set-log-volume");
            xi.AddNewChild("log-volume", snaplockcompliancevolume);
            //Invoke snaplock-set-log-volume ONTAP API
            xo = s.InvokeElem(xi);
        }
    }
    catch (Exception e)
    {
        Console.Error.WriteLine(e.Message);
    }
}
```

Examples for enabling the privileged delete feature

You can enable the SnapLock privileged delete feature by using Data ONTAP APIs.

Using C#

```
void set_privdel_on(string serverip, string serverusername, string
serverpasswd, string snaplockenterprisevolume)
{
    NaElement xi;
    NaElement xo;
    NaServer s;

    try
    {
        //Initialize connection to server, and
        //request version 1.3 of the API set
        s = new NaServer(serverip, 1, 3);
        s.Style = NaServer.AUTH_STYLE.LOGIN_PASSWORD;
        s.SetAdminUser(serverusername,
serverpasswd);
        //Set the privileged delete option ON
        xi = new NaElement("snaplock-set-options");
        xi.AddNewChild("option", "privdel");
        xi.AddNewChild("option-value", "on");
        xi.AddNewChild("volume", snaplockenterprisevolume);
        //Invoke snaplock-set-options ONTAP API
        xo = s.InvokeElem(xi);
    }
    catch (Exception e)
    {
        Console.Error.WriteLine(e.Message);
    }
}
```

Examples for performing a privileged delete

You can perform a privileged delete by using Data ONTAP APIs.

Using C#

```
void privileged_delete(string serverip, string serverusername,
string serverpasswd, string path)
{
    NaElement xi;
    NaElement xo;
    NaServer s;

    try
    {
        //Initialize connection to server, and
        //request version 1.3 of the API set
        s = new NaServer(serverip, 1, 3);
        s.Style = NaServer.AUTH_STYLE.LOGIN_PASSWORD;
        //transport needs to be HTTPS
        s.TransportType =
NaServer.TRANSPORT_TYPE.HTTPS;
        s.SetAdminUser(serverusername, serverpasswd);
        //delete the file
        xi = new NaElement("snaplock-privileged-delete-file");
        xi.AddNewChild("do-it", "true");
        xi.AddNewChild("path", path);
        //Invoke snaplock-set-options ONTAP API
        xo = s.InvokeElem(xi);
    }
    catch (Exception e)
    {
        Console.Error.WriteLine(e.Message);
    }
}
```

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