

NetApp Learning Services

# ONTAP Cluster Administration

Exercise Guide  
Content Version 7



NetApp Learning Services

# ONTAP Cluster Administration Exercise Guide

Course ID: STRSW-ILT-ONTAPADM

Catalog Number: STRSW-ILT-ONTAPADM-EG

## **ATTENTION**

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## Table of Contents

<b>Welcome.....</b>	<b>EG1</b>
<b>Module 0: Welcome .....</b>	<b>M0</b>
<b>Module 1: Netapp Ontap 9 Clusters .....</b>	<b>M1</b>
<b>Module 2: Cluster Setup.....</b>	<b>M2</b>
<b>Module 3: Cluster Management.....</b>	<b>M3</b>
<b>Module 4: Network Management .....</b>	<b>M4</b>
<b>Module 5: Physical Storage Management.....</b>	<b>M5</b>
<b>Module 6: Logical Storage Management.....</b>	<b>M6</b>
<b>Module 7: Data Access.....</b>	<b>M7</b>
<b>Module 8: Data Protection.....</b>	<b>M8</b>
<b>Module 9: Storage Efficiency.....</b>	<b>M9</b>
<b>Module 10: Cluster Maintenance .....</b>	<b>M10</b>

## Study Aid Icons

In your exercises, you might see one or more of the following icons.



### Warning

If you misconfigure a step marked with this icon, later steps might not work properly. Check the step carefully before you move forward.



### Attention

Review this step or comment carefully to save time and avoid errors.



### Information

Review information about the topic or procedure.

# Module 0: Welcome

## Exercise 1: Checking the Exercise Equipment

In this exercise, you familiarize yourself with your equipment and verify that licenses are installed.

### Objectives

This exercise focuses on enabling you to do the following:

- Verify connectivity to the NetApp ONTAP clusters
- Verify that the required licenses are installed on the ONTAP clusters

### Case Study

Through the brilliance of management and the dedicated work of the employees, Zarrot Industries was able to force its rival, the corrupt Dwurgle Enterprises, into bankruptcy. The owner and president, Mr. Zarrot, was able to acquire Dwurgle at a steep discount. The two companies' IT infrastructure must now be merged.

Dwurgle Enterprises owned a NetApp ONTAP system that must now be integrated into the IT environment here at Zarrot Industries. Your job, along with your colleagues, is to perform that integration.

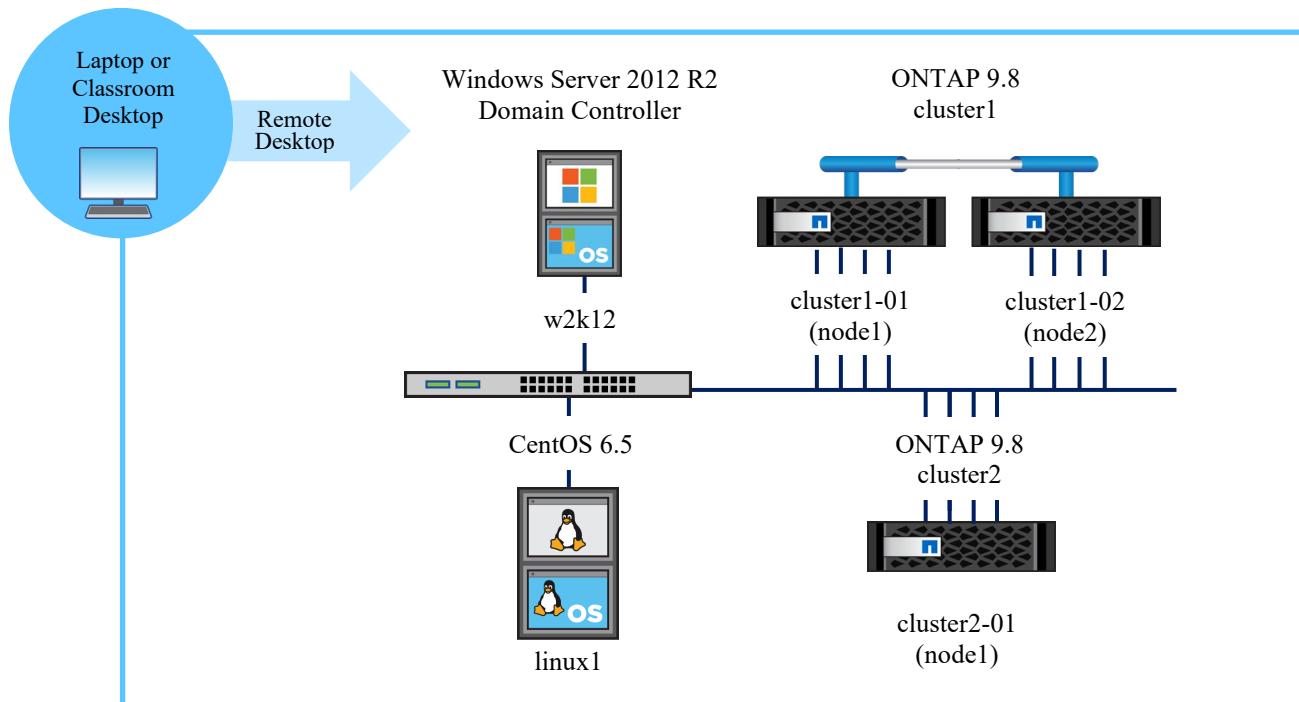
The NetApp system, along with the other equipment from Dwurgle, has been installed in the local data center. The first step is to verify that you can access the equipment and that the NetApp system has the needed licenses installed.

### Exercise Equipment

Your exercise contains the following virtual machines:

- One Windows Server 2012 R2 system
- One CentOS Linux 6.5 server system
- One ONTAP 9.8 2-node cluster (cluster1)
- One ONTAP 9.8 single-node cluster (cluster2)

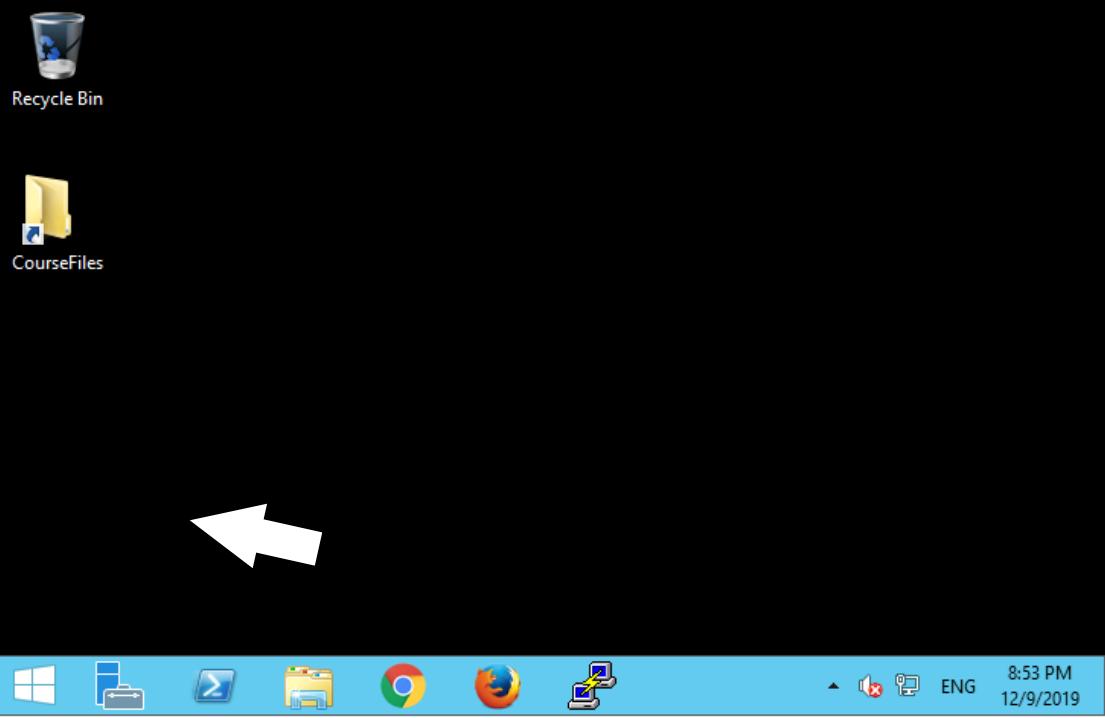
When you use the connection information that your instructor assigns to you, you first connect through Remote Desktop Connection to a Windows Server. From this Windows desktop, you connect to the other servers in your exercise environment.

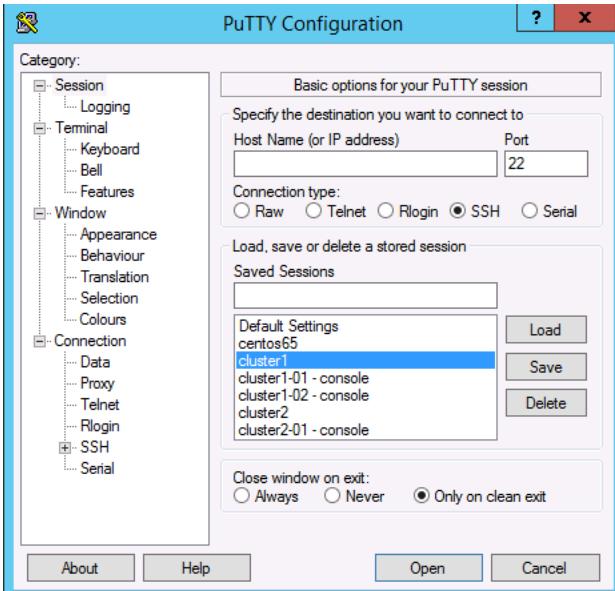


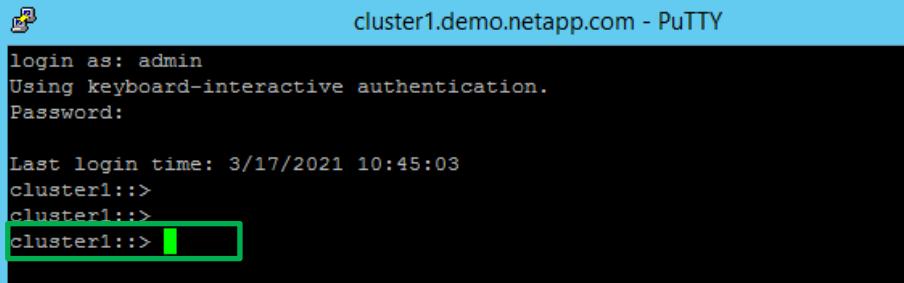
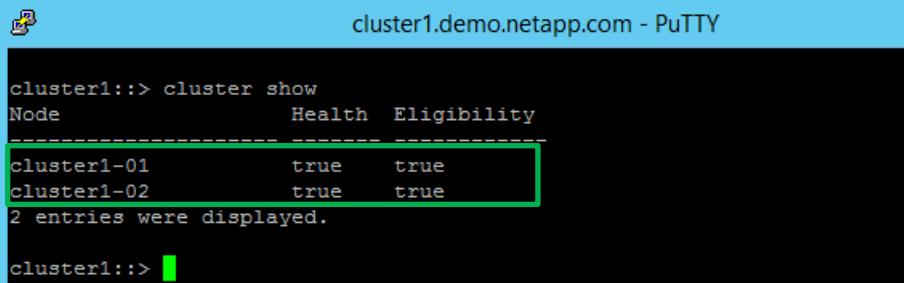
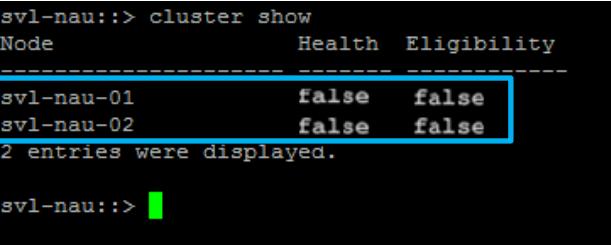
System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
CentOS Linux 6.5 Server	centos65	192.168.0.21	root (case sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!
node1 (cluster1)	cluster1-01	192.168.0.111	admin (case sensitive)	Netapp1!
node2 (cluster1)	cluster1-02	192.168.0.112	admin (case sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!
node1 (cluster2)	cluster2-01	192.168.0.113	admin (case sensitive)	Netapp1!
Windows Domain Controller	DC1	192.168.0.253	DEMO\Administrator	Netapp1!

## Task 1: Connect to Your ONTAP Cluster

In this task, you familiarize yourself with the Windows Server desktop. You connect to the ONTAP cluster and verify the health of the cluster.

Step	Action
1-1	Verify that you see the Start page of your assigned Windows Server. 
1-2	 Your desktop might look slightly different.
1-3	Verify that you see the desktop and that the taskbar contains the PuTTY program. 
1-4	 To connect to the ONTAP cluster GUI, browse to the NetApp ONTAP System Manager URL, which is built in to the ONTAP software. To connect to the ONTAP cluster CLI, use PuTTY, which is a UI for the Telnet and Secure Shell (SSH) protocols.
1-5	Double-click the PuTTY shortcut. 

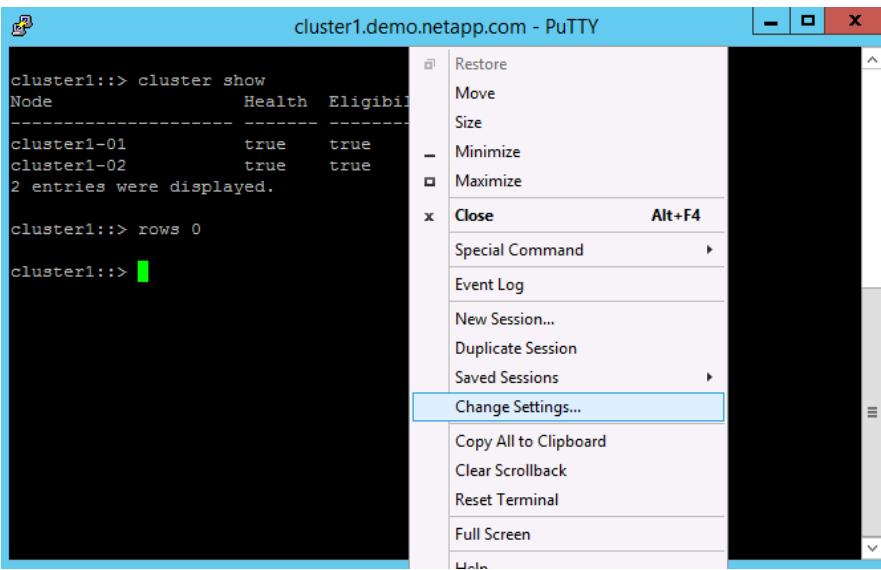
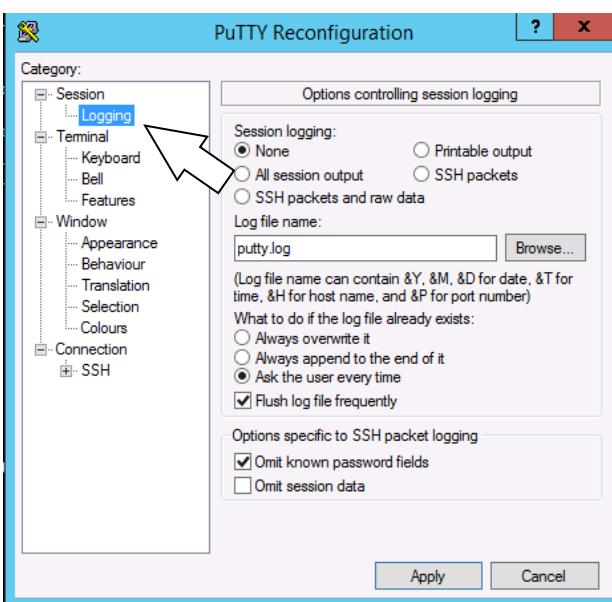
Step	Action
1-6	In the PuTTY Configuration dialog box, in the Saved Sessions list, double-click <b>cluster1</b> .
	
1-7	<p> You can also connect to the ONTAP cluster CLI by connecting to either node in the cluster: cluster-01 (node 1) or cluster1-02 (node 2).</p>
1-8	If you receive a PuTTY Security Alert the first time that you connect, click <b>Yes</b> .
	

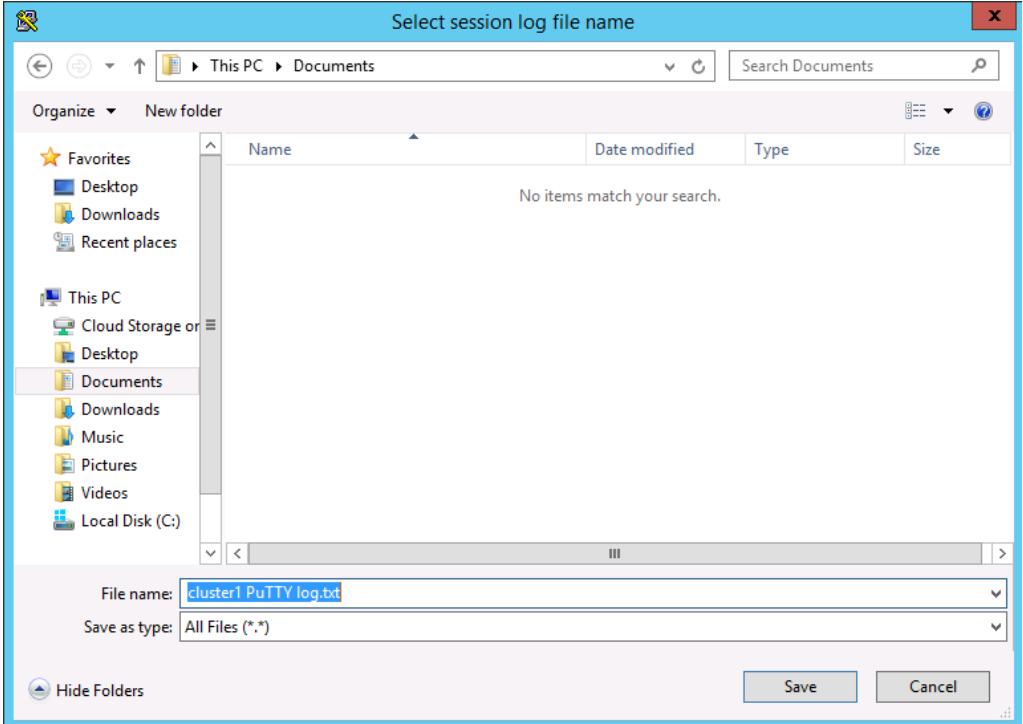
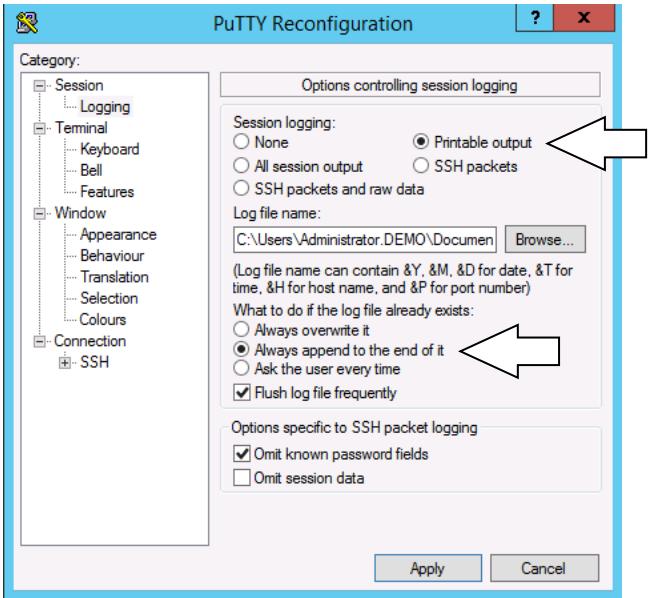
Step	Action										
1-9	<p>At the ONTAP cluster login prompt, provide the following credentials:</p> <ul style="list-style-type: none"> <li>▪ log in as: <b>admin</b></li> <li>▪ Password: <b>Netapp1!</b></li> </ul> <p>The ONTAP cluster CLI prompt and cursor appear:</p>  <pre>cluster1.demo.netapp.com - PuTTY login as: admin Using keyboard-interactive authentication. Password:  Last login time: 3/17/2021 10:45:03 cluster1::&gt; cluster1::&gt;</pre>										
1-10	 <p>If you have any difficulty logging in to the ONTAP cluster CLI, see this table and verify that you are using the correct user name and password in the correct case (both are case-sensitive).</p> <table border="1"> <thead> <tr> <th>System</th> <th>Host Name</th> <th>IP Address</th> <th>User Name</th> <th>Password</th> </tr> </thead> <tbody> <tr> <td>ONTAP cluster-management LIF</td> <td>cluster1</td> <td>192.168.0.101</td> <td>admin (case-sensitive)</td> <td>Netapp1!</td> </tr> </tbody> </table>	System	Host Name	IP Address	User Name	Password	ONTAP cluster-management LIF	cluster1	192.168.0.101	admin (case-sensitive)	Netapp1!
System	Host Name	IP Address	User Name	Password							
ONTAP cluster-management LIF	cluster1	192.168.0.101	admin (case-sensitive)	Netapp1!							
1-11	<p>Verify that both nodes of the ONTAP cluster are healthy and eligible:</p> <pre>cluster show</pre>  <pre>cluster1::&gt; cluster show Node          Health   Eligibility ----- cluster1-01    true     true cluster1-02    true     true 2 entries were displayed.  cluster1::&gt;</pre>										
1-12	 <p>If the Health or Eligibility of either node is listed as false, alert your instructor.</p>  <pre>svl-nau::&gt; cluster show Node          Health   Eligibility ----- svl-nau-01    false    false svl-nau-02    false    false 2 entries were displayed.  svl-nau::&gt;</pre>										
1-13	<p>Configure the display to work well in PuTTY:</p> <pre>cluster1::&gt; rows 0</pre>										
1-14	<p>Use the following credentials to repeat Steps 1-9 through 1-13 for the single-node cluster2 selection in PuTTY:</p> <p>login as: <b>admin</b>    Password: <b>Netapp1!</b></p>										

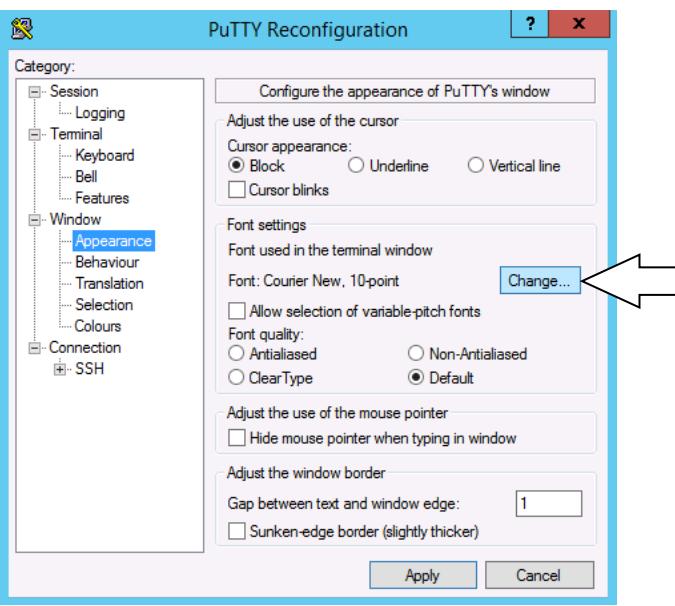
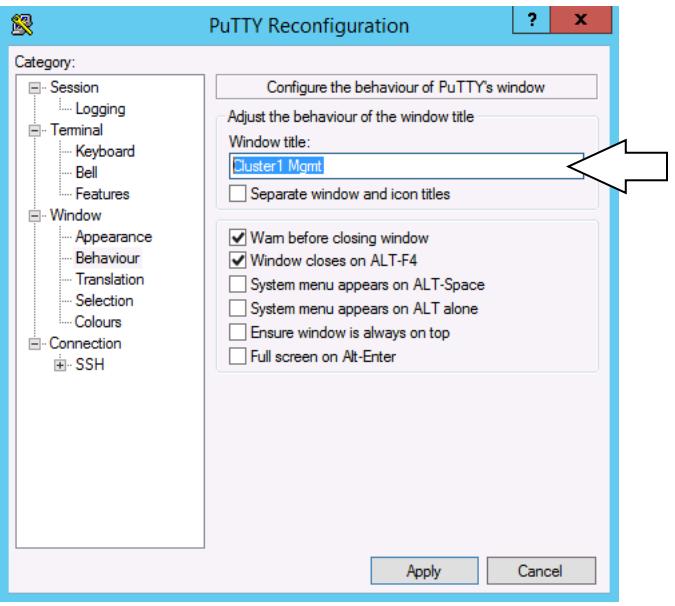
Step	Action
1-15	 You right-click the PuTTY icon for the menu to open an extra PuTTY window.

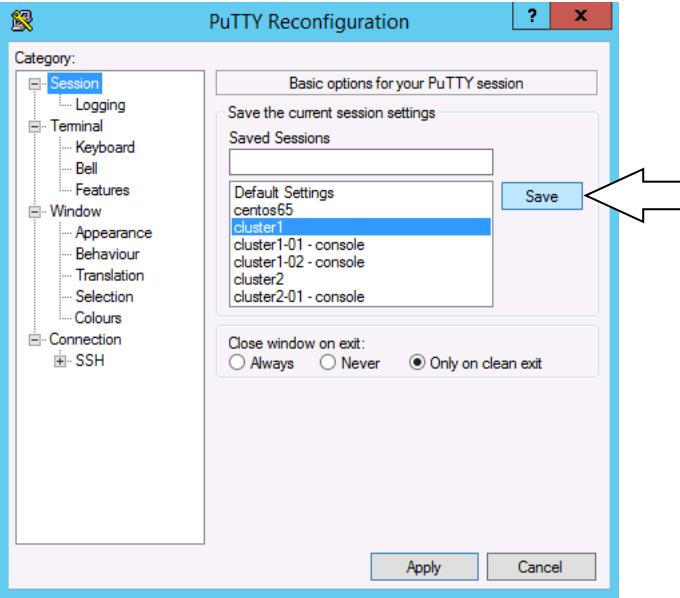
## Task 2: Configure PuTTY Saved Sessions

In this task, you improve the readability of the text and configure session logging.

Step	Action
2-1	In the PuTTY window for cluster1, right-click in the window title bar, and select <b>Change Settings</b> from the menu. 
2-2	In the Category list, select <b>Session &gt; Logging</b> . 
2-3	In the “Options controlling session logging” section, select <b>Printable output</b> .

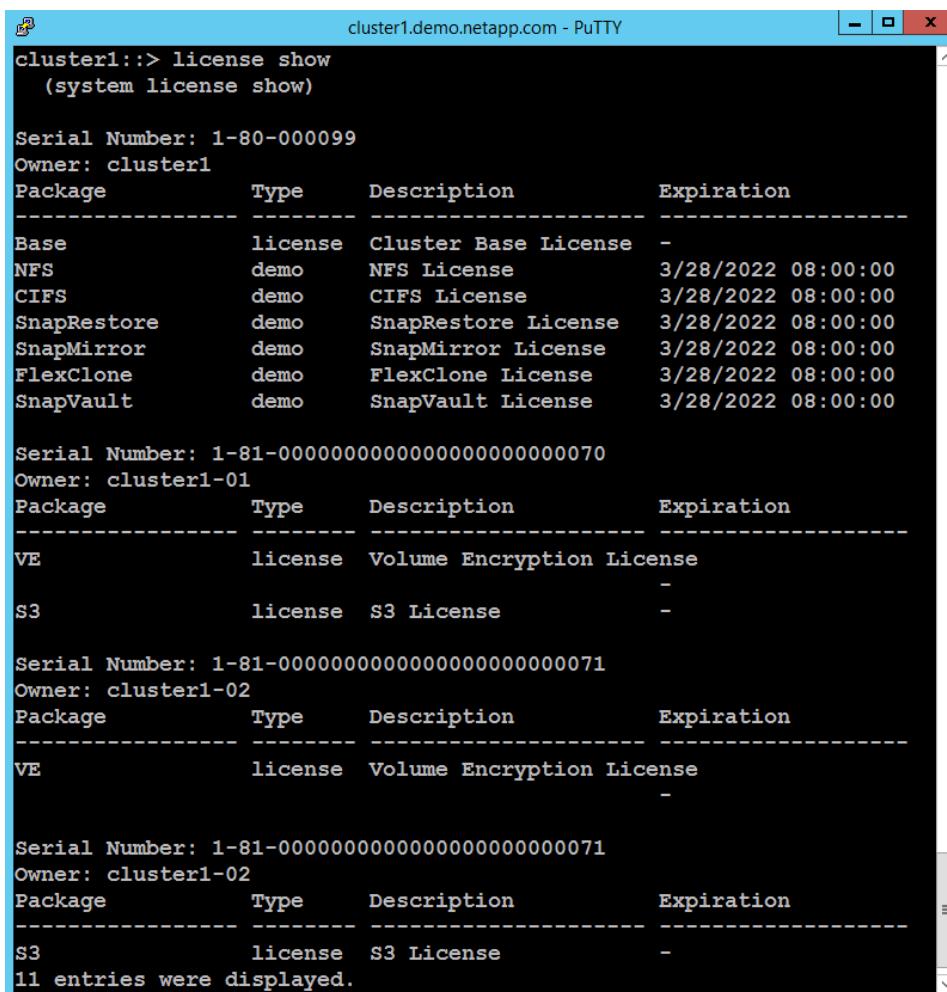
Step	Action
2-4	<p>In the “Log file name” section, click <b>Browse</b>, navigate to the Documents folder, name the log file <b>cluster1 PuTTY log.txt</b>, and then click <b>Save</b>.</p> 
2-5	<p>In the “What to do if the log file already exists” section, select <b>Always append to the end of it</b>.</p> 
2-6	<p>In the Category list, select <b>Window &gt; Appearance</b>.</p>

Step	Action
2-7	In the “Font settings” section, click <b>Change</b> , and then change the font to <b>Lucida Console, 11-point</b> or larger.
	
2-8	In the Category list, select <b>Window &gt; Behavior</b> .
2-9	In the “Window title” field, enter <b>Cluster1 Mgmt</b> .
	

Step	Action
2-10	In the Category list, select <b>Session</b> , and then click <b>Save</b> to save your changes.
	
2-11	Exit the PuTTY session for cluster1 and reopen the session again, and log in again.
2-12	On your jump host, navigate to the Documents folder, and then open the PuTTY log. You should see two timestamps, indicating that the log is appending rather than overwriting.
2-13	<p><b>i</b> Depending on how frequently you use the CLI but at least once each year, you should rename the current log file by appending the month, quarter, or year to the file name.</p> <p>You should create unique log files for maintenance events, to simplify troubleshooting, and to include with change control documentation.</p>
2-14	Repeat Steps 2-2 through 2-10 to revise the cluster2 saved session.

### Task 3: Verify That Required License Codes Are Installed

Many advanced features of the ONTAP cluster require licenses to work. In later exercises, you use several licensed features of the ONTAP cluster. In this task, you verify that the necessary licenses are preinstalled.

Step	Action
3-1	<p>In the cluster1 CLI, enter the following command:</p> <pre>license show</pre>  <pre>cluster1::&gt; license show (system license show)  Serial Number: 1-80-000099 Owner: cluster1 Package      Type    Description        Expiration ----- Base         license  Cluster Base License  - NFS          demo    NFS License        3/28/2022 08:00:00 CIFS         demo    CIFS License        3/28/2022 08:00:00 SnapRestore   demo    SnapRestore License  3/28/2022 08:00:00 SnapMirror    demo    SnapMirror License   3/28/2022 08:00:00 FlexClone     demo    FlexClone License   3/28/2022 08:00:00 SnapVault     demo    SnapVault License   3/28/2022 08:00:00  Serial Number: 1-81-0000000000000000000000000000000070 Owner: cluster1-01 Package      Type    Description        Expiration ----- VE           license  Volume Encryption License  - S3           license  S3 License        -  Serial Number: 1-81-0000000000000000000000000000000071 Owner: cluster1-02 Package      Type    Description        Expiration ----- VE           license  Volume Encryption License  - S3           license  S3 License        -  11 entries were displayed.</pre>
3-2	<p>Verify that the following required license codes are installed:</p> <ul style="list-style-type: none"> <li>▪ NFS</li> <li>▪ CIFS</li> <li>▪ S3</li> <li>▪ iSCSI (<b>on cluster2 only</b>)</li> <li>▪ SnapRestore</li> <li>▪ SnapMirror</li> <li>▪ FlexClone</li> <li>▪ VE (USA only)</li> </ul>
3-3	 <p>If any of the licenses are not installed, inform your instructor.</p>
3-4	<p>Repeat Steps 3-1 and 3-2 for cluster2.</p>

#### End of Exercise

# Module 1: NetApp ONTAP 9 Clusters

There is no exercise for Module 1.

# Module 2: Cluster Setup

## Exercise 1: Exploring ONTAP Management UIs

In this exercise, you explore the ONTAP clustershell CLI and NetApp ONTAP System Manager. You use both interfaces throughout this course.

### Objectives

This exercise focuses on enabling you to do the following:

- Explore the clustershell CLI
- Navigate clustershell command directories
- Use the `set` command to adjust preferences
- Use the Tab key to complete commands
- Review command history
- Explore the ONTAP System Manager UI

### Case Study

The NetApp storage system has arrived from Dwurgle Enterprises with the most recent version of ONTAP software installed. You need to explore the ONTAP CLI and adjust the settings to your preferences. Next you need to explore the new ONTAP System Manager UI.

### Exercise Equipment

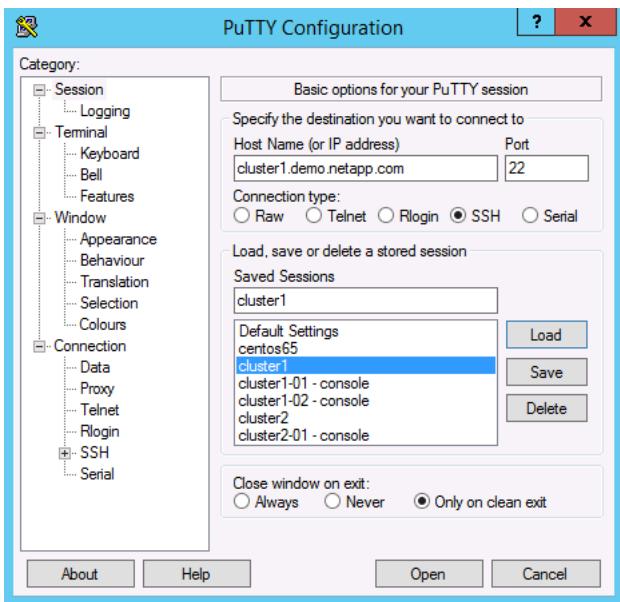
In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case-sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case-sensitive)	Netapp1!

### Task 1: Explore the Clustershell CLI

In this task, you log in to and navigate the clustershell CLI, and view manual pages.

Step	Action
1-1	From your Windows desktop, start the PuTTY application. 

Step	Action
1-2	In the PuTTY Configuration dialog box, verify that the cluster1 saved session is listed, and then double-click <b>cluster1</b> .
	
1-3	If the PuTTY Security Alert dialog box appears, click <b>Yes</b> .
1-4	Use the following credentials to log in to cluster1: <ul style="list-style-type: none"> <li>▪ log in as: <b>admin</b></li> <li>▪ Password: <b>Netapp1!</b></li> </ul>
1-5	Remove the timeout threshold for sessions to the cluster: <pre>system timeout modify -timeout 0</pre>
1-6	 Disabling automatic logout weakens security and should never be done outside of training environments.
1-7	Review the commands and command directories at the top level of the command hierarchy: <pre>?</pre>
1-8	 You do not need to press Enter after typing a question mark. You can also resize the PuTTY window to display more than 24 rows.
1-9	 An entry that ends with a right-angle bracket (>) symbol is a command directory rather than a command. The structure resembles a UNIX or DOS shell, in that you cannot run command directory names as you do commands, but you can navigate to command directories. Command directories can contain subdirectories, commands, or both. Command directories are contextual and hierarchical groupings of commands. The command structure is not flat.
1-10	Review the objects in the storage command directory: <pre>storage ?</pre>

Step	Action
1-11	Erase the storage command from the prompt and then open the <code>cluster</code> directory: <code>cluster</code>
1-12	 You can use the question mark at any level of the command hierarchy to see which commands and directories are available within that context. You notice that the clustershell prompt changes to indicate your context.
1-13	Review the available commands and directories at this level: <code>?</code>
1-14	Open the <code>statistics</code> directory: <code>statistics</code> You are now in the <code>cluster statistics</code> context.
1-15	Review the commands and directories that are available at this level: <code>?</code>
1-16	Go back up one level by typing two periods and then pressing <b>Enter</b> : <code>..</code>
1-17	Verify that you are back at the <code>cluster</code> directory level.
1-18	 From any level, you can enter <code>top</code> to go directly to the top of the command hierarchy.
1-19	Examine the manual page for the <code>storage</code> command directory: <code>man storage</code>
1-20	Exit the manual page by entering <code>q</code> .
1-21	Examine the manual page for the <code>storage aggregate</code> directory, and compare the output with the output of the <code>man storage</code> command: <code>man storage aggregate</code>
1-22	Exit the manual page by entering <code>q</code> .
1-23	Examine the manual page for the <code>storage aggregate create</code> directory: <code>man storage aggregate create</code>
1-24	Exit the manual page by entering <code>q</code> .

## Task 2: Navigate Command Directories

Explore command directories and context and use positional parameters.

Step	Action
2-1	Go to the <code>storage aggregate</code> directory level within the clustershell CLI: <code>storage aggr</code>

Step	Action
2-2	From the <code>storage aggregate</code> level, run the following command:  <code>modify ?</code>
2-3	<p> Square brackets ([]) indicate optional command elements. The output of this command shows the parameter <code>-aggregate</code> with brackets around the parameter name but not around the parameter value. The format means that the parameter name is optional, but the value is required. To save keystrokes, you can enter the aggregate name as a positional parameter rather than a named parameter. All other parameters and values are optional, except that if you enter a parameter, you must also provide a value. (The value cannot be specified based on position.)</p> <p>In this task, the aggregate name is required to determine which aggregate to modify. Although the other parameters are technically optional, you should specify at least one parameter for the command to be meaningful and to modify an attribute of the aggregate.</p>
2-4	Review the possible keyword values for the <code>-state</code> parameter:  <code>modify -state ?</code>
2-5	Review the options for the <code>storage aggregate scrub</code> command:  <code>scrub ?</code>
2-6	<p> As with the <code>modify</code> command, the aggregate name is required, but the parameter name is optional. In addition, the action value is required, but the parameter name (<code>action</code>) is optional. The command has two possible forms:</p> <ul style="list-style-type: none"> <li>▪ <code>storage aggregate scrub -aggregate aggr0_n1 -action start</code></li> <li>▪ <code>storage aggregate scrub aggr0 start</code></li> </ul>
2-7	<p> Many commands also have additional information fields that are not shown with the default command syntax. You can see a list of these additional fields by using the <code>-fields</code> parameter.</p>
2-8	Try it with the <code>storage aggregate show</code> command:  <code>show -fields ?</code>
2-9	Using the <code>-fields</code> parameter, display the name of node the aggregates are on and whether or not the aggregates are on their home node:  <code>storage aggregate show -fields node,is-home</code>
2-10	Return to the top of the command hierarchy:  <code>top</code>

## Task 3: Use the set Command to Adjust Preferences

Use the `set` command to change privilege levels, display all available object attributes with a single command, and set a default storage VM (storage virtual machine, also known as SVM) for a clustershell session.

Step	Action
3-1	Look at the <code>volume</code> directory: <code>volume ?</code> The default privilege level is <code>admin</code> .
3-2	Review the commands that are available in this directory context at this privilege level.
3-3	Switch to the advanced privilege level: <code>set -privilege advanced</code>
3-4	 Because <code>-privilege</code> is an optional positional parameter of the <code>set</code> command, you can also specify the desired privilege level as a positional parameter: <code>set advanced</code>
3-5	While you are in the advanced privilege level, look again at the <code>volume</code> directory: <code>volume ?</code>
3-6	Review the other available commands. Each command and directory that is available for privilege levels other than <code>admin</code> has an asterisk (*) in front of the description.
3-7	Switch back to the <code>admin</code> privilege level: <code>set admin</code>
3-8	Return to the top of the command hierarchy: <code>top</code>
3-9	Look at the <code>set</code> directory: <code>set ?</code>
3-10	Display the list of nodes in the cluster: <code>system node show</code>
3-11	Set the option to show all fields in a query: <code>set -showallfields true</code>
3-12	Display the list of nodes in the cluster again: <code>system node show</code>
3-13	Adjust the width of your PuTTY window to correctly show all the fields in the command output, and then repeat the command that you entered in the previous step.
3-14	Turn off the option to show all fields: <code>set -showallfields false</code>

Step	Action
<b>3-15</b>	Display the list of volumes on the cluster: <code>vol show</code>
<b>3-16</b>	Set the default SVM for your clustershell session to <code>svm1</code> : <code>set -vserver svm1</code>
<b>3-17</b>	View the list of volumes again: <code>vol show</code>
<b>3-18</b>	 You see only volumes that are associated with <code>svm1</code> .
<b>3-19</b>	Turn off the default SVM: <code>set -vserver ""</code>
<b>3-20</b>	Verify that the default SVM is unset. <code>set</code>

## Task 4: Use the Tab Key to Complete Commands

In this task, you enter command shortcuts and use Tab completion to simplify command syntax.

Step	Action
<b>4-1</b>	Display the LIFs: <code>network interface show</code>
<b>4-2</b>	Enter the following command: <code>net i show</code> The command fails because the form that you entered is ambiguous. Multiple options in the command hierarchy begin with the letter “i.”
<b>4-3</b>	Enter the command again, using <code>in</code> : <code>ne in show</code>
<b>4-4</b>	Type <code>ne</code> (the first two letters of the <code>network</code> command directory), and then press <b>Tab</b> . When you enter an unambiguous substring and press Tab, the clustershell completes the substring.
<b>4-5</b>	Continue the command: <ul style="list-style-type: none"> <li>▪ Type <code>in</code>, and then press <b>Tab</b>.</li> <li>▪ Type <code>re</code>, and then press <b>Tab</b>.</li> </ul> You notice that <code>re</code> is ambiguous in this context. The clustershell displays the options for <code>re</code> .

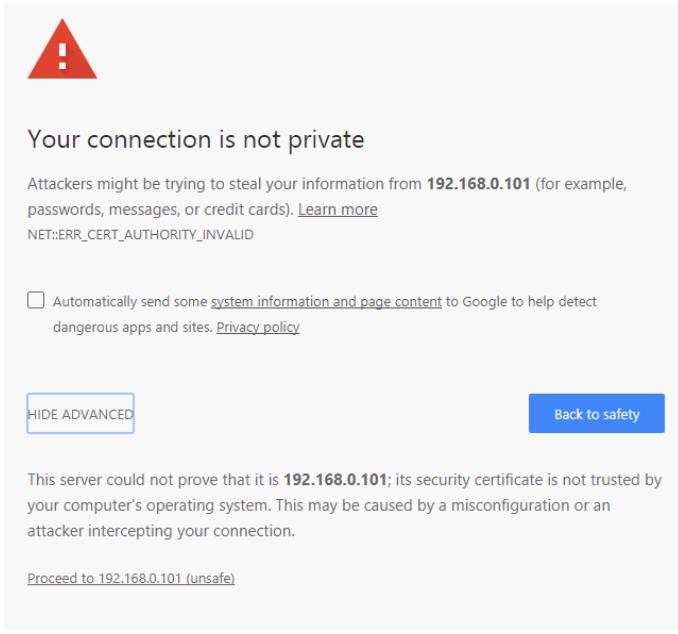
Step	Action
<b>4-6</b>	<p>Complete the command:</p> <ul style="list-style-type: none"> <li>▪ Type <b>ne</b>, and then press <b>Tab</b>.</li> <li>▪ Type <b>in</b>, and then press <b>Tab</b>.</li> <li>▪ Type <b>revert *</b> and then press <b>Enter</b></li> </ul>

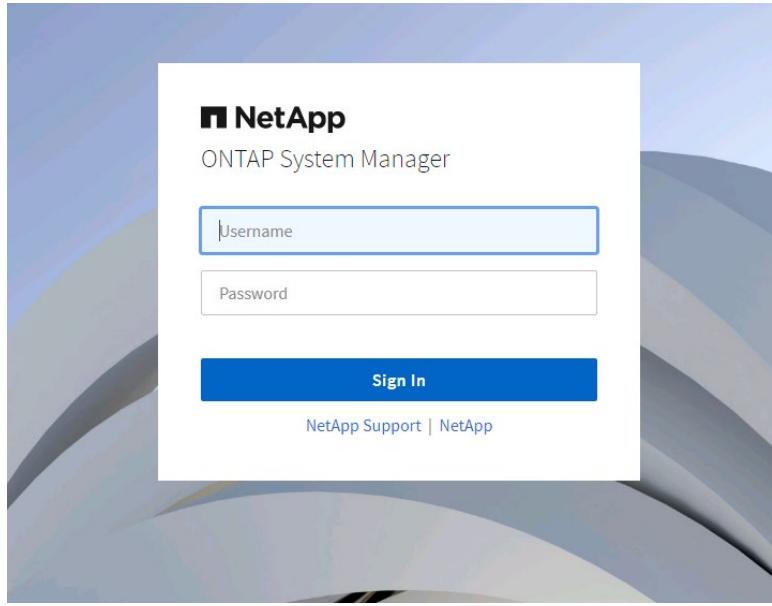
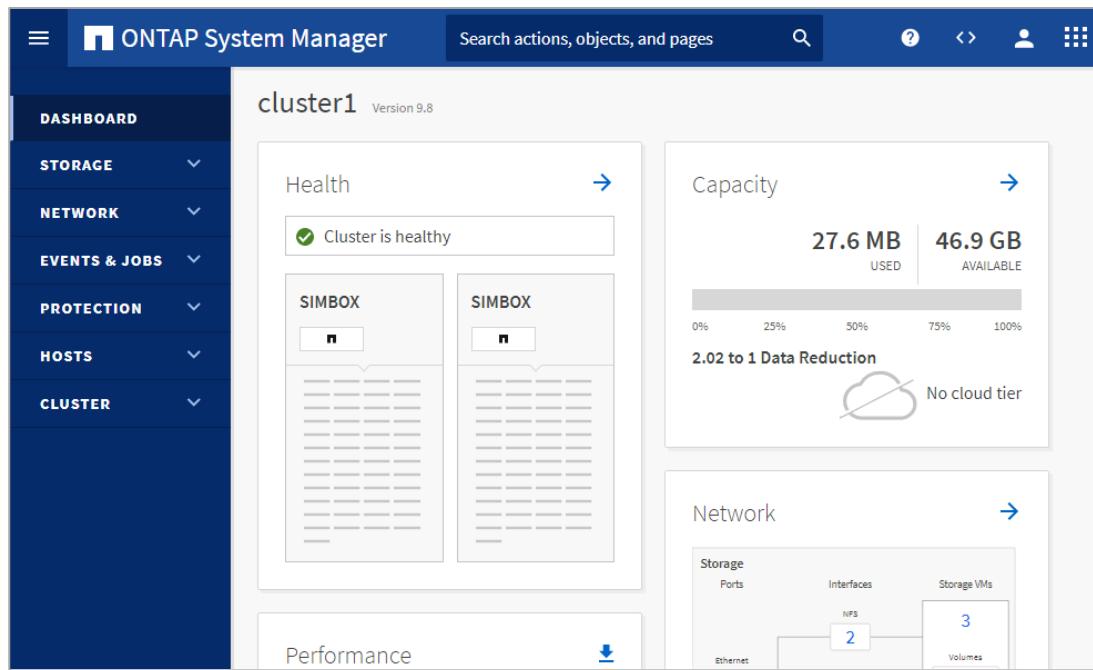
## Task 5: Review Command History

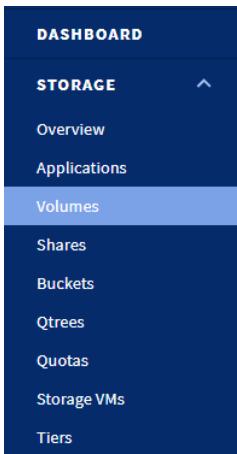
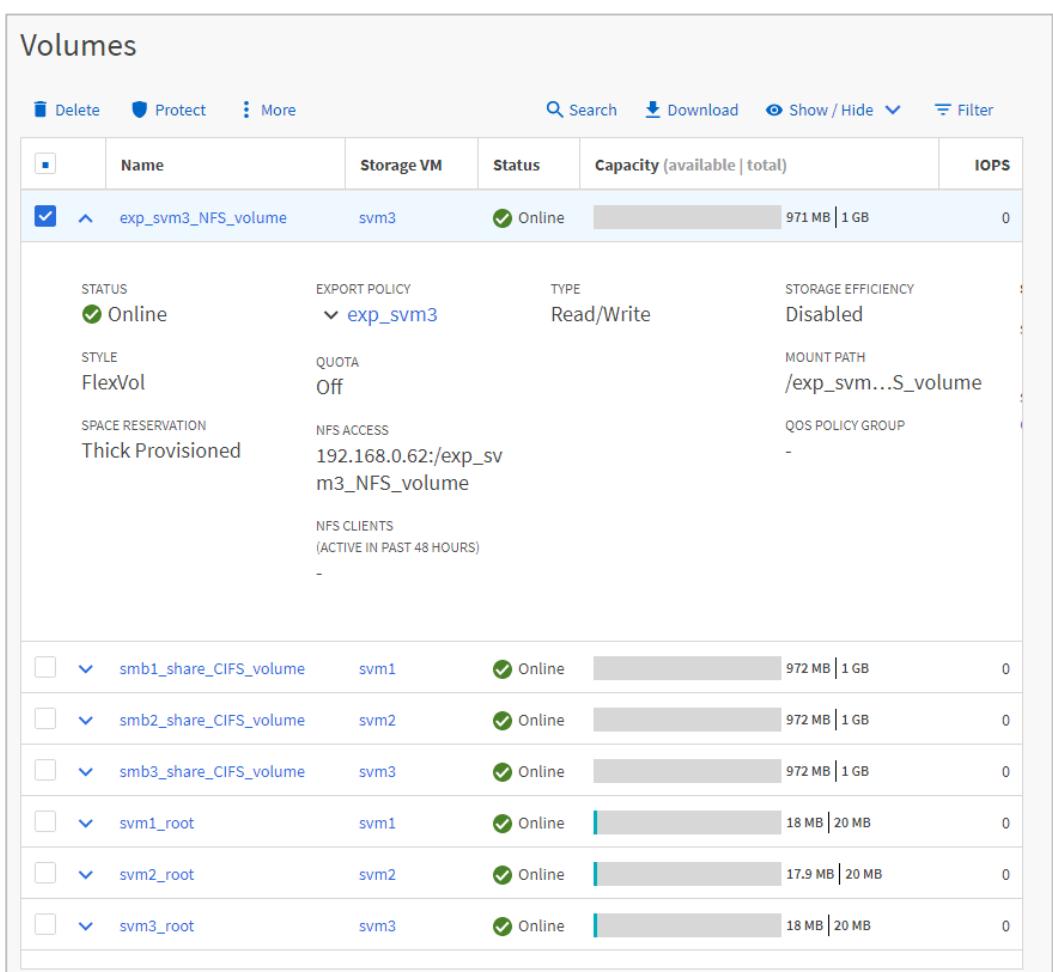
Use the `history` command, the `redo` command, and the up arrow to retrieve previous commands.

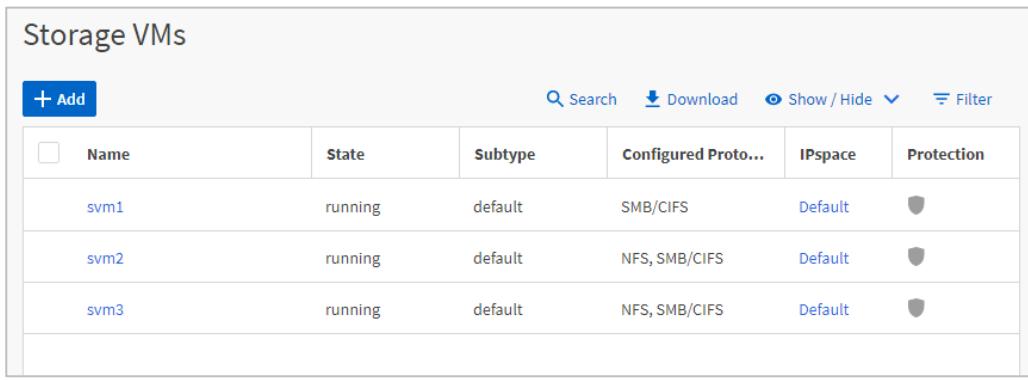
Step	Action
<b>5-1</b>	<p>Enter the following commands:</p> <pre>net int show net port show cluster show</pre>
<b>5-2</b>	From the command line, press the up-arrow key multiple times to recall previous commands.
<b>5-3</b>	Press the down-arrow key to scroll back through the commands.
<b>5-4</b>	<p>Review the command history.</p> <pre>history</pre>
<b>5-5</b>	Rerun the most recent command:
	<pre>redo</pre>
<b>5-6</b>	 The most recent command is <code>history</code> , which is the final command in the history list.
<b>5-7</b>	<p>Check the history again:</p> <pre>history</pre>
<b>5-8</b>	Rerun the command that was issued three commands ago:
	<pre>redo -3</pre>
<b>5-9</b>	<p>Find the <code>vol show</code> command in the history list, and run the command by using the command number:</p> <pre>redo &lt;command_number&gt;</pre>
<b>5-10</b>	 The number that is associated with the <code>vol show</code> command varies, based on the number of commands that you ran in this session.

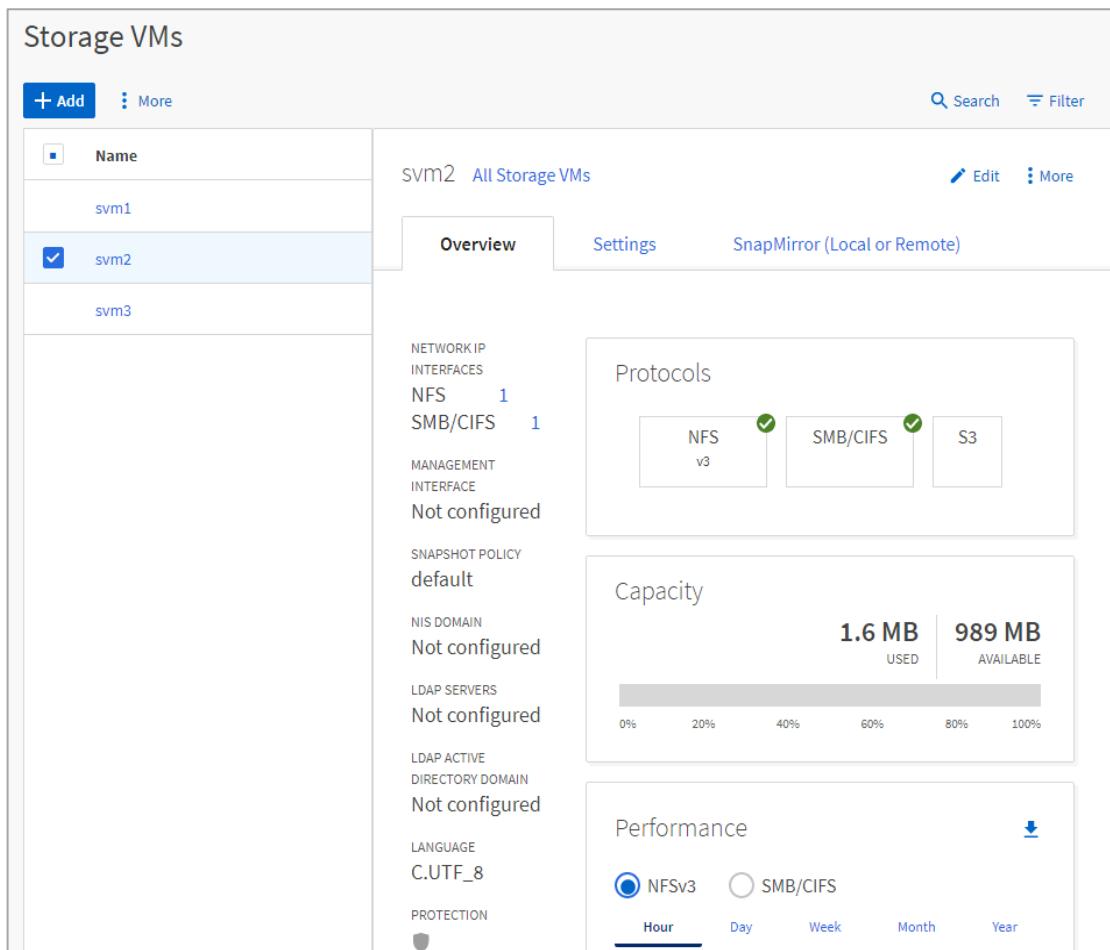
## Task 6: Explore ONTAP System Manager

Step	Action										
6-1	<p><b>i</b> NetApp ONTAP System Manager is not a separate application. System Manager is a management solution that is built in to the ONTAP software.</p> <p>To access System Manager, you open a browser, connect to the cluster management LIF, and authenticate with the cluster admin username and password:</p> <table border="1"><thead><tr><th>System</th><th>Host Name</th><th>IP Address</th><th>User Name</th><th>Password</th></tr></thead><tbody><tr><td>ONTAP cluster management LIF</td><td>cluster1</td><td>192.168.0.101</td><td>admin (case sensitive)</td><td>Netapp1!</td></tr></tbody></table>	System	Host Name	IP Address	User Name	Password	ONTAP cluster management LIF	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!
System	Host Name	IP Address	User Name	Password							
ONTAP cluster management LIF	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!							
6-2	<p>From the Windows Server desktop, access System Manager on cluster1:</p> <ol style="list-style-type: none"><li>Open the Chrome web browser. </li><li>In the address bar, enter the cluster-management LIF IP address: <b>https://192.168.0.101</b></li></ol>										
6-3	<p>If you are prompted, click <b>Advanced</b> and proceed to ONTAP System Manager.</p>  <p>The dialog box contains the following text and options:</p> <p>Your connection is not private</p> <p>Attackers might be trying to steal your information from <b>192.168.0.101</b> (for example, passwords, messages, or credit cards). <a href="#">Learn more</a></p> <p>NET::ERR_CERT_AUTHORITY_INVALID</p> <p><input type="checkbox"/> Automatically send some <a href="#">system information and page content</a> to Google to help detect dangerous apps and sites. <a href="#">Privacy policy</a></p> <p><a href="#">HIDE ADVANCED</a> <a href="#">Back to safety</a></p> <p>This server could not prove that it is <b>192.168.0.101</b>; its security certificate is not trusted by your computer's operating system. This may be caused by a misconfiguration or an attacker intercepting your connection.</p> <p><a href="#">Proceed to 192.168.0.101 (unsafe)</a></p>										

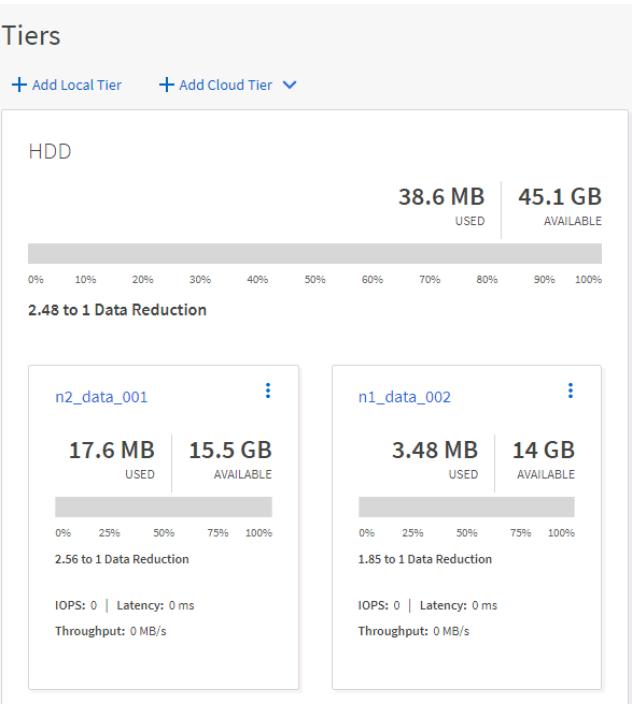
Step	Action
6-4	<p>When the System Manager window opens, enter your login credentials:</p> <ul style="list-style-type: none"> <li>▪ Username: <b>admin</b></li> <li>▪ Password: <b>Netapp1!</b></li> </ul> 
6-5	<p>Review the information on the Dashboard, which is the System Manager landing page:</p> 
6-6	<p>Use the Dashboard to answer the following questions:</p> <ul style="list-style-type: none"> <li>▪ How many nodes are in the cluster? _____</li> <li>▪ How many storage VMs are configured? _____</li> <li>▪ What are the savings from storage efficiency? _____</li> <li>▪ In the Performance panel, which information is presented? _____</li> </ul>

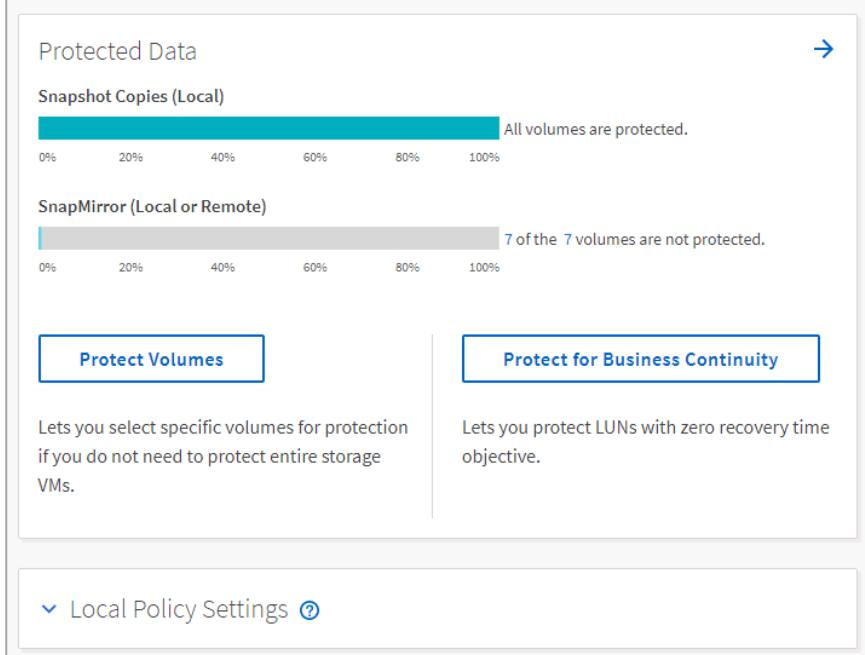
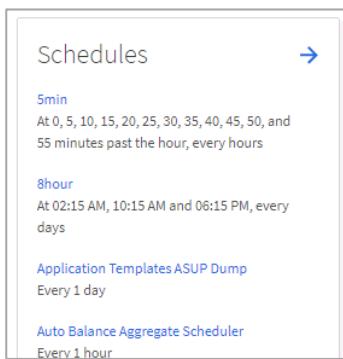
Step	Action
6-7	In the navigation pane on the left, click <b>Storage</b> and select <b>Volumes</b> :
	
6-8	Review the Volumes pane and volume information, and then expand each row by clicking the chevron (“V”) in the first column.
	
6-9	In another browser window, open System Manager on cluster2: <a href="https://192.168.0.102">https://192.168.0.102</a>

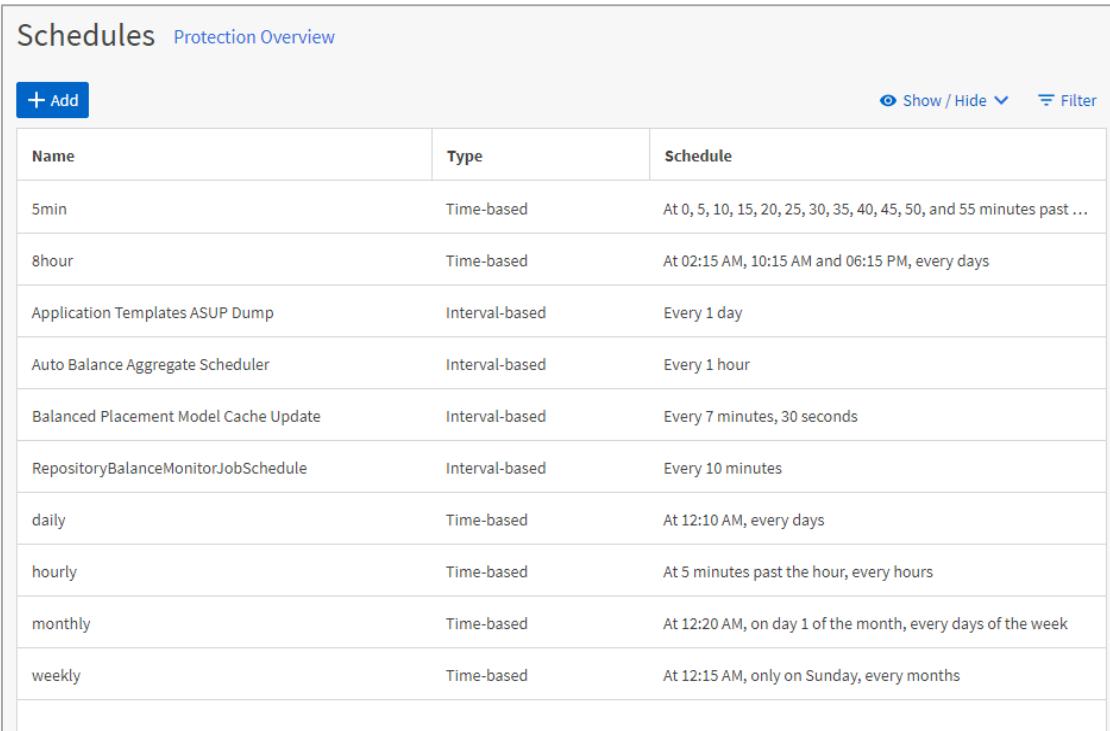
Step	Action																								
6-10	<p>When the System Manager window opens, enter your login credentials:</p> <ul style="list-style-type: none"> <li>▪ User name: <b>admin</b></li> <li>▪ Password: <b>Netapp1!</b></li> </ul> <p> You will need to log a security exception to your web browser.</p>																								
6-11	Compare the menu bars between the two clusters.																								
6-12	<p>Answer the following questions:</p> <ul style="list-style-type: none"> <li>▪ Is there a LUNs tab on the cluster1 Storage menu bar? _____</li> <li>▪ If not, why not?</li> </ul> <hr/>																								
6-13	Return to the System Manager session for <b>cluster1</b> (192.168.0.101).																								
6-14	<p>In the navigation pane on the left, click <b>Storage</b> and then <b>Storage VMs</b>.</p> 																								
6-15	<p>Review the Storage VMs pane.</p>  <table border="1"> <thead> <tr> <th>Name</th> <th>State</th> <th>Subtype</th> <th>Configured Proto...</th> <th>IPspace</th> <th>Protection</th> </tr> </thead> <tbody> <tr> <td>svm1</td> <td>running</td> <td>default</td> <td>SMB/CIFS</td> <td>Default</td> <td>shield icon</td> </tr> <tr> <td>svm2</td> <td>running</td> <td>default</td> <td>NFS, SMB/CIFS</td> <td>Default</td> <td>shield icon</td> </tr> <tr> <td>svm3</td> <td>running</td> <td>default</td> <td>NFS, SMB/CIFS</td> <td>Default</td> <td>shield icon</td> </tr> </tbody> </table>	Name	State	Subtype	Configured Proto...	IPspace	Protection	svm1	running	default	SMB/CIFS	Default	shield icon	svm2	running	default	NFS, SMB/CIFS	Default	shield icon	svm3	running	default	NFS, SMB/CIFS	Default	shield icon
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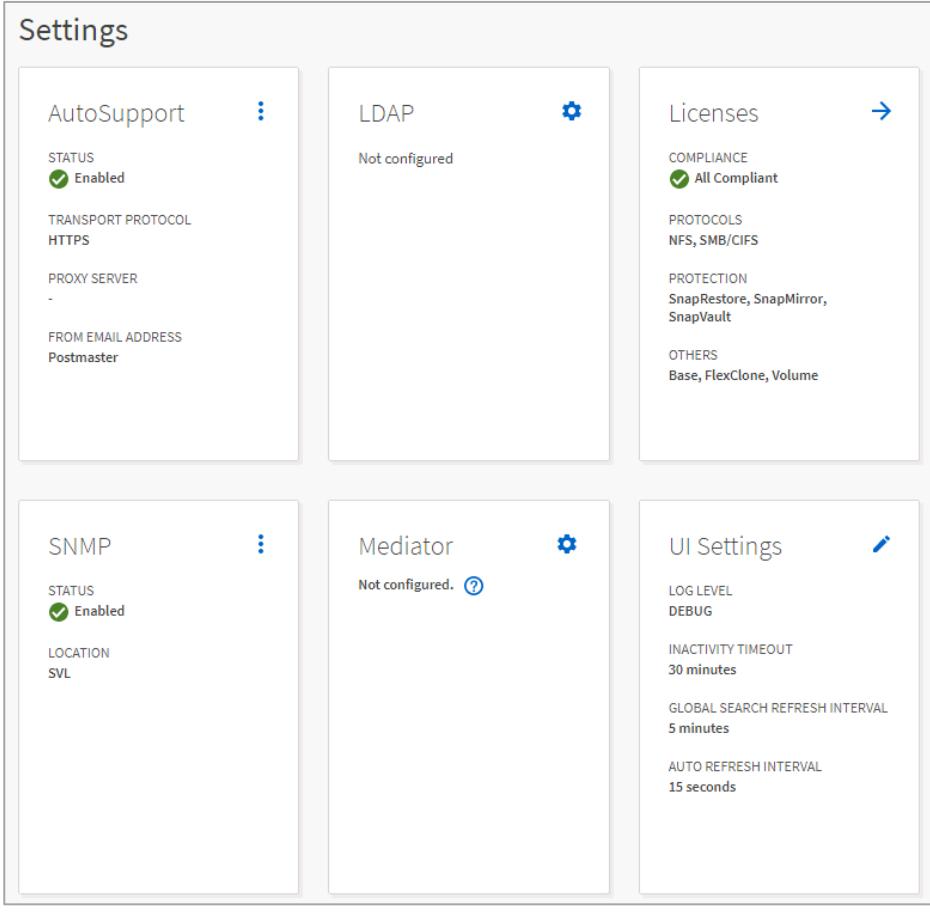
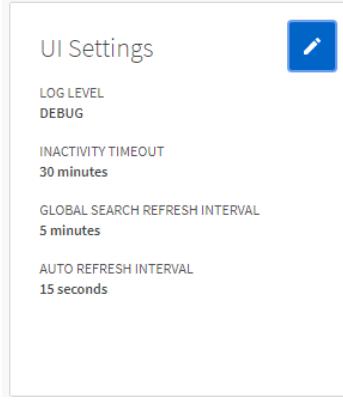
Step	Action
6-16	In the Name column of the SVMs pane, click <b>svm2</b> .
	 <p>The screenshot shows the Storage VMs pane with the following details:</p> <ul style="list-style-type: none"> <li><b>Name:</b> svm2 (selected)</li> <li><b>Protocols:</b> NFS v3 (green checkmark), SMB/CIFS (green checkmark), S3 (disabled)</li> <li><b>Capacity:</b> 1.6 MB USED   989 MB AVAILABLE (80% usage)</li> <li><b>Performance:</b> NFSv3 is selected.</li> </ul>
6-17	On the SVM dashboard, review each pane and answer the following question: Which protocols are enabled for SVM2? _____
6-18	In the navigation pane on the left, click <b>Network</b> , and then click <b>Overview</b> .

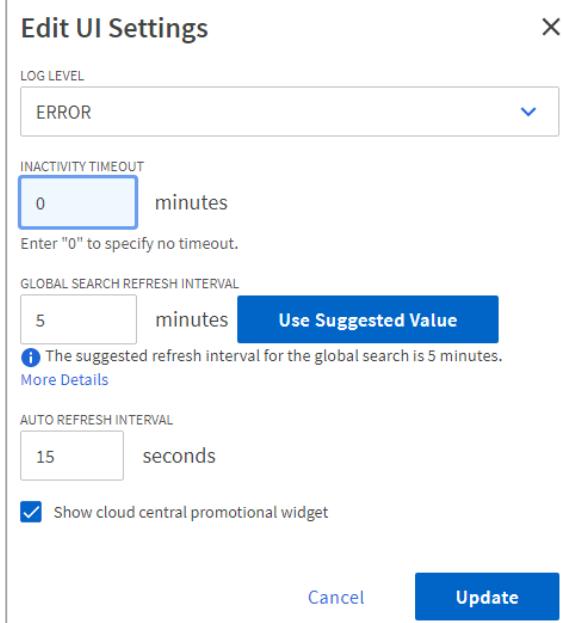
Step	Action																																								
6-19	Review the Network Interfaces pane.																																								
	<p>The screenshot shows a table titled "Network Interfaces" with columns: Name, Storage VM, IPspace, Address, Current ... (partially visible), Current P..., Protocols, and Type. There are search icons for each column. The data rows are:</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Storage VM</th> <th>IPspace</th> <th>Address</th> <th>Current ...</th> <th>Current P...</th> <th>Protocols</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>svm3_cifs_nfs_lif1</td> <td>svm3</td> <td>Default</td> <td>192.168.0.62</td> <td>cluster1-01</td> <td>e0f</td> <td>SMB/CIFS,...</td> <td>Data</td> </tr> <tr> <td>svm1_cifs_lif1</td> <td>svm1</td> <td>Default</td> <td>192.168.0.60</td> <td>cluster1-01</td> <td>e0d</td> <td>SMB/CIFS</td> <td>Data</td> </tr> <tr> <td>cluster1-01_mgmt1</td> <td></td> <td>Default</td> <td>192.168.0....</td> <td>cluster1-01</td> <td>e0c</td> <td></td> <td>Cluster/N...</td> </tr> <tr> <td>cluster1-01_clus2</td> <td></td> <td>Cluster</td> <td>169.254.8...</td> <td>cluster1-01</td> <td>e0b</td> <td></td> <td>Cluster</td> </tr> </tbody> </table>	Name	Storage VM	IPspace	Address	Current ...	Current P...	Protocols	Type	svm3_cifs_nfs_lif1	svm3	Default	192.168.0.62	cluster1-01	e0f	SMB/CIFS,...	Data	svm1_cifs_lif1	svm1	Default	192.168.0.60	cluster1-01	e0d	SMB/CIFS	Data	cluster1-01_mgmt1		Default	192.168.0....	cluster1-01	e0c		Cluster/N...	cluster1-01_clus2		Cluster	169.254.8...	cluster1-01	e0b		Cluster
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cluster1-01_clus2		Cluster	169.254.8...	cluster1-01	e0b		Cluster																																		
6-20	Answer the following question: Which network interfaces belong to svm2?																																								
6-21	In the navigation pane on the left, click <b>Storage</b> , and then <b>Tiers</b> .																																								

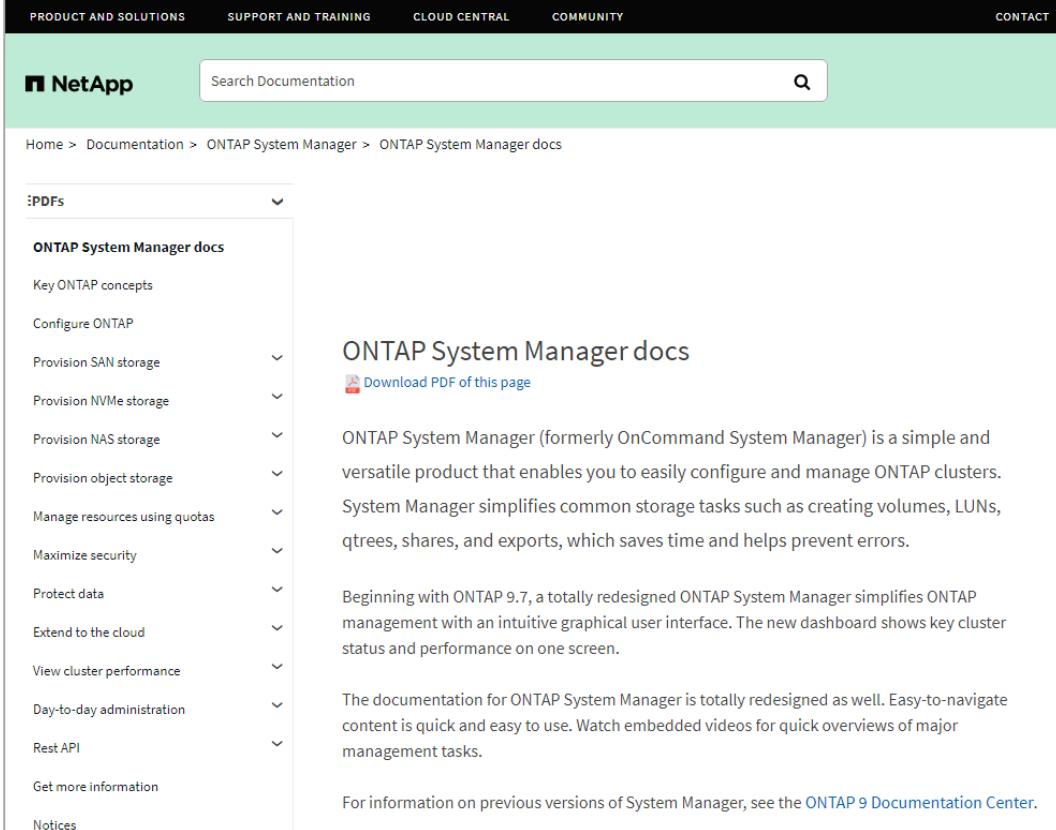
Step	Action
6-22	<p>Review the Tiers page.</p> 
6-23	On the navigation pane, explore the remaining selections under <b>Storage</b> .
6-24	On the navigation pane, click <b>Protection</b> , and then click <b>Overview</b> .

Step	Action
6-25	<p>In the Overview page, expand the Local Policy Setting pane by clicking the chevron.</p>  <p>The screenshot shows the Local Policy Setting pane expanded. It includes two progress bars: one for Snapshot Copies (Local) showing 100% protected, and another for SnapMirror (Local or Remote) showing 70% protected. Below the bars are two buttons: 'Protect Volumes' and 'Protect for Business Continuity'. A dropdown menu labeled 'Local Policy Settings' is also visible.</p>
6-26	<p>Click on the right arrow in the Schedules pane to navigate to the Schedules page.</p>  <p>The screenshot shows the Schedules pane with a list of scheduled tasks: 5min (At 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, and 55 minutes past the hour, every hours), 8hour (At 02:15 AM, 10:15 AM and 06:15 PM, every days), Application Templates ASUP Dump (Every 1 day), and Auto Balance Aggregate Scheduler (Every 1 hour). A right-pointing arrow is located at the top right of the pane.</p>

Step	Action																																	
6-27	<p>Review the Schedules page.</p>  <table border="1"> <thead> <tr> <th>Name</th> <th>Type</th> <th>Schedule</th> </tr> </thead> <tbody> <tr> <td>5min</td> <td>Time-based</td> <td>At 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, and 55 minutes past ...</td> </tr> <tr> <td>8hour</td> <td>Time-based</td> <td>At 02:15 AM, 10:15 AM and 06:15 PM, every days</td> </tr> <tr> <td>Application Templates ASUP Dump</td> <td>Interval-based</td> <td>Every 1 day</td> </tr> <tr> <td>Auto Balance Aggregate Scheduler</td> <td>Interval-based</td> <td>Every 1 hour</td> </tr> <tr> <td>Balanced Placement Model Cache Update</td> <td>Interval-based</td> <td>Every 7 minutes, 30 seconds</td> </tr> <tr> <td>RepositoryBalanceMonitorJobSchedule</td> <td>Interval-based</td> <td>Every 10 minutes</td> </tr> <tr> <td>daily</td> <td>Time-based</td> <td>At 12:10 AM, every days</td> </tr> <tr> <td>hourly</td> <td>Time-based</td> <td>At 5 minutes past the hour, every hours</td> </tr> <tr> <td>monthly</td> <td>Time-based</td> <td>At 12:20 AM, on day 1 of the month, every days of the week</td> </tr> <tr> <td>weekly</td> <td>Time-based</td> <td>At 12:15 AM, only on Sunday, every months</td> </tr> </tbody> </table>	Name	Type	Schedule	5min	Time-based	At 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, and 55 minutes past ...	8hour	Time-based	At 02:15 AM, 10:15 AM and 06:15 PM, every days	Application Templates ASUP Dump	Interval-based	Every 1 day	Auto Balance Aggregate Scheduler	Interval-based	Every 1 hour	Balanced Placement Model Cache Update	Interval-based	Every 7 minutes, 30 seconds	RepositoryBalanceMonitorJobSchedule	Interval-based	Every 10 minutes	daily	Time-based	At 12:10 AM, every days	hourly	Time-based	At 5 minutes past the hour, every hours	monthly	Time-based	At 12:20 AM, on day 1 of the month, every days of the week	weekly	Time-based	At 12:15 AM, only on Sunday, every months
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6-28	<p>On the navigation pane, click <b>Cluster</b>, and then click <b>Settings</b>.</p>  <ul style="list-style-type: none"> <li>DASHBOARD</li> <li>STORAGE ▾</li> <li>NETWORK ▾</li> <li>EVENTS &amp; JOBS ▾</li> <li>PROTECTION ▾</li> <li>HOSTS ▾</li> <li>CLUSTER ▾</li> <li>Overview</li> <li>Settings</li> <li>Disks</li> </ul>																																	

Step	Action
6-29	<p>Explore each of the panels of the Settings page:</p>  <p>The screenshot shows the 'Settings' page with six panels:</p> <ul style="list-style-type: none"> <li><b>AutoSupport</b>: STATUS Enabled (green checkmark), TRANSPORT PROTOCOL HTTPS, PROXY SERVER -, FROM EMAIL ADDRESS Postmaster.</li> <li><b>LDAP</b>: Not configured.</li> <li><b>Licenses</b>: COMPLIANCE All Compliant (green checkmark), PROTOCOLS NFS, SMB/CIFS, PROTECTION SnapRestore, SnapMirror, SnapVault, OTHERS Base, FlexClone, Volume.</li> <li><b>SNMP</b>: STATUS Enabled (green checkmark), LOCATION SVL.</li> <li><b>Mediator</b>: Not configured. (blue question mark icon).</li> <li><b>UI Settings</b>: LOG LEVEL DEBUG, INACTIVITY TIMEOUT 30 minutes, GLOBAL SEARCH REFRESH INTERVAL 5 minutes, AUTO REFRESH INTERVAL 15 seconds. A blue pencil icon is located at the top right of this panel.</li> </ul>
6-30	<p>Click the pencil (Edit) icon the UI Settings panel.</p>  <p>The screenshot shows the 'UI Settings' panel with four settings and edit icons:</p> <ul style="list-style-type: none"> <li>LOG LEVEL DEBUG</li> <li>INACTIVITY TIMEOUT 30 minutes</li> <li>GLOBAL SEARCH REFRESH INTERVAL 5 minutes</li> <li>AUTO REFRESH INTERVAL 15 seconds</li> </ul>

Step	Action
6-31	<p>Disable automatic logout due to inactivity by setting the inactivity timeout to 0 minutes.</p>  <p><b>Disabling automatic logout weakens security and should never be done outside of training environments.</b></p>
6-32	Click <b>Update</b> .
6-33	 <p>For help about any System Manager command, on the menu bar, click the Help (“?”) icon:</p> 

Step	Action
6-34	<p>On the menu bar, click <b>Help</b>, and then explore the ONTAP System Manager documentation:</p>  <p>The screenshot shows the NetApp Documentation website. At the top, there are navigation links: PRODUCT AND SOLUTIONS, SUPPORT AND TRAINING, CLOUD CENTRAL, COMMUNITY, and CONTACT. Below the header is a search bar with the placeholder "Search Documentation". The main content area shows the "ONTAP System Manager docs" page. The left sidebar has a dropdown menu set to "PDFs" which lists various ONTAP System Manager topics. The right panel contains the main content for "ONTAP System Manager docs", which includes a "Download PDF of this page" link, a brief description of the product, and links to more detailed information about its features and documentation.</p>

## End of Exercise

# Module 3: Cluster Management

## Exercise 1: Managing ONTAP Clusters and Administrators

### Objectives

This exercise focuses on enabling you to do the following:

- Create a login banner and a message of the day (MOTD)
- Explore licenses
- Configure cluster time and assign a Network Time Protocol (NTP) server
- Create custom administrators and verify access levels

### Case Study

Before you bring the new NetApp ONTAP cluster into production at Zarrot Industries, you need to perform some initial configuration tasks. You create a message of the day file to warn away unauthorized users. Next, you synchronize the cluster clock with the environment as needed by the authentication protocols. Last, you create some user accounts with which to administer the system.

### Exercise Equipment

In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!
Windows Domain Controller	DC1	192.168.0.253	DEMO\Administrator	Netapp1!

### Task 1: Create a Login Banner and MOTD

Step	Action
1-1	Start a PuTTY session with <b>cluster1</b> .
1-2	View the current clusterwide login banner: <b>security login banner show</b> Sample output: The login banner has not been configured for the cluster or any data Vserver.
1-3	Change the clusterwide login banner: <b>security login banner modify -message "Authorized users ONLY!"</b>

Step	Action																
1-4	<p>View the current clusterwide MOTD:</p> <pre><b>security login motd show</b></pre> <p>Sample output:</p> <p>The message of the day has not been configured for the cluster or any data Vserver.</p>																
1-5	<p>Enter interactive mode to change the login MOTD for the entire cluster1 cluster:</p> <pre><b>security login motd modify -vserver cluster1</b></pre> <p>Sample output:</p> <p>Enter the message of the day for Vserver "cluster1". Max size: 2048. Enter a blank line to terminate input. Press Ctrl-C to abort.</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> <tr> <td>1234567890123456789012345678901234567890123456789012345678901234567890</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> <p><b>NOTE:</b> This command is case-sensitive.</p>	0	1	2	3	4	5	6	7	1234567890123456789012345678901234567890123456789012345678901234567890							
0	1	2	3	4	5	6	7										
1234567890123456789012345678901234567890123456789012345678901234567890																	
1-6	<p>Enter (or paste) the following case-sensitive text:</p> <pre>##### # Operating System Name = \s # Software Release      = \r # Node                  = \n #####</pre>																
1-7	 A blank line is required to exit interactive mode.																
1-8	Open a second PuTTY session to cluster1 and then observe the login banner and MOTD.																
1-9	<p>Reset the cluster-wide login banner to the default:</p> <pre><b>security login banner modify -message ""</b></pre> <p><b>NOTE:</b> This command is case-sensitive.</p>																
1-10	<p>Reset the login MOTD to the default:</p> <pre><b>security login motd modify -vserver cluster1 -message ""</b></pre>																

## Task 2: Explore Licensing

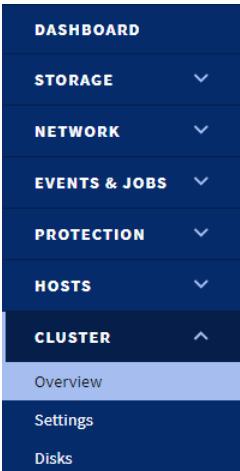
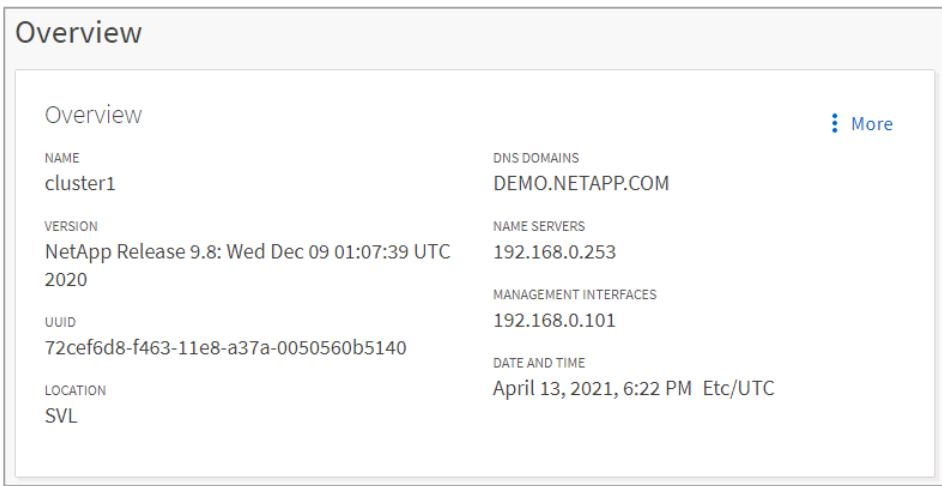
Step	Action
2-1	<p>From NetApp ONTAP System Manager for cluster1, in the navigation pane, select: <b>Cluster &gt; Settings</b>.</p>
2-2	Click the arrow in the Licenses panel and explore the licenses that are installed on the cluster.
2-3	Switch back to the cluster management Secure Shell (SSH) PuTTY session and if necessary, authenticate as <b>admin</b> .
2-4	<p>View the cluster serial ID:</p> <pre>cluster identity show</pre> <p>Sample output:</p> <pre>Cluster UUID: 05c4d787-7bc8-11e6-a812-0050560b5140 Cluster Name: cluster1 Cluster Serial Number: 1-80-000011 Cluster Location: SVL Cluster Contact:</pre> <p><b>NOTE:</b> In the sample output, the serial number is 1-80-000011.</p>

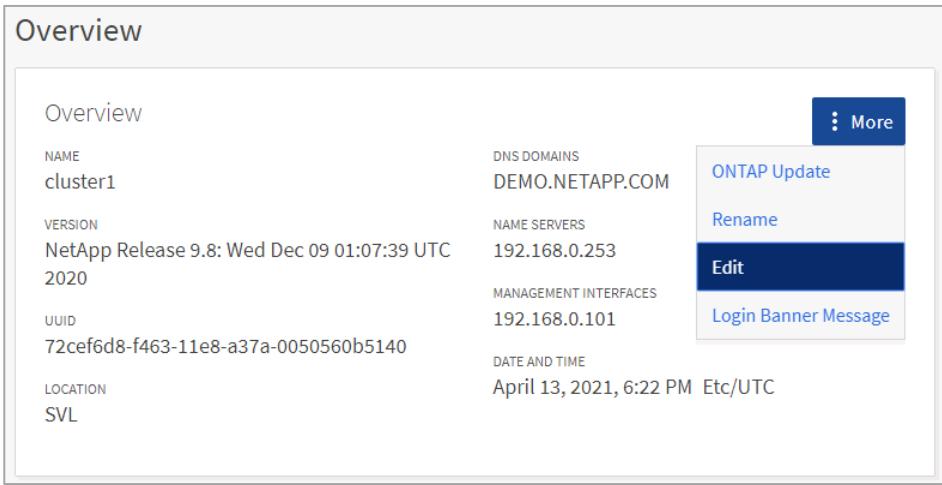
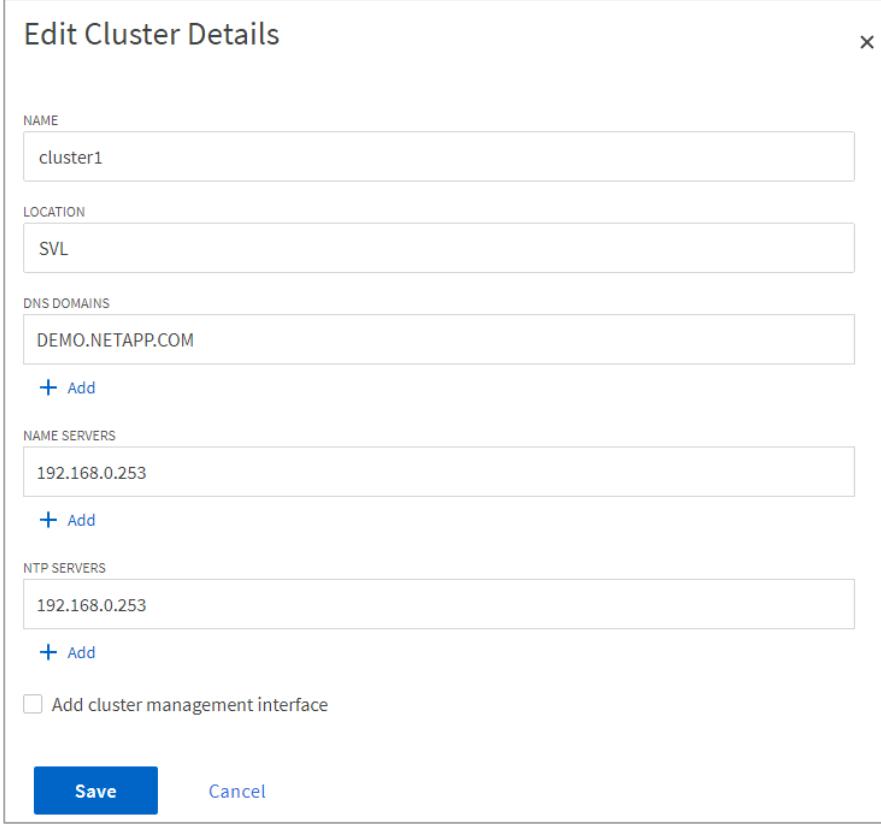
Step	Action																						
<b>2-5</b>	<p>Identify the serial numbers for each system in the cluster:</p> <pre>system node show -fields node,serialnumber</pre> <p>Sample output:</p> <pre>node      serialnumber ----- ----- cluster1-01 70 cluster1-02 71 2 entries were displayed.</pre>																						
<b>2-6</b>	<p>Navigate to the license hierarchy:</p> <pre>license</pre> <p>The prompt indicates that you are in the <code>system license</code> command hierarchy:</p> <pre>cluster1::system license&gt;</pre>																						
<b>2-7</b>	<p>List the available commands:</p> <pre>cluster1::system license&gt; ?</pre> <p>Sample output:</p> <table> <tbody> <tr> <td>add</td> <td>Add one or more licenses</td> </tr> <tr> <td>capacity&gt;</td> <td>(DEPRECATED) -The capacity directory</td> </tr> <tr> <td>clean-up</td> <td>Remove unnecessary licenses</td> </tr> <tr> <td>delete</td> <td>Delete a license</td> </tr> <tr> <td>entitlement-risk&gt;</td> <td>The entitlement-risk directory</td> </tr> <tr> <td>show</td> <td>Display licenses</td> </tr> <tr> <td>show-aggregates</td> <td>Display status of aggregates leases and license used.</td> </tr> <tr> <td>show-serial-numbers</td> <td>Display History of Serial Numbers</td> </tr> <tr> <td>show-status</td> <td>Display license status</td> </tr> <tr> <td>status&gt;</td> <td>(DEPRECATED) -Display license status</td> </tr> <tr> <td>update-leases</td> <td>Begin lease reconciliation</td> </tr> </tbody> </table>	add	Add one or more licenses	capacity>	(DEPRECATED) -The capacity directory	clean-up	Remove unnecessary licenses	delete	Delete a license	entitlement-risk>	The entitlement-risk directory	show	Display licenses	show-aggregates	Display status of aggregates leases and license used.	show-serial-numbers	Display History of Serial Numbers	show-status	Display license status	status>	(DEPRECATED) -Display license status	update-leases	Begin lease reconciliation
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status>	(DEPRECATED) -Display license status																						
update-leases	Begin lease reconciliation																						
<b>2-8</b>	<p>View the currently licensed packages, and note the node-locked licenses that are already installed on the cluster:</p> <pre>cluster1::system license&gt; show</pre>																						
<b>2-9</b>	<p>List detailed information about the available license packages:</p> <pre>cluster1::system license&gt; show-status</pre>																						

## Task 3: Configure Cluster Time and Assign an NTP Server

In this task, you synchronize date and time between the ONTAP clusters and the Windows domain controller.

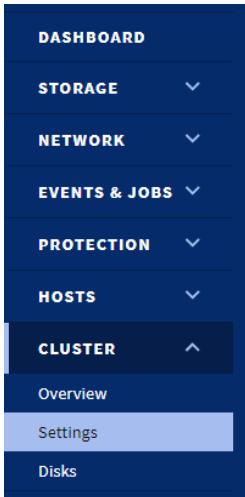
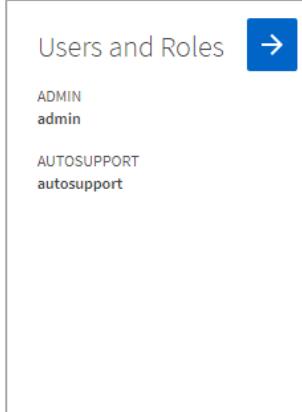
Step	Action
<b>3-1</b>	 <p>Windows domains must be synchronized to within 5 minutes of all member servers.</p> <p>If the time of the ONTAP cluster is not synchronized with a domain controller, the ONTAP cluster cannot join or remain joined to the Windows domain.</p> <p>Without synchronization, computers in the Windows domain cannot access resources in the ONTAP cluster, and resources in the cluster cannot access the Windows domain.</p>

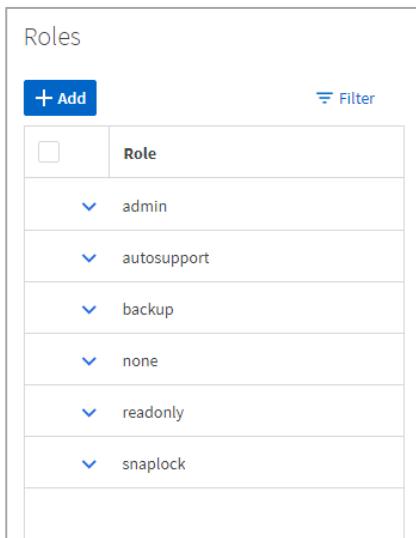
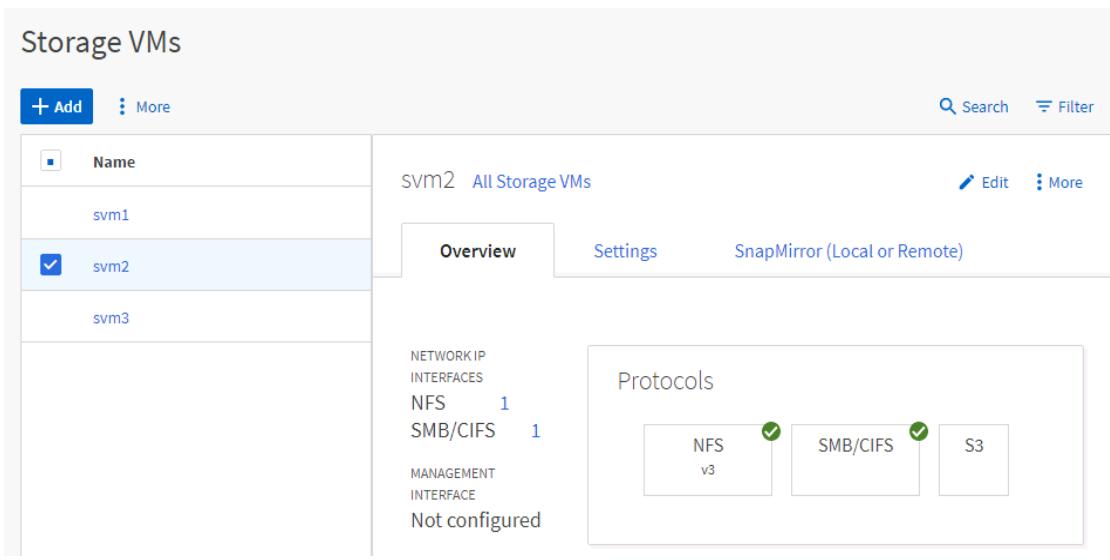
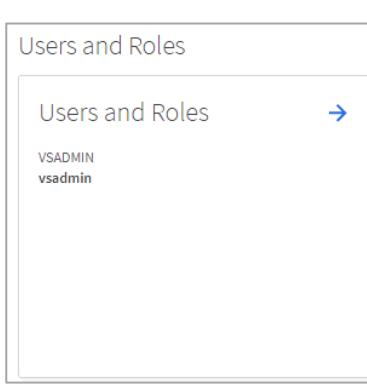
Step	Action
3-2	<p>From System Manager for cluster1, select <b>Cluster &gt; Overview</b>.</p> 
3-3	<p>In the Cluster Overview page, note the cluster date and time.</p> 
3-4	<p><b>i</b> The system date and time for computers in your exercise kit are presynchronized. The Windows and Linux systems are set to Pacific Time. The clusters are set to UTC.</p>

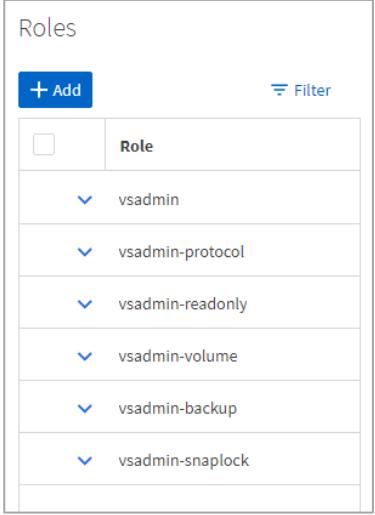
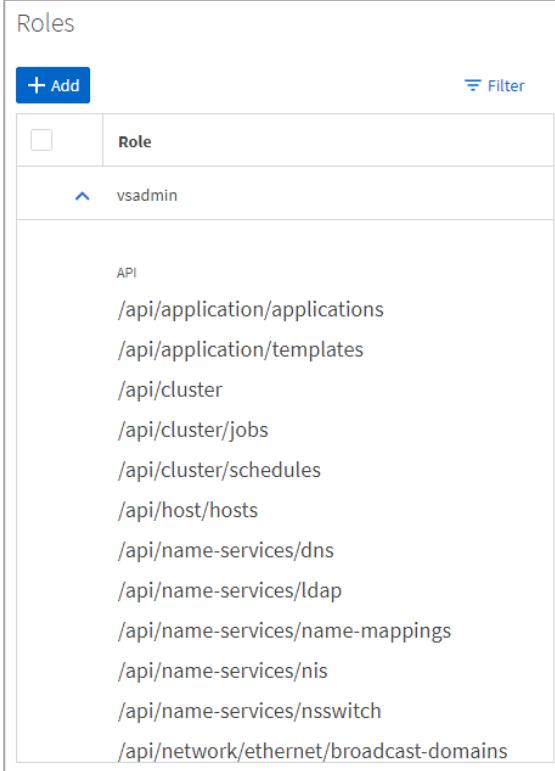
Step	Action
3-5	<p>In the Cluster Overview page, select <b>Edit</b> from the more menu.</p> 
3-6	<p>Under NTP SERVERS, click the <b>Add</b> button.</p>
3-7	<p>Set the NTP time server to <b>192.168.0.253</b>, and then click <b>Save</b>.</p> 
3-8	<p>From the clustershell, verify the date, time, time zone, and synchronization of the time with your Windows jump host to within 5 minutes:</p> <p><b>date</b></p> <p><b>Note:</b> Time synchronization might take several minutes.</p>

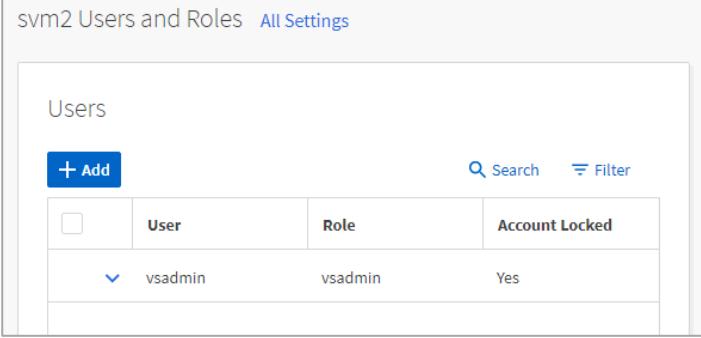
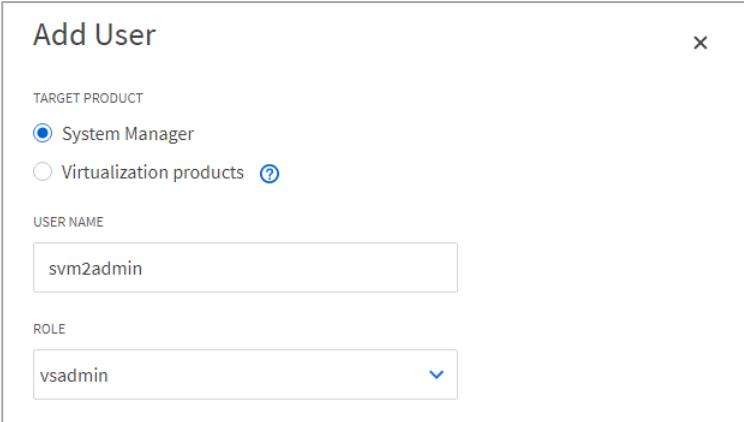
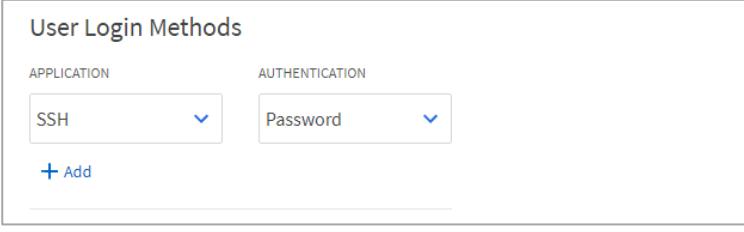
Step	Action
<b>3-9</b>	Confirm the NTP server settings that you set in System Manager: <code>ntp server show</code>
<b>3-10</b>	Repeat steps 3-2 through 3-9 on cluster2.

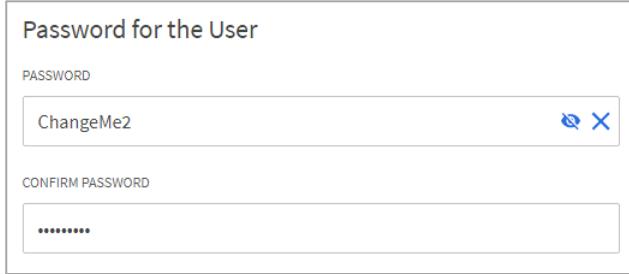
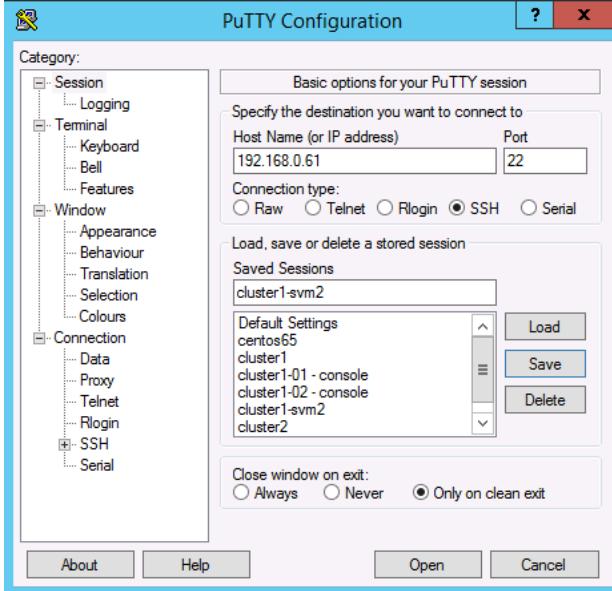
## Task 4: Create Custom Administrators and Verify Access Levels

Step	Action
<b>4-1</b>	From NetApp ONTAP System Manager for cluster1, in the navigation pane, select <b>Cluster &gt; Settings</b> .  
<b>4-2</b>	Scroll down in the Cluster Settings page and click the arrow in the <b>Users and Roles</b> pane.  

Step	Action
4-3	Explore the cluster-scoped predefined roles.
	
4-4	Navigate to the <b>Storage &gt; Storage VMs</b> page.
4-5	Click <b>svm2</b> , and then the <b>Settings</b> tab.
	
4-6	Scroll down in the svm2 Settings page, and click on the arrow in the Users and Roles pane.
	

Step	Action													
4-7	<p>Examine the storage VM (SVM)-scoped predefined roles.</p> 													
4-8	<p>Expand an SVM-scoped administrative role, and then scroll through the API list to see the ONTAP API calls that are available to a user who has the role.</p>  <table border="1"> <thead> <tr> <th data-bbox="409 1079 434 1100">API</th> </tr> </thead> <tbody> <tr> <td data-bbox="409 1121 670 1142">/api/application/applications</td> </tr> <tr> <td data-bbox="409 1163 654 1184">/api/application/templates</td> </tr> <tr> <td data-bbox="409 1205 507 1227">/api/cluster</td> </tr> <tr> <td data-bbox="409 1248 556 1269">/api/cluster/jobs</td> </tr> <tr> <td data-bbox="409 1290 605 1311">/api/cluster/schedules</td> </tr> <tr> <td data-bbox="409 1332 540 1353">/api/host/hosts</td> </tr> <tr> <td data-bbox="409 1374 621 1396">/api/name-services/dns</td> </tr> <tr> <td data-bbox="409 1417 621 1438">/api/name-services/ldap</td> </tr> <tr> <td data-bbox="409 1459 736 1480">/api/name-services/name-mappings</td> </tr> <tr> <td data-bbox="409 1501 605 1522">/api/name-services/nis</td> </tr> <tr> <td data-bbox="409 1543 670 1564">/api/name-services/nsswitch</td> </tr> <tr> <td data-bbox="409 1586 801 1607">/api/network/ethernet/broadcast-domains</td> </tr> </tbody> </table>	API	/api/application/applications	/api/application/templates	/api/cluster	/api/cluster/jobs	/api/cluster/schedules	/api/host/hosts	/api/name-services/dns	/api/name-services/ldap	/api/name-services/name-mappings	/api/name-services/nis	/api/name-services/nsswitch	/api/network/ethernet/broadcast-domains
API														
/api/application/applications														
/api/application/templates														
/api/cluster														
/api/cluster/jobs														
/api/cluster/schedules														
/api/host/hosts														
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Step	Action
4-9	<p>In the Users pane of the svm2 Users and Roles page, create a user by clicking <b>Add</b>.</p> 
4-10	<p>In the Add User dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ User Name: <b>svm2admin</b></li> <li>▪ Role: <b>vsadmin</b></li> </ul> 
4-11	<p>In the User Login Methods pane, use the pull-down lists to specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Application: <b>SSH</b></li> <li>▪ Authentication: <b>Password</b></li> </ul> 

Step	Action
4-12	<p>Assign a password to the new user account.</p> <ul style="list-style-type: none"> <li>▪ Password: <b>ChangeMe2</b></li> <li>▪ Confirm Password: <b>ChangeMe2</b></li> </ul> 
4-13	At the bottom of the window, click <b>Save</b> .
4-14	Repeat Step 4-9 through Step 4-13 for the user name <b>svm2intern</b> , the password <b>ChangeMe2</b> , the application <b>SSH</b> , and the role <b>vsadmin-readonly</b> .
4-15	<p>Use PuTTY to start an SSH session to the <b>svm2</b> data LIF that is management-enabled (IP address <b>192.168.0.61</b>), and log in as <b>svm2admin</b>.</p> 
4-16	<p>Examine the command prompt, and then answer the following question:</p> <p>What is different about the command prompt? _____</p>
4-17	<p>Try to display the status of the cluster:</p> <pre>cluster show</pre> <p>Answer the following question:</p> <p>Why does the command fail? _____</p>
4-18	<p>Examine the available commands:</p> <pre>?</pre>

Step	Action
<b>4-19</b>	Display all the available volumes and observe the SVMs that are represented in the output: <code>volume show</code>
<b>4-20</b>	Modify a volume: <code>volume modify -volume smb2_share_CIFS_volume -comment "modified by svm2admin"</code>
<b>4-21</b>	Verify the change: <code>volume show -volume smb2_share_CIFS_volume -fields comment</code>
<b>4-22</b>	Use PuTTY to start another SSH session to the same data LIF, and then log in as <b>svm2intern</b> .
<b>4-23</b>	Try to display the network ports: <code>network port show</code> <b>Note:</b> The command fails.
<b>4-24</b>	Complete the following steps: <ol style="list-style-type: none"> <li>Display the network interfaces.</li> <li>Examine the displayed LIFs.</li> <li>Compare the list to the list of displayed LIFs for the cluster admin user.</li> </ol> <code>network interface show</code>
<b>4-25</b>	Try to modify a volume, and then answer the following question: <code>volume modify -volume smb2_share_CIFS_volume -comment "modified by svm2intern"</code> Why did the command fail? _____
<b>4-26</b>	Close both svm2 administrative PuTTY sessions.

#### End of Exercise

# Module 4: Network Management

## Exercise 1: Managing Physical and Logical Network Resources

In this exercise, you manage physical and logical network resources, including Ethernet ports, interface groups, and virtual LANs (VLANs).

### Objectives

This exercise enables you to do the following:

- Create an interface group
- Create a VLAN

### Case Study

The IT department at Zarrot Industries uses network trunking and VLANs to maximize efficiency of the IT capital equipment budget.

To optimize the use of the physical network ports of the cluster you aggregate the network links. You then create the VLAN tags to match the VLANs that are defined in the IT environment and assign them to the aggregated network links.

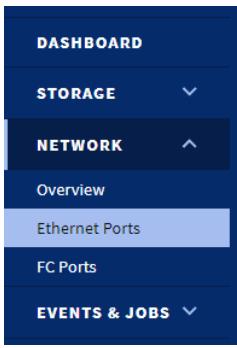
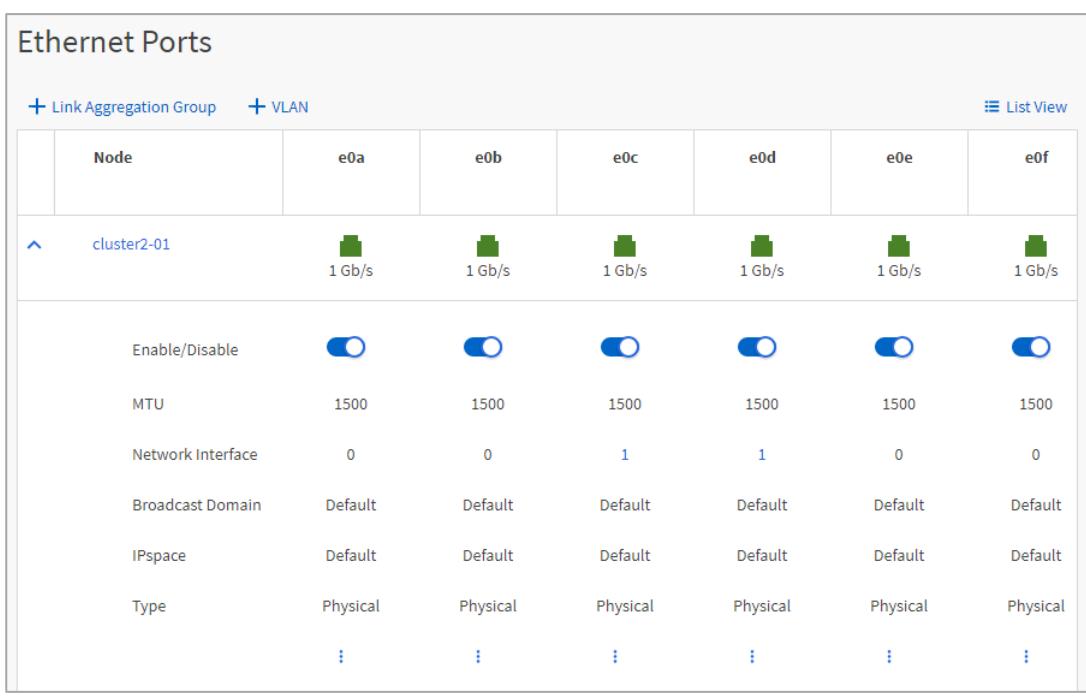
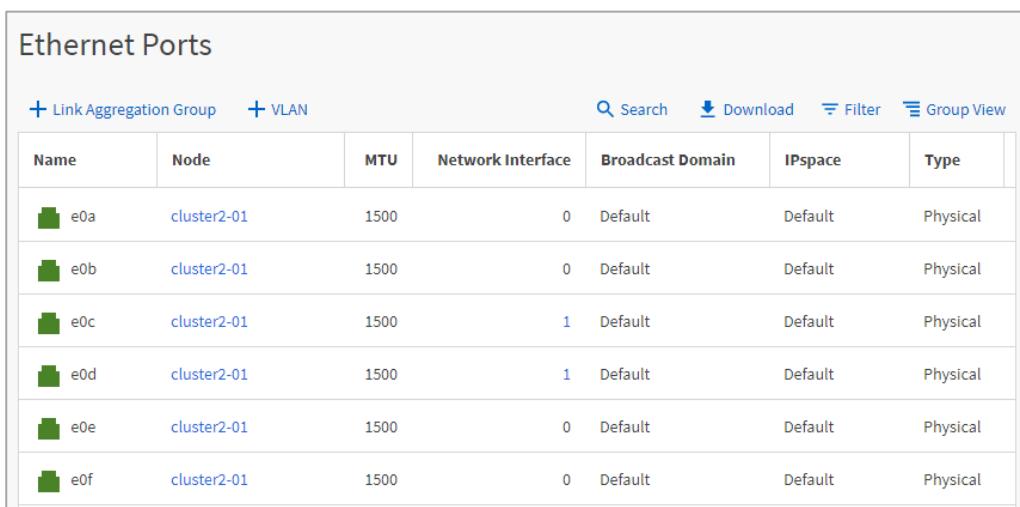
### Exercise Equipment

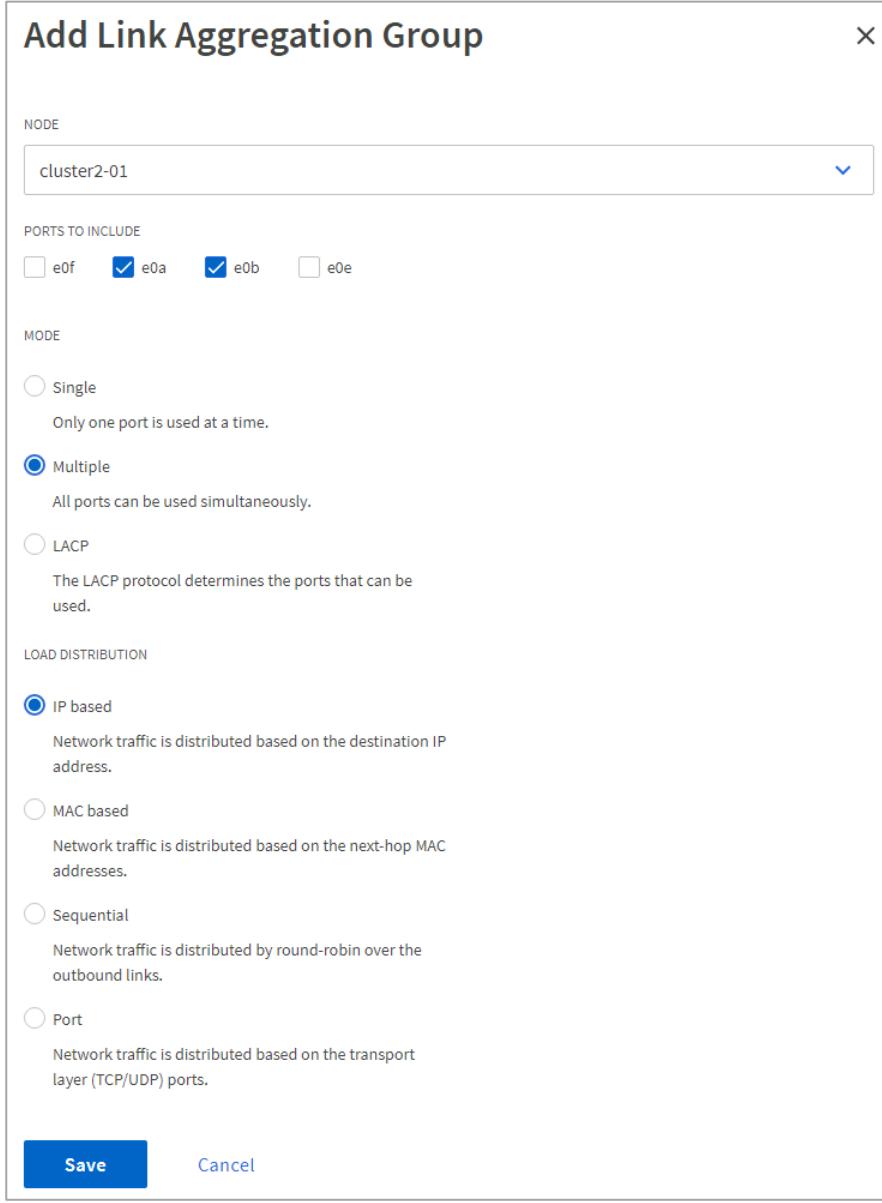
In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case-sensitive)	Netapp1!

### Task 1: Create an Interface Group

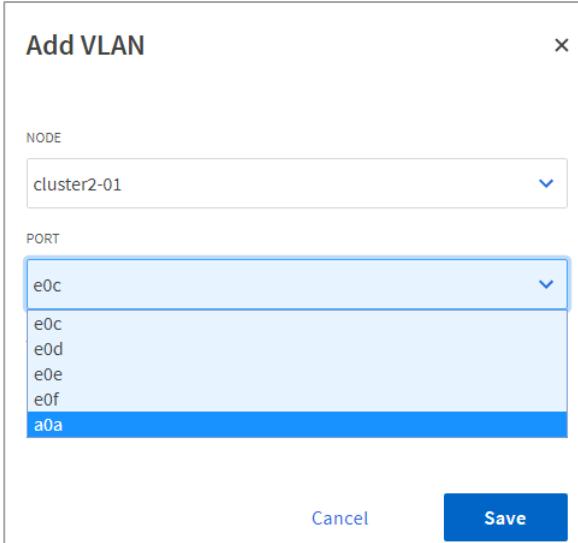
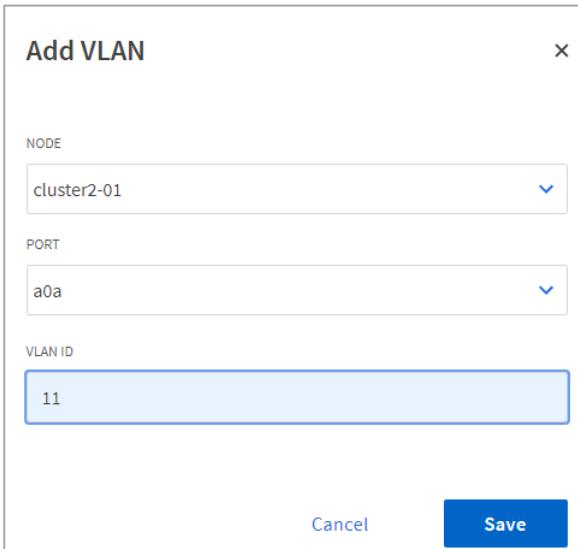
Step	Action
1-1	From the Windows Server desktop, access ONTAP System Manager on <b>cluster2</b> by following these steps: <ul style="list-style-type: none"><li>• Open a web browser.</li><li>• In the address bar, enter the cluster-management LIF IP address <a href="https://192.168.0.102/">https://192.168.0.102/</a></li></ul>
1-2	When the System Manager window opens, enter the following credentials: <ul style="list-style-type: none"><li>• User name: <b>admin</b></li><li>• Password: <b>Netapp1!</b></li></ul>

Step	Action																																																															
1-3	<p>On the navigation menu, click <b>Network</b>, and then click <b>Ethernet Ports</b>.</p> 																																																															
1-4	<p>In the Ethernet Ports pane, expand the cluster node cluster2-01:</p>  <table border="1"> <thead> <tr> <th>Node</th> <th>e0a</th> <th>e0b</th> <th>e0c</th> <th>e0d</th> <th>e0e</th> <th>e0f</th> </tr> </thead> <tbody> <tr> <td>cluster2-01</td> <td>1 Gb/s</td> <td>1 Gb/s</td> <td>1 Gb/s</td> <td>1 Gb/s</td> <td>1 Gb/s</td> <td>1 Gb/s</td> </tr> <tr> <td>Enable/Disable</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>MTU</td> <td>1500</td> <td>1500</td> <td>1500</td> <td>1500</td> <td>1500</td> <td>1500</td> </tr> <tr> <td>Network Interface</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Broadcast Domain</td> <td>Default</td> <td>Default</td> <td>Default</td> <td>Default</td> <td>Default</td> <td>Default</td> </tr> <tr> <td>IPspace</td> <td>Default</td> <td>Default</td> <td>Default</td> <td>Default</td> <td>Default</td> <td>Default</td> </tr> <tr> <td>Type</td> <td>Physical</td> <td>Physical</td> <td>Physical</td> <td>Physical</td> <td>Physical</td> <td>Physical</td> </tr> <tr> <td>⋮</td> <td>⋮</td> <td>⋮</td> <td>⋮</td> <td>⋮</td> <td>⋮</td> <td>⋮</td> </tr> </tbody> </table>	Node	e0a	e0b	e0c	e0d	e0e	e0f	cluster2-01	1 Gb/s	1 Gb/s	1 Gb/s	1 Gb/s	1 Gb/s	1 Gb/s	Enable/Disable	<input checked="" type="checkbox"/>	MTU	1500	1500	1500	1500	1500	1500	Network Interface	0	0	1	1	0	0	Broadcast Domain	Default	Default	Default	Default	Default	Default	IPspace	Default	Default	Default	Default	Default	Default	Type	Physical	Physical	Physical	Physical	Physical	Physical	⋮	⋮	⋮	⋮	⋮	⋮	⋮					
Node	e0a	e0b	e0c	e0d	e0e	e0f																																																										
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MTU	1500	1500	1500	1500	1500	1500																																																										
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⋮	⋮	⋮	⋮	⋮	⋮	⋮																																																										
1-5	<p>Click <b>List View</b> to display information about the Ethernet ports in a different format.</p>  <table border="1"> <thead> <tr> <th>Name</th> <th>Node</th> <th>MTU</th> <th>Network Interface</th> <th>Broadcast Domain</th> <th>IPspace</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>e0a</td> <td>cluster2-01</td> <td>1500</td> <td>0</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td>e0b</td> <td>cluster2-01</td> <td>1500</td> <td>0</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td>e0c</td> <td>cluster2-01</td> <td>1500</td> <td>1</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td>e0d</td> <td>cluster2-01</td> <td>1500</td> <td>1</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td>e0e</td> <td>cluster2-01</td> <td>1500</td> <td>0</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td>e0f</td> <td>cluster2-01</td> <td>1500</td> <td>0</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> </tbody> </table>	Name	Node	MTU	Network Interface	Broadcast Domain	IPspace	Type	e0a	cluster2-01	1500	0	Default	Default	Physical	e0b	cluster2-01	1500	0	Default	Default	Physical	e0c	cluster2-01	1500	1	Default	Default	Physical	e0d	cluster2-01	1500	1	Default	Default	Physical	e0e	cluster2-01	1500	0	Default	Default	Physical	e0f	cluster2-01	1500	0	Default	Default	Physical														
Name	Node	MTU	Network Interface	Broadcast Domain	IPspace	Type																																																										
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e0f	cluster2-01	1500	0	Default	Default	Physical																																																										

Step	Action
1-6	Click + Link Aggregation Group.
1-7	<p>In the Add Link Aggregation Group dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>Node: cluster2-01 (default)</li> <li>e0a: <b>selected</b></li> <li>e0b: <b>selected</b></li> <li>Mode: <b>Multiple</b></li> <li>Load distribution: IP based (default)</li> </ul> 
1-8	<p>Answer the following question:</p> <p>Why are Ethernet ports e0c and e0d not included in the Ports to include list?</p>
1-9	Click Save.

Step	Action																																																															
1-10	<p>Use the Ethernet ports pane to answer the following questions:</p> <p>What name has been automatically assigned to the new link aggregation group?</p> <p>To which broadcast domain and IPspace has the new link aggregation group been assigned to?</p> <p>To which broadcast domain and IPspace have ports e0a and e0b been assigned to?</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <p><b>Ethernet Ports</b></p> <div style="display: flex; justify-content: space-between; align-items: center;"> <span><a href="#">Link Aggregation Group</a></span> <span><a href="#">VLAN</a></span> <span><a href="#">Search</a></span> <span><a href="#">Download</a></span> <span><a href="#">Filter</a></span> <span><a href="#">Group View</a></span> </div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Name</th> <th>Node</th> <th>MTU</th> <th>Network Interface</th> <th>Broadcast Domain</th> <th>IPspace</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td> a0a</td> <td>cluster2-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default-1</td> <td>Default</td> <td>Link Aggregation Group</td> </tr> <tr> <td> e0a</td> <td>cluster2-01</td> <td>1500</td> <td></td> <td>0</td> <td></td> <td></td> <td>Physical</td> </tr> <tr> <td> e0b</td> <td>cluster2-01</td> <td>1500</td> <td></td> <td>0</td> <td></td> <td></td> <td>Physical</td> </tr> <tr> <td> e0c</td> <td>cluster2-01</td> <td>1500</td> <td></td> <td>1</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td> e0d</td> <td>cluster2-01</td> <td>1500</td> <td></td> <td>1</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td> e0e</td> <td>cluster2-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td> e0f</td> <td>cluster2-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> </tbody> </table> </div>	Name	Node	MTU	Network Interface	Broadcast Domain	IPspace	Type	a0a	cluster2-01	1500		0	Default-1	Default	Link Aggregation Group	e0a	cluster2-01	1500		0			Physical	e0b	cluster2-01	1500		0			Physical	e0c	cluster2-01	1500		1	Default	Default	Physical	e0d	cluster2-01	1500		1	Default	Default	Physical	e0e	cluster2-01	1500		0	Default	Default	Physical	e0f	cluster2-01	1500		0	Default	Default	Physical
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e0e	cluster2-01	1500		0	Default	Default	Physical																																																									
e0f	cluster2-01	1500		0	Default	Default	Physical																																																									
1-11	 <p>There is a delay as the interface group is enabled and the new broadcast domain is created. Wait for the System Manager UI to refresh (every 15 seconds) or toggle between list view and group view.</p>																																																															
1-12	 <p>You will not be able to create a VLAN on the new interface group until System Manager finishes creating the new broadcast domain.</p>																																																															

## Task 2: Create a VLAN

Step	Action
2-1	On the Ethernet Ports page, click + VLAN.
2-2	In the Add VLAN dialog box, select port <b>a0a</b> on node <b>cluster2-01</b> to host the VLAN. 
2-3	Enter <b>11</b> for the VLAN ID, then click <b>Save</b> . 
2-4	Repeat Steps 2-1 through 2-3 to create VLANs on port a0a with VLAN IDs of 22 and 33.

Step	Action																																																																																							
2-5	<p>Use the Ethernet ports pane to answer the following questions:</p> <p>What names have been automatically assigned to the new VLANs?</p> <p>To which broadcast domain and IPspace have the new VLANs been assigned?</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <h3>Ethernet Ports</h3> <div style="display: flex; justify-content: space-between; font-weight: bold; font-size: 0.9em; margin-bottom: 5px;"> <span><a href="#">Link Aggregation Group</a></span> <span><a href="#">VLAN</a></span> <span><a href="#">Search</a></span> <span><a href="#">Download</a></span> <span><a href="#">Filter</a></span> <span><a href="#">Group View</a></span> </div> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Name</th> <th>Node</th> <th>MTU</th> <th>Network Interface</th> <th>Broadcast Domain</th> <th>IPspace</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>a0a</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default-1</td> <td>Default</td> <td>Link Aggregation Group</td> </tr> <tr> <td>a0a-11</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default-2</td> <td>Default</td> <td>VLAN</td> </tr> <tr> <td>a0a-22</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default-3</td> <td>Default</td> <td>VLAN</td> </tr> <tr> <td>a0a-33</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default-4</td> <td>Default</td> <td>VLAN</td> </tr> <tr> <td>e0a</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>0</td> <td></td> <td></td> <td>Physical</td> </tr> <tr> <td>e0b</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>0</td> <td></td> <td></td> <td>Physical</td> </tr> <tr> <td>e0c</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>1</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td>e0d</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>1</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td>e0e</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> <tr> <td>e0f</td> <td>clus...-01</td> <td>1500</td> <td></td> <td>0</td> <td>Default</td> <td>Default</td> <td>Physical</td> </tr> </tbody> </table> </div>	Name	Node	MTU	Network Interface	Broadcast Domain	IPspace	Type	a0a	clus...-01	1500		0	Default-1	Default	Link Aggregation Group	a0a-11	clus...-01	1500		0	Default-2	Default	VLAN	a0a-22	clus...-01	1500		0	Default-3	Default	VLAN	a0a-33	clus...-01	1500		0	Default-4	Default	VLAN	e0a	clus...-01	1500		0			Physical	e0b	clus...-01	1500		0			Physical	e0c	clus...-01	1500		1	Default	Default	Physical	e0d	clus...-01	1500		1	Default	Default	Physical	e0e	clus...-01	1500		0	Default	Default	Physical	e0f	clus...-01	1500		0	Default	Default	Physical
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### End of Exercise

## Exercise 2: Managing Virtual Network Resources

### Objectives

This exercise enables you to do the following:

- Create an IPspace, broadcast domain, and subnet
- Create a subnet for the default IPspace
- Explore LIF failover groups
- Create data LIFs

### Case Study

In the process of integrating the data centers of Dwurgle Enterprises with Zarrot Industries, it was found that both companies had chosen to use the same IP address ranges for their networks. Instead of reconfiguring the IP addresses on all the equipment in one of the data centers, it was decided that the NetApp ONTAP IPspaces feature would be used.

When new data LIFs are created, the IT staff would prefer that the IP address are assigned automatically from a preconfigured pool. You create a pool of available IP addresses by creating a subnet.

Backups are copied to a remote Zarrot Industries site over 10Gbps Ethernet links. Mr. Zarrot does not want the backup traffic to interfere with the client traffic on the 25Gbps links. In a link failure, Mr. Zarrot wants the intercluster LIFs to fail over to only other 10Gbps links, so you define a LIF failover group.

With the acquisition of Dwurgle Enterprises, additional personnel and their systems need access to the NAS shares. To distribute the additional load across the cluster nodes and network ports, you create some additional logical network interfaces.

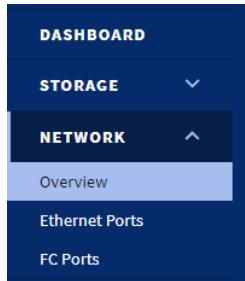
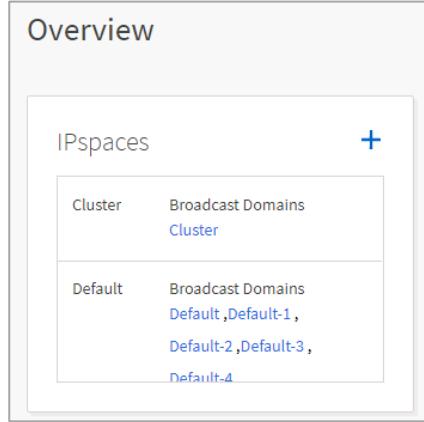
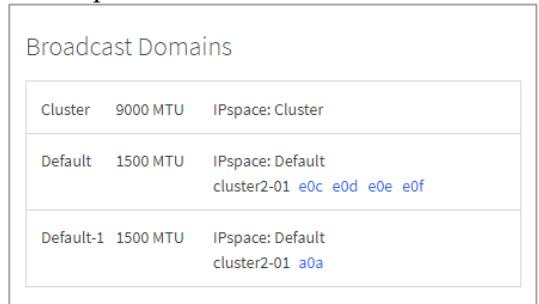
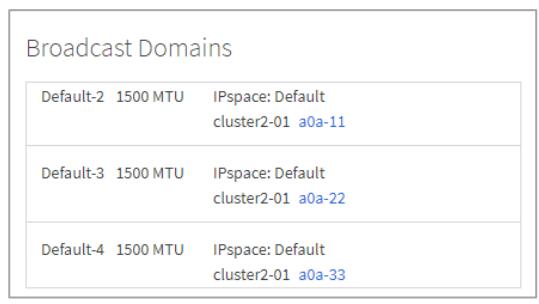
### Exercise Equipment

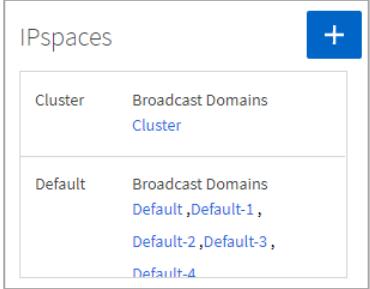
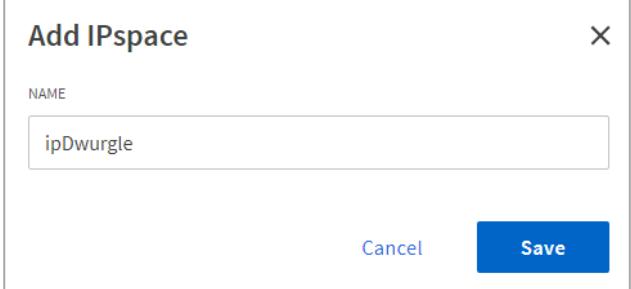
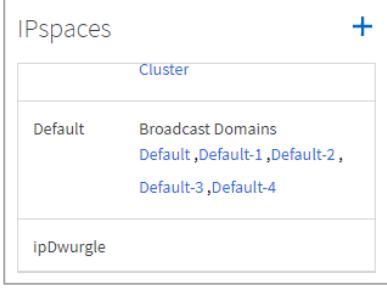
In this exercise, you use the following systems.

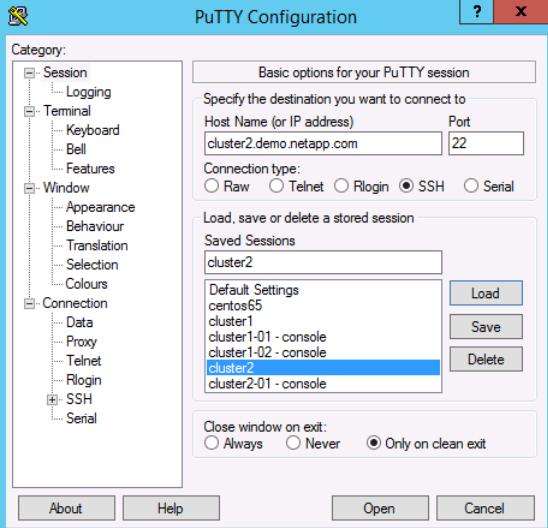
System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!

### Task 1: Create an IPspace, Broadcast Domain, and Subnet

Step	Action
1-1	From the Windows Server desktop, access ONTAP System Manager on <b>cluster2</b> .
1-2	 Ensure that you are connected to the correct cluster for each exercise.

Step	Action
<b>1-3</b>	<p>On the navigation menu, click <b>Network</b>, and then click <b>Overview</b>.</p> 
<b>1-4</b>	<p>In the IPspaces pane of the Network Overview page, observe the standard IPspaces and note the broadcast domains for each.</p> 
<b>1-5</b>	<p>Observe the contents of the Broadcast Domains pane and answer the following questions:</p> <p>Which ports are members of the Default broadcast domain?</p> <p>Which ports are members of the Default-1 broadcast domain?</p> 
<b>1-6</b>	<p>Scroll down in the Broadcast Domains pane and note the ports that belong to each broadcast domain.</p> 

Step	Action
1-7	<p>In the IPspaces pane of the Network Overview page, click the <b>Add</b> (“+”) button.</p> 
1-8	<p>Name the IPspace <b>ipDwurgle</b> and click <b>Save</b>.</p> 
1-9	<p>Verify that the new IPspace was created and that no broadcast domain has been assigned to it yet.</p> 

Step	Action
1-10	From the Windows Server desktop, open a PuTTY session with the cluster management port of <b>cluster2</b> .
	 The screenshot shows the PuTTY Configuration window. In the 'Category' tree on the left, 'Session' is expanded. Under 'Session', 'Host Name (or IP address)' is set to 'cluster2.demo.netapp.com' and 'Port' is set to '22'. The 'Connection type' section has 'SSH' selected. In the 'Saved Sessions' list on the right, 'cluster2' is highlighted. At the bottom, the 'Save' button is visible.
1-11	Log into cluster2 using the following credentials:
	<ul style="list-style-type: none"> <li>User name: <b>admin</b></li> <li>Password: <b>Netapp1!</b></li> </ul>
1-12	Display the configuration of the IPspaces: <b>network ipspace show</b>
1-13	Display the configuration of the broadcast domains: <b>network port broadcast-domain show</b>
1-14	Delete the broadcast domains that System Manager created for the link aggregation and VLAN ports: <b>network port broadcast-domain delete Default-1</b> <b>network port broadcast-domain delete Default-2</b> <b>network port broadcast-domain delete Default-3</b> <b>network port broadcast-domain delete Default-4</b>
1-15	Create a broadcast domain for the ipDwurgle IPspace with the following settings: <ul style="list-style-type: none"> <li>Name: <b>bdDwurgle</b></li> <li>IPspace: <b>ipDwurgle</b></li> <li>MTU: <b>1500</b></li> <li>Assign Ports: &lt;Enter all the link aggregation and VLAN ports&gt;</li> </ul> <b>network port broadcast-domain create -ipspace ipDwurgle -mtu 1500 -broadcast-domain bdDwurgle -port cluster2-01:a0a,cluster2-01:a0a-11,cluster2-01:a0a-22,cluster2-01:a0a-33</b>
1-16	Display the configuration of the broadcast domains: <b>network port broadcast-domain show</b>

## Task 2: Create Subnets for Automatic IP Address Assignment

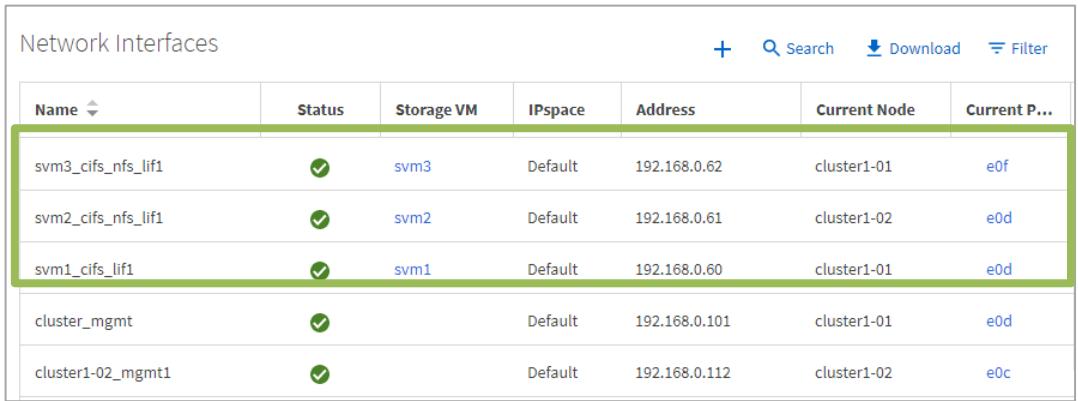
Step	Action
2-1	<p>Display the configuration of the subnets:</p> <pre>network subnet show</pre>
2-2	<p>Create a new subnet for the <b>bdDwurgle</b> broadcast domain with the following settings:</p> <ul style="list-style-type: none"> <li>• Name: <b>snDwurgle</b></li> <li>• Subnet IP/Subnet mask: <b>192.168.0.0/24</b></li> <li>• IP Adresses: <b>192.168.0.120-192.168.0.139</b></li> <li>• Gateway: &lt;none&gt;</li> <li>• Broadcast Domain: <b>bdDwurgle</b></li> </ul> <pre>network subnet create -ipspace ipDwurgle -subnet-name snDwurgle -broadcast-domain bdDwurgle -subnet 192.168.0.0/24 -ip-ranges 192.168.0.120-192.168.0.139</pre>
2-3	<p>Create a new subnet for the Default broadcast domain with the following settings:</p> <ul style="list-style-type: none"> <li>• Name: <b>snDefault</b></li> <li>• Subnet IP/Subnet mask: <b>192.168.0.0/24</b></li> <li>• IP Adresses: <b>192.168.0.120-192.168.0.139</b></li> <li>• Gateway: &lt;none&gt;</li> <li>• Broadcast Domain: <b>Default</b></li> </ul> <pre>network subnet create -ipspace Default -subnet-name snDefault -broadcast-domain Default -subnet 192.168.0.0/24 -ip-ranges 192.168.0.120-192.168.0.139</pre>
2-4	<p>Examine the subnets that you created and answer the following questions:</p> <pre>network subnet show</pre> <ul style="list-style-type: none"> <li>• What do you notice about the IP address ranges? _____</li> <li>• Do the ranges overlap? _____</li> <li>• Why is range overlap enabled or not enabled? _____</li> </ul>

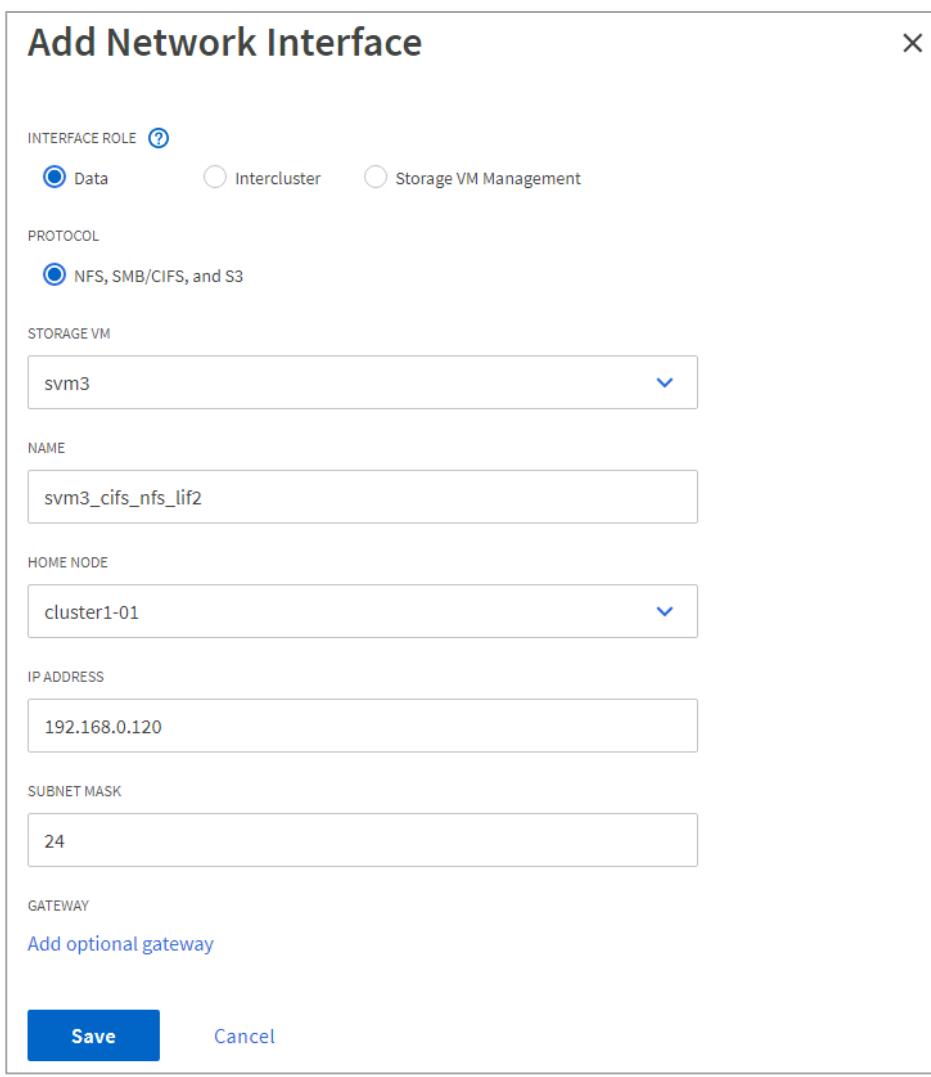
## Task 3: Explore Failover Groups

Step	Action
3-1	Start a PuTTY session with cluster <b>cluster1</b> .
3-2	 <p>Be sure to log in to the correct cluster.</p>
3-3	<p>Display information about broadcast domains:</p> <pre>network port broadcast-domain show</pre>
3-4	Examine the broadcast domains and the ports that are included in each domain.
3-5	Notice that the groups and ports align with the broadcast domains that are defined during cluster setup.

Step	Action
<b>3-6</b>	Optional: Open a PuTTY session to cluster2 to compare the changes you made in the previous tasks.
<b>3-7</b>	Display the failover policies of the LIFs in the cluster: <b>network interface show -failover</b>
<b>3-8</b>	Answer the following questions: <ul style="list-style-type: none"><li>▪ Which policy is assigned to node management LIFs? _____</li><li>▪ Why? _____</li></ul>
<b>3-9</b>	 The default failover policy assigned to a data LIF at creation time can be changed.
<b>3-10</b>	Examine the list of available failover policies: <b>network interface show -failover-policy ?</b>
<b>3-11</b>	Examine the list of failover groups: <b>network interface failover-groups show</b>
<b>3-12</b>	 In the next task, you create NAS data LIFs with data storage VMs (storage virtual machines, also known as SVMs). Which failover policy do you expect to be assigned to a NAS data LIF?

## Task 4: Create Data LIFs

Step	Action																																										
<b>4-1</b>	From ONTAP System Manager for cluster <b>cluster1</b> , in the navigation pane, click <b>Network</b> , and then click <b>Overview</b> .																																										
<b>4-2</b>	 Be sure to log in to the correct cluster.																																										
<b>4-3</b>	Notice that the cluster contains three data LIFs, one for each SVM.  <table border="1"> <thead> <tr> <th>Name</th> <th>Status</th> <th>Storage VM</th> <th>IPspace</th> <th>Address</th> <th>Current Node</th> <th>Current P...</th> </tr> </thead> <tbody> <tr> <td>svm3_cifs_nfs_lif1</td> <td>✓</td> <td>svm3</td> <td>Default</td> <td>192.168.0.62</td> <td>cluster1-01</td> <td>e0f</td> </tr> <tr> <td>svm2_cifs_nfs_lif1</td> <td>✓</td> <td>svm2</td> <td>Default</td> <td>192.168.0.61</td> <td>cluster1-02</td> <td>e0d</td> </tr> <tr> <td>svm1_cifs_lif1</td> <td>✓</td> <td>svm1</td> <td>Default</td> <td>192.168.0.60</td> <td>cluster1-01</td> <td>e0d</td> </tr> <tr> <td>cluster_mgmt</td> <td>✓</td> <td></td> <td>Default</td> <td>192.168.0.101</td> <td>cluster1-01</td> <td>e0d</td> </tr> <tr> <td>cluster1-02_mgmt1</td> <td>✓</td> <td></td> <td>Default</td> <td>192.168.0.112</td> <td>cluster1-02</td> <td>e0c</td> </tr> </tbody> </table>	Name	Status	Storage VM	IPspace	Address	Current Node	Current P...	svm3_cifs_nfs_lif1	✓	svm3	Default	192.168.0.62	cluster1-01	e0f	svm2_cifs_nfs_lif1	✓	svm2	Default	192.168.0.61	cluster1-02	e0d	svm1_cifs_lif1	✓	svm1	Default	192.168.0.60	cluster1-01	e0d	cluster_mgmt	✓		Default	192.168.0.101	cluster1-01	e0d	cluster1-02_mgmt1	✓		Default	192.168.0.112	cluster1-02	e0c
Name	Status	Storage VM	IPspace	Address	Current Node	Current P...																																					
svm3_cifs_nfs_lif1	✓	svm3	Default	192.168.0.62	cluster1-01	e0f																																					
svm2_cifs_nfs_lif1	✓	svm2	Default	192.168.0.61	cluster1-02	e0d																																					
svm1_cifs_lif1	✓	svm1	Default	192.168.0.60	cluster1-01	e0d																																					
cluster_mgmt	✓		Default	192.168.0.101	cluster1-01	e0d																																					
cluster1-02_mgmt1	✓		Default	192.168.0.112	cluster1-02	e0c																																					

Step	Action
4-4	<p>Click Add (“+”).</p> 
4-5	<p>Create a data LIF for CIFS and NFS on <b>svm3</b> by using the following parameters:</p> <ul style="list-style-type: none"> <li>• Interface Role: <b>Data</b> (default)</li> <li>• Protocol: <b>NFS,SMB/CIFS, and S3</b></li> <li>• Storage VM: <b>svm3</b></li> <li>• Name: <b>svm3_cifs_nfs_lif2</b></li> <li>• Home Node: <b>cluster1-01</b></li> <li>• IP Address: <b>192.168.0.120</b></li> <li>• Subnet Mask: <b>24</b> (default)</li> </ul> 
4-6	Click <b>Save</b> .

Step	Action
<b>4-7</b>	Answer the following question: To which network port was the LIF assigned?
<b>4-8</b>	Use PuTTY to log in to <b>cluster1</b> .
<b>4-9</b>	Create a NAS data LIF for svm2: <pre>network interface create -vserver svm2 -lif svm2_cifs_nfs_lif2 -data-protocol cifs,nfs -home-node cluster1-01 -home-port e0d -subnet-name subnet</pre>
<b>4-10</b>	Compare the command in the previous step with the System Manager dialog box in Step 4-5.
<b>4-11</b>	Display the data LIFs for svm2: <pre>network interface show -vserver svm2</pre>
<b>4-12</b>	Which IP address was assigned to the svm2_cifs_nfs_lif2 LIF? Why?
<b>4-13</b>	Display the data service policy assigned to LIFs for svm2: <pre>network interface show -vserver svm2 -fields service-policy</pre>
<b>4-14</b>	Display the data service policies for svm2: <pre>network interface service-policy show -vserver svm2</pre>
<b>4-15</b>	Change the syntax of the network interface create command shown in Step 4-9 to create a data LIF for svm1 with only the CIFS protocol permitted.
<b>4-16</b>	Display the data LIFs for svm1: <pre>network interface show -vserver svm1</pre>

## Task 5: Restrict Data LIFs

Step	Action
<b>5-1</b>	Display a list of the network services: <pre>network interface service show</pre>
<b>5-2</b>	Display a list of the storage VM and failover restrictions for each service type: <pre>set adv network interface service show -restrictions</pre>
<b>5-3</b>	Show the service policy that is assigned to each LIF: <pre>net int show -fields service-policy</pre>
<b>5-4</b>	Show which network services are provided on each LIF: <pre>net int show -fields service-policy,services</pre>

Step	Action
<b>5-5</b>	Display a list of the service-policies that are known to each SVM and the services included: <code>net int service-policy show</code>
<b>5-6</b>	Clone the default-data-files service policy belonging to svm3: <code>net int service-policy clone -vserver svm3 -policy default-data-files -target-vserver svm3 -target-policy svm3-data-files</code>
<b>5-7</b>	Modify the service policy to allow management of svm3 from only the company network: <code>net int service-policy add-service -vserver svm3 -policy svm3-data-files -service management-ssh -allowed-addresses 192.168.0.0/24</code> <code>net int service-policy add-service -vserver svm3 -policy svm3-data-files -service management-https -allowed-addresses 192.168.0.0/24</code>
<b>5-8</b>	Display the configuration of the new service policy: <code>net int service-policy show -vserver svm3 -policy svm3-data-files</code>
<b>5-9</b>	Assign the new service policy to a data LIF: <code>net int modify -vserver svm3 -lif svm3_cifs_nfs_lif1 -service-policy svm3-data-files</code>
<b>5-10</b>	Show which service policies are assigned to LIFs owned by svm3: <code>net int show -vserver svm3 -fields service-policy</code>

**End of Exercise**

# Module 5: Physical Storage Management

## Exercise 1: Managing Physical Storage

In this exercise, you manage the physical storage resources of a cluster.

### Objectives

This exercise enables you to pool physical storage devices together to create a data aggregate. You later expand an aggregate by adding physical storage devices to increase the available storage space.

### Case Study

Zarrot Industries has purchased additional storage space for its NetApp ONTAP system. After the service professional has installed the second disk shelf, the disks need to be joined into a local storage tier (aggregate) before they can be used. Rather than adding the new disks to an existing nearly full aggregate (which might result in degraded performance), it was decided to create an aggregate for the additional storage space.

Your colleague George forgot to include all the newly installed disks in the new aggregate that he created. Add the remaining unused disks (which are not needed as hot spares) into the new aggregate.

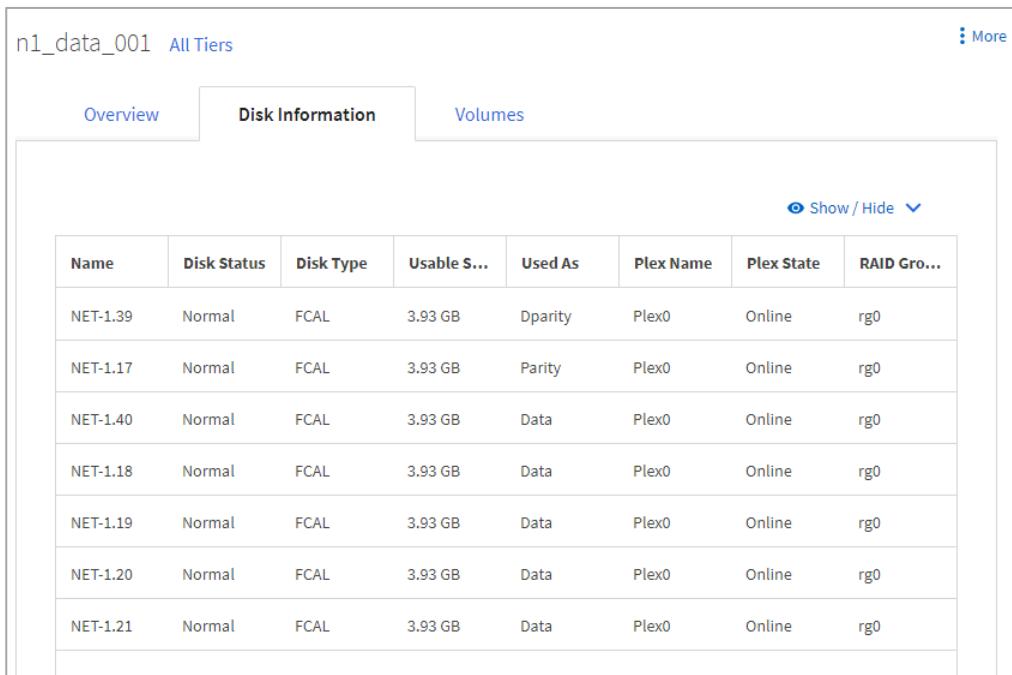
### Exercise Equipment

In this exercise, you use the following systems.

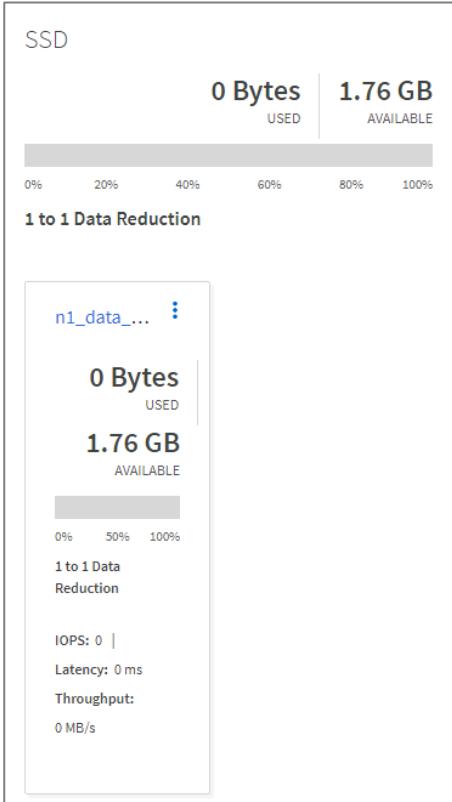
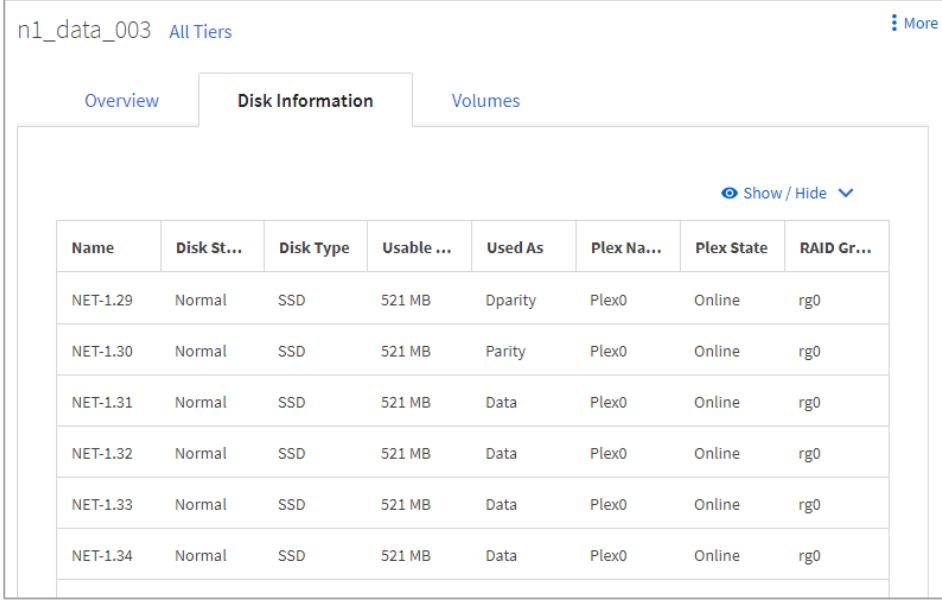
System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!

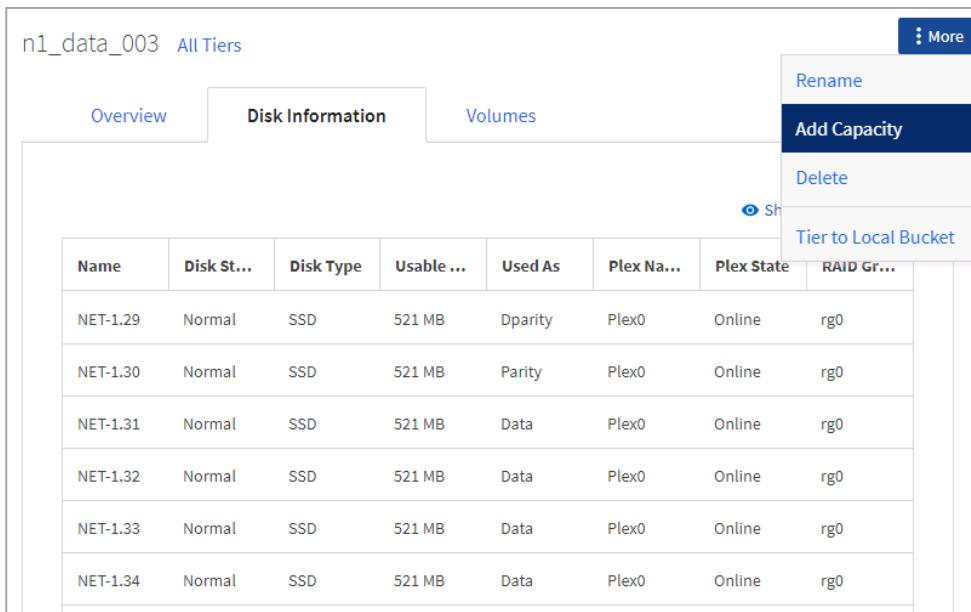
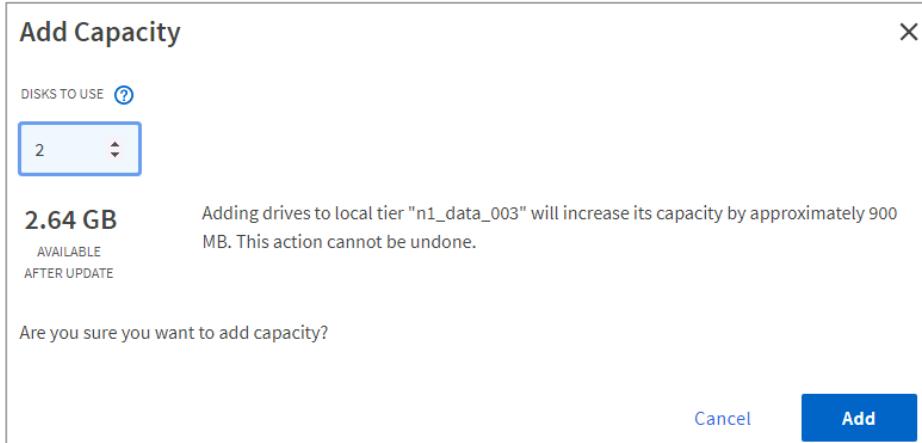
## Task 1: Examine Local Storage Tiers

Step	Action
1-1	From NetApp ONTAP System Manager for <b>cluster1</b> , in the navigation pane, navigate to <b>Storage &gt; Tiers</b> .
1-2	Click <b>n1_data_001</b> to view the aggregate details.

Step	Action																																																																
1-3	<p>Click the <b>Disk Information</b> tab to view the disks that compose the aggregate.</p>  <table border="1"> <thead> <tr> <th>Name</th><th>Disk Status</th><th>Disk Type</th><th>Usable \$...</th><th>Used As</th><th>Plex Name</th><th>Plex State</th><th>RAID Gro...</th></tr> </thead> <tbody> <tr> <td>NET-1.39</td><td>Normal</td><td>FCAL</td><td>3.93 GB</td><td>Dparity</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr> <td>NET-1.17</td><td>Normal</td><td>FCAL</td><td>3.93 GB</td><td>Parity</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr> <td>NET-1.40</td><td>Normal</td><td>FCAL</td><td>3.93 GB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr> <td>NET-1.18</td><td>Normal</td><td>FCAL</td><td>3.93 GB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr> <td>NET-1.19</td><td>Normal</td><td>FCAL</td><td>3.93 GB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr> <td>NET-1.20</td><td>Normal</td><td>FCAL</td><td>3.93 GB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr> <td>NET-1.21</td><td>Normal</td><td>FCAL</td><td>3.93 GB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> </tbody> </table>	Name	Disk Status	Disk Type	Usable \$...	Used As	Plex Name	Plex State	RAID Gro...	NET-1.39	Normal	FCAL	3.93 GB	Dparity	Plex0	Online	rg0	NET-1.17	Normal	FCAL	3.93 GB	Parity	Plex0	Online	rg0	NET-1.40	Normal	FCAL	3.93 GB	Data	Plex0	Online	rg0	NET-1.18	Normal	FCAL	3.93 GB	Data	Plex0	Online	rg0	NET-1.19	Normal	FCAL	3.93 GB	Data	Plex0	Online	rg0	NET-1.20	Normal	FCAL	3.93 GB	Data	Plex0	Online	rg0	NET-1.21	Normal	FCAL	3.93 GB	Data	Plex0	Online	rg0
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NET-1.21	Normal	FCAL	3.93 GB	Data	Plex0	Online	rg0																																																										
1-4	Click the <b>All Tiers</b> link to return to the Storage Tiers page.																																																																
1-5	Repeat Steps 1-2 through 1-4 to examine the configuration of all the local storage tiers.																																																																

## Task 2: Expand an Aggregate

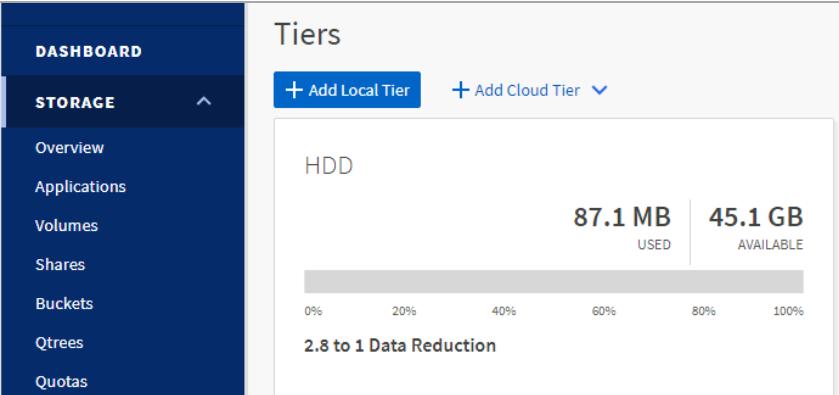
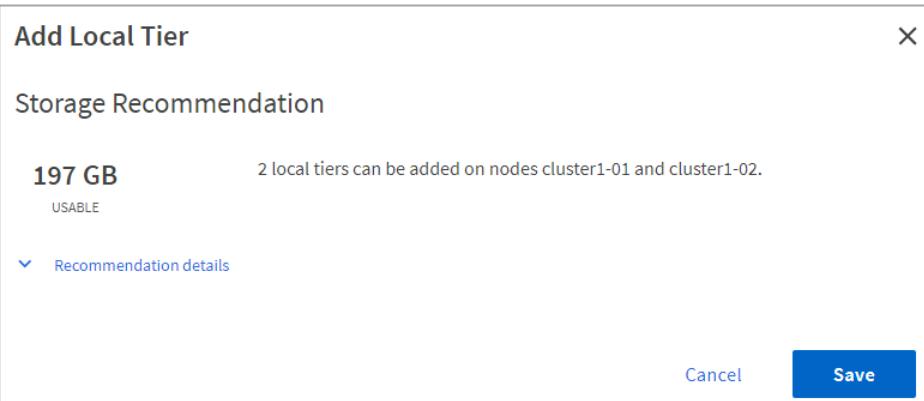
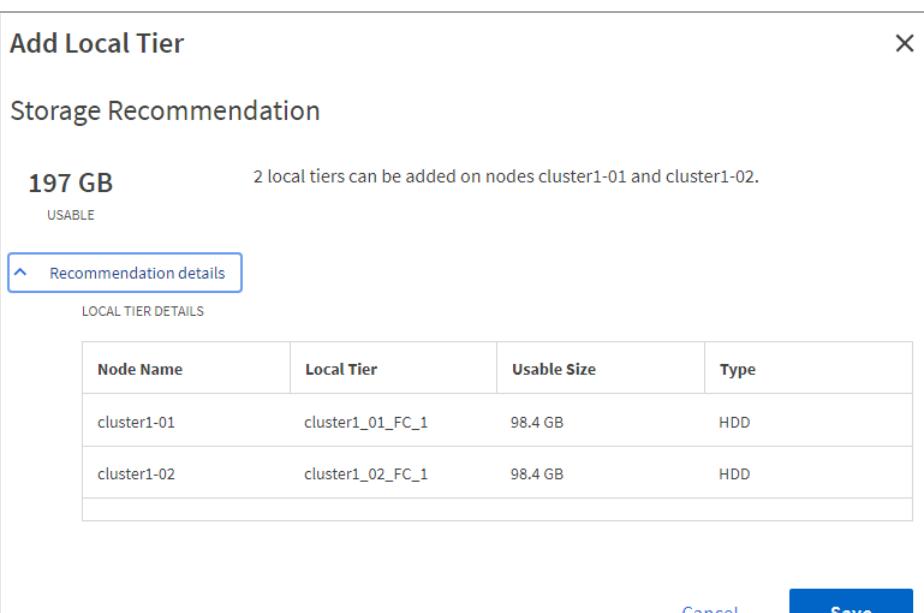
Step	Action
2-1	<p>Scroll down to the SSD section of the Storage Tiers page and select <b>n1_data_003</b>.</p> 
2-2	<p>Notice the number of disks in the aggregate.</p> 

Step	Action
2-3	<p>Click <b>More</b>, and then click <b>Add Capacity</b>.</p> 
2-4	<p>In the Number of Disks field, enter <b>2</b> (to expand the aggregate by two disks).</p>  <p><b>i</b> ONTAP system manager will attempt to add all the available drives to the aggregate while retaining sufficient spare drives. Disregard the message of insufficient space caused by the limitations of the training environment and enter the correct number of drives to add.</p>
2-5	Click <b>Add</b> .

Step	Action																																																																								
2-6	<p>Verify that the disks are added to the disk count.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Disk St...</th> <th>Disk Type</th> <th>Usable ...</th> <th>Used As</th> <th>Plex Na...</th> <th>Plex State</th> <th>RAID Gr...</th> </tr> </thead> <tbody> <tr><td>NET-1.29</td><td>Normal</td><td>SSD</td><td>521 MB</td><td>Dparity</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr><td>NET-1.30</td><td>Normal</td><td>SSD</td><td>521 MB</td><td>Parity</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr><td>NET-1.31</td><td>Normal</td><td>SSD</td><td>521 MB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr><td>NET-1.32</td><td>Normal</td><td>SSD</td><td>521 MB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr><td>NET-1.33</td><td>Normal</td><td>SSD</td><td>521 MB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr><td>NET-1.34</td><td>Normal</td><td>SSD</td><td>521 MB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr><td>NET-1.35</td><td>Normal</td><td>SSD</td><td>521 MB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> <tr><td>NET-1.36</td><td>Normal</td><td>SSD</td><td>521 MB</td><td>Data</td><td>Plex0</td><td>Online</td><td>rg0</td></tr> </tbody> </table>	Name	Disk St...	Disk Type	Usable ...	Used As	Plex Na...	Plex State	RAID Gr...	NET-1.29	Normal	SSD	521 MB	Dparity	Plex0	Online	rg0	NET-1.30	Normal	SSD	521 MB	Parity	Plex0	Online	rg0	NET-1.31	Normal	SSD	521 MB	Data	Plex0	Online	rg0	NET-1.32	Normal	SSD	521 MB	Data	Plex0	Online	rg0	NET-1.33	Normal	SSD	521 MB	Data	Plex0	Online	rg0	NET-1.34	Normal	SSD	521 MB	Data	Plex0	Online	rg0	NET-1.35	Normal	SSD	521 MB	Data	Plex0	Online	rg0	NET-1.36	Normal	SSD	521 MB	Data	Plex0	Online	rg0
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2-7	<p>Verify that the additional space is available in the n1_data_003 aggregate.</p> <p>SSD</p> <p>0 Bytes USED   2.64 GB AVAILABLE</p> <p>1 to 1 Data Reduction</p> <p>n1_data_... :</p> <p>0 Bytes USED</p> <p>2.64 GB AVAILABLE</p> <p>IOPS: 0   Latency: 0 ms Throughput: 0 MB/s</p>																																																																								

## Task 3: Create an Aggregate

For training purposes, you will create storage tiers that do not conform with NetApp recommended practices. To do this you must use the clustershell interface.

Step	Action
3-1	<p>Click <b>Add Local Tier</b> to create a new local data aggregate.</p> 
3-2	<p>In the Add Local Tier dialog box, expand the <b>Recommendation details</b>.</p> 
3-3	<p>Review the suggested configuration for newly created local tiers.</p> 

Step	Action
3-4	 ONTAP System Manager does not permit you to override the recommended configuration of local storage tiers. You must use the ONTAP CLI or API.
3-5	Click <b>Cancel</b> .
3-6	Open a PuTTY session for <b>cluster1</b> .
3-7	Display a list of the currently configured aggregates in the cluster. <code>storage aggregate show</code>
3-8	Use the disk show-spare-disks command to identify the number of spare disks of each type that each node owns. <code>storage disk</code> <code>show-spare-disks</code>
3-9	<p>Create an aggregate comprised of HDDs on node 1 with the following settings:</p> <ul style="list-style-type: none"> <li>Name: <b>cluster1_01_FC_1</b></li> <li>Disk Type: <b>FCAL</b></li> <li>Number of Disks: <b>15</b></li> </ul> <pre>storage aggregate create -aggregate cluster1_01_FC_1 -node cluster1-01 -disktype FCAL -diskcount 15</pre> <p>Sample output:</p> <pre>Info: The layout for aggregate "cluster1_01_FC_1" on node "cluster1-01" would be:  First Plex  RAID Group rg0, 15 disks (block checksum, raid_dp)       Usable Physical       Size   Size Position  Disk          Type -----  ----- dparity   NET-1.28      FCAL      -       - parity    NET-1.29      FCAL      -       - data      NET-1.30      FCAL     3.91GB  3.93GB data      NET-1.31      FCAL     3.91GB  3.93GB data      NET-1.32      FCAL     3.91GB  3.93GB data      NET-1.44      FCAL     3.91GB  3.93GB data      NET-1.45      FCAL     3.91GB  3.93GB data      NET-1.46      FCAL     3.91GB  3.93GB data      NET-1.47      FCAL     3.91GB  3.93GB data      NET-1.48      FCAL     3.91GB  3.93GB data      NET-1.49      FCAL     3.91GB  3.93GB data      NET-1.33      FCAL     3.91GB  3.93GB data      NET-1.34      FCAL     3.91GB  3.93GB data      NET-1.35      FCAL     3.91GB  3.93GB data      NET-1.36      FCAL     3.91GB  3.93GB  Aggregate capacity available for volume use would be 45.70GB.  Do you want to continue? {y n}:</pre>

Step	Action
3-10	 You select <i>only</i> the suggested number of disks (fifteen). Disks are limited, and if you use too many disks, you might run out before you complete the course.
3-11	Verify that the proposed aggregate matches the requirements and enter <b>y</b> to confirm.
3-12	Answer the following question: In a real-world environment, would the specified allocation be an efficient use of disks? _____
3-13	Examine the new aggregate: <code>storage disk show -aggregate cluster1_01_FC_1</code>
3-14	Create a second aggregate comprised of HDDs on node 2 with the following settings: <ul style="list-style-type: none"> <li>▪ Name: <b>cluster1_02_FC_1</b></li> <li>▪ Disk Type: <b>FCAL</b></li> <li>▪ Number of Disks: <b>21</b></li> <li>▪ Disk Size: <b>4GB</b></li> <li>▪ RAID Group Size: <b>11</b></li> </ul> <code>aggr create cluster1_02_FC_1 -node cluster1-02 -disktype FCAL -diskcount 21 -disksize 4 -maxraidsize 11</code>
3-15	Verify that the proposed aggregate matches the requirements and enter ‘y’ to confirm.
3-16	Examine the second aggregate: <code>storage disk show -aggregate cluster1_02_FC_1</code>
3-17	Open a PuTTY session for <b>cluster2</b> .
3-18	Display a list of the currently configured aggregates in the cluster. <code>storage aggregate show</code>
3-19	 You can see only aggr0_cluster2_01 which is the root aggregate for your single cluster node.
3-20	Use the disk show-spare-disks command to identify the number of spare disks. <code>storage disk show-spare-disks</code>

Step	Action
3-21	<p>Create an aggregate with the following settings:</p> <ul style="list-style-type: none"> <li>▪ Name: <b>n1_data_001</b></li> <li>▪ Disk Type: <b>FCAL</b></li> <li>▪ Number of Disks: <b>7</b></li> <li>▪ RAID Configuration: <b>RAID-TEC</b></li> </ul> <pre>storage aggregate create -aggregate n1_data_001 -raidtype raid_tec -disktype FCAL -diskcount 7</pre> <p>Sample output:</p> <pre>Info: The layout for aggregate "n1_data_001" on node "cluster2-01" would be:  First Plex        RAID Group rg0, 7 disks (block checksum, raid_tec)        Position   Disk           Type      Usable Size  Physical Size       -----     ---           ----      -----    -----       tparity    NET-1.3       FCAL      -        -       dparity    NET-1.11      FCAL      -        -       parity     NET-1.4       FCAL      -        -       data       NET-1.12      FCAL      3.91GB  3.93GB       data       NET-1.5       FCAL      3.91GB  3.93GB       data       NET-1.13      FCAL      3.91GB  3.93GB       data       NET-1.6       FCAL      3.91GB  3.93GB        Aggregate capacity available for volume use would be 14.06GB.  Do you want to continue? {y n}:</pre>
3-22	Verify that the proposed aggregate matches the requirements and enter <b>y</b> to confirm.
3-23	<p>Answer the following question:</p> <p>In a real-world environment, would the specified allocation be an efficient use of disks? _____</p>
3-24	<p>Examine the new aggregate:</p> <pre>storage disk show -aggregate n1_data_001</pre>

#### End of Exercise

## Exercise 2: Exploring RAID-TEC and Creating a Flash Pool

In this exercise, you explore NetApp RAID-TEC technology and create a flash pool aggregate.

## Objectives

This exercise enables you to do the following:

- Verify the operability of a degraded RAID-TEC aggregate
  - Convert an aggregate to a Flash Pool aggregate

## Case Study

Mr. Zarrot is skeptical of the resiliency of erasure encoding to data loss. Mr. Zarrot wants you to prove that an aggregate created with RAID-TEC technology can withstand the loss of three drives and still successfully serve data.

Sales at Zarrot Industries are growing rapidly. The company website is under a heavy load and would benefit from faster I/O. Mr. Zarrot has purchased some SSD drives for the NetApp system to improve I/O performance. Only data that is actively used should be stored in the SSD drives. Enable automatic tiering of data by adding the SSDs to an existing aggregate with HDDs to create a Flash Pool aggregate.

## **Exercise Equipment**

In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!

## **Task 1: Verify the Operability of a Degraded RAID-TEC Aggregate**

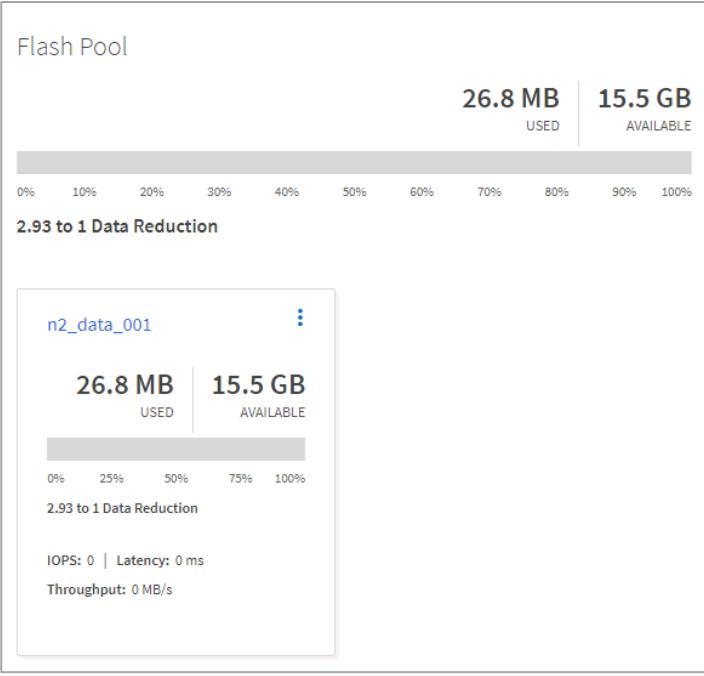
Step	Action
1-1	Start a PuTTY session with <b>cluster2</b> .
1-2	<p>Verify that your RAID-TEC aggregate is in a normal state (your list of disks might be different):</p> <pre><b>storage aggregate show-status -aggregate n1_data_001</b></pre> <p>Sample output:</p> <pre>Owner Node: cluster2-01 Aggregate: n1_data_001 (online, raid_tec) (block checksums) Plex: /n1_data_001/plex0 (online, normal, active, pool0) RAID Group /n1_data_001/plex0/rg0 (normal, block checksums)            Usable Physical Position Disk           Pool Type    RPM     Size   Size Status ----- ----- tparity  NET-1.7        0  FCAL  15000  3.93GB  3.93GB (normal) dparity  NET-1.33       0  FCAL  15000  3.93GB  3.93GB (normal) parity   NET-1.8        0  FCAL  15000  3.93GB  3.93GB (normal) data     NET-1.34       0  FCAL  15000  3.93GB  3.93GB (normal) data     NET-1.9         0  FCAL  15000  3.93GB  3.93GB (normal) data     NET-1.35       0  FCAL  15000  3.93GB  3.93GB (normal) data     NET-1.10       0  FCAL  15000  3.93GB  3.93GB (normal)  7 entries were displayed.</pre>

Step	Action
1-3	<p>Identify one of the disks that is used for the aggregate data and fail that disk (the name of your data disk might be different):</p> <pre>storage disk fail -disk NET-1.34 -immediate true</pre>
1-4	<p>When you are prompted, type <b>y</b>:</p> <p>Warning: The system will not copy contents of the disk to a replacement before failing the disk. Do you want to fail out the disk immediately?  {y n}: <b>y</b></p>
1-5	<p>Verify that the failed disk has been replaced, the new disk is reconstructing the contents of the failed disk, and the aggregate is still in a normal state:</p> <pre>storage aggregate show-status -aggregate n1_data_001</pre> <p>Sample output:</p> <pre>Owner Node: cluster2-01 Aggregate: n1_data_001 (online, raid_tec, reconstruct) (block checksums) Plex: /n1_data_001/plex0 (online, normal, active, pool0) RAID Group /n1_data_001/plex0/rg0 (reconstruction 10% completed, block checksums)  Usable Physical Position Disk                         Pool Type    RPM     Size      Size Status ----- ----- ----- ----- ----- ----- tparity   NET-1.7                      0  FCAL  15000  3.93GB  3.93GB (normal) dparity   NET-1.33                     0  FCAL  15000  3.93GB  3.93GB (normal) parity    NET-1.8                      0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.36                     0  FCAL  15000  3.93GB  3.93GB (reconstruction 7% completed) data      NET-1.9                      0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.35                     0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.10                     0  FCAL  15000  3.93GB  3.93GB (normal) 7 entries were displayed.</pre>
1-6	<p>Identify a second disk that is used for the aggregate data and fail that disk (the name of your data disk might be different):</p> <pre>storage disk fail -disk NET-1.9 -immediate true</pre>
1-7	<p>When you are prompted, type <b>y</b>:</p> <p>Warning: The system will not copy contents of the disk to a replacement before failing the disk. Do you want to fail out the disk immediately?  {y n}: <b>y</b></p>
1-8	<p>Verify that the failed disk has been replaced and that the aggregate is still in a normal state:</p> <pre>storage aggregate show-status -aggregate n1_data_001</pre> <p>Sample output:</p> <pre>Owner Node: cluster2-01 Aggregate: n1_data_001 (online, raid_tec, reconstruct) (block checksums) Plex: /n1_data_001/plex0 (online, normal, active, pool0) RAID Group /n1_data_001/plex0/rg0 (double reconstruction 22% completed, block checksums)  Usable Physical Position Disk                         Pool Type    RPM     Size      Size Status ----- ----- ----- ----- ----- ----- tparity   NET-1.7                      0  FCAL  15000  3.93GB  3.93GB (normal) dparity   NET-1.33                     0  FCAL  15000  3.93GB  3.93GB (normal) parity    NET-1.8                      0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.36                     0  FCAL  15000  3.93GB  3.93GB (reconstruction 44% completed) data      NET-1.37                     0  FCAL  15000  3.93GB  3.93GB (reconstruction 13% completed) data      NET-1.35                     0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.10                     0  FCAL  15000  3.93GB  3.93GB (normal) 7 entries were displayed.</pre>

Step	Action
1-9	<p>Fail a third disk that is used for the aggregate data (the name of your data disk might be different):</p> <pre>storage disk fail -disk NET-1.35 -immediate true</pre>
1-10	<p>When you are prompted, type <b>y</b>:</p> <p>Warning: The system will not copy contents of the disk to a replacement before failing the disk. Do you want to fail out the disk immediately?  {y n}: <b>y</b></p>
1-11	<p>Verify that the failed disk has been replaced and that the RAID group is now in a triple reconstruction state (because of the three rebuilds of failed disk):</p> <pre>storage aggregate show-status -aggregate n1_data_001</pre> <p>Sample output:</p> <pre>Owner Node: cluster2-01 Aggregate: n1_data_001 (online, raid_tec, reconstruct) (block checksums)   Plex: /n1_data_001/plex0 (online, normal, active, pool0)     RAID Group /n1_data_001/plex0/rg0 (triple reconstruction 26% completed, block checksums)        Position Disk          Pool Type     RPM   Usable Size  Physical Size Status       -----  -----          -----  -----   -----  -----  -----  -----       tparity  NET-1.3          0  FCAL  15000  3.93GB  3.93GB (normal)       dparity  NET-1.11         0  FCAL  15000  3.93GB  3.93GB (normal)       parity   NET-1.4          0  FCAL  15000  3.93GB  3.93GB (normal)       data     NET-1.14         0  FCAL  15000  3.93GB  3.93GB (reconstruction 48% completed)       data     NET-1.16         0  FCAL  15000  3.93GB  3.93GB (reconstruction 2% completed)       data     NET-1.15         0  FCAL  15000  3.93GB  3.93GB (reconstruction 7% completed)       data     NET-1.6          0  FCAL  15000  3.93GB  3.93GB (normal) 7 entries were displayed.</pre>
1-12	<p>Answer the following question:</p> <p>What happens if you try to fail another drive?</p> <hr/>

## Task 2: Convert an Aggregate to a Flash Pool

Step	Action
2-1	Open a PuTTY session for <b>cluster1</b> .
2-2	<p>From the cluster hell for cluster1, convert the <b>n2_data_001</b> aggregate into a Flash Pool aggregate:</p> <pre>aggregate modify -aggregate n2_data_001 -hybrid-enabled true</pre>
2-3	<p>Expand the Flash Pool aggregate with the following settings:</p> <ul style="list-style-type: none"> <li>▪ Disk Class: <b>SSD</b></li> <li>▪ Number of Disks: <b>5</b></li> <li>▪ RAID Type: <b>RAID4</b></li> <li>▪ RAID Group Size: <b>8</b></li> </ul> <pre>storage aggregate add-disks -aggr n2_data_001 -diskclass solid-state -diskcount 5 -raidtype raid4 -cache-raid-group-size 8</pre>

Step	Action
2-4	<p><b>i</b> The RAID policies for the SSD RAID group (or groups) are independent of the policies for the HDD RAID groups within a Flash Pool aggregate. For example, an SSD RAID group in a Flash Pool aggregate can be configured with RAID 4 and a group size of 8. The HDD RAID groups in the same Flash Pool aggregate can use RAID DP with a group size of 16.</p>
2-5	<p><b>i</b> For more information about RAID group sizes within a Flash Pool, see TR-4070: <i>NetApp Flash Pool Design and Implementation Guide</i>.</p> 
2-6	Verify that the proposed aggregate matches the requirements and enter 'y' to confirm.
2-7	Examine the new aggregate: <pre>storage disk show -aggregate n2_data_001</pre>
2-8	Return to ONTAP System Manager for cluster1.
2-9	Verify that the n2_data_001 aggregate has been moved to the Flash Pool section of the Storage Tiers page.  <p>The screenshot shows two sections of the Storage Tiers page. The top section is labeled 'Flash Pool' and displays aggregate statistics: 26.8 MB USED and 15.5 GB AVAILABLE. Below this is a progress bar from 0% to 100%. The bottom section is labeled 'n2_data_001' and also displays 26.8 MB USED and 15.5 GB AVAILABLE, along with its own progress bar. Both sections include a note '2.93 to 1 Data Reduction'. At the bottom of the screenshot, performance metrics are listed: IOPS: 0   Latency: 0 ms and Throughput: 0 MB/s.</p>
2-10	Click the <b>n2_data_001</b> aggregate.

Step	Action								
2-11	<p>Confirm that the aggregate has Flash Pool enabled.</p> <p>n2_data_001 All Tiers</p> <p>More</p> <p>Overview Disk Information Volumes</p> <table border="1"> <tbody> <tr> <td>STATUS ✓ Online</td> <td>FABRICPOOL Disabled</td> </tr> <tr> <td>NODE cluster1-02</td> <td>FLASH POOL Enabled</td> </tr> <tr> <td>TYPE Flash Pool (14 disks)</td> <td>SNAPLOCK Disabled</td> </tr> <tr> <td>RAID RAID_DP</td> <td>MIRROR Disabled</td> </tr> </tbody> </table> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <p>Capacity</p> <p>33.7 MB USED   15.5 GB AVAILABLE</p> <p>0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%</p> <p>2.28 to 1 Data Reduction</p> </div>	STATUS ✓ Online	FABRICPOOL Disabled	NODE cluster1-02	FLASH POOL Enabled	TYPE Flash Pool (14 disks)	SNAPLOCK Disabled	RAID RAID_DP	MIRROR Disabled
STATUS ✓ Online	FABRICPOOL Disabled								
NODE cluster1-02	FLASH POOL Enabled								
TYPE Flash Pool (14 disks)	SNAPLOCK Disabled								
RAID RAID_DP	MIRROR Disabled								

**End of Exercise**

# Module 6: Logical Storage Management

## Exercise 1: Managing Data Volumes

In this exercise, you manage logical storage resources.

### Objectives

This exercise focuses on enabling you to do the following:

- Create FlexVol volumes
- Expand and move a FlexVol volume

### Case Study

Because the employees of Dwurgle Enterprises need to be migrated to Zarrot Industries, it has been decided to create a second FlexVol volume to store the new users' home directories.

The users who are moving from Dwurgle Enterprises have more data than anticipated. The new volume containing the home directories for the employees from Dwurgle Enterprises was made too small. You need to expand the size of the volume to accommodate the additional data to be transferred.

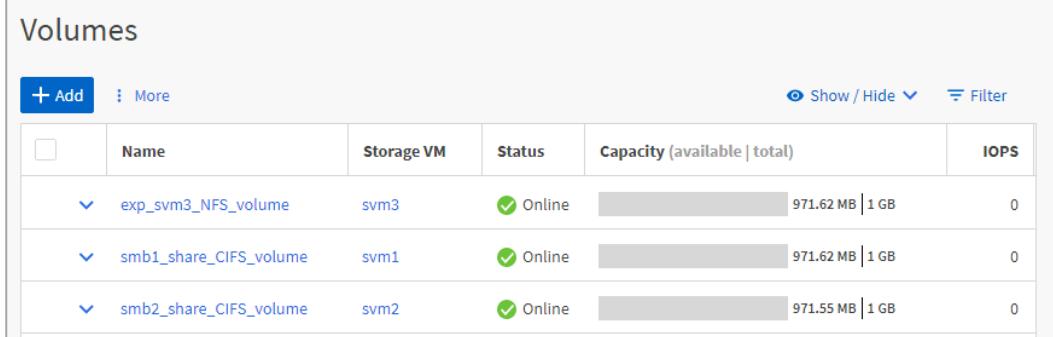
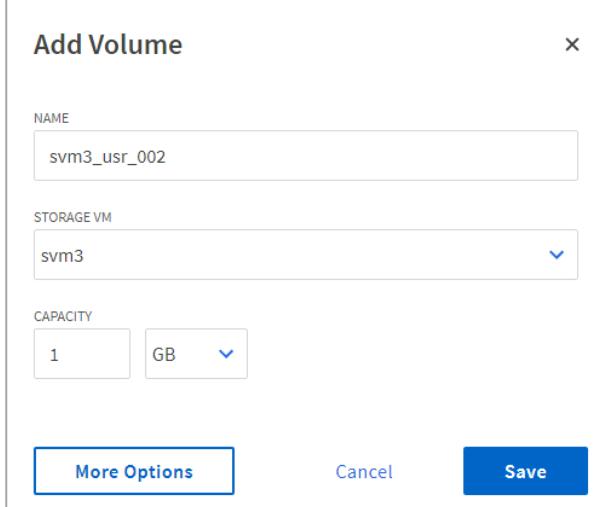
### Exercise Equipment

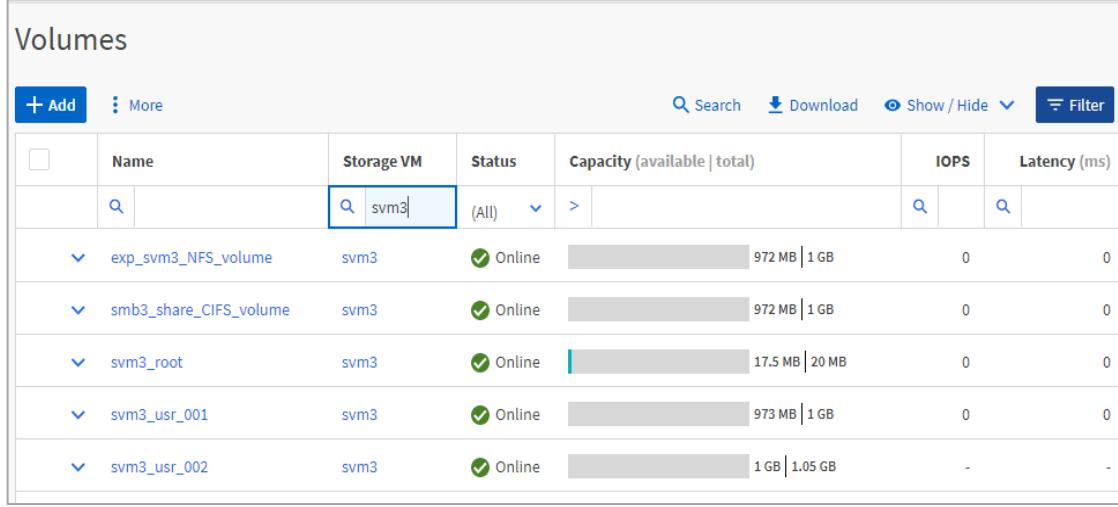
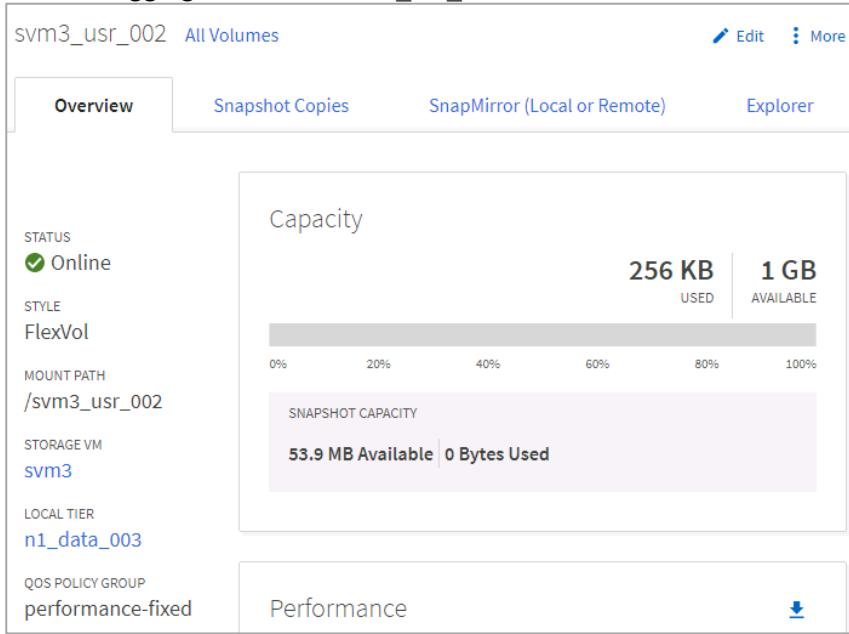
In this exercise, you use following systems.

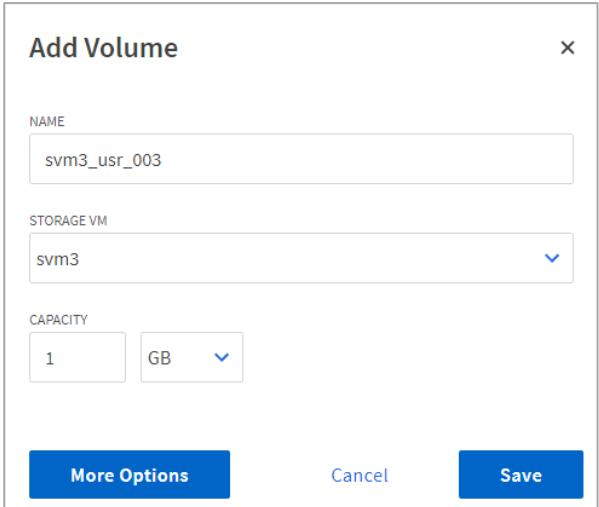
System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
NetApp ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!

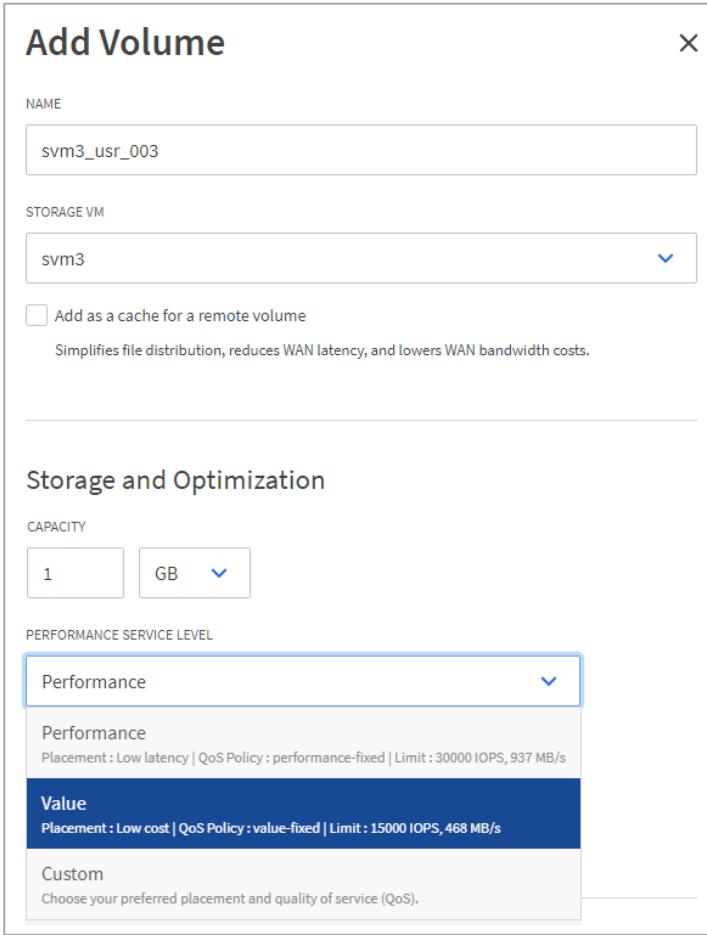
### Task 1: Create Flexible Volumes

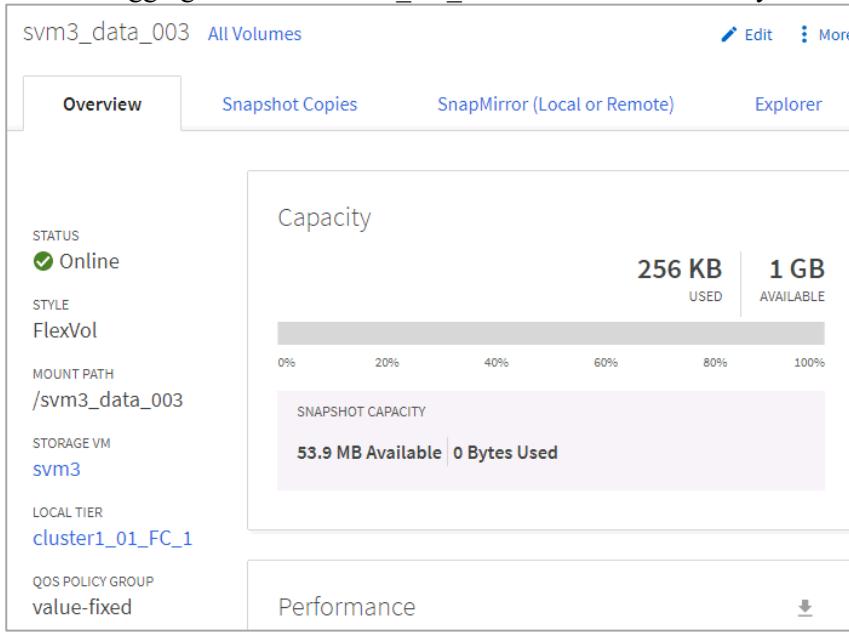
Step	Action
1-1	Return to your PuTTY clustershell session with <b>cluster1</b> .
1-2	In svm3 on the aggregate n1_data_001, create a volume:  <code>volume create -vserver svm3 -volume svm3_usr_001 -aggregate n1_data_001 -size 1gb</code>
1-3	 You should see a console message stating that the job has been queued. When the job is complete, you see a status of Successful.
1-4	View the volumes:  <code>vol show</code>
1-5	View detailed information about the new volume:  <code>vol show -vserver svm3 -volume svm3_usr_001</code>
1-6	Return to NetApp ONTAP System Manager on <b>cluster1</b> .

Step	Action
1-7	Navigate to the <b>Volumes</b> page.
1-8	On the Volumes page, click <b>Add</b> .
	
1-9	<p>In the Add Volume dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>Name: <b>svm3_usr_002</b></li> <li>Storage VM: <b>svm3</b></li> <li>Capacity: <b>1 GB</b></li> </ul> 
1-10	Click <b>Save</b> .

Step	Action
1-11	Click the <b>Filter</b> button and enter <b>svm3</b> into the Storage VM textbox.
	
1-12	Confirm the successful creation of volume <b>svm3_usr_002</b> .
1-13	Click <b>svm3_usr_002</b> , and answer the following question: In which aggregate was the <b>svm3_usr_002</b> volume created? 
1-14	On the Volumes page, click <b>Add</b> .

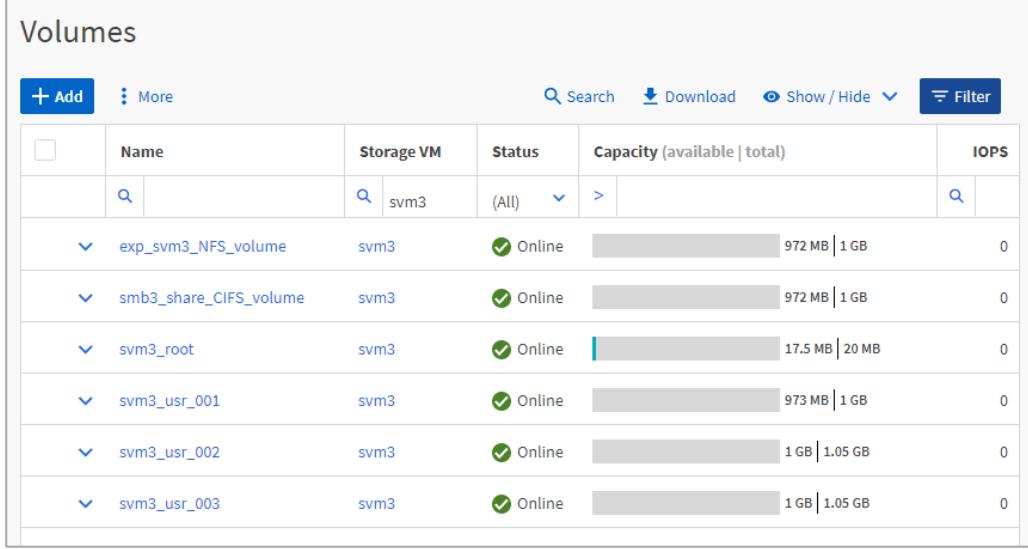
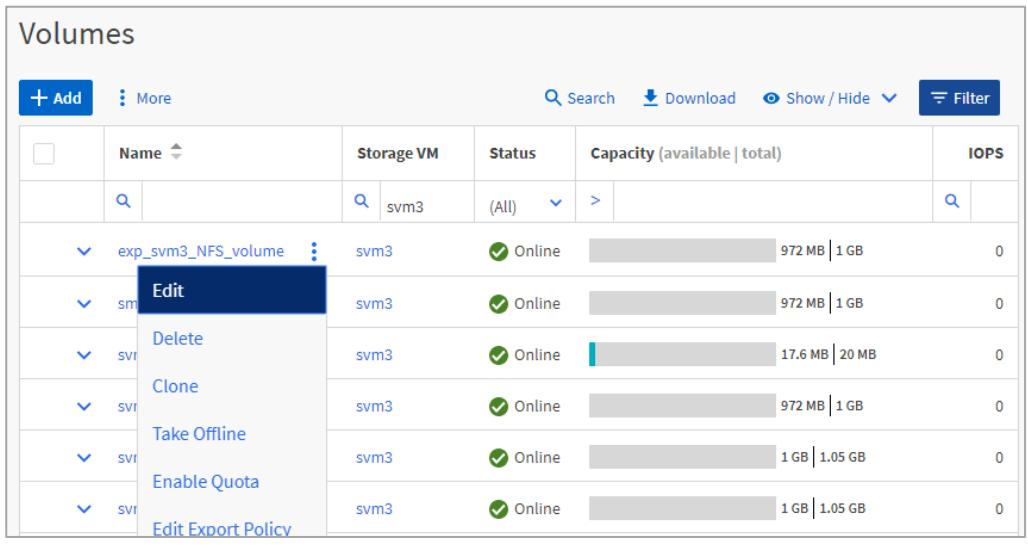
Step	Action
<b>1-15</b>	<p>In the Add Volume dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Name: <b>svm3_usr_003</b></li> <li>▪ Storage VM: <b>svm3</b></li> <li>▪ Capacity: <b>1 GB</b></li> </ul> 
<b>1-16</b>	<p>Click <b>More Options</b>.</p>

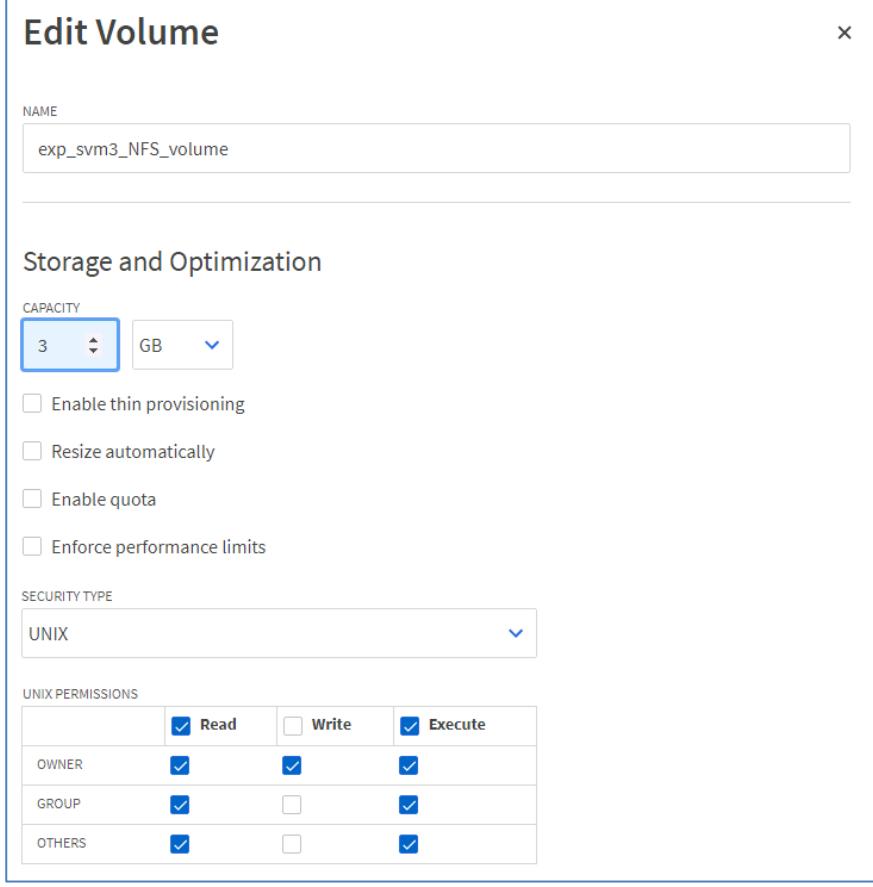
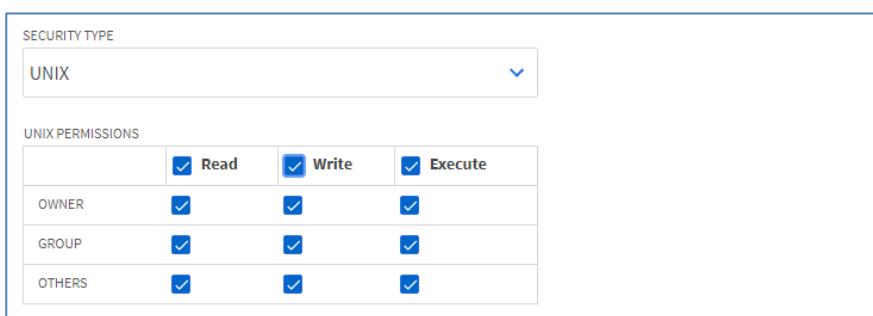
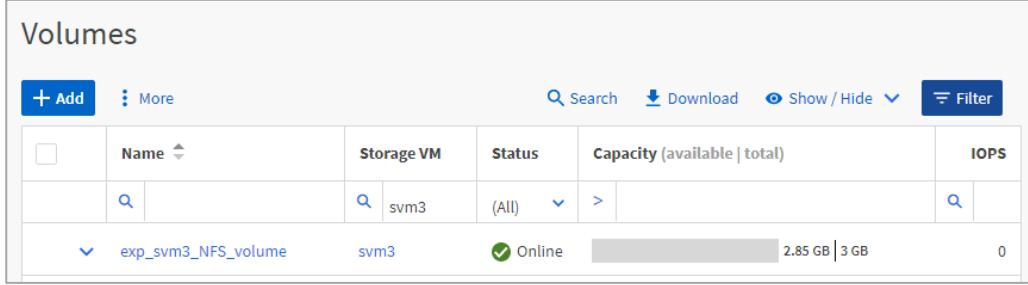
Step	Action
<b>1-17</b>	<p>In the Add Volume dialog box, set the Performance Service Level to <b>Value</b>. For the other parameters, you accept the default values.</p> 
<b>1-18</b>	Click <b>Save</b> .
<b>1-19</b>	Confirm the successful creation of volume svm3_usr_003.

Step	Action
1-20	<p>Click <b>svm3_usr_003</b>, and answer the following questions: In which aggregate was the <b>svm3_usr_003</b> volume created? Why?</p> 

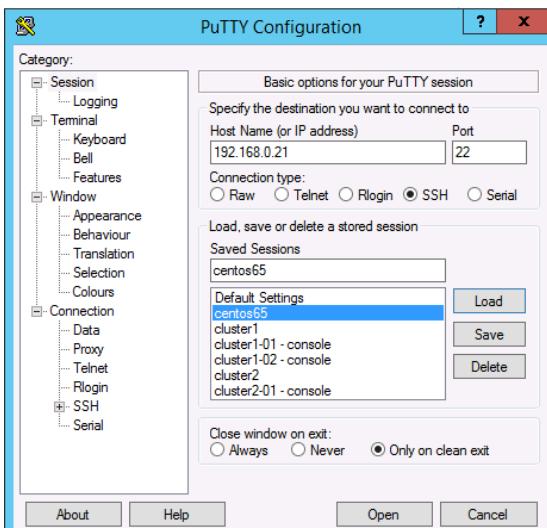
## Task 2: Expand a Volume and Move a Volume

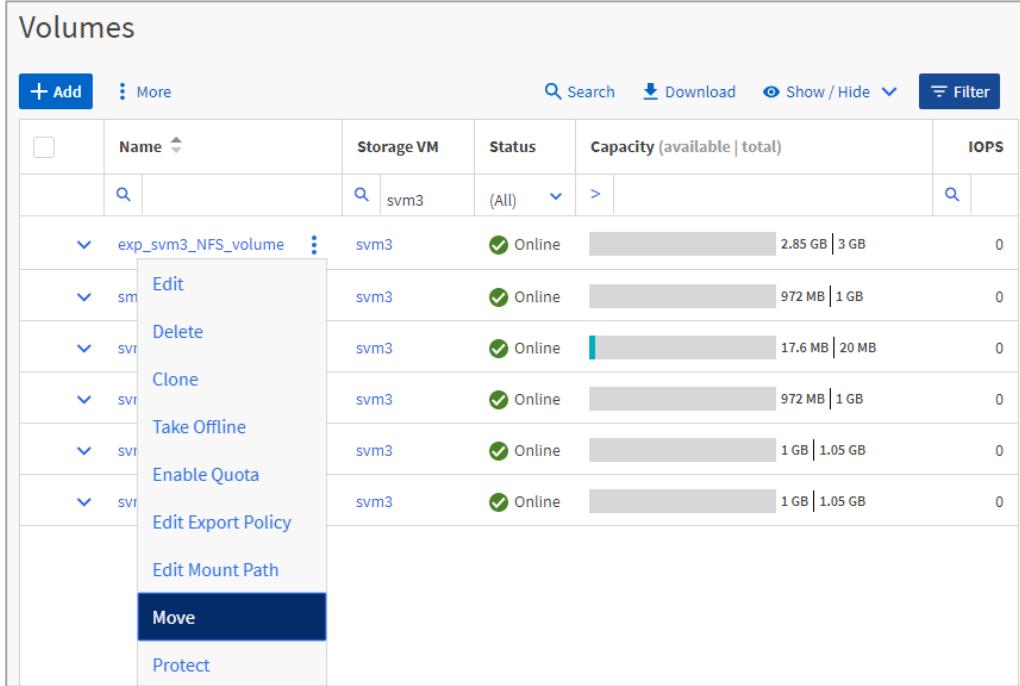
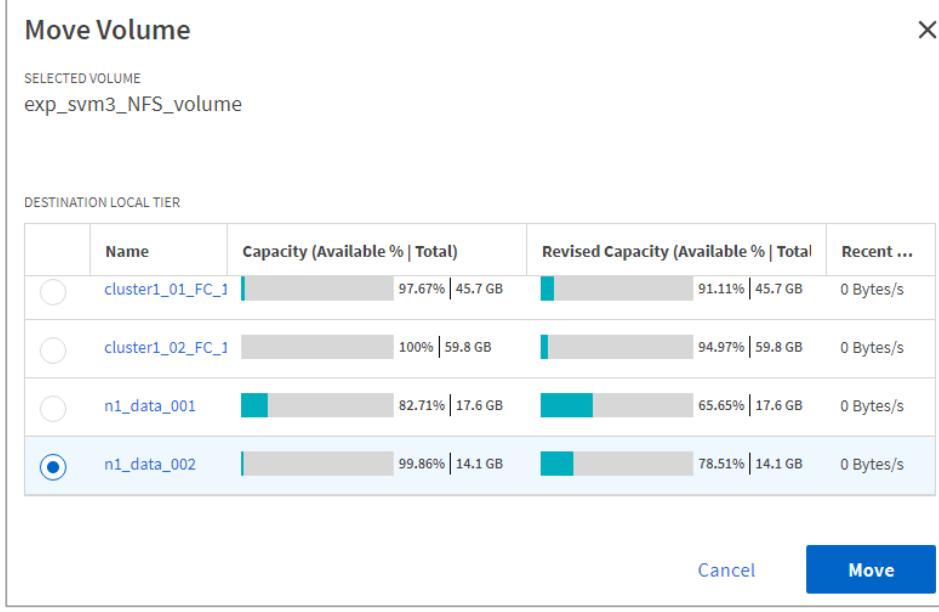
Step	Action
2-1	Remain in the ONTAP System Manager session on cluster1.
2-2	Go to the <b>Tiers</b> page.
2-3	Note the amount of space that is available on each aggregate.
2-4	 Your capacity can vary depending on your exercise kit configuration.

Step	Action
2-5	<p>Navigate to the list of volumes on svm3.</p> 
2-6	<p>Rest your mouse pointer on the <b>exp_svm3_NFS_volume</b> volume name until the More menu button appears.</p>
2-7	<p>Click <b>More</b>, and then select <b>Edit</b>.</p> 

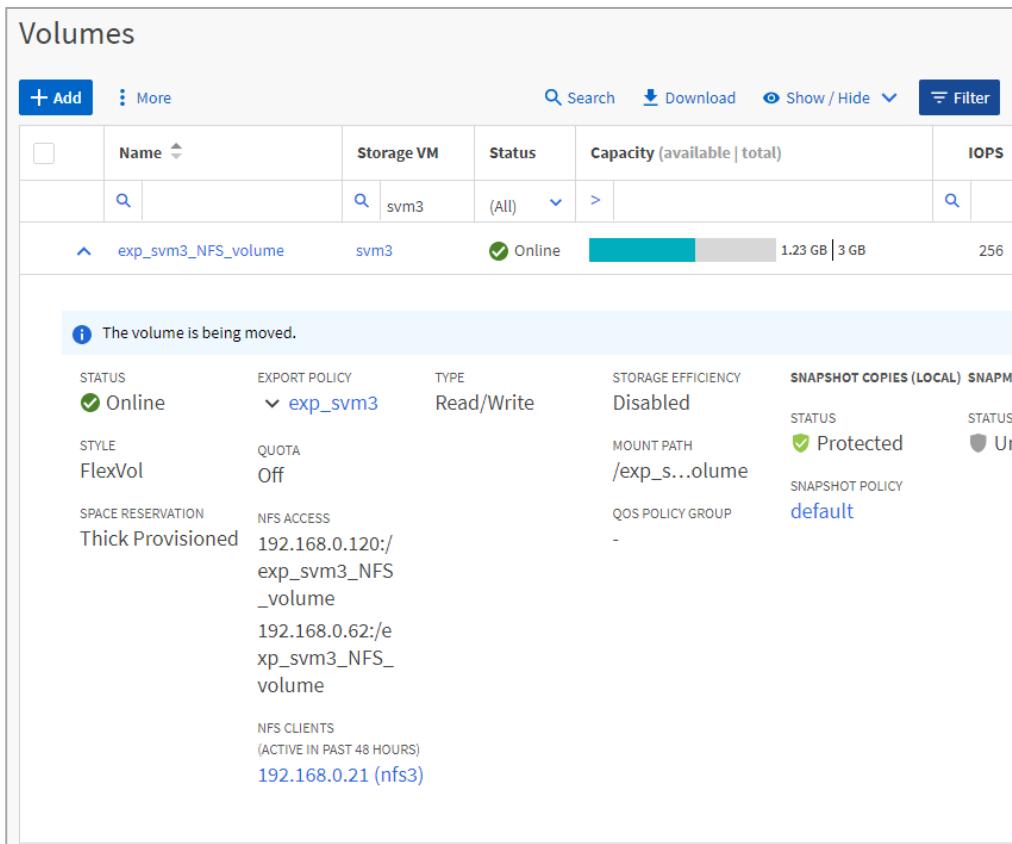
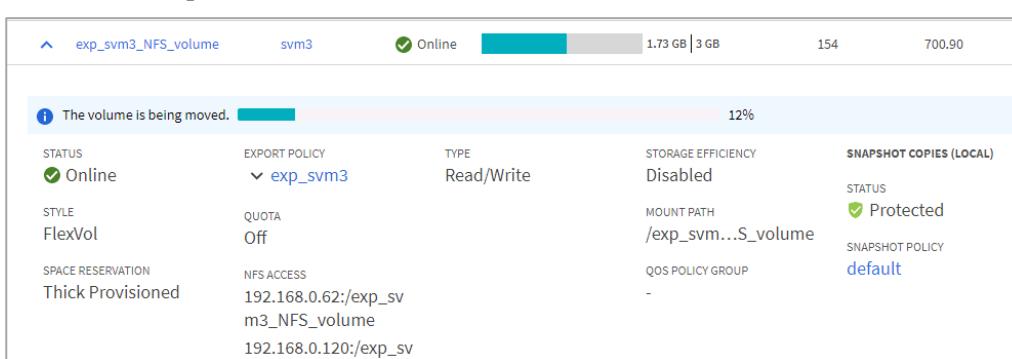
Step	Action
2-8	In the Edit Volume dialog box, increase the volume Capacity to <b>3 GB</b> .
	
2-9	Set the Unix permissions on the volume so that all users can read and write data.
	
2-10	Leave all the other parameters set to their default values and click <b>Save</b> .
2-11	Verify that the new capacity of the volume is 3GB.
	

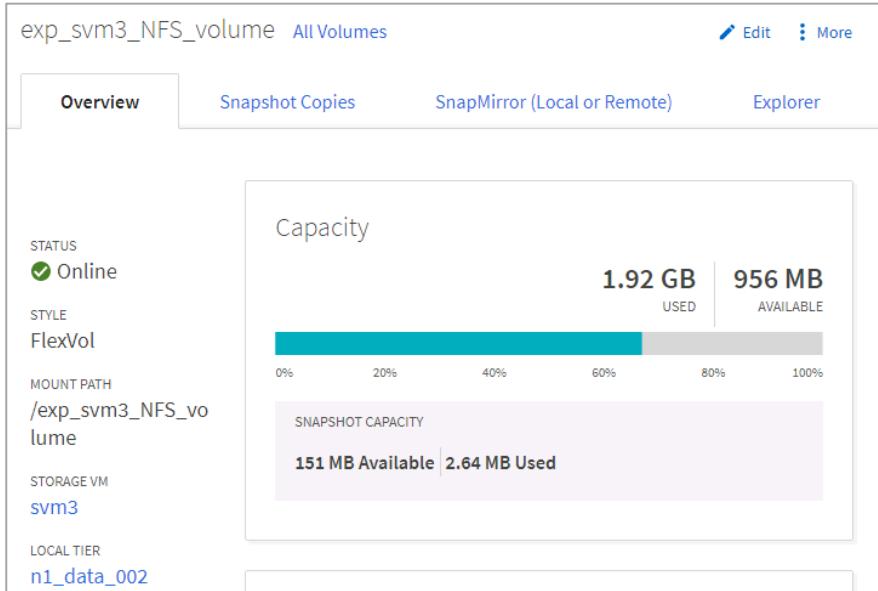
## Task 3: Move a Volume

Step	Action
3-1	<p>Open a PuTTY session with your Linux host which is named <b>centos65</b>.</p> 
3-2	<p>From PuTTY, log in to your Linux system:</p> <ul style="list-style-type: none"> <li>▪ User name: <b>root</b></li> <li>▪ Password: <b>Netapp1!</b></li> </ul> <p><b>i</b> You might experience a delay of about 15 seconds. You can open multiple sessions of PuTTY by right-clicking the PuTTY icon in the taskbar.</p>
3-3	<p>Mount the svm3 namespace to a mount point directory on the Linux client:</p> <pre>mkdir /mnt/svm3 mount 192.168.0.62:/ /mnt/svm3</pre>
3-4	<p><b>i</b> You learn about export policies and NFS mounts in Module 7.</p>
3-5	<p>Navigate to the exp_svm3_NFS_volume:</p> <pre>cd /mnt/svm3/exp_svm3_NFS_volume</pre>
3-6	<p>Confirm the available space in the exported volume:</p> <pre>df -h .</pre> <p><b>Note:</b> The period tells the Linux disk free command to display information about only the directory in which you are currently located.</p>
3-7	<p>Write a 2GB file into the exp_svm3_NFS_volume:</p> <pre>dd if=/dev/zero of=hugefile bs=4K count=500000</pre> <p><b>i</b> You type a 5 followed by five zeroes. Because the operation can take several minutes, you should continue the next step while the operation runs.</p>

Step	Action
3-8	<p>In System Manager, on the svm3 volume list, rest your mouse pointer on the <b>exp_svm3_NFS_volume</b> volume name, click <b>More</b>, and then select <b>Move</b>. The Move Volume dialog box appears.</p>  <p>The screenshot shows the 'Volumes' list in System Manager. A context menu is open over the 'exp_svm3_NFS_volume' row. The 'Move' option is highlighted with a dark blue background and white text. Other options visible in the menu include Edit, Delete, Clone, Take Offline, Enable Quota, Edit Export Policy, Edit Mount Path, and Protect.</p>
	<p>The Move Volume dialog box appears.</p>
3-9	<p><b>i</b> In subsequent steps, you move the volume to another aggregate across the cluster interconnect. Moving the volume while the file hugefile is being written does not interrupt the write operation.</p>
3-10	<p>In the Destination Local Tier section, select <b>n1_data_002</b>, and then click <b>Move</b>.</p>  <p>The screenshot shows the 'Move Volume' dialog box. Under 'SELECTED VOLUME', it says 'exp_svm3_NFS_volume'. In the 'DESTINATION LOCAL TIER' section, there is a table with four rows. The fourth row, 'n1_data_002', has a radio button next to it which is selected, indicated by a blue outline. The other three rows are 'cluster1_01_FC_1', 'cluster1_02_FC_1', and 'n1_data_001'. At the bottom right of the dialog box are 'Cancel' and 'Move' buttons.</p>

Step	Action																													
3-11	<p>Confirm your decision by clicking <b>Move</b> again.</p> <div> <h3>Move Volume</h3> <p>SELECTED VOLUME exp_svm3_NFS_volume</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Issue</th> </tr> </thead> <tbody> <tr> <td>exp_svm3_NFS_volume</td> <td><span style="color: orange;">⚠</span> Warning: The caching policy associated with the volume being moved in the destination local tier cannot be preserved. The destination is a Flash Pool. The caching policy will be disabled in the destination.</td> </tr> </tbody> </table> <p>DESTINATION LOCAL TIER</p> <table border="1"> <thead> <tr> <th></th> <th>Name</th> <th>Capacity (Available %   Total)</th> <th>Revised Capacity (Available %   Total)</th> <th>Recent ...</th> </tr> </thead> <tbody> <tr> <td><input type="radio"/></td> <td>cluster1_01_FC_1</td> <td>97.67%   45.7 GB</td> <td>91.11%   45.7 GB</td> <td>0 Bytes/s</td> </tr> <tr> <td><input type="radio"/></td> <td>cluster1_02_FC_1</td> <td>100%   59.8 GB</td> <td>94.97%   59.8 GB</td> <td>0 Bytes/s</td> </tr> <tr> <td><input type="radio"/></td> <td>n1_data_001</td> <td>82.71%   17.6 GB</td> <td>65.65%   17.6 GB</td> <td>0 Bytes/s</td> </tr> <tr> <td><input checked="" type="radio"/></td> <td>n1_data_002</td> <td>99.86%   14.1 GB</td> <td>78.51%   14.1 GB</td> <td>0 Bytes/s</td> </tr> </tbody> </table> <p style="text-align: right;"><a href="#">Cancel</a> <span style="background-color: blue; color: white; padding: 5px 10px; border-radius: 5px;">Move</span></p> </div>	Name	Issue	exp_svm3_NFS_volume	<span style="color: orange;">⚠</span> Warning: The caching policy associated with the volume being moved in the destination local tier cannot be preserved. The destination is a Flash Pool. The caching policy will be disabled in the destination.		Name	Capacity (Available %   Total)	Revised Capacity (Available %   Total)	Recent ...	<input type="radio"/>	cluster1_01_FC_1	97.67%   45.7 GB	91.11%   45.7 GB	0 Bytes/s	<input type="radio"/>	cluster1_02_FC_1	100%   59.8 GB	94.97%   59.8 GB	0 Bytes/s	<input type="radio"/>	n1_data_001	82.71%   17.6 GB	65.65%   17.6 GB	0 Bytes/s	<input checked="" type="radio"/>	n1_data_002	99.86%   14.1 GB	78.51%   14.1 GB	0 Bytes/s
Name	Issue																													
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	Name	Capacity (Available %   Total)	Revised Capacity (Available %   Total)	Recent ...																										
<input type="radio"/>	cluster1_01_FC_1	97.67%   45.7 GB	91.11%   45.7 GB	0 Bytes/s																										
<input type="radio"/>	cluster1_02_FC_1	100%   59.8 GB	94.97%   59.8 GB	0 Bytes/s																										
<input type="radio"/>	n1_data_001	82.71%   17.6 GB	65.65%   17.6 GB	0 Bytes/s																										
<input checked="" type="radio"/>	n1_data_002	99.86%   14.1 GB	78.51%   14.1 GB	0 Bytes/s																										

Step	Action
3-12	<p>In the Volumes page, expand the <b>exp_svm3_NFS_volume</b> entry and observe the status.</p> 
3-13	<p>Click <b>exp_svm3_NFS_volume</b> to display the volume details and monitor the progress of the volume move operation.</p> 
3-14	<p>Go back to PuTTY and check the Linux system to confirm the completion of the write operation and the space that is used in the volume:</p> <pre>df -h /mnt/svm3/exp_svm3_NFS_volume</pre>
3-15	<p>Periodically monitor the progress of the move operation until it finishes. The instructor might start teaching the next module while the volume move runs.</p>

Step	Action
3-16	<p>When the move is complete (in approximately 5 minutes), verify that the volume is now on n1_data_002.</p>  <p>Capacity</p> <p>1.92 GB   956 MB</p> <p>USED AVAILABLE</p> <p>0% 20% 40% 60% 80% 100%</p> <p>SNAPSHOT CAPACITY</p> <p>151 MB Available   2.64 MB Used</p>

### End of Exercise

# Module 7: Data Access

## Exercise 1: Configuring the NFS Protocol in an SVM

In this exercise, you use best practice tools to create a simple NFS server in a storage VM.

### Objectives

This exercise focuses on enabling you to do the following:

- Configure an SVM to host the NFS protocol
- Access an NFS export from a Linux client

### Case Study

It might be a long time before the IT staff can fully integrate the authentication domain of Dwurgle Enterprises with Zarrot Industries. In the meantime, the easiest way to enable the employees of Dwurgle to access the NetApp system is to create a storage virtual machine which authenticates the users' identities by using the Dwurgle domain.

You create an SVM for Dwurgle and enable the NFS access protocol.

You create an NFS exported directory and verify that Dwurgle client hosts can access it.

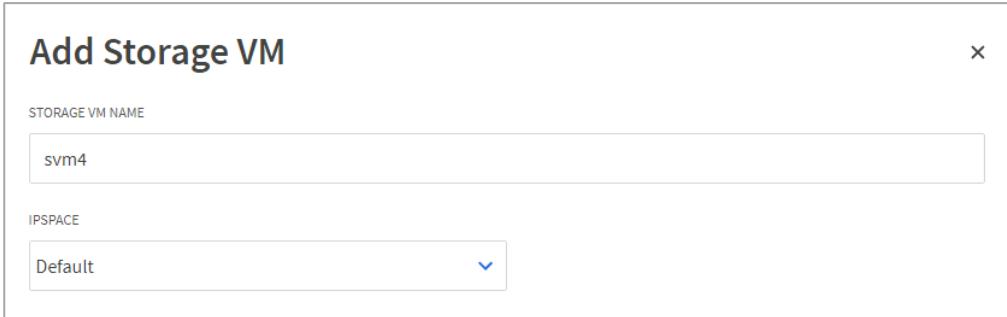
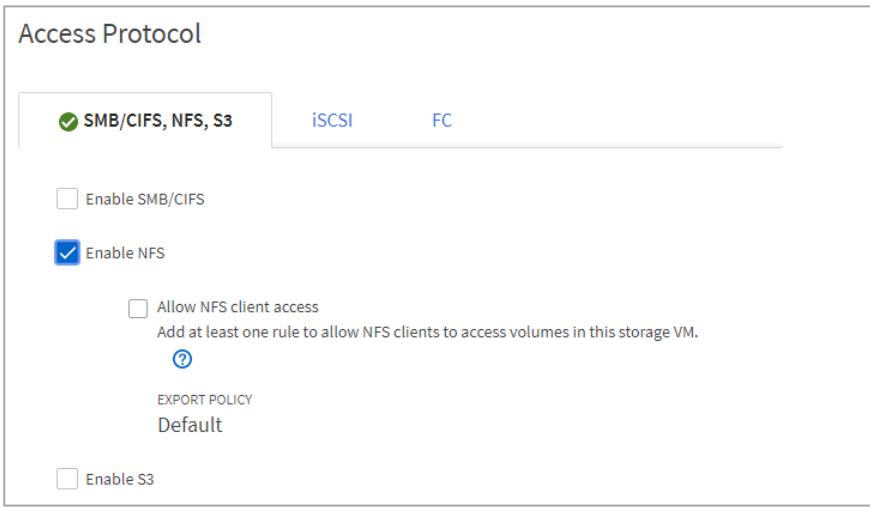
### Exercise Equipment

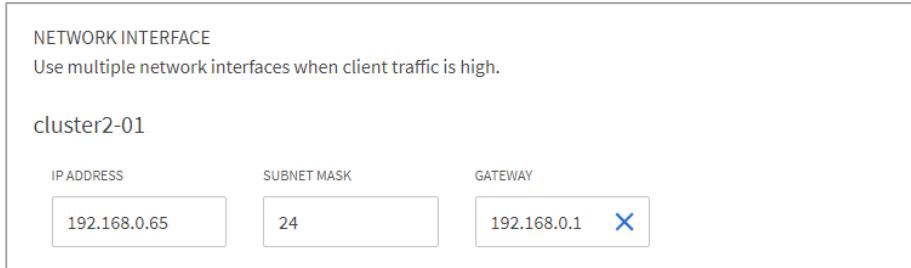
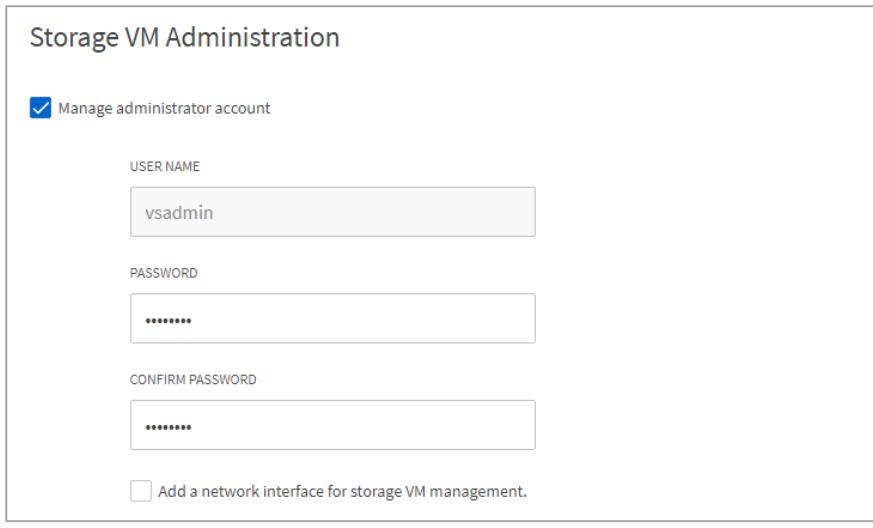
In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!
Windows Domain Controller	DC1	192.168.0.253	DEMO\Administrator	Netapp1!

### Task 1: Create an SVM to host the NFS Protocol

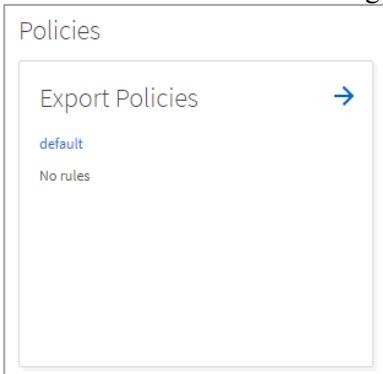
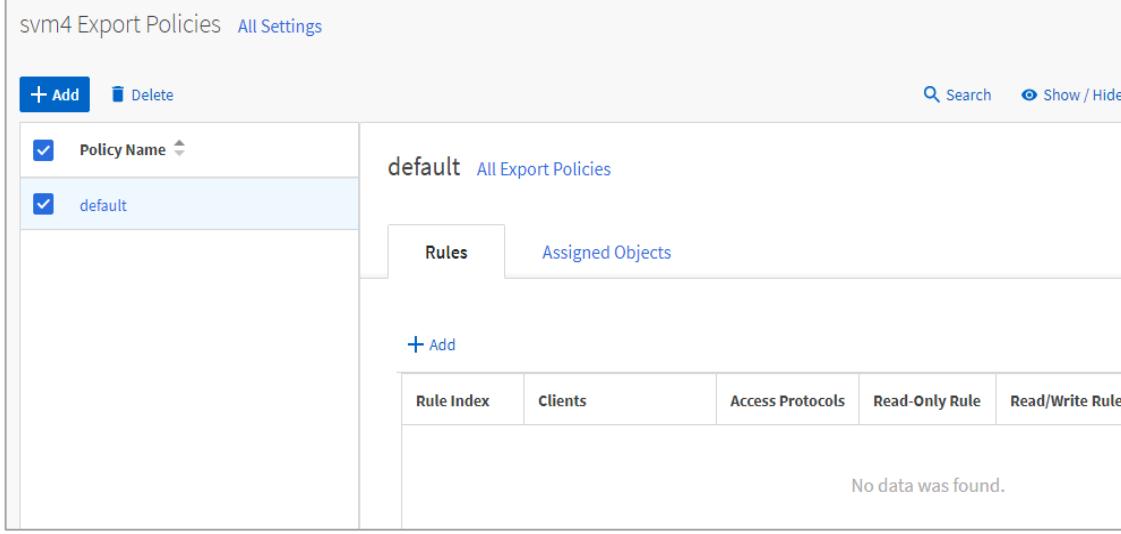
Step	Action
1-1	Log into the ONTAP System Manager for <b>cluster2</b> .
1-2	Go to the <b>Storage &gt; Storage VMs</b> page.
1-3	Click <b>Add</b> .

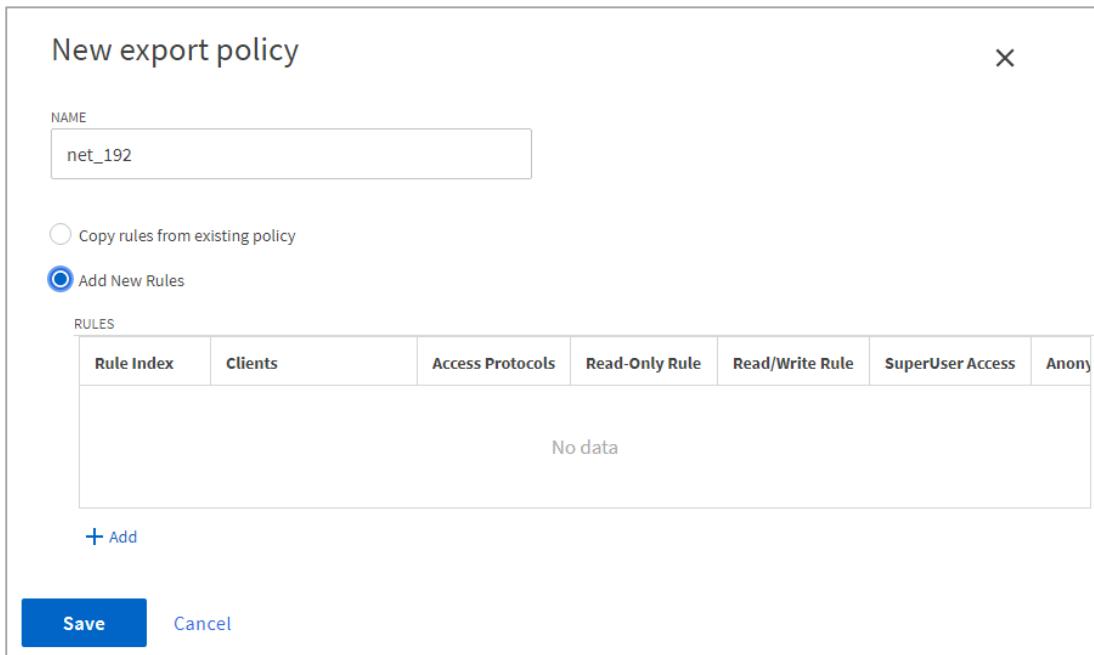
Step	Action
1-4	<p>In the Add Storage VM page, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ SVM Name: <b>svm4</b></li> <li>▪ IPspace: <b>Default (default)</b></li> </ul> 
1-5	<p>Scroll down to the Access Protocol section of the Add Storage VM page and select the <b>Enable NFS</b> checkbox.</p> 
1-6	<p> The Default export policy does not allow client access. You create an export policy to grant access later.</p>
1-7	<p>Do not change the default language.</p> 

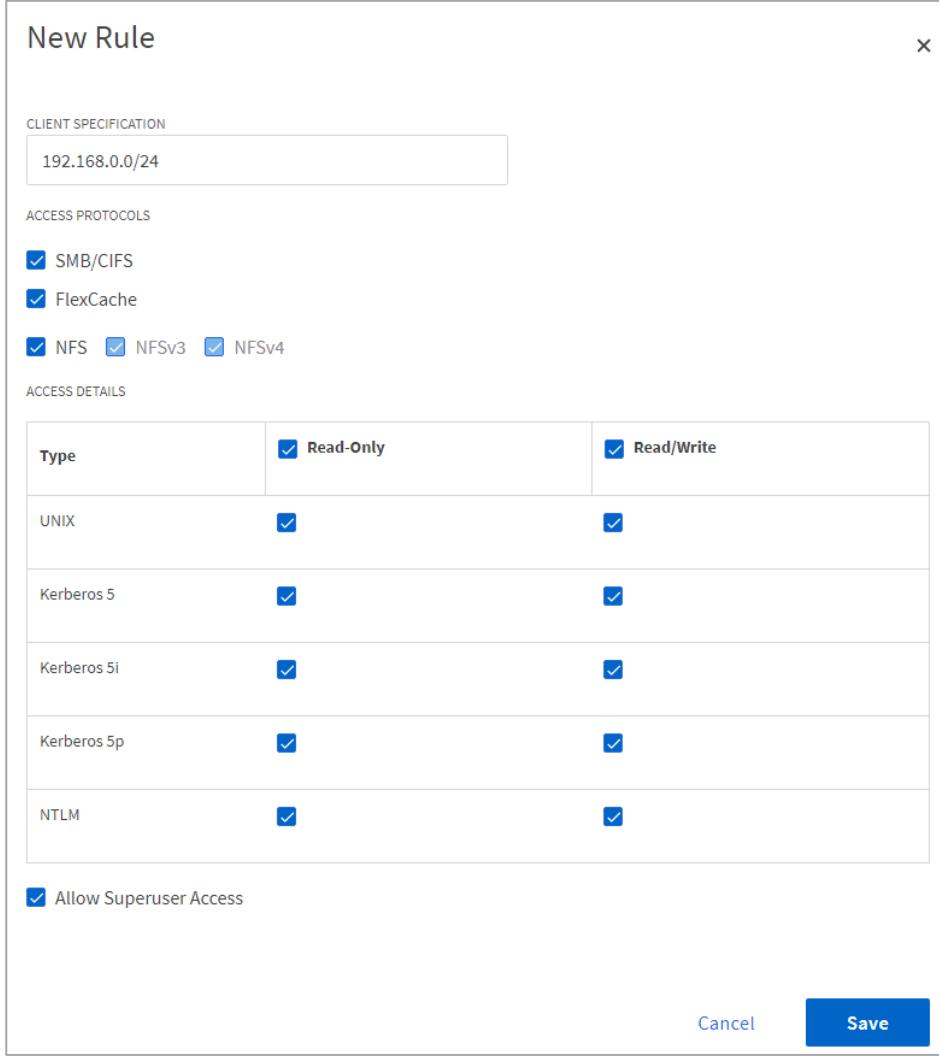
Step	Action
1-8	<p>In the Access Protocol section of the Add Storage VM page, specify the following settings:</p> <ul style="list-style-type: none"> <li>IP Address: <b>192.168.0.65</b></li> <li>Subnet mask: <b>24</b></li> <li>Gateway: <b>192.168.0.1 (default)</b></li> </ul> 
1-9	<p>In the Storage VM Administration section of the Add Storage VM page, select the <b>Manage administrator account</b> checkbox and specify the following setting:</p> <ul style="list-style-type: none"> <li>User Name: <b>vsadmin (default)</b></li> <li>Password: <b>Netapp1!</b></li> <li>Add a network interface for storage VM management: <i>unselected (default)</i></li> </ul> 
1-10	Review the configuration and then click <b>Save</b> .

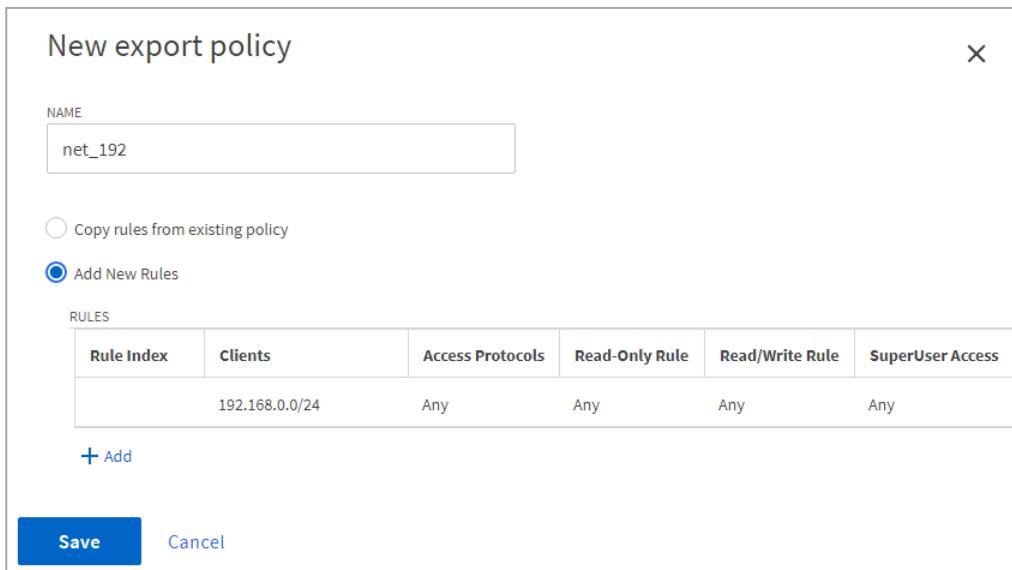
## Task 2: Create an SVM export policy

Step	Action
2-1	On the list of Storage VMs, click <b>svm4</b> .
2-2	On the Storage VM details page for svm4, click <b>Settings</b> .

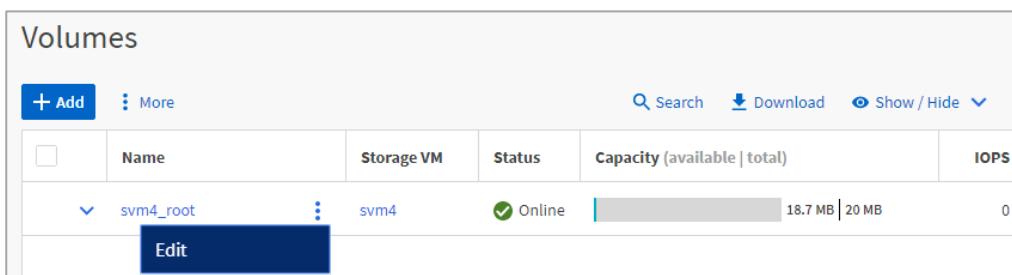
Step	Action										
2-3	<p>Scroll down in the SVM Settings page and click the arrow in the Export Policies pane.</p> 										
2-4	<p>Select the <b>default</b> policy, and then in the <b>Rules</b> tab, observe that the default export policy contains no rules granting access to client hosts.</p>  <table border="1" data-bbox="687 1058 1421 1199"> <thead> <tr> <th>Rule Index</th> <th>Clients</th> <th>Access Protocols</th> <th>Read-Only Rule</th> <th>Read/Write Rule</th> </tr> </thead> <tbody> <tr> <td colspan="5">No data was found.</td> </tr> </tbody> </table>	Rule Index	Clients	Access Protocols	Read-Only Rule	Read/Write Rule	No data was found.				
Rule Index	Clients	Access Protocols	Read-Only Rule	Read/Write Rule							
No data was found.											
2-5	<p>In the upper left of the export policies page, click the <b>Add</b> button to create a new export policy.</p>										

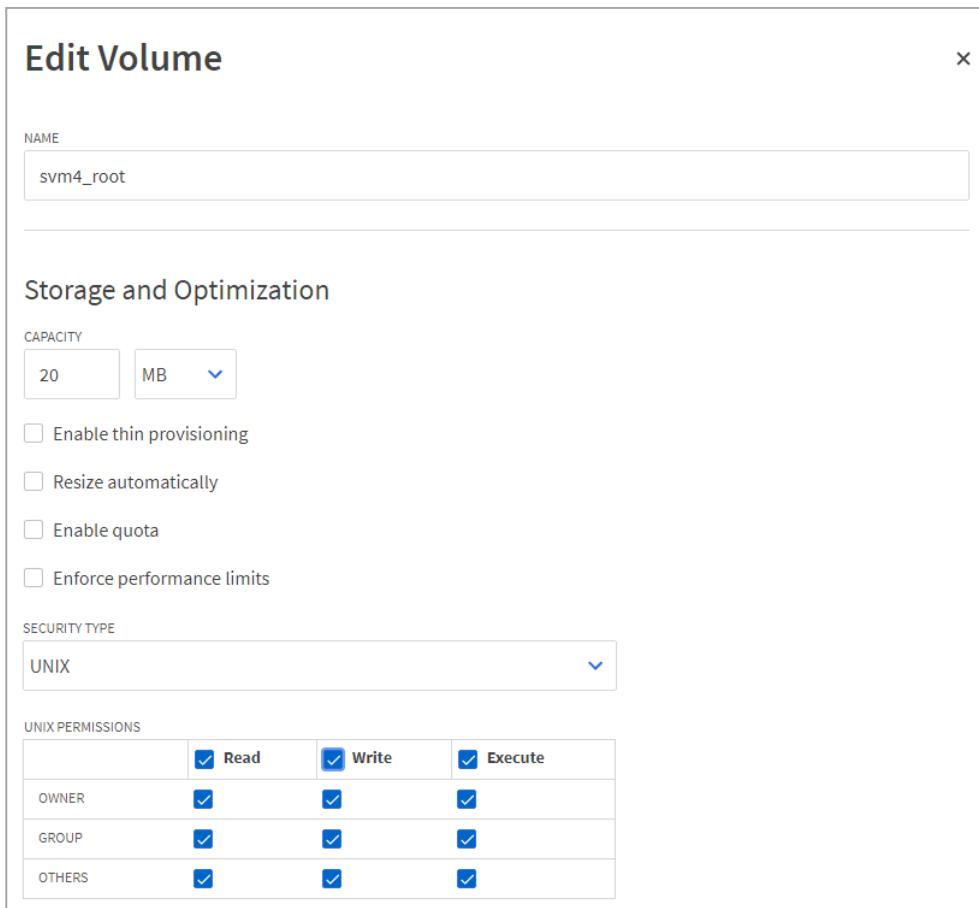
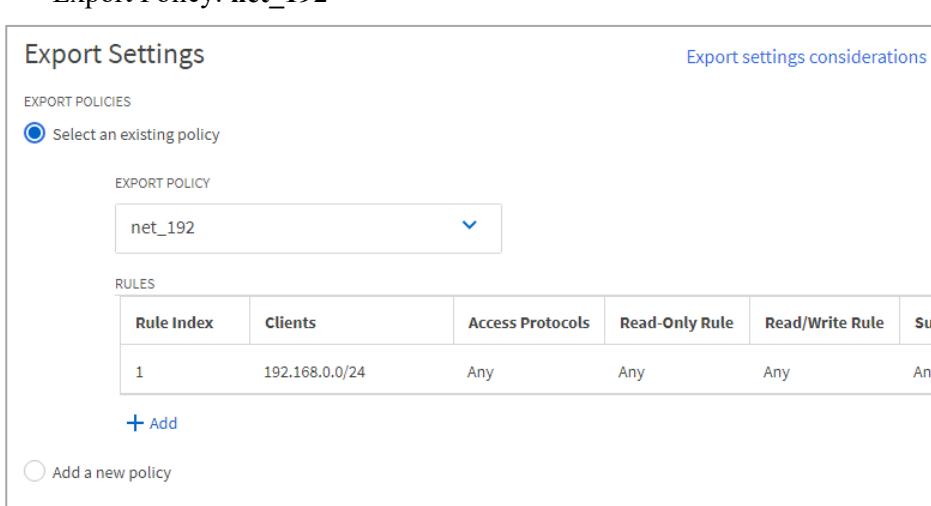
Step	Action
2-6	<p>In the New export policy dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Name: <b>net_192</b></li> <li>▪ Add New Rules: <b>selected</b></li> </ul> 
2-7	Click <b>Add</b> to create an export policy rule.

Step	Action
2-8	<p>In the New Rule dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Client Specification: <b>192.168.0.0/24</b></li> <li>▪ Access Protocols: <b>SMB/CIFS, FlexCache, and NFS</b></li> <li>▪ Access Details: <b>Read-Only</b> and <b>Read/Write</b></li> <li>▪ Allow Superuser Access: <b>selected</b></li> </ul>  <p>The screenshot shows the 'New Rule' dialog box. In the 'CLIENT SPECIFICATION' section, the IP address '192.168.0.0/24' is entered. Under 'ACCESS PROTOCOLS', 'SMB/CIFS' and 'FlexCache' are selected. In the 'ACCESS DETAILS' section, both 'Read-Only' and 'Read/Write' checkboxes are checked. The 'Allow Superuser Access' checkbox is also checked. At the bottom, there are 'Cancel' and 'Save' buttons.</p>
2-9	Click <b>Save</b> to save the export rule.

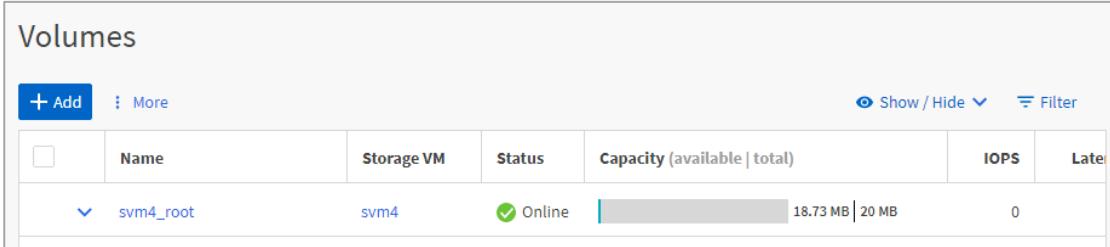
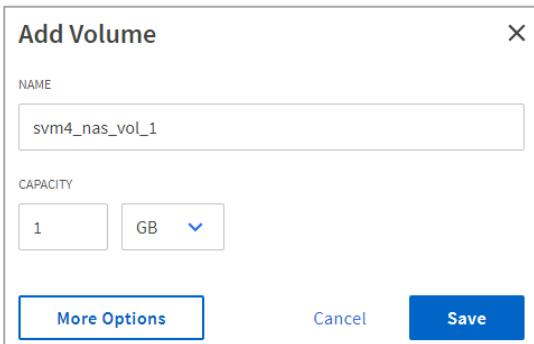
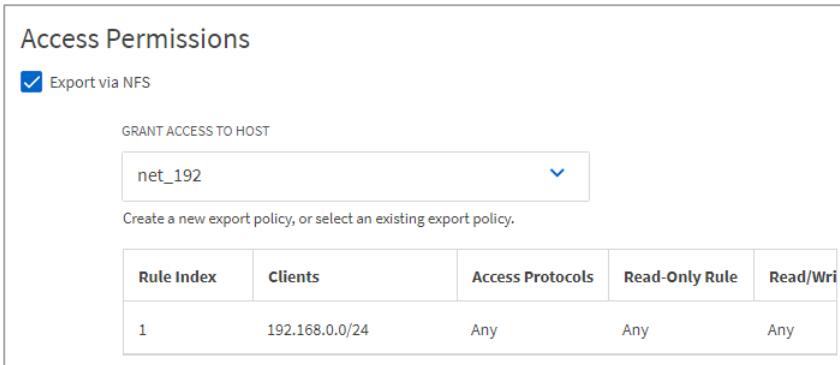
Step	Action
2-10	<p>Click <b>Save</b> to save the export policy.</p> 

## Task 3: Enable User Access to a Volume

Step	Action
3-1	Go to the <b>Storage &gt; Volumes</b> page.
3-2	<p>Position your cursor over <b>svm4_root</b>, and then select <b>Edit</b> from the <b>More</b> menu.</p> 

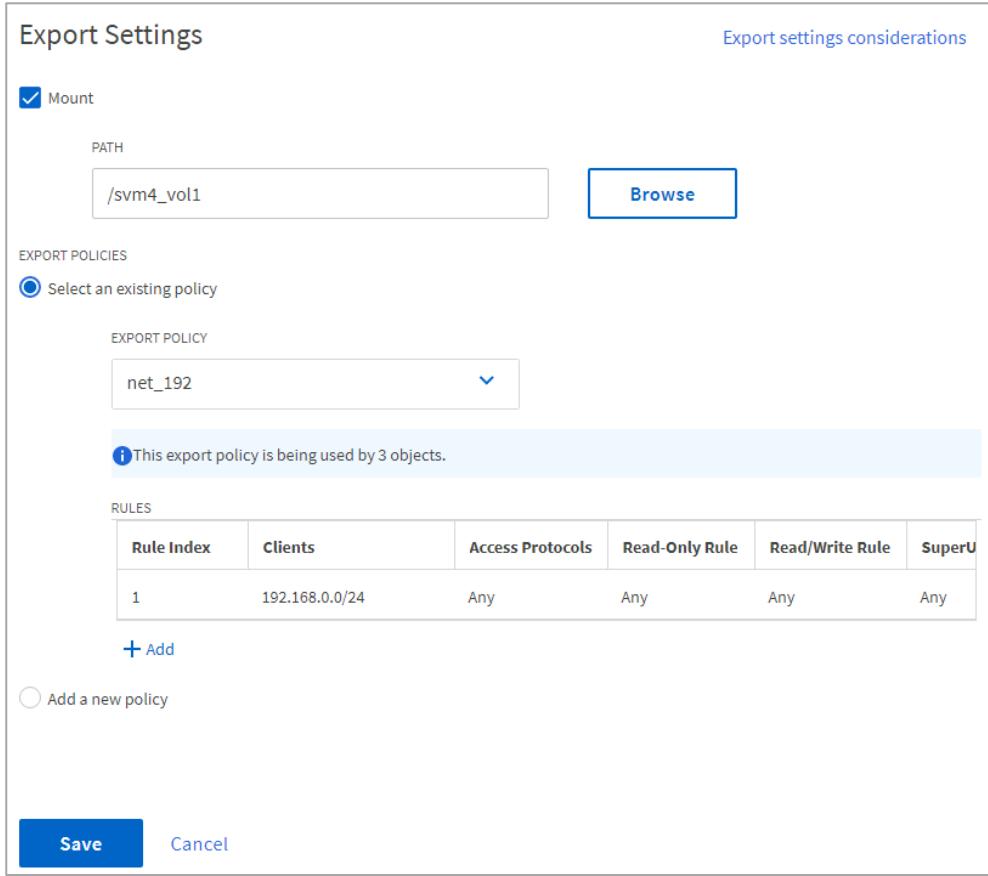
Step	Action
3-3	<p>In the Edit Volume dialog box, enable <b>Write</b> permission for Group and Others.</p> 
3-4	<p>Scroll down in the Edit Volume dialog box and specify the following settings:</p> <ul style="list-style-type: none"> <li>Select an existing policy: <b>selected (default)</b></li> <li>Export Policy: <b>net_192</b></li> </ul> 
3-5	Click <b>Save</b> .

## Task 4: Create a NAS Data Volume

Step	Action
4-1	In the Volumes page, click <b>Add</b> .
	
4-2	In the Add Volume dialog box specify the following settings: <ul style="list-style-type: none"><li>▪ Name: <b>svm4_nas_vol_1</b></li><li>▪ Capacity: <b>1 GB</b></li></ul>
	
4-3	Click <b>More Options</b> .
4-4	Scroll down to the Access Permissions section and specify the following settings: <ul style="list-style-type: none"><li>▪ Export via NFS: <b>selected (default)</b></li><li>▪ Grant Access to Host: <b>net_192</b></li></ul>
	
4-5	Click <b>Save</b> .

## Task 5: Change a Volume Mount Path

Step	Action
5-1	In the Volumes page, expand <b>svm4_nas_vol_1</b> , and note the Mount Path.
5-2	With the <b>svm4_nas_vol_1</b> volume selected, choose <b>Edit</b> from the More menu.

Step	Action
<b>5-3</b>	<p>Scroll down to the Export Settings section of the Edit Volume page and specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Mount Path: <b>/svm4_vol1</b></li> <li>▪ Export policies: <b>selected</b></li> </ul>  <p>The screenshot shows the 'Export Settings' dialog box. At the top left is a checked checkbox labeled 'Mount'. Below it is a 'PATH' input field containing '/svm4_vol1' with a 'Browse' button to its right. Under 'EXPORT POLICIES', there is a radio button labeled 'Select an existing policy' which is selected, and a dropdown menu showing 'net_192'. A note below the dropdown states 'This export policy is being used by 3 objects.' Below the policy selection is a table titled 'RULES' with columns: Rule Index, Clients, Access Protocols, Read-Only Rule, Read/Write Rule, and SuperU. One row is present with Rule Index 1, Clients 192.168.0.0/24, and Access Protocols Any. At the bottom of the dialog are 'Save' and 'Cancel' buttons.</p>
<b>5-4</b>	Note the export policy that was assigned to the volume when the volume was created and the client hosts that are granted access.
<b>5-5</b>	Click <b>Save</b> .

Step	Action
5-6	<p>In the Volumes page, observe the Mount Path and the NFS Access name.</p>

## Task 6: Access an NFS Export from a Linux Client

Step	Action
6-1	<p>From PuTTY, log in to your Linux computer:</p> <ul style="list-style-type: none"> <li>Username: <b>root</b></li> <li>Password: <b>Netapp1!</b></li> </ul>
6-2	<p>Create directories for the NFS mounts:</p> <pre>mkdir /mnt/svm4 mkdir /mnt/vol1</pre>
6-3	<p>Using the IP address of either data LIF within svm1, access svm1 exports through NFS:</p> <pre>mount -t nfs 192.168.0.65:/ /mnt/svm4 mount -t nfs 192.168.0.65:/svm4_vvol1 /mnt/vol1</pre>
6-4	<p><b>i</b> You are not mounting CIFS shares or volume names. You are mounting paths in the namespace.</p>
6-5	<p>Explore both NFS mounts, which are mounted at different points in the svm4 namespace.</p> <pre>cd /mnt/svm4 ls cd svm4_vvol1 touch my_monkey ls cd /mnt/vol1 ls</pre>

**End of Exercise**

## Exercise 2: Configuring the SMB Protocol in an SVM

In this exercise, you use best practice tools to create a simple SMB server in an SVM.

### Objectives

This exercise focuses on enabling you to do the following:

- Configure an SVM to host the SMB protocol
- Verify and create SMB shares
- Access SMB shares from a Windows client

### Case Study

It might be a long time before the IT staff can fully integrate the authentication domain of Dwurgle Enterprises with Zarrot Industries. In the meantime, the easiest way to enable the employees of Dwurgle to access the NetApp system is to authenticate the users' identities by using the Dwurgle Windows Active Directory domain.

You enable the SMB access protocol on the NAS storage VM.

You create an SMB share and verify that users from the Dwurgle domain can access it.

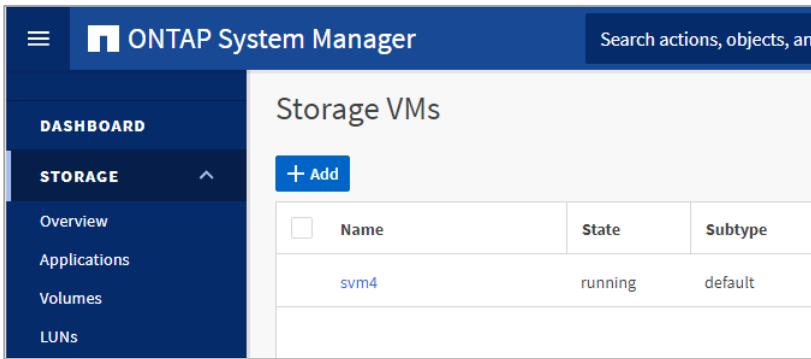
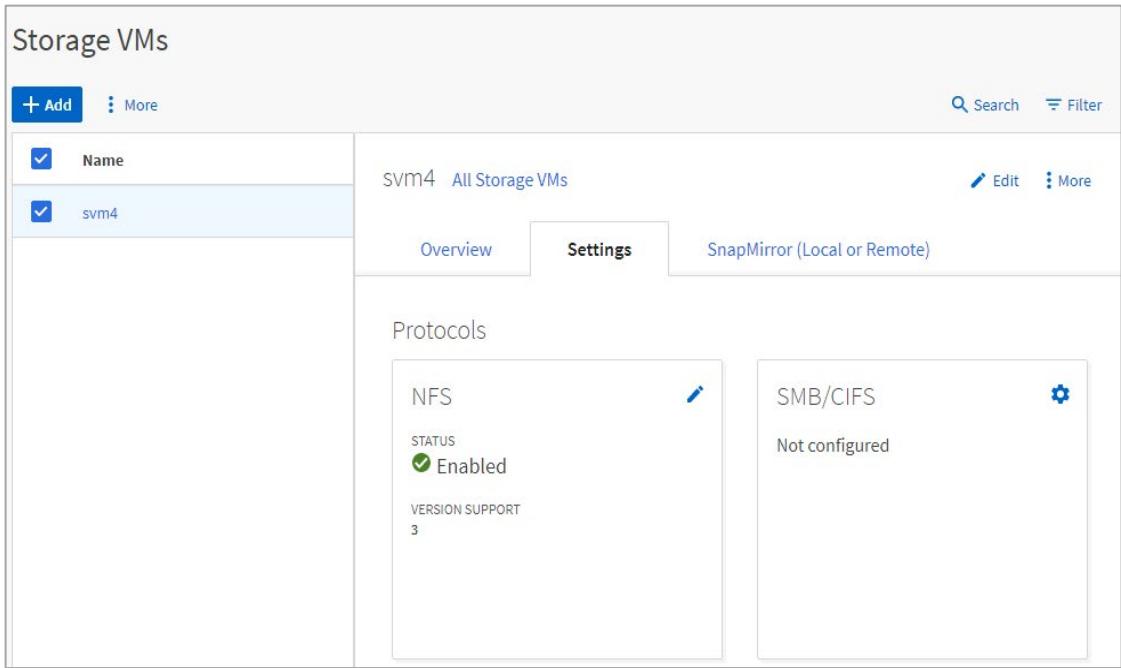
### Exercise Equipment

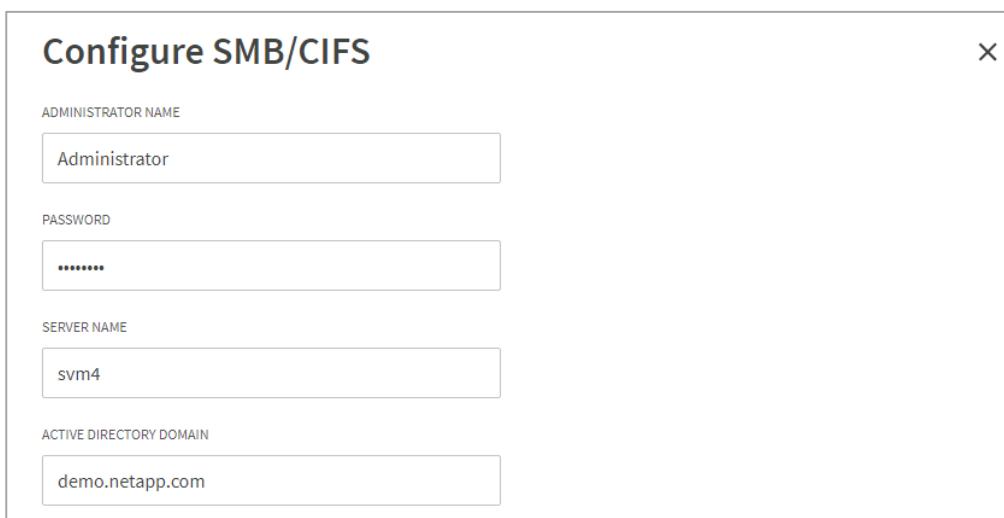
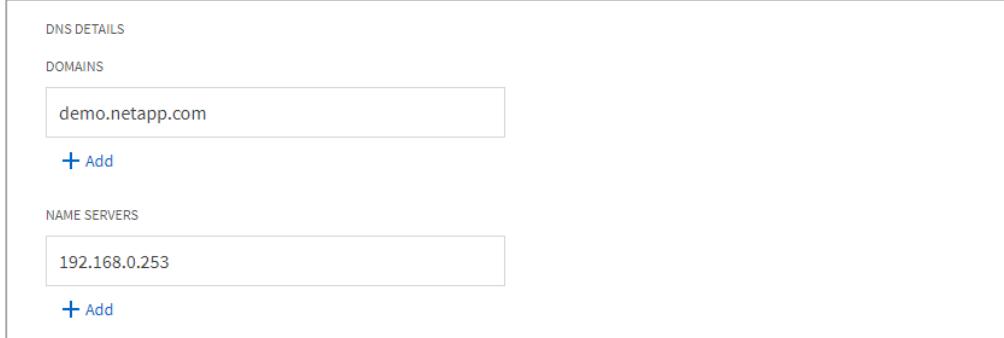
In this exercise, you use the following systems.

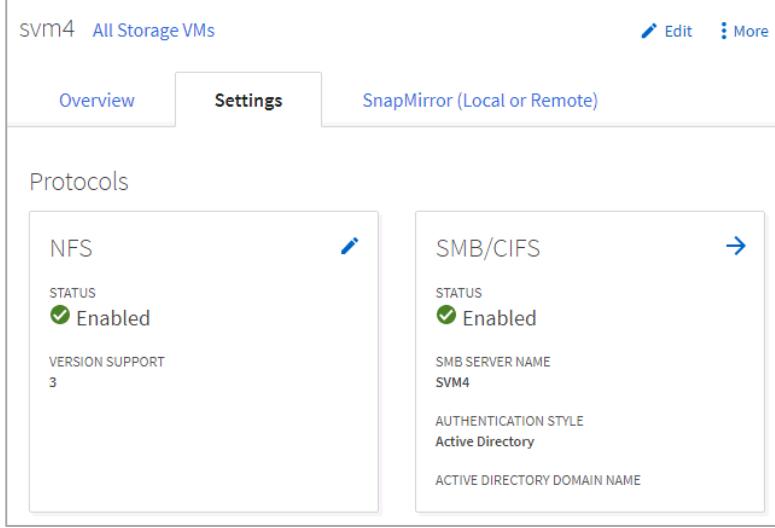
System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!
Windows Domain Controller	DC1	192.168.0.253	DEMO\Administrator	Netapp1!

### Task 1: Configure an SVM to Host the SMB Protocol

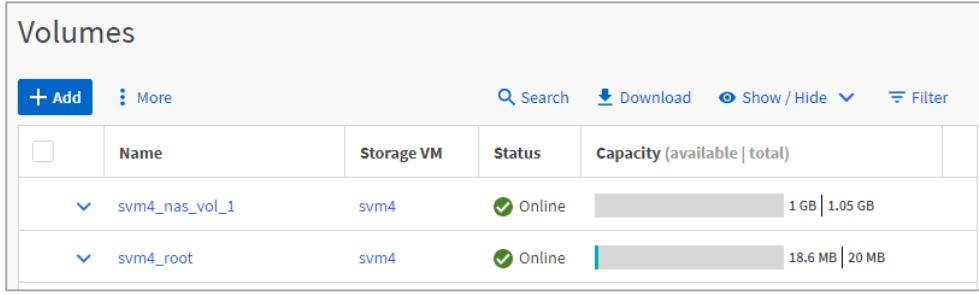
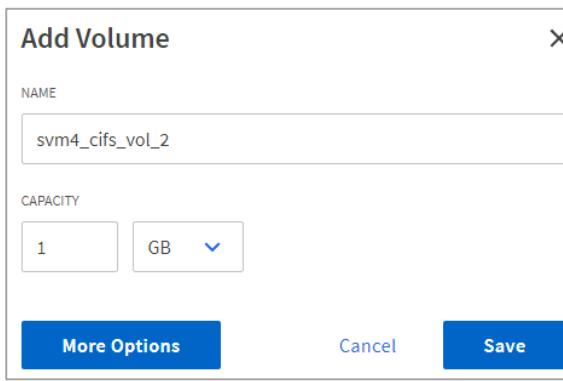
Step	Action
1-1	Begin a session with the ONTAP System Manager on <b>cluster2</b> .
1-2	Go to the <b>Storage &gt; Storage VMs</b> page.

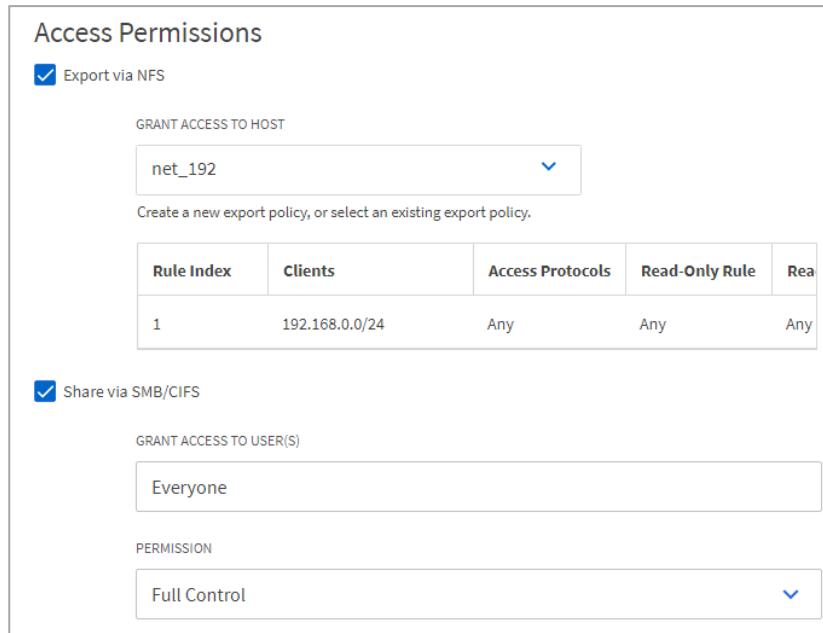
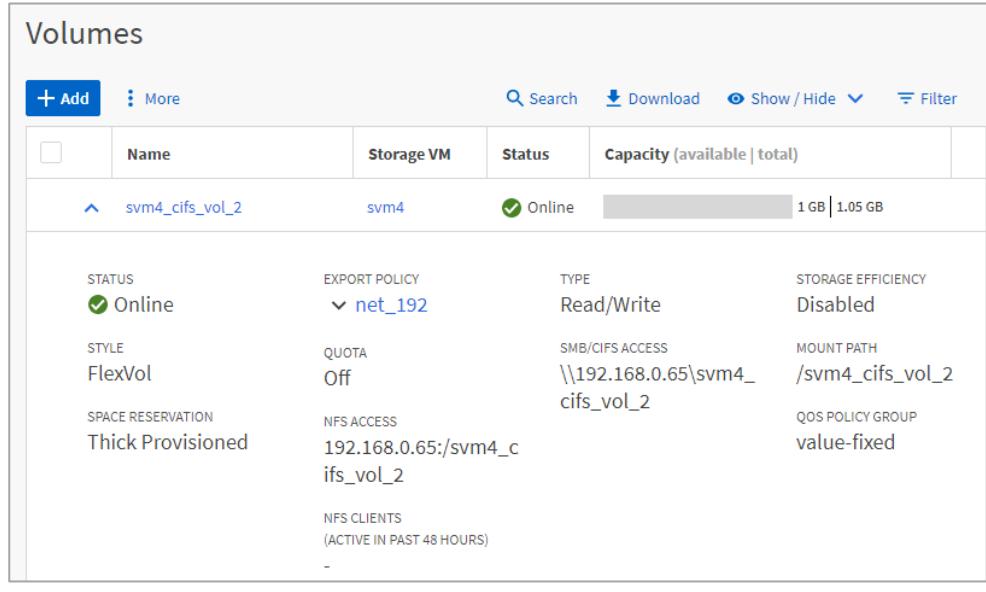
Step	Action
1-3	Click <b>svm4</b> .
	
1-4	In the svm4 storage VM page, click <b>Settings</b> .
1-5	Click the <b>gear icon</b> in the SMB/CIFS panel.
	

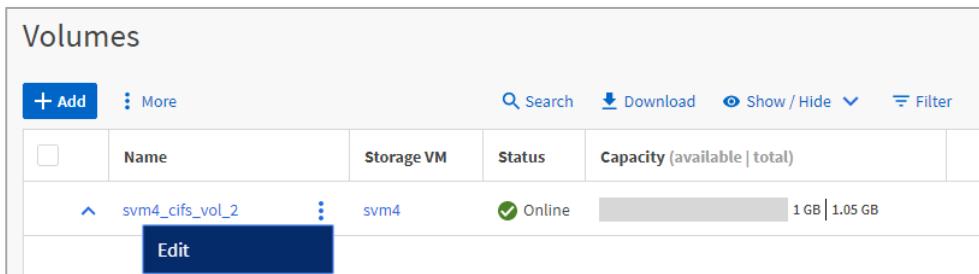
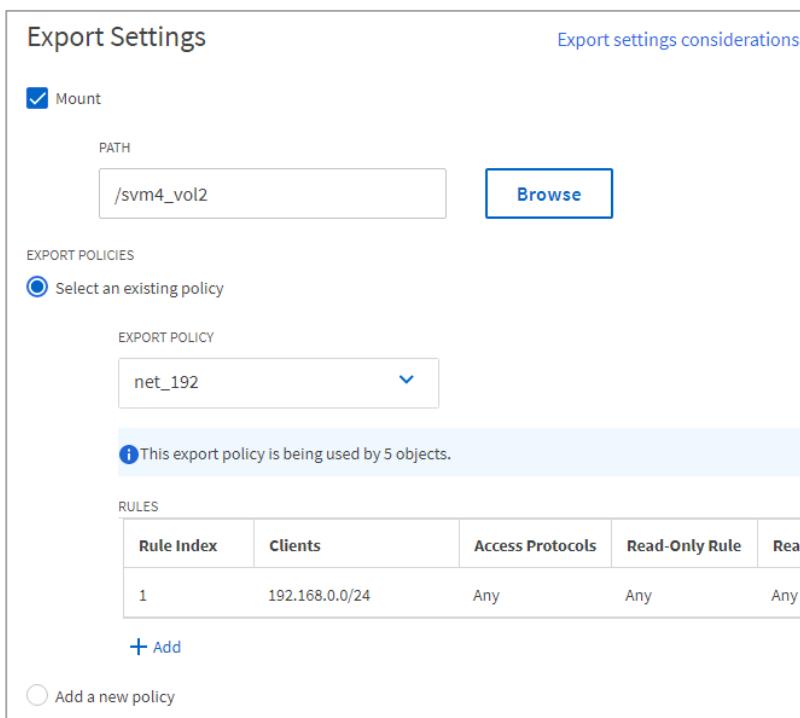
Step	Action
1-6	<p>In the Configure SMB/CIFS page, specify the following settings:</p> <ul style="list-style-type: none"> <li>Administrator Name: <b>Administrator</b></li> <li>Password: <b>Netapp1!</b></li> <li>Server Name: <b>svm4</b></li> <li>Active Directory Domain: <b>demo.netapp.com</b></li> </ul> 
1-7	 <p>The DNS domain name and NTP servers are inherited from the cluster admin SVM.</p>
1-8	<p>Change the DNS Details settings as needed for the data SVM:</p> <ul style="list-style-type: none"> <li>DNS Domain: <b>demo.netapp.com</b> (<i>default</i>)</li> <li>Name Servers: <b>192.168.0.253</b> (<i>default</i>)</li> </ul> 
1-9	<p>Share the logical network interfaces that are used for the NFS protocol:</p> <ul style="list-style-type: none"> <li>IP Address: <b>192.168.0.65</b></li> <li>Subnet mask: <b>24</b></li> <li>Gateway: <b>192.168.0.1</b> (<i>default</i>)</li> </ul> 
1-10	<p>Review the configuration and then click <b>Save</b>.</p>

Step	Action
1-11	<p>Verify that SMB/CIFS has been enabled on the storage VM.</p>  <p>The screenshot shows the SVM4 Settings page. The 'Protocols' section displays two entries: 'NFS' and 'SMB/CIFS'. Both are listed as 'Enabled'. The 'SMB/CIFS' entry includes fields for 'SMB SERVER NAME' (SVM4), 'AUTHENTICATION STYLE' (Active Directory), and 'ACTIVE DIRECTORY DOMAIN NAME'.</p>

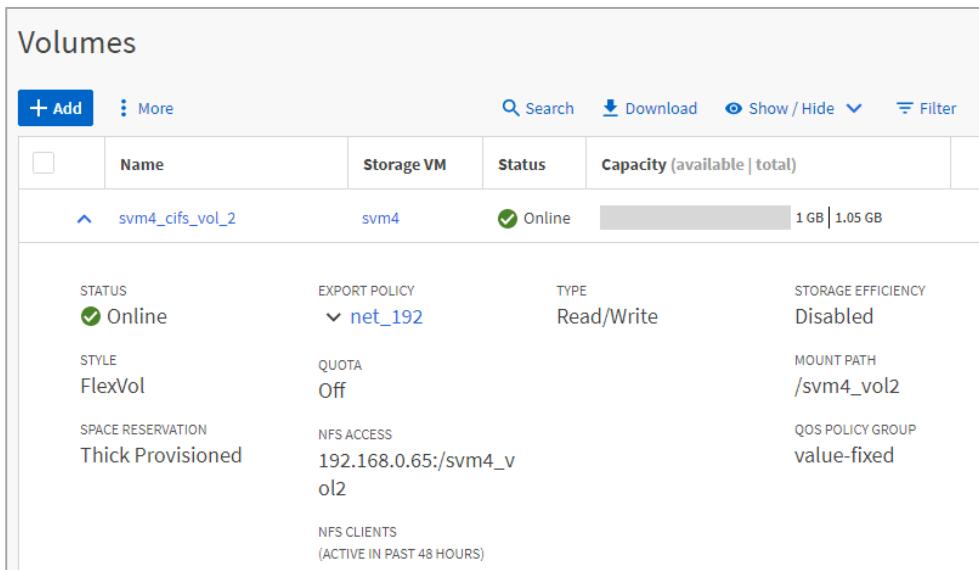
## Task 2: Create a data volume

Step	Action
2-1	Go to the <b>Storage &gt; Volumes</b> page.
2-2	In the Volumes page, click <b>Add</b> .
	 <p>The screenshot shows the Volumes page with two volumes listed: 'svm4_nas_vol_1' and 'svm4_root'. Both volumes are associated with 'svm4' and are marked as 'Online'. The 'svm4_nas_vol_1' volume has a capacity of 1 GB and 1.05 GB available. The 'svm4_root' volume has a capacity of 20 MB and 18.6 MB available.</p>
2-3	<p>In the Add Volume dialog box specify the following settings:</p> <ul style="list-style-type: none"> <li>Name: <b>svm4_cifs_vol_2</b></li> <li>Capacity: <b>1 GB</b></li> </ul>  <p>The screenshot shows the 'Add Volume' dialog box. The 'NAME' field contains 'svm4_cifs_vol_2'. The 'CAPACITY' field shows '1 GB'. At the bottom, there are 'More Options', 'Cancel', and 'Save' buttons.</p>

Step	Action
2-4	Click <b>More Options</b> .
2-5	Scroll down to the Access Permissions section and specify the following settings: <ul style="list-style-type: none"> <li>▪ Export via NFS: <b>selected (default)</b></li> <li>▪ Grant Access to Host: <b>net_192</b></li> <li>▪ Share via SMB/CIFS: <b>selected (default)</b></li> <li>▪ Grant Access to Host: <b>Everyone (default)</b></li> <li>▪ Permission: <b>Full Control (default)</b></li> </ul> 
2-6	Click <b>Save</b> .
2-7	In the Volumes page, expand the <b>svm4_cifs_vol_2</b> volume, and note the Mount Path. 

Step	Action
2-8	<p>With the <b>svm4_cifs_vol_2</b> volume selected, choose <b>Edit</b> from the More menu.</p> 
2-9	<p>Scroll down to the Export Settings section of the Edit Volume page and specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Mount Path: <b>/svm4_vo12</b></li> <li>▪ Select an existing policy: <b>selected</b></li> </ul> 
2-10	Note the export policy that was assigned to the volume when the volume was created and the client hosts that are granted access.
2-11	Click <b>Save</b> .

Step	Action
2-12	In the Volumes page, observe the Mount Path and the SMB/CIFS Access names.

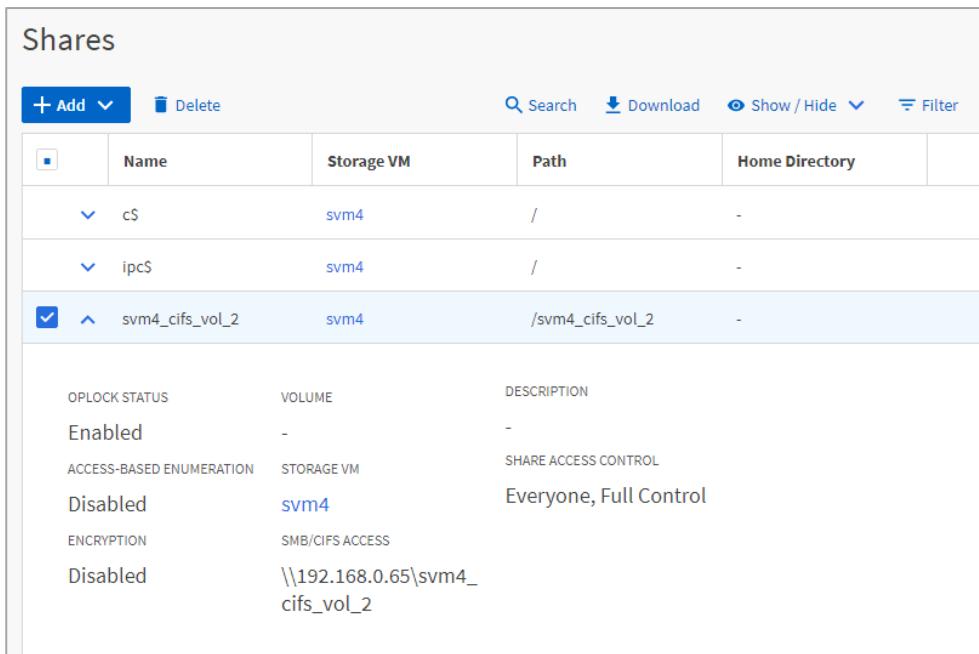


The screenshot shows the 'Volumes' page in NetApp System Manager. A single volume, 'svm4\_cifs\_vol\_2', is listed. The volume is associated with 'svm4' and is 'Online'. It has a capacity of 1 GB (available) and 1.05 GB (total). Detailed settings include:

- STATUS:** Online
- EXPORT POLICY:** net\_192
- TYPE:** Read/Write
- STORAGE EFFICIENCY:** Disabled
- STYLE:** FlexVol
- QUOTA:** Off
- MOUNT PATH:** /svm4\_vo12
- SPACE RESERVATION:** Thick Provisioned
- NFS ACCESS:** 192.168.0.65:/svm4\_vo12
- QOS POLICY GROUP:** value-fixed
- NFS CLIENTS (ACTIVE IN PAST 48 HOURS):** -

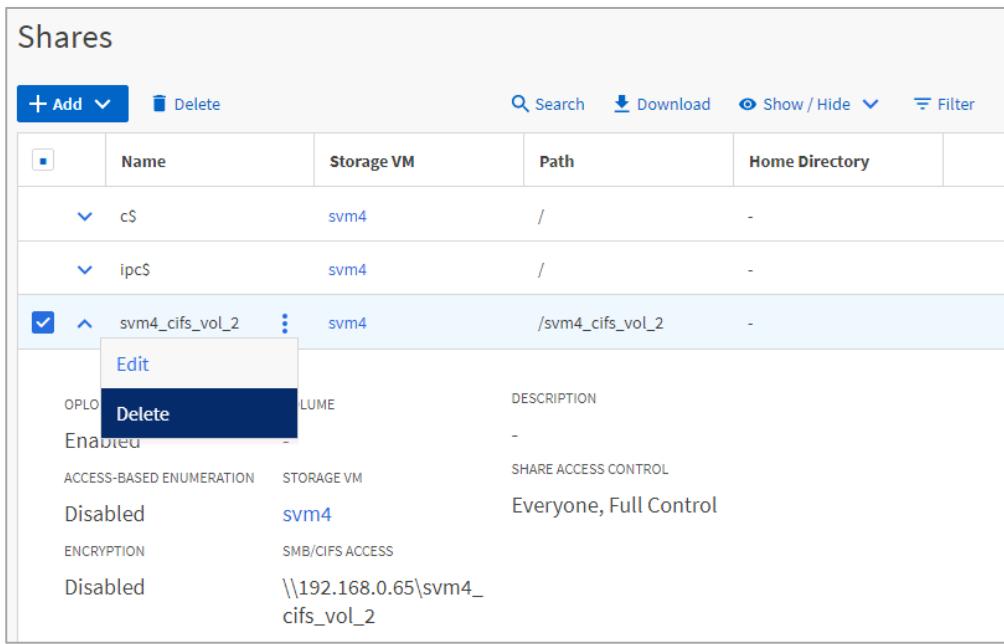
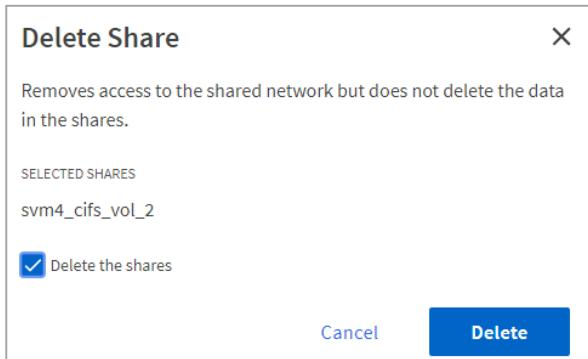
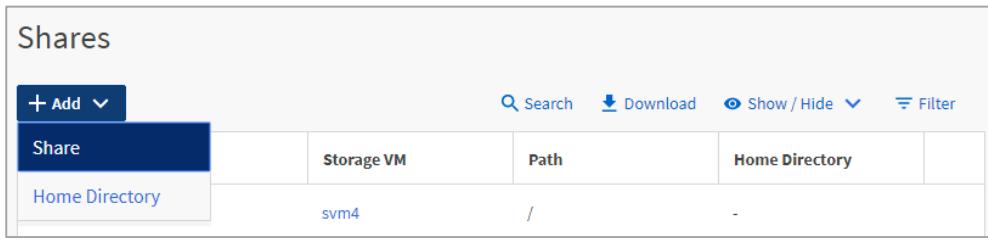
### Task 3: Verify and Create SMB Shares

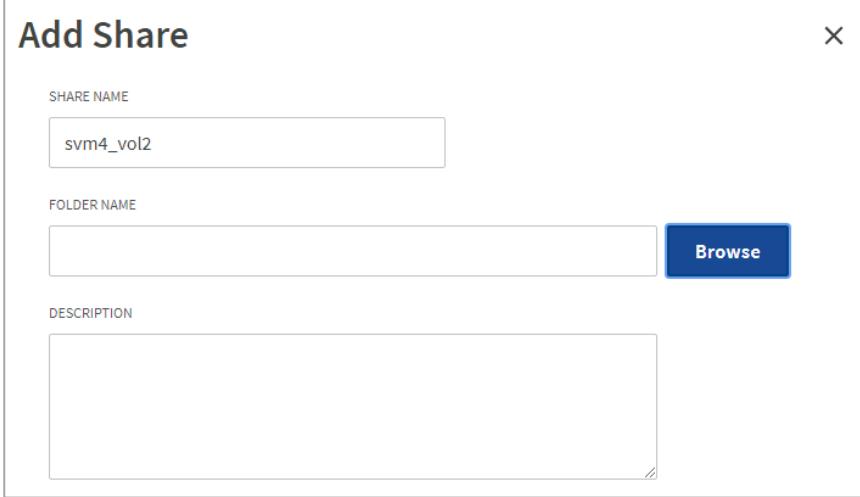
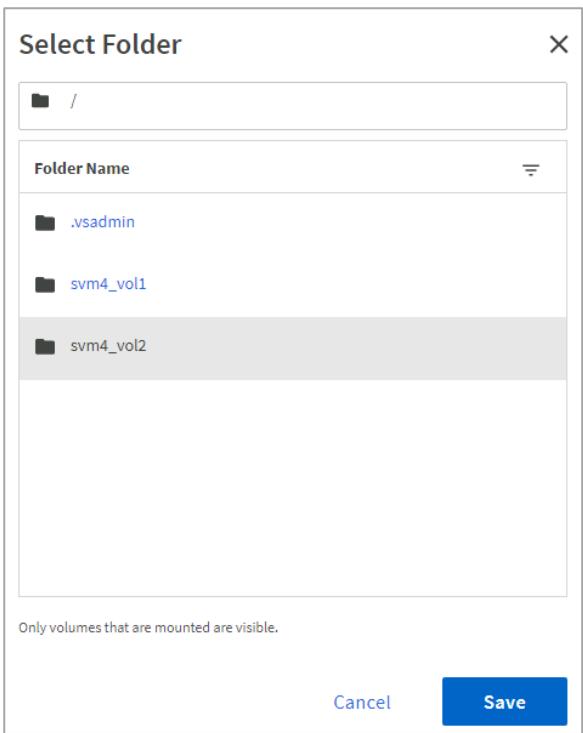
Step	Action
3-1	In System Manager on cluster2, go to the Storage > Shares page.
3-2	Expand the <b>svm4_cifs_vol_2</b> share.

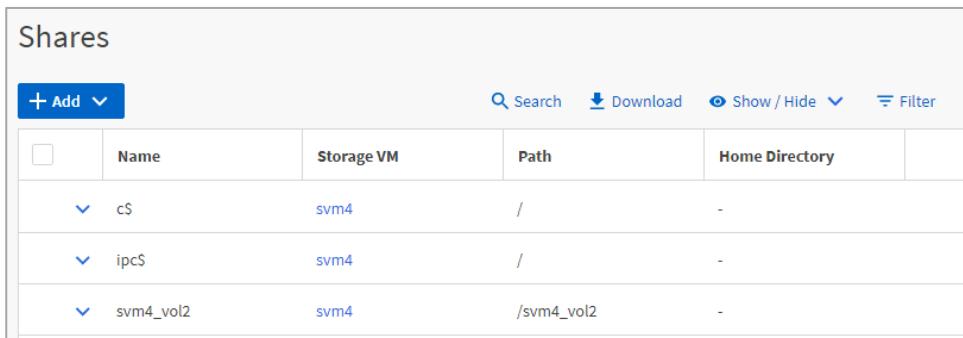
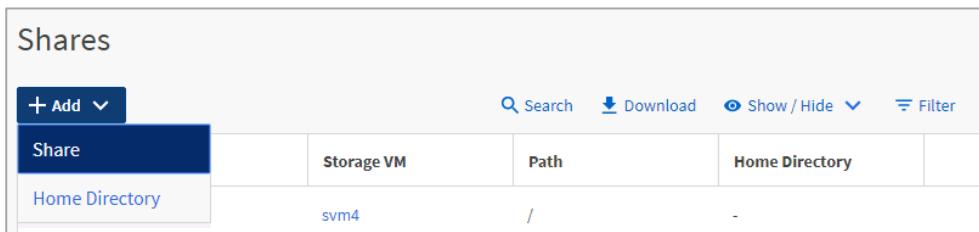


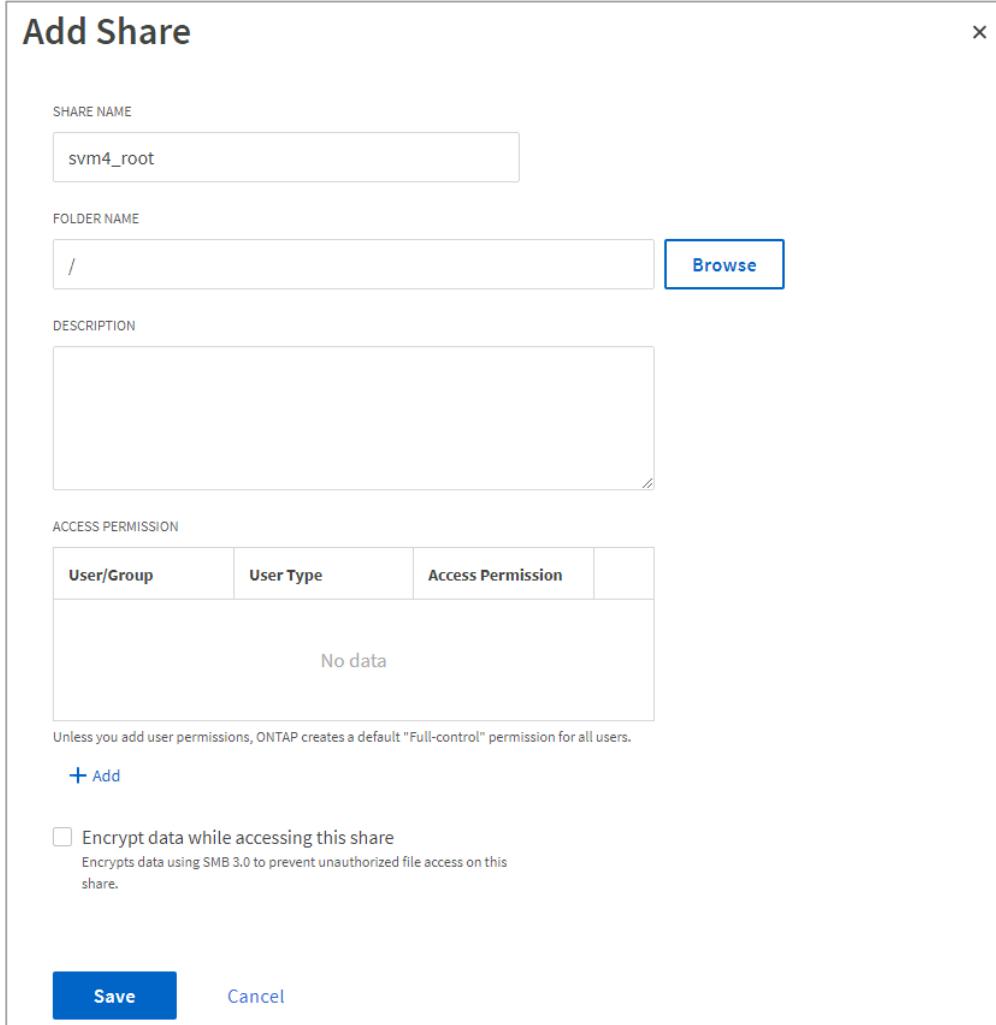
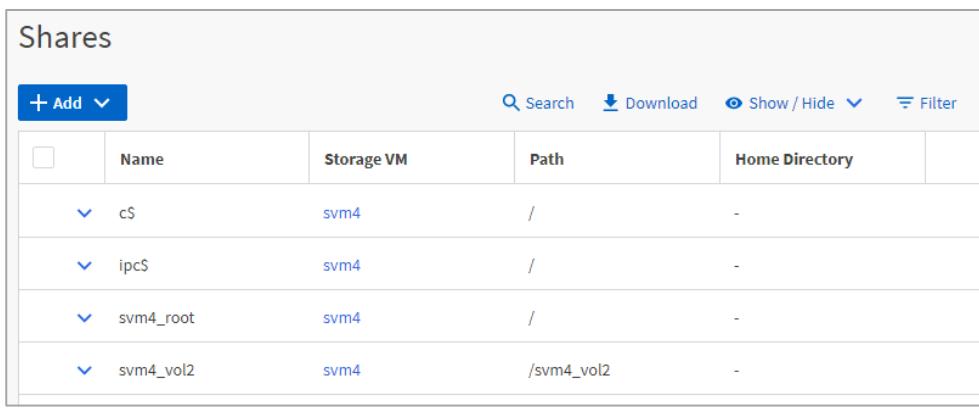
The screenshot shows the 'Shares' page in NetApp System Manager. The 'svm4\_cifs\_vol\_2' share is expanded, showing its sub-shares: 'c\$' and 'ipc\$'. The 'svm4\_cifs\_vol\_2' share itself has the following properties:

- OPLOCK STATUS:** Enabled
- ACCESS-BASED ENUMERATION:** STORAGE VM
- SHARE ACCESS CONTROL:** Everyone, Full Control
- ENCRYPTION:** SMB/CIFS ACCESS
- SMB/CIFS ACCESS:** \\192.168.0.65\svm4\_cifs\_vol\_2

Step	Action
3-3	<p>In the Shares page, select <b>svm4_cifs_vol_2</b>, and choose <b>Delete</b> from the <b>More</b> menu.</p> 
3-4	<p>In the Delete Share dialog box, select the <b>Delete the shares</b> checkbox, and then click <b>Delete</b>.</p> 
3-5	<p>In the Shares page, click <b>Add</b>, and select <b>Share</b>.</p> 

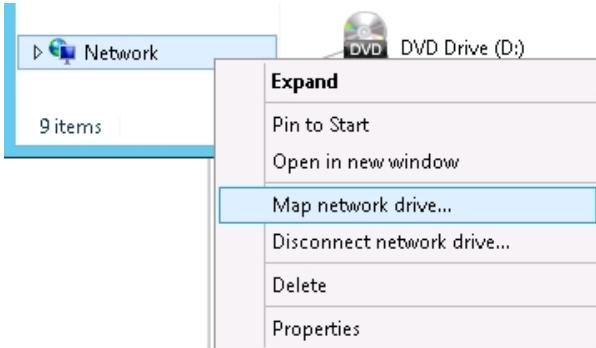
Step	Action
3-6	<p>In the Add Share page, enter the Share name <b>svm4_vol2</b> and then click <b>Browse</b>.</p> 
3-7	<p>In the Add Path dialog box, expand the root folder and select the <b>svm4_vol2</b> volume.</p> 
3-8	<p>Click <b>Save</b>.</p>
3-9	<p>Click <b>Save</b> to create the share.</p>

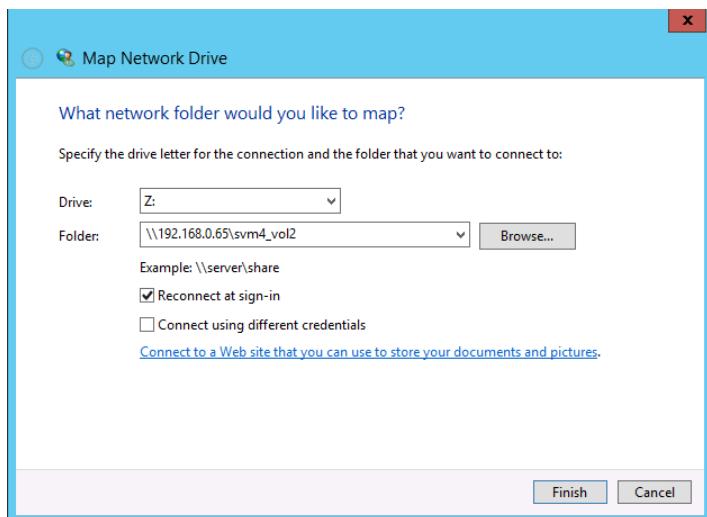
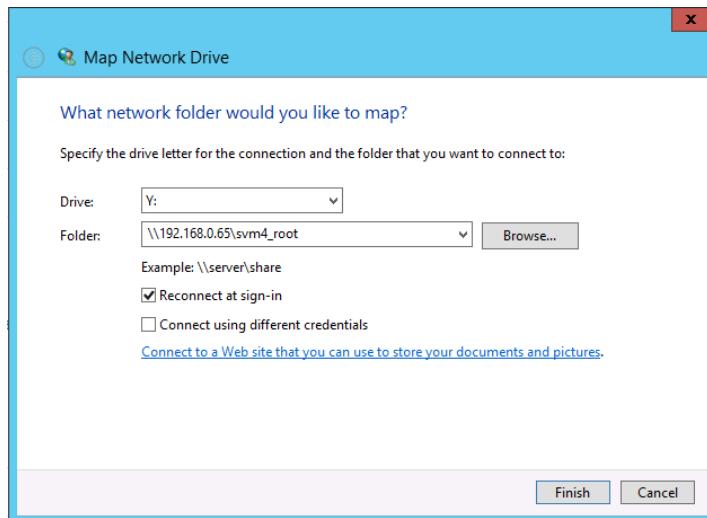
Step	Action								
3-10	<p>Confirm the new share name:</p>  <p>The Shares page displays a table with columns: Name, Storage VM, Path, and Home Directory. There are three entries:</p> <ul style="list-style-type: none"> <li>c\$ (Storage VM: svm4, Path: /, Home Directory: -)</li> <li>ipc\$ (Storage VM: svm4, Path: /, Home Directory: -)</li> <li>svm4_vol2 (Storage VM: svm4, Path: /svm4_vol2, Home Directory: -)</li> </ul>								
3-11	<p>In the Shares page, click <b>Add</b>, and select <b>Share</b>.</p>  <p>The Shares page shows the 'Add' button highlighted. A dropdown menu is open, and the 'Share' option is selected. The table below has one row visible:</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Storage VM</th> <th>Path</th> <th>Home Directory</th> </tr> </thead> <tbody> <tr> <td>Home Directory</td> <td>svm4</td> <td>/</td> <td>-</td> </tr> </tbody> </table>	Name	Storage VM	Path	Home Directory	Home Directory	svm4	/	-
Name	Storage VM	Path	Home Directory						
Home Directory	svm4	/	-						

Step	Action																									
3-12	<p>In the Add Share page, specify the following settings:</p> <ul style="list-style-type: none"> <li>Share name: <b>svm4_root</b></li> <li>Folder name: <b>/</b></li> <li>Encrypt data while accessing this share using: <i>unselected (default)</i></li> </ul> 																									
3-13	Click <b>Save</b> .																									
3-14	Confirm the share names:  <table border="1"> <thead> <tr> <th></th> <th>Name</th> <th>Storage VM</th> <th>Path</th> <th>Home Directory</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/></td> <td>c\$</td> <td>svm4</td> <td>/</td> <td>-</td> </tr> <tr> <td><input type="checkbox"/></td> <td>ipc\$</td> <td>svm4</td> <td>/</td> <td>-</td> </tr> <tr> <td><input type="checkbox"/></td> <td>svm4_root</td> <td>svm4</td> <td>/</td> <td>-</td> </tr> <tr> <td><input type="checkbox"/></td> <td>svm4_vol2</td> <td>svm4</td> <td>/svm4_vol2</td> <td>-</td> </tr> </tbody> </table>		Name	Storage VM	Path	Home Directory	<input type="checkbox"/>	c\$	svm4	/	-	<input type="checkbox"/>	ipc\$	svm4	/	-	<input type="checkbox"/>	svm4_root	svm4	/	-	<input type="checkbox"/>	svm4_vol2	svm4	/svm4_vol2	-
	Name	Storage VM	Path	Home Directory																						
<input type="checkbox"/>	c\$	svm4	/	-																						
<input type="checkbox"/>	ipc\$	svm4	/	-																						
<input type="checkbox"/>	svm4_root	svm4	/	-																						
<input type="checkbox"/>	svm4_vol2	svm4	/svm4_vol2	-																						

Step	Action																		
3-15	<p>Expand the <b>svm4_vol2</b> share and copy the SMB/CIFS Access path to your clipboard.</p>  <table border="1"> <thead> <tr> <th>OPLOCK STATUS</th> <th>VOLUME</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>Enabled</td> <td><a href="#">svm4_cifs_vol_2</a></td> <td>-</td> </tr> <tr> <td>ACCESS-BASED ENUMERATION</td> <td>STORAGE VM</td> <td>SHARE ACCESS CONTROL</td> </tr> <tr> <td>Disabled</td> <td><a href="#">svm4</a></td> <td>Everyone, Full Control</td> </tr> <tr> <td>ENCRYPTION</td> <td>SMB/CIFS ACCESS</td> <td></td> </tr> <tr> <td>Disabled</td> <td><a href="\\\\192.168.0.65\\\\svm4_vol2">\\\\192.168.0.65\\\\svm4_vol2</a></td> <td></td> </tr> </tbody> </table>	OPLOCK STATUS	VOLUME	DESCRIPTION	Enabled	<a href="#">svm4_cifs_vol_2</a>	-	ACCESS-BASED ENUMERATION	STORAGE VM	SHARE ACCESS CONTROL	Disabled	<a href="#">svm4</a>	Everyone, Full Control	ENCRYPTION	SMB/CIFS ACCESS		Disabled	<a href="\\\\192.168.0.65\\\\svm4_vol2">\\\\192.168.0.65\\\\svm4_vol2</a>	
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## Task 4: Task 4: Access SMB Shares from a Windows Client

Step	Action
4-1	<p>On the Windows Server, in the taskbar, click the folder icon to open File Explorer.</p> 
4-2	<p>Right-click Network, and then select <b>Map network drive</b>.</p> 

Step	Action
4-3	<p>In the Map Network Drive dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Drive: <b>Z (default)</b></li> <li>▪ Folder: <b>\\\192.168.0.65\svm4_vo12</b></li> <li>▪ Reconnect at sign-in: <i>selected (default)</i></li> <li>▪ Connect using different credentials: <i>unselected (default)</i></li> </ul> 
4-4	<p>Click <b>Finish</b>.</p>
4-5	<p>When the share folder opens, create files and folders on the share, and append your initials to the file names so that you know that the files are yours.</p> <p><b>Note:</b> You use the files and folders later in the course.</p>
4-6	<p>Map the <b>svm4_root</b> share to drive <b>Y</b>.</p> 
4-7	<p>Answer the following question:</p> <p>When the <b>svm4_root</b> share folder opens, what do you see?</p> <hr/>

### End of Exercise

## Exercise 3: Configuring iSCSI in an SVM

In this exercise, you use best practice tools to create a simple iSCSI server in an SVM.

### Objectives

This exercise focuses on enabling you to do the following:

- Verify the Microsoft Multipath I/O (MPIO) configuration
- Check the iSCSI Software Initiator name
- Use NetApp ONTAP System Manager to configure an SVM for iSCSI
- Configure the iSCSI Software Initiator on the Windows host
- Access the iSCSI-attached LUN on the Windows host

### Case Study

Mr. Zarrot has decided to use some of the additional storage space on the NetApp system to store Zarrot Industries new manufacturing robot application data.

To better control access to this critical data, a new storage virtual machine will be created and storage space provisioned

For the best performance and fault resiliency, multipath I/O should be configured on the application servers.

You grant the application servers access to the provisioned storage space and configure their access.

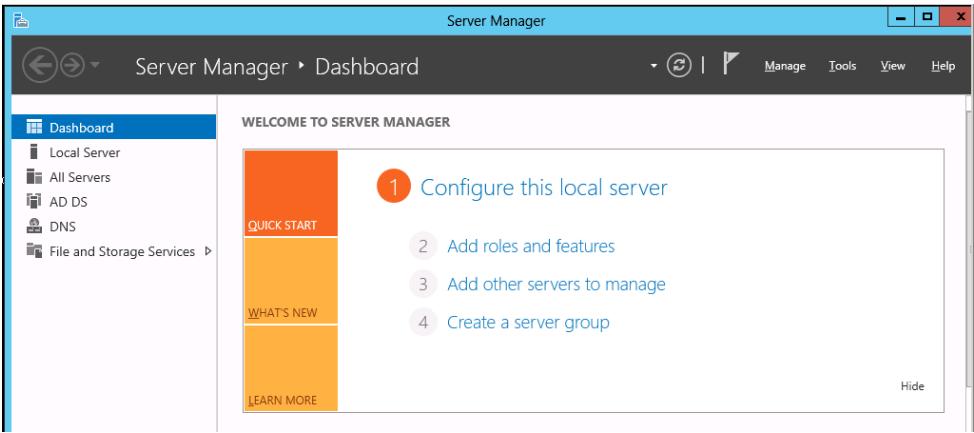
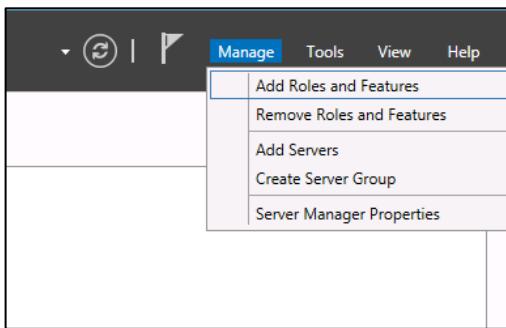
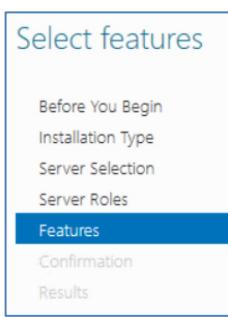
### Exercise Equipment

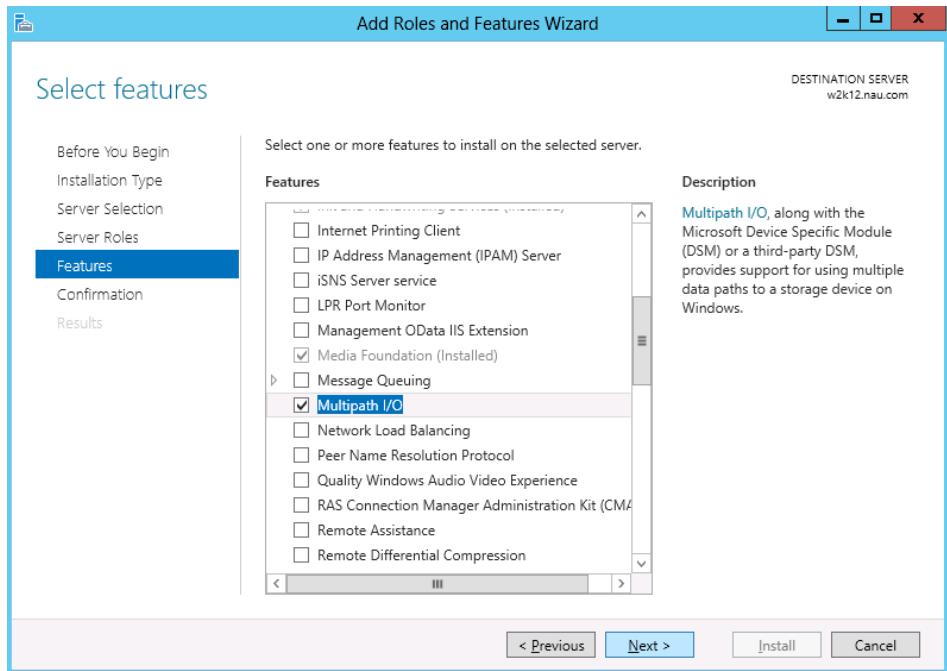
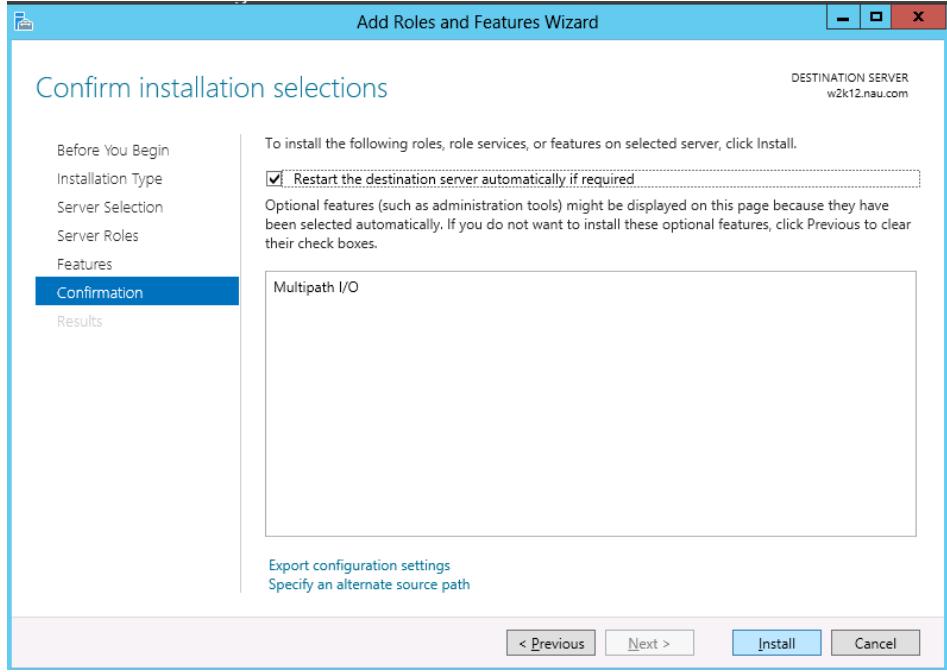
In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!

### Task 1: Verify MPIO Configuration

Step	Action
1-1	On the Windows desktop, click the Server Manager icon. 

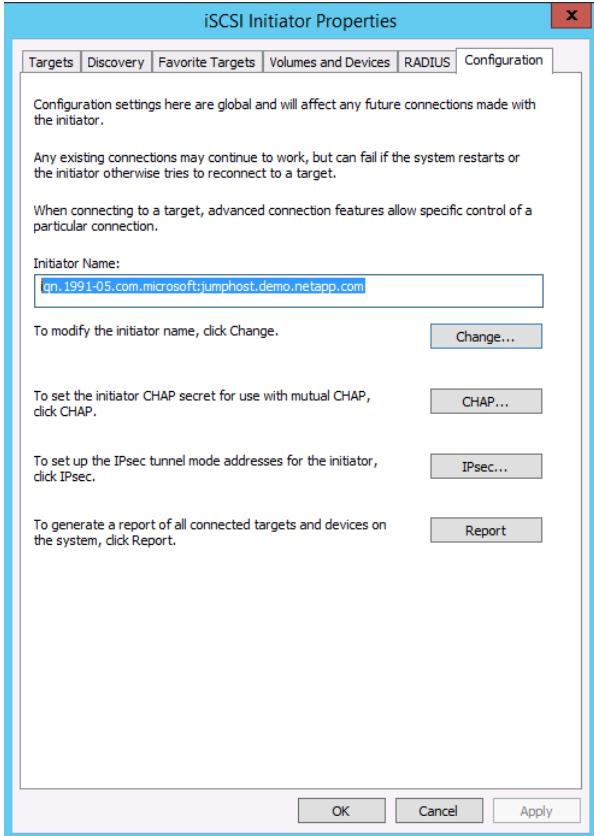
Step	Action
1-2	<p>Wait while Server Manager opens.</p> 
1-3	<p>On the Server Manager Dashboard, on the top-right menu, select <b>Manage &gt; Add Roles and Features</b>:</p> 
1-4	<p>Click <b>Next</b> twice.</p>
1-5	<p>In the left pane of the “Select destination server” page, select <b>Features</b>:</p> 

Step	Action
1-6	<p>In the Add Roles and Features wizard, on the “Select features” page, verify that Multipath I/O is installed and configured, and follow these steps:</p> <ul style="list-style-type: none"> <li>If the Multipath I/O checkbox is selected, click <b>Cancel</b>, and then proceed to Task 2.</li> <li>If the Multipath I/O checkbox is cleared, select the checkbox, and then click <b>Next</b>.</li> </ul> 
1-7	<p>On the “Confirm installation selections” page, select <b>Restart the destination server automatically if required</b>.</p> 
1-8	<p>Click <b>Yes</b> to accept the warning message.</p>
1-9	<p>Click <b>Install</b>.</p>

Step	Action
<b>1-10</b>	After the feature is installed and the Results dialog box appears, verify that the installation was successful, and then click <b>Close</b> .

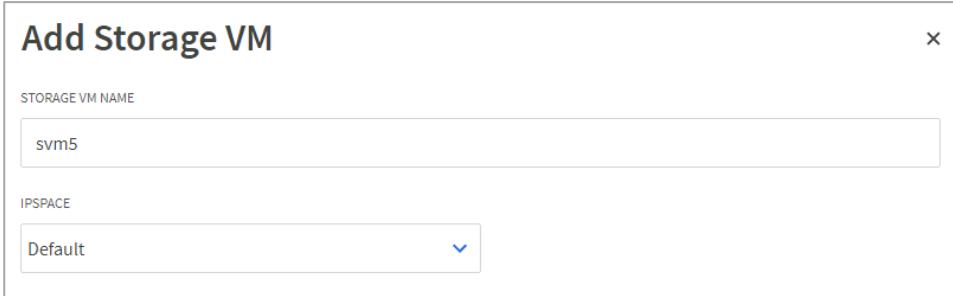
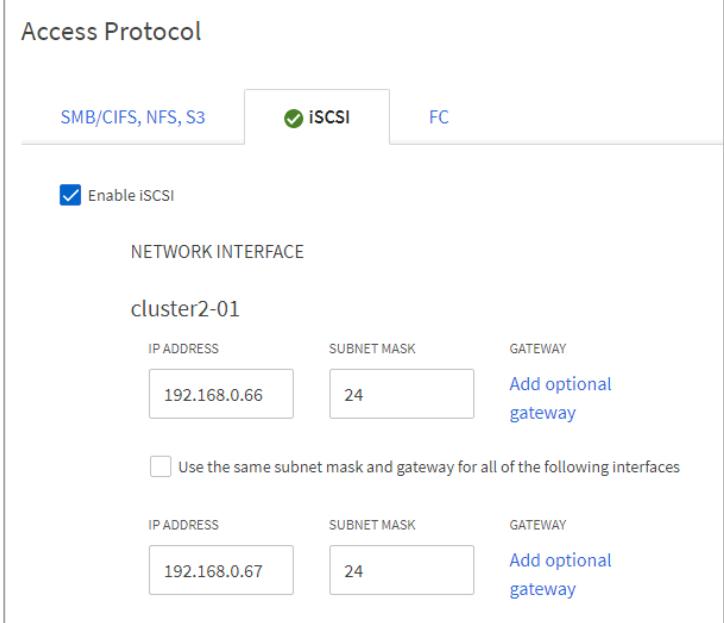
## Task 2: Check the iSCSI Software Initiator Name

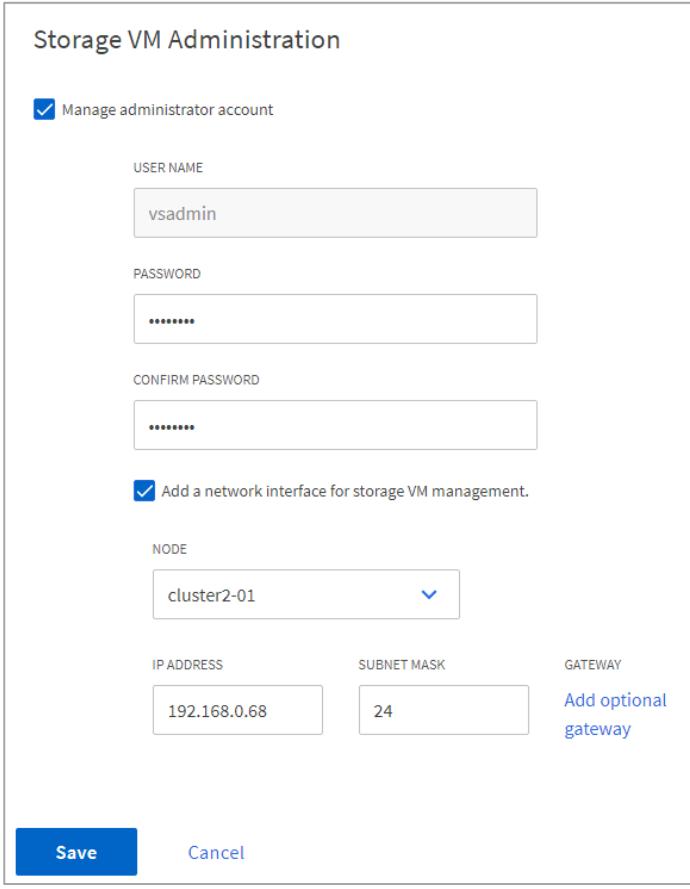
Step	Action
<b>2-1</b>	From the Server Manager Tools menu, select <b>iSCSI Initiator</b> .
<b>2-2</b>	If an error message appears, indicating that the Microsoft iSCSI service is not running, click <b>Yes</b> to start the service:
<b>2-3</b>	If a message asks whether you want to unblock the Microsoft iSCSI service through the Windows Firewall, click <b>Yes</b> .

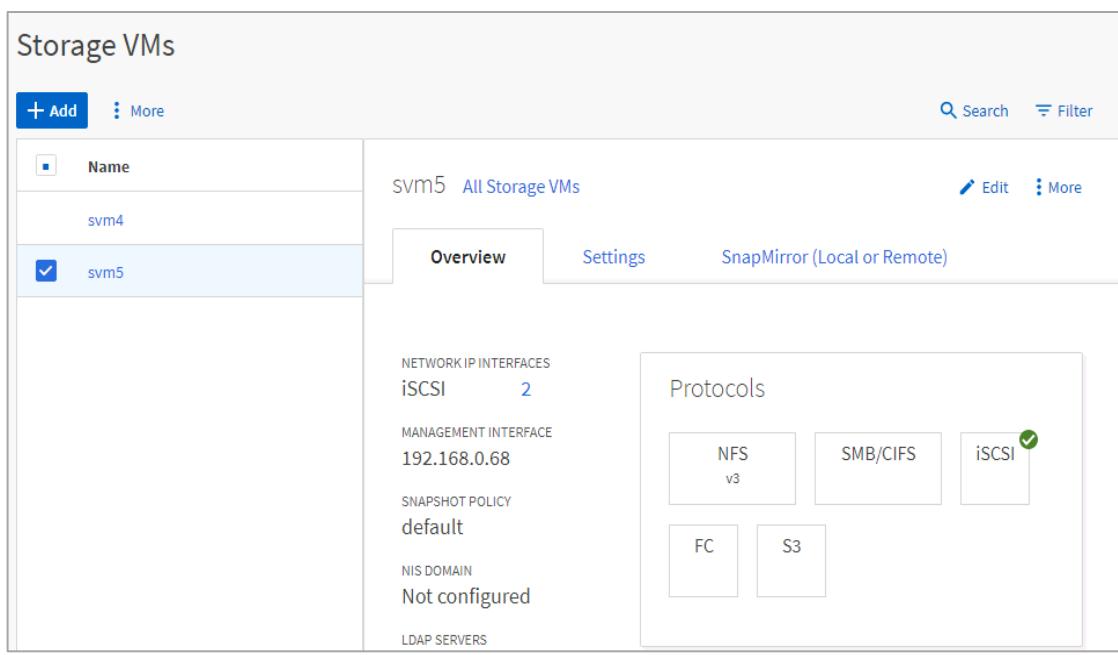
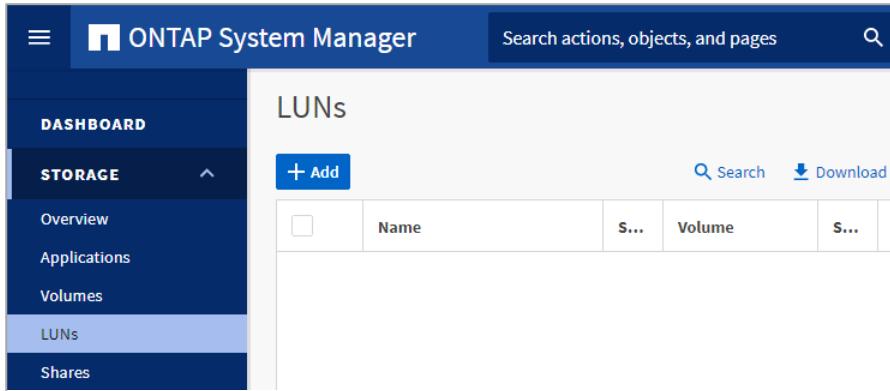
Step	Action
2-4	<p>When the iSCSI Initiator Properties dialog box appears, click the <b>Configuration</b> tab.</p> 
2-5	<p>Record and save the Initiator Name here and to a text file on the desktop. The Initiator Name is an iSCSI Qualified Name (IQN).</p> <p>Initiator Name:</p> <hr/>
2-6	Leave the iSCSI Initiator Properties dialog box open.

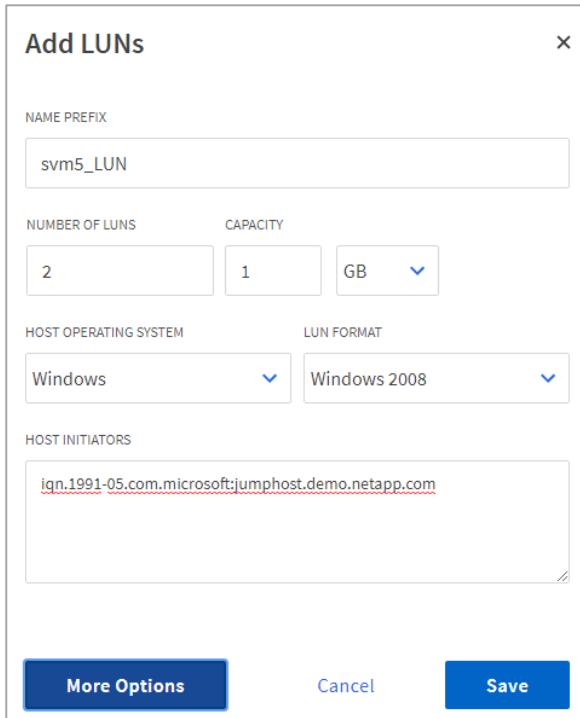
### Task 3: Use System Manager to Configure an SVM for iSCSI

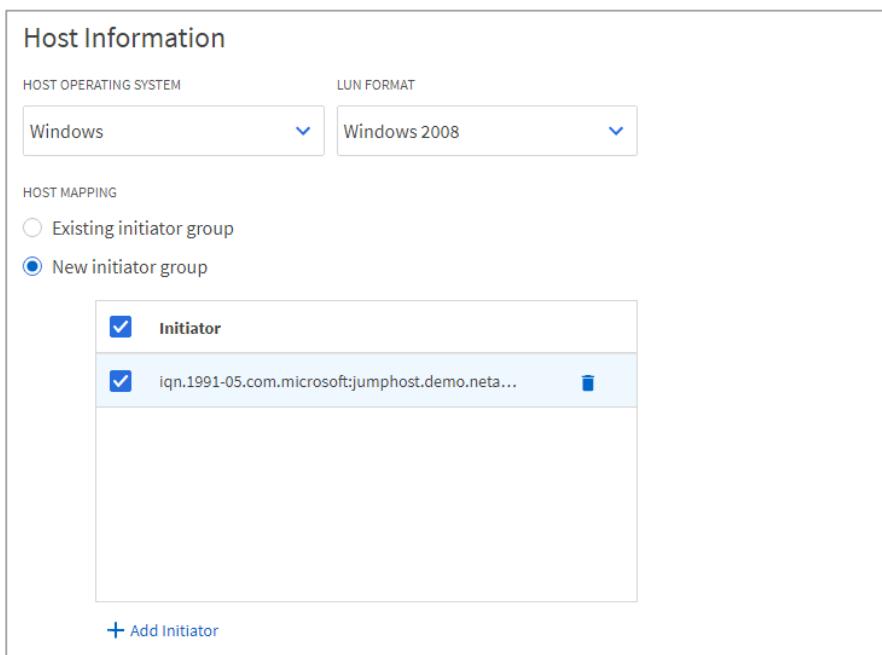
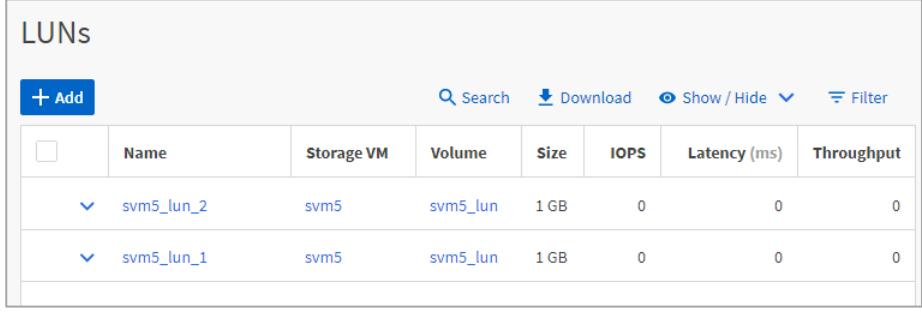
Step	Action
3-1	Return to the System Manager session on cluster2.
3-2	Go to the <b>Storage &gt; Storage VMs</b> page.
3-3	Click <b>Add</b> to create a new Storage Virtual Machine.

Step	Action
3-4	<p>On the Add Storage VM page, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ SVM Name: <b>svm5</b></li> <li>▪ IPspace: <b>Default (default)</b></li> </ul> 
3-5	<p>In the Access Protocol section of the Add Storage VM page, click the <b>iSCSI</b> tab and specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Enable iSCSI: <b>selected</b></li> <li>▪ IP Address 1: <b>192.168.0.66</b></li> <li>▪ Subnet Mask 1: <b>24</b></li> <li>▪ IP Address 2: <b>192.168.0.67</b></li> <li>▪ Subnet Mask 2: <b>24</b></li> </ul> 

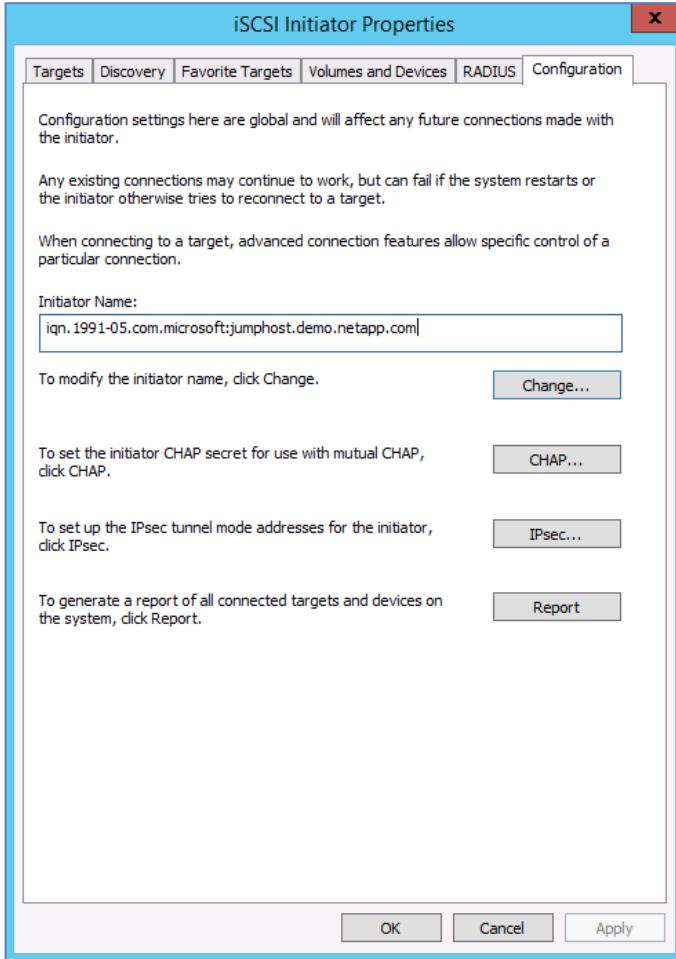
Step	Action
3-6	<p>In the Storage VM Administration section of the Add Storage VM page, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Manage administration account: <b>selected</b></li> <li>▪ User Name: <b>vsadmin</b> (<i>default</i>)</li> <li>▪ Password: <b>Netapp1!</b></li> <li>▪ Add a network interface for storage VM management: <b>selected</b></li> <li>▪ Node: <b>cluster2-01</b></li> <li>▪ IP Address: <b>192.168.0.68</b></li> <li>▪ Subnet Mask: <b>24</b></li> </ul> 
3-7	<p><b>i</b> Storage VMs cannot be managed through SAN data LIFs. You must create a management LIF if you intend to delegate management of a storage VM.</p>
3-8	<p>Click <b>Save</b>.</p>

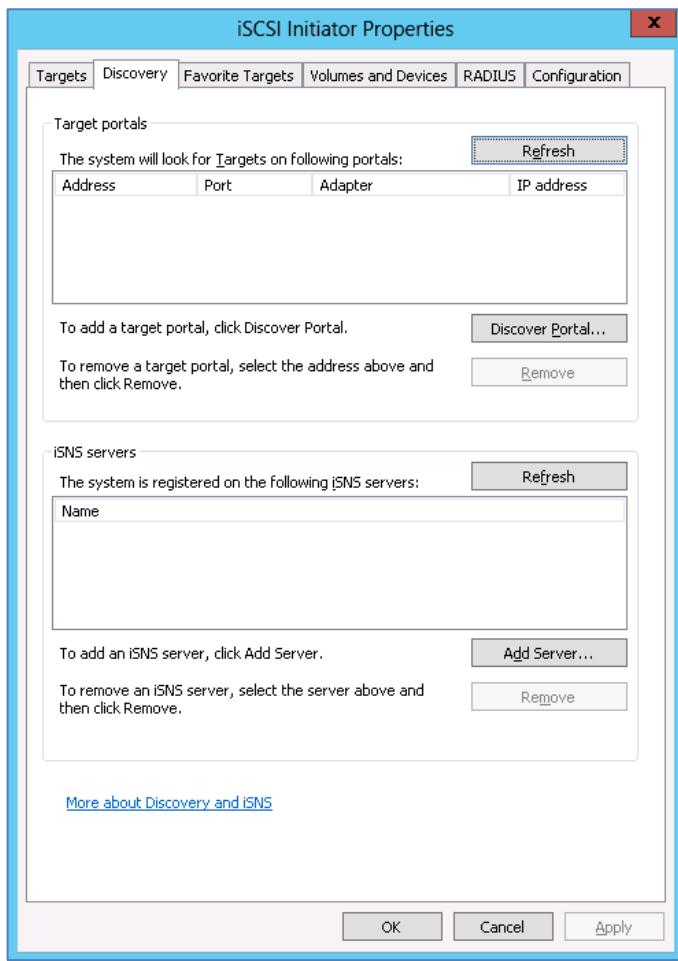
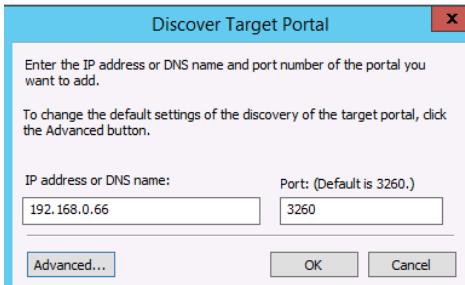
Step	Action
3-9	<p>On the list of SVMs, select <b>svm5</b>, and verify that the iSCSI protocol is enabled for the storage VM.</p> 
3-10	<p>Navigate to the <b>Storage &gt; LUNs</b> page and click <b>Add</b>.</p> 

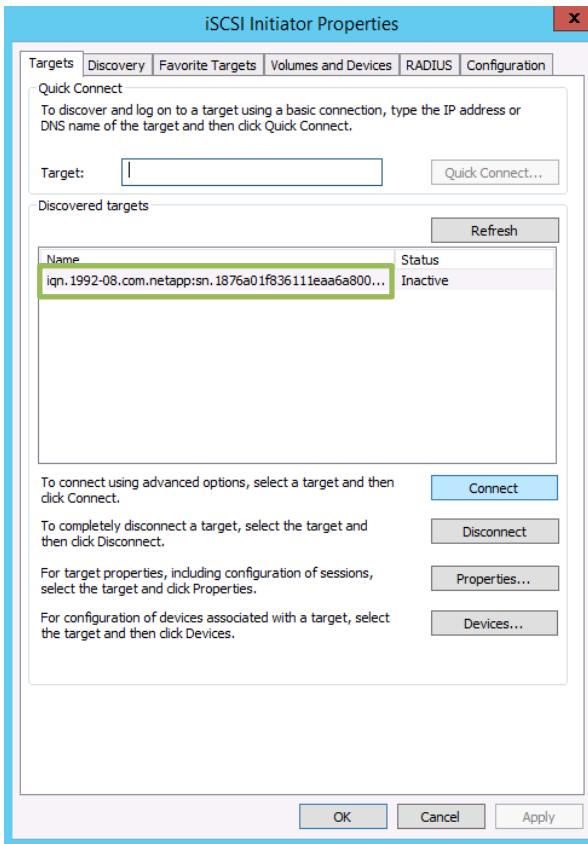
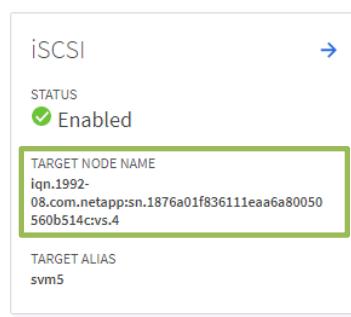
Step	Action
3-11	<p>In the Add LUNs dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Name Prefix: <b>svm5_LUN</b></li> <li>▪ Number of LUNs: <b>2</b></li> <li>▪ Capacity: <b>1 GB</b></li> <li>▪ Host Operating System: <b>Windows (default)</b></li> <li>▪ LUN Format: <b>Windows 2008 (default)</b></li> <li>▪ Host Initiators: &lt;<i>paste the client host IQN from your clipboard</i>&gt;</li> </ul> 
3-12	Click <b>More Options</b> .

Step	Action
<b>3-13</b>	Scroll down in the Add LUNs page, observe the Host Information, and select the iSCSI initiators to be included in the new initiator group.
	
<b>3-14</b>	Click <b>Save</b> .
<b>3-15</b>	Confirm the creation of the LUNs.
	

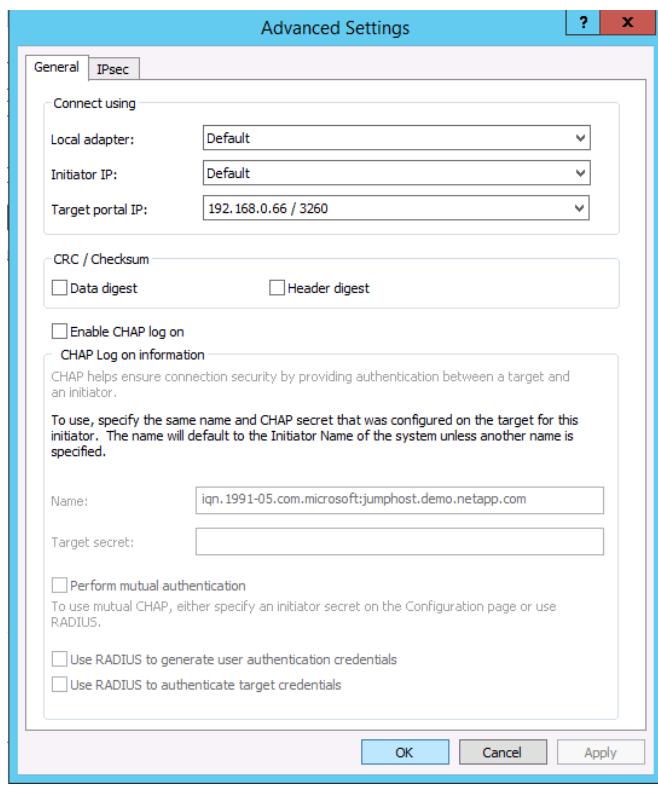
## Task 4: Configure the iSCSI Software Initiator on the Windows Host

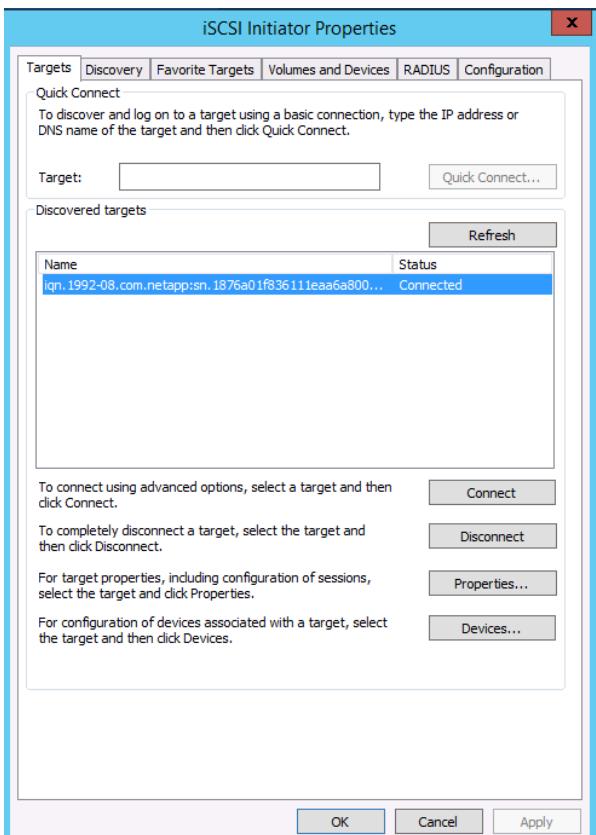
Step	Action
4-1	<p>Return to the iSCSI Initiator Properties dialog box.</p>  <p>The screenshot shows the 'iSCSI Initiator Properties' dialog box with the 'Configuration' tab selected. The 'Targets' tab is also visible at the top. The main area contains several informational text blocks and buttons:</p> <ul style="list-style-type: none"><li>A text block about global configuration settings affecting future connections.</li><li>A note about existing connections continuing to work after a system restart or initiator reconnect.</li><li>A section for setting the initiator name, with a text input field containing 'iqn.1991-05.com.microsoft:jumphost.demo.netapp.com' and a 'Change...' button.</li><li>A section for setting CHAP secrets, with a 'CHAP...' button.</li><li>A section for setting IPsec tunnel mode addresses, with an 'IPsec...' button.</li><li>A section for generating reports, with a 'Report' button.</li></ul> <p>At the bottom of the dialog box are 'OK', 'Cancel', and 'Apply' buttons.</p>

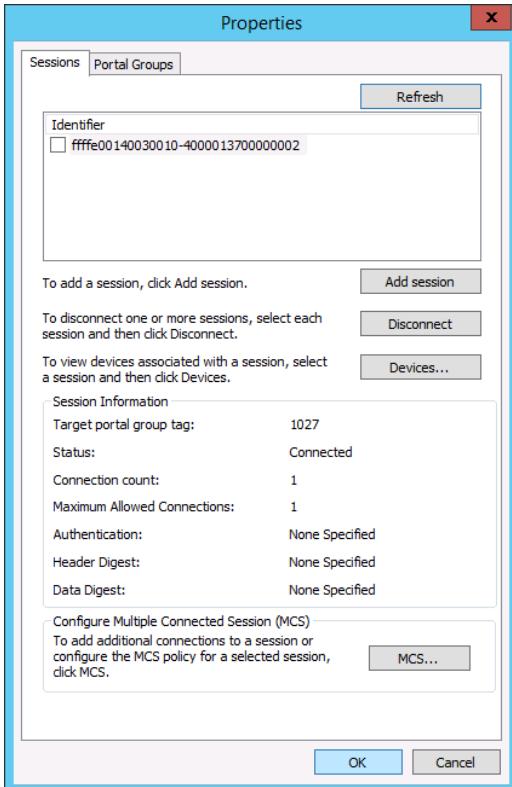
Step	Action
4-2	Click the <b>Discovery</b> tab.
	
4-3	Click <b>Discover Portal...</b> .
4-4	In the Discover Target Portal dialog box, specify the following settings: <ul style="list-style-type: none"> <li>▪ IP address or DNS name: <b>192.168.0.66</b></li> <li>▪ Port: <b>3260</b></li> </ul> 
4-5	Click <b>OK</b> .

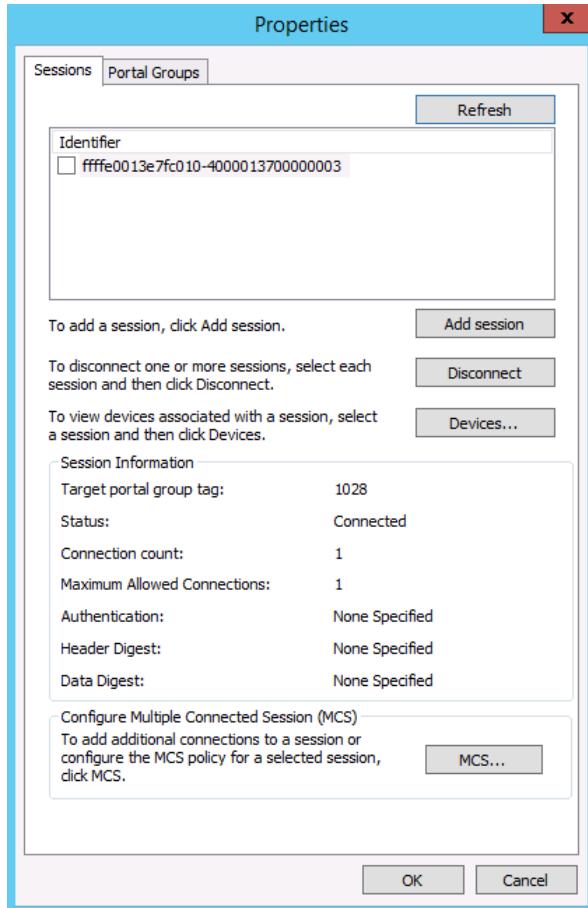
Step	Action
4-6	Click the <b>Targets</b> tab, and then note the IQN names.
	
4-7	In System Manager, return to the Storage VMs page.
4-8	Click <b>svm5</b> , and then click <b>Settings</b> .
4-9	Verify that the iSCSI Target Node Name matches a node name from the list of discovered targets in the iSCSI Initiator Properties dialog box.
	
4-10	Return to the iSCSI Initiator Properties dialog box on the Windows jump host.

Step	Action
4-11	From the “Discovered targets” list, select the correct target, and then click <b>Connect</b> .
4-12	In the Connect To Target dialog box, select the <b>Enable multi-path</b> checkbox, and then click <b>Advanced</b> .

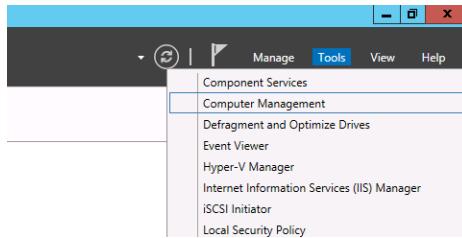
Step	Action
4-13	<p>In the Advanced Settings dialog box, from the Target portal IP list, select <b>192.168.0.66 / 3260</b>, and then click <b>OK</b>.</p> 
4-14	<p>Click <b>OK</b>.</p>

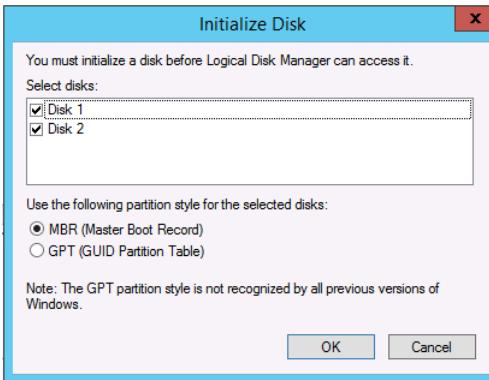
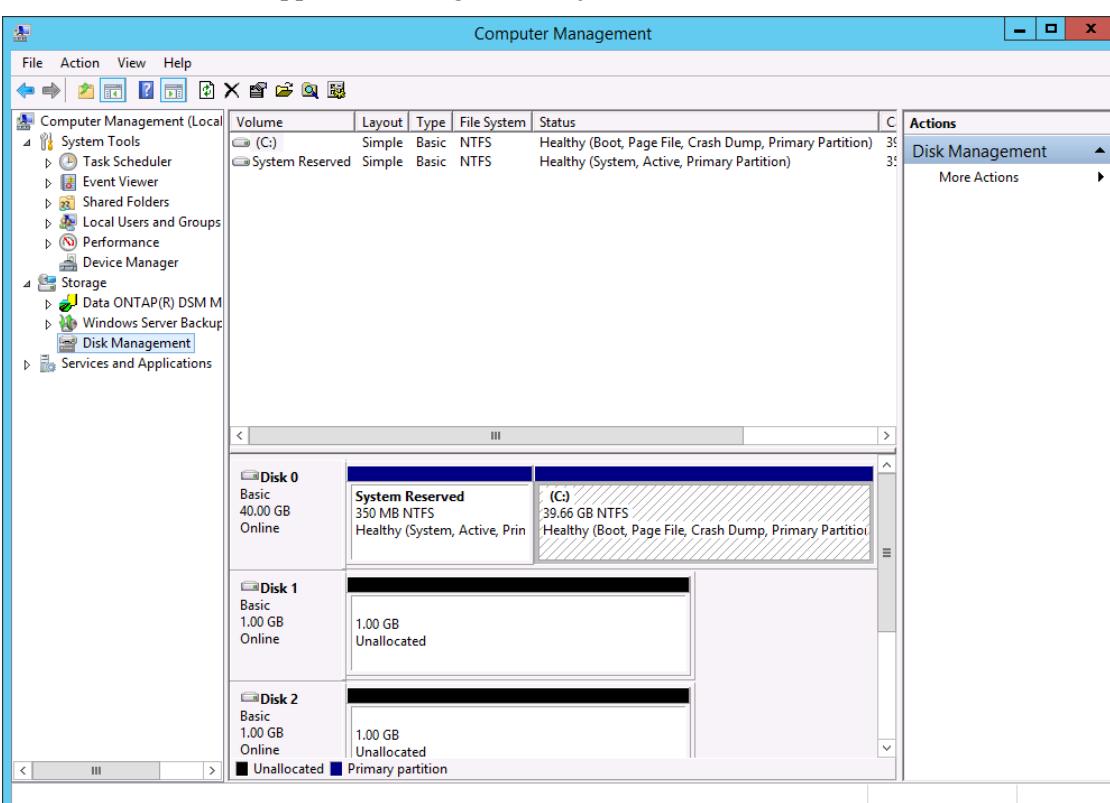
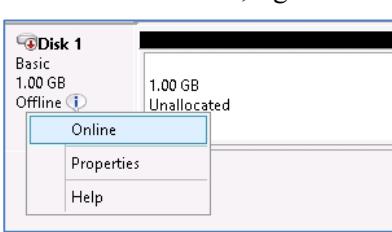
Step	Action
4-15	<p>In the iSCSI Initiator Properties dialog box, verify that the correct target has a status of Connected.</p>  <p>The screenshot shows the 'iSCSI Initiator Properties' dialog box. The 'Targets' tab is selected. In the 'Discovered targets' list, there is one entry: 'iqn.1992-08.com.netapp:sn.1876a01f836111eaa6a800...' with a status of 'Connected'. Below the list, there are four buttons: 'Connect', 'Disconnect', 'Properties...', and 'Devices...'. At the bottom of the dialog are 'OK', 'Cancel', and 'Apply' buttons.</p>

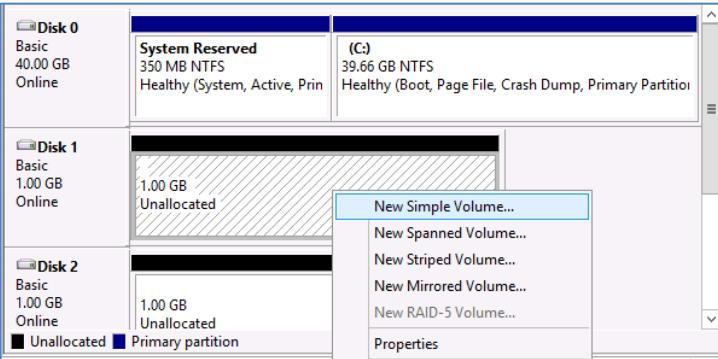
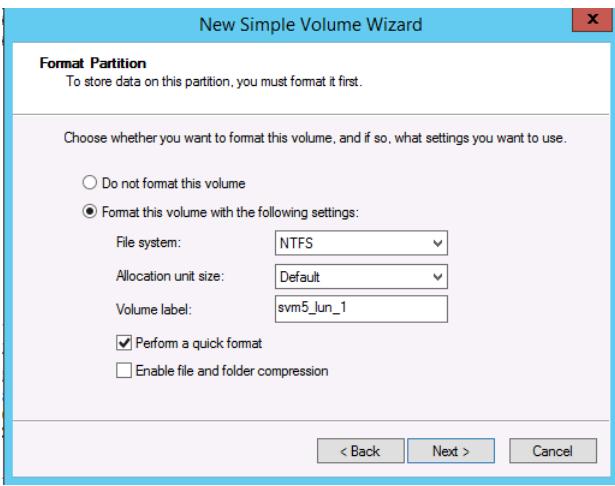
Step	Action
4-16	<p>Click Properties.</p>  <p>The screenshot shows the 'Properties' dialog box with the 'Sessions' tab selected. It displays the following information:</p> <ul style="list-style-type: none"> <li><b>Identifier:</b> fffe00140030010-4000013700000002</li> <li><b>Add session:</b> To add a session, click Add session.</li> <li><b>Disconnect:</b> To disconnect one or more sessions, select each session and then click Disconnect.</li> <li><b>Devices...</b>: To view devices associated with a session, select a session and then click Devices...</li> <li><b>Session Information:</b> <ul style="list-style-type: none"> <li>Target portal group tag: 1027</li> <li>Status: Connected</li> <li>Connection count: 1</li> <li>Maximum Allowed Connections: 1</li> <li>Authentication: None Specified</li> <li>Header Digest: None Specified</li> <li>Data Digest: None Specified</li> </ul> </li> <li><b>MCS...</b>: Configure Multiple Connected Session (MCS). To add additional connections to a session or configure the MCS policy for a selected session, click MCS...</li> </ul> <p>At the bottom of the dialog are 'OK' and 'Cancel' buttons.</p>

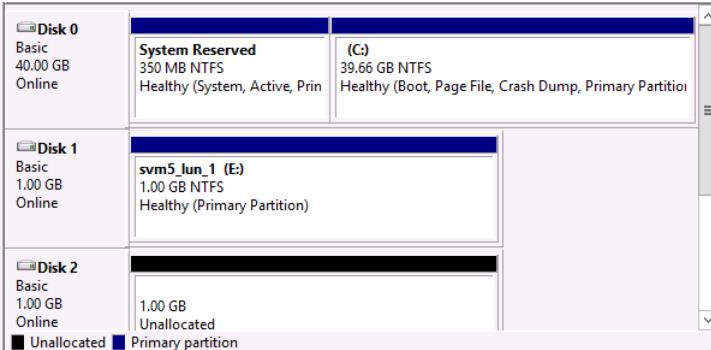
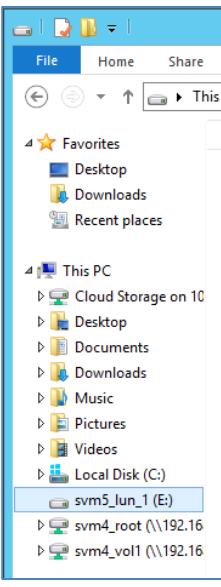
Step	Action																
4-17	In the Properties dialog box, on the Sessions tab, verify that a new session was created.																
	 <p>The screenshot shows the 'Properties' dialog box for an iSCSI session. The 'Sessions' tab is selected. A table lists session details:</p> <table border="1"> <tr> <td>Identifier</td> <td>ffffe0013e7fc010-4000013700000003</td> </tr> </table> <p>Below the table are three buttons: 'Add session', 'Disconnect', and 'Devices...'. A note says: 'To add a session, click Add session.' Another note says: 'To disconnect one or more sessions, select each session and then click Disconnect.' A third note says: 'To view devices associated with a session, select a session and then click Devices...'.</p> <p>Session Information table:</p> <table border="1"> <tr> <td>Target portal group tag:</td> <td>1028</td> </tr> <tr> <td>Status:</td> <td>Connected</td> </tr> <tr> <td>Connection count:</td> <td>1</td> </tr> <tr> <td>Maximum Allowed Connections:</td> <td>1</td> </tr> <tr> <td>Authentication:</td> <td>None Specified</td> </tr> <tr> <td>Header Digest:</td> <td>None Specified</td> </tr> <tr> <td>Data Digest:</td> <td>None Specified</td> </tr> </table> <p>Configure Multiple Connected Session (MCS) section:</p> <p>To add additional connections to a session or configure the MCS policy for a selected session, click MCS... <b>MCS...</b></p> <p>Buttons at the bottom: OK and Cancel.</p>	Identifier	ffffe0013e7fc010-4000013700000003	Target portal group tag:	1028	Status:	Connected	Connection count:	1	Maximum Allowed Connections:	1	Authentication:	None Specified	Header Digest:	None Specified	Data Digest:	None Specified
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Connection count:	1																
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Authentication:	None Specified																
Header Digest:	None Specified																
Data Digest:	None Specified																
4-18	Close the Properties dialog box by clicking <b>OK</b> .																
4-19	Close the iSCSI Initiator Properties dialog box by clicking <b>OK</b> :																

## Task 5: Access the iSCSI-Attached LUN from the Windows Host

Step	Action
5-1	On the toolbar in the upper-right corner of the Server Manager window, select <b>Tools &gt; Computer Management</b> .
	 <p>The screenshot shows the 'Server Manager' window. The 'Tools' menu is open, and 'Computer Management' is selected. Other options in the menu include 'Component Services', 'Defragment and Optimize Drives', 'Event Viewer', 'Hyper-V Manager', 'Internet Information Services (IIS) Manager', 'iSCSI Initiator', and 'Local Security Policy'.</p>
5-2	In the left navigation pane, expand the <b>Storage</b> node, and then select <b>Disk Management</b> .

Step	Action
5-3	<p>In the Initialize Disk dialog box, click <b>OK</b>.</p> 
5-4	<p>Notice that each LUN appears as a single disk object.</p> 
5-5	<p>If you do not see the LUN disk in the bottom section of the center pane, right-click the <b>Disk Management</b> node in the left pane, and then select <b>Rescan Disks</b>.</p>
5-6	<p>If the disk is Offline, right-click the disk header, and then select <b>Online</b>.</p> 

Step	Action
5-7	In the Disk Management pane, right-click the <b>Unallocated</b> partition, and then select <b>New Simple Volume</b> .
	
5-8	On the introduction page of the New Simple Volume wizard, click <b>Next</b> .
5-9	On the Specify Volume Size page, click <b>Next</b> .
5-10	On the Assign Drive Letter or Path page, click <b>Next</b> .
5-11	On the Format Partition page, specify the following settings: <ul style="list-style-type: none"> <li>▪ Do not format this volume: <i>unselected (default)</i></li> <li>▪ Format this volume with the following settings: <i>selected (default)</i></li> <li>▪ File system: <b>NTFS (default)</b></li> <li>▪ Allocation unit size: <b>Default (default)</b></li> <li>▪ Volume label: <b>svm5_lun_1</b></li> <li>▪ Perform a quick format: <i>selected (default)</i></li> <li>▪ Enable file and folder compression: <i>unselected (default)</i></li> </ul>
	
5-12	Click <b>Next</b> .
5-13	Review the Completing page, and then click <b>Finish</b> .

Step	Action
5-14	Verify that the new LUN is provisioned, and then close the Computer Management window.
	
5-15	Close Server Manager.
5-16	Note the dialog box that indicates that drive E needs to be formatted before it can be used.
5-17	Format the drive, using the defaults.
5-18	In File Explorer, navigate to the mount location of the LUN, and then verify that you can create a file in the LUN.
	

#### End of Exercise

## Exercise 4: Configuring the S3 Protocol in an SVM

In this exercise, you use best practice tools to create a S3 server in a storage virtual machine (SVM). The S3 protocol and NAS protocols can coexist in the same SVM. However, S3 user accounts are separate from NFS and SMB users and do not belong to the same authentication domain. Therefore, NetApp recommends creating a separate storage VM for S3.

### Objectives

This exercise focuses on enabling you to do the following:

- Create an SVM to host the S3 protocol
- Create and verify S3 buckets
- Create S3 user accounts
- Access an S3 bucket from a S3 client

### Case Study

Zarrot Industries wants to create an S3 object store to support their mobile-friendly applications.

You create an SVM to host the S3 object store and enable the S3 access protocol.

You create S3 user accounts to control access to the S3 object store.

You create an S3 bucket and verify that users can access it.

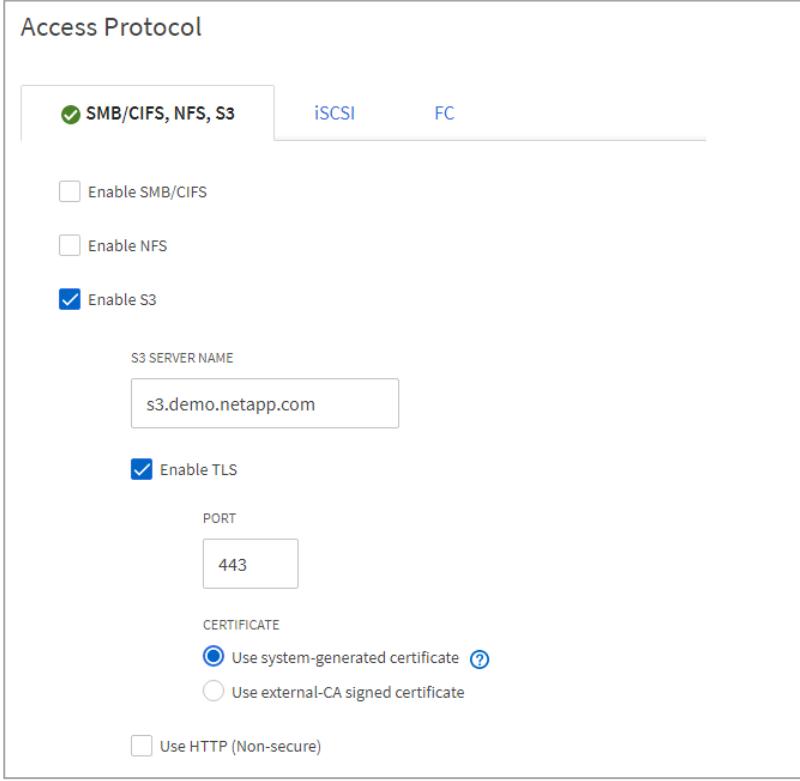
### Exercise Equipment

In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!

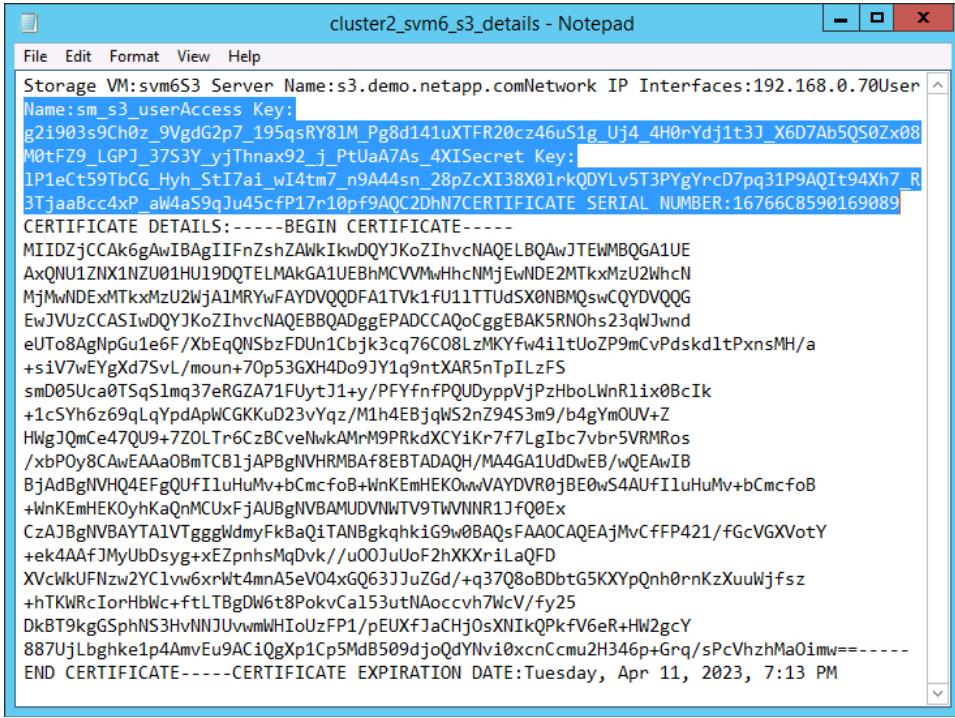
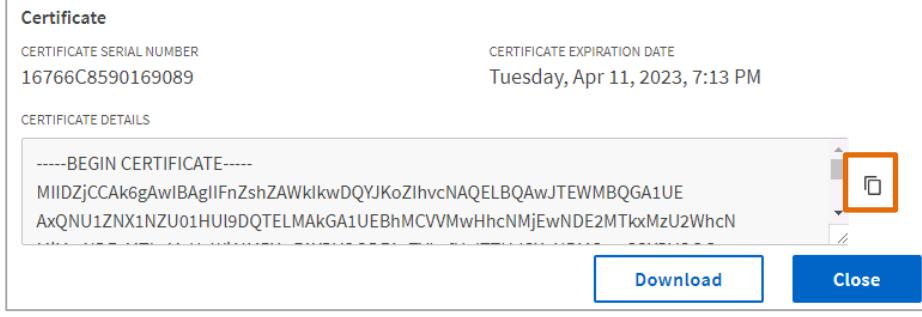
### Task 1: Enable the S3 Protocol in a Storage VM

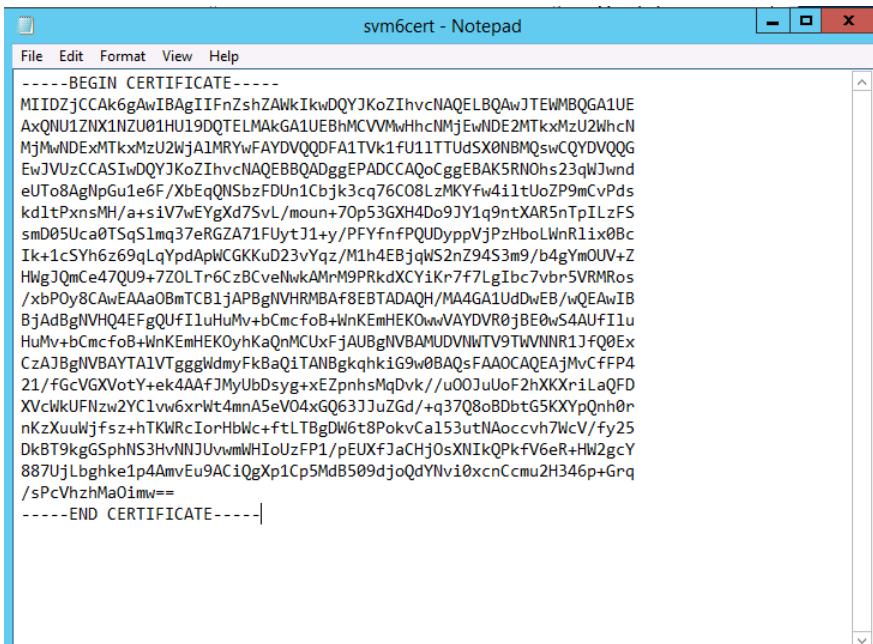
Step	Action
1-1	Return the ONTAP System Manager for <b>cluster1</b> .
1-2	Go to the <b>Storage &gt; Storage VMs</b> page.
1-3	Click <b>Add</b> .
1-4	In the Add Storage VM page, specify the following setting: <ul style="list-style-type: none"><li>▪ SVM Name: <b>svm6</b></li></ul> 

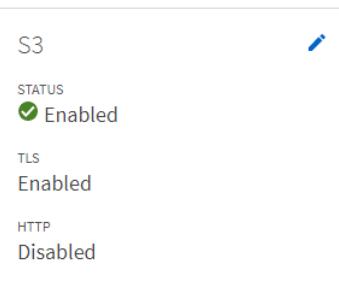
Step	Action
1-5	<p>Scroll down to the Access Protocol section of the Add Storage VM page, select the <b>Enable S3</b> checkbox, and specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ S3 Server Name: <b>s3.demo.netapp.com</b></li> <li>▪ Enable TLS: <b>selected (default)</b></li> <li>▪ Port: <b>443 (default)</b></li> <li>▪ Use system-generated certificate: <b>selected (default)</b></li> </ul> 
1-6	<p>Do not change the default language.</p> 

Step	Action										
1-7	<p>In the Network Interface section of the Add Storage VM page, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ IP Address: <b>192.168.0.170</b></li> <li>▪ Subnet mask: <b>24</b></li> <li>▪ Gateway: <b>192.168.0.1 (default)</b></li> </ul> <div data-bbox="295 312 1241 798"> <p>NETWORK INTERFACE Use multiple network interfaces when client traffic is high.</p> <p>cluster1-01</p> <table border="1"> <tr> <td>IP ADDRESS</td> <td>SUBNET MASK</td> <td>GATEWAY</td> </tr> <tr> <td>192.168.0.170</td> <td>24</td> <td>Add optional gateway</td> </tr> </table> <p><input type="checkbox"/> Use the same subnet mask and gateway for all of the following interfaces</p> <p>cluster1-02</p> <table border="1"> <tr> <td>IP ADDRESS</td> <td>SUBNET MASK</td> </tr> <tr> <td> </td> <td> </td> </tr> </table> </div>	IP ADDRESS	SUBNET MASK	GATEWAY	192.168.0.170	24	Add optional gateway	IP ADDRESS	SUBNET MASK		
IP ADDRESS	SUBNET MASK	GATEWAY									
192.168.0.170	24	Add optional gateway									
IP ADDRESS	SUBNET MASK										
1-8	<p>Do not delegate administration of this storage VM.</p> <div data-bbox="295 882 1302 1163"> <p>Storage VM Administration</p> <p><input type="checkbox"/> Manage administrator account</p> <p><b>Save</b>      <b>Cancel</b></p> </div>										
1-9	<p>Review the configuration and then click <b>Save</b>.</p>										
1-10	<p>In the Added Storage VM page, observe the S3 server information and the name of the user account that is created automatically.</p> <div data-bbox="295 1332 1220 1818"> <p><b>Added Storage VM</b></p> <table border="0"> <tr> <td>STORAGE VM</td> <td>SVM6</td> <td>S3 SERVER NAME</td> <td>s3.demo.netapp.com</td> </tr> </table> <p><b>User Details</b></p> <p>USER NAME</p> <p>sm_s3_user</p> <p><b>ACCESS KEY</b></p> <p><b>SECRET KEY</b></p> <p><b>Show secret key</b></p> </div>	STORAGE VM	SVM6	S3 SERVER NAME	s3.demo.netapp.com						
STORAGE VM	SVM6	S3 SERVER NAME	s3.demo.netapp.com								
1-11	<p>Click <b>Show secret key</b>.</p>										

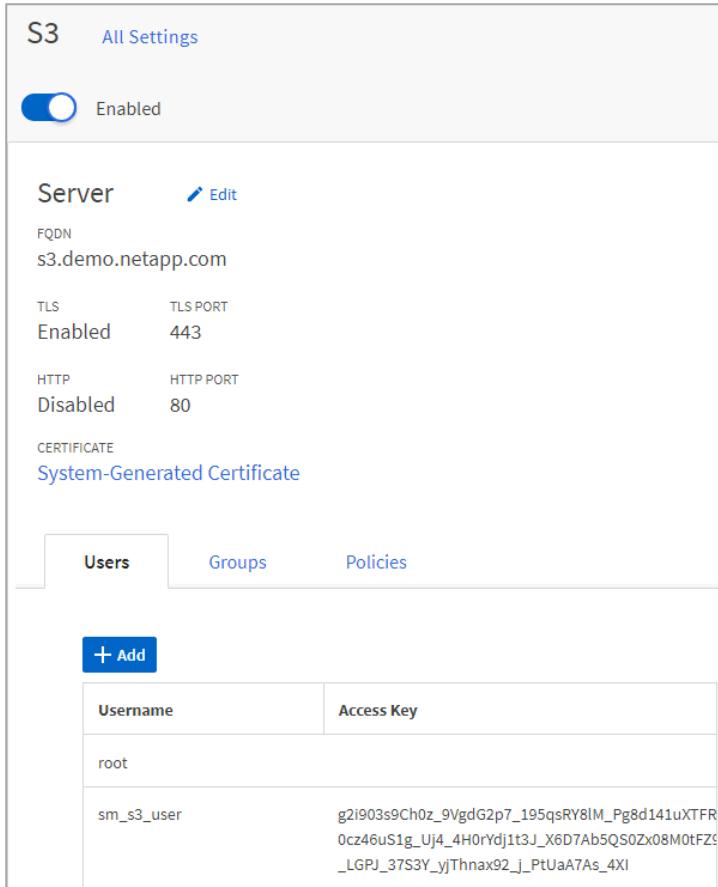
Step	Action								
1-12	<p>Observe the S3 user access key and secret access key.</p> <p><b>ACCESS KEY</b></p> <p>The secret key will not be displayed again. Save this key for future use.</p> <pre>g2i903s9Ch0z_9VgdG2p7_195qsRY8IM_Pg8d141uXTFR20cz46uS1g_Uj4_4H0rYdj1t3J_X6D7Ab 5QS0Zx08M0tFZ9_LGPJ_37S3Y_yjThnax92_j_PtUaA7As_4XI</pre> <p><b>SECRET KEY</b></p> <pre>IP1eCt59TbCG_Hyh_Stl7ai_wl4tm7_n9A44sn_28pZcXI38X0lrkQDYLv5T3PYgYrcD7pq31P9AQlt 94Xh7_R3TjaBcc4xP_aW4aS9qJu45cfP17r10pf9AQC2DhN7</pre> <p><a href="#">Hide secret key</a></p>								
1-13	<p> This window is your only opportunity to view and capture the S3 user access keys. If you have not downloaded or otherwise saved the keys, and the keys are lost, new access keys for the user must be generated.</p>								
1-14	<p> If you selected to use a system-generated certificate, the certificate information is included in the Added Storage VM page. The SVM TLS certificate can be viewed later in the SVM Settings page.</p> <p><b>Certificate</b></p> <table> <tr> <td>CERTIFICATE SERIAL NUMBER 16766C8590169089</td> <td>CERTIFICATE EXPIRATION DATE Tuesday, Apr 11, 2023, 7:13 PM</td> </tr> <tr> <td colspan="2">CERTIFICATE DETAILS</td> </tr> <tr> <td colspan="2"> -----BEGIN CERTIFICATE----- MIIDZjCCAk6gAwIBAgIJFnZshZAWkIkwdQYJKoZIhvcNAQELBQAwJTEWMBQGA1UE AxQU1ZXN1NZU01HUI9DQTELMAkGA1UEBhMCVVVMwHhcNMjEwNDE2MTkxMzU2WhcN -----END CERTIFICATE----- </td> </tr> <tr> <td colspan="2"> <a href="#">Download</a> <a href="#">Close</a> </td> </tr> </table>	CERTIFICATE SERIAL NUMBER 16766C8590169089	CERTIFICATE EXPIRATION DATE Tuesday, Apr 11, 2023, 7:13 PM	CERTIFICATE DETAILS		-----BEGIN CERTIFICATE----- MIIDZjCCAk6gAwIBAgIJFnZshZAWkIkwdQYJKoZIhvcNAQELBQAwJTEWMBQGA1UE AxQU1ZXN1NZU01HUI9DQTELMAkGA1UEBhMCVVVMwHhcNMjEwNDE2MTkxMzU2WhcN -----END CERTIFICATE-----		<a href="#">Download</a> <a href="#">Close</a>	
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<a href="#">Download</a> <a href="#">Close</a>									
1-15	Click <b>Download</b> .								
1-16	Open the downloaded file.								

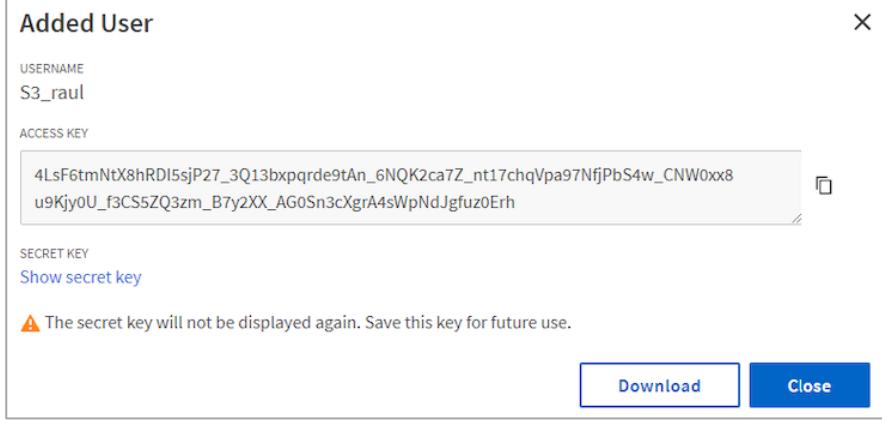
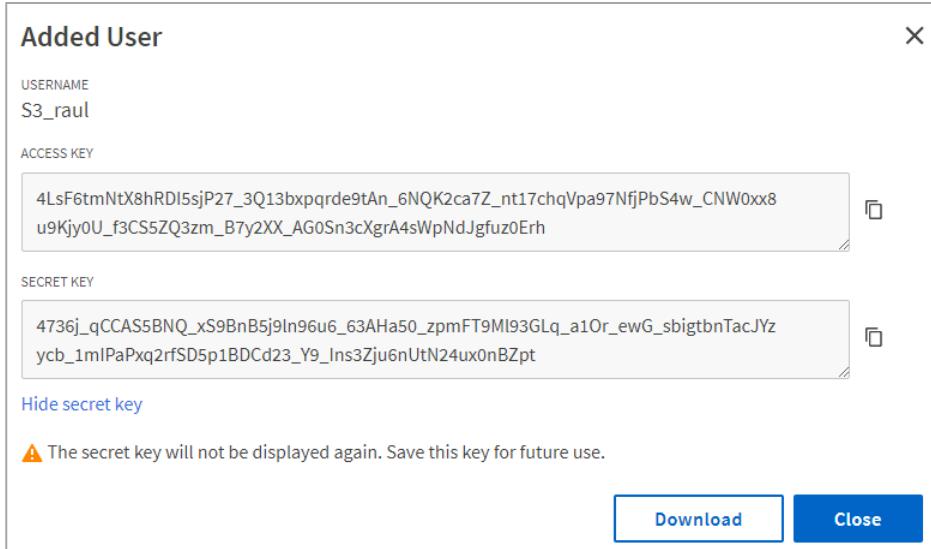
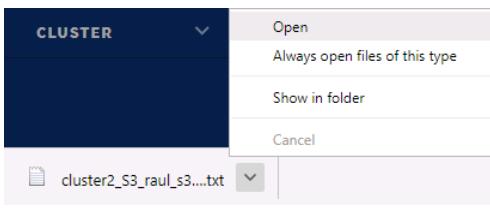
Step	Action									
1-17	<p>Examine the contents of the downloaded file and identify the following information:</p> <ul style="list-style-type: none"> <li>▪ S3 server name:</li> <li>▪ S3 server IP address:</li> <li>▪ S3 server security certificate:</li> <li>▪ S3 user name:</li> <li>▪ S3 user access key:</li> <li>▪ S3 user secret access key:</li> </ul>  <pre> cluster2_svm6_s3_details - Notepad File Edit Format View Help Storage VM:svm6S3 Server Name:s3.demo.netapp.comNetwork IP Interfaces:192.168.0.70User Name:sm_s3_userAccess Key: g21903s9Ch0z_9VgdG2p7_195qsRY81M_Pg8d141uXTRF20cz46uS1g_Uj4_4H0rYdj1t3J_X6D7Ab5QS0Zx08 M0tFZ9_LGPJ_37S3Y_jTThnax92_j_PtUa7As_4XISecret Key: 1P1eC59TbCG_Hyh_StI7ai_wI4tm7_n9A44sn_28pZcXI38X01rkQDYLw5T3PYgYrcD7pq31P9AQIt94Xh7_R 3TjaabCcc4xP_aw4a59qju45cfP17r10pf9AQc2dH7CERTIFICATE SERIAL NUMBER:16766C8590169089 CERTIFICATE DETAILS:----BEGIN CERTIFICATE---- MIIDZjCCAk6gAwIBAgIIFnZshZAWkIkWQDQYJKoZIhvcNAQELBQAwJTEWMBQGA1UE AxQU1ZXN1NZU01HU19DQTELMAkGA1UEBhMCVVMwHhcNMjEwNDE2MTkxMzU2WhcN MjMwNDExMTkxMzU2WjA1MRYwFAYDVQQDFA1TVk1fU1TTUDSX0NBMQswCQYDVQQG EwJVUzCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAK5RNOhs23qWJwnd eUT08AgNpGu1e6F/XbEqQNSbzFDUn1Cbjk3cq76C08LzMKYfw41tUoZP9mCvPdsndlPxnsMH/a +siV7wEYgXd7SvL/moun+70p53GXH4Do9JY1q9ntXAR5nTpILzFS sMD05Uca0TSqSmq37eRGZA71FUytJ1+y/PFYfnfPQUDyppVjPzHboLwnRlix0BcIK +1cSYh6z69qlqYpdApWCgKKuD23vYqz/M1h4EBjqWS2nZ9453m9/b4gYmOUV+Z HwgJ0mCe47Q9+7ZOLTr6CzBceNwkAMrM9PRkdXY1Kr7f7LgIbc7vbr5VRMRos /xbPoy8CAwEAQAA0mTCB1jAPBgNVHRMBAf8EBTADAQH/MA4GA1UdDwEB/wQEAwIB BjAdBgNVHQ4EFgQUFIluHuMv+bCmcfoB+WnkEmHEK0vwVAYDVR0jBE0wS4AUFIluHuMv+bCmcfoB +WnKEmHEKOyhKaQnMCUxFjAUBgNVBAMUDVNTV9TWNNR1JfQ0Ex CzAJBgNVBAYTA1VTggglwdmyFkBaQiTANBgqhkiG9w0BAQsFAAOCAQEajMvCffP421/fGcVGXVotY +ek4AfJMyUbDsyg+xEZpnhsMqDvk//u0QjUof2hXXkrilQFD XcvIkUFNzw2YClvw6xrT4mnA5eV04xGQ63JJuZGd/+q37Q8oFBdtG5KXYpQnh0rnKzXuuWjfesz +hTKWRcIorHbwC+fLTBgdW6t8PovkCa153utNaoccvh7Wcv/fy25 DkB9kgGSpHNS3HvnNJuUvwIHIoUzFP1/pEUxfJaCHjOsXNIkQPkfV6eR+HW2gcY 887UjLbgkhe1p4AmvEu9ACiQgXp1Cp5MdB509djoQdYNvi0xcnCcmu2H346p+Grq/sPcVzhMaOimw=----- END CERTIFICATE----CERTIFICATE EXPIRATION DATE:Tuesday, Apr 11, 2023, 7:13 PM </pre>									
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CERTIFICATE DETAILS										
-----BEGIN CERTIFICATE----- MIIDZjCCAk6gAwIBAgIIFnZshZAWkIkWQDQYJKoZIhvcNAQELBQAwJTEWMBQGA1UE AxQU1ZXN1NZU01HU19DQTELMAkGA1UEBhMCVVMwHhcNMjEwNDE2MTkxMzU2WhcN MjMwNDExMTkxMzU2WjA1MRYwFAYDVQQDFA1TVk1fU1TTUDSX0NBMQswCQYDVQQG EwJVUzCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAK5RNOhs23qWJwnd eUT08AgNpGu1e6F/XbEqQNSbzFDUn1Cbjk3cq76C08LzMKYfw41tUoZP9mCvPdsndlPxnsMH/a +siV7wEYgXd7SvL/moun+70p53GXH4Do9JY1q9ntXAR5nTpILzFS sMD05Uca0TSqSmq37eRGZA71FUytJ1+y/PFYfnfPQUDyppVjPzHboLwnRlix0BcIK +1cSYh6z69qlqYpdApWCgKKuD23vYqz/M1h4EBjqWS2nZ9453m9/b4gYmOUV+Z HwgJ0mCe47Q9+7ZOLTr6CzBceNwkAMrM9PRkdXY1Kr7f7LgIbc7vbr5VRMRos /xbPoy8CAwEAQAA0mTCB1jAPBgNVHRMBAf8EBTADAQH/MA4GA1UdDwEB/wQEAwIB BjAdBgNVHQ4EFgQUFIluHuMv+bCmcfoB+WnkEmHEK0vwVAYDVR0jBE0wS4AUFIluHuMv+bCmcfoB +WnKEmHEKOyhKaQnMCUxFjAUBgNVBAMUDVNTV9TWNNR1JfQ0Ex CzAJBgNVBAYTA1VTggglwdmyFkBaQiTANBgqhkiG9w0BAQsFAAOCAQEajMvCffP421/fGcVGXVotY +ek4AfJMyUbDsyg+xEZpnhsMqDvk//u0QjUof2hXXkrilQFD XcvIkUFNzw2YClvw6xrT4mnA5eV04xGQ63JJuZGd/+q37Q8oFBdtG5KXYpQnh0rnKzXuuWjfesz +hTKWRcIorHbwC+fLTBgdW6t8PovkCa153utNaoccvh7Wcv/fy25 DkB9kgGSpHNS3HvnNJuUvwIHIoUzFP1/pEUxfJaCHjOsXNIkQPkfV6eR+HW2gcY 887UjLbgkhe1p4AmvEu9ACiQgXp1Cp5MdB509djoQdYNvi0xcnCcmu2H346p+Grq/sPcVzhMaOimw=----- END CERTIFICATE----CERTIFICATE EXPIRATION DATE:Tuesday, Apr 11, 2023, 7:13 PM										
<input type="button" value="Download"/>	<input type="button" value="Close"/>									

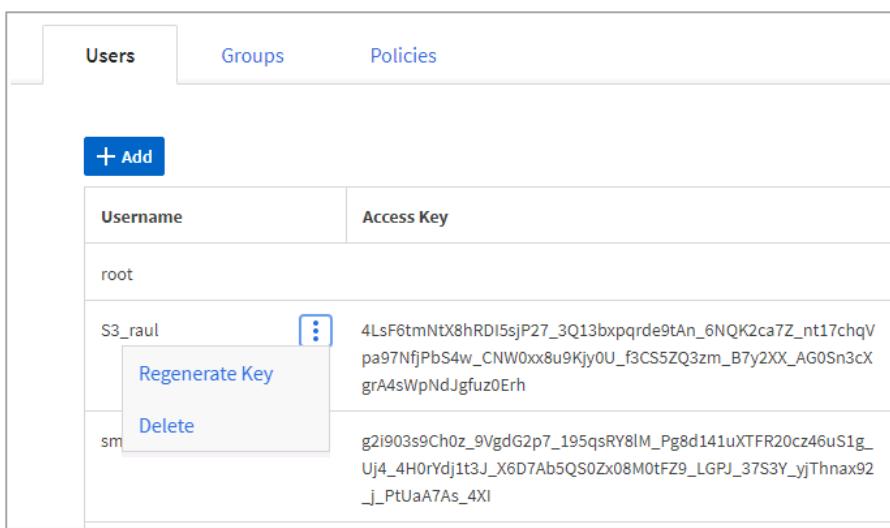
Step	Action
1-19	<p>Open a new Notepad window, paste the certificate text into it, and save the file as <b>svm6cert.crt</b>.</p>  <p><b>i</b> Verify that there are no extra spaces or lines before the begin certificate nor after the end certificate statements.</p>
1-20	Return to System Manager, and click <b>Close</b> to close the Added Storage VM window.
1-21	In the Storage VMs page, click <b>svm6</b> and then click the <b>Settings</b> tab.
1-22	Verify that the S3 protocol is enabled.



## Task 2: Create an S3 User Account

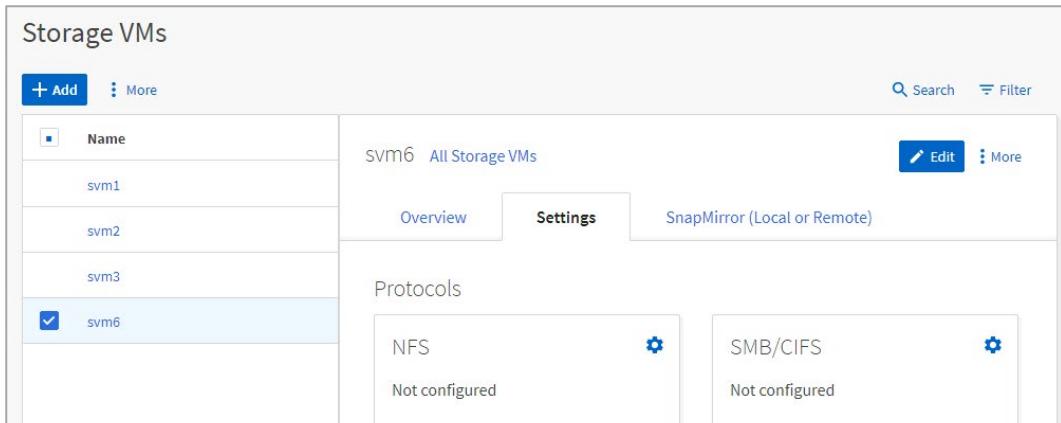
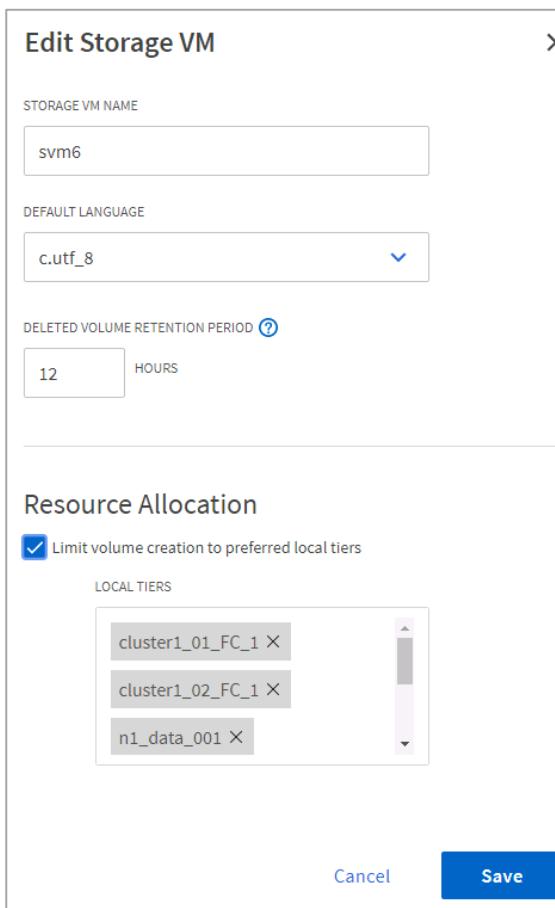
Step	Action
2-1	Click the edit (pencil) button in the S3 panel to change the S3 settings.
2-2	In the Users tab of the S3 Server page, click the <b>Add</b> user button. 
2-3	Enter a name for your S3 user account and click <b>Save</b> .

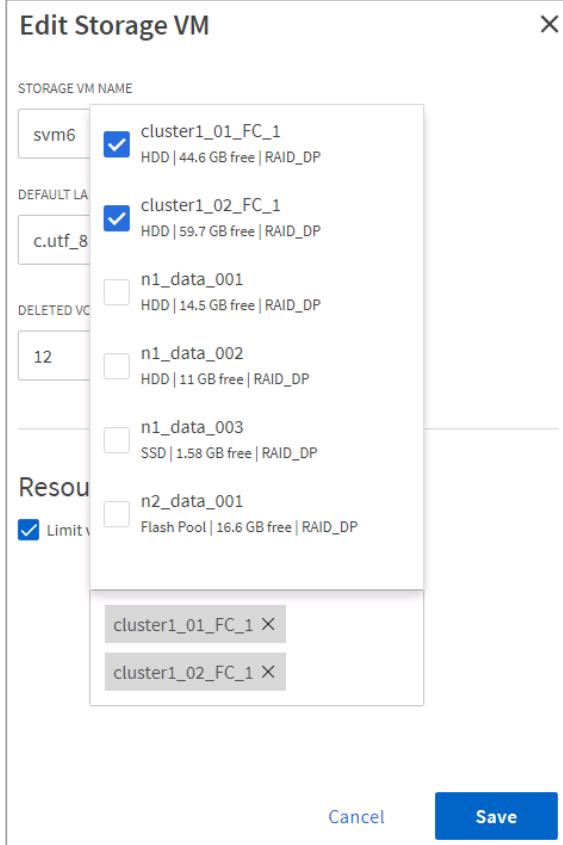
Step	Action
2-4	In the Added User page, observe the S3 user information and access key.
	 <p>The screenshot shows the 'Added User' dialog box. It contains fields for 'USERNAME' (S3_raul) and 'ACCESS KEY' (a long string of characters). Below the access key field is a note: '⚠ The secret key will not be displayed again. Save this key for future use.' At the bottom are 'Download' and 'Close' buttons.</p>
2-5	Click <b>Show secret key</b> .
2-6	Observe the S3 user access key and secret access key.
	 <p>The screenshot shows the 'Added User' dialog box with both 'ACCESS KEY' and 'SECRET KEY' fields visible. Both fields contain the same long string of characters. Below the secret key field is a note: '⚠ The secret key will not be displayed again. Save this key for future use.' At the bottom are 'Download' and 'Close' buttons.</p>
2-7	 <p>This window is your only opportunity to view and capture the S3 user access keys. If you have not downloaded or otherwise saved the keys and the keys are lost, new access keys for the user must be generated.</p>
2-8	Click <b>Download</b> .
2-9	Open the downloaded file.
	 <p>The screenshot shows a file download context menu with 'Open' selected. Other options include 'Always open files of this type', 'Show in folder', and 'Cancel'. Below the menu is a file icon labeled 'cluster2_S3_raul_s3....txt'.</p>

Step	Action								
2-10	<p>Examine the contents of the downloaded file and identify the following information:</p> <ul style="list-style-type: none"> <li>▪ S3 user name:</li> <li>▪ S3 user access key:</li> <li>▪ S3 user secret access key:</li> </ul>  <pre> cluster2_S3_raul_s3 user - Notepad File Edit Format View Help {     "AccessKey": {         "UserName": "S3_raul",         "AccessKeyId": "4LsF6tmNtX8hRDI5sjP27_3Q13bxpqrde9tAn_6NQK2ca7Z_nt17chqVpa97NfjPbS4w_CNW0xx8u9Kjy0U_f3CS5ZQ3zm_B7y2XX_AG0Sn3cXgrA4sWpNldJgfuz0Erh",         "SecretAccessKey": "4736j_qCCAS5BNQ_xS9BnB5j91n96u6_63AHa50_zpmFT9M193GLq_a10r_ewG_sbigt.bnTacJYzycb_1mIPaPxq2rfSD5p1BDCd23_Y9_Ins3Zju6nUtN24ux0nBZpt"     } } </pre>								
2-11	Return to System Manager, and click <b>Close</b> to close the Added User window.								
2-12	In the S3 Server page, position your cursor over the new S3 user name, and click the <b>More</b> menu button.								
	 <table border="1"> <thead> <tr> <th>Username</th> <th>Access Key</th> </tr> </thead> <tbody> <tr> <td>root</td> <td></td> </tr> <tr> <td>S3_raul</td> <td> <span style="color: blue;">[...]</span>   <a href="#">Regenerate Key</a>   <a href="#">Delete</a> </td> </tr> <tr> <td>sm</td> <td></td> </tr> </tbody> </table>	Username	Access Key	root		S3_raul	<span style="color: blue;">[...]</span> <a href="#">Regenerate Key</a> <a href="#">Delete</a>	sm	
Username	Access Key								
root									
S3_raul	<span style="color: blue;">[...]</span> <a href="#">Regenerate Key</a> <a href="#">Delete</a>								
sm									
2-13	Dismiss the More menu.								

## Task 3: Control SVM access to aggregates

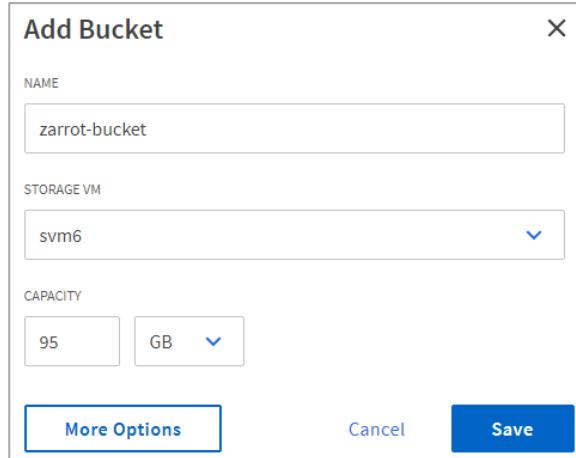
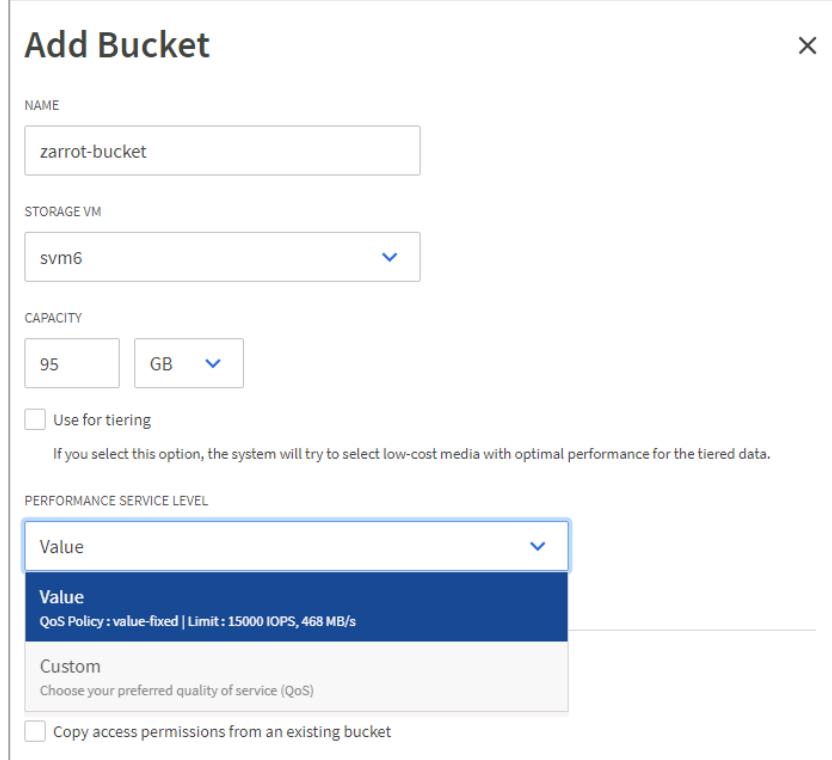
Specify which aggregates a storage VM may create volumes in.

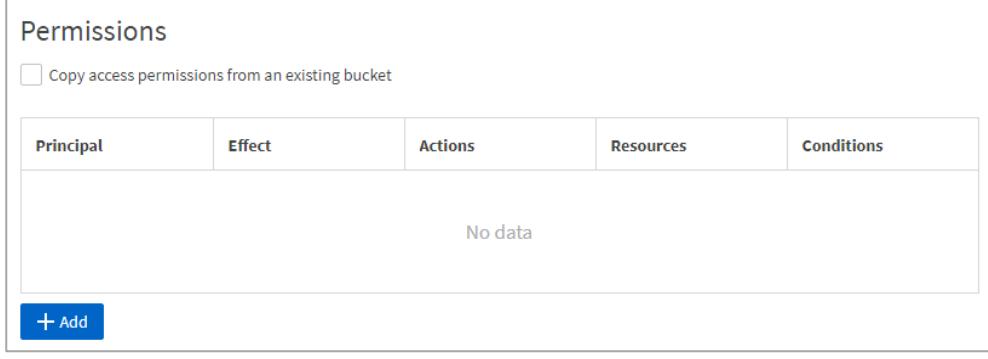
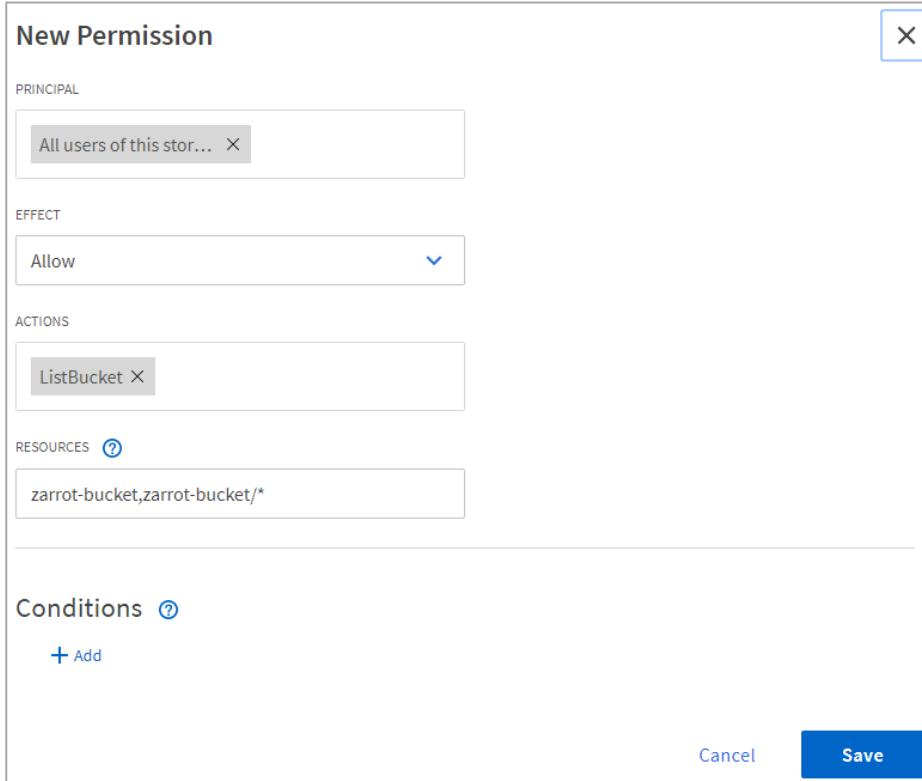
Step	Action
3-1	In the Storage VM details page for svm6, click <b>Edit</b> .  A screenshot of the Storage VMs list. The 'Name' column shows entries: svm1, svm2, svm3, and svm6. The row for svm6 has a blue checkmark next to it. To the right of the list are three tabs: Overview, Settings (which is selected), and SnapMirror (Local or Remote). Below the tabs, there's a section titled 'Protocols' with two items: 'NFS' and 'SMB/CIFS', both labeled 'Not configured'.
3-2	In the Resource Allocation section select <b>Limit volume creation to preferred local tiers</b> .  A screenshot of the 'Edit Storage VM' dialog. It shows basic information like 'STORAGE VM NAME' (svm6) and 'DEFAULT LANGUAGE' (c.utf_8). In the 'Resource Allocation' section, there's a checkbox labeled 'Limit volume creation to preferred local tiers' which is checked. Below it, under 'LOCAL TIERS', there's a list of storage components: 'cluster1_01_FC_1', 'cluster1_02_FC_1', and 'n1_data_001'. A vertical slider bar is positioned to the right of the tier list. At the bottom of the dialog are 'Cancel' and 'Save' buttons.

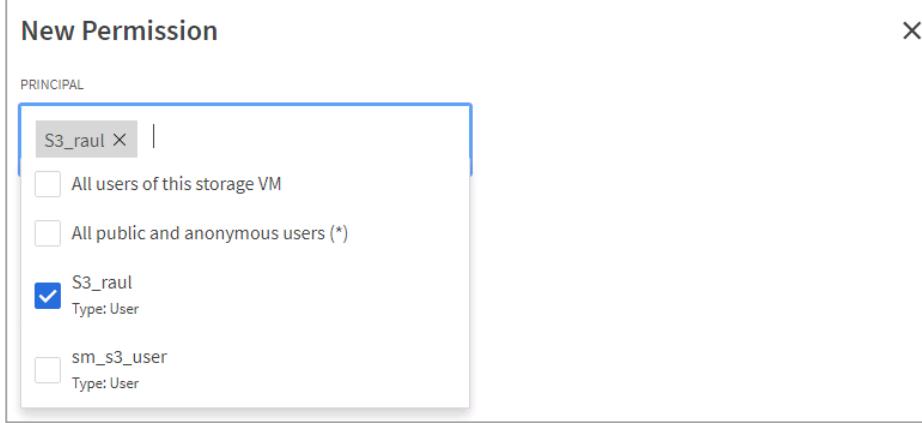
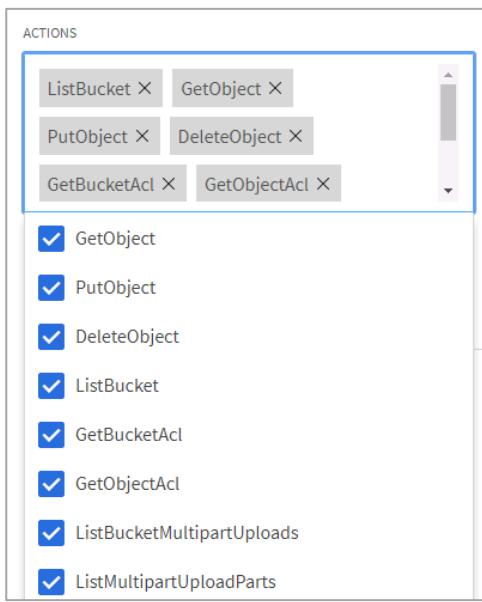
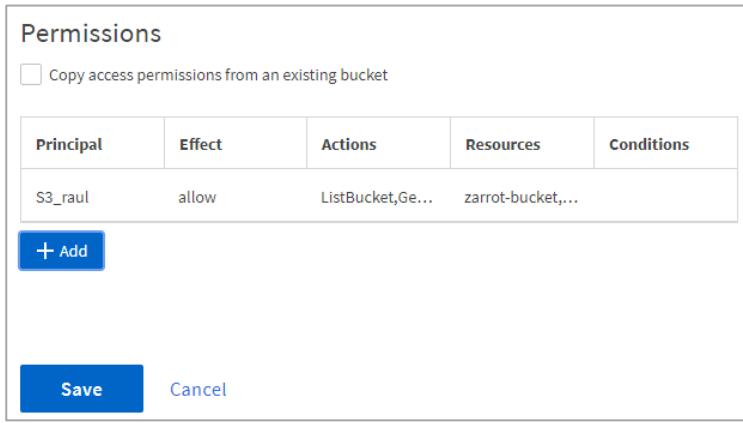
Step	Action
3-3	<p>Click the X to delete each of the local tiers from the preferred tiers list, except for cluster1_01_FC_1 and cluster1_02_FC_1.</p> 
3-4	<p><b>i</b> You cannot store data volumes on the aggr0 aggregate of a node.</p>
3-5	Click Save.

## Task 4: Create an S3 Bucket

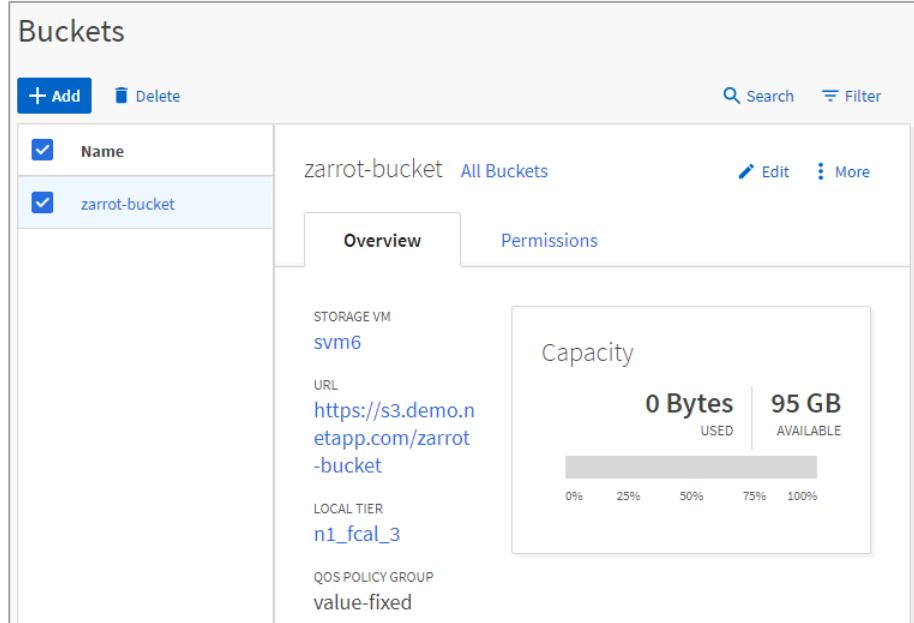
Step	Action
4-1	Navigate to the <b>Storage &gt; Buckets</b> page and click <b>Add</b> .

Step	Action
4-2	<p>Create an S3 bucket with the following settings:</p> <ul style="list-style-type: none"> <li>Name: <b>zarrot-bucket</b></li> <li>Storage VM: <b>svm6</b></li> <li>Capacity: <b>95GB</b></li> </ul> 
4-3	Click <b>More Options</b> .
4-4	<p>In the Add Bucket page, click the Performance Service Level menu, and observe the available storage performance service levels.</p> 
4-5	Select <b>Value</b> .

Step	Action
4-6	Scroll down the Add Bucket page to the Permissions section, and click <b>Add</b> .
	 <p>The screenshot shows the 'Permissions' section of the AWS S3 'Add Bucket' page. It features a table with five columns: Principal, Effect, Actions, Resources, and Conditions. Below the table, a message says 'No data'. At the bottom left is a blue '+ Add' button.</p>
4-7	Notice that the default access permission is to allow all S3 users of this storage system to list the contents of the zarrot-bucket S3 bucket.
	 <p>The screenshot shows the 'New Permission' dialog box. It includes fields for PRINCIPAL, EFFECT, ACTIONS, and RESOURCES. The PRINCIPAL field contains 'All users of this storage VM'. The EFFECT field is set to 'Allow'. The ACTIONS field contains 'ListBucket'. The RESOURCES field contains 'zarrot-bucket,zarrot-bucket/*'. Below these fields is a 'Conditions' section with a '+ Add' button. At the bottom right are 'Cancel' and 'Save' buttons.</p>
4-8	Click the X to remove 'All users of this storage VM' from the access permission principal.
	 <p>The screenshot shows the 'New Permission' dialog box again, focusing on the PRINCIPAL field. The entry 'All users of this storage VM' is highlighted with a blue background, and there is a small 'X' icon to its right, which serves as a delete button.</p>

Step	Action
4-9	Click in the Principal box and select your S3 user from the list.  
4-10	Click in the Actions box, and select all of the checkboxes to allow your S3 user to perform all operations:  
4-11	Click Save.
4-12	In the Add Bucket page, click Save.  

Step	Action
4-13	In the Buckets page, click <b>zarrot-bucket</b> and observe the URL.



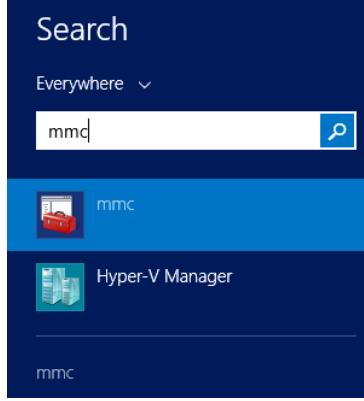
The screenshot shows the 'Buckets' page in the NetApp Storage VM interface. A sidebar on the left lists buckets: 'zarrot-bucket' and 'zarrot-bucket'. The 'zarrot-bucket' entry is selected, highlighted with a blue border. The main panel displays the 'Overview' tab for this bucket. Key details shown include:

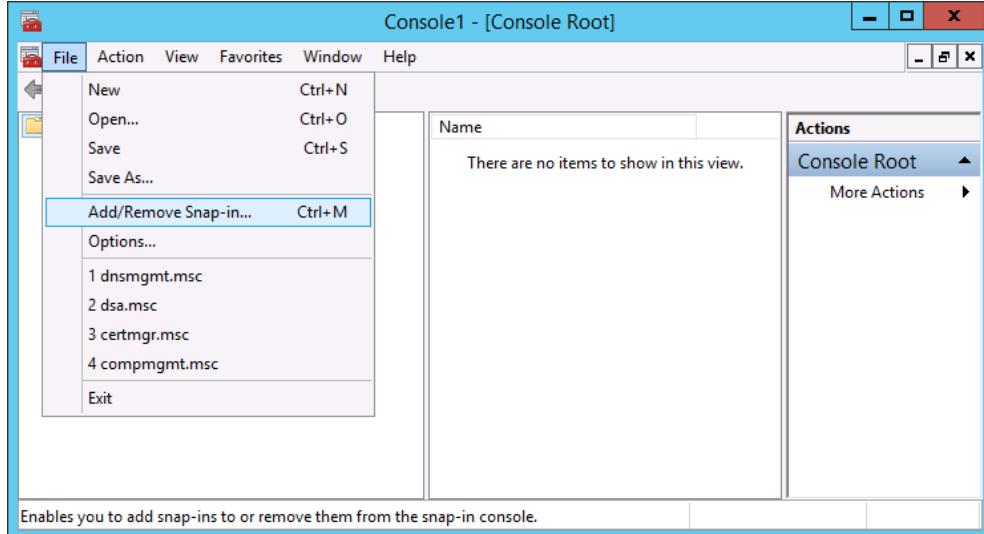
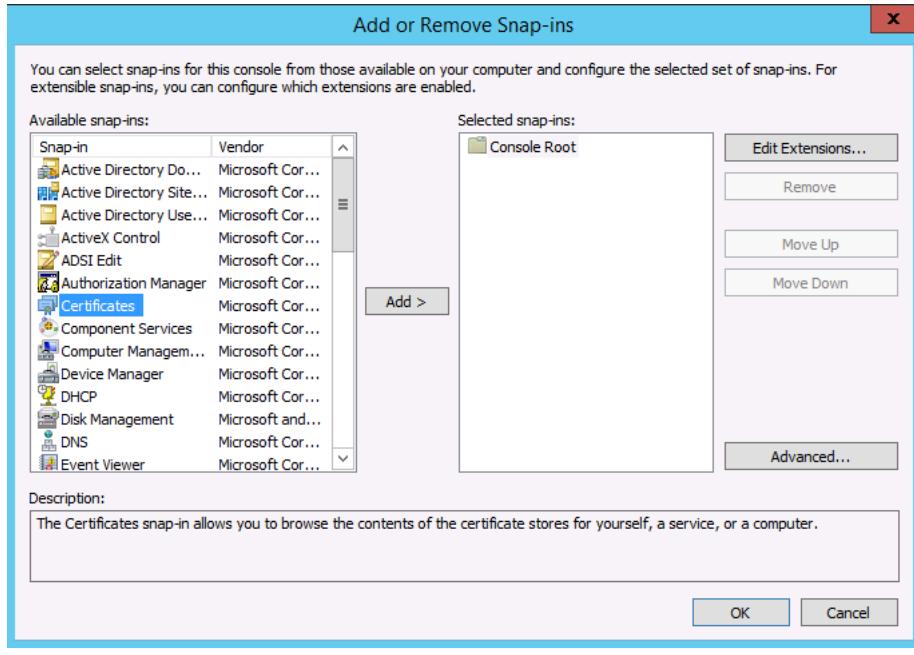
- STORAGE VM:** svm6
- URL:** <https://s3.demo.netapp.com/zarrot-bucket>
- LOCAL TIER:** n1\_fc1\_3
- QOS POLICY GROUP:** value-fixed

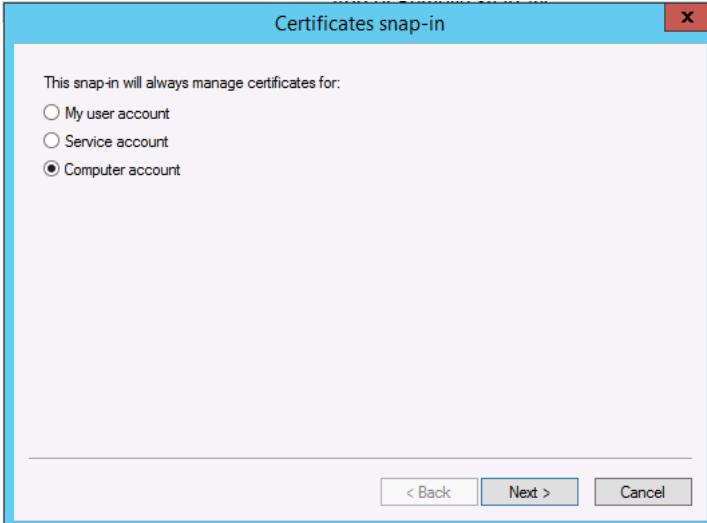
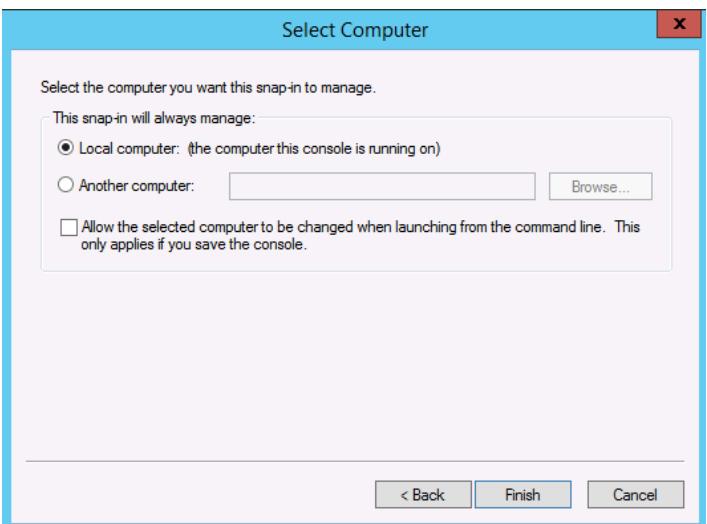
A 'Capacity' section shows 0 Bytes USED and 95 GB AVAILABLE, with a progress bar indicating 0% usage.

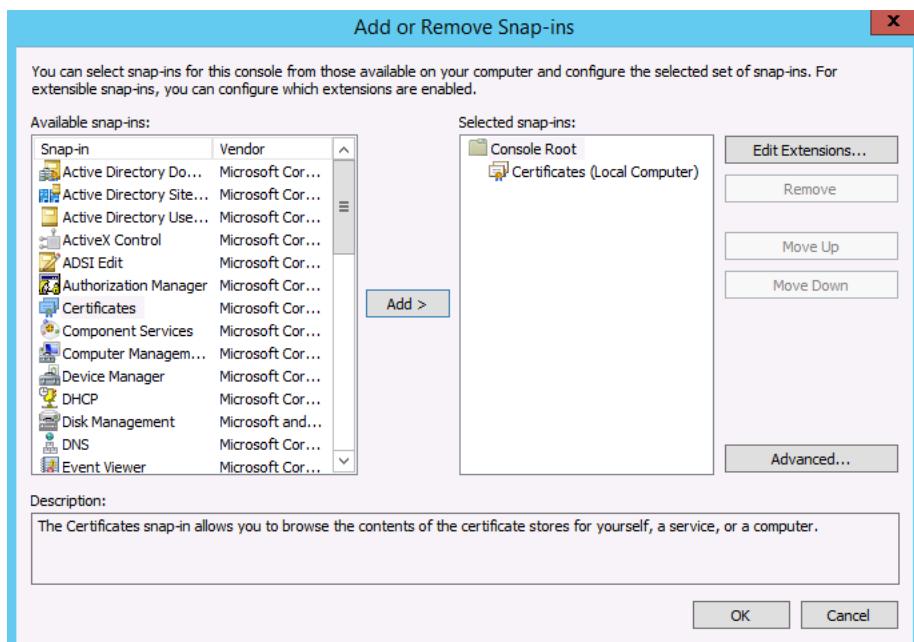
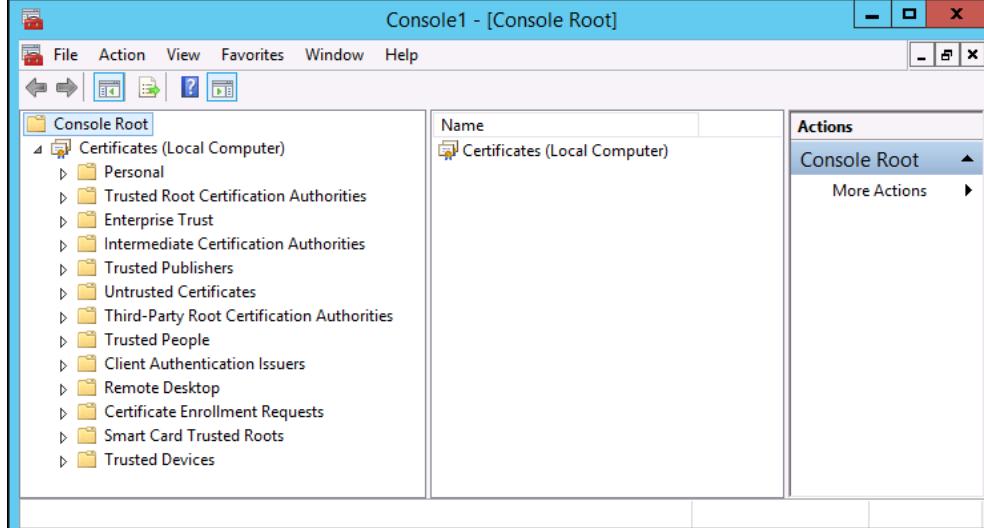
## Task 5: Establish Secure Communications

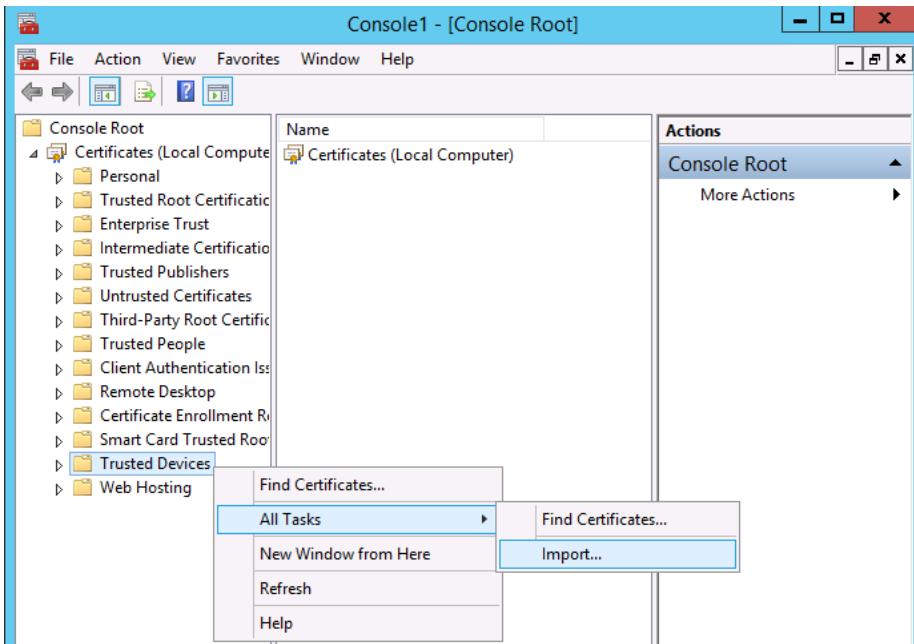
In this task, you establish secure communications, for which you must import the S3 server certificate into the Windows client host.

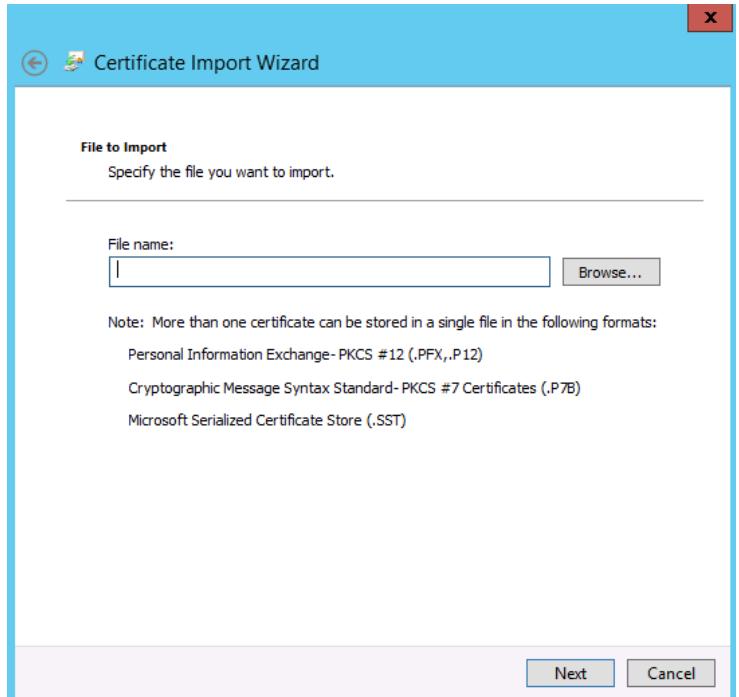
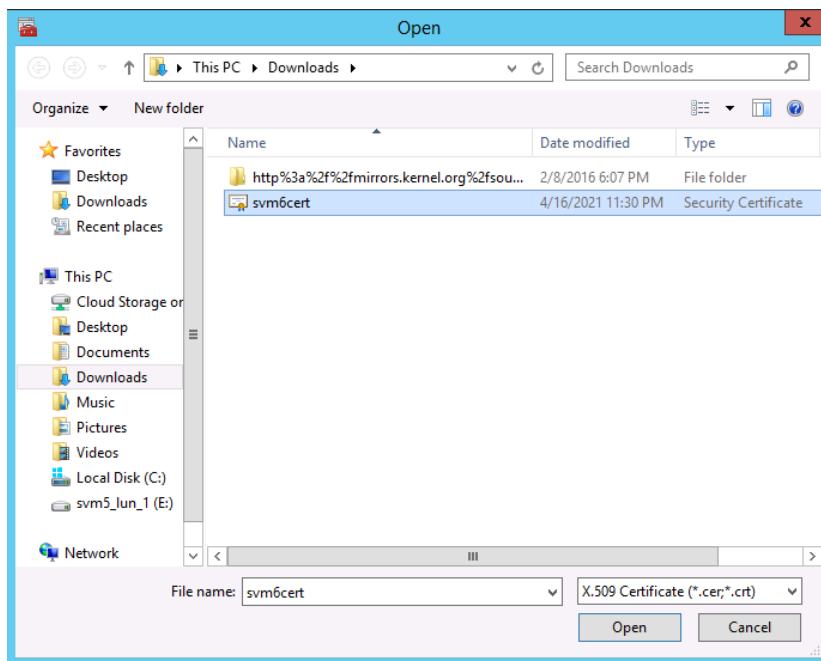
Step	Action
5-1	On the landing host desktop, click the Windows menu button.
	
5-2	Type <b>mmc</b> anywhere into the background of the Windows Start page, and then click <b>mmc.exe</b> .
	

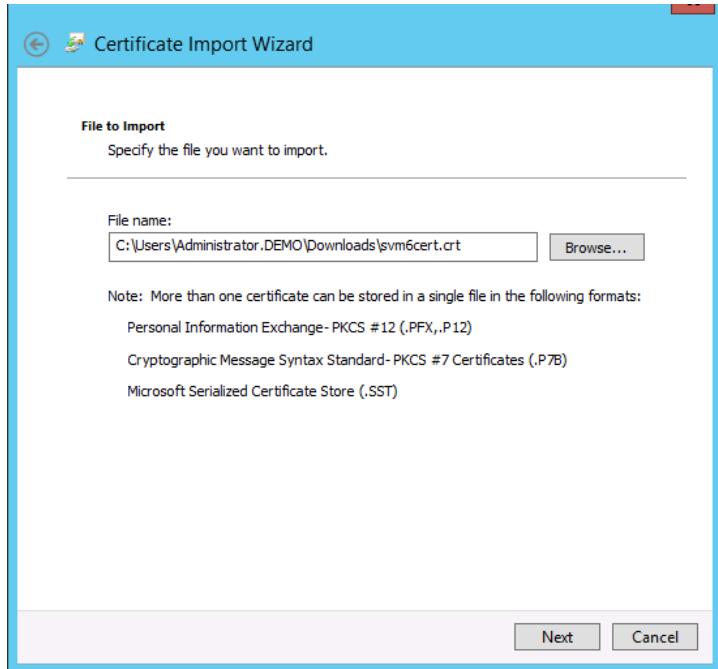
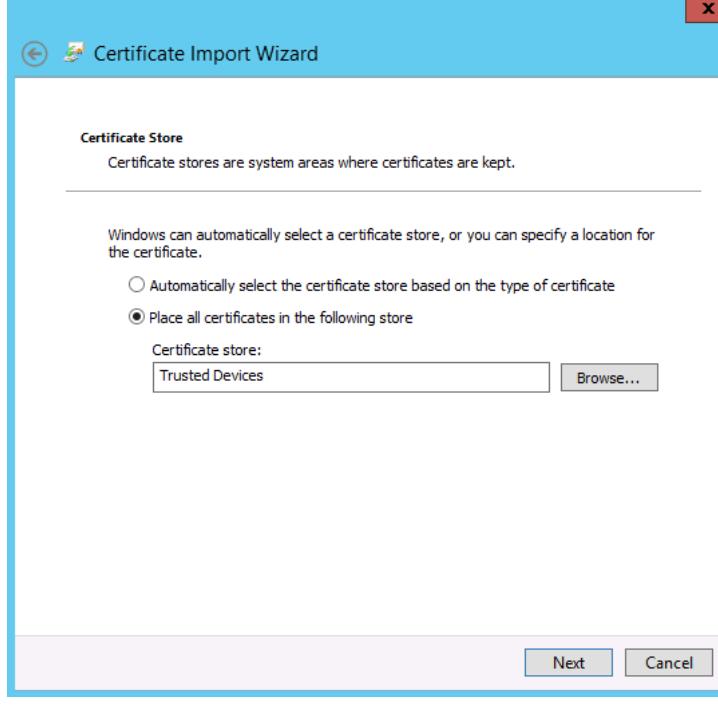
Step	Action
5-3	<p>In the Windows Management Console [Console Root] window, from the menu, select <b>File &gt; Add/Remove Snap-in</b>.</p> 
5-4	<p>On the Add or Remove Snap-ins page, from the Available snap-ins list, select <b>Certificates</b>, and then click <b>Add</b>.</p> 

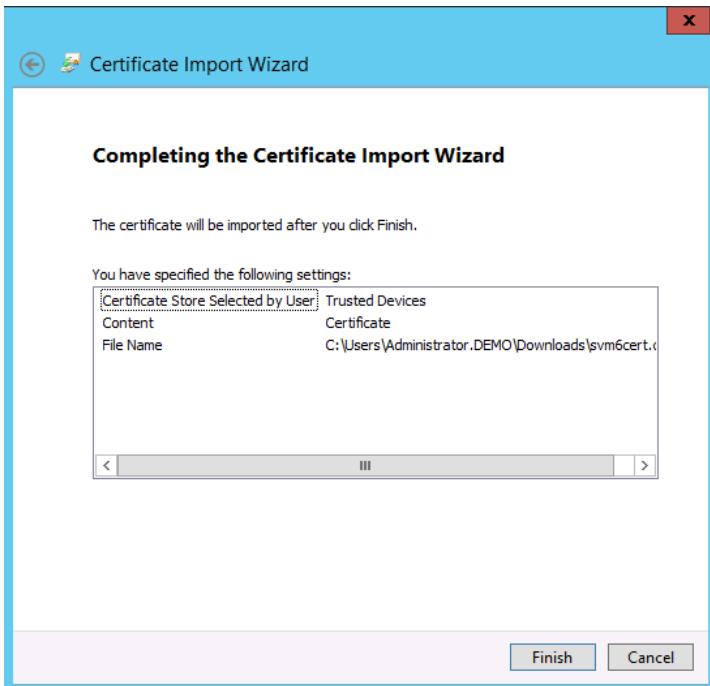
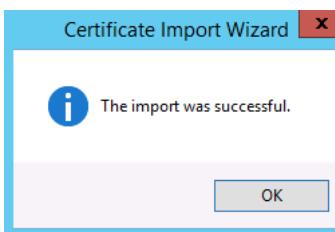
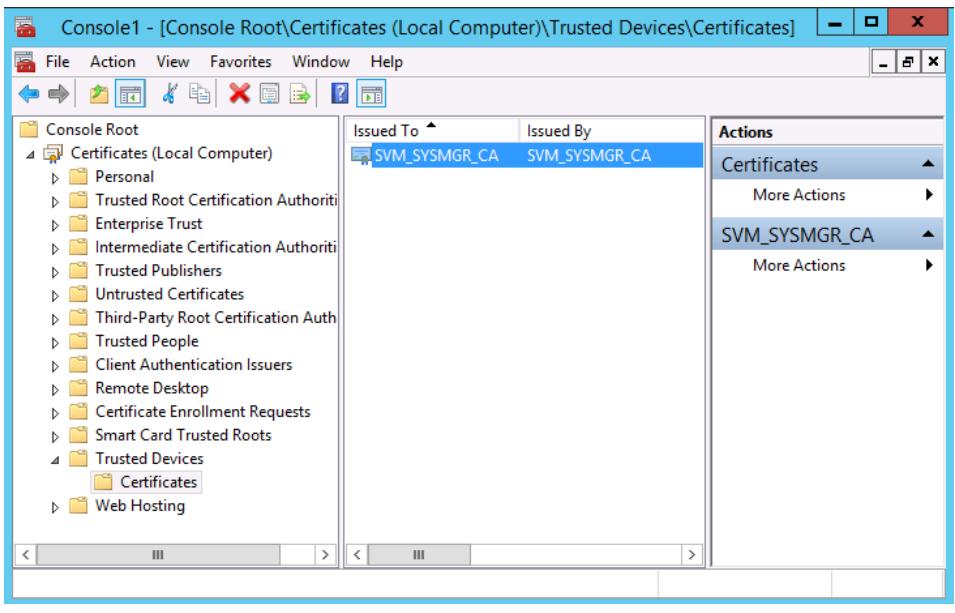
Step	Action
5-5	<p>Select <b>Computer account</b> to have the Certificates snap-in manage certificates for the computer account, and then click <b>Next</b>.</p>  <p>The dialog box is titled "Certificates snap-in". It contains the instruction: "This snap-in will always manage certificates for:". Below it are three radio buttons: "My user account", "Service account", and "Computer account", with "Computer account" being selected. At the bottom are buttons for "&lt; Back", "Next &gt;" (highlighted in blue), and "Cancel".</p>
5-6	<p>Select <b>Local computer</b> to enable the Certificates snap-in to manage certificates for the local computer, and then click <b>Finish</b>.</p>  <p>The dialog box is titled "Select Computer". It contains the instruction: "Select the computer you want this snap-in to manage.". It shows "This snap-in will always manage:" followed by two options: "Local computer: (the computer this console is running on)" (selected) and "Another computer: [input field] [Browse...]" (unchecked). There is also a checkbox for "Allow the selected computer to be changed when launching from the command line. This only applies if you save the console." At the bottom are buttons for "&lt; Back", "Finish" (highlighted in blue), and "Cancel".</p>

Step	Action
5-7	<p>Back on the Add or Remove Snap-ins page, verify that the Certificates (Local Computer) snap-in is selected, and then click <b>OK</b>.</p> 
5-8	<p>In the Windows Management Console [Console Root] window, expand the Certificates snap-in.</p> 

Step	Action
5-9	Right-click Trusted Devices, and then select All Tasks > Import.
	
5-10	<i>i</i> The Certificate Import wizard appears.
5-11	On the Welcome page, click Next.

Step	Action
5-12	<p>On the File to Import page, click <b>Browse</b>.</p> 
5-13	<p>Open the <b>svm6cert.crt</b> certificate file that you created earlier.</p> 

Step	Action
5-14	<p>On the File to Import page, click Next.</p> 
5-15	<p>Click Next to accept the default certificate store (Trusted Devices).</p> 

Step	Action
5-16	On the Completing the Certificate Import Wizard page, click <b>Finish</b> .
	
5-17	Click <b>OK</b> to dismiss the confirmation dialog box.
	
5-18	Verify that the Trusted Devices certificate store contains the ONTAP S3 certificate.
	

Step	Action
<b>5-19</b>	Close the Windows Management Console window.

## Task 6: Verify access to the S3 Object Store

Step	Action
<b>6-1</b>	From the desktop of the landing host, open a command or Windows PowerShell window. 
<b>6-2</b>	From the PowerShell command line, move to the Downloads folder. > <code>cd ~\Downloads</code>
<b>6-3</b>	Use the <code>aws</code> command to create a S3 connection profile. Enter the Access Key ID and Secret Access Key for the ONTAP S3 user account: > <code>aws configure</code> AWS Access Key ID [None: <key ID> AWS Secret Access Key [None]: <secret key> Default region name [None]: Default output format [None]:
<b>6-4</b>	Copy a file into zarrot-bucket bucket in the S3 object store: > <code>aws s3 cp svm6cert.crt s3://zarrot-bucket/file1</code> <code>--endpoint-url https://192.168.0.170 --no-verify-ssl</code>
<b>6-5</b>	Copy a second file into zarrot-bucket bucket in the S3 object store: > <code>aws s3 cp svm6cert.crt s3://zarrot-bucket/file2</code> <code>--endpoint-url https://192.168.0.170 --no-verify-ssl</code>
<b>6-6</b>	Show the objects in the zarrot-bucket S3 bucket: > <code>aws s3 ls s3://zarrot-bucket/</code> <code>--endpoint-url https://192.168.0.170 --no-verify-ssl</code>
<b>6-7</b>	Retrieve an object from the zarrot-bucket bucket and place it into a local folder: > <code>aws s3 cp s3://zarrot-bucket/file1 C:\CourseFiles\S3_file1</code> <code>--endpoint-url https://192.168.0.170 --no-verify-ssl</code>
<b>6-8</b>	Examine the contents of the local folder: > <code>ls C:\CourseFiles</code>

**End of Exercise**

## Exercise 5: Managing NAS Storage VMs

In this exercise, you use best practice tools to manage storage virtual machines that have NAS protocols enabled.

### Objectives

This exercise focuses on enabling you to do the following:

- Migrate and rehome a NAS data LIF
- Mirror the SVM root volume to protect the namespace

### Case Study

The NetApp cluster node needs to be brought down so that a new expansion controller board can be installed. To avoid disturbing the NAS clients that are actively using the system, the logical network interface through which the clients are accessing the system can be moved to a different node in the cluster. Migrate the LIF to another network port temporarily or rehome the LIF if the move is permanent.

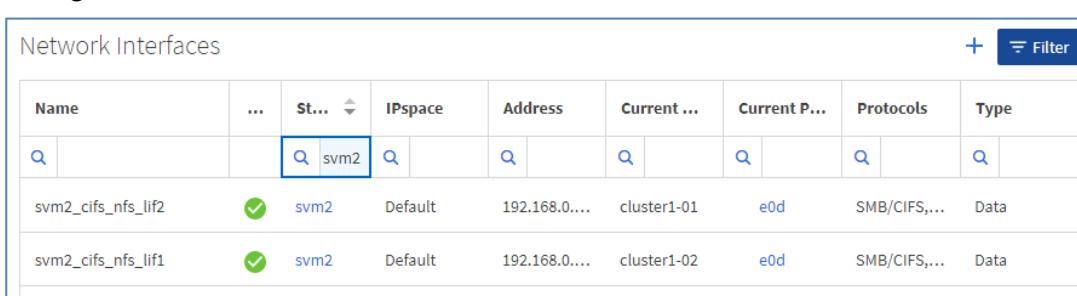
Storage VMs that serve NAS protocols provide a namespace. Ensure the namespace is accessible to NAS client hosts by mirroring the SVM root volume to a different node in the cluster.

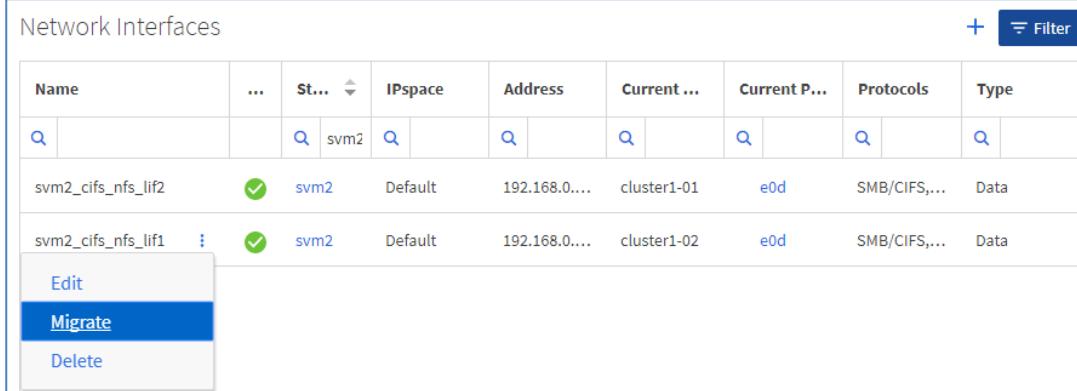
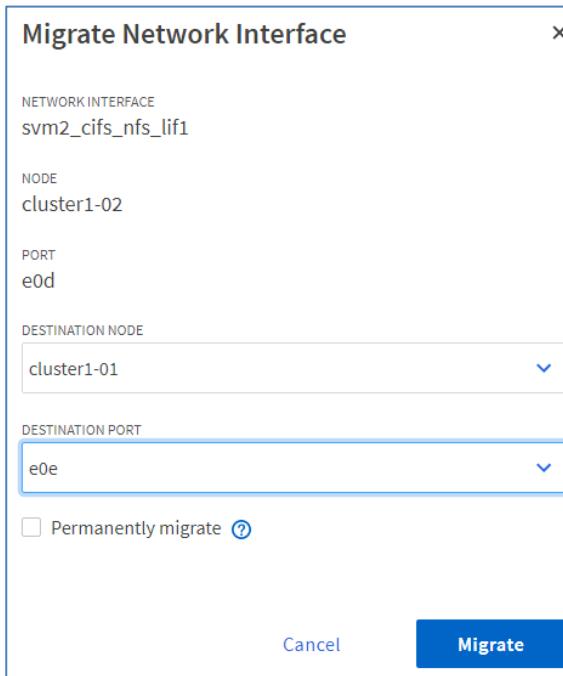
### Exercise Equipment

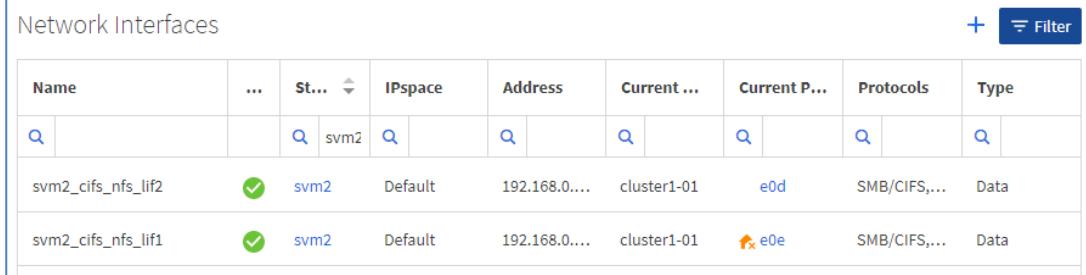
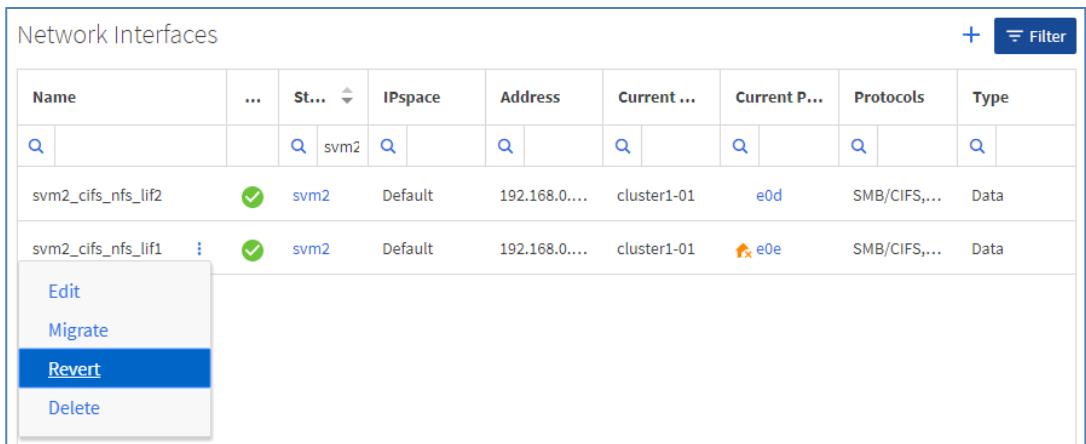
In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!

### Task 1: Migrate and Rehome a NAS Data LIF

Step	Action
1-1	<p><b>i</b> LIF migration occurs only with NAS data LIFs. LIF migration is more useful and interesting on 2-node clusters. Therefore, you perform this task on cluster1.</p>
1-2	Return to the NetApp ONTAP System Manager session on <b>cluster1</b> .
1-3	On the System Manager menu bar, select <b>Network &gt; Overview</b> .
1-4	In the Network Interfaces pane, use the Filter function to display only network interfaces that belong to svm2. 

Step	Action
1-5	In the Network Interfaces pane, position your cursor over the <b>svm2_cifs_nfs_lif1</b> name until the More menu button appears.
1-6	Select <b>Migrate</b> from the <b>More</b> menu.
	
1-7	Note the current port at the top of the Migrate Network Interface dialog box.
1-8	Select <b>cluster1-01</b> as the destination node and <b>e0e</b> as the destination port.
	
1-9	 If you select the Permanently migrate checkbox, you rehome the LIF on the destination port. For now, you leave the Permanently migrate checkbox cleared.
1-10	Click <b>Migrate</b> .

Step	Action																											
1-11	<p>Verify that the LIF is now hosted on port e0e of node cluster1-01.</p>  <table border="1"> <thead> <tr> <th>Name</th> <th>...</th> <th>St...</th> <th>IPspace</th> <th>Address</th> <th>Current ...</th> <th>Current P...</th> <th>Protocols</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>svm2_cifs_nfs_lif2</td> <td>✓</td> <td>svm2</td> <td>Default</td> <td>192.168.0....</td> <td>cluster1-01</td> <td>e0d</td> <td>SMB/CIFS,...</td> <td>Data</td> </tr> <tr> <td>svm2_cifs_nfs_lif1</td> <td>✓</td> <td>svm2</td> <td>Default</td> <td>192.168.0....</td> <td>cluster1-01</td> <td>e0e</td> <td>SMB/CIFS,...</td> <td>Data</td> </tr> </tbody> </table>	Name	...	St...	IPspace	Address	Current ...	Current P...	Protocols	Type	svm2_cifs_nfs_lif2	✓	svm2	Default	192.168.0....	cluster1-01	e0d	SMB/CIFS,...	Data	svm2_cifs_nfs_lif1	✓	svm2	Default	192.168.0....	cluster1-01	e0e	SMB/CIFS,...	Data
Name	...	St...	IPspace	Address	Current ...	Current P...	Protocols	Type																				
svm2_cifs_nfs_lif2	✓	svm2	Default	192.168.0....	cluster1-01	e0d	SMB/CIFS,...	Data																				
svm2_cifs_nfs_lif1	✓	svm2	Default	192.168.0....	cluster1-01	e0e	SMB/CIFS,...	Data																				
1-12	<p> The warning icon indicates that the LIF is not running on its home port.</p>																											
1-13	<p>Position your cursor over the <b>svm2_cifs_nfs_lif1</b> again, and then select <b>Revert</b> from the More menu.</p>  <table border="1"> <thead> <tr> <th>Name</th> <th>...</th> <th>St...</th> <th>IPspace</th> <th>Address</th> <th>Current ...</th> <th>Current P...</th> <th>Protocols</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>svm2_cifs_nfs_lif2</td> <td>✓</td> <td>svm2</td> <td>Default</td> <td>192.168.0....</td> <td>cluster1-01</td> <td>e0d</td> <td>SMB/CIFS,...</td> <td>Data</td> </tr> <tr> <td>svm2_cifs_nfs_lif1</td> <td>⋮</td> <td>✓</td> <td>svm2</td> <td>Default</td> <td>192.168.0....</td> <td>cluster1-01</td> <td>e0e</td> <td>SMB/CIFS,...</td> </tr> </tbody> </table> <p>More</p> <ul style="list-style-type: none"> <li>Edit</li> <li>Migrate</li> <li><b>Revert</b></li> <li>Delete</li> </ul>	Name	...	St...	IPspace	Address	Current ...	Current P...	Protocols	Type	svm2_cifs_nfs_lif2	✓	svm2	Default	192.168.0....	cluster1-01	e0d	SMB/CIFS,...	Data	svm2_cifs_nfs_lif1	⋮	✓	svm2	Default	192.168.0....	cluster1-01	e0e	SMB/CIFS,...
Name	...	St...	IPspace	Address	Current ...	Current P...	Protocols	Type																				
svm2_cifs_nfs_lif2	✓	svm2	Default	192.168.0....	cluster1-01	e0d	SMB/CIFS,...	Data																				
svm2_cifs_nfs_lif1	⋮	✓	svm2	Default	192.168.0....	cluster1-01	e0e	SMB/CIFS,...																				
1-14	<p>Click <b>Revert</b> to confirm the movement of the LIF.</p> <p>The LIF is again hosted on its home port.</p>																											
1-15	Start a PuTTY session with cluster1.																											
1-16	<p>Verify the current location of the data LIFs:</p> <pre>network interface show -vserver svm2</pre>																											
1-17	<p>Reassign the home port of <b>svm2_cifs_nfs_lif1</b> to port <b>e0f</b>, and leave the home node as <b>cluster1-01</b>:</p> <pre>net int modify -vserver svm2 -lif svm2_cifs_nfs_lif1 -home-port e0f</pre>																											
1-18	<p>Review the home port again and answer the following questions:</p> <pre>net int show -vserver svm2</pre> <ul style="list-style-type: none"> <li>▪ Did the LIF move? _____</li> <li>▪ What is the status of the LIF home? _____</li> </ul>																											
1-19	<p>Issue a <b>revert</b> command, which sends the LIF to its new home port:</p> <pre>net int revert *</pre>																											

Step	Action
1-20	 The asterisk (*) wildcard is a positional parameter that represents the LIF name. The revert command reverts all LIFs that are not on their home ports.
1-21	Review the status of the LIFs again: <pre>net int show -vserver svm2</pre>

## Task 2: Create Load-Sharing Mirrors of the SVM Root Volume

This task is a requirement for protecting the namespace.

Step	Action
2-1	Open a PuTTY session to <b>cluster1</b> .
2-2	Identify SVM root volumes and the aggregates and the node that they are on. Load-sharing mirrors can be created only in the CLI. <pre>vol show *root -fields aggregate,node vserver volume      aggregate    node ----- svm1   svm1_root  n1_data_001 cluster1-01 svm2   svm2_root  n2_data_001 cluster1-02 svm3   svm3_root  n1_data_002 cluster1-01 svm6   svm6_root  cluster1_02_FC_1                            cluster1-02</pre>
2-3	 You must create a load-sharing mirror (LSM) of the root volume for each NAS SVM in the cluster. You can create the LSM on any node other than the one containing the root volume, preferably in a different high-availability (HA) pair.
2-4	In this example, the root volume for svm1 (svm1_root) is located in aggregate n1_data_001 attached to storage node cluster1-01, so you create the load sharing mirror volume on storage node cluster1-02: <pre>volume create -vserver svm1 -volume svm1_root_LS_1               -aggregate n2_data_001 -type DB</pre>
2-5	Answer <b>yes</b> to any warning messages.
2-6	 Although the volume is a load-sharing mirror, you must first create the volume as a data protection type volume, and then change the volume type to a load sharing mirror.
2-7	Verify that a volume for load-sharing has been created: <pre>volume show -vserver svm1 -fields node</pre>
2-8	Create a cron schedule to run every 15 minutes: <pre>job schedule cron create 15min -minute 00,15,30,45 job schedule cron show</pre>
2-9	Define the load-sharing mirror relationships with the first load-sharing mirror: <pre>snapmirror create -source-path svm1:svm1_root                   -destination-path svm1:svm1_root_LS_1 -type LS -schedule 15min</pre>

Step	Action
2-10	<p>Initialize the mirror relationship for the set:</p> <pre>snapmirror initialize-ls-set svm1:svm1_root</pre>
2-11	<p>Confirm the load-sharing and SnapMirror relationships:</p> <pre>snapmirror show</pre> <p>Example:</p> <pre>Source          Destination Mirror Relationship Total Progress Last Path           Type    Path      State   Status    Progress Healthy Updated ----- cluster1://svm1/svm1_root               LS      cluster1://svm1/svm1_root_LS_1                            Snapmirrored                            Idle                            -       true   - </pre>
2-12	<p>Verify that the volumes type has changed from DP to LS:</p> <pre>vol show -vserver svm1</pre> <p>Example:</p> <pre>Vserver  Volume      Aggregate  State   Type  Size Available Used% ----- svm1    smb1_share_CIFS_volume                   n2_data_001  online  RW    1GB   970.6MB  0% svm1    svm1_root    n1_data_001  online  RW    20MB  17.70MB  6% svm1    svm1_root_LS_1                   n2_data_012  online  LS    20MB  17.84MB  6% 3 entries were displayed.</pre>
2-13	 On a production cluster, you need to create load-sharing mirror relationships for all SVMs that use the CIFS or NFS protocols.

### End of Exercise

# Module 8: Data Protection

## Exercise 1: Managing Snapshot Copies

In this exercise, you create and schedule a NetApp ONTAP Snapshot copy and restore data from the Snapshot copy.

### Objectives

This exercise focuses on enabling you to do the following:

- Create and schedule a Snapshot copy
- Restore data from a Snapshot copy

### Case Study

The employees acquired from Dwurgle are untried, and Mr. Zarrot is unsure of their abilities. To reduce the amount of data that might be lost due to user mistakes, Mr. Zarrot decrees that frequent Snapshot copies of all valuable data must be made.

An employee has accidentally corrupted the spreadsheet with the latest rocket part delivery forecasts. You recover the spreadsheet from the most recent Snapshot copy.

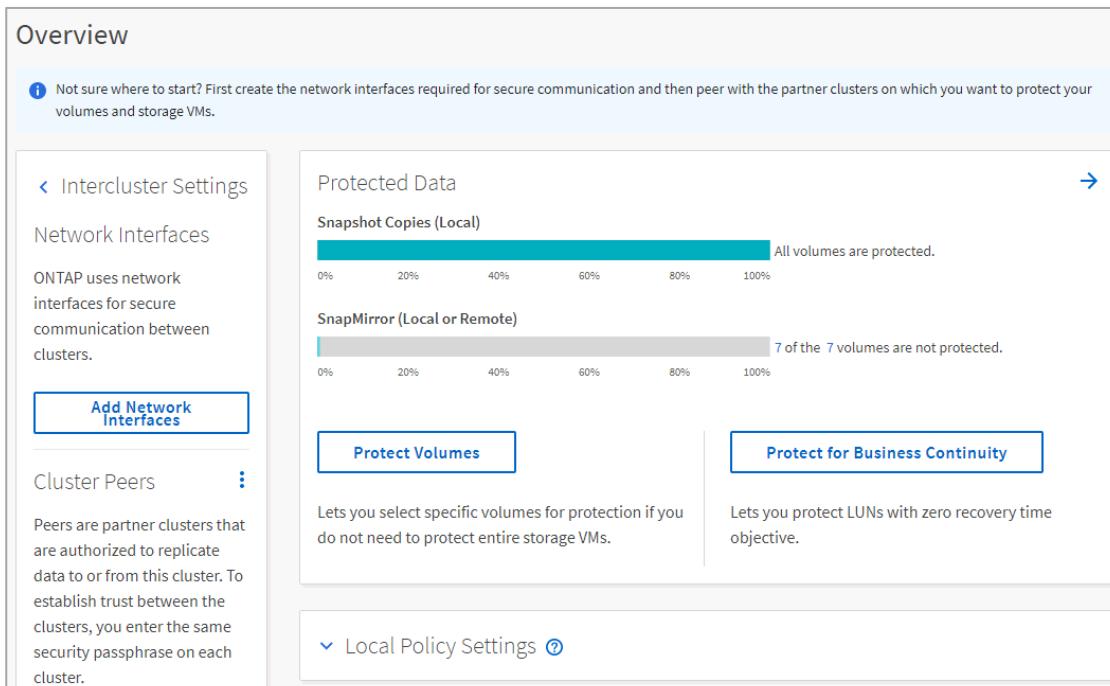
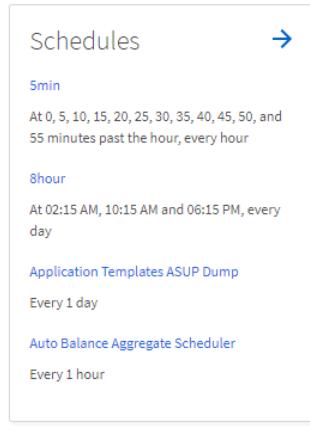
### Exercise Equipment

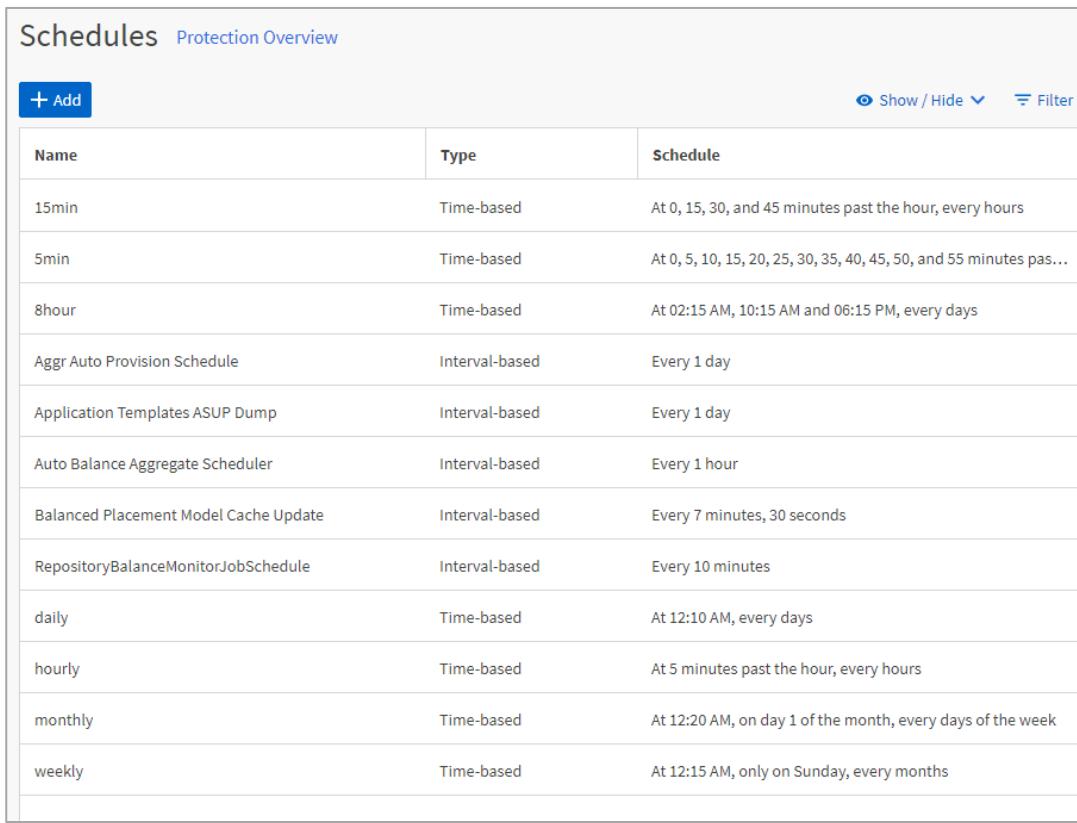
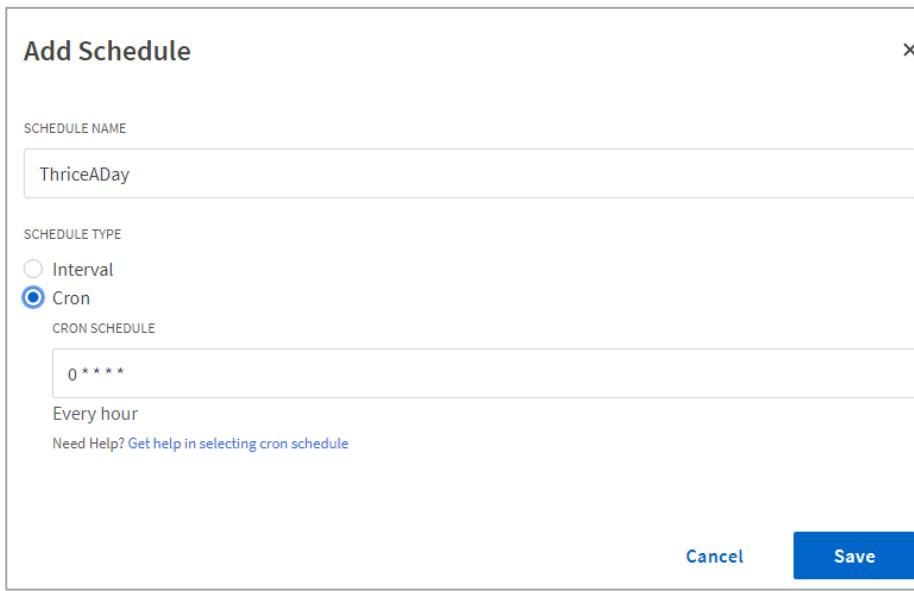
In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows 2012 R2 Server	jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!

### Task 1: Create a Schedule

Step	Action
1-1	Return to the NetApp ONTAP System Manager session on <b>cluster1</b> .
1-2	 Be sure to log in to the correct cluster.
1-3	On the navigation pane, click <b>Protection</b> , and then click <b>Overview</b> .

Step	Action
1-4	<p>In the Overview page, expand the <b>Local Policy Settings</b>.</p> 
1-5	<p>Click the arrow in the Schedules pane.</p> 

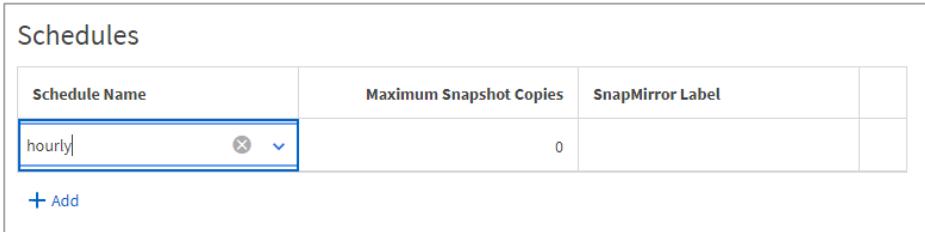
Step	Action
1-6	<p>Examine the default schedules.</p> 
1-7	Click <b>Add</b> .
1-8	<p>In the Add Schedule dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ <b>Schedule Name: ThriceADay</b></li> <li>▪ <b>Scheduled Type: Cron</b></li> </ul> 

Step	Action
1-9	Click <b>Get help in selecting cron schedule</b> to view a description of the cron format schedule.
1-10	Define a cron schedule which runs at 1 a.m., 9 a.m., and 5 p.m. every day of the week.
1-11	Click <b>Save</b> .
1-12	Verify that the schedule was created successfully.

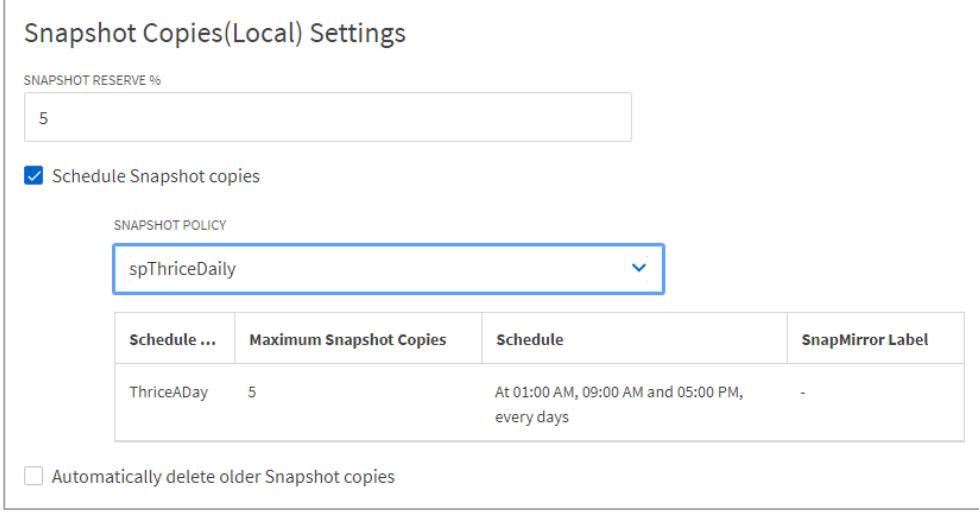
## Task 2: Create a Snapshot Policy

Step	Action
2-1	Return to the <b>Protection &gt; Overview</b> page and expand the <b>Local Policy Settings</b> again.
2-2	Click on the arrow in the <b>Snapshot Policies</b> pane.

Step	Action																
<b>2-3</b>	Examine the default Snapshot policies.																
	<p>Policies Protection Overview</p> <p>Protection Policies Snapshot Policies</p> <p>+ Add Show / Hide Filter</p> <table border="1"> <thead> <tr> <th>Policy Name</th> <th>Status</th> <th>Scope</th> <th>Snapshot Copies (maximum retain...)</th> </tr> </thead> <tbody> <tr> <td>default</td> <td>✓</td> <td>Cluster</td> <td>10</td> </tr> <tr> <td>default-1weekly</td> <td>✓</td> <td>Cluster</td> <td>9</td> </tr> <tr> <td>none</td> <td>✗</td> <td>Cluster</td> <td>0</td> </tr> </tbody> </table>	Policy Name	Status	Scope	Snapshot Copies (maximum retain...)	default	✓	Cluster	10	default-1weekly	✓	Cluster	9	none	✗	Cluster	0
Policy Name	Status	Scope	Snapshot Copies (maximum retain...)														
default	✓	Cluster	10														
default-1weekly	✓	Cluster	9														
none	✗	Cluster	0														
<b>2-4</b>	Click <b>Add</b> .																
<b>2-5</b>	Name the new snapshot policy <b>spThriceDaily</b> .																
	<p>Add Snapshot Policy</p> <p>POLICY NAME spThriceDaily</p> <p>POLICY SCOPE <input checked="" type="radio"/> Cluster <input type="radio"/> Storage VM</p> <p>Schedules</p> <table border="1"> <thead> <tr> <th>Schedule Name</th> <th>Maximum Snapshot Copies</th> <th>SnapMirror Label</th> </tr> </thead> <tbody> <tr> <td>No data</td> <td></td> <td></td> </tr> </tbody> </table> <p>+ Add</p> <p>Cancel Save</p>	Schedule Name	Maximum Snapshot Copies	SnapMirror Label	No data												
Schedule Name	Maximum Snapshot Copies	SnapMirror Label															
No data																	
<b>2-6</b>	Click <b>Add</b> .																

Step	Action						
2-7	Click the default schedule name (“hourly”) and use the menu to select the <b>ThriceADay</b> Snapshot schedule.						
	 <p>Schedules</p> <table border="1"> <thead> <tr> <th>Schedule Name</th> <th>Maximum Snapshot Copies</th> <th>SnapMirror Label</th> </tr> </thead> <tbody> <tr> <td>hourly</td> <td>0</td> <td></td> </tr> </tbody> </table> <p><a href="#">+ Add</a></p>	Schedule Name	Maximum Snapshot Copies	SnapMirror Label	hourly	0	
Schedule Name	Maximum Snapshot Copies	SnapMirror Label					
hourly	0						
2-8	Set the Maximum Snapshot Copies to be retained to <b>5</b> .						
	 <p>Schedules</p> <table border="1"> <thead> <tr> <th>Schedule Name</th> <th>Maximum Snapshot Copies</th> <th>SnapMirror Label</th> </tr> </thead> <tbody> <tr> <td>ThriceADay</td> <td>5</td> <td></td> </tr> </tbody> </table> <p><a href="#">+ Add</a></p>	Schedule Name	Maximum Snapshot Copies	SnapMirror Label	ThriceADay	5	
Schedule Name	Maximum Snapshot Copies	SnapMirror Label					
ThriceADay	5						
2-9	Click <b>Save</b> .						
2-10	Verify that the policy was created successfully and is enabled.						

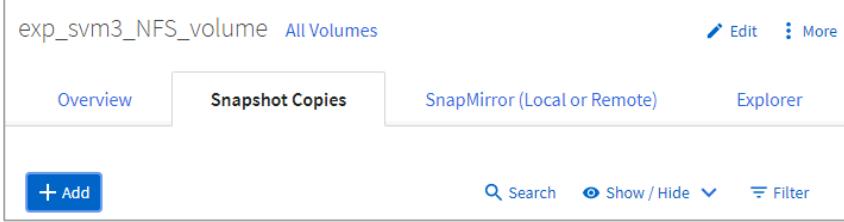
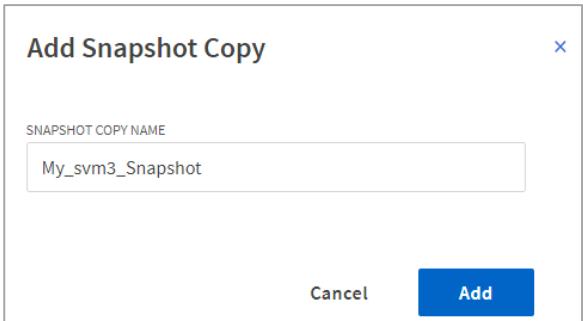
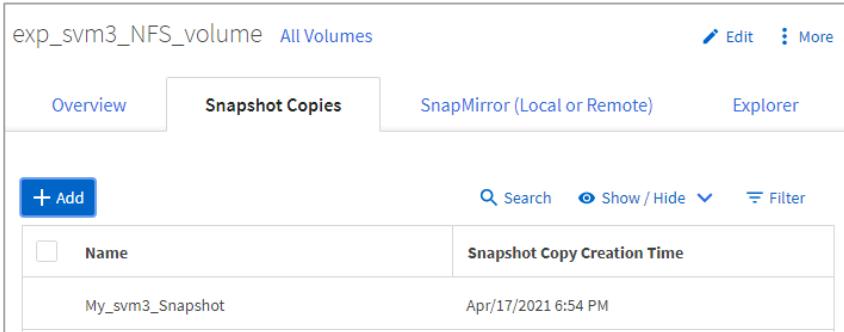
### Task 3: Assign a Snapshot Policy to a Volume

Step	Action								
3-1	Go to the <b>Storage &gt; Volumes</b> page.								
3-2	From the Volumes list, select <b>exp_svm3_NFS_volume</b> , and select <b>Edit</b> from the <b>More</b> menu.								
3-3	Scroll down in the Edit Volume page, and specify the following settings: <ul style="list-style-type: none"> <li>▪ Snapshot Reserve %: <b>5 (default)</b></li> <li>▪ Schedule Snapshot copies: <b>selected (default)</b></li> <li>▪ Snapshot Policy: <b>spThriceDaily</b></li> </ul>  <p><b>Snapshot Copies(Local) Settings</b></p> <p>SNAPSHOT RESERVE %</p> <input type="text" value="5"/> <input checked="" type="checkbox"/> Schedule Snapshot copies <p>SNAPSHOT POLICY</p> <p>spThriceDaily</p> <table border="1"> <thead> <tr> <th>Schedule ...</th> <th>Maximum Snapshot Copies</th> <th>Schedule</th> <th>SnapMirror Label</th> </tr> </thead> <tbody> <tr> <td>ThriceADay</td> <td>5</td> <td>At 01:00 AM, 09:00 AM and 05:00 PM, every days</td> <td>-</td> </tr> </tbody> </table> <p><input type="checkbox"/> Automatically delete older Snapshot copies</p>	Schedule ...	Maximum Snapshot Copies	Schedule	SnapMirror Label	ThriceADay	5	At 01:00 AM, 09:00 AM and 05:00 PM, every days	-
Schedule ...	Maximum Snapshot Copies	Schedule	SnapMirror Label						
ThriceADay	5	At 01:00 AM, 09:00 AM and 05:00 PM, every days	-						

Step	Action
3-4	Click <b>Save</b> .
3-5	In the Volumes list, click <b>exp_svm3_NFS_volume</b> to view the volume details. 
3-6	Click <b>Snapshots Copies</b> . 
3-7	Examine the list of Snapshot copies.

## Task 4: Restore a File from a Snapshot Copy

Step	Action
4-1	From PuTTY, log in to your Linux computer.
4-2	Change to the /mnt/svm3/exp_svm3_nfs_volume directory: <code>cd /mnt/svm3/exp_svm3_NFS_volume</code>
4-3	Create two files. <code>touch file1 file2</code>
4-4	Return to the System Manager session on <b>cluster1</b> .

Step	Action
4-5	In the Snapshot Copies tab for volume exp_svm3_NFS_volume, click Add.
	
4-6	Name the Snapshot copy My_svm3_Snapshot.
	
4-7	Click Add.
4-8	Confirm the creation of the new Snapshot copy.
	
4-9	Return to your PuTTY Linux session.
4-10	List the files in the /mnt/svm3/exp_svm3_NFS_volume directory: <code>ls -l</code>
4-11	Delete file1 from the /mnt/svm3/exp_svm3_NFS_volume directory: <code>rm file1</code>
4-12	Enter <b>y</b> to confirm your decision.
4-13	List all the files in the directory, including hidden files and directories: <code>ls -la</code>
4-14	Explore the hidden .snapshot directory: <code>ls .snapshot</code>
4-15	Review the contents of My_svm3_Snapshot: <code>ls .snapshot/My_svm3_Snapshot</code>

Step	Action
<b>4-16</b>	Restore file1 to the root of exp_svm3_NFS_volume: <code>cp .snapshot/My_svm3_Snapshot/file1 /mnt/svm3/exp_svm3_NFS_volume</code>
<b>4-17</b>	Verify that the file was successfully restored: <code>ls /mnt/svm3/exp_svm3_NFS_volume</code>

**End of Exercise**

# Module 9: Storage Efficiency

## Exercise 1: Managing Storage Efficiency

In this exercise, you manage storage-efficiency features.

### Objectives

This exercise focuses on enabling you to do the following:

- Explore thin provisioning
- Enable storage efficiency

### Case Study

Mr. Zarrot is shocked to learn how much of the storage space that has been allocated to applications is not actually being used to store data. Mr. Zarrot demands that the storage space is used more efficiently.

You disable reservations for storage space and allocate the space dynamically by enabling thin provisioning.

You enable the deduplication and compaction features to reduce the amount of physical storage that is needed to store data.

### Exercise Equipment

In this exercise, you use the following systems.

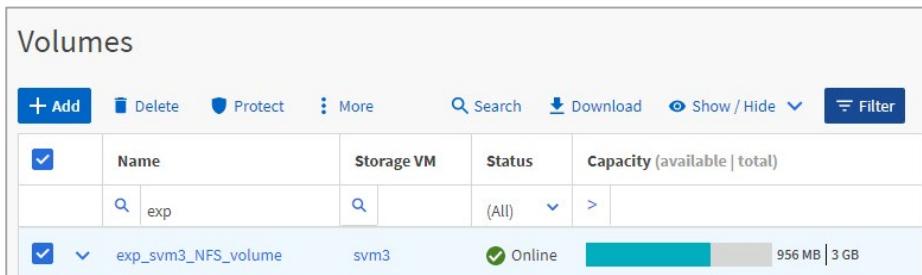
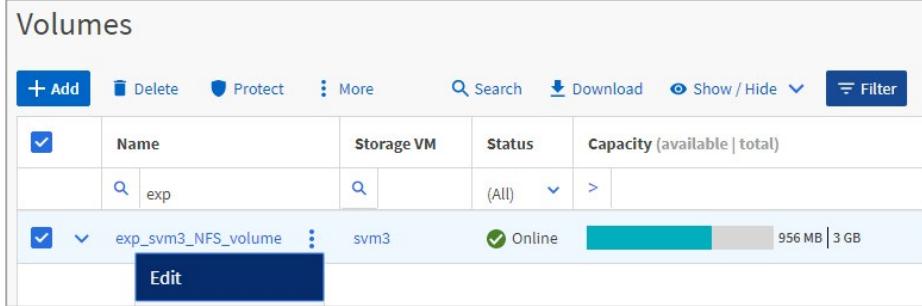
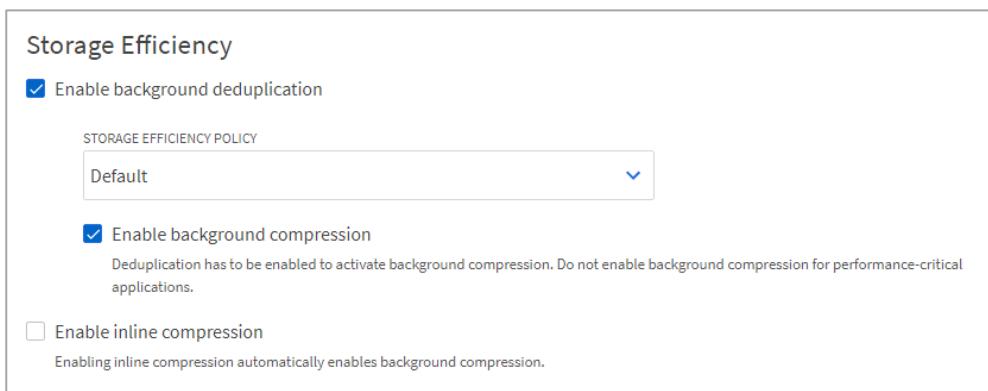
System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!

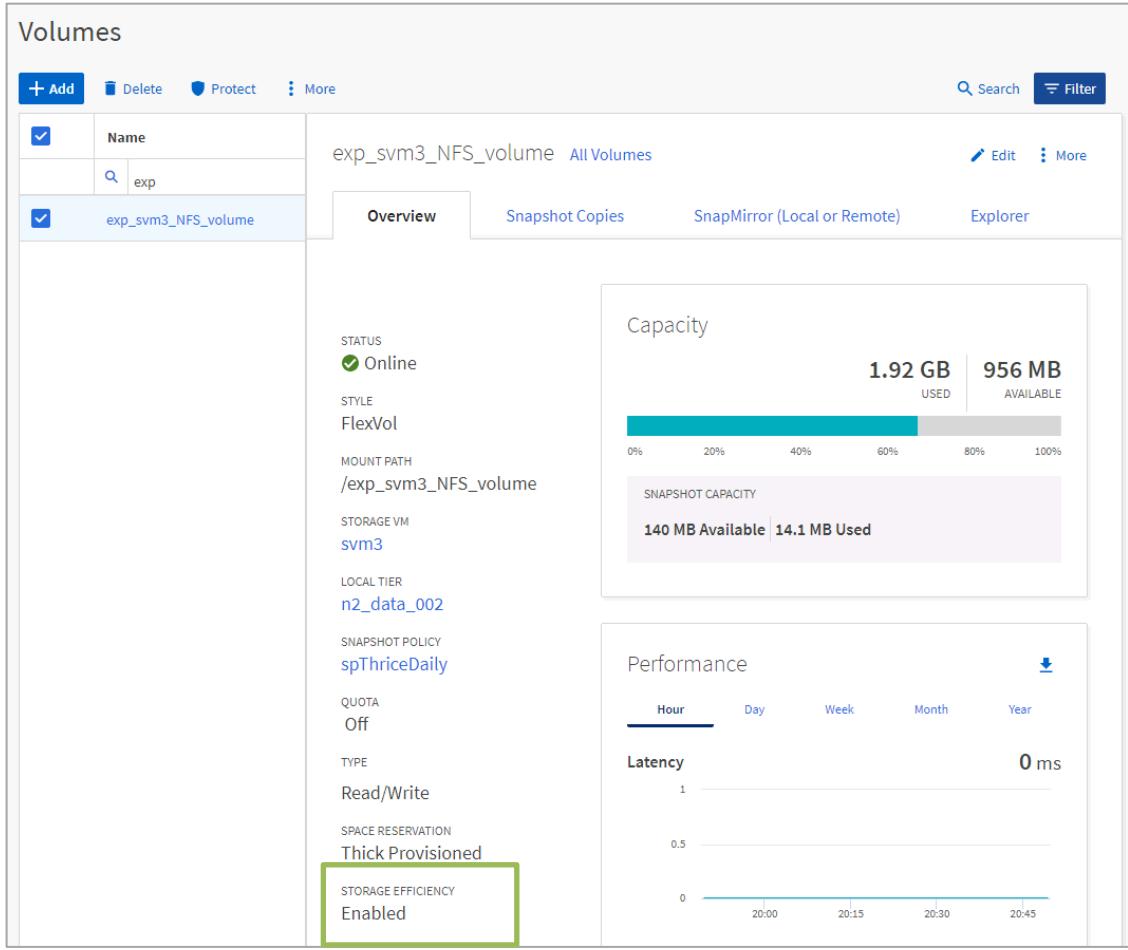
### Task 1: Explore Thin Provisioning

Step	Action
1-1	Open a PuTTY session to <b>cluster2</b> .
1-2	Create an aggregate named n1_data_002 with five disks: <code>aggregate create -aggregate n1_data_002 -disktype FCAL -diskcount 5</code>
1-3	Create another aggregate named n1_data_003 with five disks: <code>aggregate create -aggregate n1_data_003 -disktype FCAL -diskcount 5</code>
1-4	Verify that aggregates n1_data_002 and n1_data_003 are both at 0% use: <code>storage aggregate show n1*</code>

Step	Action																																
1-5	<p>Create a volume that has the following attributes:</p> <ul style="list-style-type: none"> <li>▪ SVM: <b>svm4</b></li> <li>▪ Name: <b>svm4_thickvol</b></li> <li>▪ Aggregate: <b>n1_data_002</b></li> <li>▪ Size: <b>8 GB</b></li> <li>▪ Space Reserve: <b>Thick Provisioned</b></li> </ul> <pre>volume create -vserver svm4 -volume svm4_thickvol -aggregate n1_data_002 -size 8GB -space-guarantee volume</pre>																																
1-6	<p>Create a second volume that has the following attributes:</p> <ul style="list-style-type: none"> <li>▪ SVM: <b>svm4</b></li> <li>▪ Name: <b>svm4_thinvol</b></li> <li>▪ Aggregate: <b>n1_data_003</b></li> <li>▪ Size: <b>8 GB</b></li> <li>▪ Space Reserve: <b>Thin Provisioned</b></li> </ul> <pre>volume create -vserver svm4 -volume svm4_thinvol -aggregate n1_data_003 -size 8GB -space-guarantee none</pre>																																
1-7	<p>Show the newly created volumes:</p> <pre>volume show svm4_t*</pre> <p>Sample output:</p> <table border="1"> <thead> <tr> <th>Vserver</th> <th>Volume</th> <th>Aggregate</th> <th>State</th> <th>Type</th> <th>Size</th> <th>Available</th> <th>Used%</th> </tr> </thead> <tbody> <tr> <td>svm4</td> <td>svm4_thickvo</td> <td>n1_data_002</td> <td>online</td> <td>RW</td> <td>8GB</td> <td>7.60GB</td> <td>0%</td> </tr> <tr> <td>svm4</td> <td>svm4_thinvol</td> <td>n1_data_003</td> <td>online</td> <td>RW</td> <td>8GB</td> <td>7.60GB</td> <td>0%</td> </tr> </tbody> </table> <p>2 entries were displayed.</p>	Vserver	Volume	Aggregate	State	Type	Size	Available	Used%	svm4	svm4_thickvo	n1_data_002	online	RW	8GB	7.60GB	0%	svm4	svm4_thinvol	n1_data_003	online	RW	8GB	7.60GB	0%								
Vserver	Volume	Aggregate	State	Type	Size	Available	Used%																										
svm4	svm4_thickvo	n1_data_002	online	RW	8GB	7.60GB	0%																										
svm4	svm4_thinvol	n1_data_003	online	RW	8GB	7.60GB	0%																										
1-8	<p>Compare the capacity and usage of aggregates n1_data_002 and n1_data_003:</p> <pre>storage aggregate show n1_data*</pre> <p>Sample output:</p> <table border="1"> <thead> <tr> <th>Aggregate</th> <th>Size</th> <th>Avail</th> <th>Used%</th> <th>State</th> <th>#Vols</th> <th>Nodes</th> <th>RAID</th> </tr> </thead> <tbody> <tr> <td>n1_data_001</td> <td>14.06GB</td> <td>9.88GB</td> <td>30%</td> <td>online</td> <td>6</td> <td>cluster2-01</td> <td>raid_tec</td> </tr> <tr> <td>n1_data_002</td> <td>10.55GB</td> <td>2.49GB</td> <td>76%</td> <td>online</td> <td>2</td> <td>cluster2-01</td> <td>raid_dp</td> </tr> <tr> <td>n1_data_003</td> <td>10.55GB</td> <td>10.53GB</td> <td>0%</td> <td>online</td> <td>1</td> <td>cluster2-01</td> <td>raid_dp</td> </tr> </tbody> </table> <p>3 entries were displayed.</p>	Aggregate	Size	Avail	Used%	State	#Vols	Nodes	RAID	n1_data_001	14.06GB	9.88GB	30%	online	6	cluster2-01	raid_tec	n1_data_002	10.55GB	2.49GB	76%	online	2	cluster2-01	raid_dp	n1_data_003	10.55GB	10.53GB	0%	online	1	cluster2-01	raid_dp
Aggregate	Size	Avail	Used%	State	#Vols	Nodes	RAID																										
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n1_data_002	10.55GB	2.49GB	76%	online	2	cluster2-01	raid_dp																										
n1_data_003	10.55GB	10.53GB	0%	online	1	cluster2-01	raid_dp																										
1-9	 <p>You know the following facts:</p> <ul style="list-style-type: none"> <li>▪ Each aggregate contains one volume.</li> <li>▪ The two volumes are identical, except that only one volume is thin provisioned.</li> <li>▪ Neither volume contains user data.</li> </ul>																																

## Task 2: Enable Storage Efficiency

Step	Action
2-1	Log into the NetApp ONTAP System Manager on <b>cluster1</b> .
2-2	Go to the <b>Storage &gt; Volumes</b> page.
2-3	Record the capacity and space use of the volume <b>exp_svm3_NFS_volume</b> .
	
2-4	<span style="color: blue; font-size: 2em; border-radius: 50%; padding: 5px; text-align: center;">i</span> The volume <b>exp_svm3_NFS_volume</b> contains the 2GB file named <b>hugefile</b> .
2-5	Select <b>exp_svm3_NFS_volume</b> , and then select <b>Edit</b> from the <b>More</b> menu.
	
2-6	Scroll down in the Edit Volume page to the Storage Efficiency section, and specify the following settings:
	<ul style="list-style-type: none"> <li>▪ Enable background deduplication: <b>selected</b></li> <li>▪ Storage Efficiency Policy: <b>Default</b></li> <li>▪ Enable background compression: <b>selected</b></li> </ul> 
2-7	Click <b>Save</b> .

Step	Action
2-8	In the volume details page, verify that storage efficiency is enabled on the exp_svm3_NFS_volume volume.
	 <p>The screenshot shows the 'Volumes' page in the NetApp Management interface. A specific volume, 'exp_svm3_NFS_volume', is selected. In the 'Overview' tab, under the 'Capacity' section, there is a chart showing used and available capacity. Below the chart, it says '140 MB Available   14.1 MB Used'. In the 'Performance' section, there is a graph for latency over an hour. The 'Storage Efficiency' section at the bottom is highlighted with a green box and shows the status as 'Enabled'.</p>
2-9	Return to the PuTTY session to cluster1.
2-10	<p>Display information about the <b>default</b> storage efficiency policy and answer the following question:</p> <pre>volume efficiency policy show -vserver svm3 -policy default</pre> <p>When is the storage efficiency task scheduled to run? _____</p>
2-11	<p>Display the used capacity of volume exp_svm3_NFS_volume:</p> <pre>vol show -volume exp_svm3_NFS_volume</pre>
2-12	<p>Start the storage efficiency task for the exp_svm3_NFS_volume:</p> <pre>volume efficiency start -vserver svm3 -volume exp_svm3_NFS_volume</pre>

Step	Action
<b>2-13</b>	<p>Display the used capacity of volume exp_svm3_NFS_volume and answer the following questions:</p> <pre>vol show -volume exp_svm3_NFS_volume</pre> <p>Did the storage efficiency task reduce the space consumed by the exp_svm3_NFS_volume? _____</p> <p>Why or why not? _____</p>
<b>2-14</b>	<p>Start the storage efficiency task for the exp_svm3_NFS_volume again but this time examine existing data:</p> <pre>set advanced volume efficiency start -vserver svm3 -volume exp_svm3_NFS_volume --scan-old-data true -dedupe true -compression true</pre>
<b>2-15</b>	<p>Display the used capacity of volume exp_svm3_NFS_volume and answer the following question:</p> <pre>vol show -volume exp_svm3_NFS_volume</pre> <p>Did the storage efficiency task reduce the space consumed by the exp_svm3_NFS_volume? _____</p>
<b>2-16</b>	<p>Display the amount of space saved in the volume exp_svm3_NFS_volume.</p> <pre>vol show -volume exp_svm3_NFS_volume -fields dedupe-space-saved,dedupe-space-saved-percent</pre>
<b>2-17</b>	<p>After several minutes, review the Storage Efficiency information again and compare the statistics.</p>

#### End of Exercise

## Exercise 2: Managing FlexClone Volumes

In this exercise, you explore and manage FlexClone volumes.

### Objectives

This exercise focuses on enabling you to create and split a FlexClone volume.

### Case Study

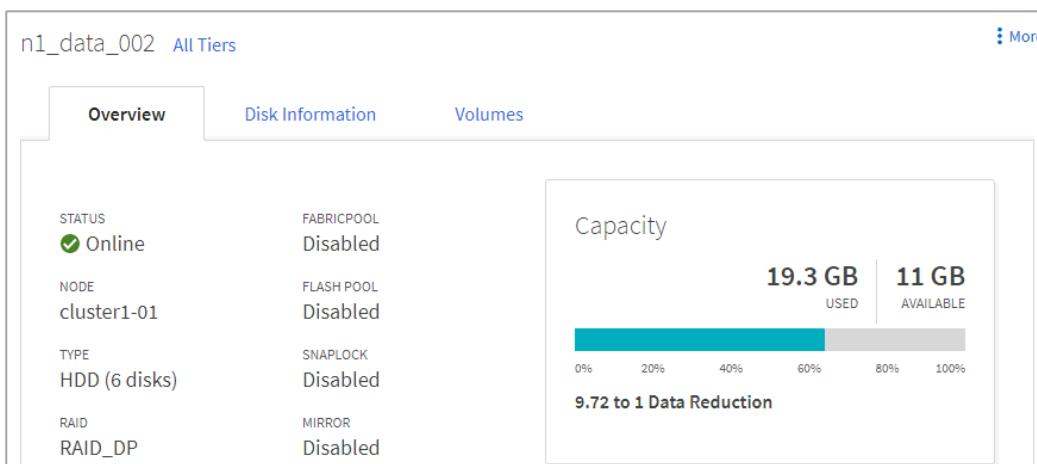
The rocket motor division of Zarrot Industries is bringing a new customer relations application online. Before going live, the new application needs to be tested. You make a clone of the customer relations data so that the new application can be realistically tested without risking the actual data.

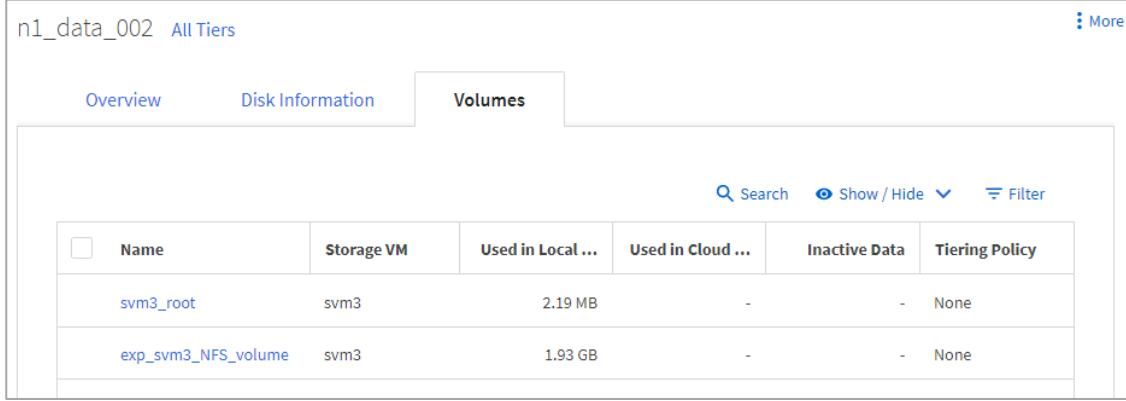
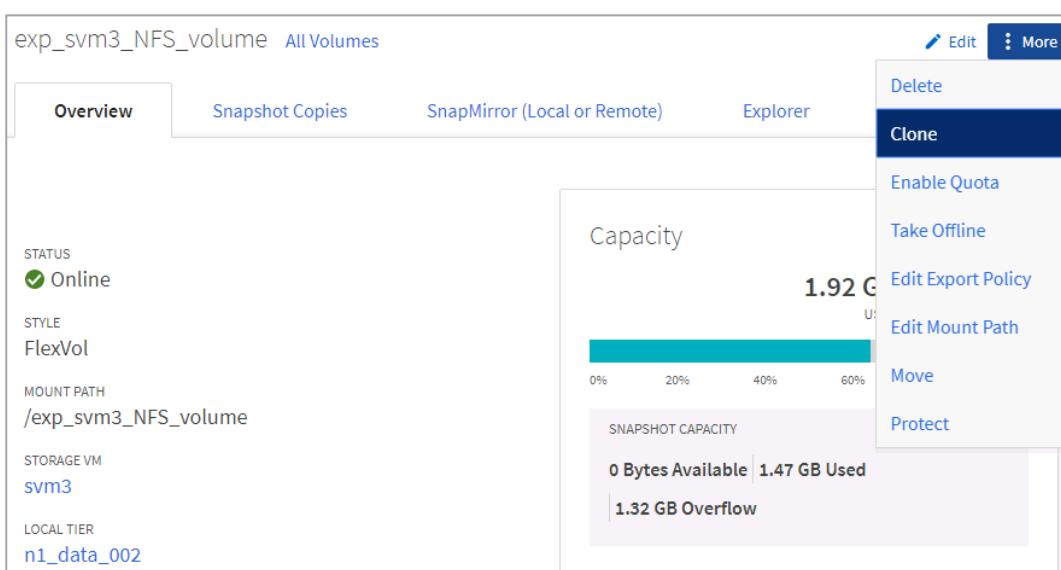
### Exercise Equipment

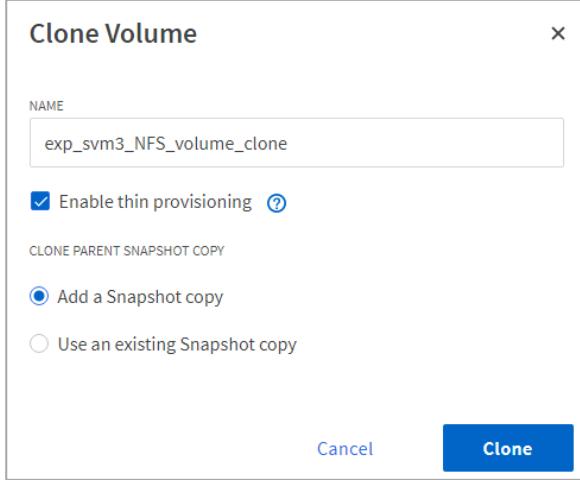
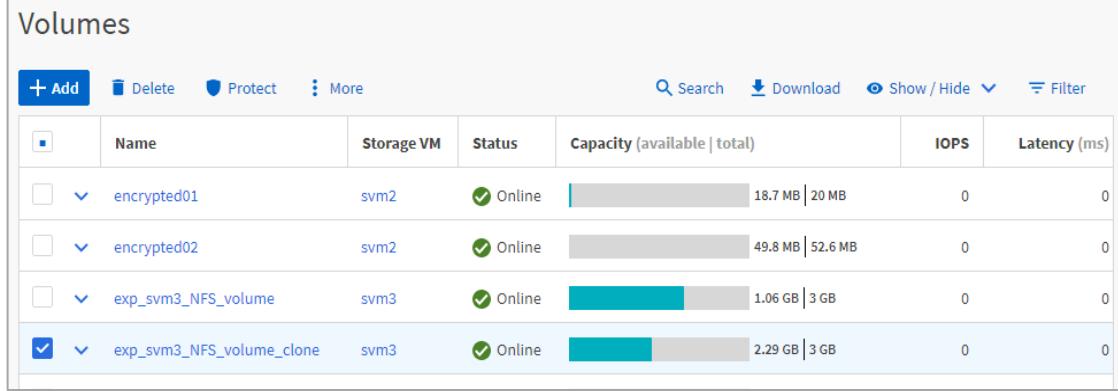
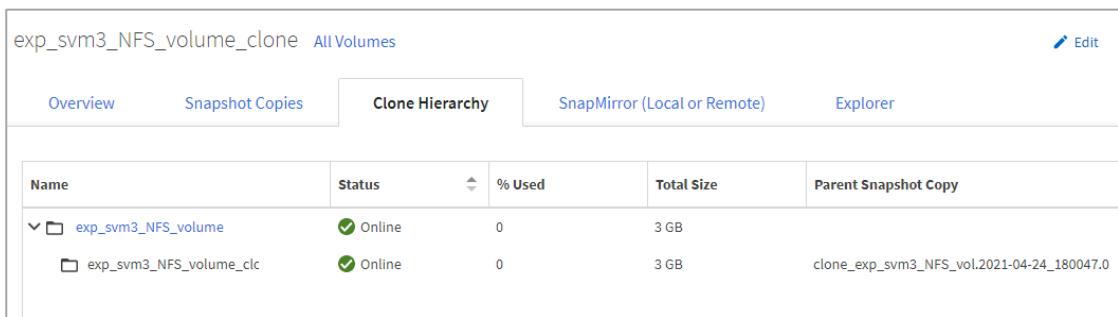
In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!

### Task 1: Create and Split a FlexClone Volume

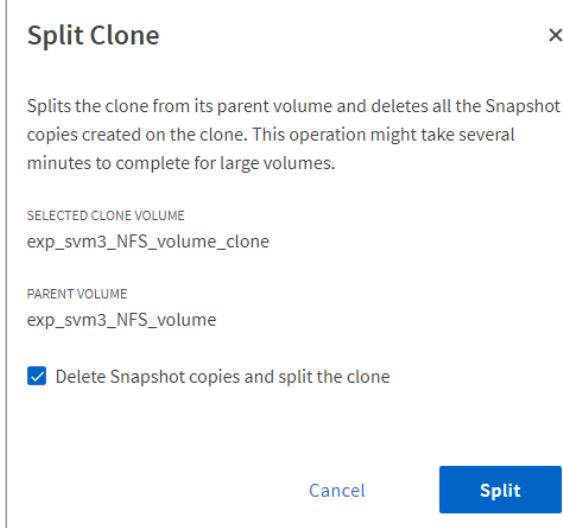
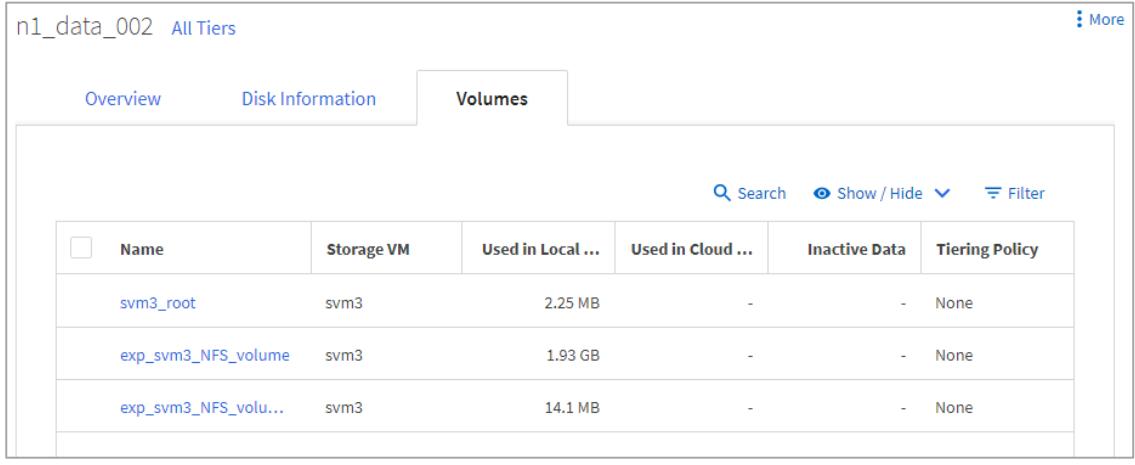
Step	Action
1-1	Return to the System Manager session on <b>cluster1</b> .
1-2	In the Volumes pane, select <b>exp_svm3_NFS_volume</b> .
1-3	In the volume details overview tab, click the local storage tier name <b>n1_data_002</b> .
1-4	Examine the Overview tab of the local tier and answer the following questions: <ul style="list-style-type: none"><li>▪ How much of the aggregate capacity is used?</li><li>▪ What is the data reduction ratio?</li></ul>
1-5	Click the <b>Volumes</b> tab.

Step	Action																		
1-6	<p>Observe the number of volumes in the aggregate and the amount of storage space each volume uses in the local tier.</p>  <table border="1"> <thead> <tr> <th>Name</th> <th>Storage VM</th> <th>Used in Local ...</th> <th>Used in Cloud ...</th> <th>Inactive Data</th> <th>Tiering Policy</th> </tr> </thead> <tbody> <tr> <td>svm3_root</td> <td>svm3</td> <td>2.19 MB</td> <td>-</td> <td>-</td> <td>None</td> </tr> <tr> <td>exp_svm3_NFS_volume</td> <td>svm3</td> <td>1.93 GB</td> <td>-</td> <td>-</td> <td>None</td> </tr> </tbody> </table>	Name	Storage VM	Used in Local ...	Used in Cloud ...	Inactive Data	Tiering Policy	svm3_root	svm3	2.19 MB	-	-	None	exp_svm3_NFS_volume	svm3	1.93 GB	-	-	None
Name	Storage VM	Used in Local ...	Used in Cloud ...	Inactive Data	Tiering Policy														
svm3_root	svm3	2.19 MB	-	-	None														
exp_svm3_NFS_volume	svm3	1.93 GB	-	-	None														
1-7	Click <b>exp_svm3_NFS_volume</b> to return to the volume page.																		
1-8	<p>Select <b>Clone</b> from the <b>More</b> menu.</p>  <p>The context menu options are:</p> <ul style="list-style-type: none"> <li>Edit</li> <li>More</li> <li>Clone</li> <li>Enable Quota</li> <li>Take Offline</li> <li>Edit Export Policy</li> <li>Edit Mount Path</li> <li>Move</li> <li>Protect</li> </ul>																		

Step	Action
1-9	<p>In the Clone Volume dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>Name: <b>exp_svm3_NFS_volume_clone</b></li> <li>Enable thin provisioning: <b>selected</b></li> <li>Add a Snapshot copy: <b>selected (default)</b></li> </ul> 
1-10	Click <b>Clone</b> .
1-11	Click <b>All Volumes</b> .
1-12	In the Volumes pane, click the name of the new clone volume.
	
1-13	In the volume details view, click <b>Clone Hierarchy</b> , and observe the parent Snapshot copy name.
	

Step	Action
1-14	<p>Click <b>Edit</b>.</p>
1-15	<p>In the Edit Volume dialog box, specify the following settings:</p> <ul style="list-style-type: none"> <li>▪ Mount: <b>selected</b></li> <li>▪ Mount Path: <b>/svm3_clone</b></li> <li>▪ Select an existing policy: <b>selected (default)</b></li> <li>▪ Export Policy: <b>default</b></li> </ul>
1-16	Click <b>Save</b> .
1-17	From PuTTY, log in to your Linux system.
1-18	Create the directory <code>/mnt/clone</code> : <code>mkdir /mnt/clone</code>
1-19	Mount the clone volume to your Linux computer: <code>mount -t nfs 192.168.0.62:/svm3_clone /mnt/clone</code>

Step	Action												
1-20	<p>Navigate to the clone volume:</p> <pre>cd /mnt/clone</pre>												
1-21	<p>Create a file called datafile:</p> <pre>echo "Edited from a FlexClone..." &gt;&gt; datafile.txt</pre>												
1-22	<p>List the contents of the clone directory.</p> <pre>ls</pre> <p>Sample output:</p> <pre>datafile.txt  file1  file2  hugefile</pre>												
1-23	<p>Review the contents of the file on the parent volume, and then verify that although the clone and parent share data blocks, they function as separate volumes:</p> <pre>cd ../../svm3/exp_svm3_NFS_volume</pre> <pre>ls</pre> <p>Sample output:</p> <pre>file1  file2  hugefile</pre>												
1-24	Return to the System Manager session on cluster1.												
1-25	<p>In the volume details view of the clone, select <b>Split Clone</b> from the <b>More</b> menu.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Status</th> <th>% Used</th> <th>Total Size</th> </tr> </thead> <tbody> <tr> <td>exp_svm3_NFS_volume</td> <td>Online</td> <td>0</td> <td>3 GB</td> </tr> <tr> <td>exp_svm3_NFS_volume_clc</td> <td>Online</td> <td>0</td> <td>3 GB</td> </tr> </tbody> </table> <p>The context menu options are: Edit, More, Delete, Split Clone (highlighted), Clone, Rekey, Enable Quota, and Take Offline.</p>	Name	Status	% Used	Total Size	exp_svm3_NFS_volume	Online	0	3 GB	exp_svm3_NFS_volume_clc	Online	0	3 GB
Name	Status	% Used	Total Size										
exp_svm3_NFS_volume	Online	0	3 GB										
exp_svm3_NFS_volume_clc	Online	0	3 GB										

Step	Action																								
1-26	<p>In the Split Clone dialog box, select <b>Delete Snapshot copies and split the clone</b>, and then click <b>Split</b>.</p> <p><b>Note:</b> The split takes some time.</p> 																								
1-27	<p>On the Volumes page, review the status.</p> <p>When the split finishes, the clone no longer shares blocks with the parent and is a separate volume.</p>																								
1-28	<p>Navigate to the <b>Storage &gt; Tiers</b> page, and then select <b>n1_data_002</b>.</p>																								
1-29	<p>Click the <b>Volumes</b> tab and answer the following questions:</p> <ul style="list-style-type: none"> <li>▪ Has the amount of Used Space increased, decreased, or remained the same? _____</li> <li>▪ Is there an ONTAP software efficiency feature that would explain why or why not?</li> </ul>  <table border="1"> <thead> <tr> <th>Name</th> <th>Storage VM</th> <th>Used in Local ...</th> <th>Used in Cloud ...</th> <th>Inactive Data</th> <th>Tiering Policy</th> </tr> </thead> <tbody> <tr> <td>svm3_root</td> <td>svm3</td> <td>2.25 MB</td> <td>-</td> <td>-</td> <td>None</td> </tr> <tr> <td>exp_svm3_NFS_volume</td> <td>svm3</td> <td>1.93 GB</td> <td>-</td> <td>-</td> <td>None</td> </tr> <tr> <td>exp_svm3_NFS_volu...</td> <td>svm3</td> <td>14.1 MB</td> <td>-</td> <td>-</td> <td>None</td> </tr> </tbody> </table>	Name	Storage VM	Used in Local ...	Used in Cloud ...	Inactive Data	Tiering Policy	svm3_root	svm3	2.25 MB	-	-	None	exp_svm3_NFS_volume	svm3	1.93 GB	-	-	None	exp_svm3_NFS_volu...	svm3	14.1 MB	-	-	None
Name	Storage VM	Used in Local ...	Used in Cloud ...	Inactive Data	Tiering Policy																				
svm3_root	svm3	2.25 MB	-	-	None																				
exp_svm3_NFS_volume	svm3	1.93 GB	-	-	None																				
exp_svm3_NFS_volu...	svm3	14.1 MB	-	-	None																				

## Task 2: Enable Logical Space Reporting and Enforcement

Step	Action
2-1	Open a PuTTY session to cluster1.

Step	Action
<b>2-2</b>	View the available and used physical space and available and used logical space in the NFS volumes in svm3:  <pre>volume show -vserver svm3 -volume exp_svm3_NFS* -fields available,physical-used,logical-used,logical-available</pre>
<b>2-3</b>	Enable logical space reporting for all NFS volumes in svm3:  <pre>volume modify -vserver svm3 -volume exp_svm3_NFS* -is-space-reporting-logical true</pre>
<b>2-4</b>	Enable logical space enforcement on all eligible NFS volumes in svm3:  <pre>volume modify -vserver svm3 -volume exp_svm3_NFS* -is-space-enforcement-logical true</pre>
<b>2-5</b>	Type Y to confirm the exception for any volumes that are not thin provisioned.
<b>2-6</b>	View the differences in available and used physical space and available and used logical space in the NFS volumes in svm3:  <pre>volume show -vserver svm3 -volume exp_svm3_NFS* -fields available,physical-used,logical-used,logical-available</pre>

**End of Exercise**

## Bonus Exercise: Create a FlexGroup Volume

In this bonus exercise, you create a NetApp ONTAP FlexGroup volume that is covered in Module 6.

Do not attempt this exercise until you have completed all exercises through Module 9, Exercise 2. This exercise makes changes to the lab environment that cannot be rolled back. The changes might negatively affect the primary course exercises.

### Objectives

This exercise focuses on enabling you to do the following:

- Provision a FlexGroup volume
- Mount the FlexGroup volume to an NFS client

### Case Study

Zarrot Industries is expanding with several new product lines. The products are very complex, and each requires thousands of parts. Each part must be meticulously described. The number of files that is needed to store all this information has exploded and is starting to reach the limits of a FlexVol volume. Instead of joining multiple FlexVol volumes together by using junction paths to form a larger namespace, the IT staff has decided to use a FlexGroup volume because of its easier setup and use.

### Exercise Equipment

In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!
CentOS Linux 6.5 Server	Centos65	192.168.0.21	admin (case sensitive)	Netapp1!

### Task 1: Create a FlexGroup Volume

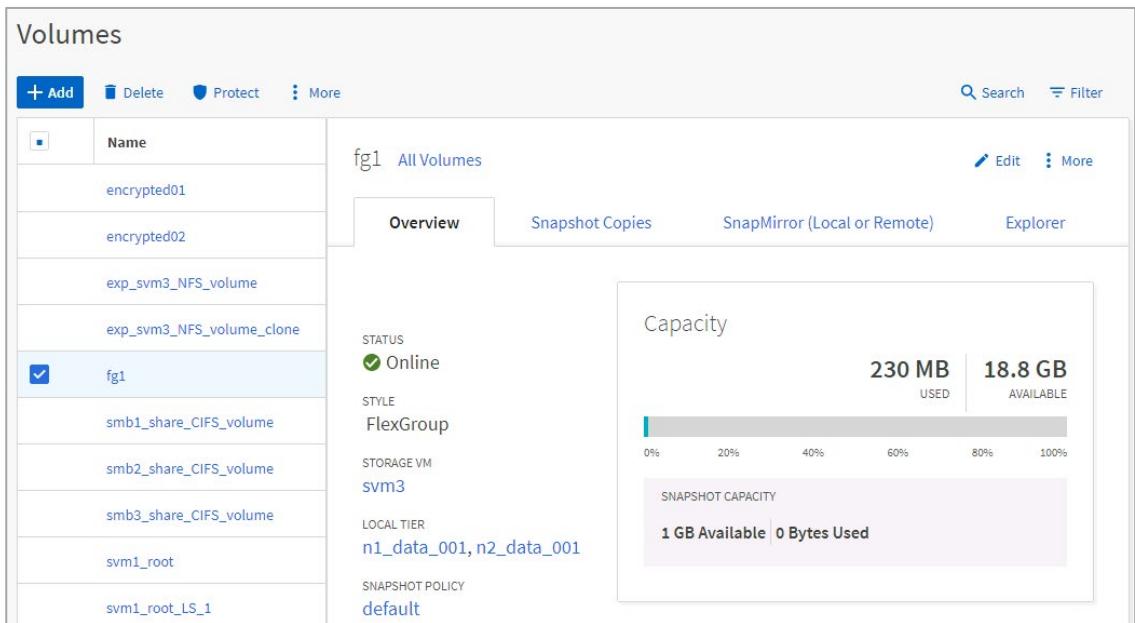
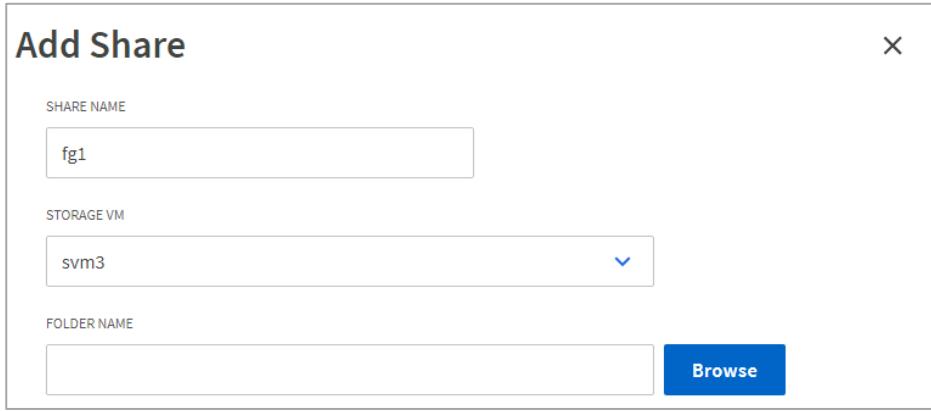
This task is performed in the CLI due to capacity limitations with the ONTAP simulator. In a production environment, you can use the ONTAP System Manager.

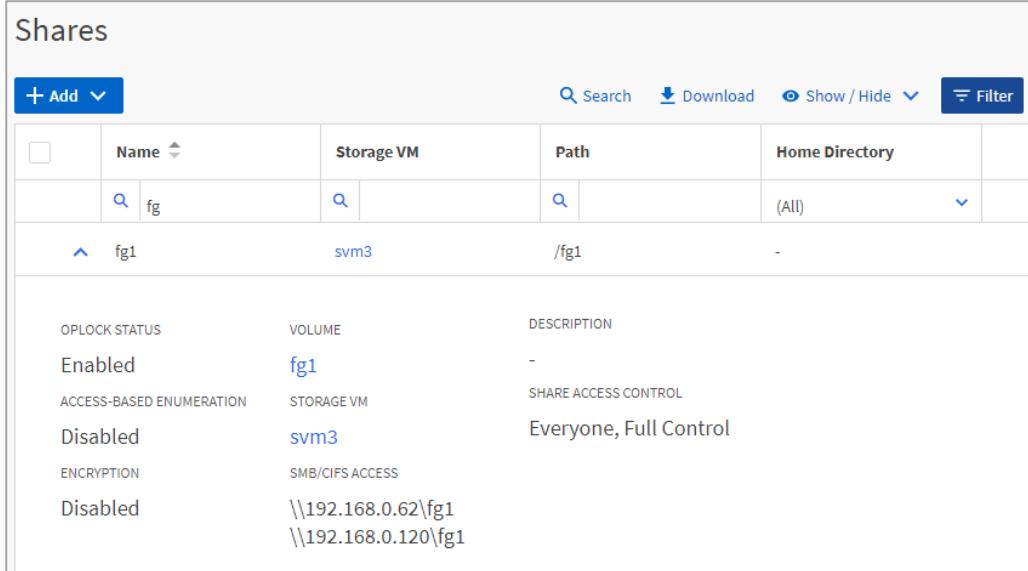
Step	Action
1-1	Open a PuTTY session to <b>cluster1</b> .
1-2	Verify the amount of available free space on the data aggregates: <b>storage aggregate show</b>
1-3	Display the current volumes that are owned by storage VM <b>svm3</b> : <b>volume show -vserver svm3</b>
1-4	Create a FlexGroup volume by using the first data aggregate of each cluster node. <b>volume create -vserver svm3 -volume fg1 -size 20GB -aggr-list n1_data_001,n2_data_001 -policy default</b>
1-5	Accept that the constituent size is smaller than the recommended minimum.

Step	Action
1-6	Accept that the storage VM will need to be modified to use 64-bit NFS identifiers.
1-7	Convert svm3 to use 64-bit identifiers for NFS to provide support for FlexGroup volumes: <pre>set advanced vserver nfs modify -vserver svm3 -v3-64bit-identifiers enabled set admin</pre>
1-8	Relist the volumes in svm3: <pre>volume show -vserver svm3</pre>
1-9	Display the constituent volumes within the FlexGroup volume: <pre>volume show -volume fg1* -is-constituent true</pre>
1-10	Display the aggregates in which the FlexGroup constituent volumes reside: <pre>volume show -volume fg1* -is-constituent true -fields aggregate</pre>

## Task 2: Map the FlexGroup Volume to Windows

Step	Action
2-1	Assign the default export policy to the FlexGroup volume: <pre>volume modify -vserver svm3 -volume fg1 -policy default</pre>
2-2	Display NAS namespace for the svm3 storage VM: <pre>volume show -vserver svm3 -fields junction-path,junction-parent</pre>
2-3	Mount the FlexGroup volume to the namespace at the /fg1 junction: <pre>volume mount -vserver svm3 -volume fg1 -junction-path /fg1</pre>
2-4	Display the junction path for the FlexGroup volume: <pre>volume show -volume fg1 -fields junction-path,junction-parent</pre>
2-5	Open ONTAP System Manager for <b>cluster1</b> in the web browser.

Step	Action
2-6	<p>Open the <b>Volumes</b> window, and click the <b>fg1</b> volume to view its properties.</p>  <p>The screenshot shows the 'Volumes' list on the left with various volumes listed. The 'fg1' volume is selected and highlighted with a blue checkmark. On the right, the properties for 'fg1' are displayed in a detailed view. The 'Overview' tab is selected. Key details shown include:</p> <ul style="list-style-type: none"> <li><b>Capacity:</b> 230 MB USED   18.8 GB AVAILABLE</li> <li><b>Snapshot Capacity:</b> 1 GB Available   0 Bytes Used</li> <li><b>STATUS:</b> Online</li> <li><b>STYLE:</b> FlexGroup</li> <li><b>STORAGE VM:</b> SVM3</li> <li><b>LOCAL TIER:</b> n1_data_001, n2_data_001</li> <li><b>SNAPSHOT POLICY:</b> default</li> </ul>
2-7	<p>Navigate to the <b>Storage &gt; Shares</b> page and click <b>Add &gt; Share</b>.</p>
2-8	<p>In the <b>Add Share</b> page, enter the following values and click <b>Browse</b>.</p> <ul style="list-style-type: none"> <li>Share Name: <b>fg1</b></li> <li>Storage VM: <b>svm3</b></li> </ul>  <p>The screenshot shows the 'Add Share' dialog box. The 'SHARE NAME' field contains 'fg1'. The 'STORAGE VM' dropdown menu is open and shows 'svm3' selected. The 'FOLDER NAME' field is empty, and there is a 'Browse' button to its right.</p>

Step	Action
2-9	<p>In the Add Path dialog box, expand the root folder and select the <b>fg1</b> volume.</p> 
2-10	Click <b>Save</b> .
2-11	In the Add Share page, click <b>Save</b> .
2-12	<p>In the Shares page, expand <b>fg1</b>, and observe the SMB/CIFS Access path.</p> 
2-13	Open File Explorer on the Windows host.
2-14	Click <b>Computer &gt; Map network drive</b> .

Step	Action
<b>2-15</b>	In the dialog box for Folder, type \\192.168.0.62\fg1.
<b>2-16</b>	Click <b>Finish</b> .
<b>2-17</b>	Right-click inside the new file folder window, and select <b>New &gt; Text Document</b> .
<b>2-18</b>	Rename the text file to <b>SMB_testfile</b> .

## Task 3: Mount a FlexGroup Volume to NFS Client

Step	Action
<b>3-1</b>	Return to the PuTTY session for the Linux system.
<b>3-2</b>	Create the directory to which to mount the FlexGroup volume to: <code>mkdir /mnt/fg1</code>
<b>3-3</b>	Mount the FlexGroup volume to your Linux client: <code>mount -t nfs 192.168.0.62:/fg1 /mnt/fg1</code>
<b>3-4</b>	Navigate to the FlexGroup volume: <code>cd /mnt/fg1</code>
<b>3-5</b>	View the available and used capacity of the FlexGroup volume: <code>df -h .</code>
<b>3-6</b>	List the files and directories in the FlexGroup volume: <code>ls -la</code>
<b>3-7</b>	Create a file: <code>touch NFS_testfile</code>
<b>3-8</b>	On cluster1, modify the export policy to enable superuser access to the FlexGroup volume: <code>vserver export-policy rule modify -vserver svm3 -policyname default -ruleindex 1 -superuser any</code>
<b>3-9</b>	 Granting superuser access to NFS volumes compromises security and should not be done in production environments.
<b>3-10</b>	Return to the PuTTY session for the Linux system and create a file: <code>touch NFS_testfile</code>
<b>3-11</b>	List the files and directories in the FlexGroup volume: <code>ls -la</code>

**End of Exercise**

# Module 10: Cluster Maintenance

## Exercise 1: Installing and Configuring Config Advisor

In this exercise, you install NetApp Active IQ Config Advisor and view its analysis of the clusters.

### Objectives

This exercise focuses on enabling you to do the following:

- Install the Config Advisor tool
- Run Config Advisor reports to check the health of your NetApp ONTAP cluster
- Examine ONTAP cluster log files

### Case Study

You have completed the integration of the Dwurgle Enterprises NetApp storage system into the Zarrot Industries IT environment. You believe that all the steps that are needed to align the NetApp system with Zarrot Industries norms and best practices have been completed. Install and run the Config Advisor tool to verify that the NetApp system conforms to the configuration best practices.

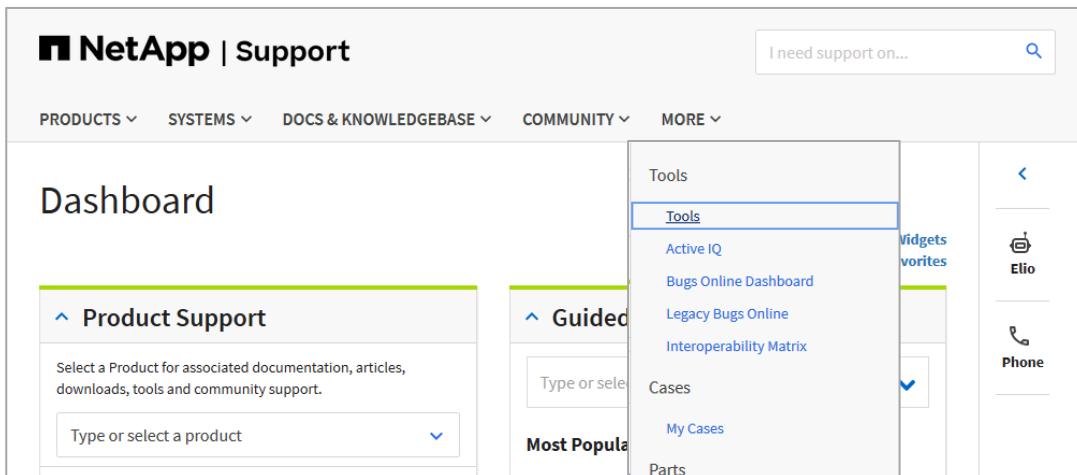
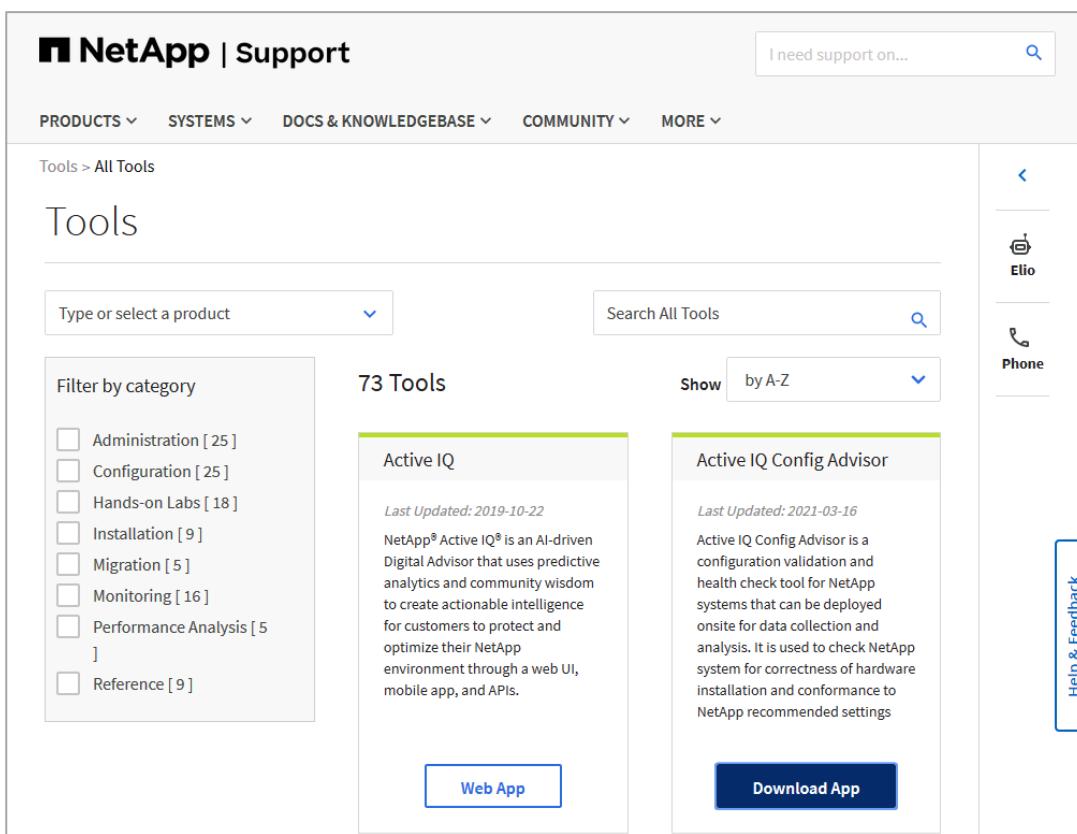
### Exercise Equipment

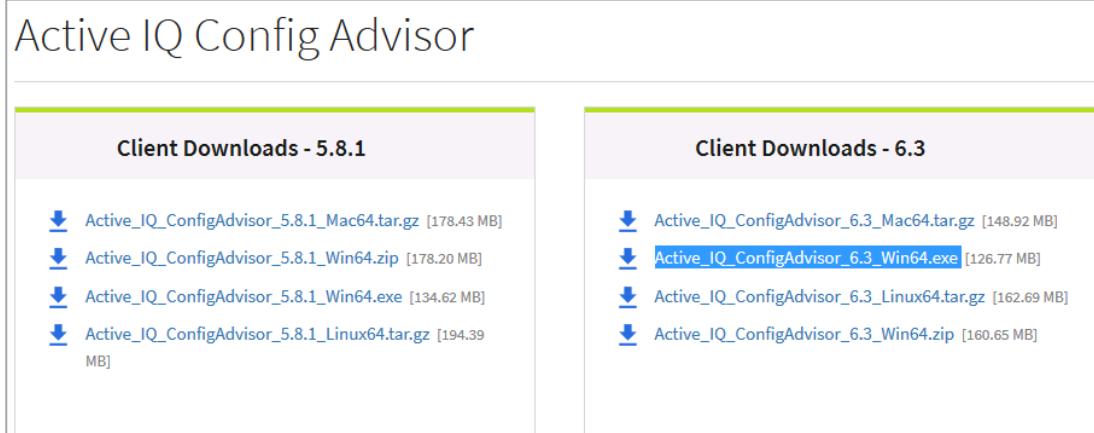
In this exercise, you use the following systems.

System	Host Name	IP Addresses	User Name	Password
Windows Server 2012 R2	Jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case sensitive)	Netapp1!

### Task 1: Download and Install Config Advisor

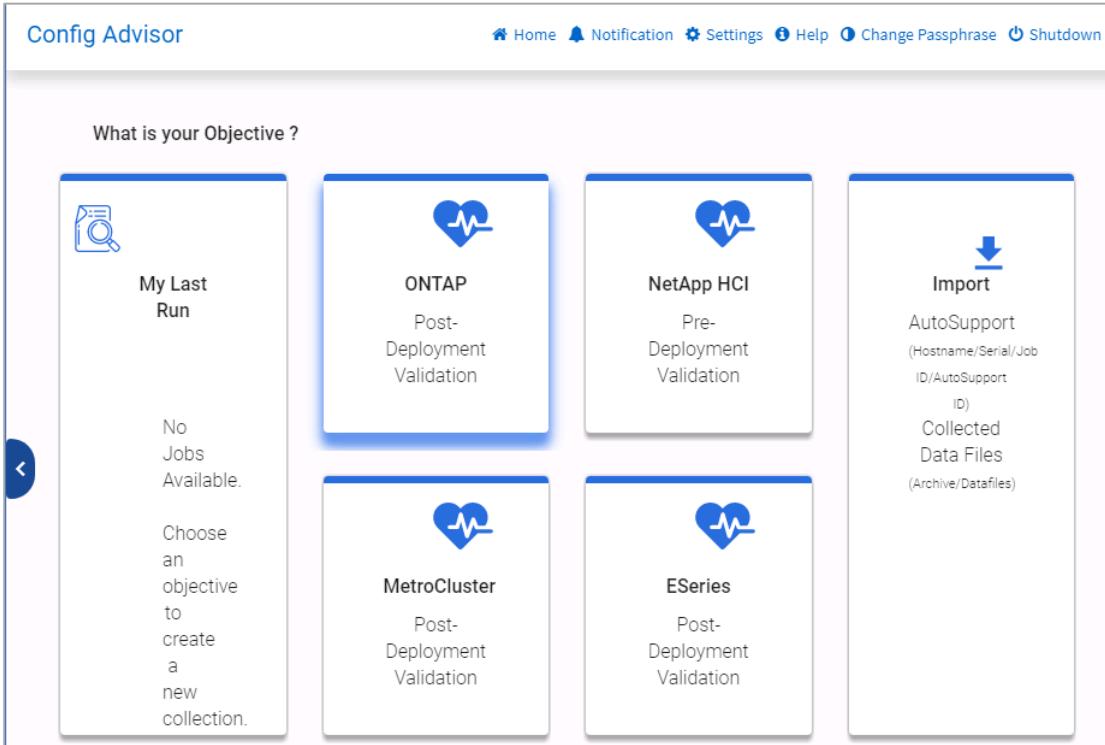
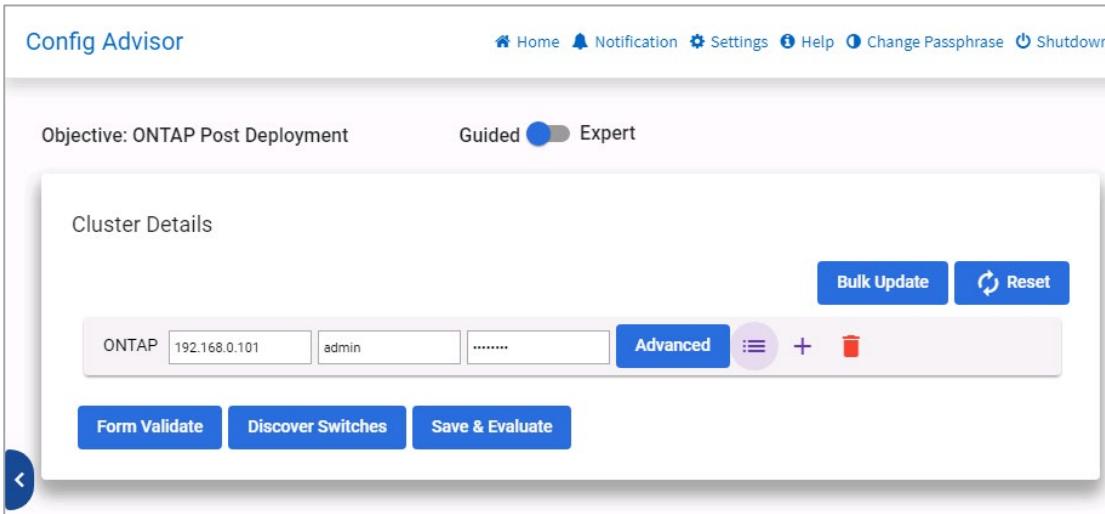
Step	Action
1-1	From your Windows jump host, open a web browser and go to the NetApp Support website. <a href="https://mysupport.netapp.com">https://mysupport.netapp.com</a>
1-2	Log into the NetApp Support Site by using your NetApp credentials.

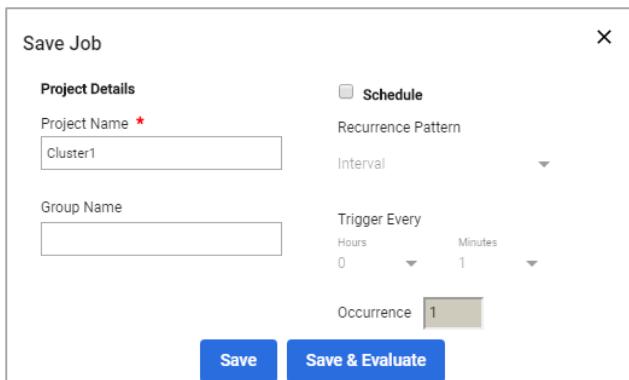
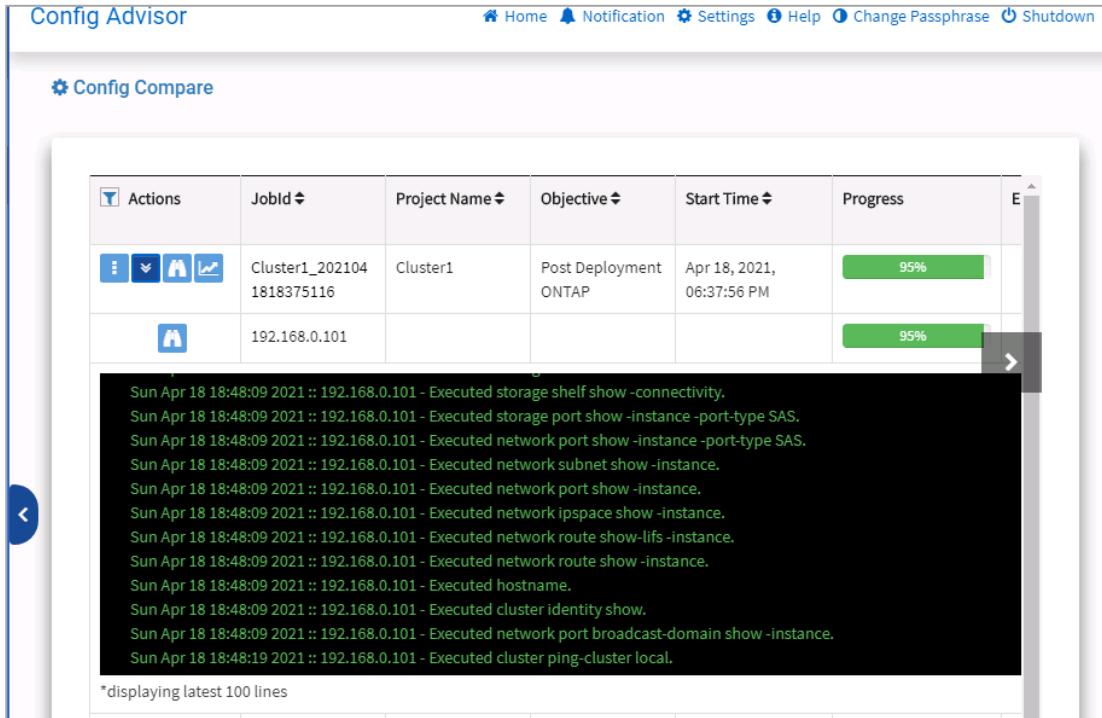
Step	Action
1-3	<p>From the <b>More</b> menu, select <b>Tools</b>.</p> 
1-4	<p>Locate the current version of Active IQ Config Advisor and click <b>Download App</b>.</p> 

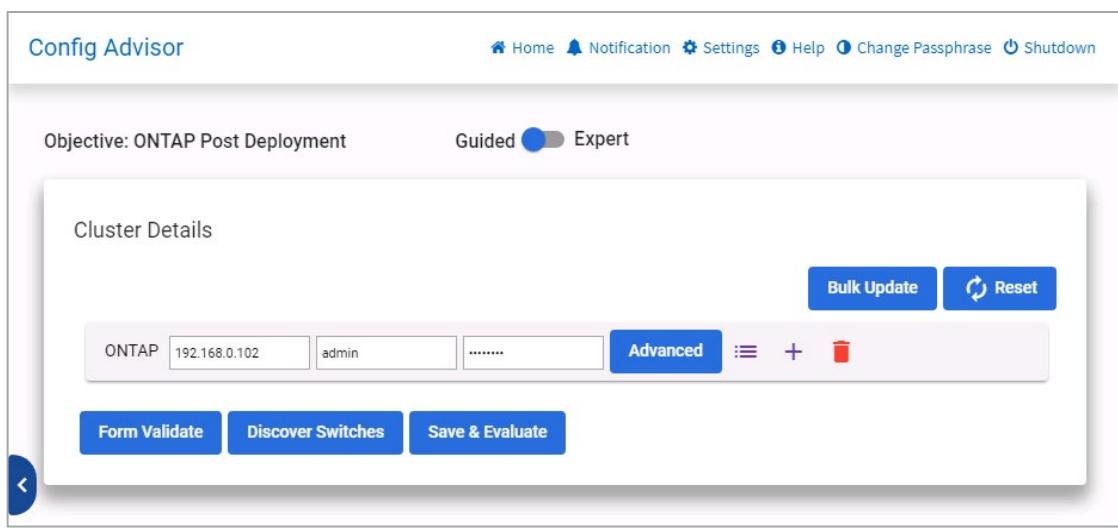
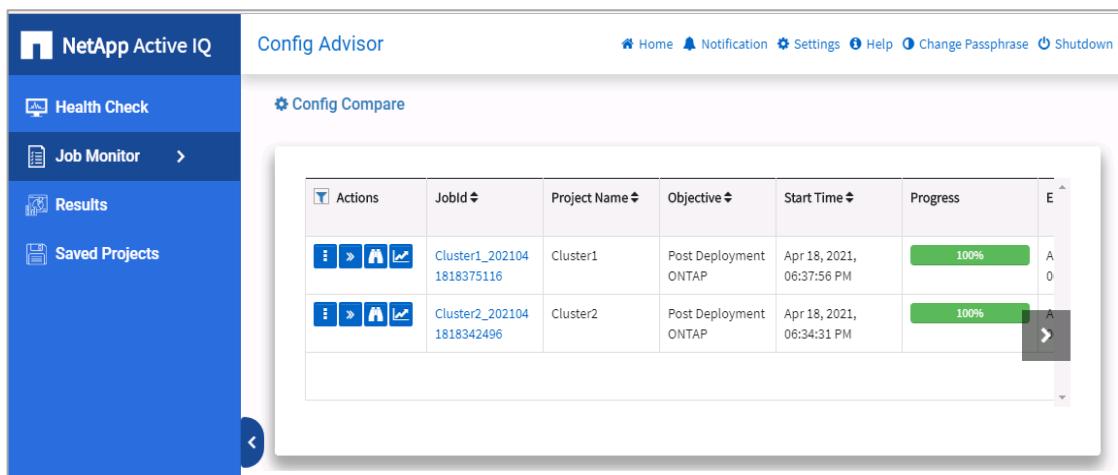
Step	Action
1-5	<p>Agree to the license terms and conditions, and then download the executable (Active_IQ_ConfigAdvisor-6.3_Win64.exe at the time this guide was created).</p> 
1-6	Locate the file in the Downloads folder, and then install Config Advisor on the Windows host.
1-7	 <p>If you are unable to download Config Advisor from the NetApp Support Site, you can install the copy in the CourseFiles folder on the Windows host desktop.</p>

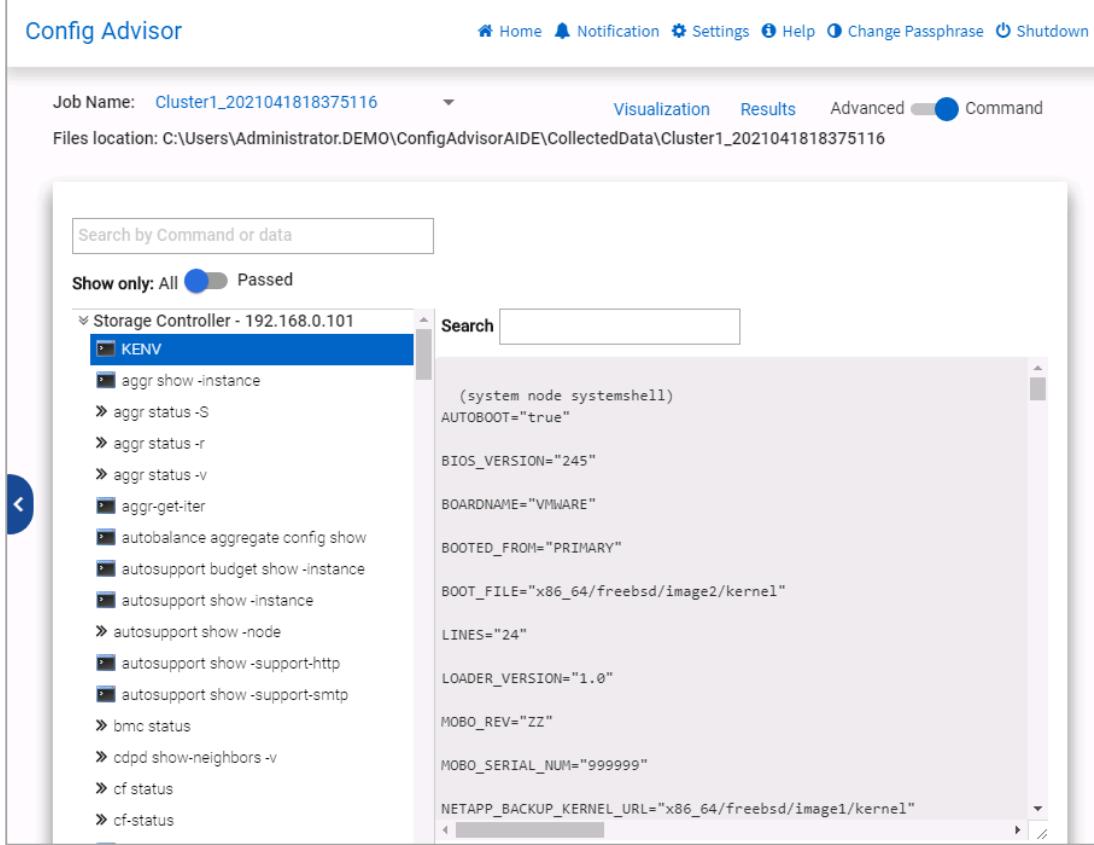
## Task 2: Verify Cluster Health with Config Advisor

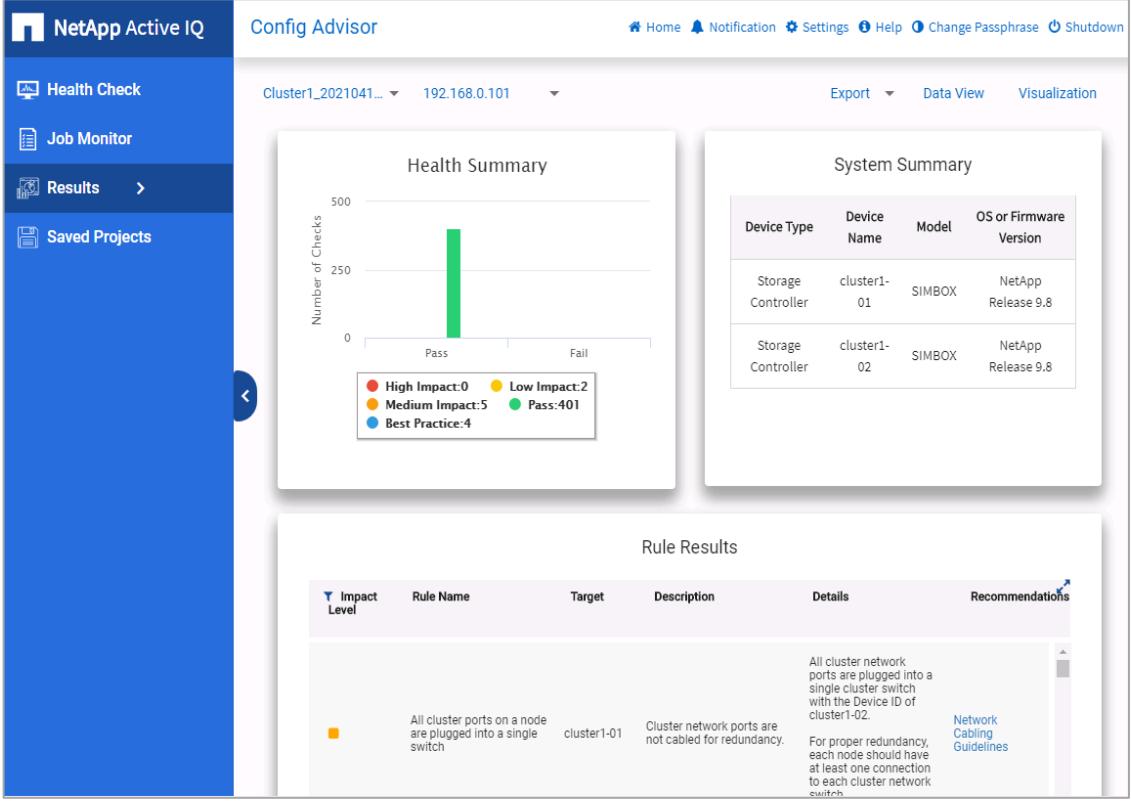
Step	Action
2-1	Run Config Advisor on the Windows jump host.
2-2	When the Basic Settings page appears, click the <b>Cancel</b> button because you are not permanently setting up Config Advisor.
2-3	<p>Enter a passphrase for the Credential Manager to use as an encryption key:</p> <ul style="list-style-type: none"> <li>▪ Passphrase: <b>Netapp1!</b></li> <li>▪ Reconfirm Passphrase: <b>Netapp1!</b></li> </ul>

Step	Action
2-4	<p>In the Config Advisor Health Check tab, click the <b>ONTAP Post-Deployment Validation</b> panel to create a collection.</p> 
2-5	<p>Enter the following cluster details:</p> <ul style="list-style-type: none"> <li>▪ Objective: <b>ONTAP Post-Deployment</b></li> <li>▪ ONTAP: <b>192.168.0.101</b></li> <li>▪ User: <b>admin</b></li> <li>▪ Password: <b>Netapp1!</b></li> </ul> 
2-6	<p>Click the <b>ViewCommands</b> button to view the commands that will be run to gather cluster information.</p>

Step	Action
2-7	 The ViewCommands button is located to the right of the Advanced button and looks like a list.
2-8	Click the <b>Save &amp; Evaluate</b> button.
2-9	Name the project <b>Cluster1</b> , and then click the <b>Save &amp; Evaluate</b> button. 
2-10	Click the chevron icon to view the progress of the data collection job.  <pre> Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed storage shelf show -connectivity. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed storage port show -instance -port-type SAS. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed network port show -instance -port-type SAS. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed network subnet show -instance. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed network port show -instance. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed network ipspace show -instance. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed network route show-lifs -instance. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed network route show -instance. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed hostname. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed cluster identity show. Sun Apr 18 18:48:09 2021 :: 192.168.0.101 - Executed network port broadcast-domain show -instance. Sun Apr 18 18:48:19 2021 :: 192.168.0.101 - Executed cluster ping-cluster local. </pre> <p>*displaying latest 100 lines</p>

Step	Action
2-11	<p>While the job is collecting data, click <b>Health Check</b> and then follow Steps 2-4 through 2-8 to create a job for <b>Cluster2</b>.</p> 
2-12	<p>When the data collection is complete, click the binoculars icon to review the raw output from the CLI commands that were run.</p> 

Step	Action
2-13	<p>Explore the raw results of the data gathering commands.</p>  <p>The screenshot shows the Config Advisor interface with the following details:</p> <ul style="list-style-type: none"> <li><b>Job Name:</b> Cluster1_2021041818375116</li> <li><b>Files location:</b> C:\Users\Administrator.DEMO\ConfigAdvisorAIDE\CollectedData\Cluster1_2021041818375116</li> <li><b>Search by Command or data:</b> Search bar at the top left.</li> <li><b>Show only:</b> All Passed (radio button selected).</li> <li><b>Storage Controller - 192.168.0.101 (KENV):</b> <ul style="list-style-type: none"> <li>Selected item: aggr show -instance</li> <li>Other items include: aggr status -S, aggr status -r, aggr status -v, aggr-get-iter, autobalance aggregate config show, autosupport budget show -instance, autosupport show -instance, autosupport show -node, autosupport show -support-http, autosupport show -support-smtp, bmc status, cdpd show-neighbors -v, cf status, cf-status.</li> </ul> </li> <li><b>Search:</b> Search bar at the top right.</li> <li><b>Raw Command Results:</b> <pre>(system node systemshell) AUTOBOOT="true" BIOS_VERSION="245" BOARDNAME="VMWARE" BOOTED_FROM="PRIMARY" BOOT_FILE="x86_64/freebsd/image2/kernel" LINES="24" LOADER_VERSION="1.0" MOBO_REV="ZZ" MOBO_SERIAL_NUM="999999" NETAPP_BACKUP_KERNEL_URL="x86_64/freebsd/image1/kernel"</pre> </li> </ul>

Step	Action
2-14	<p>Click the <b>Results</b> menu tab. You can view the tests with results.</p>  <p>The screenshot shows the NetApp Active IQ Config Advisor interface. The left sidebar has tabs for Health Check, Job Monitor, Results (selected), and Saved Projects. The main area has tabs for Home, Notification, Settings, Help, Change Passphrase, and Shutdown. The Health Check section shows a 'Health Summary' bar chart with 'Pass' at approximately 400 and 'Fail' at 0. The System Summary table lists two Storage Controllers: cluster1-01 and cluster1-02, both with SIMBOX model and NetApp Release 9.8 OS/Firmware Version. The Rule Results section shows a single rule with an orange impact level, targeting cluster1-01, describing network port redundancy issues, and linking to 'Network Cabling Guidelines'.</p>
2-15	<p><b>i</b> Physical clusters show a visualization of the cabling, and any cabling issues are included in the analysis.</p>
2-16	<p>Compare the data and analysis from cluster2 and cluster1, and then click <b>Shutdown</b> to exit Config Advisor.</p>

### Task 3: Examine Cluster Log Files

Step	Action
3-1	<p>Use a web browser to view the raw log files for node1 of cluster1:  <a href="https://192.168.0.101/spi/cluster1-01/etc/log/">https://192.168.0.101/spi/cluster1-01/etc/log/</a></p>

Step	Action
3-2	Enter the login details for cluster1.
3-3	Open the <b>autosupport</b> directory.
3-4	Select the most recently created directory with the name of <b>&lt;datetime stamp&gt;.0.files</b> .
3-5	Open the <b>OPTIONS.txt</b> file.

The screenshot shows a web browser window with the title "Active IQ Config Advisor" and the URL "https://192.168.0.101/spi/cluster1-01/etc/log". A modal dialog box titled "Authentication Required" is displayed, stating "https://192.168.0.101 requires a username and password." It contains two input fields: "User Name" with the value "admin" and "Password" with the value "\*\*\*\*\*". There are "Log In" and "Cancel" buttons at the bottom.

The screenshot shows a file browser window with the title "Index of cluster1-01/etc/log/autosupport/202104180024.0.files/". The address bar shows "Not secure | https://192.168.0.101/spi/cluster1-01/etc/log/autosupport/202104180024.0.files/". The left sidebar lists files like CLUSTER-INFO.xml, EMS-LOG-FILE.gz, OPTIONS.txt, etc. A Notepad window is open, showing the contents of the OPTIONS (1) - Notepad file:

```

OPTIONS (1) - Notepad
File Edit Format View Help
acp.domain 0
acp.enabled on
acp.netmask 0
acp.port
auditlog.enable on
auditlog.max_file_size 1000000
auditlog.readonly_api.enable off
autologout.console.enable on
autologout.console.timeout 60
autologout.telnet.enable on
autologout.telnet.timeout 60
backup.log.enable on
cdpd.enable off
cdpd.holdtime 180
cdpd.interval 60
cf.giveback.auto.after.panic.takeover on
cf.giveback.auto.delay.seconds 600
cf.giveback.auto.enable on
cf.hw_assist.enable off

```

## Task 4: Change the Cluster Admin Password

Step	Action
4-1	Open the PuTTY session to cluster1, and then log in.
4-2	Change the password to Netapp2!: <b>security login password</b> Enter your current password: <b>Netapp1!</b> Enter a new password: <b>Netapp2!</b> Enter it again: <b>Netapp2!</b>

Step	Action
<b>4-3</b>	Do <i>not</i> log out.
<b>4-4</b>	Return to NetApp ONTAP System Manager for <b>cluster1</b> , and then try to open any page.
<b>4-5</b>	Sign out of System Manager, and then log in with the new password.
<b>4-6</b>	<p>Return to the PuTTY session and reset the password to <b>Netapp1!</b></p> <p>You might need to use a creative solution.</p> <p>(You can choose to skip this task if you remember the password for the remainder of the course).</p>
<b>4-7</b>	<p>Open a second PuTTY session, and then verify that the new password works before closing the first session.</p> <p>As long as the session remains active, you can reset the password if you have difficulty logging in.</p>

#### End of Exercise