



Set up, upgrade and revert ONTAP

ONTAP 9

NetApp
August 05, 2022

This PDF was generated from https://docs.netapp.com/us-en/ontap/software_setup/concept_decide_whether_to_use_ontap_cli.html on August 05, 2022. Always check docs.netapp.com for the latest.

Table of Contents

- Set up, upgrade and revert ONTAP and system components 1
 - Setup ONTAP 1
 - Upgrade ONTAP 15
 - Update firmware 113
 - Revert ONTAP 118

Set up, upgrade and revert ONTAP and system components

Setup ONTAP

Decide whether to use System Manager or the ONTAP CLI for cluster setup

While you can set up new clusters with the ONTAP CLI, NetApp recommends that you use System Manager whenever possible to simplify the cluster setup process. Use these procedures only if your version of System Manager does not support initial cluster setup for your planned ONTAP deployment.

You should be aware of the following System Manager support requirements:

- Cluster setup is supported only for single nodes and HA pairs
- When you set up node management manually using the CLI, System Manager supports only IPv4 and does not support IPv6. However, if you launch System Manager after completing your hardware setup using DHCP with an auto assigned IP address and with Windows discovery, System Manager can configure an IPv6 management address.

In ONTAP 9.6 and earlier, System Manager does not support deployments that require IPv6 networking.

- MetroCluster setup support is for MetroCluster IP configurations with two nodes at each site.

In ONTAP 9.7 and earlier, System Manager does not support new cluster setup for MetroCluster configurations.

If you are configuring a FlexArray on non-NetApp disks, you need to use the ONTAP CLI to configure root volumes on the array LUNs, and then use the Cluster Setup wizard to set up your cluster.

For more information, see the [FlexArray Virtualization installation and requirements](#) documentation.

Before completing any of these procedures, you should have installed, cabled and powered on your new storage system according to the installation and setup instructions for your platform model.

See the [AFF and FAS documentation](#).

Configure ONTAP on a new cluster

System Manager provides a simple and easy workflow for setting up a new cluster and configuring your storage.

In some cases, such as certain MetroCluster deployments or clusters that require IPv6 network addressing, you might need to use the ONTAP CLI to set up a new cluster. Click [here](#) for more details about these requirements, as well as steps for cluster setup with the ONTAP CLI.

Whether you use System Manager or the CLI for your setup, your system should already be installed and cabled according to the [Installation and Setup Instructions](#) that came with the system. Also, cluster network interfaces should be configured on each node of the cluster for intra-cluster communication.



Assign a node-management IP address

Windows System

You should connect your Windows computer to the same subnet as the controllers. This will automatically assign a node-management IP address to your system.

Step

1. From the Windows system, open the **Network** drive to discover the nodes.
2. Double-click the node to launch the cluster setup wizard.

Other systems

You should configure the node-management IP address for one of the nodes in your cluster. You can use this node-management IP address to launch the cluster set up wizard.

See [Creating the cluster on the first node](#) for information about assigning a node-management IP address.

Initialize the cluster

You initialize the cluster by setting an administrative password for the cluster and setting up the cluster management and node management networks. You can also configure services like a DNS server to resolve host names and an NTP server to synchronize time.

Steps

1. On a web browser, enter the node-management IP address that you have configured: "https://node-management-IP"

System Manager automatically discovers the remaining nodes in the cluster.

2. Initialize the storage system by configuring the cluster management network and node management IP addresses for all the nodes.

Create your local tier

Create local tiers from the available disks or SSDs in your nodes. System Manager automatically calculates the best tier configuration based on your hardware.

Steps

1. Click **Dashboard** and then click **Prepare Storage**.

Accept the storage recommendation for your local tier.

Configure protocols

Depending on the licenses enabled on your cluster, you can enable the desired protocols on your cluster. You then create network interfaces using which you can access the storage.

Steps

1. Click **Dashboard** and then click **Configure Protocols**.
 - Enable iSCSI or FC for SAN access.
 - Enable NFS or SMB for NAS access.
 - Enable NVMe for FC-NVMe access.

Provision Storage

You can now provision storage. The options you see depends on the licenses that are installed.

Steps

1. Click **Dashboard** and then click **Provision Storage**.
 - To [provision SAN access](#), click **Add LUNs**.
 - To [provision NAS access](#), click **Add Volumes**.
 - To [provision NVMe storage](#), click **Add Namespaces**.

Configure ONTAP on a new cluster video



Set up the cluster with the ONTAP CLI

Setting up the cluster involves gathering the information needed to configure setting up each node, creating the cluster on the first node, and joining any remaining nodes to the cluster.

Get started by gathering all the relevant information in the cluster setup worksheets.

Cluster setup worksheets

The cluster setup worksheet enables you to record the values that you need during the cluster setup process. If a default value is provided, you can use that value or else enter your own.

System defaults

The system defaults are the default values for the private cluster network. It is best to use these default values. However, if they do not meet your requirements, you can use the table to record your own values.



For clusters configured to use network switches, each cluster switch must use the 9000 MTU size.

Types of information	Your values
Private cluster network ports	
Cluster network netmask	
Cluster interface IP addresses (for each cluster network port on each node) The IP addresses for each node must be on the same subnet.	

Cluster information

Types of information	Your values
Cluster name The name must begin with a letter, and it must be fewer than 44 characters. The name can include the following special characters: · - _	

Feature license keys

You can find license keys for your initial or add-on software orders at the NetApp Support Site under **My Support > Software Licenses**.

Types of information	Your values
Feature license keys	

Admin storage virtual machine (SVM)

Types of information	Your values
<p>Cluster administrator password</p> <p>The password for the admin account that the cluster requires before granting cluster administrator access to the console or through a secure protocol.</p> <div>  <p>For security purposes, recording passwords in this worksheet is not recommended.</p> </div> <p>The default rules for passwords are as follows:</p> <ul style="list-style-type: none"> • A password must be at least eight characters long. • A password must contain at least one letter and one number. 	
<p>Cluster management interface port</p> <p>The physical port that is connected to the data network and enables the cluster administrator to manage the cluster.</p>	
<p>Cluster management interface IP address</p> <p>A unique IPv4 or IPv6 address for the cluster management interface. The cluster administrator uses this address to access the admin SVM and manage the cluster. Typically, this address should be on the data network.</p> <p>You can obtain this IP address from the administrator responsible for assigning IP addresses in your organization.</p> <p>Example: 192.0.2.66</p>	
<p>Cluster management interface netmask (IPv4)</p> <p>The subnet mask that defines the range of valid IPv4 addresses on the cluster management network.</p> <p>Example: 255.255.255.0</p>	

Types of information	Your values
<p>Cluster management interface netmask length (IPv6)</p> <p>If the cluster management interface uses an IPv6 address, then this value represents the prefix length that defines the range of valid IPv6 addresses on the cluster management network.</p> <p>Example: 64</p>	
<p>Cluster management interface default gateway</p> <p>The IP address for the router on the cluster management network.</p>	
<p>DNS domain name</p> <p>The name of your network's DNS domain.</p> <p>The domain name must consist of alphanumeric characters. To enter multiple DNS domain names, separate each name with either a comma or a space.</p>	
<p>Name server IP addresses</p> <p>The IP addresses of the DNS name servers. Separate each address with either a comma or a space.</p>	

Node information (for each node in the cluster)

Types of information	Your values
<p>Physical location of the controller (optional)</p> <p>A description of the physical location of the controller. Use a description that identifies where to find this node in the cluster (for example, "Lab 5, Row 7, Rack B").</p>	
<p>Node management interface port</p> <p>The physical port that is connected to the node management network and enables the cluster administrator to manage the node.</p>	

Types of information	Your values
<p>Node management interface IP address</p> <p>A unique IPv4 or IPv6 address for the node management interface on the management network. If you defined the node management interface port to be a data port, then this IP address should be a unique IP address on the data network.</p> <p>You can obtain this IP address from the administrator responsible for assigning IP addresses in your organization.</p> <p>Example: 192.0.2.66</p>	
<p>Node management interface netmask (IPv4)</p> <p>The subnet mask that defines the range of valid IP addresses on the node management network.</p> <p>If you defined the node management interface port to be a data port, then the netmask should be the subnet mask for the data network.</p> <p>Example: 255.255.255.0</p>	
<p>Node management interface netmask length (IPv6)</p> <p>If the node management interface uses an IPv6 address, then this value represents the prefix length that defines the range of valid IPv6 addresses on the node management network.</p> <p>Example: 64</p>	
<p>Node management interface default gateway</p> <p>The IP address for the router on the node management network.</p>	

NTP server information

Types of information	Your values
<p>NTP server addresses</p> <p>The IP addresses of the Network Time Protocol (NTP) servers at your site. These servers are used to synchronize the time across the cluster.</p>	

Create the cluster on the first node

You use the Cluster Setup wizard to create the cluster on the first node. The wizard helps you to configure the cluster network that connects the nodes, create the cluster admin storage virtual machine (SVM), add feature license keys, and create the node management interface for the first node.

1. Power on all the nodes you are adding to the cluster. This is required to enable discovery for your cluster setup.
2. Connect to the console of the first node.

The node boots, and then the Cluster Setup wizard starts on the console.

```
Welcome to the cluster setup wizard....
```

3. Acknowledge the AutoSupport statement.

```
Type yes to confirm and continue {yes}: yes
```



AutoSupport is enabled by default.

4. Follow the instructions on the screen to assign an IP address to the node.
5. If you are using the GUI wizard to perform setup, follow the instructions to complete setup in your web browser. If you are using the CLI wizard to perform setup, press Enter to continue.

```
Use your web browser to complete cluster setup by accessing  
https://10.63.11.29
```

```
Otherwise, press Enter to complete cluster setup using the  
command line interface:
```

```
Do you want to create a new cluster or join an existing cluster?  
{create, join}:
```

6. Create a new cluster: `create`
7. Accept the system defaults or enter your own values.
8. After setup is completed, log in to the cluster and verify that the cluster is active and the first node is healthy by entering the ONTAP CLI command: `cluster show`

The following example shows a cluster in which the first node (cluster1-01) is healthy and eligible to participate:

```
cluster1::> cluster show
Node           Health Eligibility
-----
cluster1-01    true   true
```

You can access the Cluster Setup wizard to change any of the values you entered for the admin SVM or node SVM by using the `cluster setup` command.

Join remaining nodes to the cluster

After creating a new cluster, you use the Cluster Setup wizard to join each remaining node to the cluster one at a time. The wizard helps you to configure each node's node management interface.

When you join two nodes in a cluster, you are creating a high availability (HA) pair. If you join 4 nodes, you create two HA pairs. To learn more about HA, see [Learn about HA](#).

You can only join one node to the cluster at a time. When you start to join a node to the cluster, you must complete the join operation for that node, and the node must be part of the cluster before you can start to join the next node.

Best Practice: If you have a FAS2720 with 24 or fewer NL-SAS drives, you should verify that the storage configuration default is set to active/passive to optimize performance.

For more information, see [Setting up an active-passive configuration on nodes using root-data partitioning](#)

1. Log in to the node you plan to join in the cluster.

Cluster Setup wizard starts on the console.

```
Welcome to the cluster setup wizard....
```

2. Acknowledge the AutoSupport statement.



AutoSupport is enabled by default.

```
Type yes to confirm and continue {yes}: yes
```

3. Follow the instructions on the screen to assign an IP address to the node.
4. Join the node to the cluster: `join`
5. Follow the instructions on the screen to set up the node and join it to the cluster.
6. After setup is completed, verify that the node is healthy and eligible to participate in the cluster: `cluster show`

The following example shows a cluster after the second node (cluster1-02) has been joined to the cluster:

```
cluster1::> cluster show
```

Node	Health	Eligibility
cluster1-01	true	true
cluster1-02	true	true

You can access the Cluster Setup wizard to change any of the values you entered for the admin SVM or node SVM by using the cluster setup command.

7. Repeat this task for each remaining node.

Check your cluster with Active IQ Config Advisor

After you have joined all the nodes to your new cluster, you should run Active IQ Config Advisor to validate your configuration and check for common configuration errors.

Config Advisor is a web-based application that you install on your laptop, virtual machine or a server, and works across Windows, Linux, and Mac platforms.

Config Advisor runs a series of commands to validate your installation and check the overall health of the configuration, including the cluster and storage switches.

1. Download and install Active IQ Config Advisor.

Active IQ Config Advisor

2. Launch Active IQ, and set up a passphrase when prompted.
3. Review your settings and click **Save**.
4. On the **Objectives** page, click **ONTAP Post-Deployment Validation**.
5. Choose either Guided or Expert mode.

If you choose Guided mode, connected switches are discovered automatically.

6. Enter the cluster credentials.
7. (Optional) Click **Form Validate**.
8. To begin collecting data, click **Save & Evaluate**.
9. After data collection is complete, under **Job Monitor > Actions**, view the data collected by clicking **Data View** icon, and view the results by clicking the **Results** icon.
10. Resolve the issues identified by Config Advisor.

Synchronize the system time across the cluster

Synchronizing the time ensures that every node in the cluster has the same time, and prevents CIFS and Kerberos failures.

A Network Time Protocol (NTP) server should be set up at your site. Beginning with ONTAP 9.5, you can set up your NTP server with symmetric authentication.

For more information, see [Managing the cluster time \(cluster administrators only\)](#).

You synchronize the time across the cluster by associating the cluster with one or more NTP servers.

1. Verify that the system time and time zone is set correctly for each node.

All nodes in the cluster should be set to the same time zone.

- a. Use the `cluster date show` command to display the current date, time, and time zone for each node.

```
cluster1::> cluster date show
Node           Date           Time zone
-----
cluster1-01    01/06/2015 09:35:15 America/New_York
cluster1-02    01/06/2015 09:35:15 America/New_York
cluster1-03    01/06/2015 09:35:15 America/New_York
cluster1-04    01/06/2015 09:35:15 America/New_York
4 entries were displayed.
```

- b. Use the `cluster date modify` command to change the date or time zone for all of the nodes.

This example changes the time zone for the cluster to be GMT:

```
cluster1::> cluster date modify -timezone GMT
```

2. Use the `cluster time-service ntp server create` command to associate the cluster with your NTP server.

- To set up your NTP server without symmetric authentication enter the following command: `cluster time-service ntp server create -server server_name`
- To set up your NTP server with symmetric authentication, enter the following command: `cluster time-service ntp server create -server server_ip_address -key-id key_id`



Symmetric authentication is available Beginning with ONTAP 9.5. It is not available in ONTAP 9.4 or earlier.

This example assumes that DNS has been configured for the cluster. If you have not configured DNS, you must specify the IP address of the NTP server:

```
cluster1::> cluster time-service ntp server create -server
ntp1.example.com
```

3. Verify that the cluster is associated with an NTP server: `cluster time-service ntp server show`

```
cluster1::> cluster time-service ntp server show
Server           Version
-----
ntp1.example.com  auto
```

Related information

[System administration](#)

Commands for managing symmetric authentication on NTP servers

Beginning with ONTAP 9.5, Network Time Protocol (NTP) version 3 is supported. NTPv3 includes symmetric authentication using SHA-1 keys which increases network security.

To do this...	Use this command...
Configure an NTP server without symmetric authentication	<pre>cluster time-service ntp server create -server server_name</pre>
Configure an NTP server with symmetric authentication	<pre>cluster time-service ntp server create -server server_ip_address -key-id key_id</pre>
Enable symmetric authentication for an existing NTP server An existing NTP server can be modified to enable authentication by adding the required key-id.	<pre>cluster time-service ntp server modify -server server_name -key-id key_id</pre>
Configure a shared NTP key	<pre>cluster time-service ntp key create -id shared_key_id -type shared_key_type -value shared_key_value</pre> <p>Note: Shared keys are referred to by an ID. The ID, its type, and value must be identical on both the node and the NTP server</p>
Configure an NTP server with an unknown key ID	<pre>cluster time-service ntp server create -server server_name -key-id key_id</pre>
Configure a server with a key ID not configured on the NTP server.	<pre>cluster time-service ntp server create -server server_name -key-id key_id</pre> <p>Note: The key ID, type, and value must be identical to the key ID, type, and value configured on the NTP server.</p>
Disable symmetric authentication	<pre>cluster time-service ntp server modify -server server_name -authentication disabled</pre>

Additional system configuration tasks to complete

After setting up a cluster, you can use either System Manager or the ONTAP command-line interface (CLI) to continue configuring the cluster.

System configuration task	Resource
Configure networking: <ul style="list-style-type: none"> • Create broadcast domains • Create subnets • Create IP spaces 	Setting up the network
Set up the Service Processor	System administration
Lay out your aggregates	Disk and aggregate management
Create and configure data storage virtual machines (SVMs)	NFS configuration SMB configuration SAN administration
Configure event notifications	EMS configuration

All SAN Array Software Configuration

Use the following procedures to configure an All SAN Array using System Manager.

Supported ALL SAN Array configurations

The NetApp All SAN Arrays (ASAs) are all-flash SAN-only solutions built on proven AFF NetApp platforms.

The ASA platforms are available in two-node switched or switchless clusters, can be configured for FC or iSCSI, and use symmetric active-active for multipathing. All paths are active/optimized so in the event of a storage failover, the host does not need to wait for the ALUA transition of the failover paths to resume I/O. This reduces time to failover.



With ONTAP 9.9.1, customers can now scale AFF ASA configurations up to 12 nodes. ASAs are supported in ONTAP 9.7 and later. Supported configurations are listed in the [NetApp Interoperability Matrix Tool](#).

Related information

[NetApp Technical Report 4515: ONTAP AFF All SAN Array Systems](#)

[NetApp Technical Report 4080: Best Practices for Scalable SAN ONTAP 9](#)

Set up an ASA

All SAN Arrays (ASAs) follow the same setup procedure as non-ASA systems.

System Manager guides you through the procedures necessary to initialize your cluster, create a local tier, configure protocols, and provision storage for your ASA. See the steps to [Configure ONTAP](#).

ASA limitations and restrictions

You need to be aware of the limitations and restrictions for using AFF All SAN Array (ASA) controllers, prior to ONTAP 9.9.1.

ASAs do not support NVMe-oF protocol.



With ONTAP 9.9.1, NVMe-oF protocol support is now available with an AFF ASA system.

You should use the tested and supported maximum configuration limits established for the AFF All SAN Array (ASA) controllers. For reliable operations, you should not exceed the current tested and supported limits listed in [NetApp Hardware Universe](#).

Note: With ONTAP 9.9.1, customers can now scale AFF ASA configurations up to 12 nodes. Customers can also now deploy 8-node MCC IP configurations on AFF platforms that support ASA.

Support for persistent ports

Beginning with ONTAP 9.8, persistent ports are enabled by default on All SAN Arrays (ASAs) that are configured to use the FC protocol. Persistent ports are only available for FC and require zone membership identified by World Wide Port Name (WWPN).

Persistent ports reduce the impact of takeovers by creating a shadow LIF on the corresponding physical port of the HA partner. When a node is taken over, the shadow LIF on the partner node assumes the identity of the original LIF, including the WWPN. Before the status of path to the taken over node is changed to faulty, the shadow LIF appears as an Active/Optimized path to the host MPIO stack, and I/O is shifted. This reduces I/O disruption because the host always sees the same number of paths to the target, even during storage failover operations.

For persistent ports, the following FCP port characteristics should be identical within the HA pair:

- FCP port counts
- FCP port names
- FCP port speeds
- FCP LIF WWPN-based zoning

If any of these characteristics are not identical within the HA pair, the following EMS message is generated:

```
EMS : scsiblade.lif.persistent.ports.fcp.init.error
```

For more information on persistent ports, see [NetApp Technical Report 4080: Best Practices for Scalable SAN ONTAP 9](#).

ASA host settings and utilities

Host settings for setting up All SAN Arrays (ASAs) are the same as those for all other SAN hosts.

You can download the [NetApp Host Utilities software](#) for your specific hosts from the support site.

Ways to identify an ASA system

You can identify an ASA system using System Manager or using the ONTAP command line interface (CLI).

From the System Manager dashboard, click **Cluster > Overview** and then select the system node. The **PERSONALITY** is displayed as **All SAN Array**.

From the CLI, you can use `san config show` command. The "All SAN Array" value returns as true for ASA systems.

Upgrade ONTAP

Upgrade ONTAP overview

The [method you use to upgrade](#) your ONTAP software depends upon your configuration. If it is supported by your configuration, you should perform an automated nondisruptive upgrade (ANDU) using System Manager.

If you have an active [SupportEdge](#) contract for [Active IQ Digital Advisor](#), before you begin your upgrade, you should launch Upgrade Advisor in Active IQ Digital Advisor to help you plan your upgrade.

The procedures in this section guide you through the steps you should take before and after you upgrade, including the resources you should read and the necessary pre- and post-upgrade checks you should perform.

What version of ONTAP can I upgrade to?

The version of ONTAP that you can upgrade to varies based on your hardware platform and the version of ONTAP currently running on your cluster's nodes. See [NetApp Hardware Universe](#) to verify that your platform is supported for the target upgrade release.

These guidelines refer only to on-premises ONTAP releases. For information about upgrading ONTAP in the cloud, see [Upgrading Cloud Volumes ONTAP software](#).

To determine your current ONTAP version:

- In System Manager, click **Cluster > Overview**.
- From the command line interface (CLI), use the `cluster image show` command.
You can also use the `system node image show` command in the advanced privilege level to display details.

Types of upgrade paths

Automated nondisruptive upgrades (ANDU) are recommended whenever possible. Depending on your current and target releases, your upgrade path will be *direct*, *direct multi-hop*, or *multi-stage*. Unless otherwise noted, these paths apply to all [upgrade methods](#); nondisruptive or disruptive, automated or manual.

- *direct*
You can always upgrade directly to the next adjacent ONTAP release family using a single software image. For most releases, you can also install a software image that allows you to upgrade directly to releases that are two releases higher than the running release.

For example, you can use the direct update path from 9.8 to 9.9.1, or from 9.8 to 9.10.1.

Note: Beginning with ONTAP 9.11.1, software images support upgrading directly to releases that are three releases higher than the running release. For example, you can use the direct upgrade path from 9.8 to 9.11.1.

- *direct multi-hop*

For some automated nondisruptive upgrades (ANDU) to non-adjacent releases, you can install the software image for an intermediate release as well the target release. The automated upgrade process uses the intermediate image in the background to complete the update to the target release.

For example, if the cluster is running 9.3 and you want to upgrade to 9.7, you would load the ONTAP install packages for both 9.5 and 9.7, then initiate ANDU to 9.7. ONTAP then automatically upgrades the cluster first to 9.5 and then to 9.7. You should expect multiple takeover/giveback operations and related reboots during the process.

The following direct multi-hop upgrade paths are available using the ANDU method:

Source ONTAP release	Target ONTAP release	Images required
9.7	9.11.1	9.8, 9.11.1
	9.10.1	9.8, 9.10.1P1 or later P release
9.6	9.10.1	9.8, 9.10.1P1 or later P release
9.5	9.9.1	9.7, 9.9.1
9.3	9.7	9.5, 9.7

- *multi-stage*

If a direct or direct multi-hop path is not available for your non-adjacent target release, you must first upgrade to a supported intermediate release, and then upgrade to the target release.

For example, if you are currently running 9.6 and you want to upgrade to 9.11.1, you must complete a multi-stage upgrade: first from 9.6 to 9.8, and then from 9.8 to 9.11.1. Upgrades from earlier releases might require three or more stages, with several intermediate upgrades.

Note: Before beginning multi-stage upgrades, be sure your target release is supported on your hardware platform.

If you are planning an ONTAP upgrade from an older ONTAP version (such as 9.3), it is a best practice to upgrade first to the latest patch release in the same ONTAP release family and only then upgrade to the next supported major release. This will ensure that any issues in the older version are resolved before upgrading.

For example, if your system is running ONTAP 9.3P9 and you are planning to upgrade to 9.9.1P7, follow this upgrade path:

9.3P9 → 9.3P21 → 9.7P18 → 9.9.1P7

Learn about [Minimum Recommended ONTAP releases on the NetApp Support Site](#).

Supported upgrade paths

Detailed upgrade paths are available for the following scenarios:

- Automated nondisruptive upgrades (ANDU) within the ONTAP 9 release family (recommended).
- Manual nondisruptive and disruptive upgrades within the ONTAP 9 release family.
- Upgrades from Data ONTAP 8.* releases to ONTAP 9 releases.

Upgrade images for some earlier releases are no longer available.

ANDU paths, ONTAP 9

If your current ONTAP release is...	And your target ONTAP release is...	Your ANDU upgrade path is...
9.10.1	9.11.1	direct
9.9.1	9.11.1	direct
	9.10.1	direct
9.8	9.11.1	direct
	9.10.1	direct
	9.9.1	direct
9.7	9.11.1	direct multi-hop (requires images for 9.8 & 9.11.1)
	9.10.1	direct multi-hop (requires images for 9.8 & 9.10.1P1 or later P release)
	9.9.1	direct
	9.8	direct
9.6	9.11.1	multi-stage - 9.6 → 9.8 - 9.8 → 9.11.1
	9.10.1	direct multi-hop (requires images for 9.8 & 9.10.1P1 or later P release)
	9.9.1	multi-stage - 9.6 → 9.8 - 9.8 → 9.9.1
	9.8	direct
	9.7	direct
9.5	9.11.1	multi-stage - 9.5 → 9.9.1 (direct multi-hop, requires images for 9.7 & 9.9.1) - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.5 → 9.9.1 (direct multi-hop, requires images for 9.7 & 9.9.1) - 9.9.1 → 9.10.1
	9.9.1	direct multi-hop (requires images for 9.7 & 9.9.1)
	9.8	multi-stage - 9.5 → 9.7 - 9.7 → 9.8
	9.7	direct
	9.6	direct

If your current ONTAP release is...	And your target ONTAP release is...	Your ANDU upgrade path is...
9.4	9.11.1	multi-stage - 9.4 → 9.5 - 9.5 → 9.9.1 (direct multi-hop, requires images for 9.7 & 9.9.1) - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.4 → 9.5 - 9.5 → 9.9.1 (direct multi-hop, requires images for 9.7 & 9.9.1) - 9.9.1 → 9.10.1
	9.9.1	multi-stage - 9.4 → 9.5 - 9.5 → 9.9.1 (direct multi-hop, requires images for 9.7 & 9.9.1)
	9.8	multi-stage - 9.4 → 9.5 - 9.5 → 9.8 (direct multi-hop, requires images for 9.7 & 9.8)
	9.7	multi-stage - 9.4 → 9.5 - 9.5 → 9.7
	9.6	multi-stage - 9.4 → 9.5 - 9.5 → 9.6
	9.5	direct

If your current ONTAP release is...	And your target ONTAP release is...	Your ANDU upgrade path is...
9.3	9.11.1	multi-stage - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.9.1 - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.3 → 9.7 (direct multi-hop, requires images for 9.7 & 9.9.1) - 9.7 → 9.10.1 (direct multi-hop, requires images for 9.8 & 9.10.1)
	9.9.1	multi-stage - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.9.1
	9.8	multi-stage - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.8
	9.7	direct multi-hop (requires images for 9.5 & 9.7)
	9.6	multi-stage - 9.3 → 9.5 - 9.5 → 9.6
	9.5	direct
	9.4	not available

If your current ONTAP release is...	And your target ONTAP release is...	Your ANDU upgrade path is...
9.2	9.11.1	multi-stage - 9.2 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.9.1 (direct multi-hop, requires images for 9.8 & 9.9.1) - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.2 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.10.1 (direct multi-hop, requires images for 9.8 & 9.10.1)
	9.9.1	multi-stage - 9.2 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.9.1
	9.8	multi-stage - 9.2 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.8
	9.7	multi-stage - 9.2 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7)
	9.6	multi-stage - 9.2 → 9.3 - 9.3 → 9.6 (direct multi-hop, requires images for 9.5 & 9.6)
	9.5	multi-stage - 9.3 → 9.5 - 9.5 → 9.6
	9.4	not available
	9.3	direct

If your current ONTAP release is...	And your target ONTAP release is...	Your ANDU upgrade path is...
9.1	9.11.1	multi-stage - 9.1 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.9.1 - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.1 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.10.1 (direct multi-hop, requires images for 9.8 & 9.10.1)
	9.9.1	multi-stage - 9.1 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.9.1
	9.8	multi-stage - 9.1 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7) - 9.7 → 9.8
	9.7	multi-stage - 9.1 → 9.3 - 9.3 → 9.7 (direct multi-hop, requires images for 9.5 & 9.7)
	9.6	multi-stage - 9.1 → 9.3 - 9.3 → 9.6 (direct multi-hop, requires images for 9.5 & 9.6)
	9.5	multi-stage - 9.1 → 9.3 - 9.3 → 9.5
	9.4	not available
	9.3	direct
	9.2	not available

If your current ONTAP release is...	And your target ONTAP release is...	Your ANDU upgrade path is...
9.0		

	9.3	multi-stage - 9.0 → 9.1 - 9.1 → 9.3
If your current ONTAP release is...	And your target ONTAP release is...	Your ANDU upgrade path is...
	9.1	not available
	9.1	direct

Manual paths, ONTAP 9

If your current ONTAP release is...	And your target ONTAP release is...	Your manual upgrade path is...
9.10.1	9.11.1	direct
9.9.1	9.11.1	direct
	9.10.1	direct
9.8	9.11.1	direct
	9.10.1	direct
	9.9.1	direct
9.7	9.11.1	multi-stage - 9.7 → 9.9.1 - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.7 → 9.9.1 - 9.9.1 → 9.10.1
	9.9.1	direct
	9.8	direct
9.6	9.11.1	multi-stage - 9.6 → 9.8 - 9.8 → 9.11.1
	9.10.1	multi-stage - 9.6 → 9.8 - 9.8 → 9.10.1
	9.9.1	multi-stage - 9.6 → 9.8 - 9.8 → 9.9.1
	9.8	direct
	9.7	direct

If your current ONTAP release is...	And your target ONTAP release is...	Your manual upgrade path is...
9.5	9.11.1	multi-stage - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.10.1
	9.9.1	multi-stage - 9.5 → 9.7 - 9.7 → 9.9.1
	9.8	multi-stage - 9.5 → 9.7 - 9.7 → 9.8
	9.7	direct
	9.6	direct
9.4	9.11.1	multi-stage - 9.4 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.4 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.10.1
	9.9.1	multi-stage - 9.4 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1
	9.8	multi-stage - 9.4 → 9.5 - 9.5 → 9.7 - 9.7 → 9.8
	9.7	multi-stage - 9.4 → 9.5 - 9.5 → 9.7
	9.6	multi-stage - 9.4 → 9.5 - 9.5 → 9.6
	9.5	direct

If your current ONTAP release is...	And your target ONTAP release is...	Your manual upgrade path is...
9.3	9.11.1	multi-stage - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.10.1
	9.9.1	multi-stage - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1
	9.8	multi-stage - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.8
	9.7	multi-stage - 9.3 → 9.5 - 9.5 → 9.7
	9.6	multi-stage - 9.3 → 9.5 - 9.5 → 9.6
	9.5	direct
	9.4	not available

If your current ONTAP release is...	And your target ONTAP release is...	Your manual upgrade path is...
9.2	9.11.1	multi-stage - 9.2 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.2 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.10.1
	9.9.1	multi-stage - 9.2 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1
	9.8	multi-stage - 9.2 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.8
	9.7	multi-stage - 9.2 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7
	9.6	multi-stage - 9.2 → 9.3 - 9.3 → 9.5 - 9.5 → 9.6
	9.5	multi-stage - 9.2 → 9.3 - 9.3 → 9.5
	9.4	not available
	9.3	direct

If your current ONTAP release is...	And your target ONTAP release is...	Your manual upgrade path is...
9.1	9.11.1	multi-stage - 9.1 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.11.1
	9.10.1	multi-stage - 9.1 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1 - 9.9.1 → 9.10.1
	9.9.1	multi-stage - 9.1 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.9.1
	9.8	multi-stage - 9.1 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7 - 9.7 → 9.8
	9.7	multi-stage - 9.1 → 9.3 - 9.3 → 9.5 - 9.5 → 9.7
	9.6	multi-stage - 9.1 → 9.3 - 9.3 → 9.5 - 9.5 → 9.6
	9.5	multi-stage - 9.1 → 9.3 - 9.3 → 9.5
	9.4	not available
	9.3	direct
	9.2	not available

If your current ONTAP release is...	And your target ONTAP release is...	Your manual upgrade path is...
9.0		

	9.3	multi-stage - 9.0 → 9.1 - 9.1 → 9.3
If your current ONTAP release is...	And your target ONTAP release is...	Your manual upgrade path is...
	9.1	direct

Upgrade paths, Data ONTAP 8

Be sure to verify that your platform can run the target ONTAP release by using the [NetApp Hardware Universe](#).

Note: The Data ONTAP 8.3 Upgrade Guide erroneously states that in a four-node cluster, you should plan to upgrade the node that holds epsilon last. This is no longer a requirement for upgrades beginning with Data ONTAP 8.2.3. For more information, see [NetApp Bugs Online Bug ID 805277](#).

From Data ONTAP 8.3.x

You can upgrade directly to ONTAP 9.1, then upgrade to later releases.

From Data ONTAP releases earlier than 8.3.x, including 8.2.x

You must first upgrade to Data ONTAP 8.3.x, then upgrade to ONTAP 9.1, then upgrade to later releases.

Plan your upgrade with Upgrade Advisor

The Upgrade Advisor service in [Active IQ Digital Advisor](#) provides intelligence that helps you plan your upgrade and minimizes uncertainty and risk.

Active IQ identifies issues in your environment that can be resolved by upgrading to a newer version of ONTAP. The Upgrade Advisor service helps you plan for a successful upgrade and provides a report of issues you might need to be aware of in the ONTAP version you're upgrading to.



An active SupportEdge contract is required for Active IQ.

1. [Launch Active IQ](#)
2. Review the Active IQ health summary to help assess the health of your cluster.
3. Review the recommended upgrade path and generate your upgrade plan.

Related information

[SupportEdge Services](#)

Upgrade without Upgrade Advisor

Plan your upgrade without Upgrade Advisor

It is a best practice to use Upgrade Advisor in [Active IQ](#) to plan your upgrade. If you do not have an active [SupportEdge](#) contract for Active IQ, you should perform the necessary pre-upgrade checks and create your own upgrade plan.

How long will my upgrade take?

You should plan for at least 30 minutes to complete preparatory steps, 60 minutes to upgrade each HA pair, and at least 30 minutes to complete post-upgrade steps.



If you are using NetApp Encryption with an external key management server and the Key Management Interoperability Protocol (KMIP), you should expect the upgrade for each HA pair to be longer than one hour.

Our upgrade duration guidelines are based on typical configurations and workloads. You can use these guidelines to estimate the time it will take to perform a nondisruptive upgrade in your environment. However, the actual duration of your upgrade process will depend on your individual environment and the number of nodes.

Resources to read before you upgrade

If you don't use [Active IQ Upgrade Advisor](#), you need to review a number of NetApp resources before upgrading your ONTAP software. These resources will help you understand issues you must resolve, new system behavior in the target release, and confirm hardware support.

1. Review the *Release Notes* for the target release.

[ONTAP 9 Release Notes](#)

The “Important cautions” section describes potential issues that you should be aware of before upgrading to the new release. The “New and changed features” and “Known problems and limitations” sections describe new system behavior after upgrading to the new release.

2. Confirm that your hardware platform as well as your cluster and management switches are supported in the target release.

You can upgrade in a transitional state, but ultimately your NX-OS (cluster network switches), IOS (management network switches), and reference configuration file (RCF) software versions should be compatible with the version of ONTAP to which you are upgrading.

[NetApp Hardware Universe](#)

3. Confirm that your MetroCluster IP switches are supported in the target release.

[NetApp Interoperability Matrix Tool](#)

4. If your cluster and management switches do not have the minimum software versions for the target ONTAP release, upgrade to supported software versions.

- [NetApp Downloads: Broadcom Cluster Switches](#)
- [NetApp Downloads: Cisco Ethernet Switches](#)
- [NetApp Downloads: NetApp Cluster Switches](#)

5. If your cluster is configured for SAN, confirm that the SAN configuration is fully supported.

All SAN components—including the target ONTAP software version, host OS and patches, required Host Utilities software, multipathing software, and adapter drivers and firmware—should be supported.

[NetApp Interoperability Matrix Tool](#)

6. If you are transitioning from 7-Mode using the 7-Mode Transition Tool, confirm that the tool supports transition to the ONTAP version to which you are upgrading.

All the projects in the tool must be in the completed or aborted state before you upgrade the 7-Mode Transition Tool that supports the ONTAP version to which you are upgrading.

[7-Mode Transition Tool installation and administration](#)

What should I verify before I upgrade without Upgrade Advisor?

What to verify before upgrading

If you don't use [Active IQ](#) Upgrade Advisor to plan your upgrade, you should verify your cluster upgrade limits and your cluster activity before you upgrade.

Verify cluster upgrade limits

If you don't use [Active IQ](#) Upgrade Advisor, you need to verify that your cluster does not exceed the platform system limits. SAN also has limits that you should verify in addition to the platform system limits.

1. Verify that the cluster does not exceed the system limits for your platform.

[NetApp Hardware Universe](#)

2. If your cluster is configured for SAN, verify that it does not exceed the configuration limits for FC, FCoE, and iSCSI.

[NetApp Hardware Universe](#)

3. Determine the CPU and disk utilization: `node run -node node_name -command sysstat -c 10 -x 3`

You should monitor CPU and disk utilization for 30 seconds. The values in the **CPU** and **Disk Util** columns should not exceed 50% for all 10 measurements reported. No additional load should be added to the cluster until the upgrade is complete.

NOTE: CPU and disk utilization can vary at different times in your environment. Therefore, it is best to check your CPU and disk utilization during the timeframe of your anticipated upgrade window.

Verify current cluster activity

If you don't use [Active IQ](#) Upgrade Advisor, before upgrading, you should manually verify that no jobs are running and that any CIFS sessions that are not continuously available are terminated.

Verify that no jobs are running

Before upgrading the ONTAP software, you must verify the status of cluster jobs. If any aggregate, volume, NDMP (dump or restore), or Snapshot jobs (such as create, delete, move, modify, replicate, and mount jobs) are running or queued, you must allow the jobs to finish successfully or stop the queued entries.

1. Review the list of any running or queued aggregate, volume, or Snapshot jobs: `job show`

```
cluster1::> job show
```

Job ID	Name	Owning Vserver	Node	State
8629	Vol Reaper	cluster1	-	Queued
	Description: Vol Reaper Job			
8630	Certificate Expiry Check	cluster1	-	Queued
	Description: Certificate Expiry Check			
.				
.				
.				

2. If there are any running jobs, allow them to finish successfully.
3. Delete any of the queued aggregate, volume, or Snapshot copy jobs: `job delete -id job_id`

```
cluster1::> job delete -id 8629
```

4. Verify that no aggregate, volume, or Snapshot jobs are running or queued: `job show`

In this example, all running and queued jobs have been deleted:

```
cluster1::> job show
```

Job ID	Name	Owning Vserver	Node	State
9944	SnapMirrorDaemon_7_2147484678	cluster1	node1	Dormant
	Description: Snapmirror Daemon for 7_2147484678			
18377	SnapMirror Service Job	cluster1	node0	Dormant
	Description: SnapMirror Service Job			
2 entries were displayed				

Identifying active CIFS sessions that should be terminated

Before upgrading the ONTAP software, you should identify and gracefully terminate any CIFS sessions that are not continuously available.

Continuously available CIFS shares, which are accessed by Hyper-V or Microsoft SQL Server clients using the SMB 3.0 protocol, do not need to be terminated before upgrading.

1. Identify any established CIFS sessions that are not continuously available: `vserver cifs session show -continuously-available Yes -instance`

This command displays detailed information about any CIFS sessions that have no continuous availability. You should terminate them before proceeding with the ONTAP upgrade.

```
cluster1::> vserver cifs session show -continuously-available Yes
-instance
```

```

Node: node1
Vserver: vs1
Session ID: 1
Connection ID: 4160072788
Incoming Data LIF IP Address: 198.51.100.5
Workstation IP address: 203.0.113.20
Authentication Mechanism: NTLMv2
Windows User: CIFS\user1
UNIX User: nobody
Open Shares: 1
Open Files: 2
Open Other: 0
Connected Time: 8m 39s
Idle Time: 7m 45s
Protocol Version: SMB2_1
Continuously Available: No
1 entry was displayed.
```

2. If necessary, identify the files that are open for each CIFS session that you identified: `vserver cifs session file show -session-id session_ID`

```
cluster1::> vserver cifs session file show -session-id 1
```

```
Node:      node1
Vserver:   vs1
Connection: 4160072788
Session:    1
File      File      Open Hosting
Continuously
ID        Type      Mode Volume      Share      Available
-----
-----
1         Regular   rw  vol10      homedirshare  No
Path: \TestDocument.docx
2         Regular   rw  vol10      homedirshare  No
Path: \file1.txt
2 entries were displayed.
```

Related information

[Considerations for session-oriented protocols](#)

How firmware is updated during the ONTAP upgrade

Because upgrading ONTAP includes upgrading your firmware, you do not need to update firmware manually. When you perform an ONTAP upgrade, the firmware for your cluster included with the ONTAP upgrade package is copied to each node's boot device, and the new firmware is installed automatically.

Firmware for the following components is updated automatically if the version in your cluster is older than the firmware that is bundled with the ONTAP upgrade package:

- BIOS/LOADER
- Service Processor (SP) or baseboard management controller (BMC)
- Storage shelf
- Disk
- Flash Cache

If desired, you can also update firmware manually in between ONTAP upgrades.

What should I verify before I upgrade with or without Upgrade Advisor?

What to check before upgrading

Even if you use [Active IQ Upgrade Advisor](#) to plan your upgrade, there still are various pre-checks you should perform before you upgrade to verify cluster health, storage health, configuration, and more.

Verify cluster health

Before you upgrade a cluster, you should verify that the nodes are healthy and eligible to participate in the cluster, and that the cluster is in quorum.

1. Verify that the nodes in the cluster are online and are eligible to participate in the cluster: `cluster show`

```
cluster1::> cluster show
Node                Health  Eligibility
-----
node0               true    true
node1               true    true
```

If any node is unhealthy or ineligible, check EMS logs for errors and take corrective action.

2. If you are operating in a SAN environment, verify that each node is in a SAN quorum: `event log show -severity informational -message-name scsiblade.*`

The most recent scsiblade event message for each node should indicate that the scsi-blade is in quorum.

```
cluster1::*> event log show -severity informational -message-name
scsiblade.*
```

Time	Node	Severity	Event
MM/DD/YYYY TIME	node0	INFORMATIONAL	scsiblade.in.quorum: The scsi-blade ...
MM/DD/YYYY TIME	node1	INFORMATIONAL	scsiblade.in.quorum: The scsi-blade ...

Related information

[System administration](#)

Verify storage health

Before and after you upgrade a cluster, you should verify the status of your disks, aggregates, and volumes.

1. Verify disk status:

To check for...	Do this...
Broken disks	a. Display any broken disks: <code>storage disk show -state broken</code> b. Remove or replace any broken disks.
Disks undergoing maintenance or reconstruction	a. Display any disks in maintenance, pending, or reconstructing states: <code>storage disk show -state maintenance pending reconstructing</code> b. Wait for the maintenance or reconstruction operation to finish before proceeding.

2. Verify that all aggregates are online by displaying the state:

```
storage aggregate show -state !online
```

This command displays the aggregates that are *not* online. All aggregates must be online before and after performing a major upgrade or reversion.

```
cluster1::> storage aggregate show -state !online
There are no entries matching your query.
```

3. Verify that all volumes are online by displaying any volumes that are *not* online:

```
volume show -state !online
```

All volumes must be online before and after performing a major upgrade or reversion.

```
cluster1::> volume show -state !online
There are no entries matching your query.
```

4. Verify that there are no inconsistent volumes:

```
volume show -is-inconsistent true
```

See the Knowledge Base article [Volume Showing WAFL Inconsistent](#) on how to address the inconsistent volumes.

Related information

[Logical storage management](#)

Verify SVM routing configuration

It is a best practice to configure one default route for an SVM. To avoid disruption, you should ensure that the default route is able to reach any network address that is not reachable by a more specific route. For more information, see [SU134: Network access might be disrupted by incorrect routing configuration in clustered ONTAP](#).

The routing table for an SVM determines the network path the SVM uses to communicate with a destination. It's important to understand how routing tables work so that you can prevent network problems before they occur.

Routing rules are as follows:

- ONTAP routes traffic over the most specific available route.
- ONTAP routes traffic over a default gateway route (having 0 bits of netmask) as a last resort, when more specific routes are not available.

In the case of routes with the same destination, netmask, and metric, there is no guarantee that the system will use the same route after a reboot or after an upgrade. This is especially an issue if you have configured multiple default routes.

Verifying the LIF failover configuration

Before you perform an upgrade, you must verify that the failover policies and failover groups are configured correctly.



During the upgrade process, LIFs are migrated based on the upgrade method. Depending upon the upgrade method, the LIF failover policy might or might not be used.

If you have 8 or more nodes in your cluster, the automated upgrade is performed using the batch method. The batch upgrade method involves dividing the cluster into multiple upgrade batches, upgrading the set of nodes in the first batch, upgrading their high-availability (HA) partners, and then repeating the process for the remaining batches. In ONTAP 9.7 and earlier, if the batch method is used, LIFs are migrated to the HA partner of the node being upgraded. In ONTAP 9.8 and later, if the batch method is used, LIFs are migrated to the other batch group.

If you have less than 8 nodes in your cluster, the automated upgrade is performed using the rolling method. The rolling upgrade method involves initiating a failover operation on each node in an HA pair, updating the "failed" node, initiating giveback, and then repeating the process for each HA pair in the cluster. If the rolling

method is used, LIFs are migrated to the failover target node as defined by the LIF failover policy.

1. Display the failover policy for each data LIF:

If your ONTAP version is...	Use this command
9.6 or later	<code>network interface show -service-policy data -failover</code>
9.5 or earlier	<code>network interface show -role data -failover</code>

This example shows the default failover configuration for a two-node cluster with two data LIFs:

```
cluster1::> network interface show -role data -failover
      Logical      Home      Failover      Failover
Vserver  Interface  Node:Port      Policy      Group
-----
vs0
      lif0          node0:e0b      nextavail    system-
defined
      Failover Targets: node0:e0b, node0:e0c,
                        node0:e0d, node0:e0e,
                        node0:e0f, node1:e0b,
                        node1:e0c, node1:e0d,
                        node1:e0e, node1:e0f
vs1
      lif1          node1:e0b      nextavail    system-
defined
      Failover Targets: node1:e0b, node1:e0c,
                        node1:e0d, node1:e0e,
                        node1:e0f, node0:e0b,
                        node0:e0c, node0:e0d,
                        node0:e0e, node0:e0f
```

The **Failover Targets** field shows a prioritized list of failover targets for each LIF. For example, if lif0 fails over from its home port (e0b on node0), it's first attempts to fail over to port e0c on node0. If lif0 cannot fail over to e0c, it next attempts to fail over to port e0d on node0, and so on.

2. If the failover policy is set to disabled for any LIFs, other than SAN LIFs, use the network interface modify command to enable failover.
3. For each LIF, verify that the **Failover Targets** field includes data ports from a different node that will remain up while the LIF's home node is being upgraded.

You can use the `network interface failover-groups modify` command to add a failover target to the failover group.

Example

```
network interface failover-groups modify -vserver vs0 -failover-group
fg1 -targets sti8-vsim-ucs572q:e0d,sti8-vsim-ucs572r:e0d
```

Related information

[Network and LIF management](#)

Verify status

Before you upgrade, you should verify the following:

- HA pair status
- LDAP status (for ONTAP 9.2 or later)
- DNS server status (for ONTAP 9.2 or later),
- Networking and storage status (for MetroCluster configurations)

Verifying HA status

Before performing a nondisruptive upgrade, you should verify that storage failover is enabled for each HA pair. If the cluster consists of only two nodes, you should also verify that cluster HA is enabled.

You do not need to verify the HA status if you plan to perform a disruptive upgrade, because this upgrade method does not require storage failover.

1. Verify that storage failover is enabled and possible for each HA pair: `storage failover show`

This example shows that storage failover is enabled and possible on node0 and node1:

```
cluster1::> storage failover show
```

Node	Partner	Takeover Possible	State
node0	node1	true	Connected to node1
node1	node0	true	Connected to node0

2 entries were displayed.

If necessary, you can enable storage failover by using the `storage failover modify` command.

2. If the cluster consists of only two nodes (a single HA pair), verify that cluster HA is configured: `cluster ha show`

This example shows that cluster HA is configured:


```
cluster1::> cluster ha show
High Availability Configured: true
```

If necessary, you can enable cluster HA by using the cluster ha modify command.

Verifying LDAP status (ONTAP 9.2 and later)

Beginning with ONTAP 9.2, if LDAP is used by your storage virtual machines (SVMs), you must have an established LDAP connection to perform a nondisruptive upgrade. You should verify the LDAP connection before you begin the upgrade.

The task does not apply if you are upgrading from ONTAP 9.1 or earlier.

1. Check the LDAP status: `ldap check -vserver vservice_name`
2. If the LDAP status is down, modify it: `ldap client modify -client-config LDAP_client -ldap -servers ip_address`
3. Verify that the LDAP status is up: `ldap check -vserver vservice_name`

Verifying DNS server status (ONTAP 9.2 and later)

Beginning with ONTAP 9.2 and later, you should verify the status of your Domain Name Service (DNS) server before and after performing a nondisruptive upgrade.

The task does not apply if you are upgrading from ONTAP 9.1 or earlier.

1. Check the status of your DNS servers: `dns check -vserver vservice_name`

An up status indicates the service is running. A down status indicates that the service is not running.

2. If the DNS server is down, modify it: `dns modify -vserver vservice_name -domains domain_name -name-servers name_server_ipaddress`
3. Verify the status of the DNS server is up.

Verify all LIFS are on home ports before upgrade

During a reboot, some LIFs might have been migrated to their assigned failover ports. Before and after you upgrade a cluster, you must enable and revert any LIFs that are not on their home ports.

The network interface revert command reverts a LIF that is not currently on its home port back to its home port, provided that the home port is operational. A LIF's home port is specified when the LIF is created; you can determine the home port for a LIF by using the network interface show command.

1. Display the status of all LIFs: `network interface show`

This example displays the status of all LIFs for a storage virtual machine (SVM).

```
cluster1::> network interface show -vserver vs0
```

	Logical	Status	Network	Current	
Current Is					
Vserver	Interface	Admin/Oper	Address/Mask	Node	Port
Home					
vs0					
	data001	down/down	192.0.2.120/24	node0	e0e
true					
	data002	down/down	192.0.2.121/24	node0	e0f
true					
	data003	down/down	192.0.2.122/24	node0	e2a
true					
	data004	down/down	192.0.2.123/24	node0	e2b
true					
	data005	down/down	192.0.2.124/24	node0	e0e
false					
	data006	down/down	192.0.2.125/24	node0	e0f
false					
	data007	down/down	192.0.2.126/24	node0	e2a
false					
	data008	down/down	192.0.2.127/24	node0	e2b
false					

8 entries were displayed.

If any LIFs appear with a Status Admin status of down or with an Is home status of false, continue with the next step.

2. Enable the data LIFs: `network interface modify {-role data} -status-admin up`

```
cluster1::> network interface modify {-role data} -status-admin up
8 entries were modified.
```

3. Revert LIFs to their home ports: `network interface revert *`

This command reverts all LIFs back to their home ports.

```
cluster1::> network interface revert *
8 entries were acted on.
```

4. Verify that all LIFs are in their home ports: `network interface show`

This example shows that all LIFs for SVM vs0 are on their home ports.

```
cluster1::> network interface show -vserver vs0
```

	Logical	Status	Network	Current	
Current Is					
Vserver	Interface	Admin/Oper	Address/Mask	Node	Port
Home					
-----	-----	-----	-----	-----	-----
vs0					
	data001	up/up	192.0.2.120/24	node0	e0e
true					
	data002	up/up	192.0.2.121/24	node0	e0f
true					
	data003	up/up	192.0.2.122/24	node0	e2a
true					
	data004	up/up	192.0.2.123/24	node0	e2b
true					
	data005	up/up	192.0.2.124/24	node1	e0e
true					
	data006	up/up	192.0.2.125/24	node1	e0f
true					
	data007	up/up	192.0.2.126/24	node1	e2a
true					
	data008	up/up	192.0.2.127/24	node1	e2b
true					

8 entries were displayed.

Use Active IQ Config Advisor to verify there are no common configuration errors

Before you upgrade, you can use the Active IQ Config Advisor tool to check for common configuration errors.

Active IQ Config Advisor is a configuration validation and health check tool for NetApp systems. This tool can be deployed at both secure sites and nonsecure sites for data collection and system analysis.



Support for Active IQ Config Advisor is limited and is available only online.

1. Log in to the NetApp Support Site, and then click **TOOLS > Tools**.
2. Under **Active IQ Config Advisor**, click [Download App](#).
3. Download, install, and run Active IQ Config Advisor by following the directions on the web page.
4. After running Active IQ Config Advisor, review the tool's output, and follow the recommendations that are provided to address any issues that are discovered by the tool.

Special considerations

Pre-upgrade checks

Depending on your environment, you need to consider certain factors before you start your upgrade. Get started by reviewing the table below to see what special considerations you need to consider.

Ask yourself...	If your answer is yes, then do this...
Do I have a mixed version cluster?	Check mixed version requirements
Do I have a SAN configuration?	Verify the SAN configuration
Do I have a MetroCluster configuration?	<ul style="list-style-type: none">• Review specific upgrade requirements for MetroCluster configurations• Verify networking and storage status
Are nodes on my cluster using root-data partitioning and root-data-data-partitioning?	Examine upgrade considerations for root-data and root-data-data partitioning
Do I have deduplicated volumes and aggregates?	Verify you have enough free space for your deduplicated volumes and aggregates
Is my cluster running SnapMirror?	<ul style="list-style-type: none">• Review upgrade requirements for SnapMirror• Prepare your SnapMirror relationships for upgrade
Is my cluster running SnapLock?	Review upgrade considerations for SnapLock
Am I upgrading from ONTAP 8.3 and have load-sharing mirrors?	Prepare all load-sharing mirrors for upgrade
Am I using NetApp Storage Encryption with external key management servers?	Delete any existing key management server connections
Do I have netgroups loaded into SVMs?	Verify that the netgroup file is present on each node
Do I have LDAP clients using SSLv3?	Configure LDAP clients to use TLS
Am I using session-oriented protocols?	Review considerations for session-oriented protocols
Is SSL FIPS mode enabled on a cluster where administrator accounts authenticate with an SSH public key?	Review requirements for SSH public keys

Mixed version requirements

Beginning with ONTAP 9.3, by default, you cannot join new nodes to the cluster that are running a version of ONTAP that is different from the version running on the existing nodes.

If you plan to add new nodes to your cluster that are running a version of ONTAP that is later than the nodes in your existing cluster, you should upgrade the nodes in your cluster to the later version first, then add the new nodes.

Mixed version clusters are not recommended, but in certain cases you might need to temporarily enter a mixed version state. For example, you need to enter a mixed version state if you are upgrading to a later version of

ONTAP that is not supported on certain nodes in your existing cluster. In this case, you should upgrade the nodes that do support the later version of ONTAP, then unjoin the nodes that do not support the version of ONTAP you are upgrading to using the advanced privilege `cluster unjoin -skip-lastlow-version -node check` command.

You might also need to enter a mixed version state for a technical refresh or an interrupted upgrade. In such cases you can override ONTAP default behavior and join nodes of a different version using the following advanced privilege commands:

- `cluster join -allow-mixed-version-join`
- `cluster add-node -allow-mixed-version-join`

When you have to enter a mixed version state, you should complete the upgrade as quickly as possible. An HA pair must not run an ONTAP version from a release that is different from other HA pairs in the cluster for more than seven days. For correct cluster operation, the period the cluster is in a mixed version state should be as short as possible.

When the cluster is in a mixed version state, you should not enter any commands that alter the cluster operation or configuration except as necessary to satisfy the upgrade requirements.

Verifying the SAN configuration

Upgrading in a SAN environment changes which paths are direct. Therefore, before performing an upgrade, you should verify that each host is configured with the correct number of direct and indirect paths, and that each host is connected to the correct LIFs.

1. On each host, verify that a sufficient number of direct and indirect paths are configured, and that each path is active.

Each host must have a path to each node in the cluster.

2. Verify that each host is connected to a LIF on each node.

You should record the list of initiators for comparison after the upgrade.

For...	Enter...
iSCSI	<code>iscsi initiator show -fields igroup,initiator-name,tpgroup</code>
FC	<code>fc initiator show -fields igroup,wwpn,lif</code>

MetroCluster configurations

Upgrade requirements for MetroCluster configurations

If you have to upgrade a MetroCluster configuration, you should be aware of some important requirements.

Required methods for performing major and minor upgrades of MetroCluster configurations

Patch upgrades to MetroCluster configurations can be performed with automatic non-disruptive upgrade (NDU) procedure.

Beginning with ONTAP 9.3, major upgrades to MetroCluster configurations can be performed with automatic non-disruptive upgrade (NDU) procedure. On systems running ONTAP 9.2 or earlier, major upgrades to MetroCluster configurations must be performed with the NDU procedure that is specific to MetroCluster configurations.

General requirements

- Both clusters must be running the same version of ONTAP.

You can verify the ONTAP version by using the version command.

- The MetroCluster configuration must be in either normal or switchover mode.



Upgrade in switchover mode is only supported in minor patch upgrades.

- For all configurations except two-node clusters, you can nondisruptively upgrade both clusters at the same time.

For nondisruptive upgrade in two-node clusters, the clusters must be upgraded one node at a time.

- The aggregates in both clusters must not be in resyncing RAID status.

During MetroCluster healing, the mirrored aggregates are resynchronized. You can verify if the MetroCluster configuration is in this state by using the `storage aggregate plex show -in -progress true` command. If any aggregates are being synchronized, you should not perform an upgrade until the resynchronization is complete.

- Negotiated switchover operations will fail while the upgrade is in progress.

To avoid issues with upgrade or revert operations, do not attempt an unplanned switchover during an upgrade or revert operation unless all nodes on both clusters are running the same version of ONTAP.

Configuration requirements for normal operation

- The source SVM LIFs must be up and located on their home nodes.

Data LIFs for the destination SVMs are not required to be up or to be on their home nodes.

- All aggregates at the local site must be online.
- All root and data volumes owned by the local cluster's SVMs must be online.

Configuration requirements for switchover

- All LIFs must be up and located on their home nodes.
- All aggregates must be online, except for the root aggregates at the DR site.

Root aggregates at the DR site are offline during certain phases of switchover.

- All volumes must be online.

Related information

[Verifying networking and storage status for MetroCluster configurations](#)

Verify networking and storage status for MetroCluster configurations

Before performing an upgrade in a MetroCluster configuration, you should verify the status of the LIFs, aggregates, and volumes for each cluster.

1. Verify the LIF status: `network interface show`

In normal operation, LIFs for source SVMs must have an admin status of up and be located on their home nodes. LIFs for destination SVMs are not required to be up or located on their home nodes. In switchover, all LIFs have an admin status of up, but they do not need to be located on their home nodes.

```
cluster1::> network interface show
```

	Logical	Status	Network	Current	
Current Is					
Vserver	Interface	Admin/Oper	Address/Mask	Node	Port
Home					

Cluster	cluster1-a1_clus1	up/up	192.0.2.1/24	cluster1-01	e2a
true	cluster1-a1_clus2	up/up	192.0.2.2/24	cluster1-01	e2b
true					
cluster1-01	clus_mgmt	up/up	198.51.100.1/24	cluster1-01	e3a
true	cluster1-a1_inet4_intercluster1	up/up	198.51.100.2/24	cluster1-01	e3c
true	...				

27 entries were displayed.

2. Verify the state of the aggregates: `storage aggregate show -state !online`

This command displays any aggregates that are *not* online. In normal operation, all aggregates located at the local site must be online. However, if the MetroCluster configuration is in switchover, root aggregates at the disaster recovery site are permitted to be offline.

This example shows a cluster in normal operation:

```
cluster1::> storage aggregate show -state !online
There are no entries matching your query.
```

This example shows a cluster in switchover, in which the root aggregates at the disaster recovery site are offline:

```
cluster1::> storage aggregate show -state !online
Aggregate      Size Available Used% State  #Vols  Nodes      RAID
Status
-----
aggr0_b1
0B            0B      0% offline    0 cluster2-01
raid_dp,
mirror
degraded
aggr0_b2
0B            0B      0% offline    0 cluster2-02
raid_dp,
mirror
degraded
2 entries were displayed.
```

3. Verify the state of the volumes: `volume show -state !online`

This command displays any volumes that are *not* online.

If the MetroCluster configuration is in normal operation (it is not in switchover state), the output should show all volumes owned by the cluster's secondary SVMs (those with the SVM name appended with "-mc").

Those volumes come online only in the event of a switchover.

This example shows a cluster in normal operation, in which the volumes at the disaster recovery site are not online.


```
cluster1::> volume show -state !online
(volume show)
Vserver   Volume           Aggregate      State      Type      Size
Available Used%
-----
vs2-mc    vol1             aggr1_b1      -          RW        -
-         -
vs2-mc    root_vs2        aggr0_b1      -          RW        -
-         -
vs2-mc    vol2            aggr1_b1      -          RW        -
-         -
vs2-mc    vol3            aggr1_b1      -          RW        -
-         -
vs2-mc    vol4            aggr1_b1      -          RW        -
-         -
5 entries were displayed.
```

4. Verify that there are no inconsistent volumes: `volume show -is-inconsistent true`

If any inconsistent volumes are returned, you must contact NetApp Support before you precede with the upgrade.

Related information

[Upgrade requirements for MetroCluster configurations](#)

Upgrade considerations for root-data partitioning and root-data-data partitioning

Root-data partitioning and root-data-data-partitioning is supported for some platform models and configurations. This partitioning capability is enabled during system initialization; it cannot be applied to existing aggregates.

For information about migrating your data to a node that is configured for root-data partitioning or root-data-data partitioning, contact your account team or partner organization.

Related information

[ONTAP concepts](#)

Verify that deduplicated volumes and aggregates contain sufficient free space

Before upgrading ONTAP, you must verify that any deduplicated volumes and the aggregates that contain them have sufficient free space for the deduplication metadata. If there is insufficient free space, deduplication will be disabled when the ONTAP upgrade is completed.

Each deduplicated volume must contain at least 4% free space. Each aggregate that contains a deduplicated volume must contain at least 3% free space.

1. Determine which volumes are deduplicated: `volume efficiency show`
2. Determine the free space available on each volume that you identified: `vol show -vserver Vserver_name -volume volume_name -fields volume, size, used, available, percent-used, junction-path`

Each deduplicated volume must not contain more than 96% used capacity. If necessary, you can increase the sizes of any volumes that exceed this capacity.

Logical storage management

In this example, the percent-used field displays the percentage of used space on the deduplicated volume.:

```
vserver      volume size      junction-path available used    percent-used
-----
cluster1-01 vol0      22.99GB -          14.11GB      7.73GB 35%
cluster1-02 vol0      22.99GB -          12.97GB      8.87GB 40%
2 entries were displayed.
```

3. Identify the free space available on each aggregate that contains a deduplicated volume: `aggr show -aggregate aggregate_name -fields aggregate, size, usedsize, availsize, percent-used`

Each aggregate must not contain more than 97% used capacity. If necessary, you can increase the sizes of any aggregates that exceed this capacity.

Disk and aggregate management

In this example, the percent-used field displays the percentage of used space on the aggregate containing the deduplicated volume (`aggr_2`):

```
aggr show -aggregate aggregate_name -fields
aggregate,size,usedsize,availsize,percent-used
aggregate      availsize percent-used size      usedsize
-----
aggr0_cluster1_01 1.11GB    95%          24.30GB 23.19GB
aggr0_cluster1_02 1022MB    96%          24.30GB 23.30GB
2 entries were displayed.
```

SnapMirror

Upgrade requirements for SnapMirror

You must perform certain tasks to successfully upgrade a cluster that is running SnapMirror.

- If you are upgrading clusters with DP SnapMirror relationships, you must upgrade the destination cluster/nodes before you upgrade the source cluster/nodes.

- Before upgrading a cluster that is running SnapMirror, SnapMirror operations must be quiesced for each node that contains destination volumes, and each peered SVM must have a unique name across the clusters.

To prevent SnapMirror transfers from failing, you must suspend SnapMirror operations and, in some cases, upgrade destination nodes before upgrading source nodes. The following table describes the two options for suspending SnapMirror operations.

Option	Description	Upgrade destination nodes before source nodes?
Suspend SnapMirror operations for the duration of the NDU (nondisruptive upgrade).	The simplest method for upgrading in a SnapMirror environment is to suspend all SnapMirror operations, perform the upgrade, and then resume the SnapMirror operations. However, no SnapMirror transfers will occur during the entire NDU. You must use this method if your cluster contains nodes that are mirroring volumes to each other.	No, the nodes can be upgraded in any order.
Suspend SnapMirror operations one destination volume at a time.	You can suspend SnapMirror transfers for a particular destination volume, upgrade the node (or HA pair) that contains the destination volume, upgrade the node (or HA pair) that contains the source volume, and then resume the SnapMirror transfers for the destination volume. By using this method, SnapMirror transfers for all other destination volumes can continue while the nodes that contain the original destination and source volumes are upgraded.	Yes.

SVM peering requires SVM names to be unique across clusters. It is best practice to name SVMs with a unique fully qualified domain name (FQDN), for example, “dataVerser.HQ” or “mirrorVserver.Offsite”. Using the FQDN naming style makes it much easier to make sure of uniqueness.

Related information

[ONTAP concepts](#)

Prepare SnapMirror relationships for a nondisruptive upgrade

It is recommended that you quiesce your SnapMirror operations before performing a nondisruptive upgrade of ONTAP.

1. Use the `snapmirror show` command to determine the destination path for each SnapMirror relationship.

2. For each destination volume, suspend future SnapMirror transfers: `snapmirror quiesce -destination-path destination`

If there are no active transfers for the SnapMirror relationship, this command sets its status to Quiesced. If the relationship has active transfers, the status is set to Quiescing until the transfer is completed, and then the status becomes Quiesced.

This example quiesces transfers involving the destination volume vol1 from SVMvs0.example.com:

```
cluster1::> snapmirror quiesce -destination-path vs0.example.com:vol1
```

3. Verify that all SnapMirror relationships are quiesced: `snapmirror show -status !Quiesced`

This command displays any SnapMirror relationships that are *not* quiesced.

This example shows that all SnapMirror relationships are quiesced:

```
cluster1::> snapmirror show -status !Quiesced
There are no entries matching your query.
```

4. If any SnapMirror relationships are currently being transferred, do one of the following options:

Option	Description
Wait for the transfers to finish before performing the ONTAP upgrade.	After each transfer finishes, the relationship changes to Quiesced status.
Stop the transfers: <code>snapmirror abort -destination-path destination -h</code> Note: You must use the <code>-foreground true</code> parameter if you are aborting load-sharing mirror transfers.	This command stops the SnapMirror transfer and restores the destination volume to the last Snapshot copy that was successfully transferred. The relationship is set to Quiesced status.

Related information

[Upgrade requirements for SnapMirror](#)

Upgrade considerations for SnapLock

SnapLock does not allow the download of certain kernel versions if these are qualified as bad SnapLock releases or if SnapLock is disabled in those releases. These download restrictions only apply if the node has SnapLock data.

Prepare all load-sharing mirrors for a major upgrade

Before performing a major upgrade from ONTAP 8.3, you should move all of the load-sharing mirror source volumes to an aggregate on the node that you will upgrade last. This ensures that load-sharing mirror destination volumes are the same or later versions of ONTAP.

1. Record the locations of all load-sharing mirror source volumes.

Knowing where the load-sharing mirror source volumes came from helps facilitate returning them to their original locations after the major upgrade.

2. Determine the node and aggregate to which you will move the load-sharing mirror source volumes.
3. Move the load-sharing mirror source volumes to the node and aggregate by using the volume move start command.

Delete existing external key management server connections before upgrading

If you are using NetApp Storage Encryption (NSE) on ONTAP 9.2 or earlier and upgrading to ONTAP 9.3 or later, you must use the command line interface (CLI) to delete any existing external key management (KMIP) server connections before performing the upgrade.

1. Verify that the NSE drives are unlocked, open, and set to the default manufacture secure ID 0x0:

```
storage encryption disk show -disk*
```

2. Enter the advanced privilege mode:

```
set -privilege advanced
```

3. Use the default manufacture secure ID 0x0 to assign the FIPS key to the self-encrypting disks (SEDs):

```
storage encryption disk modify -fips-key-id 0x0 -disk *
```

4. Verify that assigning the FIPS key to all disks is complete: `storage encryption disk show-status`

5. Verify that the **mode** for all disks is set to **data**: `storage encryption disk show`

6. View the configured KMIP servers: `security key-manager show`

7. Delete the configured KMIP servers: `security key-manager delete -address kmip_ip_address`

8. Delete the external key manager configuration: `security key-manager delete-kmip-config`



This step does not remove the NSE certificates.

After the upgrade is complete, you must reconfigure the KMIP server connections.

Related information

[Reconfiguring KMIP server connections after upgrading to ONTAP 9.3 or later](#)

Verifying that the netgroup file is present on all nodes

If you have loaded netgroups into storage virtual machines (SVMs), before you upgrade or revert, you must verify that the netgroup file is present on each node. A missing netgroup file on a node can cause an upgrade or revert to fail.

[NFS management](#) contains more information about netgroups and loading them from a URI.

1. Set the privilege level to advanced: `set -privilege advanced`
2. Display the netgroup status for each SVM: `vserver services netgroup status`
3. Verify that for each SVM, each node shows the same netgroup file hash value: `vserver services name-service netgroup status`

If this is the case, you can skip the next step and proceed with the upgrade or revert. Otherwise, proceed to the next step.

4. On any one node of the cluster, manually load the netgroup file: `vserver services netgroup load -vserver vserver_name -source uri`

This command downloads the netgroup file on all nodes. If a netgroup file already exists on a node, it is overwritten.

Configure LDAP clients to use TLS for highest security

Before upgrading to the target ONTAP release, you must configure LDAP clients using SSLv3 for secure communications with LDAP servers to use TLS. SSL will not be available after the upgrade.

By default, LDAP communications between client and server applications are not encrypted. You must disallow the use of SSL and enforce the use of TLS.

1. Verify that the LDAP servers in your environment support TLS.

If they do not, do not proceed. You should upgrade your LDAP servers to a version that supports TLS.

2. Check which ONTAP LDAP client configurations have LDAP over SSL/TLS enabled: `vserver services name-service ldap client show`

If there are none, you can skip the remaining steps. However, you should consider using LDAP over TLS for better security.

3. For each LDAP client configuration, disallow SSL to enforce the use of TLS: `vserver services name-service ldap client modify -vserver vserver_name -client-config ldap_client_config_name -allow-ssl false`
4. Verify that the use of SSL is no longer allowed for any LDAP clients: `vserver services name-service ldap client show`

Related information

[NFS management](#)

Considerations for session-oriented protocols

Clusters and session-oriented protocols might cause adverse effects on clients and applications in certain areas during upgrades.

If you are using session-oriented protocols, consider the following:

- SMB

If you serve continuously available (CA) shares with SMBv3, you can use the automated nondisruptive upgrade method (with System Manager or the CLI), and no disruption is experienced by the client.

If you are serving shares with SMBv1 or SMBv2, or non-CA shares with SMBv3, client sessions are disrupted during upgrade takeover and reboot operations. You should direct users to end their sessions before you upgrade.

For more information, see [TR-4100: Nondisruptive Operations with SMB File Shares ONTAP 9.x](#).

Hyper-V and SQL Server over SMB support nondisruptive operations (NDOs). If you configured a Hyper-V or SQL Server over SMB solution, the application servers and the contained virtual machines or databases remain online and provide continuous availability during the ONTAP upgrade.

- NFSv4.x

NFSv4.x clients will automatically recover from connection losses experienced during the upgrade using normal NFSv4.x recovery procedures. Applications might experience a temporary I/O delay during this process.

- NDMP

State is lost and the client user must retry the operation.

- Backups and restores

State is lost and the client user must retry the operation.



Do not initiate a backup or restore during or immediately before an upgrade. Doing so might result in data loss.

- Applications (for example, Oracle or Exchange)

Effects depend on the applications. For timeout-based applications, you might be able to change the timeout setting to longer than the ONTAP reboot time to minimize adverse effects.

Download and install the ONTAP software image

You must first download the ONTAP software from the NetApp Support site; then you can install it using the automatic nondisruptive upgrade (ANDU) or manual upgrade process.

Download the software image

Depending on your ONTAP release, you can copy the ONTAP software image from the NetApp Support Site to one of the following locations: an HTTP, HTTPS or FTP server on your network, or a local folder.

You should note the following important information:

- Software images are specific to platform models.

You must obtain the correct image for your cluster. Software images, firmware version information, and the latest firmware for your platform model are available on the NetApp Support Site.

- Software images include the latest version of system firmware that was available when a given version of ONTAP was released.
- If you are upgrading a system with NetApp Volume Encryption to ONTAP 9.5 or later, you must download the ONTAP software image for non-restricted countries, which includes NetApp Volume Encryption.

If you use the ONTAP software image for restricted countries to upgrade a system with NetApp Volume Encryption, the system panics and you lose access to your volumes.

- If you are upgrading from ONTAP 9.5 to 9.9.1, you must copy the software image for ONTAP 9.7 and 9.9.1.
- If you are upgrading from ONTAP 9.3 to 9.7, you must copy the software image for ONTAP 9.5 and 9.7.

Steps

1. Locate the target ONTAP software in the [Software Downloads](#) area of the NetApp Support Site.
2. Copy the software image (for example, 97_q_image.tgz) to the appropriate location.

Depending on your ONTAP release, the location will be a directory on an HTTP, HTTPS or FTP server from which the image will be served to the local system, or to a local folder on the storage system.

You can copy the image to this location...	If you are running these ONTAP releases...
An HTTP or FTP server	ONTAP 9.0 and later
A local folder	ONTAP 9.4 and later
An HTTPS server The server's CA certificate must be installed on the local system.	ONTAP 9.6 and later

Install the software image

You must install the target software image on the cluster's nodes.

- If you are upgrading a system with NetApp Volume Encryption to ONTAP 9.5 or later, you must have downloaded the ONTAP software image for non-restricted countries, which includes NetApp Volume Encryption.

If you use the ONTAP software image for restricted countries to upgrade a system with NetApp Volume Encryption, the system panics and you lose access to your volumes.

- If you are upgrading from ONTAP 9.5 directly to 9.9.1, you must download the software image for ONTAP 9.7 and 9.9.1. If you are upgrading from ONTAP 9.3 directly to 9.7, you must download the software image for ONTAP 9.5 and 9.7.

The automated upgrade process uses both images in the background to complete the upgrade.

For automatic nondisruptive upgrade (ANDU)

1. Check the image repository and delete any previous images.

```
cluster image package show-repository
```



```
cluster image package show-repository\  
<<name_of_vsim|There are no packages in the repository.\r\n
```

2. Download the image.

```
cluster image package get -url url_to_image_on_nss
```

Example

```
cluster image package get -url http://10.60.132.98/x/eng/rlse/DOT/9.7P13X2/  
promo/9.7P13X2/x86\_64.optimize/image.tgz
```

3. Verify the package is downloaded.

```
cluster image package show-repository
```

Example

```
cluster image package show-repository -fields download-ver\  
<<name_of_vsim| download-verX;X\r\n  
<<name_of_vsim| Downloaded VersionX;X\r\n  
<<name_of_vsim| ONTAP 9.10.1.X;X\r\n
```

For manual upgrades

1. Set the privilege level to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (**>**) appears.

2. Download the image.

- If you are upgrading a cluster without a MetroCluster configuration or a two-node MetroCluster configuration, use the following command to download the image:

```
system node image update -node * -package location -replace-package true  
-setdefault true -background true
```

location can be a web server or a local folder, depending on the ONTAP version. See the `system node image update` man page for details.

This command downloads and installs the software image on all of the nodes simultaneously. To download and install the image on each node one at a time, do not specify the `-background` parameter.

- If you are upgrading a four or eight-node MetroCluster configuration, you must issue the following command on both clusters:

```
system node image update -node * -package location -replace-package true  
-background true -setdefault false
```

This command uses an extended query to change the target software image, which is installed as the

alternate image on each node.

3. Enter `y` to continue when prompted.
4. Verify that the software image is downloaded and installed on each node.

```
system node image show-update-progress -node *
```

This command displays the current status of the software image download and installation. You should continue to run this command until all nodes report a **Run Status** of **Exited**, and an **Exit Status** of **Success**.

The system node image update command can fail and display error or warning messages. After resolving any errors or warnings, you can run the command again.

This example shows a two-node cluster in which the software image is downloaded and installed successfully on both nodes:

```
cluster1::*> system node image show-update-progress -node *
There is no update/install in progress
Status of most recent operation:
    Run Status:      Exited
    Exit Status:     Success
    Phase:           Run Script
    Exit Message:    After a clean shutdown, image2 will be set as
the default boot image on node0.
There is no update/install in progress
Status of most recent operation:
    Run Status:      Exited
    Exit Status:     Success
    Phase:           Run Script
    Exit Message:    After a clean shutdown, image2 will be set as
the default boot image on node1.
2 entries were acted on.
```

Which upgrade method should I use?

Which upgrade method should I use?

The method you use to upgrade — nondisruptive or disruptive, automated or manual — depends upon your configuration. If available, the automated nondisruptive upgrade (ANDU) using System Manager is the preferred method.

Nondisruptive upgrades

Nondisruptive upgrades take advantage of ONTAP's high-availability (HA) failover technology to ensure that clusters continue to serve data during the upgrade. There are two types of nondisruptive upgrade processes.

- *Batch* updates

In a batch update, the cluster is divided into several batches, each of which contains multiple HA pairs. In

the first batch, half of the nodes are upgraded, followed by their HA partners. The process is then repeated sequentially for the remaining batches.

- **Rolling updates**

In a rolling update, a node is taken offline and upgraded while its partner takes over its storage. When the node upgrade is complete, the partner node gives control back to the original owning node and the process is repeated, this time on the partner node. Each additional HA pair is upgraded in sequence until all HA pairs are running the target release.

Note: The term *rolling upgrade* is frequently used in the software industry for software upgrades that don't cause disruptions in service and hence is often synonymous with "nondisruptive upgrade". In ONTAP 9 upgrades, a *rolling update* is one of the processes that can be used for nondisruptive upgrades.

Nondisruptive upgrades can be performed using an *automated* or *manual* method.

- **Automated nondisruptive upgrade (ANDU)**

- When an administrator initiates an ANDU, ONTAP automatically installs the target ONTAP image on each node, validates the cluster components to ensure that the cluster can be upgraded nondisruptively, and then executes a batch or rolling update in the background.
 - Batch updates are the default for clusters of 8 nodes or more.
 - Rolling updates are the default for clusters with fewer than 8 nodes. Rolling updates can also be selected explicitly for clusters with 8 nodes or more.
- An ANDU can be executed using System Manager or the ONTAP command line interface (CLI). If available for your configuration, ANDU using System Manager is the recommended method of upgrade.

- **Manual nondisruptive upgrade**

- An administrator must manually confirm upgrade readiness of the cluster components on each node, then manually perform rolling update process steps in the foreground.
- Manual nondisruptive upgrades are executed using the ONTAP CLI.
- You should only use a manual method if ANDU is not supported for your configuration.

Disruptive upgrades

In a disruptive upgrade, storage failover is disabled for each HA pair, and then each node is rebooted one at a time. Disruptive upgrades can be performed more quickly than nondisruptive upgrades, and require fewer steps to complete. However, you should not perform a disruptive upgrade unless you can take the cluster offline for the duration of the upgrade. If you are operating in a SAN environment, you should be prepared to shut down or suspend all SAN clients before performing a disruptive upgrade. Disruptive upgrades are performed using the ONTAP CLI.

Methods for non-MetroCluster configurations

Clusters with 2 or more nodes can use any of the following upgrade methods, which are listed in order of recommended usage.

- [Automated nondisruptive using System Manager](#)
- [Automated nondisruptive using the CLI](#)
- [Manual nondisruptive using the CLI](#)
- [Manual disruptive using the CLI](#)

Single node clusters must use one of disruptive methods, although the automated method is recommended.

- [Automated disruptive using the CLI](#)
- [Manual disruptive using the CLI](#)

Methods for MetroCluster configurations

The upgrade methods available for each configuration are listed in order of recommended usage.

ONTAP version	Number of nodes	Upgrade method
9.3 or later	2,4	<ul style="list-style-type: none"> • Automated nondisruptive using System Manager • Automated nondisruptive using the CLI • Manual disruptive using the CLI
9.3 or later	8	<ul style="list-style-type: none"> • Automated nondisruptive using the CLI • Manual nondisruptive using the CLI • Manual disruptive using the CLI
9.2 or earlier	2	<ul style="list-style-type: none"> • Manual nondisruptive (for 2-node clusters) using the CLI • Manual disruptive using the CLI
9.2 or earlier	4, 8	<ul style="list-style-type: none"> • Manual nondisruptive using the CLI • Manual disruptive using the CLI
9.0 or later	4, 8 (patch only)	Automated nondisruptive using System Manager
9.2 or earlier	2, 4, 8 (patch only)	Automated nondisruptive using System Manager

Automated nondisruptive update using System Manager

You can nondisruptively update the version of ONTAP on your cluster using System Manager.

The update process checks your hardware platform and configuration to verify that your system is supported by the ONTAP version to which you are upgrading. ONTAP automatically shifts workloads during an upgrade between clusters so you can continue serving data.

This procedure updates your system to the specified version of ONTAP. It is assumed that your hardware platform and configuration is supported for the target release.

Beginning with ONTAP 9.10.1, if you have a cluster with 8 or more nodes you can select to have them updated one HA pair at a time. This allows you, if needed, to correct upgrade issues on the first HA pair before moving to subsequent pairs.

Download the
software image

Upgrade ONTAP



If issues are encountered during your automated upgrade, you can view EMS messages and details in System Manager: Click **Events & Jobs > Events**.

Steps

1. If you want to download the software image to an HTTP or FTP server on your network, copy the software image from the NetApp support site to the directory on the HTTP or FTP server from which the image will be served.

If you want to download the software image to a local folder, then click the software image on the NetApp support site, select **Save As**, and then choose the local folder to place the image.

2. Depending on the ONTAP version that you are running, perform one of the following steps:

ONTAP version	Steps
ONTAP 9.8 or later	Click Cluster > Overview .
ONTAP 9.5, 9.6, and 9.7	Click Configuration > Cluster > Update .
ONTAP 9.4 or earlier	Click Configuration > Cluster Update .

3. In the right corner of the Overview pane, click .
4. Click **ONTAP Update**.
5. In the Cluster Update tab, add a new image or select an available image.

If you want to...	Then...
Add a new software image from the local client Note: You should have already downloaded the image to the local client. Download and install the ONTAP software images	<ol style="list-style-type: none">a. Under Available Software Images, click Add from Local.b. Browse to the location you saved the software image, select the image, and then click Open. The software image uploads after you click Open .

Add a new software image from the NetApp Support Site	<p>a. Click Add from Server.</p> <p>b. In the Add a New Software Image dialog box, enter the URL of the HTTP server or FTP server on which you have saved the image that was downloaded from the NetApp Support Site.</p> <p>For anonymous FTP, you must specify the URL in the ftp://anonymous@ftpserver format.</p> <p>c. Click Add.</p>
Select an available image	Choose one of the listed images.

6. Click **Validate** to run the pre-update validation checks to verify whether the cluster is ready for an update.

The validation operation checks the cluster components to validate that the update can be completed nondisruptively, and then displays any errors or warnings. It also displays any required remedial action that you must perform before updating the software.



You must perform all of the required remedial actions for the errors before proceeding with the update. Although you can ignore the remedial actions for the warnings, the best practice is to perform all of the remedial actions before proceeding with the update.

7. Click **Next**.
8. Click **Update**.

Validation is performed again.

- When the validation is complete, a table displays any errors and warnings, along with any required remedial actions to be taken before proceeding.
- If the validation is completed with warnings, you can choose to select **Update with warnings**.



If you prefer to have your nodes updated one HA pair at a time instead of a batch update of all the HA pairs in your cluster, select **Update one HA pair at a time**. This option is only available in ONTAP 9.10.1 or later for clusters of eight or more nodes.

When the validation is complete and the update is in progress, the update might be paused because of errors. You can click the error message to view the details, and then perform the remedial actions before resuming the update.

After the update is completed successfully, the node reboots, and you are redirected to the System Manager login page. If the node takes a long time to reboot, you must refresh your browser.

Resuming an upgrade (using System Manager) after an error in the automated upgrade process

If an automated upgrade pauses because of an error, you can resolve the error and resume the automated upgrade, or you can cancel the automated upgrade and complete the process manually. If you choose to continue the automated upgrade, do not perform any of the upgrade steps manually.

1. Depending on the ONTAP version that you are running, perform one of the following steps:

- ONTAP 9.8 or later: Click **Cluster** > **Overview**
- ONTAP 9.5, 9.6, or 9.7: Click **Configuration** > **Cluster** > **Update**.
- ONTAP 9.4 or earlier: Click **Configuration** > **Cluster Update**.

Then in the right corner of the Overview pane, click the three blue vertical dots, and **ONTAP Update**.

2. Continue the automated update or cancel it and continue manually.

If you want to...	Then...
Resume the automated update	Click Resume .
Cancel the automated update and continue manually	Click Cancel .

Video: Upgrades made easy

Take a look at the simplified ONTAP upgrade capabilities of System Manager in ONTAP 9.8.



Automated nondisruptive ONTAP upgrade using the CLI

You can use the command line interface (CLI) to verify that the cluster can be upgraded nondisruptively, install the target ONTAP image on each node, and then execute an upgrade in the background.

After you upgrade, you should verify your cluster version, cluster health, and storage health.



If you are using a MetroCluster FC configuration, you also need to verify that the cluster is enabled for automatic unplanned switchover.

If you do not plan to monitor the progress of the upgrade process, it is a good practice to [request EMS notifications of errors that might require manual intervention](#).

Before you begin

- You should launch Active IQ Digital Advisor.

The Upgrade Advisor component of Active IQ Digital Advisor helps you plan for a successful upgrade.

Data-driven insights and recommendations from Active IQ Digital Advisor are provided to all NetApp customers with an active **SupportEdge** contract (features vary by product and support tier).

- You must have met the upgrade preparation requirements.
- For each HA pair, each node should have one or more ports on the same broadcast domain.

When a set of nodes is upgraded during a batch upgrade, the LIFs are migrated to the HA partner nodes. If the partners do not have any ports in the same broadcast domain, then the LIF migration fails.

- If you are upgrading from ONTAP 9.3 to 9.7, you must have obtained the software image for 9.5 and 9.7.
- If you are upgrading from ONTAP 9.5 to 9.9.1, you must have obtained the software image for 9.7 and 9.9.1.

About this task

The `cluster image validate` command checks the cluster components to validate that the upgrade can be completed nondisruptively, and then it provides the status of each check and any required action you must take before performing the software upgrade.



Modifying the setting of the storage failover `modify-auto-giveback` command option before the start of an automatic nondisruptive upgrade (ANDU) has no impact on the upgrade process. The ANDU process ignores any preset value to this option during the takeover/giveback required for the update. For example, setting `-autogiveback` to false prior to beginning ANDU does not interrupt the automatic upgrade before giveback.

1. Delete the previous ONTAP software package:

```
cluster image package delete -version previous_ONTAP_Version
```

2. Download the target ONTAP software package:

```
cluster image package get -url location
```



If you are upgrading from ONTAP 9.3 to 9.7, download the software package for ONTAP 9.5, and then use the same command to download the software package for 9.7. If you are upgrading from ONTAP 9.5 to 9.9.1, download the software package for ONTAP 9.7, and then use the same command to download the software package for 9.9.1.


```
cluster1::> cluster image package get -url
http://www.example.com/software/9.7/image.tgz

Package download completed.
Package processing completed.
```

3. Verify that the software package is available in the cluster package repository:

```
cluster image package show-repository
```

```
cluster1::> cluster image package show-repository
Package Version  Package Build Time
-----
9.7              MM/DD/YYYY 10:32:15
```

4. Verify that the cluster is ready to be upgraded nondisruptively:

```
cluster image validate -version package_version_number
```

- If you are upgrading a two-node or four-node MetroCluster configuration, you must run this command on both clusters before proceeding.
- If you are upgrading from ONTAP 9.3 to 9.7, use the 9.7 package for verification. You do not need to validate the 9.5 package separately.
- If you are upgrading from ONTAP 9.5 to 9.9.1, use the 9.9.1 package for verification. You do not need to validate the 9.7 package separately.

```
cluster1::> cluster image validate -version 9.7
```

WARNING: There are additional manual upgrade validation checks that must be performed after these automated validation checks have completed...

5. Monitor the progress of the validation:

```
cluster image show-update-progress
```

6. Complete all required actions identified by the validation.

7. Generate a software upgrade estimate:

```
cluster image update -version package_version_number -estimate-only
```

The software upgrade estimate displays details about each component to be updated, and the estimated duration of the upgrade.

8. Perform the software upgrade:

```
cluster image update -version package_version_number
```

- If you are upgrading from ONTAP 9.3 to 9.7, use the 9.7 `package_version_number` in the above command.
- If you are upgrading from ONTAP 9.5 to 9.9.1, use the 9.9.1 `package_version_number` in the above command.
- For any MetroCluster configuration, except a 2-node MetroCluster system, the ONTAP upgrade process starts simultaneously on the HA pairs at both sites (the local site and the disaster recovery site) after the user initiates and provides confirmation on the command line. For a 2-node MetroCluster system, the update is started first on the disaster recovery site, that is, the site where the upgrade is not initiated. After the update is fully completed on the disaster recovery site, the upgrade begins on the local site.
- If the cluster consists of 2 to 6 nodes, a rolling upgrade is performed. If the cluster consists of 8 or more nodes, a batch upgrade is performed by default. If desired, you can use the `-force-rolling` parameter to specify a rolling upgrade instead.
- After completing each takeover and giveback, the upgrade waits for 8 minutes to enable client applications to recover from the pause in I/O that occurs during the takeover and giveback. If your environment requires more or less time for client stabilization, you can use the `-stabilize-minutes` parameter to specify a different amount of stabilization time.

```
cluster1::> cluster image update -version 9.7

Starting validation for this update. Please wait..

It can take several minutes to complete validation...

WARNING: There are additional manual upgrade validation checks...

Pre-update Check      Status      Error-Action
-----
...
20 entries were displayed

Would you like to proceed with update ? {y|n}: y
Starting update...

cluster-1::>
```

9. Display the cluster update progress:

```
cluster image show-update-progress
```



If you are upgrading a 4-node or 8-node MetroCluster configuration, the `cluster image show-update-progress` command only displays the progress for the node on which you run the command. You must run the command on each node to see individual node progress.

10. Verify that the upgrade was completed successfully on each node.

```
cluster1::> cluster image show-update-progress
```

Update Phase	Status	Estimated Duration	Elapsed Duration
Pre-update checks	completed	00:10:00	00:02:07
Data ONTAP updates	completed	01:31:00	01:39:00
Post-update checks	completed	00:10:00	00:02:00

3 entries were displayed.

```
Updated nodes: node0, node1.
```

```
cluster1::>
```

11. Trigger an AutoSupport notification:

```
autosupport invoke -node * -type all -message "Finishing_NDU"
```

If your cluster is not configured to send AutoSupport messages, a copy of the notification is saved locally.

12. Verify that the cluster is enabled for automatic unplanned switchover:



This procedure is performed only for MetroCluster FC configurations. If you are using a MetroCluster IP configuration, skip this procedure.

a. Check whether automatic unplanned switchover is enabled:

```
metrocluster show
```

If automatic unplanned switchover is enabled, the following statement appears in the command output:

```
AUSO Failure Domain      auso-on-cluster-disaster
```

b. If the statement does not appear in the output, enable automatic unplanned switchover:

```
metrocluster modify -auto-switchover-failure-domain auso-on-cluster-disaster
```

c. Verify that automatic unplanned switchover has been enabled by repeating Step 1.

Resuming an upgrade (using the CLI) after an error in the automated upgrade process

If an automated upgrade pauses because of an error, you can resolve the error and resume the automated upgrade, or you can cancel the automated upgrade and complete the process manually. If you choose to continue the automated upgrade, do not perform any of the upgrade steps manually.

About this task

If you want to manually complete the upgrade, use the `cluster image cancel-update` command to cancel the automated process and proceed manually. If you want to continue the automated upgrade,

complete the following steps.

Steps

1. View the upgrade error:

```
cluster image show-update-progress
```

2. Resolve the error.
3. Resume the update:

```
cluster image resume-update
```

Related information

[Launch Active IQ](#)

[Active IQ documentation](#)

Automated disruptive using the CLI (single-node cluster only)

Beginning with ONTAP 9.2, you can perform an automated update of a single-node cluster. Because single-node clusters lack redundancy, updates are always disruptive.

- You must have satisfied upgrade preparation requirements.
 1. Delete the previous ONTAP software package: `cluster image package delete -version previous_package_version`
 2. Download the target ONTAP software package: `cluster image package get -url location`

```
cluster1::> cluster image package get -url  
http://www.example.com/software/9.7/image.tgz
```

```
Package download completed.  
Package processing completed.
```

3. Verify that the software package is available in the cluster package repository: `cluster image package show-repository`

```
cluster1::> cluster image package show-repository  
Package Version  Package Build Time  
-----  
9.7              M/DD/YYYY 10:32:15
```

4. Verify that the cluster is ready to be upgraded: `cluster image validate -version package_version_number`

```
cluster1::> cluster image validate -version 9.7
```

WARNING: There are additional manual upgrade validation checks that must be performed after these automated validation checks have completed...

5. Monitor the progress of the validation: `cluster image show-update-progress`
6. Complete all required actions identified by the validation.
7. Optionally, generate a software upgrade estimate: `cluster image update -version package_version_number -estimate-only`

The software upgrade estimate displays details about each component to be updated, and the estimated duration of the upgrade.

8. Perform the software upgrade: `cluster image update -version package_version_number`



If an issue is encountered, the update pauses and prompts you to take corrective action. You can use the `cluster image show-update-progress` command to view details about any issues and the progress of the update. After correcting the issue, you can resume the update by using the `cluster image resume-update` command.

9. Display the cluster update progress: `cluster image show-update-progress`

The node is rebooted as part of the update and cannot be accessed while rebooting.

10. Trigger a notification: `autosupport invoke -node * -type all -message "Finishing_Upgrade"`

If your cluster is not configured to send messages, a copy of the notification is saved locally.

Manual nondisruptive using the CLI

Manual nondisruptive upgrade using the CLI (non-MetroCluster systems)

To upgrade a cluster of two or more nodes using the manual nondisruptive method, you must initiate a failover operation on each node in an HA pair, update the “failed” node, initiate giveback, and then repeat the process for each HA pair in the cluster.

You must have satisfied upgrade preparation requirements.

1. Update the first node in an HA pair

You upgrade the first node in an HA pair by initiating a takeover by the node’s partner. The partner serves the node’s data while the first node is upgraded.

2. Update the second node in an HA pair

After upgrading or downgrading the first node in an HA pair, you upgrade its partner by initiating a takeover on it. The first node serves the partner’s data while the partner node is upgraded.

3. Repeat these steps for each additional HA pair.

You should complete post-upgrade tasks.

Updating the first node in an HA pair

You can update the first node in an HA pair by initiating a takeover by the node's partner. The partner serves the node's data while the first node is upgraded.

If you are performing a major upgrade, the first node to be upgraded must be the same node on which you configured the data LIFs for external connectivity and installed the first ONTAP image.

After upgrading the first node, you should upgrade the partner node as quickly as possible. Do not allow the two nodes to remain in a state of version mismatch longer than necessary.

1. Update the first node in the cluster by invoking an AutoSupport message: `autosupport invoke -node * -type all -message "Starting_NDU"`

This AutoSupport notification includes a record of the system status just prior to update. It saves useful troubleshooting information in case there is a problem with the update process.

If the cluster is not configured to send AutoSupport messages, a copy of the notification is saved locally.

2. Set the privilege level to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (***>**) appears.

3. Set the new ONTAP software image to be the default image: `system image modify {-node nodenameA -iscurrent false} -isdefault true`

The `system image modify` command uses an extended query to change the new ONTAP software image (which is installed as the alternate image) to the default image for the node.

4. Monitor the progress of the update: `system node upgrade-revert show`
5. Verify that the new ONTAP software image is set as the default image: `system image show`

In the following example, image2 is the new ONTAP version and is set as the default image on node0:

```
cluster1::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node0					
	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME
node1					
	image1	true	true	X.X.X	MM/DD/YYYY TIME
	image2	false	false	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

6. Disable automatic giveback on the partner node if it is enabled: `storage failover modify -node nodenameB -auto-giveback false`

If the cluster is a two-node cluster, a message is displayed warning you that disabling automatic giveback prevents the management cluster services from going online in the event of an alternating-failure scenario. Enter `y` to continue.

7. Verify that automatic giveback is disabled for node's partner: `storage failover show -node nodenameB -fields auto-giveback`

```
cluster1::> storage failover show -node node1 -fields auto-giveback
node      auto-giveback
-----
node1     false
1 entry was displayed.
```

8. Run the following command twice to determine whether the node to be updated is currently serving any clients `system node run -node nodenameA -command uptime`

The `uptime` command displays the total number of operations that the node has performed for NFS, SMB, FC, and iSCSI clients since the node was last booted. For each protocol, you must run the command twice to determine whether the operation counts are increasing. If they are increasing, the node is currently serving clients for that protocol. If they are not increasing, the node is not currently serving clients for that protocol.

NOTE: You should make a note of each protocol that has increasing client operations so that after the node is updated, you can verify that client traffic has resumed.

The following example shows a node with NFS, SMB, FC, and iSCSI operations. However, the node is currently serving only NFS and iSCSI clients.

```
cluster1::> system node run -node node0 -command uptime
2:58pm up 7 days, 19:16 800000260 NFS ops, 1017333 CIFS ops, 0 HTTP
ops, 40395 FCP ops, 32810 iSCSI ops

cluster1::> system node run -node node0 -command uptime
2:58pm up 7 days, 19:17 800001573 NFS ops, 1017333 CIFS ops, 0 HTTP
ops, 40395 FCP ops, 32815 iSCSI ops
```

9. Migrate all of the data LIFs away from the node: `network interface migrate-all -node nodenameA`
10. Verify any LIFs that you migrated: `network interface show`

For more information about parameters you can use to verify LIF status, see the `network interface show` man page.

The following example shows that node0's data LIFs migrated successfully. For each LIF, the fields included in this example enable you to verify the LIF's home node and port, the current node and port to

which the LIF migrated, and the LIF's operational and administrative status.

```
cluster1::> network interface show -data-protocol nfs|cifs -role data
-home-node node0 -fields home-node,curr-node,curr-port,home-port,status-
admin,status-oper
vserver lif      home-node home-port curr-node curr-port status-oper
status-admin
-----
vs0      data001 node0      e0a      node1     e0a      up      up
vs0      data002 node0      e0b      node1     e0b      up      up
vs0      data003 node0      e0b      node1     e0b      up      up
vs0      data004 node0      e0a      node1     e0a      up      up
4 entries were displayed.
```

11. Initiate a takeover: `storage failover takeover -ofnode nodenameA`

Do not specify the `-option immediate` parameter, because a normal takeover is required for the node that is being taken over to boot onto the new software image. If you did not manually migrate the LIFs away from the node, they automatically migrate to the node's HA partner to ensure that there are no service disruptions.

The first node boots up to the Waiting for giveback state.

NOTE: If AutoSupport is enabled, an AutoSupport message is sent indicating that the node is out of cluster quorum. You can ignore this notification and proceed with the update.

12. Verify that the takeover is successful: `storage failover show`

You might see error messages indicating version mismatch and mailbox format problems. This is expected behavior and it represents a temporary state in a major nondisruptive upgrade and is not harmful.

The following example shows that the takeover was successful. Node node0 is in the Waiting for giveback state, and its partner is in the In takeover state.

```
cluster1::> storage failover show
Node      Partner      Takeover
Possible State Description
-----
node0      node1      -      Waiting for giveback (HA
mailboxes)
node1      node0      false   In takeover
2 entries were displayed.
```

13. Wait at least eight minutes for the following conditions to take effect:

- Client multipathing (if deployed) is stabilized.

- Clients are recovered from the pause in an I/O operation that occurs during takeover.

The recovery time is client specific and might take longer than eight minutes, depending on the characteristics of the client applications.

14. Return the aggregates to the first node: `storage failover giveback -ofnode nodenameA`

The giveback first returns the root aggregate to the partner node and then, after that node has finished booting, returns the non-root aggregates and any LIFs that were set to automatically revert. The newly booted node begins to serve data to clients from each aggregate as soon as the aggregate is returned.

15. Verify that all aggregates have been returned: `storage failover show-giveback`

If the Giveback Status field indicates that there are no aggregates to give back, then all aggregates have been returned. If the giveback is vetoed, the command displays the giveback progress and which subsystem vetoed the giveback.

16. If any aggregates have not been returned, perform the following steps:

- a. Review the veto workaround to determine whether you want to address the “veto” condition or override the veto.

High-availability configuration

- b. If necessary, address the “veto” condition described in the error message, ensuring that any identified operations are terminated gracefully.
- c. Rerun the storage failover giveback command.

If you decided to override the “veto” condition, set the `-override-vetoes` parameter to true.

17. Wait at least eight minutes for the following conditions to take effect:

- Client multipathing (if deployed) is stabilized.
- Clients are recovered from the pause in an I/O operation that occurs during giveback.

The recovery time is client specific and might take longer than eight minutes, depending on the characteristics of the client applications.

18. Verify that the update was completed successfully for the node:

- a. Go to the advanced privilege level: `set -privilege advanced`
- b. Verify that update status is complete for the node: `system node upgrade-revert show -node nodenameA`

The status should be listed as complete.

If the status is not complete, contact technical support.

- c. Return to the admin privilege level: `set -privilege admin`

19. Verify that the node's ports are up: `network port show -node nodenameA`

You must run this command on a node that is upgraded to the higher version of ONTAP 9.

The following example shows that all of the node's ports are up:

```
cluster1::> network port show -node node0
```

					Speed	
(Mbps)						
Node	Port	IPspace	Broadcast Domain	Link	MTU	Admin/Oper
-----	-----	-----	-----	-----	-----	-----
node0						
	e0M	Default	-	up	1500	auto/100
	e0a	Default	-	up	1500	auto/1000
	e0b	Default	-	up	1500	auto/1000
	e1a	Cluster	Cluster	up	9000	auto/10000
	e1b	Cluster	Cluster	up	9000	auto/10000
5 entries were displayed.						

20. Revert the LIFs back to the node: `network interface revert *`

This command returns the LIFs that were migrated away from the node.

```
cluster1::> network interface revert *
8 entries were acted on.
```

21. Verify that the node's data LIFs successfully reverted back to the node, and that they are up: `network interface show`

The following example shows that all of the data LIFs hosted by the node have successfully reverted back to the node, and that their operational status is up:

```
cluster1::> network interface show
```

	Logical	Status	Network	Current	
Current Is					
Vserver	Interface	Admin/Oper	Address/Mask	Node	Port
Home					
-----	-----	-----	-----	-----	-----
vs0					
	data001	up/up	192.0.2.120/24	node0	e0a
true					
	data002	up/up	192.0.2.121/24	node0	e0b
true					
	data003	up/up	192.0.2.122/24	node0	e0b
true					
	data004	up/up	192.0.2.123/24	node0	e0a
true					
4 entries were displayed.					

22. If you previously determined that this node serves clients, verify that the node is providing service for each protocol that it was previously serving: `system node run -node nodenameA -command uptime`

The operation counts reset to zero during the update.

The following example shows that the updated node has resumed serving its NFS and iSCSI clients:

```
cluster1::> system node run -node node0 -command uptime
3:15pm up 0 days, 0:16 129 NFS ops, 0 CIFS ops, 0 HTTP ops, 0 FCP
ops, 2 iSCSI ops
```

23. Reenable automatic giveback on the partner node if it was previously disabled: `storage failover modify -node nodenameB -auto-giveback true`

You should proceed to update the node's HA partner as quickly as possible. If you must suspend the update process for any reason, both nodes in the HA pair should be running the same ONTAP version.

Updating the partner node in an HA pair

After updating the first node in an HA pair, you update its partner by initiating a takeover on it. The first node serves the partner's data while the partner node is upgraded.

1. Set the privilege level to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (***>**) appears.

2. Set the new ONTAP software image to be the default image: `system image modify {-node nodenameB -iscurrent false} -isdefault true`

The system image modify command uses an extended query to change the new ONTAP software image (which is installed as the alternate image) to be the default image for the node.

3. Monitor the progress of the update: `system node upgrade-revert show`
4. Verify that the new ONTAP software image is set as the default image: `system image show`

In the following example, `image2` is the new version of ONTAP and is set as the default image on the node:

```
cluster1::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node0					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME
node1					
	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

5. Disable automatic giveback on the partner node if it is enabled: `storage failover modify -node nodenameA -auto-giveback false`

If the cluster is a two-node cluster, a message is displayed warning you that disabling automatic giveback prevents the management cluster services from going online in the event of an alternating-failure scenario. Enter `y` to continue.

6. Verify that automatic giveback is disabled for the partner node: `storage failover show -node nodenameA -fields auto-giveback`

```
cluster1::> storage failover show -node node0 -fields auto-giveback
```

node	auto-giveback

node0	false

1 entry was displayed.

7. Run the following command twice to determine whether the node to be updated is currently serving any clients: `system node run -node nodenameB -command uptime`

The `uptime` command displays the total number of operations that the node has performed for NFS, SMB, FC, and iSCSI clients since the node was last booted. For each protocol, you must run the command twice to determine whether the operation counts are increasing. If they are increasing, the node is currently serving clients for that protocol. If they are not increasing, the node is not currently serving clients for that protocol.

NOTE: You should make a note of each protocol that has increasing client operations so that after the node is updated, you can verify that client traffic has resumed.

The following example shows a node with NFS, SMB, FC, and iSCSI operations. However, the node is currently serving only NFS and iSCSI clients.

```
cluster1::> system node run -node node1 -command uptime
2:58pm up 7 days, 19:16 800000260 NFS ops, 1017333 CIFS ops, 0 HTTP
ops, 40395 FCP ops, 32810 iSCSI ops

cluster1::> system node run -node node1 -command uptime
2:58pm up 7 days, 19:17 800001573 NFS ops, 1017333 CIFS ops, 0 HTTP
ops, 40395 FCP ops, 32815 iSCSI ops
```

8. Migrate all of the data LIFs away from the node: `network interface migrate-all -node nodenameB`
9. Verify the status of any LIFs that you migrated: `network interface show`

For more information about parameters you can use to verify LIF status, see the `network interface show` man page.

The following example shows that node1's data LIFs migrated successfully. For each LIF, the fields included in this example enable you to verify the LIF's home node and port, the current node and port to which the LIF migrated, and the LIF's operational and administrative status.

```
cluster1::> network interface show -data-protocol nfs|cifs -role data
-home-node node1 -fields home-node,curr-node,curr-port,home-port,status-
admin,status-oper
vserver lif      home-node home-port curr-node curr-port status-oper
status-admin
-----
vs0      data001 node1      e0a      node0      e0a      up      up
vs0      data002 node1      e0b      node0      e0b      up      up
vs0      data003 node1      e0b      node0      e0b      up      up
vs0      data004 node1      e0a      node0      e0a      up      up
4 entries were displayed.
```

10. Initiate a takeover: `storage failover takeover -ofnode nodenameB -option allow-version-mismatch`

Do not specify the `-option immediate` parameter, because a normal takeover is required for the node that is being taken over to boot onto the new software image. If you did not manually migrate the LIFs away from the node, they automatically migrate to the node's HA partner so that there are no service disruptions.

The node that is taken over boots up to the Waiting for giveback state.

NOTE: If AutoSupport is enabled, an AutoSupport message is sent indicating that the node is out of cluster quorum. You can ignore this notification and proceed with the update.

11. Verify that the takeover was successful: `storage failover show`

The following example shows that the takeover was successful. Node node1 is in the Waiting for giveback

state, and its partner is in the In takeover state.

```
cluster1::> storage failover show
```

Node	Partner	Takeover Possible	State Description
node0	node1	-	In takeover
node1	node0	false	Waiting for giveback (HA mailboxes)

2 entries were displayed.

12. Wait at least eight minutes for the following conditions to take effect:

- Client multipathing (if deployed) is stabilized.
- Clients are recovered from the pause in I/O that occurs during takeover.

The recovery time is client-specific and might take longer than eight minutes, depending on the characteristics of the client applications.

13. Return the aggregates to the partner node: `storage failover giveback -ofnode nodenameB`

The giveback operation first returns the root aggregate to the partner node and then, after that node has finished booting, returns the non-root aggregates and any LIFs that were set to automatically revert. The newly booted node begins to serve data to clients from each aggregate as soon as the aggregate is returned.

14. Verify that all aggregates are returned: `storage failover show-giveback`

If the Giveback Status field indicates that there are no aggregates to give back, then all aggregates are returned. If the giveback is vetoed, the command displays the giveback progress and which subsystem vetoed the giveback operation.

15. If any aggregates are not returned, perform the following steps:

- a. Review the veto workaround to determine whether you want to address the “veto” condition or override the veto.

[High-availability configuration](#)

- b. If necessary, address the “veto” condition described in the error message, ensuring that any identified operations are terminated gracefully.
- c. Rerun the storage failover giveback command.

If you decided to override the “veto” condition, set the `-override-vetoes` parameter to true.

16. Wait at least eight minutes for the following conditions to take effect:

- Client multipathing (if deployed) is stabilized.
- Clients are recovered from the pause in an I/O operation that occurs during giveback.

The recovery time is client specific and might take longer than eight minutes, depending on the

characteristics of the client applications.

17. Verify that the update was completed successfully for the node:

- a. Go to the advanced privilege level: `set -privilege advanced`
- b. Verify that update status is complete for the node: `system node upgrade-revert show -node nodenameB`

The status should be listed as complete.

If the status is not complete, from the node, run the `system node upgrade-revert upgrade` command. If the command does not complete the update, contact technical support.

- c. Return to the admin privilege level: `set -privilege admin`

18. Verify that the node's ports are up: `network port show -node nodenameB`

You must run this command on a node that has been upgraded to ONTAP 9.4.

The following example shows that all of the node's data ports are up:

```
cluster1::> network port show -node node1
```

						Speed
(Mbps)						
Node	Port	IPspace	Broadcast Domain	Link	MTU	Admin/Oper
-----	-----	-----	-----	-----	-----	-----

node1						
	e0M	Default	-	up	1500	auto/100
	e0a	Default	-	up	1500	auto/1000
	e0b	Default	-	up	1500	auto/1000
	e1a	Cluster	Cluster	up	9000	auto/10000
	e1b	Cluster	Cluster	up	9000	auto/10000
5 entries were displayed.						

19. Revert the LIFs back to the node: `network interface revert *`

This command returns the LIFs that were migrated away from the node.

```
cluster1::> network interface revert *
8 entries were acted on.
```

20. Verify that the node's data LIFs successfully reverted back to the node, and that they are up: `network interface show`

The following example shows that all of the data LIFs hosted by the node is successfully reverted back to the node, and that their operational status is up:

```

cluster1::> network interface show

```

Current Is	Logical	Status	Network	Current	
Vserver	Interface	Admin/Oper	Address/Mask	Node	Port
Home					
vs0					
	data001	up/up	192.0.2.120/24	node1	e0a
true					
	data002	up/up	192.0.2.121/24	node1	e0b
true					
	data003	up/up	192.0.2.122/24	node1	e0b
true					
	data004	up/up	192.0.2.123/24	node1	e0a
true					

4 entries were displayed.

21. If you previously determined that this node serves clients, verify that the node is providing service for each protocol that it was previously serving: `system node run -node nodenameB -command uptime`

The operation counts reset to zero during the update.

The following example shows that the updated node has resumed serving its NFS and iSCSI clients:

```

cluster1::> system node run -node node1 -command uptime
3:15pm up 0 days, 0:16 129 NFS ops, 0 CIFS ops, 0 HTTP ops, 0 FCP
ops, 2 iSCSI ops

```

22. If this was the last node in the cluster to be updated, trigger an AutoSupport notification: `autosupport invoke -node * -type all -message "Finishing_NDU"`

This AutoSupport notification includes a record of the system status just prior to update. It saves useful troubleshooting information in case there is a problem with the update process.

If the cluster is not configured to send AutoSupport messages, a copy of the notification is saved locally.

23. Confirm that the new ONTAP software is running on both nodes of the HA pair: `system node image show`

In the following example, image2 is the updated version of ONTAP and is the default version on both nodes:


```
cluster1::*> system node image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node0					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME
node1					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

24. Reenable automatic giveback on the partner node if it was previously disabled: `storage failover modify -node nodenameA -auto-giveback true`
25. Verify that the cluster is in quorum and that services are running by using the `cluster show` and `cluster ring show` (advanced privilege level) commands.

You must perform this step before upgrading any additional HA pairs.

26. Return to the admin privilege level: `set -privilege admin`

Upgrade any additional HA pairs.

MetroCluster configurations

Manual nondisruptive upgrade of a four- or eight-node MetroCluster configuration using the CLI

The manual update procedure for upgrading or downgrading a four- or eight-node MetroCluster configuration involves preparing for the update, updating the DR pairs in each of the one or two DR groups simultaneously, and performing some post-update tasks.

- This task applies to the following configurations:
 - Four-node MetroCluster FC or IP configurations running ONTAP 9.2 or earlier
 - Eight-node MetroCluster FC configurations, regardless of ONTAP version
- If you have a two-node MetroCluster configuration, do not use this procedure.
- The following tasks refer to the old and new versions of ONTAP.
 - When upgrading, the old version is a previous version of ONTAP, with a lower version number than the new version of ONTAP.
 - When downgrading, the old version is a later version of ONTAP, with a higher version number than the new version of ONTAP.
- This task uses the following high-level workflow:



Differences when updating software on an eight-node or four-node MetroCluster configuration

The MetroCluster software update process differs, depending on whether there are eight or four nodes in the MetroCluster configuration.

A MetroCluster configuration consists of one or two DR groups. Each DR group consists of two HA pairs, one HA pair at each MetroCluster cluster. An eight-node MetroCluster includes two DR groups:



The MetroCluster software update procedure involves upgrading or downgrading one DR group at a time.

For four-node MetroCluster configurations:

1. Update DR Group One:
 - a. Update node_A_1 and node_B_1.
 - b. Update node_A_2 and node_B_2.

For eight-node MetroCluster configurations, you perform the DR group update procedure twice:

1. Update DR Group One:
 - a. Update node_A_1 and node_B_1.
 - b. Update node_A_2 and node_B_2.
2. Update DR Group Two:
 - a. Update node_A_3 and node_B_3.
 - b. Update node_A_4 and node_B_4.

Preparing to update a MetroCluster DR group

Before you actually update the software on the nodes, you must identify the DR relationships among the nodes, send an AutoSupport message that you are initiating an update, and confirm the ONTAP version running on each node.

You must have [downloaded and installed the software images](#).

This task must be repeated on each DR group. If the MetroCluster configuration consists of eight nodes, there are two DR groups. Thereby, this task must be repeated on each DR group.

The examples provided in this task use the names shown in the following illustration to identify the clusters and nodes:



1. Identify the DR pairs in the configuration: `metrocluster node show -fields dr-partner`

```
cluster_A::> metrocluster node show -fields dr-partner
(metrocluster node show)
dr-group-id cluster      node          dr-partner
-----
1           cluster_A    node_A_1      node_B_1
1           cluster_A    node_A_2      node_B_2
1           cluster_B    node_B_1      node_A_1
1           cluster_B    node_B_2      node_A_2
4 entries were displayed.

cluster_A::>
```

2. Set the privilege level from admin to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (***>**) appears.

3. Confirm the ONTAP version running on each node:

- a. Confirm the version on cluster_A: `system image show`

```
cluster_A::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date
node_A_1					
	image1	true	true	X.X.X	MM/DD/YYYY TIME
	image2	false	false	Y.Y.Y	MM/DD/YYYY TIME
node_A_2					
	image1	true	true	X.X.X	MM/DD/YYYY TIME
	image2	false	false	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

```
cluster_A::>
```

- b. Confirm the version on cluster_B: `system image show`

```
cluster_B::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date
node_B_1					
	image1	true	true	X.X.X	MM/DD/YYYY TIME
	image2	false	false	Y.Y.Y	MM/DD/YYYY TIME
node_B_2					
	image1	true	true	X.X.X	MM/DD/YYYY TIME
	image2	false	false	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

```
cluster_B::>
```

4. Trigger an AutoSupport notification: `autosupport invoke -node * -type all -message "Starting_NDU"`

This AutoSupport notification includes a record of the system status before the update. It saves useful troubleshooting information if there is a problem with the update process.

If your cluster is not configured to send AutoSupport messages, then a copy of the notification is saved locally.

5. For each node in the first set, set the target ONTAP software image to be the default image: `system image modify {-node nodename -iscurrent false} -isdefault true`

This command uses an extended query to change the target software image, which is installed as the alternate image, to be the default image for the node.

6. Verify that the target ONTAP software image is set as the default image:

- a. Verify the images on cluster_A: `system image show`

In the following example, image2 is the new ONTAP version and is set as the default image on each of the nodes in the first set:

```
cluster_A::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date
node_A_1	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME
node_A_2	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME

2 entries were displayed.

- b. Verify the images on cluster_B: `system image show`

The following example shows that the target version is set as the default image on each of the nodes in the first set:

```
cluster_B::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date
node_A_1	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/YY/YYYY TIME
node_A_2	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME

2 entries were displayed.

7. Determine whether the nodes to be upgraded are currently serving any clients twice for each node: `system node run -node target-node -command uptime`

The uptime command displays the total number of operations that the node has performed for NFS, CIFS, FC, and iSCSI clients since the node was last booted. For each protocol, you need to run the command twice to determine whether the operation counts are increasing. If they are increasing, the node is currently serving clients for that protocol. If they are not increasing, the node is not currently serving clients for that protocol.

NOTE: You should make a note of each protocol that has increasing client operations so that after the node is upgraded, you can verify that client traffic has resumed.

This example shows a node with NFS, CIFS, FC, and iSCSI operations. However, the node is currently serving only NFS and iSCSI clients.

```
cluster_x::> system node run -node node0 -command uptime
2:58pm up 7 days, 19:16 800000260 NFS ops, 1017333 CIFS ops, 0 HTTP
ops, 40395 FCP ops, 32810 iSCSI ops

cluster_x::> system node run -node node0 -command uptime
2:58pm up 7 days, 19:17 800001573 NFS ops, 1017333 CIFS ops, 0 HTTP
ops, 40395 FCP ops, 32815 iSCSI ops
```

Updating the first DR pair in a MetroCluster DR group

You must perform a takeover and giveback of the nodes in the correct order to make the new version of ONTAP the current version of the node.

All nodes must be running the old version of ONTAP.

In this task, node_A_1 and node_B_1 are updated.

If you have updated the ONTAP software on the first DR group, and are now updating the second DR group in an eight-node MetroCluster configuration, in this task you would be updating node_A_3 and node_B_3.

1. If MetroCluster Tiebreaker software is enabled, disabled it.
2. For each node in the HA pair, disable automatic giveback: `storage failover modify -node target-node -auto-giveback false`

This command must be repeated for each node in the HA pair.

3. Verify that automatic giveback is disabled: `storage failover show -fields auto-giveback`

This example shows that automatic giveback has been disabled on both nodes:

```
cluster_x::> storage failover show -fields auto-giveback
node      auto-giveback
-----
node_x_1  false
node_x_2  false
2 entries were displayed.
```

4. Ensure that I/O is not exceeding ~50% for each controller. Ensure that CPU utilization is not exceeding ~50% per controller.
5. Initiate a takeover of the target node on cluster_A:

Do not specify the `-option immediate` parameter, because a normal takeover is required for the nodes that are being taken over to boot onto the new software image.

- a. Take over the DR partner on cluster_A (node_A_1): `storage failover takeover -ofnode node_A_1`

The node boots up to the "Waiting for giveback" state.



If AutoSupport is enabled, then an AutoSupport message is sent indicating that the nodes are out of cluster quorum. You can ignore this notification and proceed with the upgrade.

- b. Verify that the takeover is successful: `storage failover show`

The following example shows that the takeover is successful. Node_A_1 is in the "Waiting for giveback" state and node_A_2 is in the "In takeover" state.

```
cluster1::> storage failover show
```

Node	Partner	Takeover Possible	State Description
node_A_1	node_A_2	-	Waiting for giveback (HA mailboxes)
node_A_2	node_A_1	false	In takeover

2 entries were displayed.

6. Take over the DR partner on cluster_B (node_B_1):

Do not specify the `-option immediate` parameter, because a normal takeover is required for the nodes that are being taken over to boot onto the new software image.

- a. Take over node_B_1: `storage failover takeover -ofnode node_B_1`

The node boots up to the "Waiting for giveback" state.



If AutoSupport is enabled, then an AutoSupport message is sent indicating that the nodes are out of cluster quorum. You can ignore this notification and proceed with the upgrade.

- b. Verify that the takeover is successful: `storage failover show`

The following example shows that the takeover is successful. Node_B_1 is in the "Waiting for giveback" state and node_B_2 is in the "In takeover" state.


```
cluster1::> storage failover show
```

Node	Partner	Takeover Possible	State Description
node_B_1	node_B_2	-	Waiting for giveback (HA mailboxes)
node_B_2	node_B_1	false	In takeover

2 entries were displayed.

7. Wait at least eight minutes to ensure the following conditions:

- Client multipathing (if deployed) is stabilized.
- Clients are recovered from the pause in I/O that occurs during takeover.

The recovery time is client-specific and might take longer than eight minutes depending on the characteristics of the client applications.

8. Return the aggregates to the target nodes:

After upgrading MetroCluster IP configurations to ONTAP 9.5 or later, the aggregates will be in a degraded state for a short period before resynchronizing and returning to a mirrored state.

- Give back the aggregates to the DR partner on cluster_A: `storage failover giveback -ofnode node_A_1`
- Give back the aggregates to the DR partner on cluster_B: `storage failover giveback -ofnode node_B_1`

The giveback operation first returns the root aggregate to the node and then, after the node has finished booting, returns the non-root aggregates.

9. Verify that all aggregates have been returned by issuing the following command on both clusters: `storage failover show-giveback`

If the Giveback Status field indicates that there are no aggregates to give back, then all aggregates have been returned. If the giveback is vetoed, the command displays the giveback progress and which subsystem vetoed the giveback.

10. If any aggregates have not been returned, do the following:

- Review the veto workaround to determine whether you want to address the “veto” condition or override the veto.
- If necessary, address the “veto” condition described in the error message, ensuring that any identified operations are terminated gracefully.
- Reenter the `storage failover giveback` command.

If you decided to override the “veto” condition, set the `-override-vetoes` parameter to true.

11. Wait at least eight minutes to ensure the following conditions:

- Client multipathing (if deployed) is stabilized.

- Clients are recovered from the pause in I/O that occurs during giveback.

The recovery time is client-specific and might take longer than eight minutes depending on the characteristics of the client applications.

12. Set the privilege level from admin to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (***>**) appears.

13. Confirm the version on cluster_A: `system image show`

The following example shows that System image2 should be the default and current version on node_A_1:

```
cluster_A::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node_A_1					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME
node_A_2					
	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

```
cluster_A::>
```

14. Confirm the version on cluster_B: `system image show`

The following example shows that System image2 (ONTAP 9.0.0) is the default and current version on node_A_1:

```
cluster_A::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node_B_1					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME
node_B_2					
	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

```
cluster_A::>
```

Updating the second DR pair in a MetroCluster DR group

You must perform a takeover and giveback of the node in the correct order to make the new version of ONTAP the current version of the node.

You should have upgraded the first DR pair (node_A_1 and node_B_1).

In this task, node_A_2 and node_B_2 are updated.

If you have updated the ONTAP software on the first DR group, and are now updating the second DR group in an eight-node MetroCluster configuration, in this task you are updating node_A_4 and node_B_4.

1. Initiate a takeover of the target node on cluster_A:

Do not specify the `-option immediate` parameter, because a normal takeover is required for the nodes that are being taken over to boot onto the new software image.

a. Take over the DR partner on cluster_A:

```
storage failover takeover -ofnode node_A_2 -option allow-version-mismatch
```



The `allow-version-mismatch` option is not required for upgrades from ONTAP 9.0 to ONTAP 9.1 or for any patch upgrades.

The node boots up to the "Waiting for giveback" state.

If AutoSupport is enabled, then an AutoSupport message is sent indicating that the nodes are out of cluster quorum. You can ignore this notification and proceed with the upgrade.

b. Verify that the takeover is successful: `storage failover show`

The following example shows that the takeover is successful. Node_A_2 is in the "Waiting for giveback" state and node_A_1 is in the "In takeover" state.

```
cluster1::> storage failover show
```

Node	Partner	Takeover Possible	State Description
node_A_1	node_A_2	false	In takeover
node_A_2	node_A_1	-	Waiting for giveback (HA mailboxes)

2 entries were displayed.

2. Initiate a takeover of the target node on cluster_B:

Do not specify the `-option immediate` parameter, because a normal takeover is required for the nodes that are being taken over to boot onto the new software image.

a. Take over the DR partner on cluster_B (node_B_2):

If you are upgrading from...	Enter this command...
ONTAP 9.2 or ONTAP 9.1	<code>storage failover takeover -ofnode node_B_2</code>
ONTAP 9.0 or Data ONTAP 8.3.x	<code>storage failover takeover -ofnode node_B_2 -option allow-version-mismatch</code> NOTE: The <code>allow-version-mismatch</code> option is not required for upgrades from ONTAP 9.0 to ONTAP 9.1 or for any patch upgrades.

The node boots up to the "Waiting for giveback" state.

+

NOTE: If AutoSupport is enabled, an AutoSupport message is sent indicating that the nodes are out of cluster quorum. You can safely ignore this notification and proceed with the upgrade.

- a. Verify that the takeover is successful: `storage failover show`

The following example shows that the takeover is successful. Node_B_2 is in the "Waiting for giveback" state and node_B_1 is in the "In takeover" state.

```
cluster1::> storage failover show
```

Node	Partner	Takeover Possible	State Description
node_B_1	node_B_2	false	In takeover
node_B_2	node_B_1	-	Waiting for giveback (HA mailboxes)

2 entries were displayed.

1. Wait at least eight minutes to ensure the following conditions:

- Client multipathing (if deployed) is stabilized.
- Clients are recovered from the pause in I/O that occurs during takeover.

The recovery time is client-specific and might take longer than eight minutes depending on the characteristics of the client applications.

2. Return the aggregates to the target nodes:

After upgrading MetroCluster IP configurations to ONTAP 9.5, the aggregates will be in a degraded state for a short period before resynchronizing and returning to a mirrored state.

- b. Give back the aggregates to the DR partner on cluster_A: `storage failover giveback -ofnode node_A_2`

- c. Give back the aggregates to the DR partner on cluster_B: `storage failover giveback -ofnode node_B_2`

The giveback operation first returns the root aggregate to the node and then, after the node has finished booting, returns the non-root aggregates.

1. Verify that all aggregates have been returned by issuing the following command on both clusters:
`storage failover show-giveback`

If the Giveback Status field indicates that there are no aggregates to give back, then all aggregates have been returned. If the giveback is vetoed, the command displays the giveback progress and which subsystem vetoed the giveback.

2. If any aggregates have not been returned, do the following:
- d. Review the veto workaround to determine whether you want to address the “veto” condition or override the veto.
- e. If necessary, address the “veto” condition described in the error message, ensuring that any identified operations are terminated gracefully.
- f. Reenter the storage failover giveback command.

If you decided to override the “veto” condition, set the `-override-vetoes` parameter to true.

. Wait at least eight minutes to ensure the following conditions:

Client multipathing (if deployed) is stabilized.

Clients are recovered from the pause in I/O that occurs during giveback.

+

The recovery time is client-specific and might take longer than eight minutes depending on the characteristics of the client applications.

1. Set the privilege level from admin to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (`*>`) appears.

2. Confirm the version on cluster_A: `system image show`

The following example shows that System image2 (target ONTAP image) is the default and current version on node_A_2:

```
cluster_B::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node_A_1					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME
node_A_2					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

```
cluster_A::>
```

3. Confirm the version on cluster_B: system image show

The following example shows that System image2 (target ONTAP image) is the default and current version on node_B_2:

```
cluster_B::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node_B_1					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME
node_B_2					
	image1	false	false	X.X.X	MM/DD/YYYY TIME
	image2	true	true	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

```
cluster_A::>
```

4. For each node in the HA pair, enable automatic giveback: storage failover modify -node target-node -auto-giveback true

This command must be repeated for each node in the HA pair.

5. Verify that automatic giveback is enabled: storage failover show -fields auto-giveback

This example shows that automatic giveback has been enabled on both nodes:

```
cluster_x::> storage failover show -fields auto-giveback
node      auto-giveback
-----
node_x_1  true
node_x_2  true
2 entries were displayed.
```

Manual nondisruptive upgrade of a two-node MetroCluster configuration in ONTAP 9.2 or earlier using the CLI

You can upgrade ONTAP nondisruptively for a two-node MetroCluster configuration. This method has several steps: initiating a negotiated switchover, updating the cluster at the “failed” site, initiating switchback, and then repeating the process on the cluster at the other site.

This procedure is for two-node MetroCluster configurations running ONTAP 9.2 or earlier only.

+

Do not use this procedure if you have a four-node MetroCluster configuration.

+

If you have a two-node MetroCluster configuration running ONTAP 9.3 or later, perform an [automated nondisruptive upgrade using System Manager](#).

1. Set the privilege level to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (***>**) appears.

2. On the cluster to be upgraded, install the new ONTAP software image as the default: `system node image update -package package_location -setdefault true -replace-package true`

```
cluster_B::*> system node image update -package
http://www.example.com/NewImage.tgz -setdefault true -replace-package
true
```

3. Verify that the target software image is set as the default image: `system node image show`

The following example shows that NewImage is set as the default image:

```
cluster_B::*> system node image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node_B_1					
	OldImage	false	true	X.X.X	MM/DD/YYYY TIME
	NewImage	true	false	Y.Y.Y	MM/DD/YYYY TIME

2 entries were displayed.

4. If the target software image is not set as the default image, then change it: `system image modify {-node * -iscurrent false} -isdefault true`
5. Verify that all cluster SVMs are in a health state: `metrocluster vserver show`
6. On the cluster that is not being updated, initiate a negotiated switchover: `metrocluster switchover`

The operation can take several minutes. You can use the `metrocluster operation show` command to verify that the switchover is completed.

In the following example, a negotiated switchover is performed on the remote cluster ("cluster_A"). This causes the local cluster ("cluster_B") to halt so that you can update it.

```
cluster_A::> metrocluster switchover
```

Warning: negotiated switchover is about to start. It will stop all the data

Vservers on cluster "cluster_B" and automatically re-start them on cluster "cluster_A". It will finally gracefully shutdown cluster "cluster_B".

Do you want to continue? {y|n}: y

7. Verify that all cluster SVMs are in a health state: `metrocluster vserver show`
8. Resynchronize the data aggregates on the "surviving" cluster: `metrocluster heal -phase aggregates`

After upgrading MetroCluster IP configurations to ONTAP 9.5 or later, the aggregates will be in a degraded state for a short period before resynchronizing and returning to a mirrored state.

```
cluster_A::> metrocluster heal -phase aggregates
[Job 130] Job succeeded: Heal Aggregates is successful.
```

9. Verify that the healing operation was completed successfully: `metrocluster operation show`


```
cluster_A::> metrocluster operation show
Operation: heal-aggregates
State: successful
Start Time: MM/DD/YYYY TIME
End Time: MM/DD/YYYY TIME
Errors: -
```

10. Resynchronize the root aggregates on the “surviving” cluster: `metrocluster heal -phase root-aggregates`

```
cluster_A::> metrocluster heal -phase root-aggregates
[Job 131] Job succeeded: Heal Root Aggregates is successful.
```

11. Verify that the healing operation was completed successfully: `metrocluster operation show`

```
cluster_A::> metrocluster operation show
Operation: heal-root-aggregates
State: successful
Start Time: MM/DD/YYYY TIME
End Time: MM/DD/YYYY TIME
Errors: -
```

12. On the halted cluster, boot the node from the LOADER prompt: `boot_ontap`
13. Wait for the boot process to finish, and then verify that all cluster SVMs are in a health state: `metrocluster vservers show`
14. Perform a switchback from the “surviving” cluster: `metrocluster switchback`
15. Verify that the switchback was completed successfully: `metrocluster operation show`

```
cluster_A::> metrocluster operation show
Operation: switchback
State: successful
Start Time: MM/DD/YYYY TIME
End Time: MM/DD/YYYY TIME
Errors: -
```

16. Verify that all cluster SVMs are in a health state: `metrocluster vservers show`
17. Repeat all previous steps on the other cluster.
18. Verify that the MetroCluster configuration is healthy:
 - a. Check the configuration: `metrocluster check run`

```
cluster_A::> metrocluster check run
```

```
Last Checked On: MM/DD/YYYY TIME
```

Component	Result
nodes	ok
lifs	ok
config-replication	ok
aggregates	ok

```
4 entries were displayed.
```

Command completed. Use the "metrocluster check show -instance" command or sub-commands in "metrocluster check" directory for detailed results.

To check if the nodes are ready to do a switchover or switchback operation, run "metrocluster switchover -simulate" or "metrocluster switchback -simulate", respectively.

- b. If you want to view more detailed results, use the metrocluster check run command: metrocluster check aggregate show metrocluster check config-replication show metrocluster check lif show` metrocluster check node show
- c. Set the privilege level to advanced: set -privilege advanced
- d. Simulate the switchover operation: metrocluster switchover -simulate
- e. Review the results of the switchover simulation: metrocluster operation show

```
cluster_A::*> metrocluster operation show
```

```
Operation: switchover
```

```
State: successful
```

```
Start time: MM/DD/YYYY TIME
```

```
End time: MM/DD/YYYY TIME
```

```
Errors: -
```

- f. Return to the admin privilege level: set -privilege admin
- g. Repeat these substeps on the other cluster.

You should perform any post-upgrade tasks.

Related information

[MetroCluster Disaster recovery](#)

Manual disruptive upgrade using the CLI

If you can take your cluster offline to upgrade to a new ONTAP release, then you can use the disruptive upgrade method. This method has several steps: disabling storage failover for each HA pair, rebooting each node in the cluster, and then reenabling storage failover.

- You must have satisfied preparation requirements.

In particular, you must download and install the software image using the procedure [for manual upgrades](#).

- If you are operating in a SAN environment, all SAN clients must be shut down or suspended until the upgrade is complete.

If SAN clients are not shut down or suspended prior to a disruptive upgrade, then the client file systems and applications suffer errors that might require manual recovery after the upgrade is completed.

In a disruptive upgrade, downtime is required because storage failover is disabled for each HA pair, and each node is updated. When storage failover is disabled, each node behaves as a single-node cluster; that is, system services associated with the node are interrupted for as long as it takes the system to reboot.

1. Set the privilege level from admin to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (***>**) appears.

2. Set the new ONTAP software image to be the default image: `system image modify {-node * -iscurrent false} -isdefault true`

This command uses an extended query to change the target ONTAP software image (which is installed as the alternate image) to be the default image for each node.

3. Verify that the new ONTAP software image is set as the default image: `system image show`

In the following example, image 2 is the new ONTAP version and is set as the default image on both nodes:

```
cluster1::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date

node0					
	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME
node1					
	image1	false	true	X.X.X	MM/DD/YYYY TIME
	image2	true	false	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

4. Perform either one of the following steps:

If the cluster consists of...	Do this...
One node	Continue to the next step.

If the cluster consists of...	Do this...
Two nodes	<p>a. Disable cluster high availability: <code>cluster ha modify -configured false</code></p> <p>Enter <code>y</code> to continue when prompted.</p> <p>b. Disable storage failover for the HA pair: <code>storage failover modify -node * -enabled false</code></p>
More than two nodes	<p>Disable storage failover for each HA pair in the cluster: <code>storage failover modify -node * -enabled false</code></p>

5. Reboot a node in the cluster: `system node reboot -node nodename -ignore-quorum-warnings`



Do not reboot more than one node at a time.

The node boots the new ONTAP image. The ONTAP login prompt appears, indicating that the reboot process is complete.

6. After the node or set of nodes has rebooted with the new ONTAP image, confirm that the new software is running: `system node image show`

In the following example, image1 is the new ONTAP version and is set as the current version on node0:

```
cluster1::*> system node image show
```

Node	Image	Is Default	Is Current	Version	Install Date
node0	image1	true	true	X.X.X	MM/DD/YYYY TIME
	image2	false	false	Y.Y.Y	MM/DD/YYYY TIME
node1	image1	true	false	X.X.X	MM/DD/YYYY TIME
	image2	false	true	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

7. Verify that the upgrade is completed successfully:
 - a. Set the privilege level to advanced: `set -privilege advanced`
 - b. Verify that the upgrade status is complete for each node: `system node upgrade-revert show -node nodename`

The status should be listed as complete.

If the status is not complete, [contact NetApp Support](#) immediately.

- c. Return to the admin privilege level: `set -privilege admin`
8. Repeat Steps 2 through 7 for each additional node.
9. If the cluster consists of two or more nodes, enable storage failover for each HA pair in the cluster:
`storage failover modify -node * -enabled true`
10. If the cluster consists of only two nodes, enable cluster high availability: `cluster ha modify -configured true`

What should I do after my upgrade?

What to do after upgrading

After upgrading your ONTAP software, there are several tasks you should perform to verify your cluster readiness.

Post-upgrade cluster verification

After you upgrade, you should verify your cluster version, cluster health, and storage health.



Before you begin

If you are using a MetroCluster FC configuration, you also need to verify that the cluster is enabled for automatic unplanned switchover.

Verify cluster version

After all of the HA pairs have been upgraded, you must use the version command to verify that all of the nodes are running the target release.

The cluster version is the lowest version of ONTAP running on any node in the cluster. If the cluster version is not the target ONTAP release, you can upgrade your cluster.

1. Verify that the cluster version is the target ONTAP release:

```
version
```

2. If the cluster version is not the target ONTAP release, you can verify the upgrade status of all nodes:

```
system node upgrade-revert show
```

Verify cluster health

After you upgrade a cluster, you should verify that the nodes are healthy and eligible to participate in the cluster, and that the cluster is in quorum.

1. Verify that the nodes in the cluster are online and are eligible to participate in the cluster:

```
cluster show
```

```
cluster1::> cluster show
Node           Health Eligibility
-----
node0          true  true
node1          true  true
```

If any node is unhealthy or ineligible, check EMS logs for errors and take corrective action.

2. Set the privilege level to advanced:

```
set -privilege advanced
```

Enter “y” to continue.

3. Verify the configuration details for each RDB process.

- The relational database epoch and database epochs should match for each node.
- The per-ring quorum master should be the same for all nodes.

Note that each ring might have a different quorum master.

To display this RDB process...	Enter this command...
Management application	<code>cluster ring show -unitname mgmt</code>
Volume location database	<code>cluster ring show -unitname vldb</code>
Virtual-Interface manager	<code>cluster ring show -unitname vifmgr</code>
SAN management daemon	<code>cluster ring show -unitname bcomd</code>

This example shows the volume location database process:

```
cluster1::*> cluster ring show -unitname vldb
Node      UnitName Epoch    DB Epoch DB Trnxs Master    Online
-----
node0     vldb      154      154      14847   node0     master
node1     vldb      154      154      14847   node0     secondary
node2     vldb      154      154      14847   node0     secondary
node3     vldb      154      154      14847   node0     secondary
4 entries were displayed.
```

4. If you are operating in a SAN environment, verify that each node is in a SAN quorum: `event log show -severity informational -message-name scsiblade.*`

The most recent scsiblade event message for each node should indicate that the scsi-blade is in quorum.

```
cluster1::*> event log show -severity informational -message-name
scsiblade.*
```

Time	Node	Severity	Event
MM/DD/YYYY TIME	node0	INFORMATIONAL	scsiblade.in.quorum: The scsi-blade ...
MM/DD/YYYY TIME	node1	INFORMATIONAL	scsiblade.in.quorum: The scsi-blade ...

Related information

[System administration](#)

Verify that automatic unplanned switchover is enabled

After you upgrade a cluster, you should verify that automatic unplanned switchover is enabled.



About this task

This procedure is performed only for MetroCluster FC configurations. If you are using a MetroCluster IP configuration, skip this procedure.

Steps

1. Check whether automatic unplanned switchover is enabled:

```
metrocluster show
```

If automatic unplanned switchover is enabled, the following statement appears in the command output:

```
AUSO Failure Domain  auso-on-cluster-disaster
```

2. If the statement does not appear, enable an automatic unplanned switchover:

```
metrocluster modify -auto-switchover-failure-domain auso-on-cluster-disaster
```

3. Verify that an automatic unplanned switchover has been enabled by repeating Step 1.

Verify storage health

After you upgrade a cluster, you should verify the status of your disks, aggregates, and volumes.

1. Verify disk status:

To check for...	Do this...
-----------------	------------

Broken disks	<p>a. Display any broken disks:</p> <pre>storage disk show -state broken</pre> <p>b. Remove or replace any broken disks.</p>
Disks undergoing maintenance or reconstruction	<p>a. Display any disks in maintenance, pending, or reconstructing states:</p> <pre>storage disk show -state maintenance pending reconstructing</pre> <p>b. Wait for the maintenance or reconstruction operation to finish before proceeding.</p>

2. Verify that all aggregates are online by displaying the state of physical and logical storage, including storage aggregates:

```
storage aggregate show -state !online
```

This command displays the aggregates that are *not* online. All aggregates must be online before and after performing a major upgrade or reversion.

```
cluster1::> storage aggregate show -state !online
There are no entries matching your query.
```

3. Verify that all volumes are online by displaying any volumes that are *not* online:

```
volume show -state !online
```

All volumes must be online before and after performing a major upgrade or reversion.

```
cluster1::> volume show -state !online
There are no entries matching your query.
```

4. Verify that there are no inconsistent volumes:

```
volume show -is-inconsistent true
```

See the Knowledge Base article [Volume Showing WAFL Inconsistent](#) on how to address the inconsistent volumes.

Related information

[Disk and aggregate management](#)

Verify all LIFS are on home ports after upgrade

During a reboot, some LIFs might have been migrated to their assigned failover ports.

After you upgrade a cluster, you must enable and revert any LIFs that are not on their home ports.

The network interface revert command reverts a LIF that is not currently on its home port back to its home port, provided that the home port is operational. A LIF's home port is specified when the LIF is created; you can determine the home port for a LIF by using the network interface show command.

1. Display the status of all LIFs: `network interface show -fields home-ports,curr-port`

This example displays the status of all LIFs for a storage virtual machine (SVM).

```

cluster1::> network interface show -fields home-port,curr-port
vserver                                lif             home-port curr-port
-----
C1_sti96-vsim-ucs539g_1622463615 clus_mgmt e0d          e0d
C1_sti96-vsim-ucs539g_1622463615 sti96-vsim-ucs539g_cluster_mgmt_inet6
e0d e0d
C1_sti96-vsim-ucs539g_1622463615 sti96-vsim-ucs539g_mgmt1 e0c e0c
C1_sti96-vsim-ucs539g_1622463615 sti96-vsim-ucs539g_mgmt1_inet6 e0c e0c
C1_sti96-vsim-ucs539g_1622463615 sti96-vsim-ucs539h_cluster_mgmt_inet6
e0d e0d
C1_sti96-vsim-ucs539g_1622463615 sti96-vsim-ucs539h_mgmt1 e0c e0c
C1_sti96-vsim-ucs539g_1622463615 sti96-vsim-ucs539h_mgmt1_inet6 e0c e0c
Cluster                               sti96-vsim-ucs539g_clus1 e0a e0a
Cluster                               sti96-vsim-ucs539g_clus2 e0b e0b
Cluster                               sti96-vsim-ucs539h_clus1 e0a e0a
Cluster                               sti96-vsim-ucs539h_clus2 e0b e0b
vs0                                   sti96-vsim-ucs539g_data1 e0d e0d
vs0                                   sti96-vsim-ucs539g_data1_inet6 e0d e0d
vs0                                   sti96-vsim-ucs539g_data2 e0e e0e
vs0                                   sti96-vsim-ucs539g_data2_inet6 e0e e0e
vs0                                   sti96-vsim-ucs539g_data3 e0f e0f
vs0                                   sti96-vsim-ucs539g_data3_inet6 e0f e0f
vs0                                   sti96-vsim-ucs539g_data4 e0d e0d
vs0                                   sti96-vsim-ucs539g_data4_inet6 e0d e0d
vs0                                   sti96-vsim-ucs539g_data5 e0e e0e
vs0                                   sti96-vsim-ucs539g_data5_inet6 e0e e0e
vs0                                   sti96-vsim-ucs539g_data6 e0f e0f
vs0                                   sti96-vsim-ucs539g_data6_inet6 e0f e0f
vs0                                   sti96-vsim-ucs539h_data1 e0d e0d
vs0                                   sti96-vsim-ucs539h_data1_inet6 e0d e0d
vs0                                   sti96-vsim-ucs539h_data2 e0e e0e
vs0                                   sti96-vsim-ucs539h_data2_inet6 e0e e0e
vs0                                   sti96-vsim-ucs539h_data3 e0f e0f
vs0                                   sti96-vsim-ucs539h_data3_inet6 e0f e0f
vs0                                   sti96-vsim-ucs539h_data4 e0d e0d
vs0                                   sti96-vsim-ucs539h_data4_inet6 e0d e0d
vs0                                   sti96-vsim-ucs539h_data5 e0e e0e
vs0                                   sti96-vsim-ucs539h_data5_inet6 e0e e0e
vs0                                   sti96-vsim-ucs539h_data6 e0f e0f
vs0                                   sti96-vsim-ucs539h_data6_inet6 e0f e0f
35 entries were displayed.

```

If any LIFs appear with a Status Admin status of "down" or with an Is home status of "false", continue with the next step.

2. Enable the data LIFs: `network interface modify {-role data} -status-admin up`

```
cluster1::> network interface modify {-role data} -status-admin up
8 entries were modified.
```

3. Revert LIFs to their home ports: `network interface revert *`

This command reverts all LIFs back to their home ports.

```
cluster1::> network interface revert *
8 entries were acted on.
```

4. Verify that all LIFs are in their home ports: `network interface show`

This example shows that all LIFs for SVM vs0 are on their home ports.

```
cluster1::> network interface show -vserver vs0
```

Vserver	Logical Interface	Status Admin/Oper	Network Address/Mask	Current Node	Current Port	Is Home
vs0						
	data001	up/up	192.0.2.120/24	node0	e0e	true
	data002	up/up	192.0.2.121/24	node0	e0f	true
	data003	up/up	192.0.2.122/24	node0	e2a	true
	data004	up/up	192.0.2.123/24	node0	e2b	true
	data005	up/up	192.0.2.124/24	node1	e0e	true
	data006	up/up	192.0.2.125/24	node1	e0f	true
	data007	up/up	192.0.2.126/24	node1	e2a	true
	data008	up/up	192.0.2.127/24	node1	e2b	true

```
8 entries were displayed.
```

Verify special configurations

Post upgrade checks for special configurations

If your cluster is configured with any of the following features you might need to perform additional steps after you upgrade.

Ask yourself...	If your answer is yes, then do this...
Did I upgrade to ONTAP 9.8 or later from ONTAP 9.7 or earlier	Verify your network configuration
Do I have a MetroCluster configuration?	Verify your networking and storage status
Do I have a SAN configuration?	Verify your SAN configuration

Ask yourself...	If your answer is yes, then do this...
Am I using NetApp Storage Encryption and I upgraded to ONTAP 9.3 or later?	Reconfigure KMIP server connections
Do I have load-sharing mirrors?	Relocate moved load-sharing mirror source volumes
Am I using SnapMirror?	Resume SnapMirror operations
Did I upgrade from ONTAP 8.3.0?	Set the desired NT ACL permissions display level for NFS clients
Do I have administrator accounts created prior to ONTAP 9.0?	Enforce SHA-2 on administrator passwords
Do I have user accounts for Service Processor (SP) access created prior to ONTAP 9.9.1?	Verify the change in accounts that can access the Service Processor

Verifying your network configuration after upgrade

ONTAP 9.8 and later automatically monitors layer 2 reachability. After you upgrade from ONTAP 9.7x or earlier to ONTAP 9.8 or later, you should verify that each .network port has reachability to its expected broadcast domain.

1. Verify each port has reachability to its expected domain:

```
network port reachability show -detail
```

A reachability-status of ok indicates that the port has layer 2 reachability to its assigned domain.

Verify networking and storage status for MetroCluster configurations

After performing an update in a MetroCluster configuration, you should verify the status of the LIFs, aggregates, and volumes for each cluster.

1. Verify the LIF status:

```
network interface show
```

In normal operation, LIFs for source SVMs must have an admin status of up and be located on their home nodes. LIFs for destination SVMs are not required to be up or located on their home nodes. In switchover, all LIFs have an admin status of up, but they do not need to be located on their home nodes.

```

cluster1::> network interface show

```

Current Is	Logical	Status	Network	Current	
Vserver	Interface	Admin/Oper	Address/Mask	Node	Port
Home					
-----	-----	-----	-----	-----	-----
Cluster					
	cluster1-a1_clus1	up/up	192.0.2.1/24	cluster1-01	e2a
true					
	cluster1-a1_clus2	up/up	192.0.2.2/24	cluster1-01	e2b
true					
cluster1-01					
	clus_mgmt	up/up	198.51.100.1/24	cluster1-01	e3a
true					
	cluster1-a1_inet4_intercluster1	up/up	198.51.100.2/24	cluster1-01	e3c
true					
	...				

27 entries were displayed.

2. Verify the state of the aggregates: `storage aggregate show -state !online`

This command displays any aggregates that are *not* online. In normal operation, all aggregates located at the local site must be online. However, if the MetroCluster configuration is in switchover, root aggregates at the disaster recovery site are permitted to be offline.

This example shows a cluster in normal operation:

```

cluster1::> storage aggregate show -state !online
There are no entries matching your query.

```

This example shows a cluster in switchover, in which the root aggregates at the disaster recovery site are offline:

```

cluster1::> storage aggregate show -state !online
Aggregate      Size Available Used% State   #Vols  Nodes      RAID
Status
-----
-----
aggr0_b1
          0B          0B      0% offline      0 cluster2-01
raid_dp,
mirror
degraded
aggr0_b2
          0B          0B      0% offline      0 cluster2-02
raid_dp,
mirror
degraded
2 entries were displayed.

```

3. Verify the state of the volumes: `volume show -state !online`

This command displays any volumes that are *not* online.

If the MetroCluster configuration is in normal operation (it is not in switchover state), the output should show all volumes owned by the cluster's secondary SVMs (those with the SVM name appended with "-mc").

Those volumes come online only in the event of a switchover.

This example shows a cluster in normal operation, in which the volumes at the disaster recovery site are not online.

```
cluster1::> volume show -state !online
(volume show)
Vserver   Volume           Aggregate      State      Type      Size
Available Used%
-----
vs2-mc    vol1             aggr1_b1      -          RW        -
-         -
vs2-mc    root_vs2        aggr0_b1      -          RW        -
-         -
vs2-mc    vol2            aggr1_b1      -          RW        -
-         -
vs2-mc    vol3            aggr1_b1      -          RW        -
-         -
vs2-mc    vol4            aggr1_b1      -          RW        -
-         -
5 entries were displayed.
```

4. Verify that there are no inconsistent volumes: `volume show -is-inconsistent true`

See the Knowledge Base article [Volume Showing WAFL Inconsistent](#) on how to address the inconsistent volumes.

Verify the SAN configuration after an upgrade

If you are upgrading in a SAN environment, then after the upgrade, you should verify that each initiator that was connected to a LIF before the upgrade has successfully reconnected to the LIF.

1. Verify that each initiator is connected to the correct LIF.

You should compare the list of initiators to the list you made during the upgrade preparation.

For...	Enter...
iSCSI	<code>iscsi initiator show -fields igroup,initiator-name,tpgroup</code>
FC	<code>fcp initiator show -fields igroup,wwpn,lif</code>

Reconfiguring KMIP server connections after upgrading to ONTAP 9.3 or later

After performing an upgrade to ONTAP 9.3 or later, you must reconfigure your external key management (KMIP) server connections.

1. Configure the key manager connectivity: `security key-manager setup`
2. Add your KMIP servers: `security key-manager add -address key_management_server_ip_address`
3. Verify that KMIP servers are connected: `security key-manager show -status`
4. Query the key servers: `security key-manager query`
5. Create a new authentication key and passphrase: `security key-manager create-key -prompt -for-key true`

The passphrase must have a minimum of 32 characters.

6. Query the new authentication key: `security key-manager query`
7. Assign the new authentication key to your self-encrypting disks (SEDs): `storage encryption disk modify -disk disk_ID -data-key-id key_ID`



Make sure you are using the new authentication key from your query.

8. If needed, assign a FIPS key to the SEDs: `storage encryption disk modify -disk disk_id -fips-key-id fips_authentication_key_id`

If your security setup requires you to use different keys for data authentication and FIPS 140-2 authentication, you should create a separate key for each. If that is not the case, you can use the same authentication key for FIPS compliance that you use for data access.

Relocating moved load-sharing mirror source volumes

After successfully completing a nondisruptive upgrade, you can move load-sharing mirror source volumes back to the locations they were in originally before the upgrade.

1. Identify the location to which you are moving the load-sharing mirror source volume by using the record you created before moving the load-sharing mirror source volume.
2. Move the load-sharing mirror source volume back to its original location by using the volume move start command.

Resuming SnapMirror operations

After completing a nondisruptive upgrade, you must resume any SnapMirror relationships that were suspended.

Existing SnapMirror relationships must have been suspended by using the `snapmirror quiesce` command, and the cluster must have been nondisruptively upgraded.

1. Resume transfers for each SnapMirror relationship that was previously quiesced: `snapmirror resume *`

This command resumes the transfers for all quiesced SnapMirror relationships.

2. Verify that the SnapMirror operations have resumed: `snapmirror show`


```
cluster1::> snapmirror show
```

Source	Destination	Mirror	Relationship	Total	Last	Path	Type	Path	State	Status	Progress	Healthy
cluster1-vs1:dp_src1	DP	cluster1-vs2:dp_dst1	Snapmirrored									
			Idle	-							true	-
cluster1-vs1:xdp_src1	XDP	cluster1-vs2:xdp_dst1	Snapmirrored									
			Idle	-							true	-
cluster1://cluster1-vs1/ls_src1	LS	cluster1://cluster1-vs1/ls_mr1	Snapmirrored									
			Idle	-							true	-
		cluster1://cluster1-vs1/ls_mr2	Snapmirrored									
			Idle	-							true	-

4 entries were displayed.

For each SnapMirror relationship, verify that the Relationship Status is **Idle**. If the status is **Transferring**, wait for the SnapMirror transfer to complete, and then reenter the command to verify that the status has changed to **Idle**.

For each SnapMirror relationship that is configured to run on a schedule, you should verify that the first scheduled SnapMirror transfer completes successfully.

Setting the desired NT ACL permissions display level for NFS clients

After upgrading from ONTAP 8.3.0, the default handling for displaying NT ACL permissions to NFS clients has changed. You should check the setting and change it to the desired setting for your environment if necessary. This task does not apply if you are upgrading from ONTAP 8.3.1 or later.

In multiprotocol environments, ONTAP displays to NFS clients the permissions of NTFS security-style files and directories based on the access granted by the NT ACL to any user. In ONTAP 8.3.0, ONTAP by default displayed to NFS clients the permission based on the maximum access granted by the NT ACL. After upgrading, the default setting changes to display permissions based on the minimum access granted by the NT ACL. This change applies to new and existing storage virtual machines (SVMs).

1. Set the privilege level to advanced: `set -privilege advanced`

2. Check the setting for displaying NT ACL permissions for NFS clients: `vserver nfs show -vserver vserver_name -fields ntac1-display-permissive-perms`

After upgrading from 8.3.0, the value for this new parameter is disabled, meaning ONTAP displays the minimum permissions.

3. If you prefer to display the maximum permissions, change the setting individually for each SVM as desired:
`vserver nfs modify -vserver vserver_name -ntac1-display-permissive-perms enabled`
4. Verify that the change took effect: `vserver nfs show -vserver vserver_name -fields ntac1-display-permissive-perms`
5. Return to the admin privilege level: `set -privilege admin`

Enforcing SHA-2 on administrator account passwords

Administrator accounts created prior to ONTAP 9.0 continue to use MD5 passwords after the upgrade, until the passwords are manually changed. MD5 is less secure than SHA-2. Therefore, after upgrading, you should prompt users of MD5 accounts to change their passwords to use the default SHA-512 hash function.

The password hash functionality enables you to do the following:

- Display user accounts that match the specified hash function.
- Expire accounts that use a specified hash function (for example, MD5), forcing the users to change their passwords in their next login.
- Lock accounts whose passwords use the specified hash function.
- When reverting to a release earlier than ONTAP 9, reset the cluster administrator's own password for it to be compatible with the hash function (MD5) that is supported by the earlier release.

ONTAP accepts pre-hashed SHA-2 passwords only by using NetApp Manageability SDK (`security-login-create` and `security-login-modify-password`).

Manageability enhancements

1. Migrate the MD5 administrator accounts to the SHA-512 password hash function:
 - a. Expire all MD5 administrator accounts: `security login expire-password -vserver * -username * -hash-function md5`

Doing so forces MD5 account users to change their passwords upon next login.
 - b. Ask users of MD5 accounts to log in through a console or SSH session.

The system detects that the accounts are expired and prompts users to change their passwords. SHA-512 is used by default for the changed passwords.
2. For MD5 accounts whose users do not log in to change their passwords within a period of time, force the account migration:
 - a. Lock accounts that still use the MD5 hash function (advanced privilege level): `security login expire-password -vserver * -username * -hash-function md5 -lock-after integer`

After the number of days specified by `-lock-after`, users cannot access their MD5 accounts.

- b. Unlock the accounts when the users are ready to change their passwords: `security login unlock -vserver vserver_name -username user_name`
- c. Have users log in to their accounts through a console or SSH session and change their passwords when the system prompts them to do so.

Change in user accounts that can access the Service Processor

If you created user accounts in ONTAP 9.8 and earlier releases that can access the Service Processor (SP) with a non-admin role and you upgrade to ONTAP 9.9.1 or later, any non-admin value in the `-role` parameter is modified to `admin`.

For more information, see [Accounts that can access the SP](#).

When you need to update the Disk Qualification Package

The Disk Qualification Package (DQP) adds full support for newly qualified drives. Before you update drive firmware or add new drive types or sizes to a cluster, you must update the DQP. A best practice is to also update the DQP regularly; for example, every quarter or semi-annually.

You need to download and install the DQP in the following situations:

- Whenever you add a new drive type or size to the node

For example, if you already have 1-TB drives and add 2-TB drives, you need to check for the latest DQP update.

- Whenever you update the disk firmware
- Whenever newer disk firmware or DQP files are available
- Whenever you upgrade to a new version of ONTAP.

The DQP is not updated as part of an ONTAP upgrade.

Related information

[NetApp Downloads: Disk Qualification Package](#)

[NetApp Downloads: Disk Drive Firmware](#)

Update firmware

With System Manager, you can apply a firmware update to supported devices in your cluster, such as disks, disk shelves, the Disk Qualification Package (DQP) the service processor (SP), or the Baseboard Management Controller (BMC).

You can apply firmware updates manually or automatically. Select either procedure:

- [Update firmware manually](#)

- [Update firmware automatically](#)

Update firmware manually

About this task

Beginning with ONTAP 9.9.1, you can receive alerts from Active IQ that inform you when firmware updates are pending on the cluster. Then, you can download the firmware image and upload it using System Manager.



View firmware update alerts from Active IQ

Beginning with ONTAP 9.9.1, you can receive alerts in System Manager from Active IQ Unified Manager that inform you when firmware updates are pending on the cluster.



When working with ONTAP 9.9.1, to receive alerts about firmware updates, you must be registered with Active IQ Unified Manager. Refer to [Active IQ Unified Manager documentation resources](#).

Steps

1. Go to **Dashboard**.

In the **Health** section, a message displays if there are any recommended firmware updates for the cluster.

2. Click on the alert message.

The **Firmware Update** tab is displayed in the **Update** page.

Download the cluster firmware



For ONTAP 9.8, you must navigate to the NetApp Support Site to download an updated firmware image package.

Beginning with ONTAP 9.9.1, you can use System Manager to download firmware updates from the **Update** page when you view firmware alerts (see [View firmware update alerts from Active IQ.](#)).

Steps

Perform the procedure that is appropriate for the version of ONTAP that is installed on the cluster.

For ONTAP 9.8 and ONTAP 9.9.1, if you are not registered with Active IQ, then perform these steps...	Beginning with ONTAP 9.9.1, if you are registered with Active IQ, then perform these steps...
<ol style="list-style-type: none"> 1. Navigate to the NetApp Support Site. 2. Log into the NetApp Support Site. 3. Select the firmware package that you want to use to update your cluster firmware. 4. Copy the files to an HTTP or FTP server on your network or to a local folder. 	<ol style="list-style-type: none"> 1. On the Update page, for the firmware update that you want to perform, click on the link that says *Download from NetApp Support Site". The NetApp Support Site is displayed. 2. Log into the NetApp Support Site. 3. Download the firmware image package you want to update with. 4. Copy the files to an HTTP or FTP server on your network or to a local folder.

Update the cluster firmware

After the firmware package files are downloaded, you can update the cluster firmware.

Steps

1. In System Manager, click **Cluster > Overview**.
2. In the right corner of the **Overview** pane, click **More**  and select **ONTAP Update**.
3. Click the **Firmware Update** tab, and then perform one of the following procedures, depending on which version of ONTAP you are using:

ONTAP version	Procedure
ONTAP 9.10.0 or earlier	<ol style="list-style-type: none"> 1. Select From Server or Local Client 2. Provide the server URL or the file location.
ONTAP 9.10.1	<p>Note: To schedule fixes and updates to occur automatically and receive recommendations about updating, see Update firmware automatically.</p> <ol style="list-style-type: none"> 1. In the list of recommended updates, select the Actions button to perform the following tasks: <ul style="list-style-type: none"> ◦ Update: Install the update. ◦ Schedule: Set a schedule for installing the update. ◦ Dismiss: Remove the recommendation notice from the list. <p>If the update has been schedule, the options of the Actions button are:</p> <ul style="list-style-type: none"> ◦ Update: Install the update now. ◦ Edit Schedule: Change the schedule date for the update. ◦ Cancel Schedule: Cancel the scheduled date for the update. 2. If you want to update manually, select the Update Firmware button.



You can monitor or verify updates under **Firmware Update Summary**.

Update firmware automatically

Beginning with ONTAP 9.10.1, you can use System Manager to enable the Automatic Update feature, which allows ONTAP to automatically download and install recommended firmware patches, upgrades, and updates provided by NetApp (the default behavior).

Before you begin

The Automatic Update feature requires AutoSupport connectivity over HTTPS. To troubleshoot connectivity problems, see [Troubleshoot AutoSupport message delivery over HTTP or HTTPS](#).

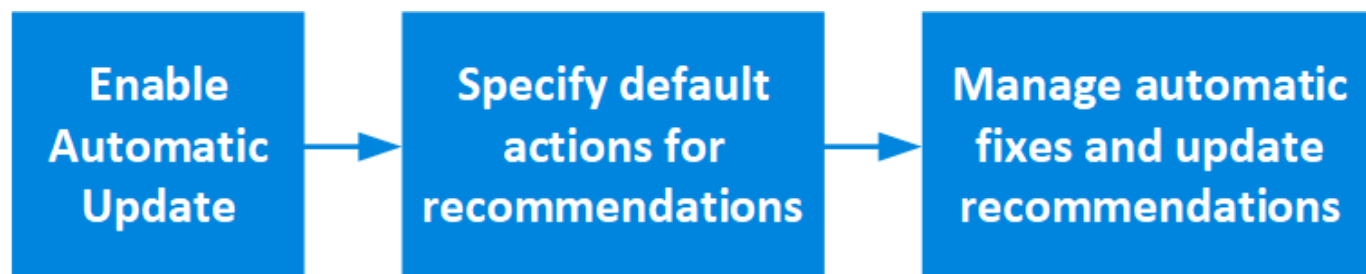
About this task

Updates include firmware patches, upgrades, and updates for the following categories:

- **Storage firmware:** Storage devices, disks, and disk shelves
- **SP/BMC firmware:** Service processors and BMC modules

In System Manager, you can change the default behavior per category so that you receive recommendations for updates to firmware, allowing you to decide which ones to install and to set the schedule when you want them to install. You can also turn off the feature.

To schedule updates to occur automatically and to receive recommendations about updating, you perform the following workflow tasks:



- [Ensure the Automatic Update feature is enabled](#)
- [Specify default actions for update recommendations](#)
- [Manage automatic update recommendations](#)

Ensure the Automatic Update feature is enabled

In System Manager, to enable the Automatic Update feature, you must accept the terms and conditions specified by NetApp.

Before you begin

The Automatic Update feature requires that AutoSupport is enabled and using the HTTPS protocol.

Steps

1. In System Manager, click **Events**.
2. In the **Overview** section, under **Recommended Actions**, click **Action** next to **Enable automatic update**.
3. Click **Enable**.

Information is displayed about the Automatic Update feature. It describes the default behavior (automatically download and install updates) and notifies you that you can modify the default behavior. The information also contains terms and conditions to which you must agree if you want to use this feature.

4. To accept the terms and conditions, and to enable the feature, click the checkbox, then click **Save**.

Specify default actions for update recommendations

You can set a default action that you want performed for storage firmware updates and SP/BMC firmware updates.

Steps

1. In System Manager, click **Cluster > Settings**.
2. In the **Automatic Update** section, click  to view a list of actions.
3. Click **Edit Automatic Update Settings**.
4. Select default actions for both categories of updates.

Manage automatic update recommendations

In System Manager, you can view a list of recommendations and perform actions on each one or on all of them at once.

Steps

1. Use either method to view the list of recommendations:

View from the Overview page	View from the Settings page
<ol style="list-style-type: none">1. Click Cluster > Overview.2. In the Overview section, click More , then click ONTAP Update.3. Select the Firmware Update tab.4. On the Firmware Update tab, click More , then click View All Automatic Updates.	<ol style="list-style-type: none">1. Click Cluster > Settings.2. In the Automatic Update section, click , then click View All Automatic Updates.

The Automatic Update Log displays the recommendations and details about each one, including a description, a category, a scheduled time to install, status, and any errors.

2. Click  next to the description to view a list of actions you can perform on the recommendation.

You can perform one of the following actions, depending on the state of the recommendation:

If the update is in this state...	You can perform...
Has not been scheduled	Update: Starts the updating process. Schedule: Lets you set a date for starting the updating process. Dismiss: Removes the recommendation from the list.

Has been scheduled	Update: Starts the updating process. Edit Schedule: Lets you modify the scheduled date for starting the updating process. Cancel Schedule: Cancels the scheduled date.
Has been dismissed	Undismiss: Returns the recommendation to the list.
Is being applied or is being downloaded	Cancel: Cancels the update.

Revert ONTAP

Revert ONTAP overview

To transition a cluster to an earlier ONTAP release, you must perform a reversion.

The information in this section will guide you through the steps you should take before and after you revert, including the resources you should read and the necessary pre- and post-revert checks you should perform.



If you need to transition a cluster from ONTAP 9.1 to ONTAP 9.0, you need to use the downgrade procedure documented [here](#).

Do I need technical support to revert?

You can revert without assistance on new or test clusters. You should call technical support to revert production clusters. You should also call technical support if you experience any of the following:

- You are in a production environment and revert fails or you encounter any problems before or after the revert such as:
 - The revert process fails and cannot finish.
 - The revert process finishes, but the cluster is unusable in a production environment.
 - The revert process finishes and the cluster goes into production, but you are not satisfied with its behavior.
- You created volumes in ONTAP 9.5 or later and you need to revert to an earlier version. Volumes using adaptive compression must be uncompressed before reverting.

Revert paths

The version of ONTAP that you can revert to varies based on the version of ONTAP currently running on your nodes. You can use the `system image show` command to determine the version of ONTAP running on each node.

These guidelines refer only to on-premises ONTAP releases. For information about reverting ONTAP in the cloud, see [Reverting or downgrading Cloud Volumes ONTAP](#).

You can revert from...	To...
ONTAP 9.11.1	ONTAP 9.10.1
ONTAP 9.10.1	ONTAP 9.9.1
ONTAP 9.9.1	ONTAP 9.8
ONTAP 9.8	ONTAP 9.7
ONTAP 9.7	ONTAP 9.6
ONTAP 9.6	ONTAP 9.5
ONTAP 9.5	ONTAP 9.4
ONTAP 9.4	ONTAP 9.3
ONTAP 9.3	ONTAP 9.2
ONTAP 9.2	ONTAP 9.1
ONTAP 9.1 or ONTAP 9	Data ONTAP 8.3.x



If you need to change from ONTAP 9.1 to 9.0, you should follow the [downgrade process](#) documented here.

What should I read before I revert?

Resources to review before you revert

Before you revert ONTAP, you should confirm hardware support and review resources to understand issues you might encounter or need to resolve.

1. Review the [ONTAP 9 Release Notes](#) for the target release.

The “Important cautions” section describes potential issues that you should be aware of before downgrading or reverting.

2. Confirm that your hardware platform is supported in the target release.

[NetApp Hardware Universe](#)

3. Confirm that your cluster and management switches are supported in the target release.

You must verify that the NX-OS (cluster network switches), IOS (management network switches), and reference configuration file (RCF) software versions are compatible with the version of ONTAP to which you are reverting.

4. If your cluster is configured for SAN, confirm that the SAN configuration is fully supported.

All SAN components—including target ONTAP software version, host OS and patches, required Host Utilities software, and adapter drivers and firmware—should be supported.

[NetApp Interoperability Matrix Tool](#)

Revert considerations

You need to consider the revert issues and limitations before beginning an ONTAP reversion.

- Reversion is disruptive.

No client access can occur during the reversion. If you are reverting a production cluster, be sure to include this disruption in your planning.

- Reversion affects all nodes in the cluster.

The reversion affects all nodes in the cluster; however, the reversion must be performed and completed on each HA pair before other HA pairs are reverted.

- The reversion is complete when all nodes are running the new target release.

When the cluster is in a mixed-version state, you should not enter any commands that alter the cluster operation or configuration except as necessary to satisfy reversion requirements; monitoring operations are permitted.



If you have reverted some, but not all of the nodes, do not attempt to upgrade the cluster back to the source release.

- When you revert a node, it clears the cached data in a Flash Cache module.

Because there is no cached data in the Flash Cache module, the node serves initial read requests from disk, which results in decreased read performance during this period. The node repopulates the cache as it serves read requests.

- A LUN that is backed up to tape running on ONTAP 9.x can be restored only to 9.x and later releases and not to an earlier release.
- If your current version of ONTAP supports In-Band ACP (IBACP) functionality, and you revert to a version of ONTAP that does not support IBACP, the alternate path to your disk shelf is disabled.
- If LDAP is used by any of your storage virtual machines (SVMs), LDAP referral must be disabled before reversion.
- In MetroCluster IP systems using switches which are MetroCluster compliant but not MetroCluster validated, the reversion from ONTAP 9.7 to 9.6 is disruptive as there is no support for systems using ONTAP 9.6 and earlier.

Things to verify before you revert

Before revert, you should verify your cluster health, storage health, and system time. You

should also delete any cluster jobs that are running and gracefully terminate any SMB sessions that are not continuously available.

Verify cluster health

Before you revert cluster, you should verify that the nodes are healthy and eligible to participate in the cluster, and that the cluster is in quorum.

- 1. Verify that the nodes in the cluster are online and are eligible to participate in the cluster: `cluster show`

```
cluster1::> cluster show
Node                Health  Eligibility
-----
node0                true   true
node1                true   true
```

If any node is unhealthy or ineligible, check EMS logs for errors and take corrective action.

- 2. Set the privilege level to advanced:

```
set -privilege advanced
```

Enter `y` to continue.

- 3. Verify the configuration details for each RDB process.
 - The relational database epoch and database epochs should match for each node.
 - The per-ring quorum master should be the same for all nodes.

Note that each ring might have a different quorum master.

To display this RDB process...	Enter this command...
Management application	<code>cluster ring show -unitname mgmt</code>
Volume location database	<code>cluster ring show -unitname vl原因</code>
Virtual-Interface manager	<code>cluster ring show -unitname vifmgr</code>
SAN management daemon	<code>cluster ring show -unitname bcomd</code>

This example shows the volume location database process:

```
cluster1::*> cluster ring show -unitname vldb
```

Node	UnitName	Epoch	DB Epoch	DB Trnxs	Master	Online
node0	vldb	154	154	14847	node0	master
node1	vldb	154	154	14847	node0	secondary
node2	vldb	154	154	14847	node0	secondary
node3	vldb	154	154	14847	node0	secondary

4 entries were displayed.

4. Return to the admin privilege level:

```
set -privilege admin
```

5. If you are operating in a SAN environment, verify that each node is in a SAN quorum: event log show -severity informational -message-name scsiblade.*

The most recent scsiblade event message for each node should indicate that the scsi-blade is in quorum.

```
cluster1::*> event log show -severity informational -message-name scsiblade.*
```

Time	Node	Severity	Event
MM/DD/YYYY TIME	node0	INFORMATIONAL	scsiblade.in.quorum: The scsi-blade ...
MM/DD/YYYY TIME	node1	INFORMATIONAL	scsiblade.in.quorum: The scsi-blade ...

Related information

[System administration](#)

Verify storage health

Before you revert a cluster, you should verify the status of your disks, aggregates, and volumes.

1. Verify disk status:

To check for...	Do this...
Broken disks	a. Display any broken disks: <code>storage disk show -state broken</code> b. Remove or replace any broken disks.

To check for...	Do this...
Disks undergoing maintenance or reconstruction	<ol style="list-style-type: none"> Display any disks in maintenance, pending, or reconstructing states: <code>storage disk show -state maintenance pending reconstructing</code> Wait for the maintenance or reconstruction operation to finish before proceeding.

- Verify that all aggregates are online by displaying the state of physical and logical storage, including storage aggregates: `storage aggregate show -state !online`

This command displays the aggregates that are *not* online. All aggregates must be online before and after performing a major upgrade or reversion.

```
cluster1::> storage aggregate show -state !online
There are no entries matching your query.
```

- Verify that all volumes are online by displaying any volumes that are *not* online: `volume show -state !online`

All volumes must be online before and after performing a major upgrade or reversion.

```
cluster1::> volume show -state !online
There are no entries matching your query.
```

- Verify that there are no inconsistent volumes: `volume show -is-inconsistent true`

See the Knowledge Base article [Volume Showing WAFL Inconsistent](#) on how to address the inconsistent volumes.

Related information

[Disk and aggregate management](#)

Verifying the system time

Before you revert, you should verify that NTP is configured, and that the time is synchronized across the cluster.

- Verify that the cluster is associated with an NTP server: `cluster time-service ntp server show`
- Verify that each node has the same date and time: `cluster date show`

```
cluster1::> cluster date show
```

Node	Date	Timezone
node0	4/6/2013 20:54:38	GMT
node1	4/6/2013 20:54:38	GMT
node2	4/6/2013 20:54:38	GMT
node3	4/6/2013 20:54:38	GMT

4 entries were displayed.

Verify that no jobs are running

Before you revert the ONTAP software, you must verify the status of cluster jobs. If any aggregate, volume, NDMP (dump or restore), or Snapshot jobs (such as create, delete, move, modify, replicate, and mount jobs) are running or queued, you must allow the jobs to finish successfully or stop the queued entries.

1. Review the list of any running or queued aggregate, volume, or Snapshot jobs: `job show`

```
cluster1::> job show
```

Job ID	Name	Owning Vserver	Node	State
8629	Vol Reaper	cluster1	-	Queued
	Description: Vol Reaper Job			
8630	Certificate Expiry Check	cluster1	-	Queued
	Description: Certificate Expiry Check			
.				
.				
.				

2. Delete any running or queued aggregate, volume, or Snapshot copy jobs: `job delete -id job_id`

```
cluster1::> job delete -id 8629
```

3. Verify that no aggregate, volume, or Snapshot jobs are running or queued: `job show`

In this example, all running and queued jobs have been deleted:

```
cluster1::> job show
```

Job ID	Name	Owning Vserver	Node	State
9944	SnapMirrorDaemon_7_2147484678	cluster1	node1	Dormant
	Description: Snapmirror Daemon for 7_2147484678			
18377	SnapMirror Service Job	cluster1	node0	Dormant
	Description: SnapMirror Service Job			

2 entries were displayed

SMB sessions that should be terminated

Before you revert, you should identify and gracefully terminate any SMB sessions that are not continuously available.

Continuously available SMB shares, which are accessed by Hyper-V or Microsoft SQL Server clients using the SMB 3.0 protocol, do not need to be terminated before upgrading or downgrading.

1. Identify any established SMB sessions that are not continuously available: `vserver cifs session show -continuously-available Yes -instance`

This command displays detailed information about any SMB sessions that have no continuous availability. You should terminate them before proceeding with the ONTAP downgrade.

```
cluster1::> vserver cifs session show -continuously-available Yes
-instance
```

```
Node: node1
Vserver: vs1
Session ID: 1
Connection ID: 4160072788
Incoming Data LIF IP Address: 198.51.100.5
Workstation IP address: 203.0.113.20
Authentication Mechanism: NTLMv2
Windows User: CIFSLAB\user1
UNIX User: nobody
Open Shares: 1
Open Files: 2
Open Other: 0
Connected Time: 8m 39s
Idle Time: 7m 45s
Protocol Version: SMB2_1
Continuously Available: No
1 entry was displayed.
```

2. If necessary, identify the files that are open for each SMB session that you identified: `vserver cifs session file show -session-id session_ID`

```
cluster1::> vserver cifs session file show -session-id 1
```

```
Node:      node1
Vserver:    vs1
Connection: 4160072788
Session:    1
File      File      Open Hosting
Continuously
ID        Type      Mode Volume      Share      Available
-----
-----
1         Regular   rw   vol10          homedirshare   No
Path: \TestDocument.docx
2         Regular   rw   vol10          homedirshare   No
Path: \file1.txt
2 entries were displayed.
```


What else should I check before I revert?

Pre-revert checks

Depending on your environment, you need to consider certain factors before revert. Get started by reviewing the table below to see what special considerations you need to consider.

Ask yourself...	If your answer is yes, then do this...
Is my cluster running SnapMirror?	<ul style="list-style-type: none">• Review considerations for reverting systems with SnapMirror Synchronous relationships• Review reversion requirements for SnapMirror and SnapVault relationships
Is my cluster running SnapLock?	Set autocommit periods
Do I have Split FlexClone volumes?	Reverse physical block sharing
Do I have FlexGroup volumes?	Disable qtree functionality
Do I have CIFS servers in workgroup mode?	Move or delete CIFS servers in workgroup mode
Do I have deduplicated volumes?	Verify volume contains enough free space
Do I have a 2 or 4-node MetroCluster configuration?	Disable automatic unplanned switchover
Do I have Snapshot copies?	Prepare Snapshot copies
Am I reverting to ONTAP 8.3.x?	Identify user accounts that use SHA-2 hash function
Is anti-ransomware protection configured for ONTAP 9.11.1 or later?	Check anti-ransomware licensing

SnapMirror

Considerations for reverting systems with SnapMirror Synchronous relationships

You must be aware of the considerations for SnapMirror Synchronous relationships before reverting from ONTAP 9.6 to ONTAP 9.5.

Before reverting, you must take the following steps if you have SnapMirror Synchronous relationships:

- You must delete any SnapMirror Synchronous relationship in which the source volume is serving data using NFSv4 or SMB.

ONTAP 9.5 does not support NFSv4 and SMB.

- You must delete any SnapMirror Synchronous relationships in a mirror-mirror cascade deployment.

A mirror-mirror cascade deployment is not supported for SnapMirror Synchronous relationships in ONTAP 9.5.

- If the common Snapshot copies in ONTAP 9.5 are not available during revert, you must initialize the SnapMirror Synchronous relationship after reverting.

After two hours of upgrade to ONTAP 9.6, the common Snapshot copies from ONTAP 9.5 are automatically replaced by the common Snapshot copies in ONTAP 9.6. Therefore, you cannot resynchronize the SnapMirror Synchronous relationship after reverting if the common Snapshot copies from ONTAP 9.5 are not available.

Reversion requirements for SnapMirror and SnapVault relationships

The system node `revert-to` command notifies you of any SnapMirror and SnapVault relationships that need to be deleted or reconfigured for the reversion process to be completed. However, you should be aware of these requirements before you begin the reversion.

- All SnapVault and data protection mirror relationships must be quiesced and then broken.

After the reversion is completed, you can resynchronize and resume these relationships if a common Snapshot copy exists.

- SnapVault relationships must not contain the following SnapMirror policy types:
 - `async-mirror`

You must delete any relationship that uses this policy type.

- `MirrorAndVault`

If any of these relationships exist, you should change the SnapMirror policy to `mirror-vault`.

- All load-sharing mirror relationships and destination volumes must be deleted.
- SnapMirror relationships with FlexClone destination volumes must be deleted.
- Network compression must be disabled for each SnapMirror policy.
- The `all_source_snapshot` rule must be removed from any `async-mirror` type SnapMirror policies.



The Single File Snapshot Restore (SFSR) and Partial File Snapshot Restore (PFSR) operations are deprecated on the root volume.

- Any currently running single file and Snapshot restore operations must be completed before the reversion can proceed.

You can either wait for the restore operation to finish, or you can abort it.

- Any incomplete single file and Snapshot restore operations must be removed by using the `snapmirror restore` command.

Set autocommit periods for SnapLock volumes before reverting

To revert from ONTAP 9, the value of the autocommit period for SnapLock volumes must be set in hours, not days. Before attempting to revert, you must check the autocommit value for your SnapLock volumes and modify it from days to hours, if necessary.

1. Verify that there are SnapLock volumes in the cluster that have unsupported autocommit periods:
`volume snaplock show -autocommit-period *days`

2. Modify the unsupported autocommit periods to hours: `volume snaplock modify -vserver vserver_name -volume volume_name -autocommit-period value hours`

Reverse physical block sharing in split FlexClone volumes

If you have split a FlexClone volume from its parent volume, you must undo the sharing of any physical block between the clone and its parent volume before reverting from ONTAP 9.4 or later to an earlier version of ONTAP.

This task is applicable only for AFF systems when split has been run on any of the FlexClone volumes.

1. Log in to the advanced privilege level: `set -privilege advanced`
2. Identify the split FlexClone volumes with shared physical blocks: `volume clone sharing-by-split show`

```
cluster1::> volume clone sharing-by-split show
Node           Vserver   Volume      Aggregate
-----
node1          vs1       vol_clone1   aggr1
node2          vs2       vol_clone2   aggr2
2 entries were displayed.
```

3. Undo the physical block sharing in all of the split FlexClone volumes across the cluster: `volume clone sharing-by-split undo start-all`
4. Verify that there are no split FlexClone volumes with shared physical blocks: `volume clone sharing-by-split show`

```
cluster1::> volume clone sharing-by-split show
This table is currently empty.
```

Disable qtree functionality in FlexGroup volumes before reverting

Qtrees for FlexGroup volumes are not supported prior to ONTAP 9.3. You must disable the qtree functionality on FlexGroup volumes before reverting from ONTAP 9.3 to an earlier version of ONTAP.

The qtree functionality is enabled either when you create a qtree or if you modify the security-style and oplock-mode attributes of the default qtree.

1. Identify and delete all of the non-default qtrees in each FlexGroup volume that are enabled with the qtree functionality:
 - a. Log in to the advanced privilege level: `set -privilege advanced`
 - b. Verify if any FlexGroup volume is enabled with the qtree functionality.

For ONTAP 9.6 or later, use: `volume show is-qtrees-enabled true`

For ONTAP 9.5 or earlier, use: `volume show -is-flexgroup-qtree-enabled true`

```
cluster1::*> volume show -is-flexgroup-qtree-enabled true
Vserver   Volume      Aggregate    State      Type      Size
Available Used%
-----
vs0        fg          -            online     RW        320MB
220.4MB   31%
```

- c. Delete all of the non-default qtrees in each FlexGroup volume that are enabled with the qtree functionality: `volume qtree delete -vserver svm_name -volume volume_name -qtree qtree_name`

If the qtree functionality is enabled because you modified the attributes of the default qtree and if you do not have any qtrees, you can skip this step.

```
cluster1::*> volume qtree delete -vserver vs0 -volume fg -qtree
qtree4
WARNING: Are you sure you want to delete qtree qtree4 in volume fg
vserver vs0? {y|n}: y
[Job 38] Job is queued: Delete qtree qtree4 in volume fg vserver vs0.
```

2. Disable the qtree functionality on each FlexGroup volume: `volume flexgroup qtree-disable -vserver svm_name -volume volume_name`

```
cluster1::*> volume flexgroup qtree-disable -vserver vs0 -volume fg
```

3. Identify and delete any Snapshot copies that are enabled with the qtree functionality.

- a. Verify if any Snapshot copies are enabled with the qtree functionality: `volume snapshot show -vserver vserver_name -volume volume_name -fields is-flexgroup-qtree-enabled`

```
cluster1::*> volume snapshot show -vserver vs0 -volume fg -fields is-
flexgroup-qtree-enabled
vserver volume snapshot is-flexgroup-qtree-enabled
-----
vs0        fg          fg_snap1 true
vs0        fg          daily.2017-09-27_0010 true
vs0        fg          daily.2017-09-28_0010 true
vs0        fg          snapmirror.0241f354-a865-11e7-a1c0-
00a098a71764_2147867740.2017-10-04_124524 true
```

- b. Delete all of the Snapshot copies that are enabled with the qtree functionality: `volume snapshot`

```
delete -vserver svm_name -volume volume_name -snapshot snapshot_name -force true -ignore-owners true
```

The Snapshot copies that must be deleted include regular Snapshot copies and the Snapshot copies taken for SnapMirror relationships. If you have created any SnapMirror relationship for the FlexGroup volumes with a destination cluster that is running ONTAP 9.2 or earlier, you must delete all of the Snapshot copies that were taken when the source FlexGroup volume was enabled for the qtree functionality.

```
cluster1::> volume snapshot delete -vserver vs0 -volume fg -snapshot daily.2017-09-27_0010 -force true -ignore-owners true
```

Related information

[FlexGroup volumes management](#)

Identify and move SMB servers in workgroup mode

Before performing a revert, you must delete any SMB servers in workgroup mode or move them in to a domain. Workgroup mode is not supported on ONTAP versions prior to ONTAP 9.

1. Identify any SMB servers with a Authentication Style of workgroup: `vserver cifs show`
2. Move or delete the servers you identified:

If you are going to...	Then use this command....
Move the SMB server from the workgroup to an Active Directory domain:	<code>vserver cifs modify -vserver vserver_name -domain domain_name</code>
Delete the SMB server	<code>vserver cifs delete -vserver vserver_name</code>

3. If you deleted the SMB server, enter the username of the domain, then enter the user password.

Related information

[SMB management](#)

Verify deduplicated volumes have enough free space before reverting

Before reverting from any version of ONTAP 9, you must ensure that the volumes contain sufficient free space for the revert operation.

The volume must have enough space to accommodate the savings that were achieved through the inline detection of blocks of zeros. See the Knowledge Base article [How to see space savings from deduplication, compression, and compaction in ONTAP 9](#).

If you have enabled both deduplication and data compression on a volume that you want to revert, then you must revert data compression before reverting deduplication.

1. Use the volume efficiency show command with the -fields option to view the progress of the efficiency operations that are running on the volumes.

The following command displays the progress of efficiency operations: `volume efficiency show -fields vserver,volume,progress`

2. Use the volume efficiency stop command with the -all option to stop all active and queued deduplication operations.

The following command stops all active and queued deduplication operations on volume VolA: `volume efficiency stop -vserver vs1 -volume VolA -all`

3. Use the set -privilege advanced command to log in at the advanced privilege level.
4. Use the volume efficiency revert-to command with the -version option to downgrade the efficiency metadata of a volume to a specific version of ONTAP.

The following command reverts the efficiency metadata on volume VolA to ONTAP 9.x: `volume efficiency revert-to -vserver vs1 -volume VolA -version 9.x`



The volume efficiency revert-to command reverts volumes that are present on the node on which this command is executed. This command does not revert volumes across nodes.

5. Use the volume efficiency show command with the -op-status option to monitor the progress of the downgrade.

The following command monitors and displays the status of the downgrade: `volume efficiency show -vserver vs1 -op-status Downgrading`

6. If the revert does not succeed, use the volume efficiency show command with the -instance option to see why the revert failed.

The following command displays detailed information about all fields: `volume efficiency show -vserver vs1 -volume voll - instance`

7. After the revert operation is complete, return to the admin privilege level: `set -privilege admin`

[Logical storage management](#)

Disable automatic unplanned switchover before reverting two-node and four-node MetroCluster configurations

Before reverting a two-node or four-node MetroCluster configuration, you must disable automatic unplanned switchover (AUSO).

1. On both the clusters in MetroCluster, disable automatic unplanned switchover: `metrocluster modify -auto-switchover-failure-domain auso-disabled`

Related information

[MetroCluster management and disaster recovery](#)

Prepare Snapshot copies before reverting

Before reverting to an earlier ONTAP release, you must disable all Snapshot copy policies and delete any Snapshot copies that were created after upgrading to the current release.

If you are reverting in a SnapMirror environment, you must first have deleted the following mirror relationships:

- All load-sharing mirror relationships
- Any data protection mirror relationships that were created in ONTAP 8.3.x
- All data protection mirror relationships if the cluster was re-created in ONTAP 8.3.x

1. Disable Snapshot copy policies for all data SVMs: `volume snapshot policy modify -vserver * -enabled false`
2. Disable Snapshot copy policies for each node's aggregates:
 - a. Identify the node's aggregates by using the `run-nodenodenameaggr status` command.
 - b. Disable the Snapshot copy policy for each aggregate: `run -node nodename aggr options aggr_name nosnap on`
 - c. Repeat this step for each remaining node.
3. Disable Snapshot copy policies for each node's root volume:
 - a. Identify the node's root volume by using the `run-nodenodenamevol status` command.

You identify the root volume by the word `root` in the Options column of the `vol status` command output.

```
vs1::> run -node node1 vol status
```

Volume State	Status	Options
vol0 online	raid_dp, flex 64-bit	root, nvfail=on

- b. Disable the Snapshot copy policy on the root volume: `run -node nodename vol options root_volume_name nosnap on`
 - c. Repeat this step for each remaining node.
4. Delete all Snapshot copies that were created after upgrading to the current release:
 - a. Set the privilege level to advanced: `set -privilege advanced`
 - b. Disable the snapshots: `snapshot policy modify -vserver * -enabled false`
 - c. Delete the node's newer-version Snapshot copies: `volume snapshot prepare-for-revert -node nodename`

This command deletes the newer-version Snapshot copies on each data volume, root aggregate, and root volume.

If any Snapshot copies cannot be deleted, the command fails and notifies you of any required actions you must take before the Snapshot copies can be deleted. You must complete the required

actions and then rerun the volume snapshot prepare-for-revert command before proceeding to the next step.

```
cluster1::*> volume snapshot prepare-for-revert -node node1
```

Warning: This command will delete all Snapshot copies that have the format used by the current version of ONTAP. It will fail if any Snapshot copy polices are enabled, or
if any Snapshot copies have an owner. Continue? {y|n}: y

- d. Verify that the Snapshot copies have been deleted: `volume snapshot show -node nodename`

If any newer-version Snapshot copies remain, force them to be deleted: `volume snapshot delete {-fs-version 9.0 -node nodename -is-constituent true} -ignore -owners -force`

- e. Repeat this step c for each remaining node.
f. Return to the admin privilege level: `set -privilege admin`



You must perform these steps on both the clusters in MetroCluster configuration.

Identify user accounts that use SHA-2 hash function

If you are reverting from ONTAP 9.1 or ONTAP 9.0 to ONTAP 8.3.x, SHA-2 account users can no longer be authenticated with their passwords. Before you revert, you should identify the user accounts that use the SHA-2 hash function, so that after reverting, you can have them reset their passwords to use the encryption type (MD5) that is supported by the release you revert to.

1. Change to the privilege setting to advanced: `set -privilege advanced`
2. Identify the user accounts that use the SHA-2 has function: `security login show -vserver * -username * -application * -authentication-method password -hash-function !md5`
3. Retain the command output for use after the revert.



During the revert, you will be prompted to run the advanced command `security login password-prepare-to-downgrade` to reset your own password to use the MD5 hash function. If your password is not encrypted with MD5, the command prompts you for a new password and encrypts it with MD5, enabling your credential to be authenticated after the revert.

Check anti-ransomware licensing before reverting from ONTAP 9.11.1 or later

If you have configured anti-ransomware protection and you revert from ONTAP 9.11.1 or later to ONTAP 9.10.1 or earlier, you might experience warning messages and limited anti-ransomware functionality.

In ONTAP 9.11.1, the Anti-ransomware license replaced the Multi-Tenant Key Management (MTKM) license. If your system has the Anti_ransomware license but no MT_EK_MGMT license, you will see a warning during

revert that anti-ransomware cannot be enabled on new volumes upon revert.

The volumes with existing anti-ransomware protection will continue to work normally after revert, and anti-ransomware status can be displayed using the ONTAP CLI. However, System Manager cannot show anti-ransomware status without the MTKM license.

Therefore, if you want anti-ransomware protection to continue after reverting to ONTAP 9.10.1, be sure the MTKM license is installed before reverting. [Learn about anti-ransomware licensing.](#)

Download and install the ONTAP software image

You must first download the ONTAP software from the NetApp Support site; then you can install it.

Download the software image

To downgrade or revert from ONTAP 9.4 and later, you can copy the ONTAP software image from the NetApp Support Site to a local folder. For a downgrade or revert to ONTAP 9.3 or earlier, you must copy the ONTAP software image to an HTTP server or FTP server on your network.

You should note the following important information:

- Software images are specific to platform models.

You must obtain the correct image for your cluster. Software images, firmware version information, and the latest firmware for your platform model are available on the NetApp Support Site.

- Software images include the latest version of system firmware that was available when a given version of ONTAP was released.
- If you are downgrading a system with NetApp Volume Encryption from ONTAP 9.5 or later, you must download the ONTAP software image for non-restricted countries, which includes NetApp Volume Encryption.

If you use the ONTAP software image for restricted countries to downgrade or revert a system with NetApp Volume Encryption, the system panics and you lose access to your volumes.

1. Locate the target ONTAP software in the [Software Downloads](#) area of the NetApp Support Site.
2. Copy the software image.
 - For ONTAP 9.3 or earlier, copy the software image (for example, 93_q_image.tgz) from the NetApp Support Site to the directory on the HTTP server or FTP server from which the image will be served.
 - For ONTAP 9.4 or later, copy the software image (for example, 97_q_image.tgz) from the NetApp Support Site to the directory on the HTTP server or FTP server from which the image will be served or to a local folder.

Install the software image

You must install the target software image on the cluster's nodes.

- If you are downgrading or reverting a system with NetApp Volume Encryption from ONTAP 9.5 or later, you must have downloaded the ONTAP software image for non-restricted countries, which includes NetApp Volume Encryption.

If you use the ONTAP software image for restricted countries to downgrade or revert a system with NetApp Volume Encryption, the system panics and you lose access to your volumes.

1. Set the privilege level to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (***>**) appears.

2. Install the software image on the nodes.

This command downloads and installs the software image on all of the nodes simultaneously. To download and install the image on each node one at a time, do not specify the `-background` parameter.

- If you are downgrading or reverting a non-MetroCluster configuration or a two-node MetroCluster configuration: `system node image update -node * -package location -replace -package true -setdefault true -background true`

This command uses an extended query to change the target software image, which is installed as the alternate image, to be the default image for the node.

- If you are downgrading or reverting a four or eight-node MetroCluster configuration, you must issue the following command on both clusters: `system node image update -node * -package location -replace-package true true -background true -setdefault false`

This command uses an extended query to change the target software image, which is installed as the alternate image on each node.

3. Enter **y** to continue when prompted.
4. Verify that the software image is downloaded and installed on each node: `system node image show-update-progress -node *`

This command displays the current status of the software image download and installation. You should continue to run this command until all nodes report a Run Status of Exited, and an Exit Status of Success.

The system node image update command can fail and display error or warning messages. After resolving any errors or warnings, you can run the command again.

This example shows a two-node cluster in which the software image is downloaded and installed successfully on both nodes:

```
cluster1::*> system node image show-update-progress -node *
There is no update/install in progress
Status of most recent operation:
    Run Status:      Exited
    Exit Status:     Success
    Phase:           Run Script
    Exit Message:    After a clean shutdown, image2 will be set as
the default boot image on node0.
There is no update/install in progress
Status of most recent operation:
    Run Status:      Exited
    Exit Status:     Success
    Phase:           Run Script
    Exit Message:    After a clean shutdown, image2 will be set as
the default boot image on node1.
2 entries were acted on.
```

Revert an ONTAP cluster

To take the cluster offline to revert to an earlier ONTAP release, you must disable storage failover and the data LIFs, address reversion preconditions, revert the cluster and file system configurations on a node, and then repeat the process for each additional node in the cluster.

You must have completed the revert [verifications](#) and [pre-checks](#).

Reverting a cluster requires you to take the cluster offline for the duration of the reversion.

1. Set the privilege level from admin to advanced, entering **y** when prompted to continue: `set -privilege advanced`

The advanced prompt (***>**) appears.

2. Verify that the target ONTAP software is installed: `system image show`

The following example shows that version 9.1 is installed as the alternate image on both nodes:

```
cluster1::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date
node0	image1	true	true	9.2	MM/DD/YYYY TIME
	image2	false	false	9.1	MM/DD/YYYY TIME
node1	image1	true	true	9.2	MM/DD/YYYY TIME
	image2	false	false	9.1	MM/DD/YYYY TIME

4 entries were displayed.

3. Disable all of the data LIFs in the cluster: `network interface modify {-role data} -status -admin down`
4. If the cluster consists of only two nodes, disable cluster HA: `cluster ha modify -configured false`
5. Disable storage failover for the nodes in the HA pair from either node: `storage failover modify -node nodename -enabled false`

You only need to disable storage failover once for the HA pair. When you disable storage failover for a node, storage failover is also disabled on the node's partner.

6. Log in to the node that you want to revert.

To revert a node, you must be logged in to the cluster through the node's node management LIF.

7. Set the node's target ONTAP software image to be the default image: `system image modify -node nodename -image target_image -isdefault true`
8. Verify that the target ONTAP software image is set as the default image for the node that you are reverting: `system image show`

The following example shows that version 9.1 is set as the default image on node0:

```
cluster1::*> system image show
```

Node	Image	Is Default	Is Current	Version	Install Date
node0	image1	false	true	9.2	MM/DD/YYYY TIME
	image2	true	false	9.1	MM/DD/YYYY TIME
node1	image1	true	true	9.2	MM/DD/YYYY TIME
	image2	false	false	9.1	MM/DD/YYYY TIME

4 entries were displayed.

9. If the cluster consists of only two nodes, verify that the node does not hold epsilon:

- a. Check whether the node currently holds epsilon: `cluster show -node nodename`

The following example shows that the node holds epsilon:

```
cluster1::*> cluster show -node node1

Node: node1
UUID: 026efc12-ac1a-11e0-80ed-0f7eba8fc313
Epsilon: true
Eligibility: true
Health: true
```

- b. If the node holds epsilon, mark epsilon as false on the node so that epsilon can be transferred to the node's partner: `cluster modify -node nodenameA -epsilon false`

- c. Transfer epsilon to the node's partner by marking epsilon true on the partner node: `cluster modify -node nodenameB -epsilon true`

10. Verify that the node is ready for reversion: `system node revert-to -node nodename -check -only true -version 9.x`

The check-only parameter identifies any preconditions that must be addressed before reverting, such as the following examples:

- Disabling storage failover
- Disabling the Snapshot policy
- Deleting Snapshot copies that were created after upgrading to the later version of ONTAP

11. Verify that all of the preconditions have been addressed: `system node revert-to -node nodename -check-only true -version 9.x`

12. Revert the cluster configuration of the node: `system node revert-to -node nodename -version 9.x`

The `-version` option refers to the target release. For example, if the software you installed and verified is ONTAP 9.1, the correct value of the `-version` option is 9.1.

The cluster configuration is reverted, and then you are logged out of the clustershell.

13. Log back in to the clustershell, and then switch to the nodeshell: `run -node nodename`

After logging on the clustershell again, it might take a few minutes before it is ready to accept the nodeshell command. So, if the command fails, wait a few minutes and try it again.

14. Revert the file system configuration of the node: `revert_to 9.x`

This command verifies that the node's file system configuration is ready to be reverted, and then reverts it. If any preconditions are identified, you must address them and then rerun the `revert_to` command.



Using a system console to monitor the revert process displays greater details than seen in nodeshell.

If AUTOBOOT is true, when the command finishes, the node will reboot to ONTAP.

If AUTOBOOT is false, when the command finishes the LOADER prompt is displayed. Enter `yes` to revert; then use `boot_ontap` to manually reboot the node.

15. After the node has rebooted, confirm that the new software is running: `system node image show`

In the following example, image1 is the new ONTAP version and is set as the current version on node0:

```
cluster1::*> system node image show
```

Node	Image	Is Default	Is Current	Version	Install Date
node0	image1	true	true	X.X.X	MM/DD/YYYY TIME
	image2	false	false	Y.Y.Y	MM/DD/YYYY TIME
node1	image1	true	false	X.X.X	MM/DD/YYYY TIME
	image2	false	true	Y.Y.Y	MM/DD/YYYY TIME

4 entries were displayed.

16. Verify that the revert status is complete for each node: `system node upgrade-revert show -node nodename`

The status should be listed as complete.

17. Repeat [\[step-5\]](#) through [\[step-17\]](#) on the other node in the HA pair.
18. If the cluster consists of only two nodes, reenable cluster HA: `cluster ha modify -configured true`
19. Reenable storage failover on both nodes if it was previously disabled: `storage failover modify -node nodename -enabled true`
20. Repeat [\[step-6\]](#) through [\[step-18\]](#) for each additional HA pair and both the clusters in MetroCluster Configuration.

What should I do after reverting my cluster?

Verify cluster and storage health after downgrade or revert

After you downgrade or revert a cluster, you should verify that the nodes are healthy and eligible to participate in the cluster, and that the cluster is in quorum. You should also verify the status of your disks, aggregates, and volumes.

Verify cluster health

1. Verify that the nodes in the cluster are online and are eligible to participate in the cluster: `cluster show`

```
cluster1::> cluster show
Node           Health Eligibility
-----
node0          true   true
node1          true   true
```

If any node is unhealthy or ineligible, check EMS logs for errors and take corrective action.

2. Set the privilege level to advanced:

```
set -privilege advanced
```

Enter `y` to continue.

3. Verify the configuration details for each RDB process.

- The relational database epoch and database epochs should match for each node.
- The per-ring quorum master should be the same for all nodes.

Note that each ring might have a different quorum master.

To display this RDB process...	Enter this command...
Management application	<code>cluster ring show -unitname mgmt</code>
Volume location database	<code>cluster ring show -unitname vldb</code>
Virtual-Interface manager	<code>cluster ring show -unitname vifmgr</code>
SAN management daemon	<code>cluster ring show -unitname bcomd</code>

This example shows the volume location database process:

```
cluster1::*> cluster ring show -unitname vldb
Node      UnitName Epoch   DB Epoch DB Trnxs Master   Online
-----
node0     vldb      154      154      14847   node0   master
node1     vldb      154      154      14847   node0   secondary
node2     vldb      154      154      14847   node0   secondary
node3     vldb      154      154      14847   node0   secondary
4 entries were displayed.
```

4. Return to the admin privilege level: `set -privilege admin`

5. If you are operating in a SAN environment, verify that each node is in a SAN quorum: `event log show -severity informational -message-name scsiblade.*`

The most recent scsiblade event message for each node should indicate that the scsi-blade is in quorum.

```
cluster1::*> event log show -severity informational -message-name
scsiblade.*
Time                Node        Severity    Event
-----
MM/DD/YYYY TIME    node0      INFORMATIONAL  scsiblade.in.quorum: The
scsi-blade ...
MM/DD/YYYY TIME    node1      INFORMATIONAL  scsiblade.in.quorum: The
scsi-blade ...
```

Related information

[System administration](#)

Verify storage health

After you revert or downgrade a cluster, you should verify the status of your disks, aggregates, and volumes.

1. Verify disk status:

To check for...	Do this...
Broken disks	<ol style="list-style-type: none">a. Display any broken disks: <code>storage disk show -state broken</code>b. Remove or replace any broken disks.
Disks undergoing maintenance or reconstruction	<ol style="list-style-type: none">a. Display any disks in maintenance, pending, or reconstructing states: <code>storage disk show -state maintenance pending reconstructing</code>b. Wait for the maintenance or reconstruction operation to finish before proceeding.

2. Verify that all aggregates are online by displaying the state of physical and logical storage, including storage aggregates: `storage aggregate show -state !online`

This command displays the aggregates that are *not* online. All aggregates must be online before and after performing a major upgrade or reversion.

```
cluster1::> storage aggregate show -state !online
There are no entries matching your query.
```

3. Verify that all volumes are online by displaying any volumes that are *not* online: `volume show -state`

!online

All volumes must be online before and after performing a major upgrade or reversion.

```
cluster1::> volume show -state !online
There are no entries matching your query.
```

4. Verify that there are no inconsistent volumes: `volume show -is-inconsistent true`

See the Knowledge Base article [Volume Showing WAFL Inconsistent](#) on how to address the inconsistent volumes.

Related information

[Disk and aggregate management](#)

Enable automatic switchover for MetroCluster configurations

This topic provides information regarding the additional tasks that you must perform after the reversion of MetroCluster configurations.

1. Enable automatic unplanned switchover: `metrocluster modify -auto-switchover-failure -domain auto-on-cluster-disaster`
2. Validate the MetroCluster configuration: `metrocluster check run`

Enable and revert LIFs to home ports after a revert

During a reboot, some LIFs might have been migrated to their assigned failover ports. After you revert a cluster, you must enable and revert any LIFs that are not on their home ports.

The network interface revert command reverts a LIF that is not currently on its home port back to its home port, provided that the home port is operational. A LIF's home port is specified when the LIF is created; you can determine the home port for a LIF by using the network interface show command.

1. Display the status of all LIFs: `network interface show`

This example displays the status of all LIFs for a storage virtual machine (SVM).

```
cluster1::> network interface show -vserver vs0
```

Current Is	Logical Interface	Status Admin/Oper	Network Address/Mask	Current Node	Port
vs0					
true	data001	down/down	192.0.2.120/24	node0	e0e
true	data002	down/down	192.0.2.121/24	node0	e0f
true	data003	down/down	192.0.2.122/24	node0	e2a
true	data004	down/down	192.0.2.123/24	node0	e2b
false	data005	down/down	192.0.2.124/24	node0	e0e
false	data006	down/down	192.0.2.125/24	node0	e0f
false	data007	down/down	192.0.2.126/24	node0	e2a
false	data008	down/down	192.0.2.127/24	node0	e2b

8 entries were displayed.

If any LIFs appear with a Status Admin status of down or with an Is home status of false, continue with the next step.

2. Enable the data LIFs: `network interface modify {-role data} -status-admin up`

```
cluster1::> network interface modify {-role data} -status-admin up
8 entries were modified.
```

3. Revert LIFs to their home ports: `network interface revert *`

This command reverts all LIFs back to their home ports.

```
cluster1::> network interface revert *
8 entries were acted on.
```

4. Verify that all LIFs are in their home ports: `network interface show`

This example shows that all LIFs for SVM vs0 are on their home ports.

```
cluster1::> network interface show -vserver vs0
```

	Logical	Status	Network	Current	
Current Is					
Vserver	Interface	Admin/Oper	Address/Mask	Node	Port
Home					
-----	-----	-----	-----	-----	
vs0					
	data001	up/up	192.0.2.120/24	node0	e0e
true					
	data002	up/up	192.0.2.121/24	node0	e0f
true					
	data003	up/up	192.0.2.122/24	node0	e2a
true					
	data004	up/up	192.0.2.123/24	node0	e2b
true					
	data005	up/up	192.0.2.124/24	node1	e0e
true					
	data006	up/up	192.0.2.125/24	node1	e0f
true					
	data007	up/up	192.0.2.126/24	node1	e2a
true					
	data008	up/up	192.0.2.127/24	node1	e2b
true					

8 entries were displayed.

Enable Snapshot copy policies after reverting

After reverting to an earlier version of ONTAP, you must enable Snapshot copy policies to start creating Snapshot copies again.

You are reenabling the Snapshot schedules that you disabled before you reverted to an earlier version of ONTAP.

1. Enable Snapshot copy policies for all data SVMs:

```
volume snapshot policy modify -vserver * -enabled true
```

```
snapshot policy modify pg-rpo-hourly -enable true
```

2. For each node, enable the Snapshot copy policy of the root volume by using the run-nodenodenamevol optionsroot_vol_namenosnap off command.

```
cluster1::> run -node node1 vol options vol0 nosnap off
```

Verify client access (SMB and NFS)

For the configured protocols, test access from SMB and NFS clients to verify that the cluster is accessible.

Verify IPv6 firewall entries

A reversion from any version of ONTAP 9 might result in missing default IPv6 firewall entries for some services in firewall policies. You need to verify that the required firewall entries have been restored to your system.

1. Verify that all firewall policies are correct by comparing them to the default policies: `system services firewall policy show`

The following example shows the default policies:

```
cluster1::*> system services firewall policy show
Policy           Service      Action IP-List
-----
cluster
    dns          allow  0.0.0.0/0
    http         allow  0.0.0.0/0
    https        allow  0.0.0.0/0
    ndmp         allow  0.0.0.0/0
    ntp          allow  0.0.0.0/0
    rsh          allow  0.0.0.0/0
    snmp         allow  0.0.0.0/0
    ssh          allow  0.0.0.0/0
    telnet       allow  0.0.0.0/0
data
    dns          allow  0.0.0.0/0, ::/0
    http         deny   0.0.0.0/0, ::/0
    https        deny   0.0.0.0/0, ::/0
    ndmp         allow  0.0.0.0/0, ::/0
    ntp          deny   0.0.0.0/0, ::/0
    rsh          deny   0.0.0.0/0, ::/0
.
.
.
```

2. Manually add any missing default IPv6 firewall entries by creating a new firewall policy: `system services firewall policy create`

```
cluster1::*> system services firewall policy create -policy newIPv6
               -service ssh -action allow -ip-list ::/0
```

3. Apply the new policy to the LIF to allow access to a network service: `network interface modify`

```
cluster1::*> network interface modify -vserver VS1 -lif LIF1  
-firewall-policy newIPv6
```

Revert password hash function to the supported encryption type

If you reverted from ONTAP 9.1 or ONTAP 9.0 to ONTAP 8.3.x, SHA-2 account users can no longer be authenticated with their passwords. Passwords must be reset to use the MDS encryption type.

1. Set a temporary password for each SHA-2 user account that you [identified prior to reverting](#): `security login password -username user_name -vserver vs_server_name`
2. Communicate the temporary password to the affected users and have them log in through a console or SSH session to change their passwords as prompted by the system.

Considerations for whether to manually update the SP firmware

If the SP automatic update functionality is enabled (the default), downgrading or reverting to ONTAP 8.3.x does not require a manual SP firmware update. The SP firmware is automatically updated to the newest compatible version that is supported by the ONTAP version you reverted or downgraded to.

If the SP automatic update functionality is disabled (not recommended), after the ONTAP revert or downgrade process is complete, you must manually update the SP firmware to a version that is supported for the ONTAP version you reverted or downgraded to.

[NetApp BIOS/ONTAP Support Matrix](#)

[NetApp Downloads: System Firmware and Diagnostics](#)

Change in user accounts that can access the Service Processor

If you created user accounts on ONTAP 9.8 or earlier, upgraded to ONTAP 9.9.1 or later (when the `-role` parameter is changed to `admin`), and then reverted back to ONTAP 9.8 or earlier, the `-role` parameter is restored to its original value. You should nonetheless verify that the modified values are acceptable.

During revert, if the role for an SP user has been deleted, the "rbac.spuser.role.notfound" EMS message will be logged.

For more information, see [Accounts that can access the SP](#).

Copyright Information

Copyright © 2022 NetApp, Inc. All rights reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means-graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system-without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP "AS IS" AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

RESTRICTED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.277-7103 (October 1988) and FAR 52-227-19 (June 1987).

Trademark Information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.