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# ONTAP Cluster Administration

Exercise Guide  
Content Version 1.0



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## ONTAP Cluster Administration

### Exercise Guide

Course ID: STRSW-ILT-ONTAPADM  
Catalog Number: STRSW-ILT-ONTAPADM-EG

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## MODULE 0: GETTING STARTED

Your instructor will provide you with any license codes that you need for the exercises.

### EXERCISE 0: CHECKING THE LAB SETUP

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 an ONTAP cluster
- Verify that required licenses are installed on the ONTAP clusters

### STUDY AID ICONS

These four icons may be used throughout your exercises to identify steps that require your special attention:

#### Warning



You should follow all of the exercise steps, but misconfiguring steps labeled with this icon might cause later steps to not work properly. Check this step carefully before continuing to the next step.

#### Attention



Steps or comments labeled with this icon should be reviewed carefully to save time, learn a best practice, or avoid errors.

#### Information



Comments labeled with this icon provide additional information about the topic or procedure.

#### Knowledge



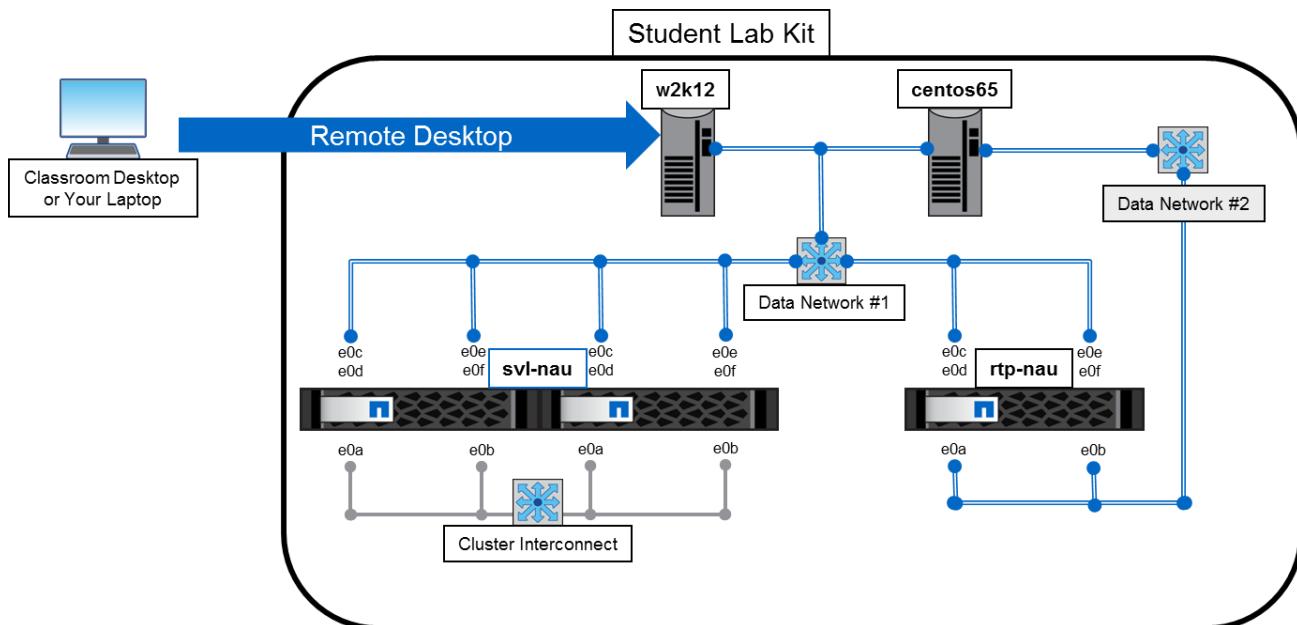
Comments labeled with this icon provide reference material that gives additional context that you may find useful.

### EXERCISE EQUIPMENT DIAGRAM

Your lab contains the following virtual machines (VMs):

- Windows 2012 Server with Domain Controller and DNS Server Manager
- ONTAP svl-nau (a two-node cluster) and ONTAP rtp-nau (a single-node cluster)
- One CentOS 6.5 Linux server

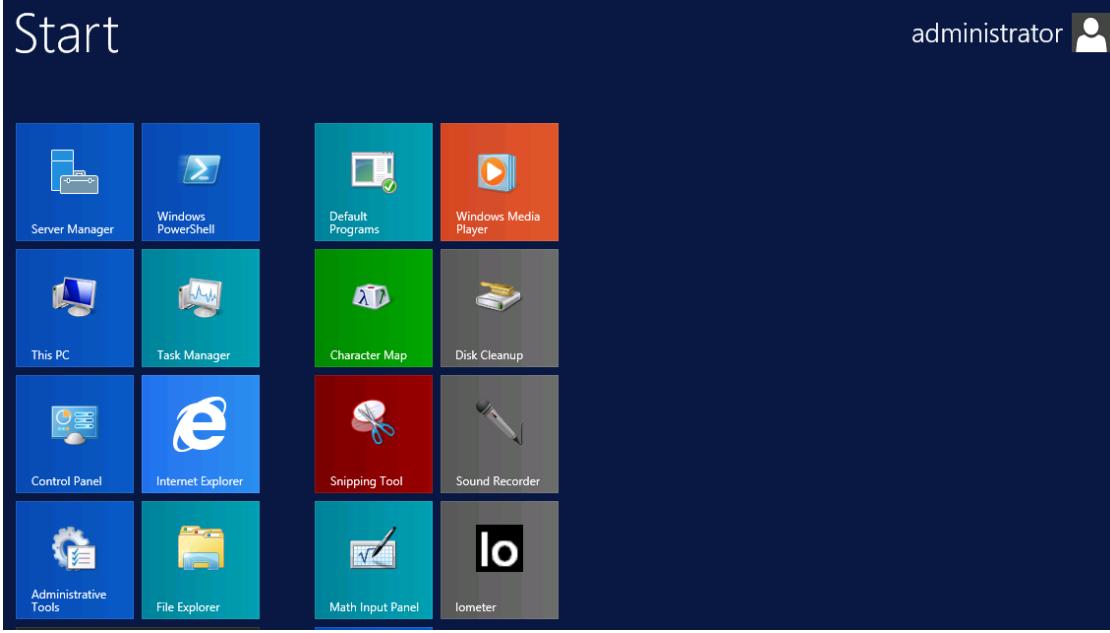
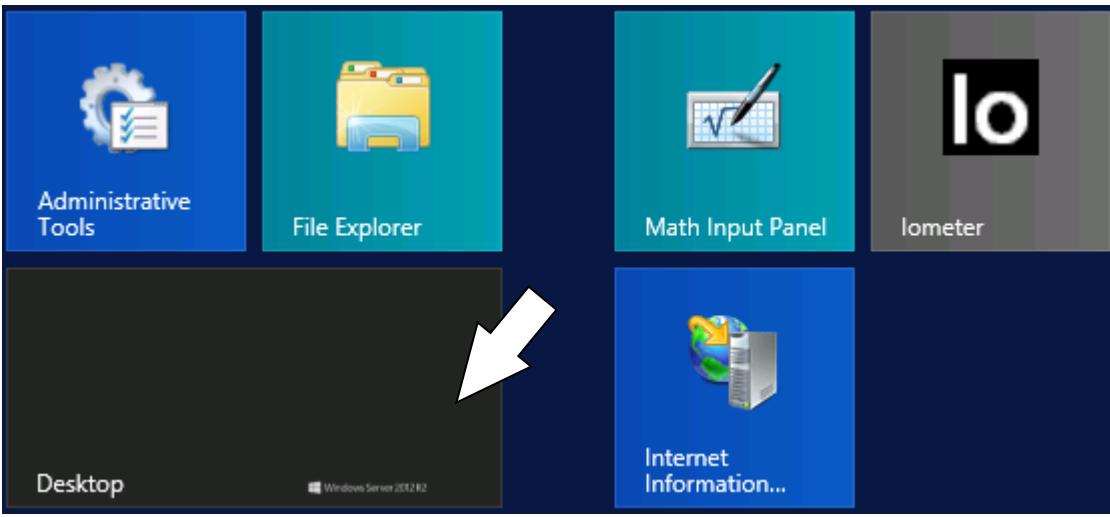
When you use the connection information that your instructor assigns to you, you connect first via remote desktop to Windows 2012 Server. From this Windows desktop, you connect to the other servers in your exercise environment.

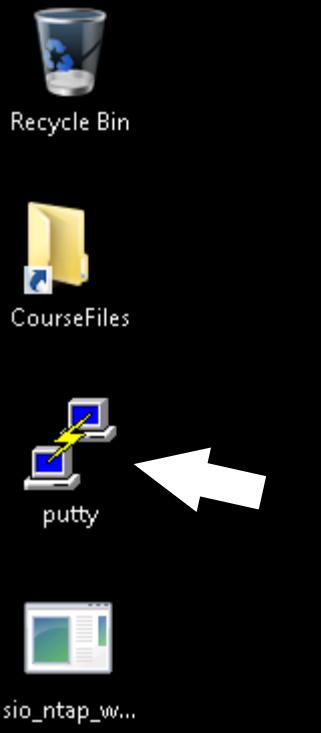
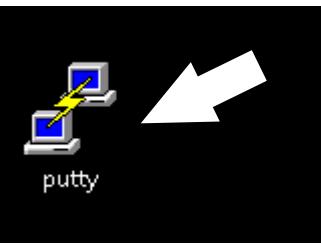


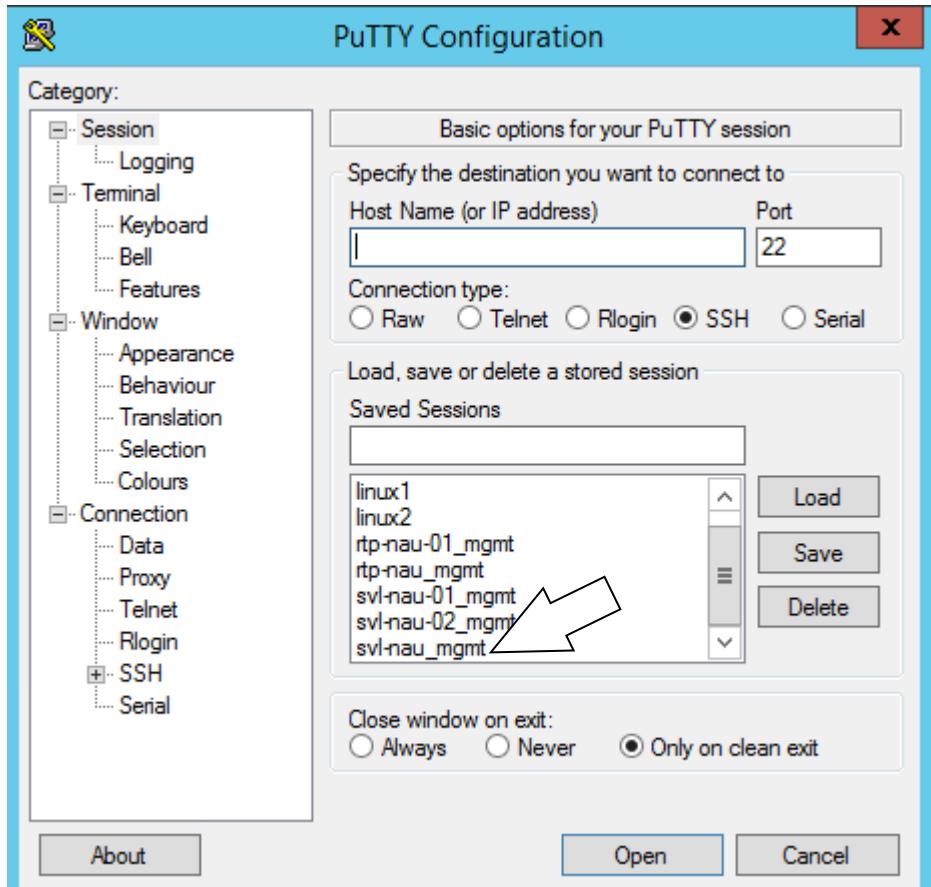
Machine	Host Name	IP Addresses	User Name	Password
Windows 2012 Server	w2k12	192.168.0.11	LEARN\Administrator	Netapp123
ONTAP cluster-management logical interface (LIF)	svl-nau	192.168.0.50	admin (case-sensitive)	Netapp123
node 1	svl-nau-01	192.168.0.51	admin (case-sensitive)	Netapp123
node 2	svl-nau-02	192.168.0.52	admin (case-sensitive)	Netapp123
ONTAP cluster-management LIF	rtp-nau	192.168.0.100	admin (case-sensitive)	Netapp123
node 1	rtp-nau-01	192.168.0.101	admin (case-sensitive)	Netapp123
Linux server	CentOS65	192.168.0.21	root	Netapp123

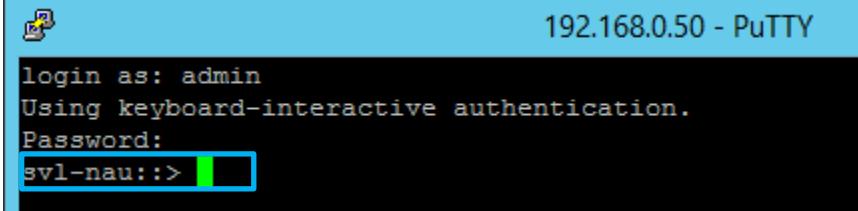
## TASK 1: VERIFY CONNECTIVITY TO AN ONTAP CLUSTER

In this task, you familiarize yourself with the Windows 2012 Server desktop. You verify connectivity to the ONTAP cluster and the health of the ONTAP cluster.

STEP	ACTION
1.	<p>Verify that you see the Start page of your assigned Windows 2012 Server.</p> 
2.	<p>Your desktop might look slightly different.</p> 
3.	<p>On the Windows 2012 Server Start page, scroll down and click the <b>Desktop</b> tile.</p> 

STEP	ACTION
4.	<p>Verify that you see the desktop and that the desktop contains the PuTTY program.</p> 
5.	<p> To connect to the ONTAP cluster UI, you browse to the NetApp OnCommand System Manager URL, which is built in to ONTAP.</p> <p>To connect to the CLI of the ONTAP cluster, you use PuTTY, which is a UI for the Telnet and Secure Shell (SSH) protocols.</p>
6.	<p>Double-click the PuTTY shortcut.</p> 

STEP	ACTION
7.	In the PuTTY Configuration dialog box, complete the following steps: a. In the saved Session list, verify that svl-nau-mgmt is displayed. b. Double-click <b>svl-nau-mgmt</b> .
	 <p>The screenshot shows the PuTTY Configuration dialog box. The left pane contains a tree view of categories: Session, Logging, Terminal, Keyboard, Bell, Features, Window, Appearance, Behaviour, Translation, Selection, Colours, Connection, Data, Proxy, Telnet, Rlogin, SSH, and Serial. The 'Saved Sessions' section on the right lists sessions: linux1, linux2, rtp-nau-01_mgmt, rtp-nau_mgmt, svl-nau-01_mgmt, svl-nau-02_mgmt, and svl-nau_mgmt. An arrow points to the 'svl-nau_mgmt' session in the list. The right pane includes fields for Host Name (or IP address) and Port, and radio buttons for Connection type (Raw, Telnet, Rlogin, SSH, Serial). It also has buttons for Load, Save, and Delete, and a section for Close window on exit (Always, Never, Only on clean exit).</p>
8.	 <p>You can also connect to the ONTAP cluster CLI by connecting to either node in the cluster: svl-nau-01 (node 1) or svl-nau-02 (node 2).</p>
9.	If you receive a PuTTY Security Alert the first time you connect, click Yes.

STEP	ACTION										
10.	<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>Netapp123</b></li> </ul> <p>The ONTAP cluster CLI prompt and cursor appear.</p> 										
11.	 <p>If you have any difficulty logging in to the ONTAP cluster CLI, refer to this table. Verify that you are using the correct username 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>svl-nau</td> <td>192.168.0.50</td> <td>admin (case sensitive)</td> <td>Netapp123</td> </tr> </tbody> </table>	System	Host Name	IP Address	User Name	Password	ONTAP cluster-management LIF	svl-nau	192.168.0.50	admin (case sensitive)	Netapp123
System	Host Name	IP Address	User Name	Password							
ONTAP cluster-management LIF	svl-nau	192.168.0.50	admin (case sensitive)	Netapp123							
12.	<p>Verify that both nodes of the ONTAP cluster are healthy and eligible:</p> <pre>cluster show  svl-nau::&gt; cluster show Node          Health  Eligibility ----- svl-nau-01    true    true svl-nau-02    true    true 2 entries were displayed.  svl-nau::&gt;</pre>										
13.	 <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>										
14.	<p>Configure the display to work well in PuTTY:</p> <pre>rows 0</pre>										

STEP	ACTION
15.	<p>Use the following credentials to repeat steps 7 through 9 for the single-node rtp-nau_mgmt selection in PuTTY:</p> <ul style="list-style-type: none"> <li>▪ Login as: <b>admin</b></li> <li>▪ Password: <b>Netapp123</b></li> </ul>

## TASK 2: VERIFY THAT REQUIRED LICENSE CODES ARE INSTALLED

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

STEP	ACTION
1.	<p>In the svl-nau_mgmt CLI, enter the following command:</p> <pre>license show</pre> <pre>svl-nau::&gt; license show   (system license show)  Serial Number: 1-80-000054 Owner: svl-nau Package      Type      Description          Expiration ----- Base         license    Cluster Base License  -                Serial Number: 1-81-000000000000000000000000000070 Owner: svl-nau-01 Package      Type      Description          Expiration ----- NFS          license   NFS License           - CIFS          license   CIFS License           - SnapRestore   license   SnapRestore License  - SnapMirror    license   SnapMirror License   - FlexClone     license   FlexClone License   - SnapVault     license   SnapVault License   -  Serial Number: 1-81-000000000000000000000000000071 Owner: svl-nau-02 Package      Type      Description          Expiration ----- NFS          license   NFS License           -                Serial Number: 1-81-000000000000000000000000000071 Owner: svl-nau-02 Package      Type      Description          Expiration ----- CIFS          license   CIFS License           - SnapRestore   license   SnapRestore License  - SnapMirror    license   SnapMirror License   - FlexClone     license   FlexClone License   - SnapVault     license   SnapVault License   - 13 entries were displayed.</pre>

STEP	ACTION
<b>2.</b>	Verify that the following required license codes are installed: <ul style="list-style-type: none"> <li>▪ NFS</li> <li>▪ CIFS</li> <li>▪ iSCSI (on cluster rtp-nau only)</li> <li>▪ SnapRestore</li> <li>▪ SnapMirror</li> <li>▪ FlexClone</li> <li>▪ SnapVault</li> </ul>
<b>3.</b>	If any of the licenses are not installed, inform your instructor. 
<b>4.</b>	Repeat steps 1 and 2 with the rtp-nau cluster.

**END OF EXERCISE**

## MODULE 1: ONTAP OVERVIEW

There is no hands-on exercise for Module 1.

## MODULE 2: CLUSTER SETUP

### EXERCISE 1: EXPLORING ONTAP MANAGEMENT UIS

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

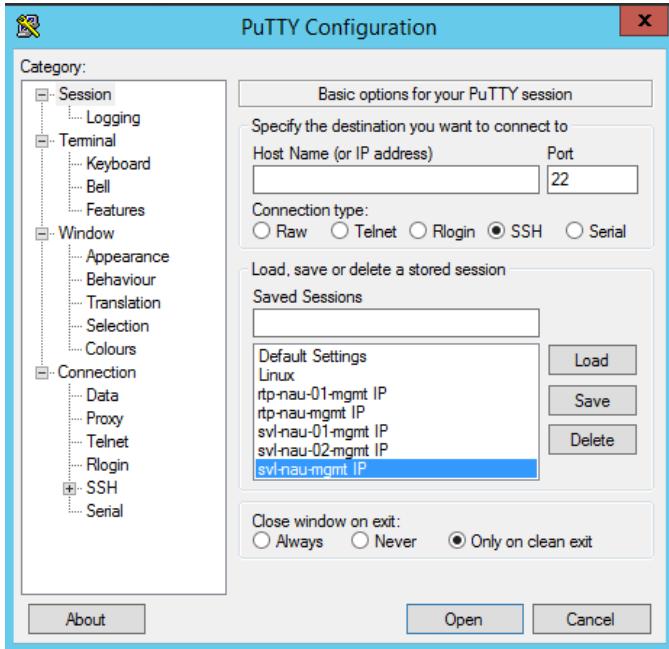
#### OBJECTIVES

This exercise focuses on enabling you to do the following:

- Explore the clustershell CLI
- Explore the System Manager graphical interface

#### TASK 1: EXPLORE THE CLUSTERSHELL CLI

Log in to and navigate the clustershell CLI, and view manual pages.

STEP	ACTION
1.	From your Windows desktop, start the PuTTY application. 
2.	In the PuTTY Configuration window, in the saved Session list, complete the following steps: <ul style="list-style-type: none"><li>▪ Select <b>svl-nau-mgmt IP</b>.</li><li>▪ Click the <b>Load</b> button.</li><li>▪ Note the IP address.</li></ul> 
3.	Click <b>Open</b> to start the Secure Shell (SSH) session.

STEP	ACTION
4.	If a PuTTY Security Alert window appears, click <b>Yes</b> to continue.  
5.	Use the following credentials to log in to svl-nau: <ul style="list-style-type: none"> <li>▪ Log in as: <b>admin</b></li> <li>▪ Password: <b>Netapp123</b>.</li> </ul>
6.	Remove the timeout threshold for sessions to the cluster: <pre>system timeout modify -timeout 0</pre>
7.	Review the commands and command directories at the top level of the command hierarchy: <code>?</code>
8.	 You do not need to press <b>Enter</b> after typing a question mark.
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 execute command directory names as you do commands, but you can navigate to command directories. Command directories can contain subdirectories, commands, or both. Command directories provide contextual and hierarchical grouping of commands; the command structure is not flat.
10.	Review the objects in the <code>storage</code> command directory: <code>storage ?</code>
11.	Open the <code>cluster</code> directory: <code>cluster</code>
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. Notice that the clustershell prompt changes to indicate which context you are in.
13.	Review the available commands and directories at this level: <code>?</code>

STEP	ACTION
14.	 You can use the question mark at any level of the command hierarchy to see which commands and directories are available within that context. Notice that the clustershell prompt changes to indicate which context you are in.
15.	Open the <code>statistics</code> directory: <code>statistics</code> You are now in the <code>cluster statistics</code> context.
16.	Review the commands and directories that are available at this level: <code>?</code>
17.	Go back one level by typing two periods and then pressing the <b>Enter</b> key: <code>..</code>
18.	Notice that you are back at the <code>cluster</code> directory level.
19.	 From any level, you can enter <code>top</code> to go directly to the top of the entire command hierarchy.
20.	Examine the manual page for the <code>storage</code> command directory: <code>man storage</code>
21.	Enter <code>q</code> to exit the manual page.
22.	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 in step 15: <code>man storage aggregate</code>
23.	Enter <code>q</code> to exit the manual page.
24.	Examine the manual page for the <code>storage aggregate create</code> directory: <code>man storage aggregate create</code>
25.	Enter <code>q</code> to exit the manual page.

## TASK 2: NAVIGATE COMMAND DIRECTORIES

Explore command directories and context, and use positional parameters.

STEP	ACTION
1.	Go to the <code>storage aggregate</code> directory level within the clustershell CLI: <code>storage aggr</code>
2.	From the <code>storage aggregate</code> level, run the following command: <code>modify ?</code>

STEP	ACTION
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, but brackets surround both parameter and value: If you provide one, you must provide the other. (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, at least one parameter should be specified for the command to be meaningful (that is, to actually modify an attribute of the aggregate).</p>
4.	<p>Review the possible keyword values for the <code>-state</code> parameter:</p> <pre><b>modify -state ?</b></pre>
5.	<p>Review the options for the <code>storage aggregate scrub</code> command:</p> <pre><b>scrub ?</b></pre>
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 -action start</code></li> <li>▪ <code>storage aggregate scrub aggr0 start</code></li> </ul>
7.	<p>Return to the top of the command hierarchy:</p> <pre><b>top</b></pre>

### TASK 3: ADJUST PREFERENCES BY USING THE SET COMMAND

Use the `set` command to change privilege levels, display all available table volumes from a command, and set a default storage virtual machine (SVM) for a clustershell session.

STEP	ACTION
1.	<p>Look at the <code>volume</code> directory:</p> <pre><b>volume ?</b></pre> <p>The default privilege level is <code>admin</code>.</p>
2.	<p>Review the commands that are available in this directory context at this privilege level.</p>
3.	<p>Switch to the advanced privilege level:</p> <pre><b>set -privilege advanced</b></pre>
4.	 <p>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:</p> <pre><b>set advanced</b></pre>
5.	<p>While you are in the advanced privilege level, look again at the <code>volume</code> directory:</p> <pre><b>volume ?</b></pre>

STEP	ACTION
6.	Review the additional 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.
7.	Switch back to the <code>admin</code> privilege level: <code>set admin</code>
8.	Return to the top of the command hierarchy: <code>top</code>
9.	Look at the <code>set</code> directory: <code>set ?</code>
10.	Display the list of nodes in the cluster: <code>system node show</code>
11.	Set the option to show all fields in a query: <code>set -showallfields true</code>
12.	Display the list of nodes in the cluster again: <code>system node show</code>
13.	Adjust the width of your PuTTY window to correctly show all of the fields in the command output, and then repeat the command that you entered in step 11.
14.	Turn off the option to show all fields: <code>set -showallfields false</code>
15.	Display the list of volumes on the cluster: <code>vol show</code>
16.	Set the default SVM for your clustershell session to <code>svm_red</code> : <code>set -vserver svm_red</code>
17.	View the list of volumes again: <code>vol show</code>
18.	 You see only volumes associated with <code>svmred</code> .
19.	Turn off the default SVM: <code>set -vserver ""</code>

## TASK 4: PRACTICE TAB COMPLETION

Enter command shortcuts and use table completion to simplify command syntax.

STEP	ACTION
1.	Display the logical interfaces (LIFs): <code>network interface show</code>
2.	Type the following command: <code>net i sh</code> The command fails because the form that you entered is ambiguous. Multiple options in the command hierarchy begin with the letter “i”.
3.	Retype the command, using <code>in</code> : <code>ne in sh</code>
4.	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.
5.	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> Note that <code>re</code> is ambiguous in this context. The clustershell displays the options for <code>re</code> .
6.	Complete the command: <ul style="list-style-type: none"><li>▪ Type <code>ne</code>, and then press <b>Tab</b>.</li><li>▪ Type <code>in</code>, and then press <b>Tab</b>.</li><li>▪ Type <code>revert *</code>.</li></ul>

## TASK 5: USE THE COMMAND HISTORY

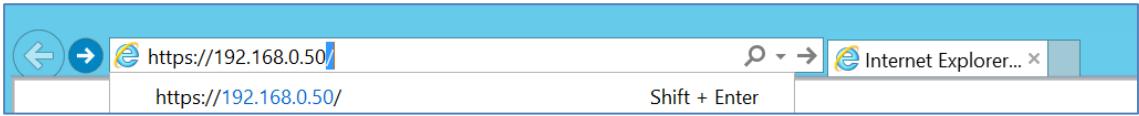
Use the `history` command, the `redo` command, and the up arrow to retrieve previous commands.

STEP	ACTION
1.	Enter the following commands: <code>net int show</code> <code>net port show</code> <code>cluster show</code>
2.	From the command line, press the up arrow key multiple times to recall previous commands.
3.	Press the down arrow key to scroll back through the commands.
4.	Check the command history: <code>history</code>
5.	Rerun the most recent command: <code>redo</code>

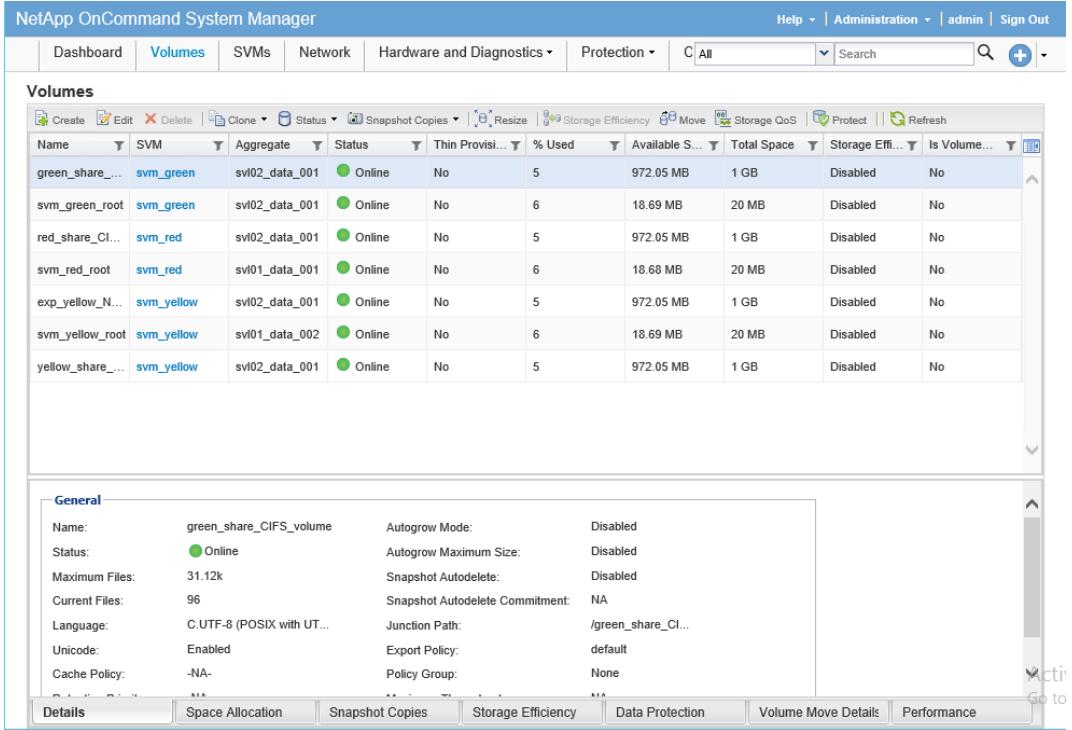
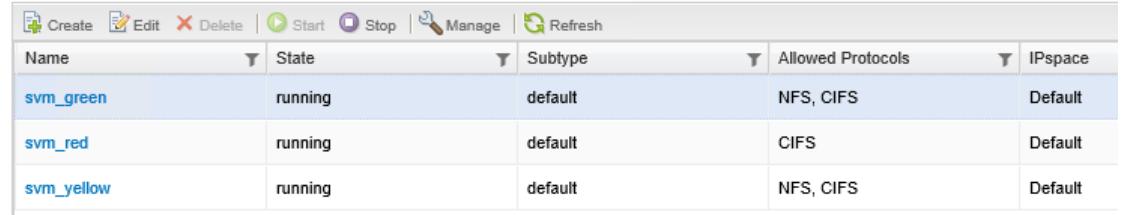
STEP	ACTION
6.	 The most recent command is <code>history</code> , which is the last command in the history list.
7.	Check the history again: <code>history</code>
8.	Re-run the command that was issued three commands ago: <code>redo -3</code>
9.	Find the <code>vol show</code> command in the history list, and run the command by using the command number: <code>redo #</code>
10.	 The number that is associated with the <code>vol show</code> command varies, based on the number of commands that you execute in this session.

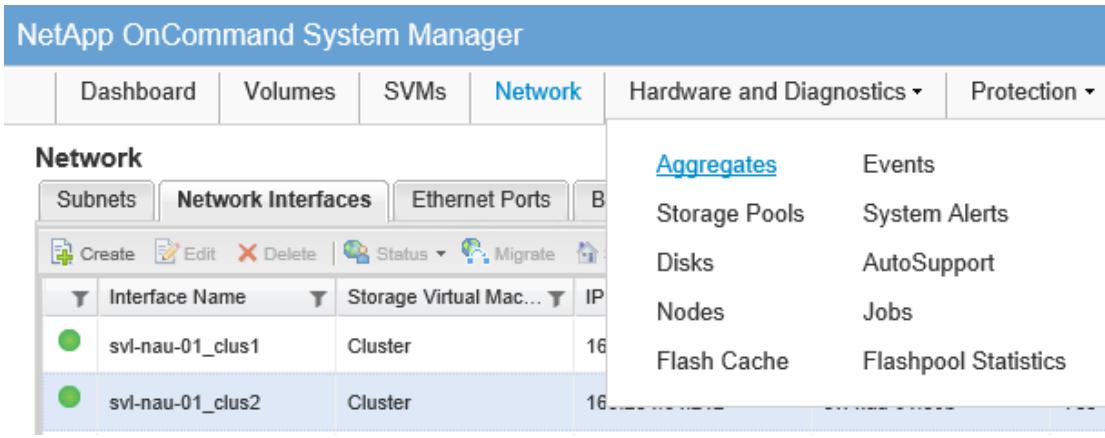
## TASK 6: NAVIGATE ONCOMMAND SYSTEM MANAGER

Take a tour of the new System Manager layout.

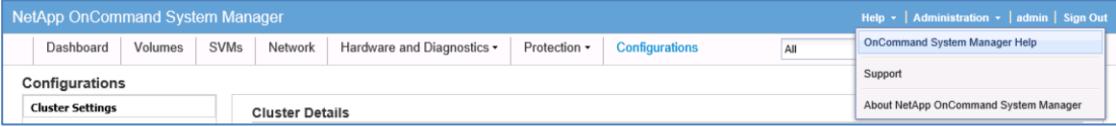
STEP	ACTION
1.	 Use <code>https://</code> in the System Manager URL.
2.	From the Windows Server desktop, access System Manager on cluster svl-nau: <ul style="list-style-type: none"> <li>▪ Open a web browser.</li> <li>▪ In the address bar, enter the cluster-management LIF IP address <b>https://192.168.0.50</b>.</li> </ul> 
3.	If prompted, click <b>Continue</b> . <div style="background-color: #f0f0f0; padding: 10px; margin-top: 10px;">  <b>There is a problem with this website's security certificate.</b> <p>The security certificate presented by this website was not issued by a trusted certificate authority. The security certificate presented by this website was issued for a different website's address.</p> <p>Security certificate problems may indicate an attempt to fool you or intercept any data you send to the server.</p> <p><b>We recommend that you close this webpage and do not continue to this website.</b></p> <p> <input checked="" type="checkbox"/> <a href="#">Click here to close this webpage.</a>   <input type="checkbox"/> <a href="#">Continue to this website (not recommended).</a>   <input type="checkbox"/> <a href="#">More information</a> </p> </div>

STEP	ACTION
4.	<p>When the System Manager window opens, enter your login credentials:</p> <p>User name: <b>admin</b></p> <p>Password: <b>Netapp123</b></p>
5.	<p>Take a few minutes to review the information that is presented on the Dashboard, which is the new System Manager landing page.</p>
6.	<p>Answer the following questions:</p> <ul style="list-style-type: none"> <li>▪ How many disks are available in the cluster? _____</li> <li>▪ How many of the available disks are SSDs? _____</li> </ul>
7.	<p>Answer the following questions:</p> <ul style="list-style-type: none"> <li>▪ In the Dashboard, did you click both tabs? _____</li> <li>▪ On the Cluster Performance tab, which information is presented? _____</li> </ul>
8.	<p>On the menu bar, click the <b>Volumes</b> tab.</p>

STEP	ACTION
9.	<p>Review the Volumes pane and the general volume information (including tabs) at the bottom of the pane.</p>  <p>The screenshot shows the 'Volumes' pane with a list of volumes and their details. A specific volume, 'green_share_CIFS_volume', is selected and shown in a detailed view below. The detailed view includes tabs for General, Details, Space Allocation, Snapshot Copies, Storage Efficiency, Data Protection, Volume Move Details, and Performance.</p>
10.	In another browser window, open System Manager on cluster rtp-nau (IP address 192.168.0.100).
11.	Compare the menu bars between the two clusters.
12.	<p>Answer the following questions:</p> <ul style="list-style-type: none"> <li>▪ Is there a LUNs tab on the svl-nau menu bar? _____</li> <li>▪ If not, why not?</li> </ul> <hr/>
13.	Return to the System Manager session for cluster svl-nau (192.168.0.50).
14.	On the menu bar, click the <b>SVMs</b> tab.
	 <p>The screenshot shows the 'SVMs' tab selected in the menu bar of the NetApp OnCommand System Manager interface.</p>
15.	Review the SVMs pane.
	 <p>The screenshot shows the 'SVMs' pane with a list of SVMs and their details. The SVMs listed are 'svm_green', 'svm_red', and 'svm_yellow', all in a 'running' state with 'default' subtype and 'NFS, CIFS' allowed protocols.</p>

STEP	ACTION
16.	In the Name column of the SVMs pane, click one of the SVMs.
17.	On the SVMs menu bar, review each tab.  
18.	Answer the following question: Where can you find the date of the most recent Snapshot copy for volume finance2_NFS_volume?  <hr/>
19.	On the menu bar, click the <b>Network</b> tab.  
20.	Review the Network pane.
21.	Answer the following question: Are any network interfaces not on their home port? If the answer is “yes”, then send the LIF to its home port.
22.	On the menu bar, click <b>Hardware and Diagnostics</b> , and then select <b>Aggregates</b> .  

STEP	ACTION																																										
23.	<p>Review the Aggregates pane.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Node</th> <th>Type</th> <th>Used (%)</th> <th>Available Space</th> <th>Used Space</th> <th>Total Space</th> </tr> </thead> <tbody> <tr> <td>aggr0_svl01</td> <td>svl-nau-01</td> <td>Standard</td> <td>31</td> <td>11.51 GB</td> <td>5.19 GB</td> <td>16.7 GB</td> </tr> <tr> <td>aggr0_svl02</td> <td>svl-nau-02</td> <td>Standard</td> <td>31</td> <td>11.51 GB</td> <td>5.19 GB</td> <td>16.7 GB</td> </tr> <tr> <td>svl01_data_001</td> <td>svl-nau-01</td> <td>Standard</td> <td>29</td> <td>12.48 GB</td> <td>5.1 GB</td> <td>17.58 GB</td> </tr> <tr> <td>svl01_data_002</td> <td>svl-nau-01</td> <td>Standard</td> <td>7</td> <td>13.04 GB</td> <td>1.03 GB</td> <td>14.06 GB</td> </tr> <tr> <td>svl01_data_003</td> <td>svl-nau-01</td> <td>Standard</td> <td>57</td> <td>6.02 GB</td> <td>8.04 GB</td> <td>14.06 GB</td> </tr> </tbody> </table>	Name	Node	Type	Used (%)	Available Space	Used Space	Total Space	aggr0_svl01	svl-nau-01	Standard	31	11.51 GB	5.19 GB	16.7 GB	aggr0_svl02	svl-nau-02	Standard	31	11.51 GB	5.19 GB	16.7 GB	svl01_data_001	svl-nau-01	Standard	29	12.48 GB	5.1 GB	17.58 GB	svl01_data_002	svl-nau-01	Standard	7	13.04 GB	1.03 GB	14.06 GB	svl01_data_003	svl-nau-01	Standard	57	6.02 GB	8.04 GB	14.06 GB
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24.	<p>Review the tabs at the bottom of the screen.</p>																																										
25.	<p>On the menu bar, click <b>Hardware and Diagnostics</b>, and then explore the remaining selections.</p>																																										
26.	<p>On the menu bar, click <b>Protection</b>, and then select <b>Schedules</b>.</p>																																										
27.	<p>Review the Schedules pane.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>5min</td> <td>Time based</td> </tr> <tr> <td>8hour</td> <td>Time based</td> </tr> <tr> <td>Auto Balance Aggregate Scheduler</td> <td>Interval based</td> </tr> <tr> <td>daily</td> <td>Time based</td> </tr> <tr> <td>hourly</td> <td>Time based</td> </tr> <tr> <td>RepositoryBalanceMonitorJobSchedule</td> <td>Interval based</td> </tr> <tr> <td>weekly</td> <td>Time based</td> </tr> </tbody> </table>	Name	Type	5min	Time based	8hour	Time based	Auto Balance Aggregate Scheduler	Interval based	daily	Time based	hourly	Time based	RepositoryBalanceMonitorJobSchedule	Interval based	weekly	Time based																										
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28.	<p>On the menu bar, click <b>Protection</b>, and then explore the remaining selections.</p>																																										
29.	<p>On the menu bar, click the <b>Configurations</b> tab.</p>																																										

STEP	ACTION
30.	In the Configurations navigation pane, review the Cluster Settings.  
31.	In the Configurations navigation pane, review the Services.  
32.	In the Configurations navigation pane, review the Cluster User Details.  
33.	 You can find help about any System Manager command by clicking Help above the menu bar.
34.	Above the menu bar, click <b>Help</b> , and then review each Help menu option.  
35.	View System Manager Help from within different locations in System Manager; for example: <ul style="list-style-type: none"> <li>▪ Click the <b>SVMs</b> tab.</li> <li>▪ Click <b>Help</b>.</li> <li>▪ Click <b>OnCommand System Manager Help</b>.</li> </ul>

#### END OF EXERCISE

## MODULE 3: MANAGEMENT

### EXERCISE 1: MANAGING ONTAP CLUSTERS AND ADMINISTRATORS

#### OBJECTIVES

This exercise focuses on enabling you to do the following:

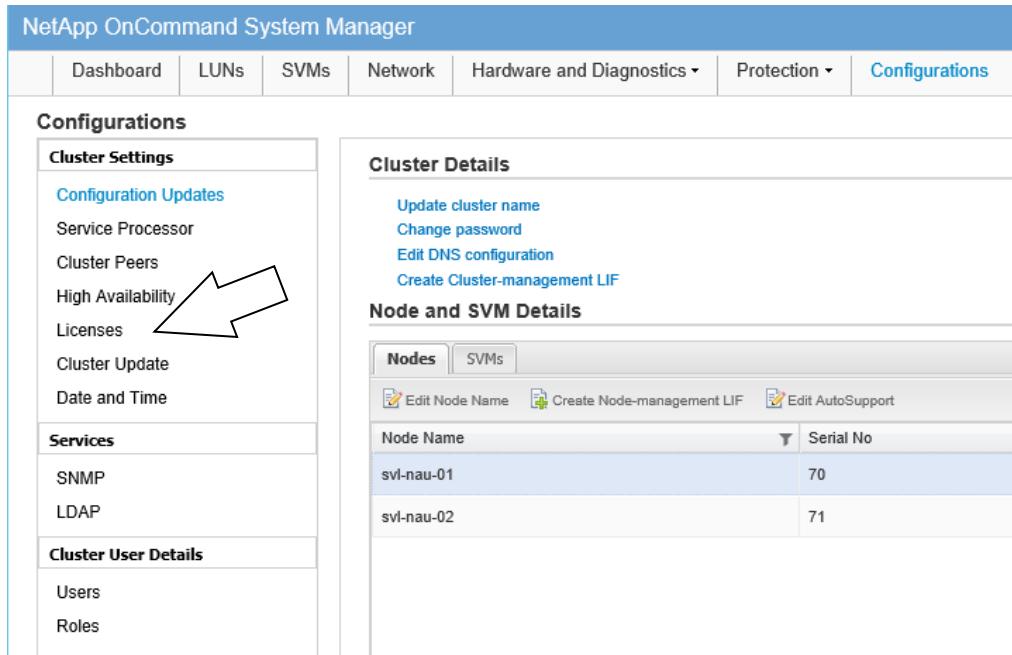
- Create a login banner and a message of the day (MOTD)
- Apply and explore licenses
- Configure cluster time and assign a Network Time Protocol (NTP) server
- Create custom administrators and verify access levels
- Authenticate a cluster administrator with Active Directory

#### TASK 1: CREATE A LOGIN BANNER AND MOTD

STEP	ACTION
1.	Start a PuTTY session with cluster svl-nau.
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.
3.	Change the clusterwide login banner: <b>security login banner modify -message "Authorized users ONLY!"</b> <b>Note:</b> This command is case-sensitive.
4.	View the current clusterwide MOTD: <b>security login motd show</b> Sample output: The message of the day has not been configured for the cluster or any data Vserver.
5.	Enter interactive mode to change the login MOTD for the entire svl-nau cluster: <b>security login motd modify -vserver svl-nau</b> Sample output: Enter the message of the day for Vserver "cluster2". Max size: 2048. Enter a blank line to terminate input. Press Ctrl-C to abort. 0 1 2 3 4 5 6 7 8 1234567890123456789012345678901234567890123456789012345678901234567890 <b>NOTE:</b> This command is case-sensitive.

STEP	ACTION
6.	<p>Enter (or paste) the following case-sensitive text:</p> <pre>##### # Operating System Name = \s      # # Software Release       = \r      # # Node                   = \n      # # Name                   = \N      # # Active Sessions        = \u      # # Current Time           = \t      # # Current Date           = \d      # #####</pre>
7.	 A blank line is required to exit interactive mode.
8.	<p>Open a second PuTTY session to the svl-nau cluster management logical interface (LIF) and observe the login banner and MOTD.</p>
9.	<p>Reset the clusterwide login banner to the default:</p> <pre>security login banner modify -message ""</pre> <p><b>NOTE:</b> This command is case-sensitive.</p>
10.	<p>Reset the login MOTD to the default:</p> <pre>security login motd modify -vserver svl-nau -message ""</pre>

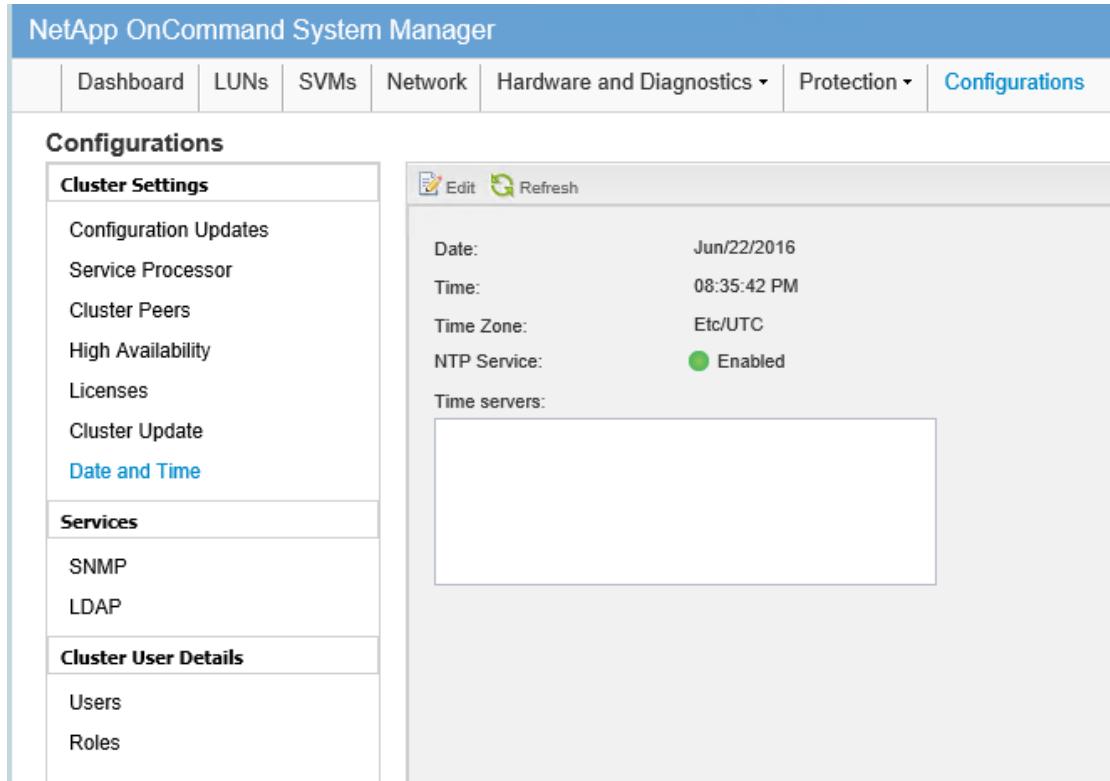
## TASK 2: EXPLORE LICENSING

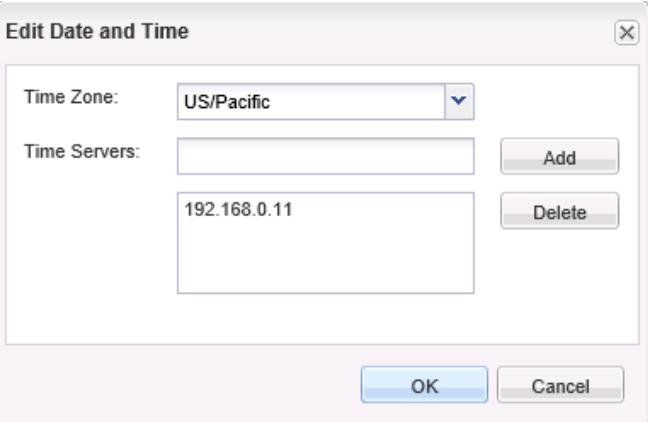
STEP	ACTION
1.	<p>In NetApp OnCommand System Manager for cluster svl-nau, complete the following steps:</p> <ol style="list-style-type: none"> <li>Click the <b>Configurations</b> tab</li> <li>Under Cluster Settings, click <b>Licenses</b>.</li> </ol> 
2.	Verify that the Cluster Base License package is present.
3.	Switch back to the cluster management Secure Shell (SSH) PuTTY session and, if necessary, authenticate as <b>admin</b> .
4.	<p>View the cluster serial ID:</p> <pre>cluster identity show</pre> <p>Sample output:</p> <pre>Cluster UUID: a270d4d1-cd8d-11e2-80c5-123478563412 Cluster Name: svl-nau Cluster Serial Number: 1-80-000099 Cluster Location: Cluster Contact:</pre> <p><b>NOTE:</b> In the sample output, the serial number is 1-80-000099.</p>

STEP	ACTION										
5.	<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 ----- svl-nau-01  70 svl-nau-02  71 2 entries were displayed.</pre>										
6.	<p>Navigate to the license hierarchy:</p> <pre>license</pre> <p>The prompt takes you to the <code>system license</code> command hierarchy.</p> <pre>svl-nau::system license&gt;</pre>										
7.	<p>List the available commands:</p> <pre>svl-nau::system license&gt; ?</pre> <p>Sample output:</p> <table> <tbody> <tr> <td>add</td> <td>Add one or more licenses</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>show</td> <td>Display licenses</td> </tr> <tr> <td>status&gt;</td> <td>Display license status</td> </tr> </tbody> </table>	add	Add one or more licenses	clean-up	Remove unnecessary licenses	delete	Delete a license	show	Display licenses	status>	Display license status
add	Add one or more licenses										
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show	Display licenses										
status>	Display license status										
8.	<p>View the currently licensed packages:</p> <pre>svl-nau::system license&gt; show</pre> <p>Note the node-locked licenses that have already been installed on the cluster.</p>										
9.	<p>List details about the available license packages:</p> <pre>svl-nau::system license&gt; status show</pre>										

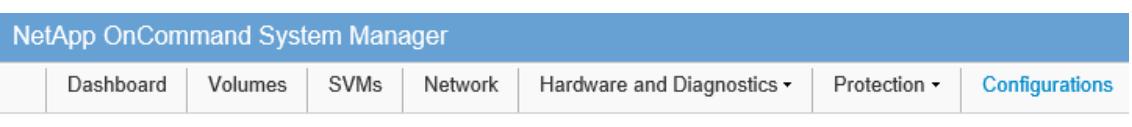
### TASK 3: CONFIGURE CLUSTER TIME AND ASSIGN AN NTP SERVER

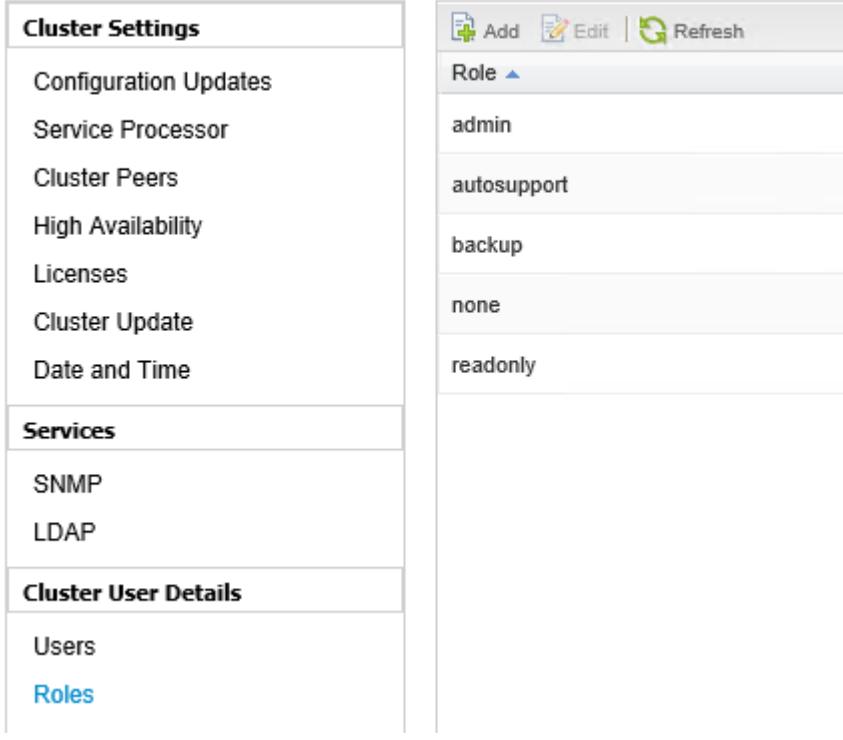
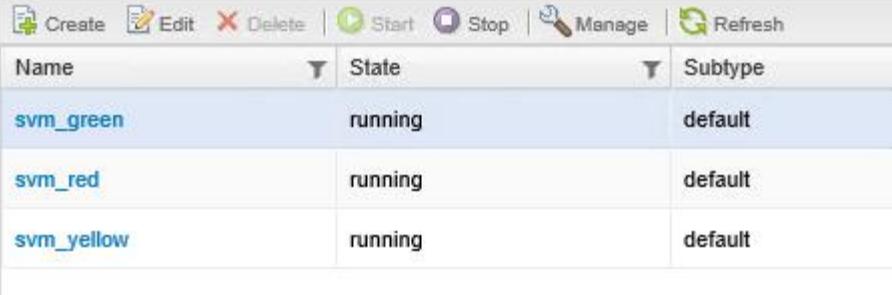
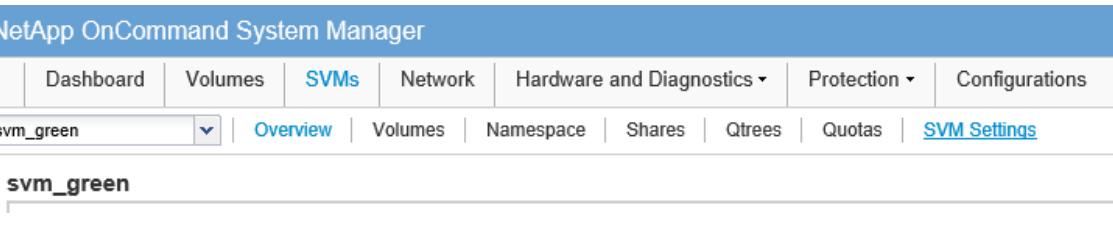
STEP	ACTION
1.	 <p>Windows domains must be synchronized to within 5 minutes of all member servers. If the time of the ONTAP cluster is not synchronized with a domain controller, then the ONTAP cluster cannot join or remain joined to the Windows domain.</p> <p>Without synchronization, computers in the Windows domain cannot access resources in the ONTAP cluster, and resources in the cluster cannot access the Windows domain.</p> <p>In this task, you synchronize date and time between the ONTAP clusters and the Windows domain controller.</p>

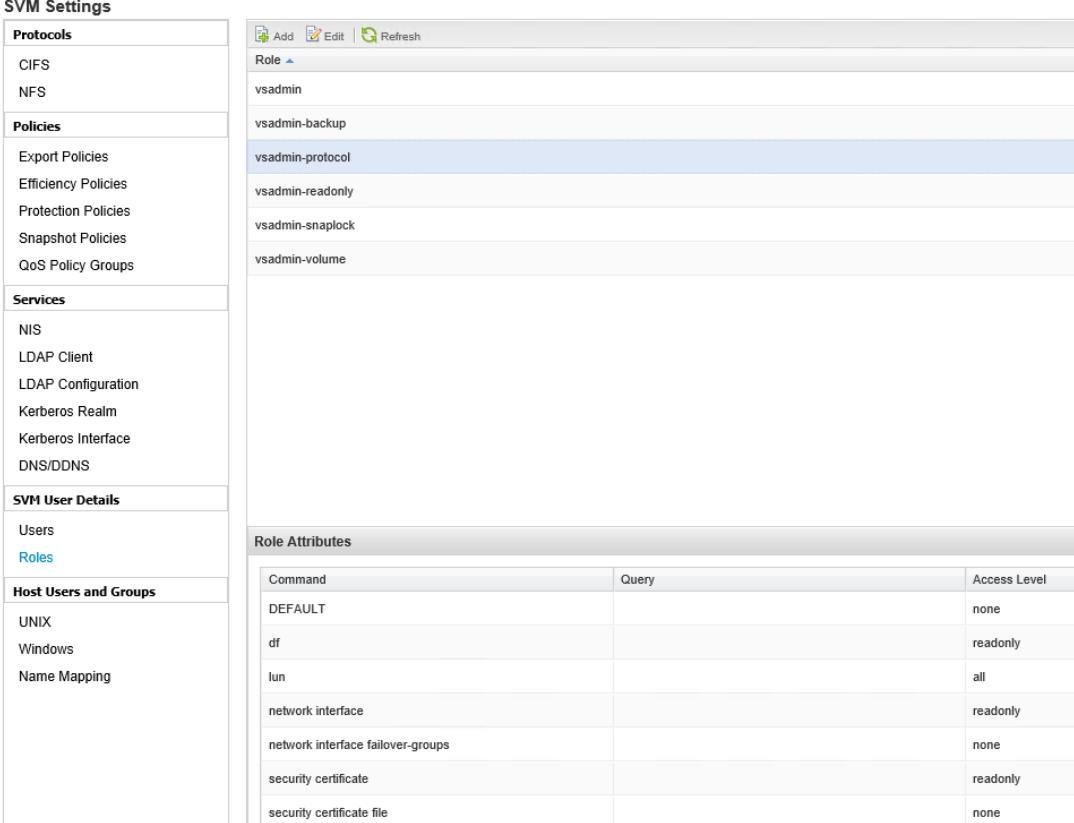
STEP	ACTION
2.	<p>In System Manager for cluster svl-nau, complete the following steps:</p> <ol style="list-style-type: none"> <li>Click the <b>Configurations</b> tab.</li> <li>Under Cluster Settings, click <b>Date and Time</b>.</li> </ol> <p>The system data and time for computers in your lab kit are presynchronized. The Windows and Linux systems are set to Pacific Time. The clusters are set to UTC.</p>  <p>The screenshot shows the 'Configurations' tab selected in the top navigation bar. Under 'Cluster Settings', the 'Date and Time' option is highlighted. The main pane displays current system time settings: Date: Jun/22/2016, Time: 08:35:42 PM, Time Zone: Etc/UTC, and NTP Service: Enabled. A large empty text area labeled 'Time servers:' is present.</p>
3.	On the Date and Time pane toolbar, click <b>Edit</b> .
4.	In the Time Zone list, select <b>US/Pacific</b> .

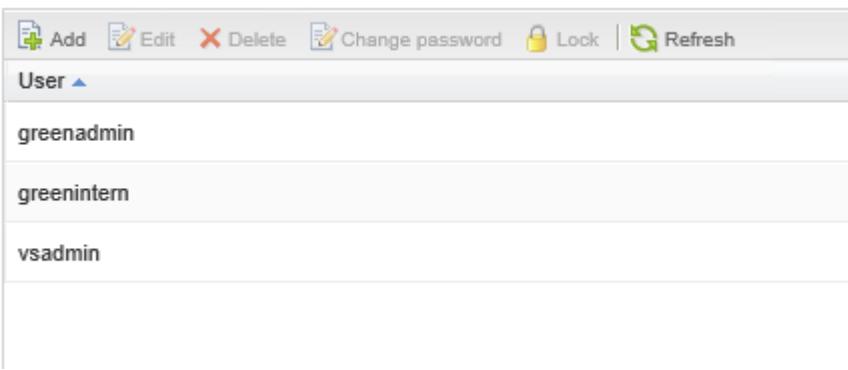
STEP	ACTION
5.	<p>Set the NTP time services to 192.168.0.11, and then click <b>Add</b>.</p> 
6.	Click <b>OK</b> .
7.	Click <b>OK</b> again to confirm.
8.	<p>From the clustershell, verify the date, time, time zone, and synchronization of the time with your Windows machine within 5 minutes:</p> <p><b>date</b> Time synchronization might take several minutes.</p>
9.	<p>Verify the NTP server settings that you set in System Manager: <b>ntp server show</b></p>
10.	Repeat steps 1 through 8 for the rtp-nau cluster.

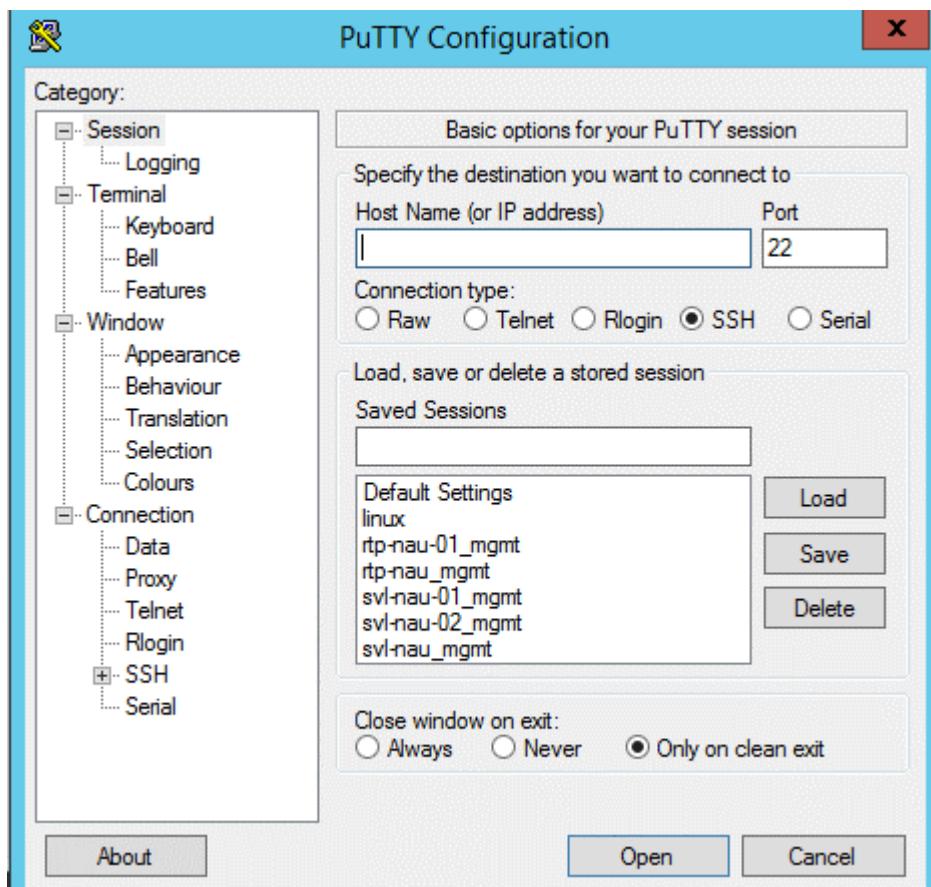
#### TASK 4: CREATE CUSTOM ADMINISTRATORS AND VERIFY ACCESS LEVELS

STEP	ACTION
1.	Log in to System Manager for cluster svl-nau.
2.	<p>On the System Manager menu bar, click <b>Configurations</b>.</p> 
3.	In the left pane, under Cluster User Details, click <b>Roles</b> .

STEP	ACTION																												
4.	<p>Explore the cluster-scoped predefined roles.</p> <p><b>Configurations</b></p>  <table border="1"> <thead> <tr> <th colspan="2">Cluster Settings</th> </tr> </thead> <tbody> <tr><td>Configuration Updates</td><td></td></tr> <tr><td>Service Processor</td><td></td></tr> <tr><td>Cluster Peers</td><td></td></tr> <tr><td>High Availability</td><td></td></tr> <tr><td>Licenses</td><td></td></tr> <tr><td>Cluster Update</td><td></td></tr> <tr><td>Date and Time</td><td></td></tr> <tr><th colspan="2">Services</th></tr> <tr><td>SNMP</td><td></td></tr> <tr><td>LDAP</td><td></td></tr> <tr><th colspan="2">Cluster User Details</th></tr> <tr><td>Users</td><td></td></tr> <tr><th>Roles</th><td></td></tr> </tbody> </table>	Cluster Settings		Configuration Updates		Service Processor		Cluster Peers		High Availability		Licenses		Cluster Update		Date and Time		Services		SNMP		LDAP		Cluster User Details		Users		Roles	
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5.	<p>On the System Manager menu bar, complete the following steps:</p> <ol style="list-style-type: none"> <li>Click <b>SVMs</b>.</li> <li>Select <b>svm_green</b>.</li> </ol> <p><b>SVMs</b></p>  <table border="1"> <thead> <tr> <th>Name</th> <th>State</th> <th>Subtype</th> </tr> </thead> <tbody> <tr> <td>svm_green</td> <td>running</td> <td>default</td> </tr> <tr> <td>svm_red</td> <td>running</td> <td>default</td> </tr> <tr> <td>svm_yellow</td> <td>running</td> <td>default</td> </tr> </tbody> </table>	Name	State	Subtype	svm_green	running	default	svm_red	running	default	svm_yellow	running	default																
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6.	<p>Click <b>SVM Settings</b>.</p>  <p>NetApp OnCommand System Manager</p> <p>SVMs Overview Volumes Namespaces Shares Qtrees Quotas SVM Settings</p> <p>svm_green</p>																												
7.	<p>In the left pane, under SVM User Details, click <b>Roles</b>.</p>																												

STEP	ACTION																								
8.	Examine the SVM-scoped predefined roles.																								
9.	Select an SVM-scoped administrative role, and then scroll through the <b>Role Attributes</b> pane to see the commands that are available to a user who has the role.   <p>The screenshot shows the SVM Settings interface. On the left, there's a sidebar with sections for Protocols (CIFS, NFS), Policies (Export Policies, Efficiency Policies, Protection Policies, Snapshot Policies, QoS Policy Groups), Services (NIS, LDAP Client, LDAP Configuration, Kerberos Realm, Kerberos Interface, DNS/DDNS), SVM User Details (Users, Roles), and Host Users and Groups (UNIX, Windows, Name Mapping). The main pane is titled 'Role' and lists predefined roles: vsadmin, vsadmin-backup, vsadmin-protocol (which is selected and highlighted in blue), vsadmin-readonly, vsadmin-snaplock, and vsadmin-volume. Below this is the 'Role Attributes' pane, which contains a table mapping commands to access levels:</p> <table border="1"> <thead> <tr> <th>Command</th> <th>Query</th> <th>Access Level</th> </tr> </thead> <tbody> <tr> <td>DEFAULT</td> <td></td> <td>none</td> </tr> <tr> <td>df</td> <td></td> <td>readonly</td> </tr> <tr> <td>lun</td> <td></td> <td>all</td> </tr> <tr> <td>network interface</td> <td></td> <td>readonly</td> </tr> <tr> <td>network interface failover-groups</td> <td></td> <td>none</td> </tr> <tr> <td>security certificate</td> <td></td> <td>readonly</td> </tr> <tr> <td>security certificate file</td> <td></td> <td>none</td> </tr> </tbody> </table>	Command	Query	Access Level	DEFAULT		none	df		readonly	lun		all	network interface		readonly	network interface failover-groups		none	security certificate		readonly	security certificate file		none
Command	Query	Access Level																							
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security certificate		readonly																							
security certificate file		none																							
10.	Under SVM User Details, click <b>Users</b> .																								
11.	Click <b>Add</b> to create a user.																								
12.	Complete the following steps: a. Name the user <b>greenadmin</b> . b. Choose a password. c. On the right side of the window, click the <b>Add</b> button.																								

STEP	ACTION
13.	<p>Complete the following steps:</p> <ol style="list-style-type: none"> <li>Select the application <b>ssh</b>.</li> <li>Select the role <b>vsadmin</b>.</li> <li>Click <b>OK</b>.</li> </ol> 
14.	<p>At the bottom of the window, click <b>Add</b> to finish creating the user greenadmin.</p>
15.	<p>Add another user with the following properties:</p> <ul style="list-style-type: none"> <li>▪ User name: <b>greenintern</b></li> <li>▪ Application: <b>ssh</b></li> <li>▪ Role: <b>vsadmin_READONLY</b></li> </ul> 

STEP	ACTION
16.	Use PuTTY to start an SSH session to the svm_green data LIF that is management-enabled (IP address 192.168.0.61), and log in as <b>greenadmin</b> .
	
17.	Examine the command prompt.
18.	Answer the following question: What is different about the command prompt? _____
19.	Display the status of the cluster: <b>cluster show</b> The command fails.
20.	Answer the following question: Why did the command fail? _____
21.	Examine the commands that are available: ?
22.	Display all the available volumes and observe the SVMs that are represented in the output: <b>volume show</b>

STEP	ACTION
23.	Modify a volume:  <code>volume modify -volume green_share_CIFS_volume -comment "modified by greenadmin"</code>
24.	Verify the change:  <code>volume show -volume green_share_CIFS_volume -fields comment</code>
25.	Use PuTTY to start another SSH session to the same data LIF, and log in as <b>greenintern</b> :
26.	Display the network ports:  <code>network port show</code>  The command fails.
27.	Complete the following steps:  a. Display the network interfaces. b. Examine the displayed LIFs. c. Compare the list to a list of displayed LIFs for the cluster admin user:  <code>network interface show</code>
28.	Modify a volume:  <code>volume modify -volume green_share_CIFS_volume -comment "modified by greenintern"</code>  The command fails. Why?
29.	Answer the following question:  Why did the command fail? _____
30.	Close both svm_green administrative PuTTY sessions.

#### TASK 5: AUTHENTICATE A CLUSTER ADMINISTRATOR BY USING ACTIVE DIRECTORY

STEP	ACTION
1.	Start a PuTTY session with cluster svl-nau.
2.	Check the defined cluster administrators:  <code>security login show -vserver svl-nau</code>
3.	Create a cluster user with the authentication type <b>domain</b> :  <code>security login create -vserver svl-nau -user-or-group-name LEARN\Administrator -application ssh -authentication-method domain -role admin</code>
4.	Verify the new domain user:  <code>security login show -vserver svl-nau</code>
5.	Activate a domain tunnel SVM to make the authentication call to the Active Directory server:  <code>security login domain-tunnel create -vserver svm_red</code>

STEP	ACTION
<b>6.</b>	Start another CLI session with svl-nau.
<b>7.</b>	Log in to the cluster with user <b>learn\Administrator</b> and password <b>Netapp123</b> .
<b>8.</b>	Verify the identity of the new user: <b>security login whoami</b>

END OF EXERCISE

## MODULE 4: NETWORK MANAGEMENT

### EXERCISE 1: MANAGING PHYSICAL AND LOGICAL NETWORK RESOURCES

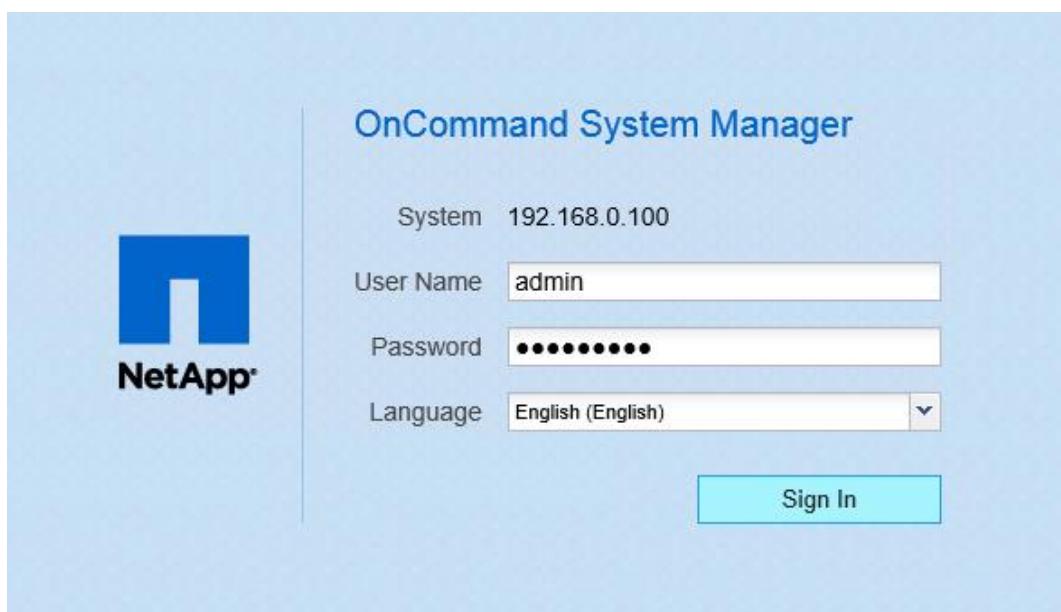
In this exercise, you manage physical and logical network resources, including Ethernet ports, interface groups, and virtual LANs (VLANs).

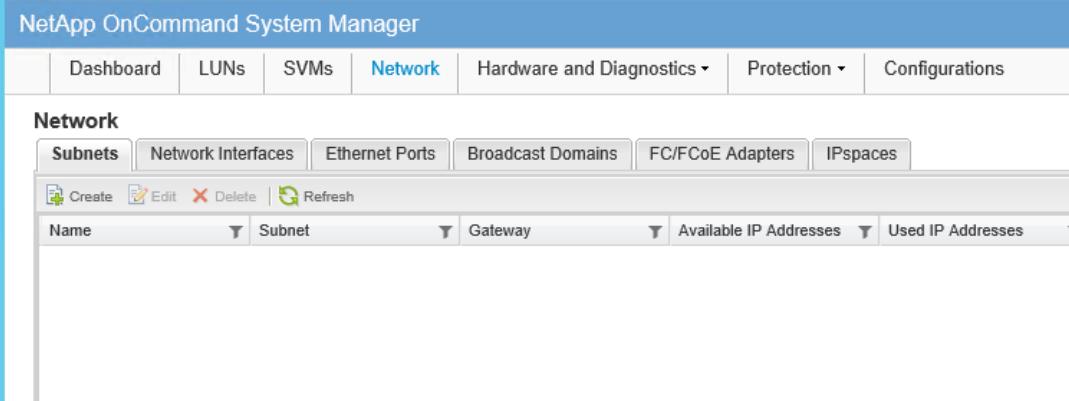
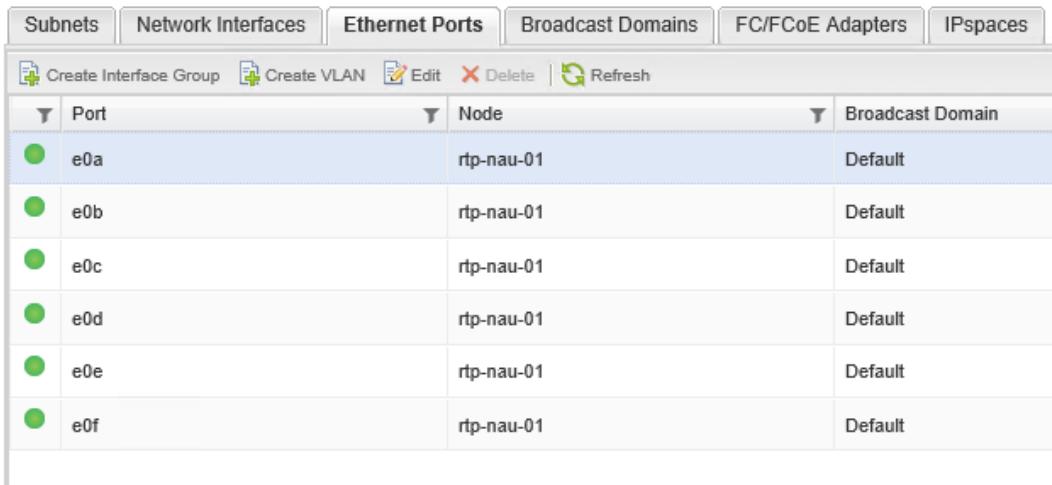
#### OBJECTIVES

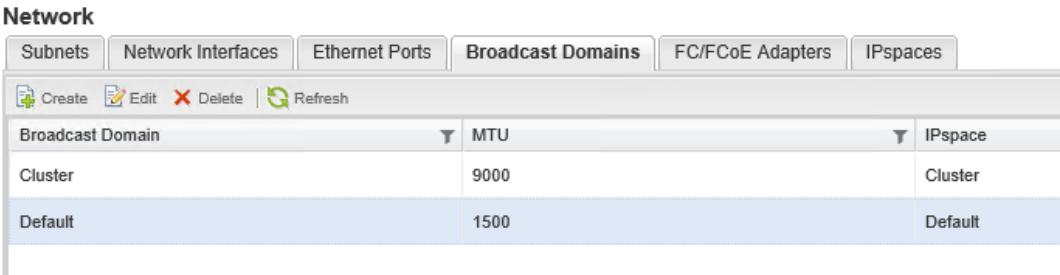
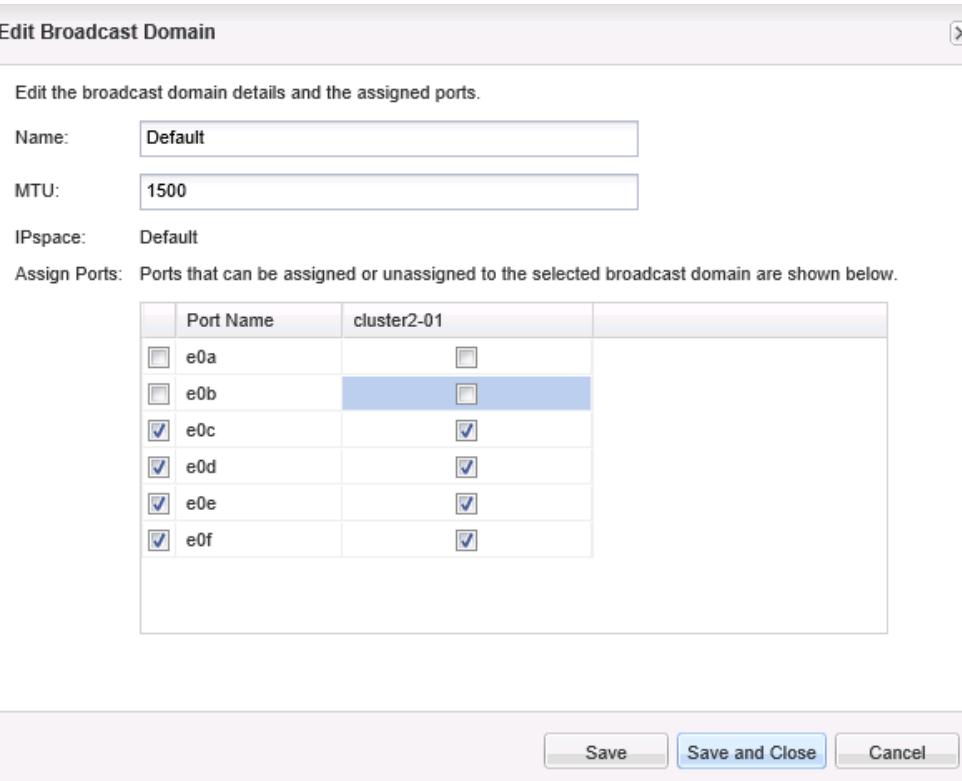
This exercise focuses on enabling you to do the following:

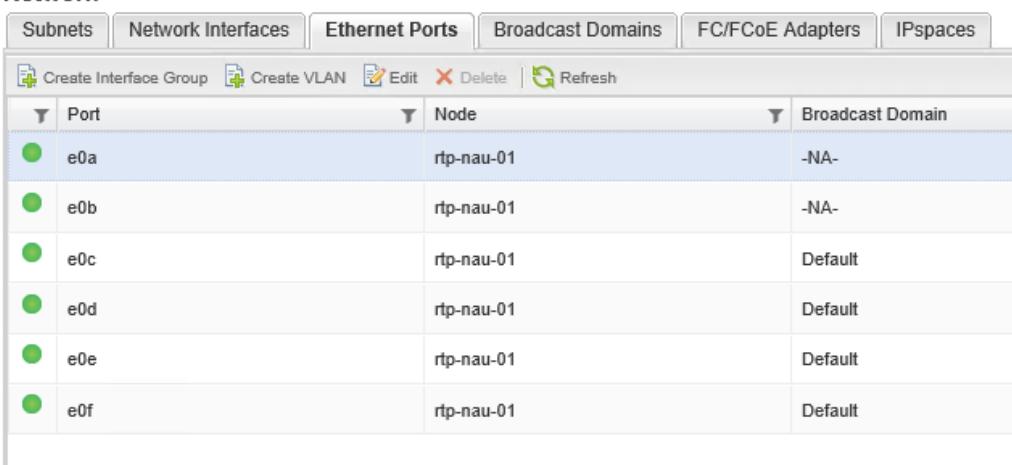
- Create an interface group
- Explore IPspaces, subnets, and broadcast domains
- Create a VLAN

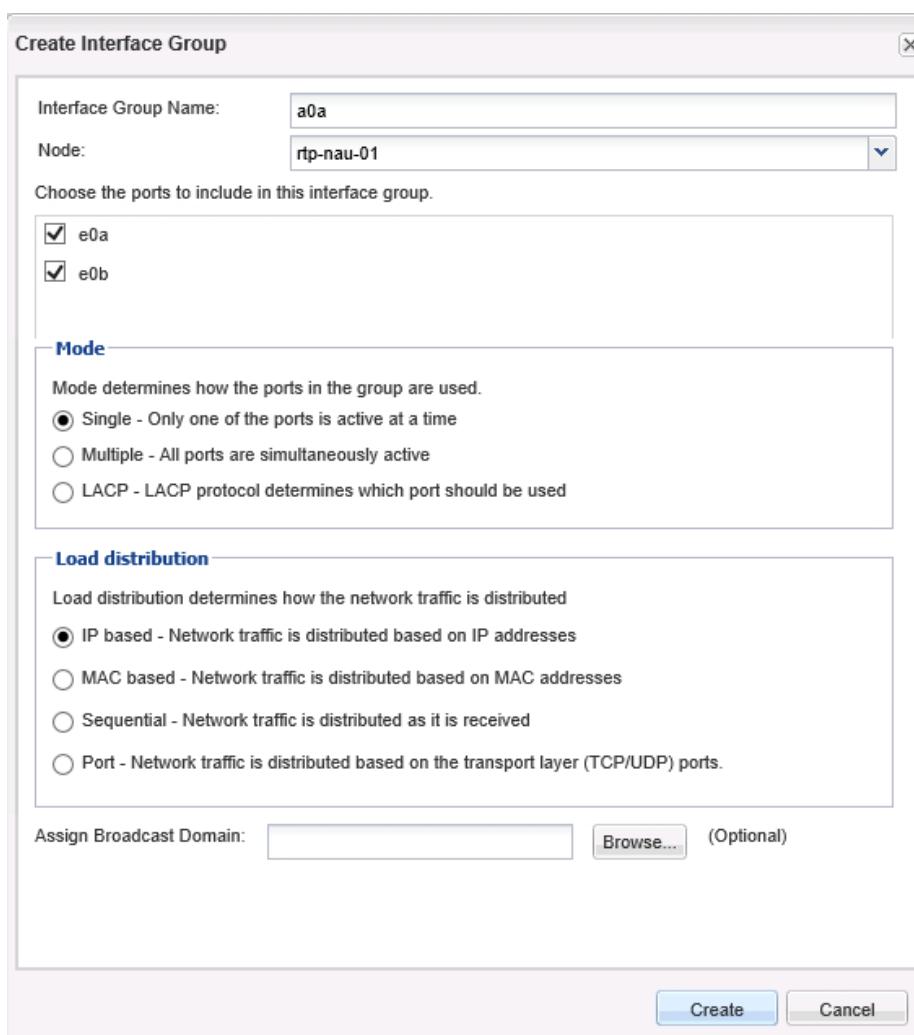
#### TASK 1: CREATE AN INTERFACE GROUP

STEP	ACTION
1.	<p>Log in to NetApp OnCommand System Manager on cluster rtp-nau (192.168.0.100).</p> 

STEP	ACTION
2.	<p>On the System Manager menu bar, select <b>Network</b>.</p> 
3.	<p>Click the <b>Ethernet Ports</b> tab.</p> <p>Notice that all ports belong to the Default broadcast domain.</p> 
4.	 <p>A multinode cluster would also contain ports that are assigned to the cluster broadcast domain.</p>
5.	<p>On the Ethernet Ports tab, click <b>Create Interface Group</b>.</p>
6.	<p>Review the content of the error message that appears.</p> 

STEP	ACTION
7.	<p>Answer the following questions:</p> <ul style="list-style-type: none"> <li>▪ Can you create an interface group? _____</li> <li>▪ Why or why not? _____</li> </ul>
8.	Click <b>Show Details</b> to verify your answers in the previous step.
9.	Click <b>OK</b> , and then click <b>Cancel</b> .
10.	<p>Click the <b>Broadcast Domain</b> tab, and then select the <b>Default</b> broadcast domain.</p> 
11.	Click <b>Edit</b> .
12.	<p>In the list of port names, clear the <b>e0a</b> and <b>e0b</b> checkboxes, and leave the rest of the ports in the broadcast domain.</p> 
13.	Click <b>Save and Close</b> .

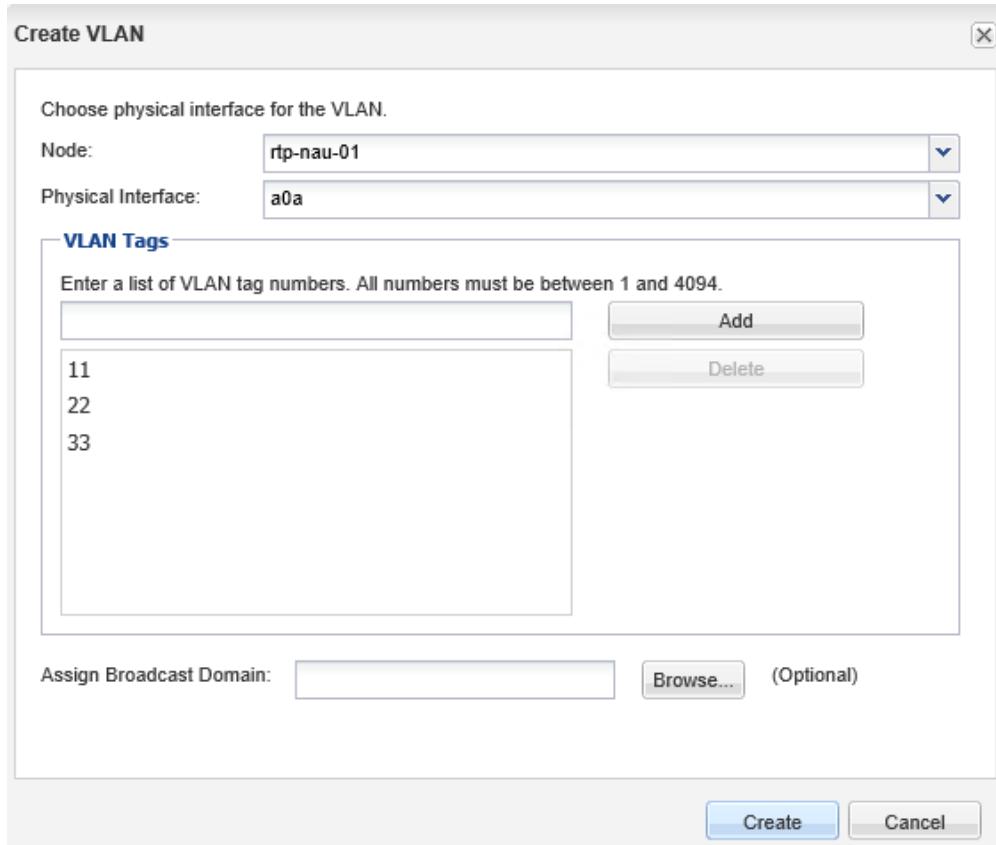
STEP	ACTION																					
14.	<p>Click the <b>Ethernet Ports</b> tab.</p> <p>Notice the broadcast domain that is associated with e0a and e0b.</p>  <table border="1"> <thead> <tr> <th>Port</th> <th>Node</th> <th>Broadcast Domain</th> </tr> </thead> <tbody> <tr> <td>e0a</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>e0b</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>e0c</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0d</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0e</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0f</td> <td>rtp-nau-01</td> <td>Default</td> </tr> </tbody> </table>	Port	Node	Broadcast Domain	e0a	rtp-nau-01	-NA-	e0b	rtp-nau-01	-NA-	e0c	rtp-nau-01	Default	e0d	rtp-nau-01	Default	e0e	rtp-nau-01	Default	e0f	rtp-nau-01	Default
Port	Node	Broadcast Domain																				
e0a	rtp-nau-01	-NA-																				
e0b	rtp-nau-01	-NA-																				
e0c	rtp-nau-01	Default																				
e0d	rtp-nau-01	Default																				
e0e	rtp-nau-01	Default																				
e0f	rtp-nau-01	Default																				
15.	Click <b>Create Interface group</b> .																					

STEP	ACTION
16.	<p>Set the following properties for the interface group:</p> <ul style="list-style-type: none"> <li>▪ <b>Interface Group Name:</b> a0a</li> <li>▪ <b>Node:</b> rtp-nau-01</li> <li>▪ <b>Ports:</b> e0a and e0b</li> <li>▪ <b>Mode:</b> Multiple</li> <li>▪ <b>Load distribution:</b> IP based</li> <li>▪ <b>Assign Broadcast Domain:</b> Leave blank</li> </ul> 
17.	Click <b>Create</b> .

STEP	ACTION																								
18.	<p>Click the <b>Refresh</b> button, and then examine the interface groups in the list of Ethernet ports.</p> <p><b>Network</b></p> <table border="1"> <thead> <tr> <th>Port</th> <th>Node</th> <th>Broadcast Domain</th> </tr> </thead> <tbody> <tr> <td>a0a</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>e0a</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>e0b</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>e0c</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0d</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0e</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0f</td> <td>rtp-nau-01</td> <td>Default</td> </tr> </tbody> </table>	Port	Node	Broadcast Domain	a0a	rtp-nau-01	-NA-	e0a	rtp-nau-01	-NA-	e0b	rtp-nau-01	-NA-	e0c	rtp-nau-01	Default	e0d	rtp-nau-01	Default	e0e	rtp-nau-01	Default	e0f	rtp-nau-01	Default
Port	Node	Broadcast Domain																							
a0a	rtp-nau-01	-NA-																							
e0a	rtp-nau-01	-NA-																							
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e0d	rtp-nau-01	Default																							
e0e	rtp-nau-01	Default																							
e0f	rtp-nau-01	Default																							

## TASK 2: CREATE A VLAN

STEP	ACTION
1.	On the Ethernet Ports tab, click <b>Create VLAN</b> .
2.	Select port <b>a0a</b> on node <b>rtp-nau-01</b> to host the VLAN.

STEP	ACTION
3.	<p>Select a list of VLAN tags to identify each VLAN that is hosted on this port:</p> <ol style="list-style-type: none"> <li>Type <b>11</b>, and then click <b>Add</b>.</li> <li>Type <b>22</b>, and then click <b>Add</b>.</li> <li>Type <b>33</b>, and then click <b>Add</b>.</li> </ol> 
4.	Click <b>Create</b> to create the VLAN.

STEP	ACTION																																	
5.	<p>Click the <b>Refresh</b> button, and then examine your VLANs in the list of Ethernet ports.</p> <p><b>Network</b></p> <table border="1"> <thead> <tr> <th>Port</th> <th>Node</th> <th>Broadcast Domain</th> </tr> </thead> <tbody> <tr> <td>a0a</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>a0a-11</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>a0a-22</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>a0a-33</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>e0a</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>e0b</td> <td>rtp-nau-01</td> <td>-NA-</td> </tr> <tr> <td>e0c</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0d</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0e</td> <td>rtp-nau-01</td> <td>Default</td> </tr> <tr> <td>e0f</td> <td>rtp-nau-01</td> <td>Default</td> </tr> </tbody> </table>	Port	Node	Broadcast Domain	a0a	rtp-nau-01	-NA-	a0a-11	rtp-nau-01	-NA-	a0a-22	rtp-nau-01	-NA-	a0a-33	rtp-nau-01	-NA-	e0a	rtp-nau-01	-NA-	e0b	rtp-nau-01	-NA-	e0c	rtp-nau-01	Default	e0d	rtp-nau-01	Default	e0e	rtp-nau-01	Default	e0f	rtp-nau-01	Default
Port	Node	Broadcast Domain																																
a0a	rtp-nau-01	-NA-																																
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e0f	rtp-nau-01	Default																																

END OF EXERCISE

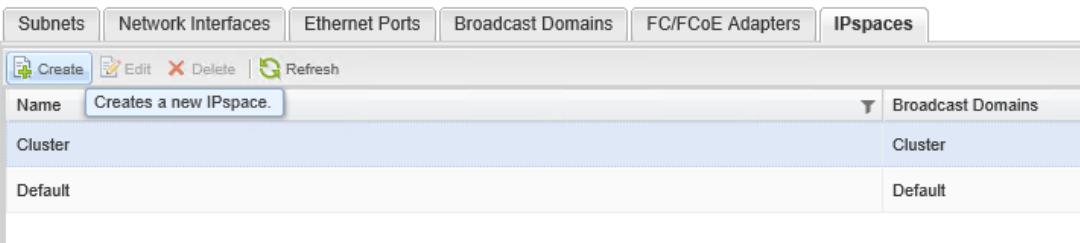
## EXERCISE 2: MANAGING VIRTUAL NETWORK RESOURCES

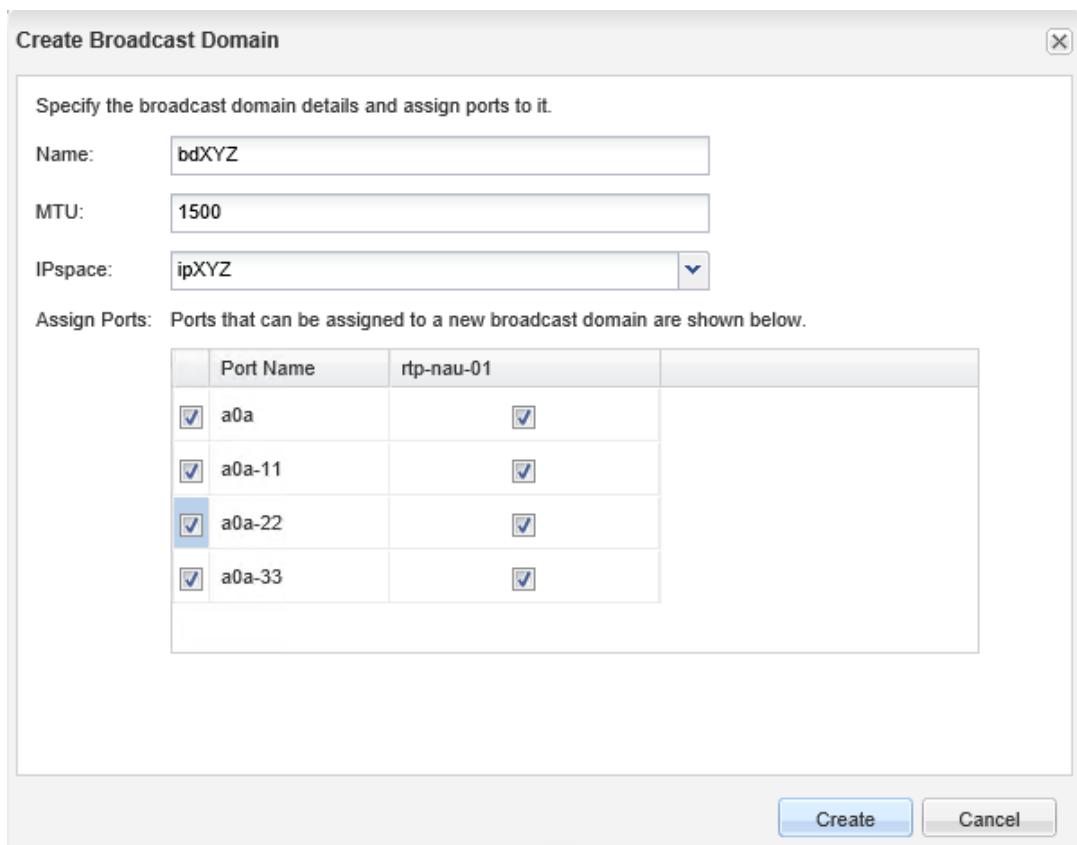
### OBJECTIVES

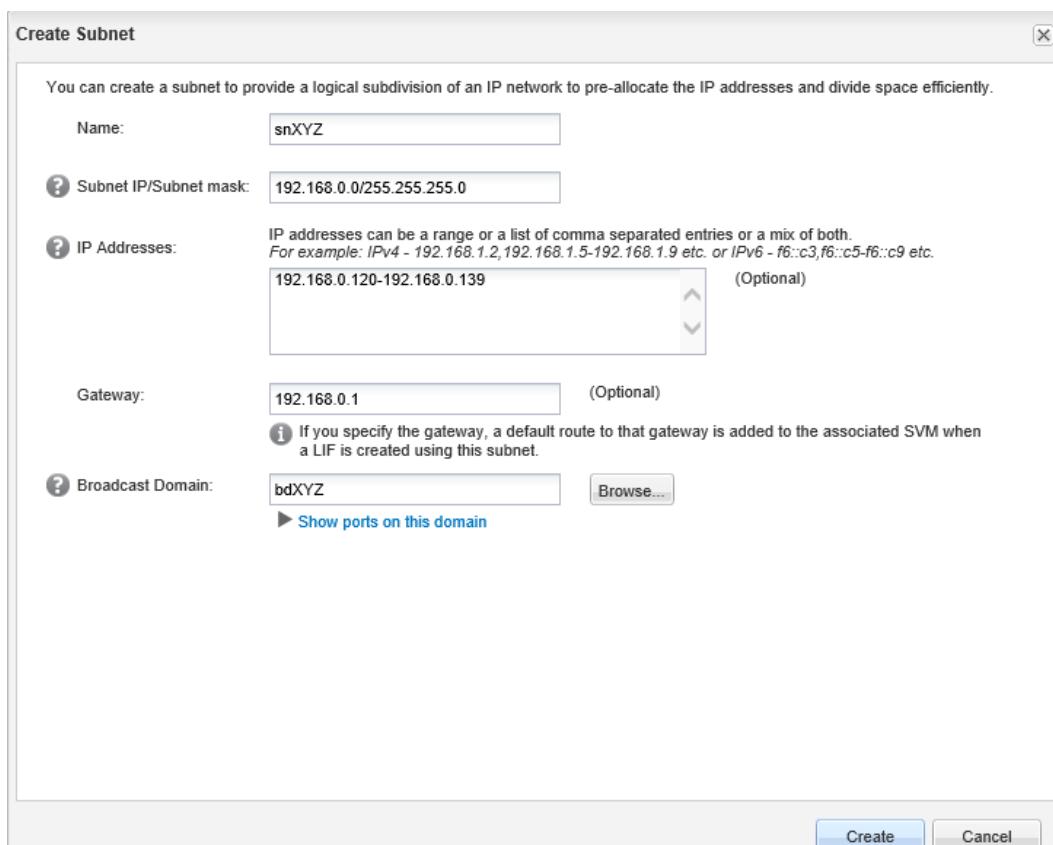
This exercise focuses on enabling you to do the following:

- Create an IPspace, broadcast domain, and subnet
- Explore logical interface (LIF) failover groups
- Create data LIFs

### TASK 1: CREATE A NEW IPSPACE, BROADCAST DOMAIN, AND SUBNET

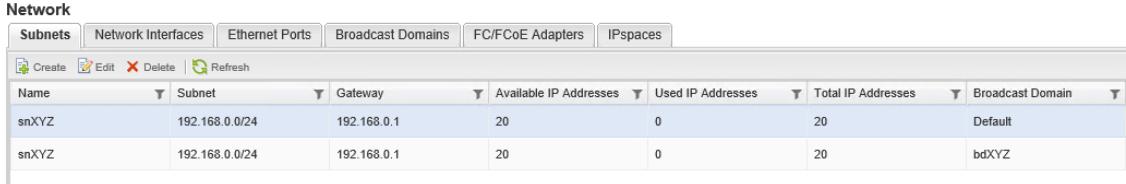
STEP	ACTION
1.	In System Manager on rtp-nau, complete the following steps: <ol style="list-style-type: none"><li>a. On the System Manager menu bar, select <b>Network</b>.</li><li>b. In the Network pane, click the <b>IPspaces</b> tab.</li></ol>
2.	Click <b>Create</b> . 
3.	Name the IPspace <b>ipXYZ</b> . 
4.	Click <b>Create</b> .
5.	Click the <b>Broadcast Domains</b> tab.
6.	Click <b>Create</b> .

STEP	ACTION
7.	<p>Create a broadcast domain that has the following parameters:</p> <ul style="list-style-type: none"> <li>▪ <b>Name:</b> bdXYZ</li> <li>▪ <b>MTU:</b> 1500</li> <li>▪ <b>IPspace:</b> ipXYZ</li> <li>▪ <b>Assign Ports:</b> Select all checkboxes</li> </ul> 
8.	Click the <b>Subnets</b> tab.
9.	Click <b>Create</b> .

STEP	ACTION
10.	<p>Set the following parameters to create the subnet:</p> <ul style="list-style-type: none"> <li>▪ <b>Name:</b> snXYZ</li> <li>▪ <b>Subnet IP/Subnet Mask:</b> 192.168.0.0/255.255.255.0</li> <li>▪ <b>IP Addresses:</b> 192.168.0.120-192.168.0.139</li> <li>▪ <b>Gateway:</b> 192.168.0.1</li> <li>▪ <b>Broadcast Domain:</b> bdXYZ</li> </ul> 

## TASK 2: CREATE A SUBNET FOR THE DEFAULT IPSPACE

STEP	ACTION
1.	On the Subnets tab, click <b>Create</b> .
2.	<p>Set the following parameters to create the subnet:</p> <ul style="list-style-type: none"> <li>▪ <b>Name:</b> snDefault</li> <li>▪ <b>Subnet IP/Subnet Mask:</b> 192.168.0.0/255.255.255.0</li> <li>▪ <b>IP Addresses:</b> 192.168.0.120-192.168.0.139</li> <li>▪ <b>Gateway:</b> 192.168.0.1</li> <li>▪ <b>Broadcast Domain:</b> Default</li> </ul>

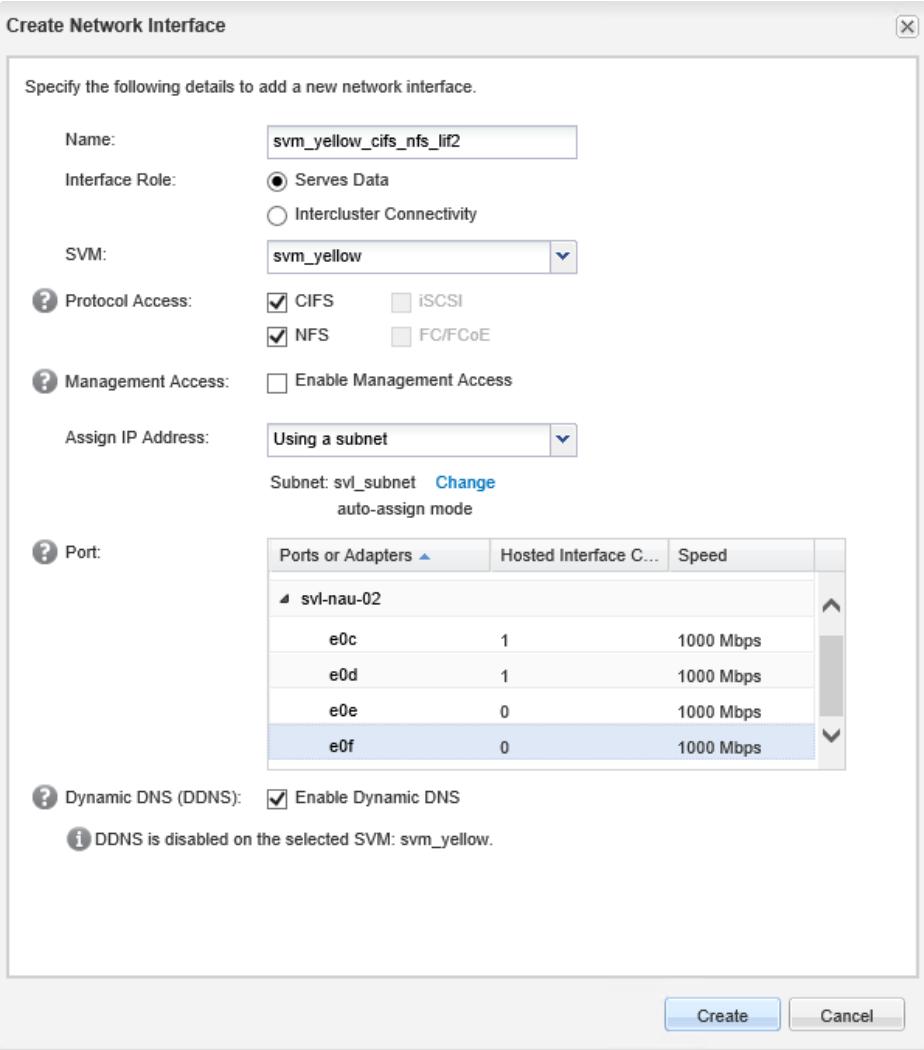
STEP	ACTION																					
3.	<p>Examine the subnets that you created.</p>  <table border="1"> <thead> <tr> <th>Name</th> <th>Subnet</th> <th>Gateway</th> <th>Available IP Addresses</th> <th>Used IP Addresses</th> <th>Total IP Addresses</th> <th>Broadcast Domain</th> </tr> </thead> <tbody> <tr> <td>snXYZ</td> <td>192.168.0.0/24</td> <td>192.168.0.1</td> <td>20</td> <td>0</td> <td>20</td> <td>Default</td> </tr> <tr> <td>snXYZ</td> <td>192.168.0.0/24</td> <td>192.168.0.1</td> <td>20</td> <td>0</td> <td>20</td> <td>bdXYZ</td> </tr> </tbody> </table>	Name	Subnet	Gateway	Available IP Addresses	Used IP Addresses	Total IP Addresses	Broadcast Domain	snXYZ	192.168.0.0/24	192.168.0.1	20	0	20	Default	snXYZ	192.168.0.0/24	192.168.0.1	20	0	20	bdXYZ
Name	Subnet	Gateway	Available IP Addresses	Used IP Addresses	Total IP Addresses	Broadcast Domain																
snXYZ	192.168.0.0/24	192.168.0.1	20	0	20	Default																
snXYZ	192.168.0.0/24	192.168.0.1	20	0	20	bdXYZ																
4.	<p>Answer the following questions:</p> <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
1.	Use PuTTY to log in to svl-nau.
2.	 <p>Be sure to log in to the correct cluster.</p>
3.	<p>Display information about broadcast domains:</p> <pre>network port broadcast-domain show</pre>
4.	<p>Examine the failover groups and the ports that are included in each group.  Notice that the groups and ports align with the broadcast domains that are defined in the cluster.</p>
5.	<p>Display the failover policies of the LIFs on the cluster:</p> <pre>net int show -fields failover-policy</pre>
6.	<p>Answer the following questions:</p> <ul style="list-style-type: none"> <li>▪ Which policy is assigned to node management LIFs? _____</li> <li>▪ Why? _____</li> </ul>
7.	 <p>Failover policies are assigned to LIFs by default, depending on the role of each LIF role.</p>
8.	<p>Examine the list of available failover policies:</p> <pre>net int show -failover-policy ?</pre>
9.	 <p>In the next task, you will create NAS data LIFs with data storage virtual machines (SVMs). Which failover policy do you expect to be assigned to a NAS data LIF?</p>

#### TASK 4: CREATE DATA LIFs

STEP	ACTION
1.	Open System Manager on svl-nau.
2.	 Be sure to log in to the correct cluster.
3.	On the System Manager menu bar, select <b>Network</b> .
4.	In the Network pane, click <b>Network Interfaces</b> .
5.	Notice that the cluster contains three data LIFs, one for each SVM.
6.	 Best practice suggests that at least one data LIF should exist per protocol per node. (CIFS and NFS can share data LIFs.)
7.	Click <b>Create</b> .

STEP	ACTION
8.	<p>Create a data LIF for CIFS and NFS on svm_yellow, using the following parameters:</p> <ul style="list-style-type: none"> <li>▪ <b>Name:</b> svm_yellow_cifs_nfs_lif2</li> <li>▪ <b>Interface Role:</b> Serves Data</li> <li>▪ <b>SVM:</b> svm_yellow</li> <li>▪ <b>Protocol Access:</b> CIFS, NFS</li> <li>▪ <b>Assign IP Address:</b> Using a subnet</li> <li>▪ <b>Subnet:</b> svl_subnet</li> <li>▪ <b>Autoselect address:</b> selected</li> <li>▪ <b>Port:</b> svl-nau-02:e0f</li> </ul> 
9.	Use PuTTY to log in to svl-nau.
10.	<p>Create a NAS data LIF for svm_green:</p> <pre>net int create -vserver svm_green -lif svm_green_cifs_nfs_lif2 -role data -data-protocol cifs,nfs -home-node svl-nau-01 -home-port e0d -subnet-name svl_subnet</pre>
11.	<p>Display the data LIFs for svm_green:</p> <pre>net int show -vserver svm_green</pre>

STEP	ACTION
12.	Use the command in step 8 to create a CIFS data LIF for svm_red.
13.	 Be sure to put the LIF on the correct node.

END OF EXERCISE

## MODULE 5: PHYSICAL STORAGE

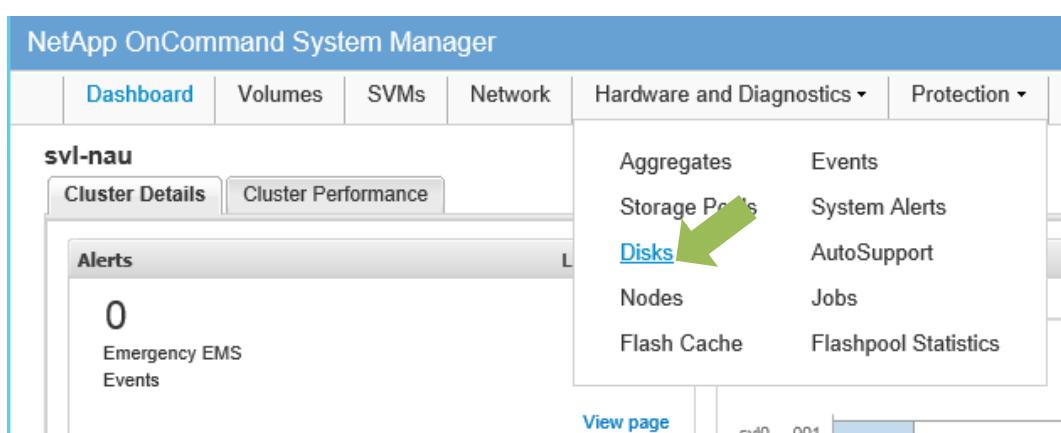
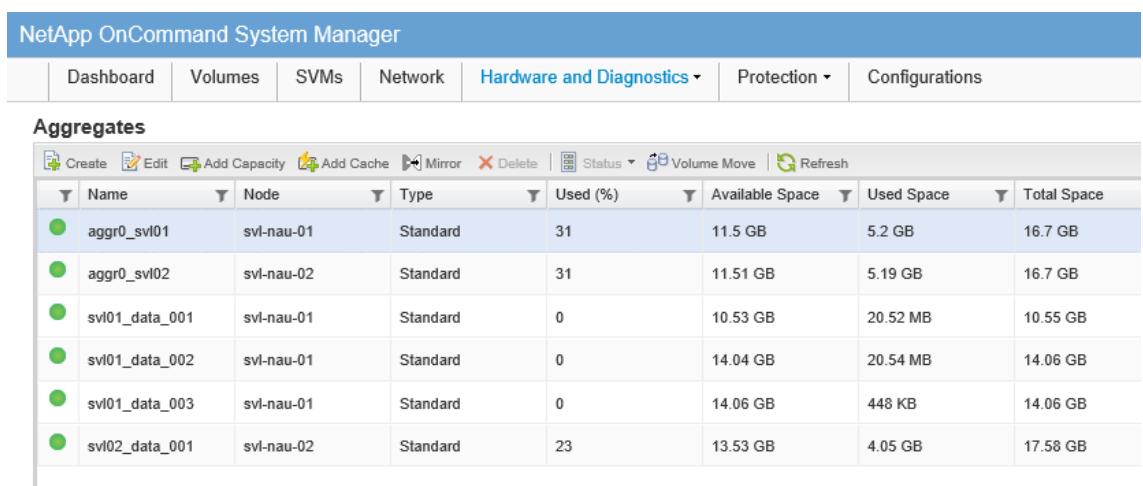
### EXERCISE 1: MANAGING PHYSICAL STORAGE

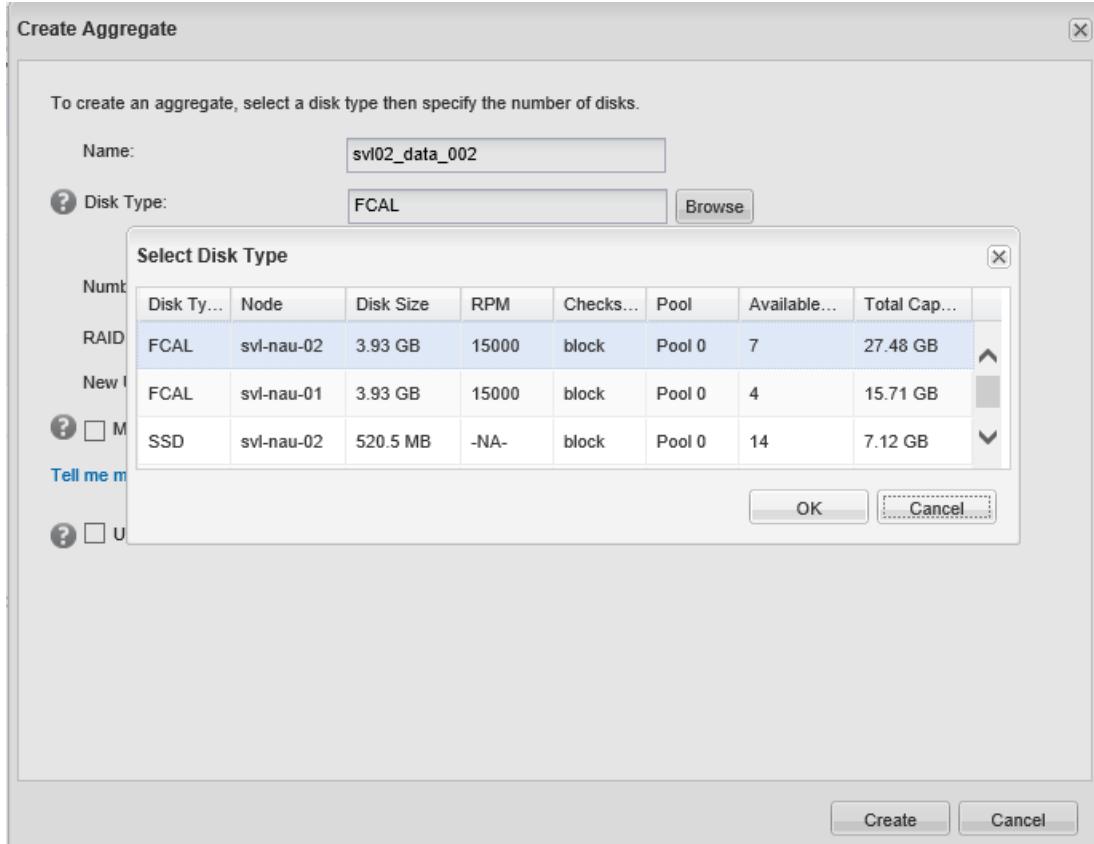
In this exercise, you manage the physical storage resources of a cluster.

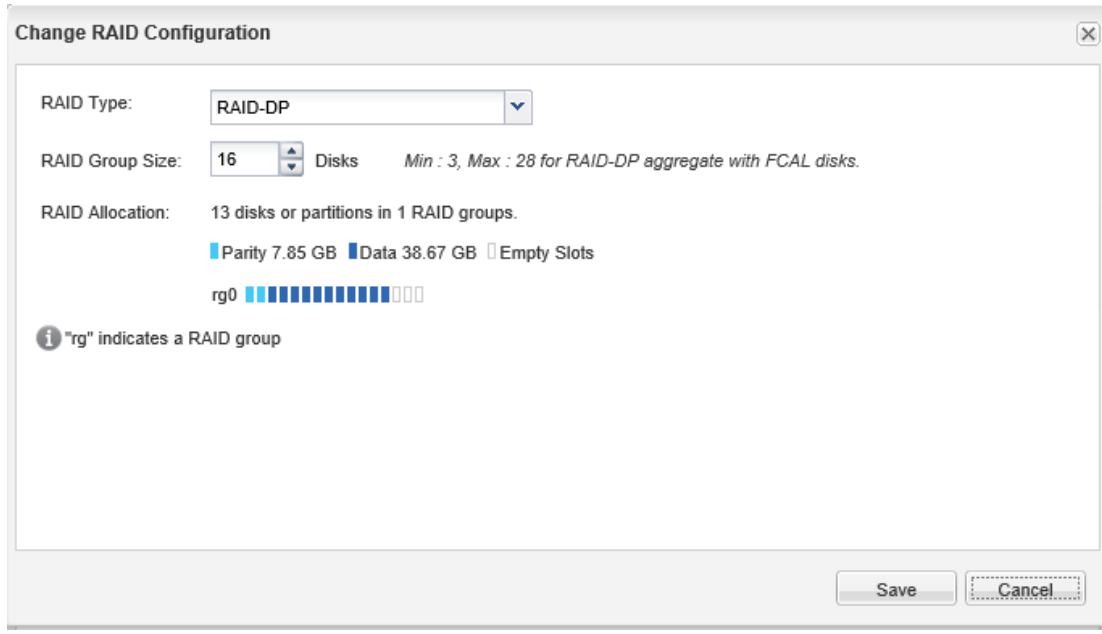
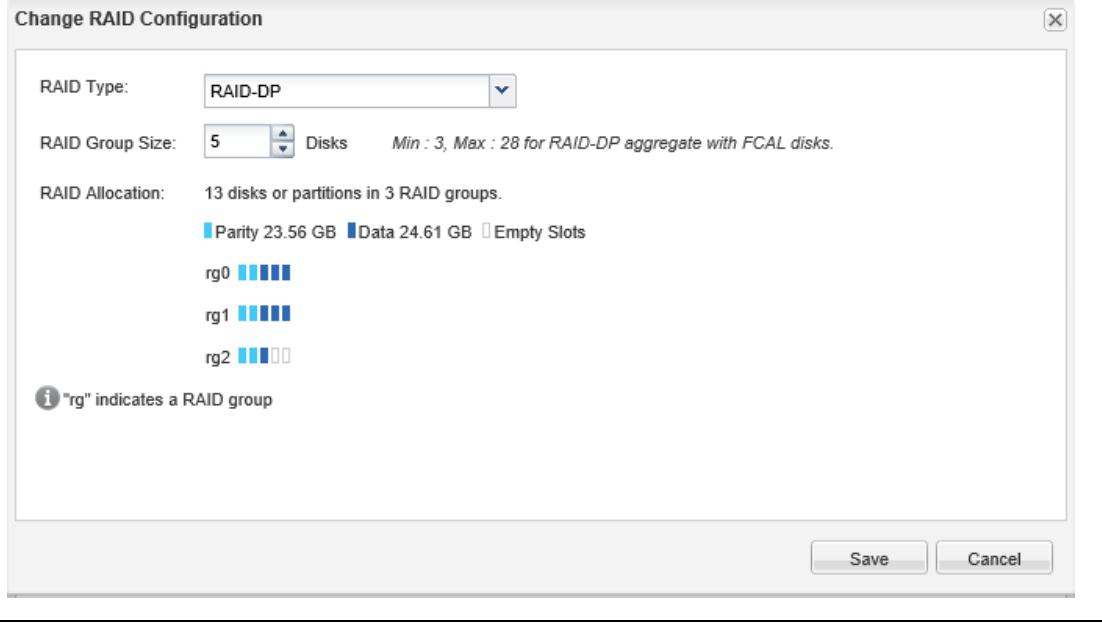
#### OBJECTIVES

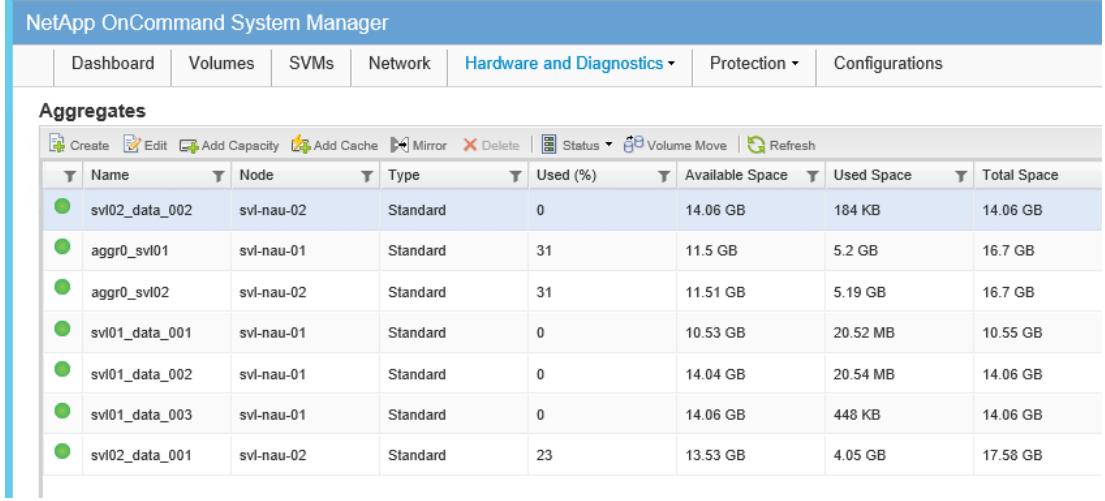
This exercise focuses on enabling you to create and expand a data aggregate.

#### TASK 1: CREATE AN AGGREGATE

STEP	ACTION																																																	
1.	<p>In NetApp OnCommand System Manager on svl-nau, complete the following steps:</p> <ol style="list-style-type: none"><li>On the menu bar, select <b>Hardware and Diagnostics</b>.</li><li>Select <b>Disks</b>.</li></ol>  <p>The screenshot shows the NetApp OnCommand System Manager interface. The top navigation bar has tabs for Dashboard, Volumes, SVMs, Network, Hardware and Diagnostics (which is currently selected), Protection, and Configurations. Below the navigation bar is a cluster summary section for 'svl-nau' with tabs for Cluster Details and Cluster Performance. Underneath is an Alerts section showing 0 Emergency EMS Events. To the right is a sidebar with links: Aggregates, Storage Pools, Nodes, Events, System Alerts, AutoSupport, Jobs, Flash Cache, and Flashpool Statistics. A green arrow points to the 'Disks' link in the sidebar.</p>																																																	
2.	<p>At the bottom of the Summary page, examine the number of spare disks of each type that each node owns.</p>																																																	
3.	<p>In System Manager on svl-nau, on the menu bar, select <b>Hardware and Diagnostics</b>, and then select <b>Aggregates</b>.</p> <p>You can see aggr0 for each node in your cluster, in addition to data aggregates that were created on the cluster.</p>  <p>The screenshot shows the Aggregates list in NetApp OnCommand System Manager. The top navigation bar includes a 'Create' button and other options like Edit, Add Capacity, Add Cache, Mirror, Delete, Status, Volume Move, and Refresh. The main table lists six aggregates: aggr0_svl01, aggr0_svl02, svl01_data_001, svl01_data_002, svl01_data_003, and svl02_data_001. Each row provides details such as Name, Node, Type, Used (%), Available Space, Used Space, and Total Space.</p> <table border="1"><thead><tr><th>Name</th><th>Node</th><th>Type</th><th>Used (%)</th><th>Available Space</th><th>Used Space</th><th>Total Space</th></tr></thead><tbody><tr><td>aggr0_svl01</td><td>svl-nau-01</td><td>Standard</td><td>31</td><td>11.5 GB</td><td>5.2 GB</td><td>16.7 GB</td></tr><tr><td>aggr0_svl02</td><td>svl-nau-02</td><td>Standard</td><td>31</td><td>11.51 GB</td><td>5.19 GB</td><td>16.7 GB</td></tr><tr><td>svl01_data_001</td><td>svl-nau-01</td><td>Standard</td><td>0</td><td>10.53 GB</td><td>20.52 MB</td><td>10.55 GB</td></tr><tr><td>svl01_data_002</td><td>svl-nau-01</td><td>Standard</td><td>0</td><td>14.04 GB</td><td>20.54 MB</td><td>14.06 GB</td></tr><tr><td>svl01_data_003</td><td>svl-nau-01</td><td>Standard</td><td>0</td><td>14.06 GB</td><td>448 KB</td><td>14.06 GB</td></tr><tr><td>svl02_data_001</td><td>svl-nau-02</td><td>Standard</td><td>23</td><td>13.53 GB</td><td>4.05 GB</td><td>17.58 GB</td></tr></tbody></table>	Name	Node	Type	Used (%)	Available Space	Used Space	Total Space	aggr0_svl01	svl-nau-01	Standard	31	11.5 GB	5.2 GB	16.7 GB	aggr0_svl02	svl-nau-02	Standard	31	11.51 GB	5.19 GB	16.7 GB	svl01_data_001	svl-nau-01	Standard	0	10.53 GB	20.52 MB	10.55 GB	svl01_data_002	svl-nau-01	Standard	0	14.04 GB	20.54 MB	14.06 GB	svl01_data_003	svl-nau-01	Standard	0	14.06 GB	448 KB	14.06 GB	svl02_data_001	svl-nau-02	Standard	23	13.53 GB	4.05 GB	17.58 GB
Name	Node	Type	Used (%)	Available Space	Used Space	Total Space																																												
aggr0_svl01	svl-nau-01	Standard	31	11.5 GB	5.2 GB	16.7 GB																																												
aggr0_svl02	svl-nau-02	Standard	31	11.51 GB	5.19 GB	16.7 GB																																												
svl01_data_001	svl-nau-01	Standard	0	10.53 GB	20.52 MB	10.55 GB																																												
svl01_data_002	svl-nau-01	Standard	0	14.04 GB	20.54 MB	14.06 GB																																												
svl01_data_003	svl-nau-01	Standard	0	14.06 GB	448 KB	14.06 GB																																												
svl02_data_001	svl-nau-02	Standard	23	13.53 GB	4.05 GB	17.58 GB																																												

STEP	ACTION																																
4.	On the Aggregates toolbar, click <b>Create</b> . The Create Aggregate Wizard appears.																																
5.	In the Name field, type <b>svl02_data_002</b> .																																
6.	Complete the following steps: a. Click <b>Browse</b> . b. In the Select Disk Type windows, select <b>FCAL</b> on node svl-nau-02, and then click <b>OK</b> .																																
	 <table border="1"> <thead> <tr> <th>Disk Ty...</th> <th>Node</th> <th>Disk Size</th> <th>RPM</th> <th>Checks...</th> <th>Pool</th> <th>Available...</th> <th>Total Cap...</th> </tr> </thead> <tbody> <tr> <td>FCAL</td> <td>svl-nau-02</td> <td>3.93 GB</td> <td>15000</td> <td>block</td> <td>Pool 0</td> <td>7</td> <td>27.48 GB</td> </tr> <tr> <td>FCAL</td> <td>svl-nau-01</td> <td>3.93 GB</td> <td>15000</td> <td>block</td> <td>Pool 0</td> <td>4</td> <td>15.71 GB</td> </tr> <tr> <td>SSD</td> <td>svl-nau-02</td> <td>520.5 MB</td> <td>-NA-</td> <td>block</td> <td>Pool 0</td> <td>14</td> <td>7.12 GB</td> </tr> </tbody> </table>	Disk Ty...	Node	Disk Size	RPM	Checks...	Pool	Available...	Total Cap...	FCAL	svl-nau-02	3.93 GB	15000	block	Pool 0	7	27.48 GB	FCAL	svl-nau-01	3.93 GB	15000	block	Pool 0	4	15.71 GB	SSD	svl-nau-02	520.5 MB	-NA-	block	Pool 0	14	7.12 GB
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SSD	svl-nau-02	520.5 MB	-NA-	block	Pool 0	14	7.12 GB																										
7.	Leave the Number of Disks value at 13.																																

STEP	ACTION
8.	To the right of the Add Disk To selection, click <b>Change</b> . Notice the RAID allocation.  
9.	Answer the following question: In a real-world environment, would the specified allocation be an efficient use of disks? _____
10.	Click the up and down arrows to adjust the RAID Group Size value to <b>5</b> . Observe the effect on how the disks are distributed in the RAID groups and how many parity disks are used.  
11.	Change the RAID Group Size value to <b>16</b> .

STEP	ACTION																																																								
12.	In the RAID Type list, select <b>RAID-TEC</b> . Notice the new default RAID Group Size value.																																																								
13.	Experiment with various RAID Group Size values and view the effects of your changes.																																																								
14.	Return the RAID Group Size value to <b>24</b> , and leave the RAID Type value as RAID-TEC.																																																								
15.	Click <b>Save</b> .																																																								
16.	Select seven disks for the new aggregate, and then click <b>Create</b>																																																								
17.	 Choose <i>only</i> the suggested number of disks (seven). Disks are limited, and if you use too many disks, you might run out before you complete the course.																																																								
18.	Examine the new aggregate.  <p>The screenshot shows the NetApp OnCommand System Manager interface under the Hardware and Diagnostics tab. The 'Aggregates' section displays a table with the following data:</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Node</th> <th>Type</th> <th>Used (%)</th> <th>Available Space</th> <th>Used Space</th> <th>Total Space</th> </tr> </thead> <tbody> <tr> <td>svl02_data_002</td> <td>svl-nau-02</td> <td>Standard</td> <td>0</td> <td>14.06 GB</td> <td>184 KB</td> <td>14.06 GB</td> </tr> <tr> <td>aggr0_svl01</td> <td>svl-nau-01</td> <td>Standard</td> <td>31</td> <td>11.5 GB</td> <td>5.2 GB</td> <td>16.7 GB</td> </tr> <tr> <td>aggr0_svl02</td> <td>svl-nau-02</td> <td>Standard</td> <td>31</td> <td>11.51 GB</td> <td>5.19 GB</td> <td>16.7 GB</td> </tr> <tr> <td>svl01_data_001</td> <td>svl-nau-01</td> <td>Standard</td> <td>0</td> <td>10.53 GB</td> <td>20.52 MB</td> <td>10.55 GB</td> </tr> <tr> <td>svl01_data_002</td> <td>svl-nau-01</td> <td>Standard</td> <td>0</td> <td>14.04 GB</td> <td>20.54 MB</td> <td>14.06 GB</td> </tr> <tr> <td>svl01_data_003</td> <td>svl-nau-01</td> <td>Standard</td> <td>0</td> <td>14.06 GB</td> <td>448 KB</td> <td>14.06 GB</td> </tr> <tr> <td>svl02_data_001</td> <td>svl-nau-02</td> <td>Standard</td> <td>23</td> <td>13.53 GB</td> <td>4.05 GB</td> <td>17.58 GB</td> </tr> </tbody> </table>	Name	Node	Type	Used (%)	Available Space	Used Space	Total Space	svl02_data_002	svl-nau-02	Standard	0	14.06 GB	184 KB	14.06 GB	aggr0_svl01	svl-nau-01	Standard	31	11.5 GB	5.2 GB	16.7 GB	aggr0_svl02	svl-nau-02	Standard	31	11.51 GB	5.19 GB	16.7 GB	svl01_data_001	svl-nau-01	Standard	0	10.53 GB	20.52 MB	10.55 GB	svl01_data_002	svl-nau-01	Standard	0	14.04 GB	20.54 MB	14.06 GB	svl01_data_003	svl-nau-01	Standard	0	14.06 GB	448 KB	14.06 GB	svl02_data_001	svl-nau-02	Standard	23	13.53 GB	4.05 GB	17.58 GB
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svl02_data_001	svl-nau-02	Standard	23	13.53 GB	4.05 GB	17.58 GB																																																			

## TASK 2: EXPAND AN AGGREGATE

STEP	ACTION
1.	From the aggregates list on svl-nau, select <b>svl01_data_001</b> .
2.	Notice the number of disks in the aggregate.
3.	On the Aggregates toolbar, click <b>Add Capacity</b> .

STEP	ACTION										
4.	<p>Expand the aggregate by two disks, and then click <b>Add</b>.</p> <p>Review the existing disks of the aggregate and select disks to add to the aggregate.</p> <p>Aggregate Name: svl01_data_001</p> <p>Node: svl-nau-01</p> <p>Existing Usable Capacity: 10.55 GB</p> <p>Existing Disks or Partitions:</p> <table border="1"> <thead> <tr> <th>Disk Type</th> <th>Node</th> <th>Disk Size</th> <th>RPM</th> <th>Checksum</th> </tr> </thead> <tbody> <tr> <td>FCAL</td> <td>svl-nau-01</td> <td>3.93 GB</td> <td>15000</td> <td>block</td> </tr> </tbody> </table> <p>Disk Type to Add: FCAL <input type="button" value="Browse"/></p> <p>3.93 GB disks from node: svl-nau-01</p> <p>Number of Disks: 2 <small>Max: 3 (excluding hot spares: 1)</small></p> <p>Add Disks To: All RAID groups <input type="button" value="Change"/></p> <p>New Usable Capacity: 17.58 GB (Estimated)</p>	Disk Type	Node	Disk Size	RPM	Checksum	FCAL	svl-nau-01	3.93 GB	15000	block
Disk Type	Node	Disk Size	RPM	Checksum							
FCAL	svl-nau-01	3.93 GB	15000	block							
5.	Click <b>OK</b> .										
6.	Click the <b>Refresh</b> button to monitor progress and verify that the disks are added to the disk count.										

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 focuses on enabling you to do the following:

- Verify a degraded RAID-TEC aggregate
- Create a flash pool

### TASK 1: VERIFY THE OPERABILITY OF A DEGRADED RAID-TEC AGGREGATE

STEP	ACTION
1.	Start a PuTTY session with cluster svl-nau.
2.	<p>Verify that your RAID-TEC aggregate is in a normal state (your list of disks might be different):</p> <pre>storage aggregate show-status -aggregate svl02_data_002</pre> <p>Sample output:</p> <pre>Owner Node: svl-nau-02  Aggregate: svl02_data_002 (online, raid_tec) (block checksums) Plex: /svl02_data_002/plex0 (online, normal, active, pool0) RAID Group /svl02_data_002/plex0/rg0 (normal, block checksums)            Usable Physical Position Disk           Pool Type    RPM     Size     Size Status ----- ----- ----- ----- ----- ----- ----- tparity   NET-1.48        0  FCAL  15000  3.93GB  3.93GB (normal) dparity   NET-1.36        0  FCAL  15000  3.93GB  3.93GB (normal) parity    NET-1.50        0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.37        0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.51        0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.38        0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.52        0  FCAL  15000  3.93GB  3.93GB (normal)  7 entries were displayed.</pre>
3.	<p>Fail one of the disks that is used for the aggregate:</p> <pre>storage disk fail -disk NET-1.37 -immediate true</pre>
4.	<p>When prompted, type <b>y</b>:</p> <pre>Warning: The system will not prefail the disk and its contents will not be copied to a replacement disk before being failed out. Do you want to fail out the disk immediately? {y n}: y</pre>

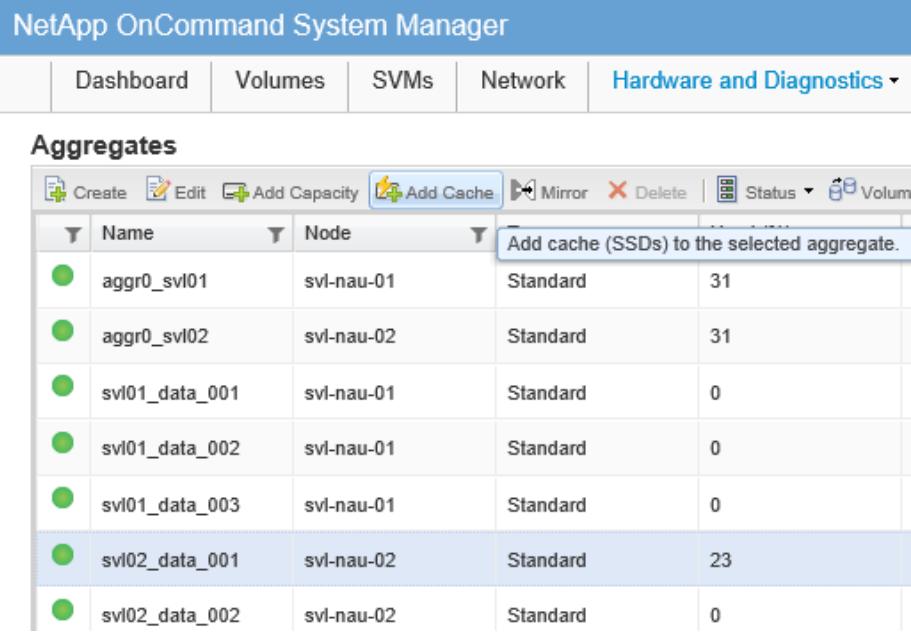
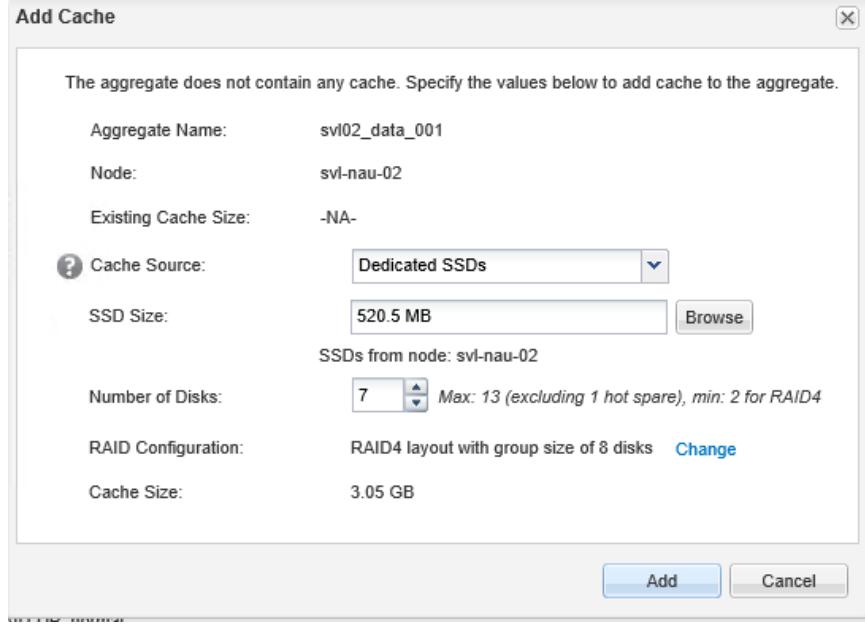
STEP	ACTION
5.	<p>Verify that the failed disk has been replaced, the new disk is reconstructing the contents of the failed disk, and the aggregate is still in a normal state:</p> <pre><b>storage aggregate show-status -aggregate svl02_data_002</b></pre> <p>Sample output:</p> <pre>Owner Node: svl-nau-02  Aggregate: svl02_data_002 (online, raid_tec, reconstruct) (block checksums) Plex: /svl02_data_002/plex0 (online, normal, active, pool0) RAID Group /svl02_data_002/plex0/rg0 (reconstruction 1% completed, block checksums)  Usable Physical Position Disk Pool Type RPM Size Size Status ----- ----- tparity NET-1.48 0 FCAL 15000 3.93GB 3.93GB (normal) dparity NET-1.36 0 FCAL 15000 3.93GB 3.93GB (normal) parity NET-1.50 0 FCAL 15000 3.93GB 3.93GB (normal) data NET-1.39 0 FCAL 15000 3.93GB 3.93GB (reconstruction 1% completed) data NET-1.51 0 FCAL 15000 3.93GB 3.93GB (normal) data NET-1.38 0 FCAL 15000 3.93GB 3.93GB (normal) data NET-1.52 0 FCAL 15000 3.93GB 3.93GB (normal)  7 entries were displayed.</pre>
6.	<p>Enter the following command to fail a second disk that is used for the aggregate:</p> <pre><b>storage disk fail -disk NET-1.51 -immediate true</b></pre>
7.	<p>When prompted, type <b>y</b>:</p> <pre>Warning: The system will not prefail the disk and its contents will not be copied to a replacement disk before being failed out. Do you want to fail out the disk immediately? {y n}: <b>y</b></pre>

STEP	ACTION
8.	<p>Verify that the failed disk has been replaced and that the aggregate is still in a normal state:</p> <pre><b>storage aggregate show-status -aggregate svl02_data_002</b></pre> <p>Sample output:</p> <pre>Owner Node: svl-nau-02  Aggregate: svl02_data_002 (online, raid_tec, reconstruct) (block checksums) Plex: /svl02_data_002/plex0 (online, normal, active, pool0)  RAID Group /svl02_data_002/plex0/rg0 (double reconstruction 7% completed, block checksums)        Usable Physical Position Disk          Pool Type    RPM     Size     Size Status ----- -----  -----  -----  -----  ----- tparity   NET-1.48        0  FCAL  15000  3.93GB  3.93GB (normal) dparity   NET-1.36        0  FCAL  15000  3.93GB  3.93GB (normal) parity    NET-1.50        0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.39        0  FCAL  15000  3.93GB  3.93GB (reconstruction 12% completed) data      NET-1.53        0  FCAL  15000  3.93GB  3.93GB (reconstruction 2% completed) data      NET-1.38        0  FCAL  15000  3.93GB  3.93GB (normal) data      NET-1.52        0  FCAL  15000  3.93GB  3.93GB (normal)  7 entries were displayed.</pre>
9.	<p>Fail a third disk that is used for the aggregate:</p> <pre><b>storage disk fail -disk NET-1.38 -immediate true</b></pre>
10.	<p>When prompted, type <b>y</b>:</p> <pre>Warning: The system will not prefail the disk and its contents will not be copied to a replacement disk before being failed out. Do you want to fail out the disk immediately? {y n}: <b>y</b></pre>

STEP	ACTION
11.	<p>Verify that failed the disk has been replaced and that the RAID group is now in a triple reconstruction state because of the three failed disk rebuilds:</p> <pre>storage aggregate show-status -aggregate svl02_data_002</pre> <p>Sample output:</p> <pre>Owner Node: svl-nau-02  Aggregate: svl02_data_002 (online, raid_tec, reconstruct) (block checksums)   Plex: /svl02_data_002/plex0 (online, normal, active, pool0)     RAID Group /svl02_data_002/plex0/rg0 (triple reconstruction 11% completed, block     checksums)        Usable Physical       Position Disk          Pool Type   RPM     Size    Size Status       ----- -----       tparity   NET-1.48        0  FCAL   15000  3.93GB  3.93GB (normal)       dparity   NET-1.36        0  FCAL   15000  3.93GB  3.93GB (normal)       parity    NET-1.50        0  FCAL   15000  3.93GB  3.93GB (normal)       data      NET-1.39        0  FCAL   15000  3.93GB  3.93GB       (reconstruction 22% completed)       data      NET-1.53        0  FCAL   15000  3.93GB  3.93GB       (reconstruction 12% completed)       data      NET-1.40        0  FCAL   15000  3.93GB  3.93GB       (reconstruction 0% completed)       data      NET-1.52        0  FCAL   15000  3.93GB  3.93GB (normal)  7 entries were displayed.</pre>
12.	<p>Answer the following question:</p> <p>What happens if you try to fail data disk NET-1.52?</p> <hr/>

## TASK 2: CONVERT AN AGGREGATE TO A FLASH POOL

STEP	ACTION
1.	<p>In System Manager for svl-nau, complete the following steps:</p> <ol style="list-style-type: none"> <li>On the menu bar, select <b>Hardware and Diagnostics</b>.</li> <li>Select <b>Aggregates</b>.</li> </ol>

STEP	ACTION
2.	<p>Select aggregate <b>svl02_data_001</b>, and then click <b>Add Cache</b>.</p> 
3.	In the Cache Source list, select <b>Dedicated SSDs</b> .
4.	Adjust the Number of Disks value to <b>7</b> .
5.	<p>Click <b>Add</b>.</p> 
6.	Click <b>Refresh</b> to monitor the creation of the storage pool.
7.	Verify that the value in the Type column for svl02_data_001 changes to Flash Pool.

#### END OF EXERCISE

## MODULE 6: LOGICAL STORAGE

### EXERCISE 1: MANAGING DATA VOLUMES AND SNAPSHOT COPIES

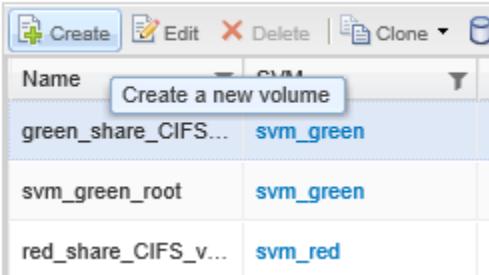
In this exercise, you manage logical storage resources.

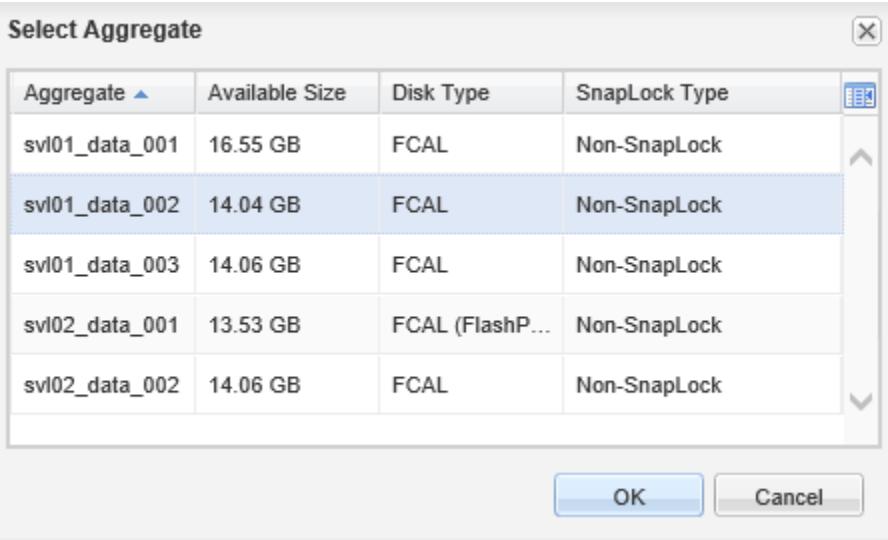
#### OBJECTIVES

This exercise focuses on enabling you to do the following:

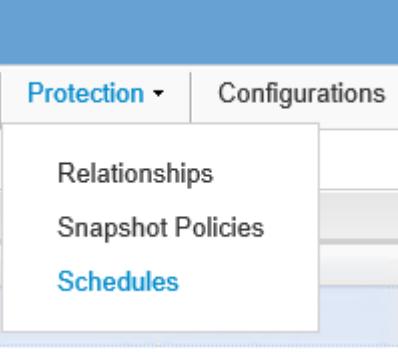
- Create a data FlexVol volume
- Manage Snapshot copies

#### TASK 1: CREATE FLEXIBLE VOLUMES

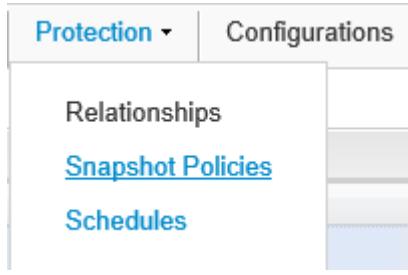
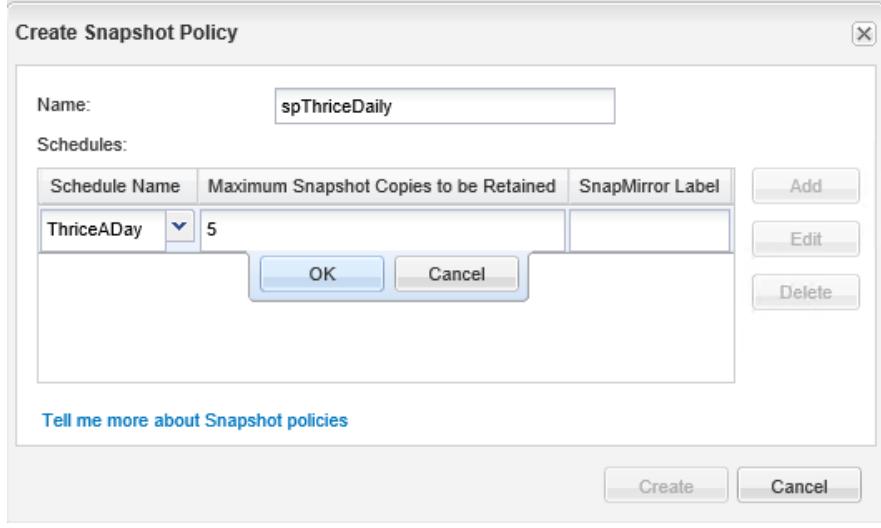
STEP	ACTION
1.	Return to your clustershell session with svl-nau.
2.	In storage virtual machine (SVM) yellow on the aggregate svl01_data_002, create a volume: <pre>volume create -vserver svm_yellow -volume yellow_usr_001 -aggregate svl01_data_001 -size 1gb -junction-path /usr001</pre>
3.	 A FlexVol volume is a virtual storage resource that a single SVM owns.
4.	View the volumes: <pre>vol show</pre>
5.	View the details of the new volume: <pre>vol show -vserver svm_yellow -volume yellow_usr_001</pre>
6.	Return to NetApp OnCommand System Manager on svl-nau.
7.	On the System Manager menu bar, select <b>Volumes</b> .
8.	On the Volumes toolbar, click <b>Create</b> . 
9.	Select <b>svm_yellow</b> .
10.	Change the volume name to <b>yellow_usr_002</b> .

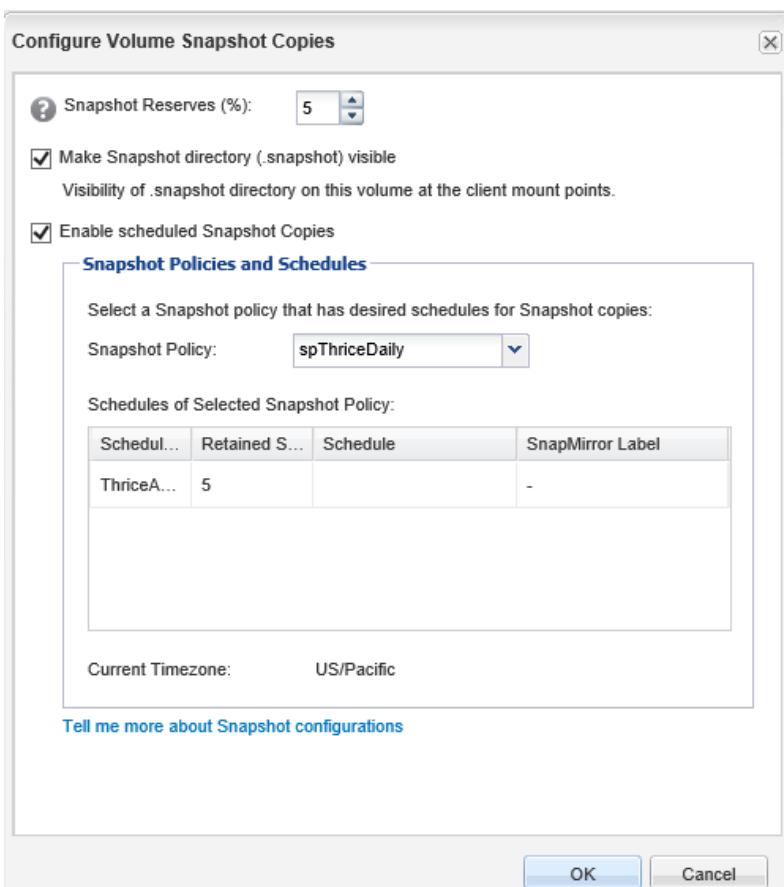
STEP	ACTION
11.	Select <b>aggregate svl01_data_002</b> .
	
12.	Leave the other parameters at the defaults.
13.	Click <b>Create</b> .
14.	Verify the successful creation of yellow_usr_002.

## TASK 2: MANAGE SNAPSHOT COPIES

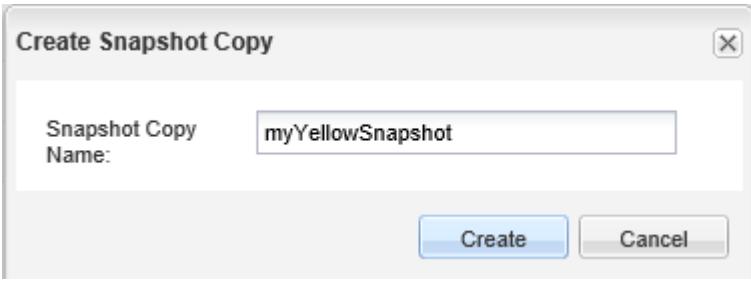
STEP	ACTION
1.	Return to the System Manager session on <b>svl-nau</b> .
2.	On the System Manager menu bar, complete the following steps: a. Select <b>Protection</b> . b. Select <b>Schedules</b> . 

STEP	ACTION
3.	<p>Examine the default schedules.</p> <p><b>Schedules</b></p>
4.	Click <b>Create</b> .
5.	Name the schedule <b>ThriceADay</b> .
6.	Select the <b>Interval</b> option.
7.	Select the <b>Run Every</b> checkbox, and then select <b>8 hours</b> .
8.	Click <b>Create</b> .
9.	Verify that the schedule was created successfully.

STEP	ACTION
10.	<p>On the System Manager menu bar, complete the following steps:</p> <ol style="list-style-type: none"> <li>Select <b>Protection</b>.</li> <li>Select <b>Snapshot Policies</b>.</li> </ol> 
11.	Click <b>Create</b> .
12.	Name the policy <b>spThriceDaily</b> .
13.	Click <b>Add</b> .
14.	<p>In the Create Snapshot Policy window, complete the following steps:</p> <ol style="list-style-type: none"> <li>Select the <b>ThriceADay</b> schedule.</li> <li>In the Maximum Snapshot Copies to be Retained field, specify <b>5</b>.</li> <li>Leave the SnapMirror Label field blank.</li> </ol> 
15.	Click <b>OK</b> .
16.	Click <b>Create</b> .
17.	Verify that the policy was created successfully and is enabled.
18.	In System Manager, navigate to the <code>exp_yellow_NFS_volume</code> .
19.	On the System Manager menu bar, select <b>Volumes</b> .

STEP	ACTION
20.	<p>On the Volumes toolbar, select <b>Snapshot Copies</b>, and then click <b>Configure</b>.</p> 
21.	In the Configure Volume Snapshot Copies window, verify that the “Make Snapshot directory (snapshot) visible” checkbox is selected.
22.	<p>From the Snapshot Policy list, select <b>spThriceDaily</b>.</p> 
23.	Click <b>OK</b> .
24.	At the bottom of the Volumes list, click the <b>Snapshot Copies</b> tab, and then examine the list of Snapshot copies.

### TASK 3: RESTORE A FILE FROM A SNAPSHOT COPY

STEP	ACTION
1.	From the svl-nau clustershell session, enter the following command:  <code>vol modify -volume exp_yellow_NFS_volume -vserver svm_yellow -policy default -unix-permissions 777</code>
2.	 Export policies are discussed in another module.
3.	From PuTTY, log in to your Linux machine: <ul style="list-style-type: none"><li>▪ User name: <b>root</b></li><li>▪ Password: <b>Netapp123</b></li></ul>
4.	Create directory /mnt/yellow:  <code>mkdir /mnt/yellow</code>
5.	Mount volume exp_yellow_NFS_volume to your Linux machine:  <code>mount 192.168.0.62:/exp_yellow_NFS_volume /mnt/yellow</code>
6.	 NFS mounts are discussed in more detail in another module.
7.	Create two files on exp_yellow_NFS_volume:  <code>touch /mnt/yellow/file1 /mnt/yellow/file2</code>
8.	Return to the System Manager session on svl-nau.
9.	In the Volumes list, select <b>exp_yellow_NFS_volume</b> .
10.	On the Volumes toolbar, click <b>Snapshot Copies</b> , and then select <b>Create</b> .  
11.	Name the Snapshot copy <b>myYellowSnapshot</b> .  

STEP	ACTION
12.	Click <b>Create</b> .
13.	Return to the Linux session.
14.	Navigate to the /mnt/yellow directory, and then delete file1:  <pre>cd /mnt/yellow rm file1</pre>
15.	List all the files in this directory, including hidden files and directories:  <pre>ls -la</pre>
16.	Explore the hidden .snapshot directory: <pre>ls .snapshot</pre>
17.	Check the contents of myYellowSnapshot:  <pre>ls .snapshot/myYellowSnapshot</pre>
18.	Restore file1 to the root of exp_yellow_NFS_volume:  <pre>cp .snapshot/myYellowSnapshot/file1 /mnt/yellow/</pre>
19.	Verify that the file was successfully restored:  <pre>ls /mnt/yellow/</pre>

END OF EXERCISE

## EXERCISE 2: MANAGING FLEXVOL VOLUMES

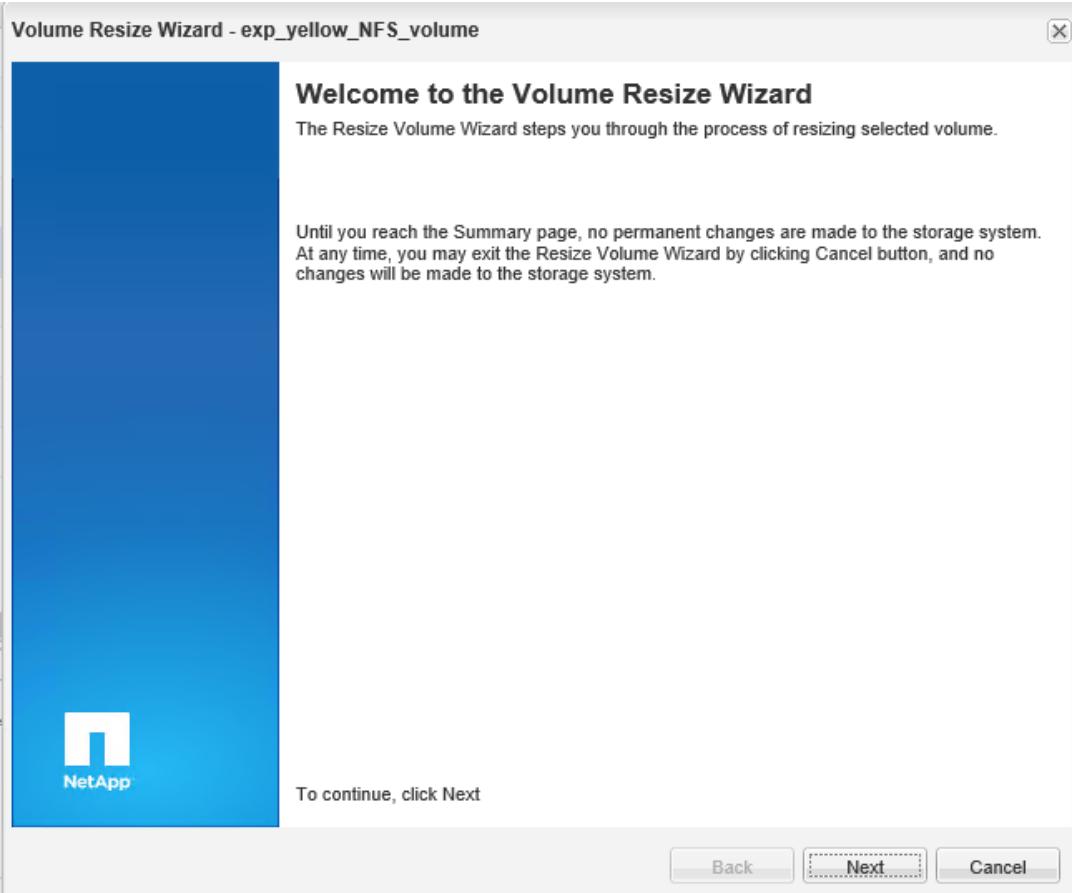
Manage logical storage size and location.

### OBJECTIVES

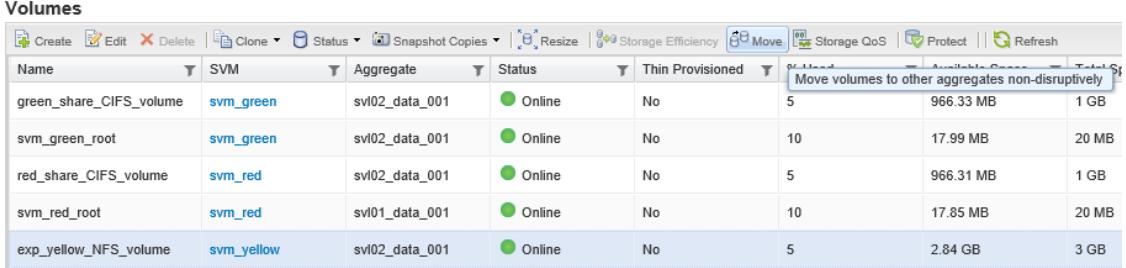
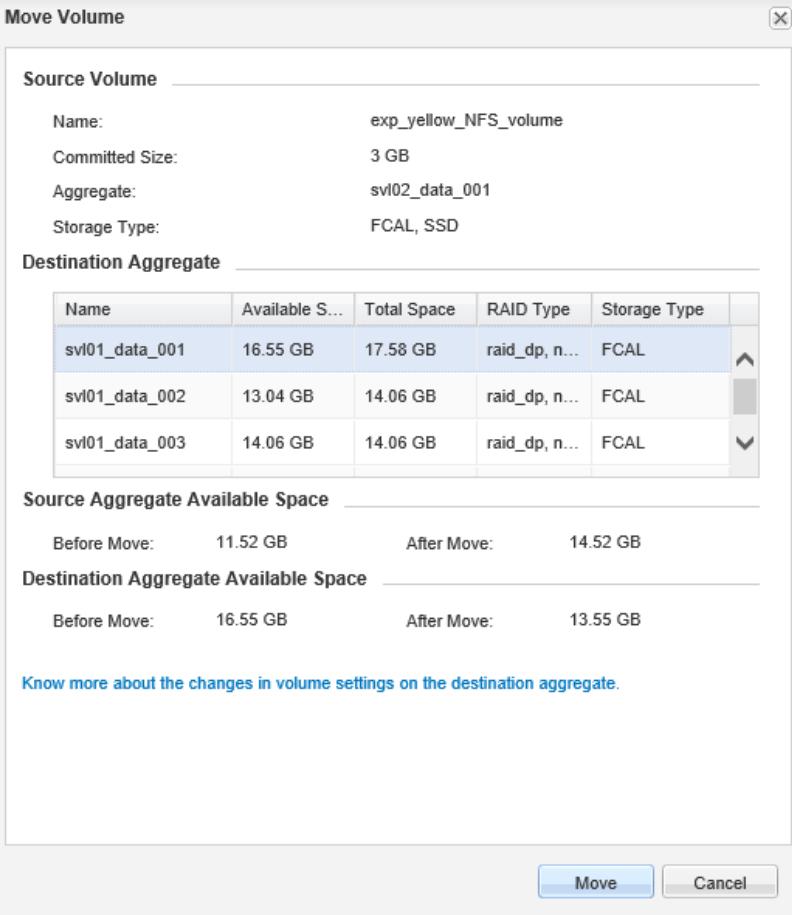
This exercise focuses on enabling you to do the following:

- Expand a volume
- Perform a volume move operation

### TASK 1: EXPAND A VOLUME AND PERFORM A VOLUME MOVE

STEP	ACTION
1.	In System Manager on syl-nau, navigate to the list of aggregates on the cluster, and then notice the amount of space that is available on each aggregate.
2.	 Your capacity can vary depending on how your lab kit is configured.
3.	Navigate to the list of Volumes on the cluster.
4.	Select volume <b>exp_yellow_NFS_volume</b> .
5.	On the Volumes toolbar, click <b>Resize</b> .
6.	Wait for the Volume Resize Wizard to open. 

STEP	ACTION
7.	Click <b>Next</b> .
8.	Set Total Capacity to <b>3 GB</b> .  
9.	Click <b>Next</b> .
10.	On the Snapshot Copies page, click <b>Next</b> .
11.	On the Summary page, click <b>Next</b> .
12.	Confirm the success message, and then click <b>Finish</b> .
13.	Verify that the new capacity of the volume is 3 GB.
14.	Use PuTTY to log in to the Linux machine: <ul style="list-style-type: none"> <li>▪ User name: <b>root</b></li> <li>▪ Password: <b>Netapp123</b></li> </ul>
15.	Linux is an NFS client and is already mounted to <code>exp_yellow_NFS_volume</code> as <code>/mnt/yellow</code> .
16.	On Linux, change to the <code>exp_yellow_NFS_volume</code> : <code>cd /mnt/yellow/exp_yellow_NFS_volume</code>

STEP	ACTION
17.	<p>Write a 2-GB file into volume <code>exp_yellow_NFS_volume</code>:</p> <pre>dd if=/dev/zero of=hugefile bs=4K count=500000</pre> <p>The operation can take several minutes; continue to the next step while the operation runs.</p>
18.	<p>In the <code>svm1</code> volume list in System Manager, select <code>exp_yellow_NFS_volume</code>, and then click the <b>Move</b> button to move the volume to another aggregate across the cluster interconnect.</p> 
19.	 <p>Moving the volume while the file “hugefile” is being written does not interrupt the write operation.</p>
20.	<p>In the Destination Aggregate section, select <code>svl01_data_001</code>, and then click the <b>Move</b> button.</p> 
21.	<p>Click <b>Move</b> again to confirm.</p>

STEP	ACTION																								
22.	Click <b>OK</b> to acknowledge the job in progress.																								
23.	Use the Volume Move Details tab and the refresh button to monitor the progress of the move operation.																								
24.	Check the Linux system to verify the progress and eventual completion of the write operation.																								
25.	When the move is complete, verify that the volume now resides on svl01_data_001.  <table border="1"> <thead> <tr> <th>Name</th> <th>SVM</th> <th>Aggregate</th> <th>Status</th> </tr> </thead> <tbody> <tr> <td>green_share_CIFS_volume</td> <td>svm_green</td> <td>svl02_data_001</td> <td>Online</td> </tr> <tr> <td>svm_green_root</td> <td>svm_green</td> <td>svl02_data_001</td> <td>Online</td> </tr> <tr> <td>red_share_CIFS_volume</td> <td>svm_red</td> <td>svl02_data_001</td> <td>Online</td> </tr> <tr> <td>svm_red_root</td> <td>svm_red</td> <td>svl01_data_001</td> <td>Online</td> </tr> <tr> <td>exp_yellow_NFS_volume</td> <td>svm_yellow</td> <td>svl01_data_001</td> <td>Online</td> </tr> </tbody> </table>	Name	SVM	Aggregate	Status	green_share_CIFS_volume	svm_green	svl02_data_001	Online	svm_green_root	svm_green	svl02_data_001	Online	red_share_CIFS_volume	svm_red	svl02_data_001	Online	svm_red_root	svm_red	svl01_data_001	Online	exp_yellow_NFS_volume	svm_yellow	svl01_data_001	Online
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exp_yellow_NFS_volume	svm_yellow	svl01_data_001	Online																						

END OF EXERCISE

## MODULE 7: STORAGE EFFICIENCY

### EXERCISE 1: MANAGING STORAGE EFFICIENCY

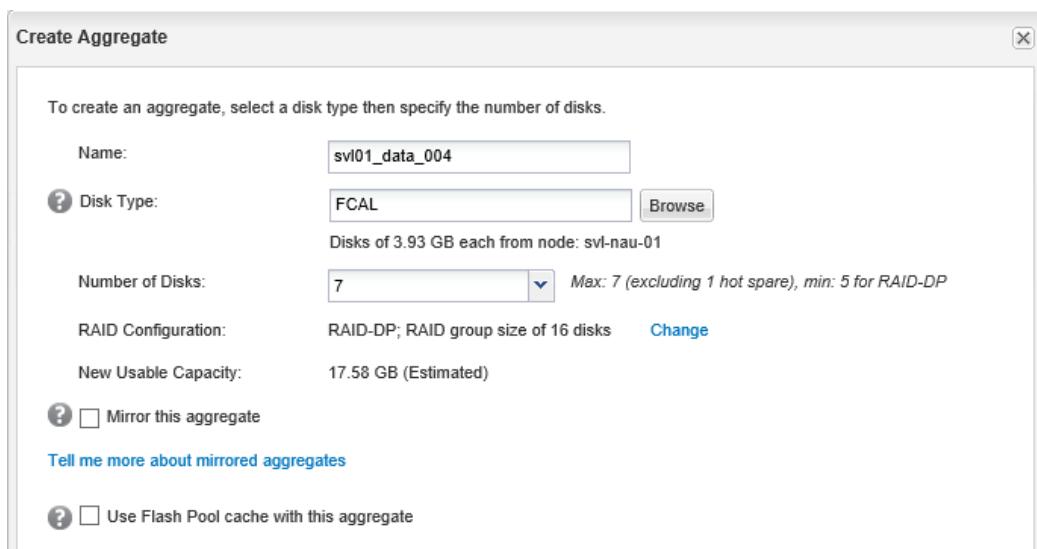
Manage storage-efficiency features.

#### OBJECTIVES

This exercise focuses on enabling you to do the following:

- Explore thin provisioning
- Enable storage efficiency

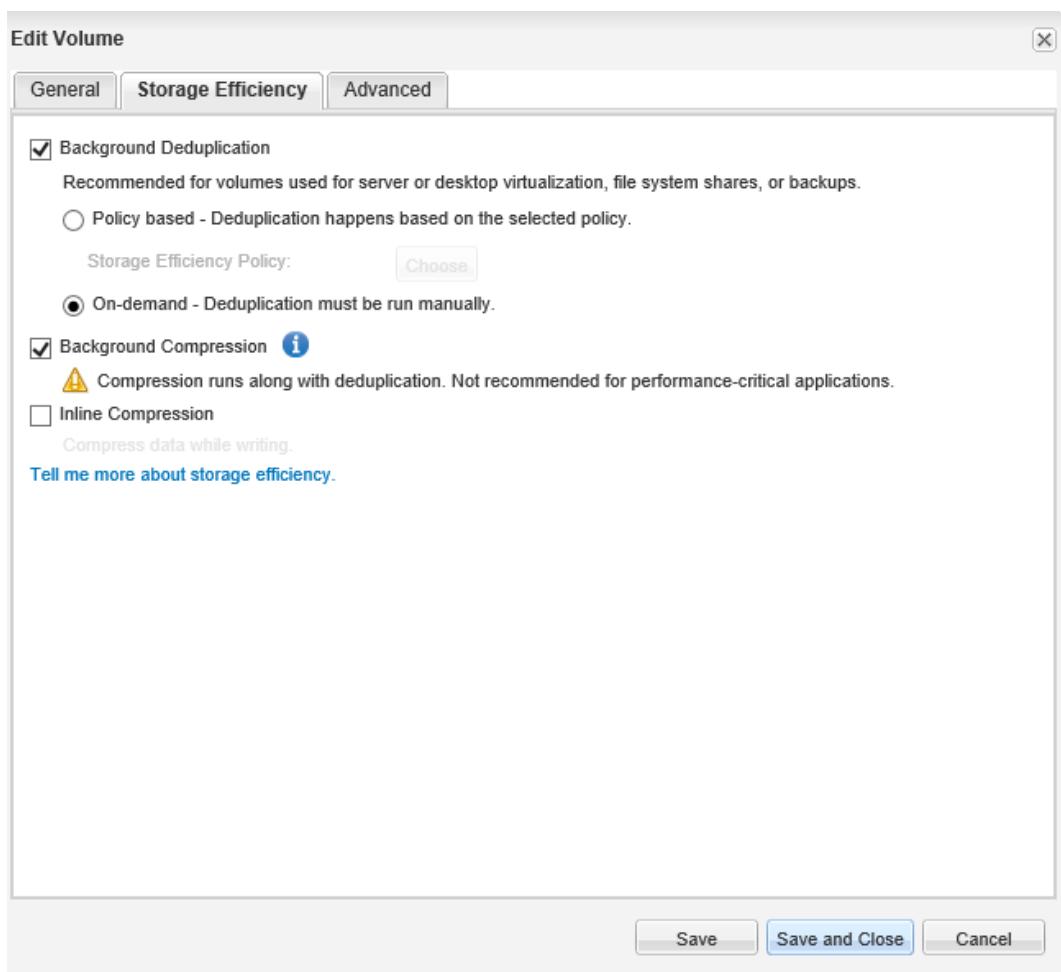
#### TASK 1: EXPLORE THIN PROVISIONING

STEP	ACTION
1.	<p>On System Manager for svl-nau create an FCAL aggregate named svl01_data_004 with 7 disks on node svl-nau-01.</p> 
2.	On System Manager for svl-nau go to the list of aggregates.
3.	Notice that aggregates svl01_data_004 and svl02_data_002 are both at 0% usage.
4.	In NetApp OnCommand System Manager on svl-nau, go to the Dashboard.
5.	 The aggregates are nearly identical except for the RAID type. Neither aggregate contains any volumes.
6.	<p>Create a volume that has the following attributes:</p> <ul style="list-style-type: none"><li>▪ <b>SVM:</b> svm_yellow</li><li>▪ <b>Name:</b> yellow_thickvol</li><li>▪ <b>Aggregate:</b> svl01_data_004</li><li>▪ <b>Size:</b> 8GB</li><li>▪ <b>Space Reserve:</b> Thick Provisioned</li><li>▪ All other attributes: Accept the default.</li></ul>

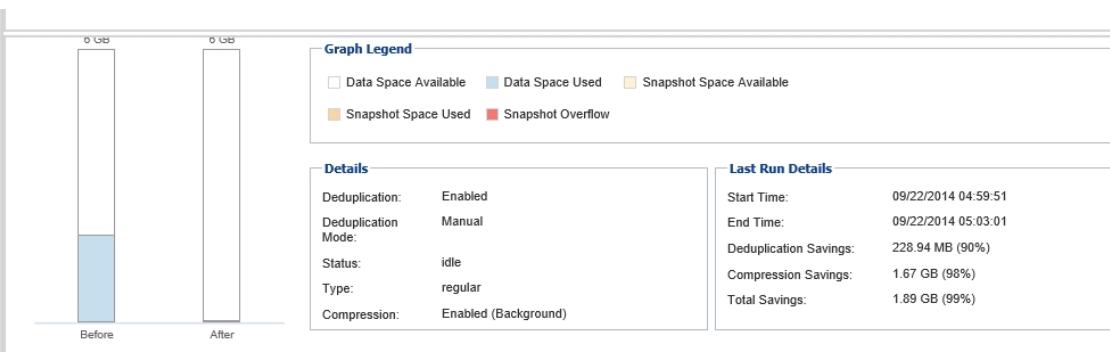
STEP	ACTION
7.	Create a second volume that has the following attributes: <ul style="list-style-type: none"><li>▪ <b>SVM:</b> svm_yellow</li><li>▪ <b>Name:</b> yellow_thinvol</li><li>▪ <b>Aggregate:</b> svl02_data_002</li><li>▪ <b>Size:</b> 8GB</li><li>▪ <b>Space Reserve:</b> Thin Provisioned</li><li>▪ All other attributes: Accept the default.</li></ul>
8.	Return to the aggregate list.
9.	Compare the capacity and usage of aggregates svl01_data_004 and svl02_data_002.  The screenshot shows a table with three columns: Aggregate Name, Location, and Type. There are three rows: <ul style="list-style-type: none"><li>svl01_data_004, svl-nau-01, Standard, 46</li><li>svl02_data_001, svl-nau-02, Flash Pool, 17</li><li>svl02_data_002, svl-nau-02, Standard, 0</li></ul> Two green arrows point from the right side of the table towards the 'svl01_data_004' row.
10.	 Consider the following facts: <ul style="list-style-type: none"><li>▪ Each aggregate contains one volume.</li><li>▪ The two volumes are identical, except that only one is thin provisioned.</li><li>▪ Neither volume contains user data.</li></ul>

## TASK 2: ENABLE STORAGE EFFICIENCY

STEP	ACTION
1.	In System Manager on svl-nau, on the menu bar, select <b>Volumes</b> .
2.	Record the capacity and space usage of volume exp_yellow_NFS_volume.
3.	 Volume exp_yellow_NFS_volume contains the 2-GB file named “hugefile”.
4.	Select <b>exp_yellow_NFS_volume</b> , and then click the <b>Edit</b> button.
5.	Select the <b>Storage Efficiency</b> tab.

STEP	ACTION
6.	<p>To enable on-demand deduplication and data compression for the volume, complete the following steps:</p> <ol style="list-style-type: none"> <li>Select the <b>Background Deduplication</b> checkbox.</li> <li>Select the <b>On-demand</b> option.</li> <li>Select the <b>Background Compression</b> checkbox.</li> <li>Click <b>Save and Close</b>.</li> </ol> 
7.	Verify that the Storage Efficiency column shows that volume <b>exp_yellow_NFS_volume</b> is enabled.
8.	Select <b>exp_yellow_NFS_volume</b> , and then on the Volumes toolbar, click <b>Storage Efficiency</b> to run on-demand deduplication.

Volumes							
Name	SVM	Aggregate	Status	Thin Provisioned	Run deduplication on the selected volume	Snapshot Copies	Protect
green_share_CIFS_volume	svm_green	svl02_data_001	Online	No	5	966.22 MB	
svm_green_root	svm_green	svl02_data_001	Online	No	10	17.92 MB	
red_share_CIFS_volume	svm_red	svl02_data_001	Online	No	5	966.2 MB	
svm_red_root	svm_red	svl01_data_001	Online	No	10	17.82 MB	
exp_yellow_NFS_volume	svm_yellow	svl01_data_001	Online	No	69	949.02 MB	

STEP	ACTION
9.	Select <b>Scan Entire Volume</b> , and then click the <b>Start</b> button.
10.	At the bottom of the page, click the <b>Storage Efficiency</b> tab, and then review the storage efficiency statistics. 
11.	After several minutes, return to this tab and compare the statistics. In the meantime, you can continue with the next task. 

#### END OF EXERCISE

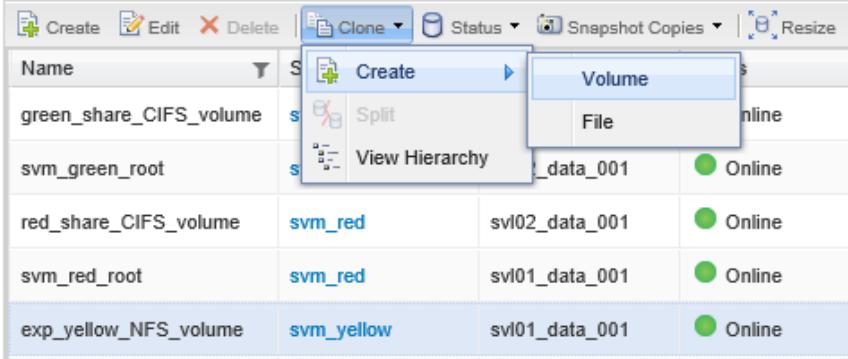
## EXERCISE 2: MANAGING FLEXCLONE VOLUMES

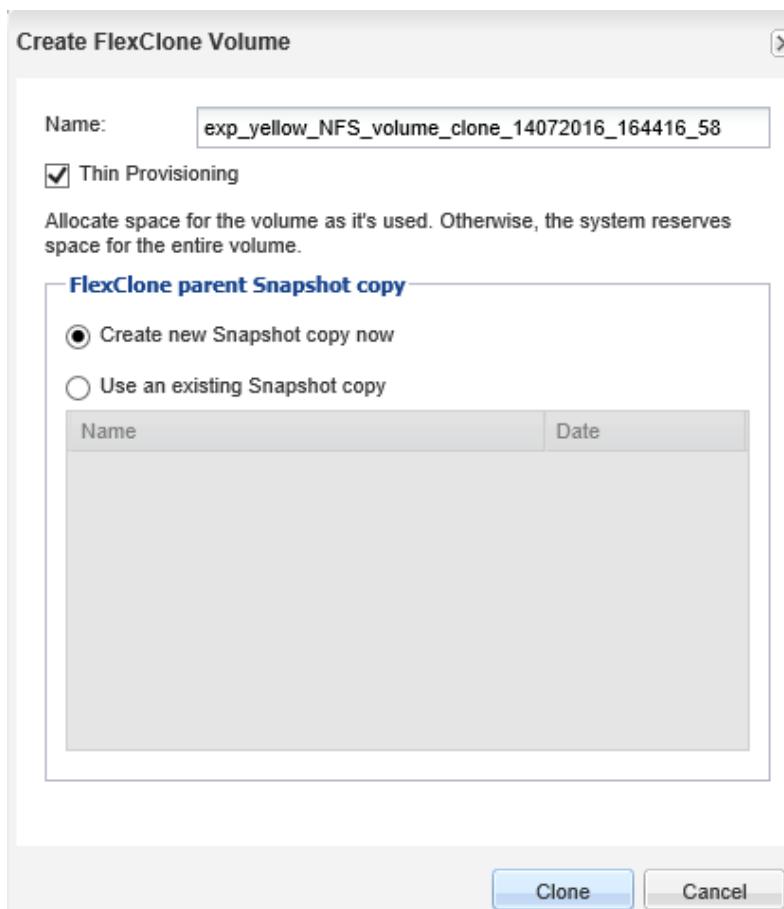
Explore and manage FlexClone volumes.

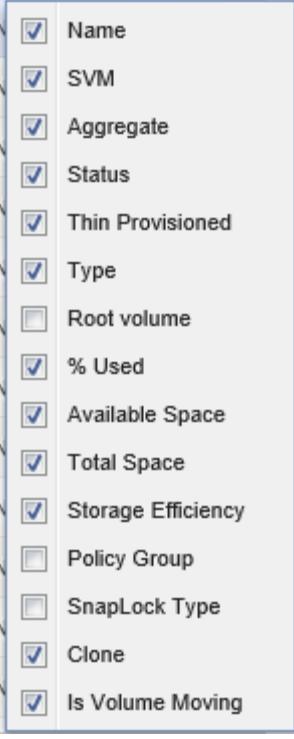
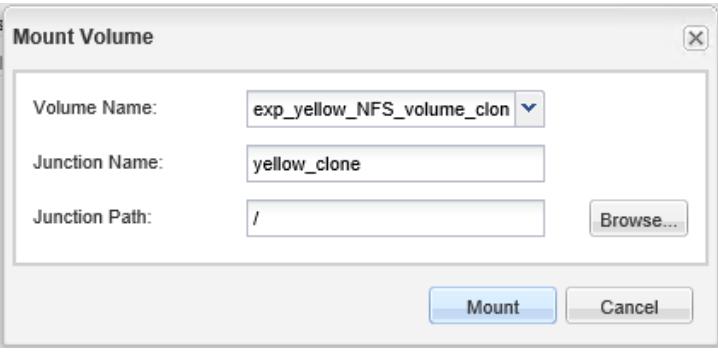
### OBJECTIVES

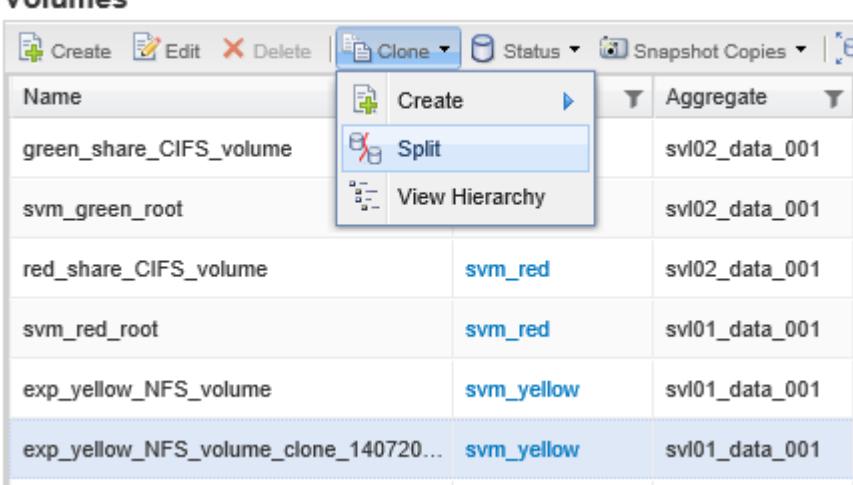
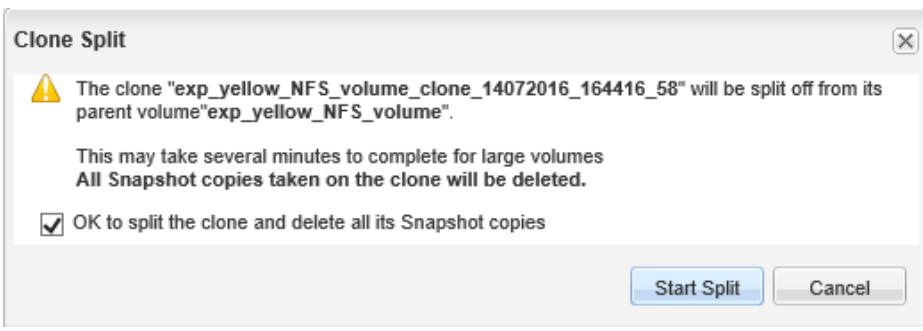
This exercise focuses on enabling you to create and split a FlexClone volume.

### TASK 1: CREATE AND SPLIT A FLEXCLONE VOLUME

STEP	ACTION																								
1.	<p>In System Manager for cluster svl-nau, on the Volumes page, complete the following steps to create a FlexClone copy of the volume:</p> <ol style="list-style-type: none"><li>Select <b>exp_yellow_NFS_volume</b>.</li><li>Click <b>Clone</b>.</li><li>Select <b>Create</b>.</li><li>Select <b>Volume</b>.</li></ol> <p><b>Volumes</b></p>  <table border="1"><thead><tr><th>Name</th><th>SVM</th><th>Data LUN</th><th>Status</th></tr></thead><tbody><tr><td>green_share_CIFS_volume</td><td>svm_green</td><td>svl01_data_001</td><td>Online</td></tr><tr><td>svm_green_root</td><td>svm_green</td><td>svl02_data_001</td><td>Online</td></tr><tr><td>red_share_CIFS_volume</td><td>svm_red</td><td>svl01_data_001</td><td>Online</td></tr><tr><td>svm_red_root</td><td>svm_red</td><td>svl01_data_001</td><td>Online</td></tr><tr><td>exp_yellow_NFS_volume</td><td>svm_yellow</td><td>svl01_data_001</td><td>Online</td></tr></tbody></table>	Name	SVM	Data LUN	Status	green_share_CIFS_volume	svm_green	svl01_data_001	Online	svm_green_root	svm_green	svl02_data_001	Online	red_share_CIFS_volume	svm_red	svl01_data_001	Online	svm_red_root	svm_red	svl01_data_001	Online	exp_yellow_NFS_volume	svm_yellow	svl01_data_001	Online
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exp_yellow_NFS_volume	svm_yellow	svl01_data_001	Online																						

STEP	ACTION
2.	<p>In the Create FlexClone Volume window, complete the following steps:</p> <ol style="list-style-type: none"> <li>Accept the default Name.</li> <li>Select the <b>Thin Provisioning</b> checkbox.</li> <li>Select the <b>Create new Snapshot copy now</b> option.</li> <li>Click <b>Clone</b>.</li> </ol> 
3.	<p>In the top-right corner of the Volumes page, click the small blue icon to display a selection list that enables you to add additional fields.</p> 

STEP	ACTION
4.	Select the <b>Type</b> and <b>Clone</b> checkboxes. 
5.	Notice the name of the new clone volume.
6.	In the System Manager menu bar, select <b>SVMs</b> to go to the SVMs page.
7.	Select <b>svm_yellow</b> .
8.	On the <b>svm_yellow</b> toolbar, click <b>Namespace</b> .
9.	Click <b>Mount</b> to mount the clone into the <b>svm_yellow</b> namespace.
10.	In the Mount Volume window, mount your clone volume under the SVM root as <b>yellow_clone</b> . 
11.	From your Linux machine, navigate to the clone volume: <pre>cd /mnt/clone mount 192.168.0.62:/yellow_clone /mnt/clone</pre>

STEP	ACTION
12.	<p>Create a file called “datafile”:</p> <pre>echo "Edited from a FlexClone..." &gt;&gt; datafile ls datafile  file1  file2  hugefile</pre>
13.	<p>Check the contents of the file on the parent volume, and notice that although the clone and parent share common data blocks, they function as separate volumes:</p> <pre>cd ../yellow/ ls file1  file2  hugefile</pre>
14.	<p>In System Manager, on the Volumes page, complete the following steps:</p> <ol style="list-style-type: none"> <li>Select the clone.</li> <li>On the toolbar, select <b>Clone</b>.</li> <li>Select <b>Split</b>.</li> </ol> 
15.	<p>In the Clone Split window, select <b>OK to split the clone and delete all its Snapshot copies</b> checkbox, and then click <b>Start Split</b>.</p> <p>The split takes some time.</p> 
16.	Click <b>Run In Background</b> .

STEP	ACTION
17.	On the Volumes page, notice the status in the Clone column. The clone no longer shares blocks with the parent and is now a separate volume.

END OF EXERCISE

## MODULE 8: NAS PROTOCOLS

### EXERCISE 1: CONFIGURING NAS PROTOCOLS

In this exercise, you use best practice tools to create simple NFS and SMB servers in a storage virtual machine (SVM).

#### OBJECTIVES

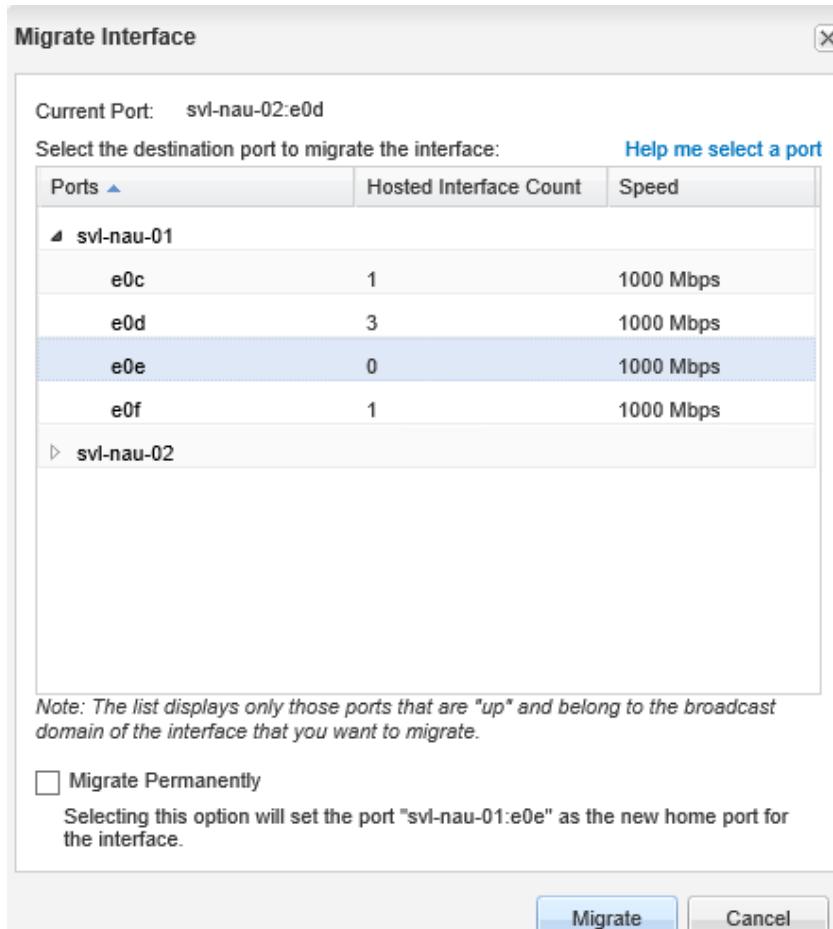
This exercise focuses on enabling you to do the following:

- Migrate and rehome a NAS data logical interface (LIF)
- Create an SVM
- Use NetApp OnCommand System Manager to configure an SVM and NAS protocols
- Create an export policy
- Create a CIFS share
- Access a CIFS share from a Windows client
- Access an NFS export from a Linux client

#### TASK 1: MIGRATE AND REHOME A NAS DATA LIF

LIF migration occurs only with NAS data LIFs. LIF migration is more useful and interesting on two-node clusters. For this reason, you perform this task on cluster svl-nau.

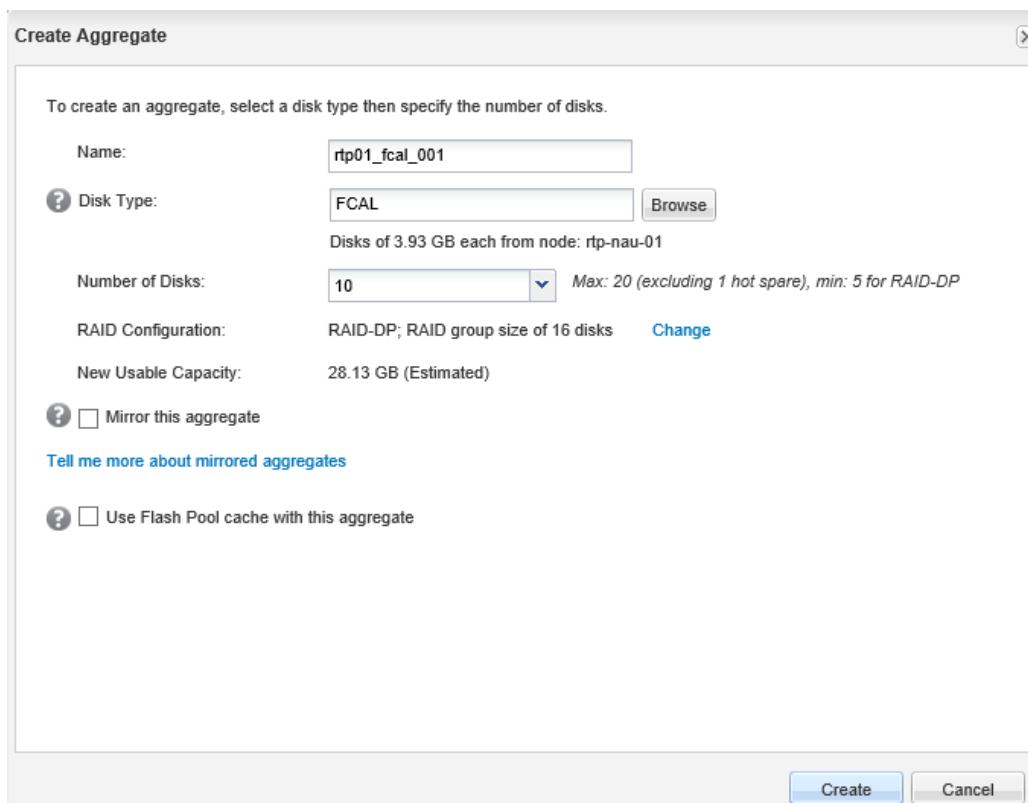
STEP	ACTION
1.	Log in to System Manager on svl-nau.
2.	On the System Manager menu bar, select <b>Network</b> .
3.	In the Network pane, click the <b>Network Interfaces</b> tab.
4.	Click <b>svm_green_cifs_nfs_lif1</b> , and then click the <b>Migrate</b> button.
5.	Click <b>Yes</b> to clear the CIFS warning.
6.	Notice the current port at the top of the Migrate Interface window.

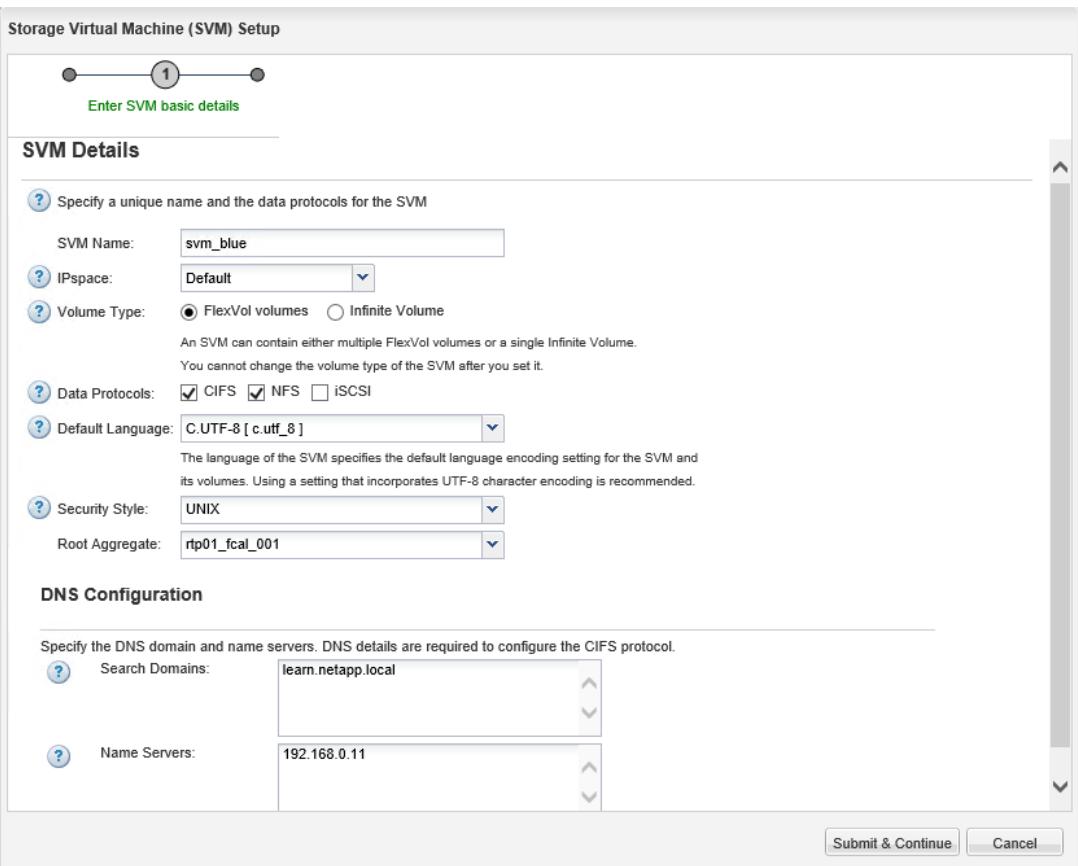
STEP	ACTION
7.	<p>Select <b>svl-nau-01:e0e</b> as the destination port.</p> <p>You can rehome the LIF on the destination port by selecting the Migrate Permanently checkbox. For now, leave the Migrate Permanently checkbox cleared.</p> 
8.	Click <b>Migrate</b> .
9.	Notice that the LIF is now hosted on cluster1-01:e0f.
10.	The red warning icon means that the LIF is not running on its home port.
11.	Select <b>svm_green_cifs_nfs_lif1</b> again, and then click <b>Send to Home</b> . The LIF is now hosted on its home port.
12.	Use a PuTTY to log in to svl-nau.
13.	Verify the current location of the data LIFs: <code>net int show -vserver svm_green</code>

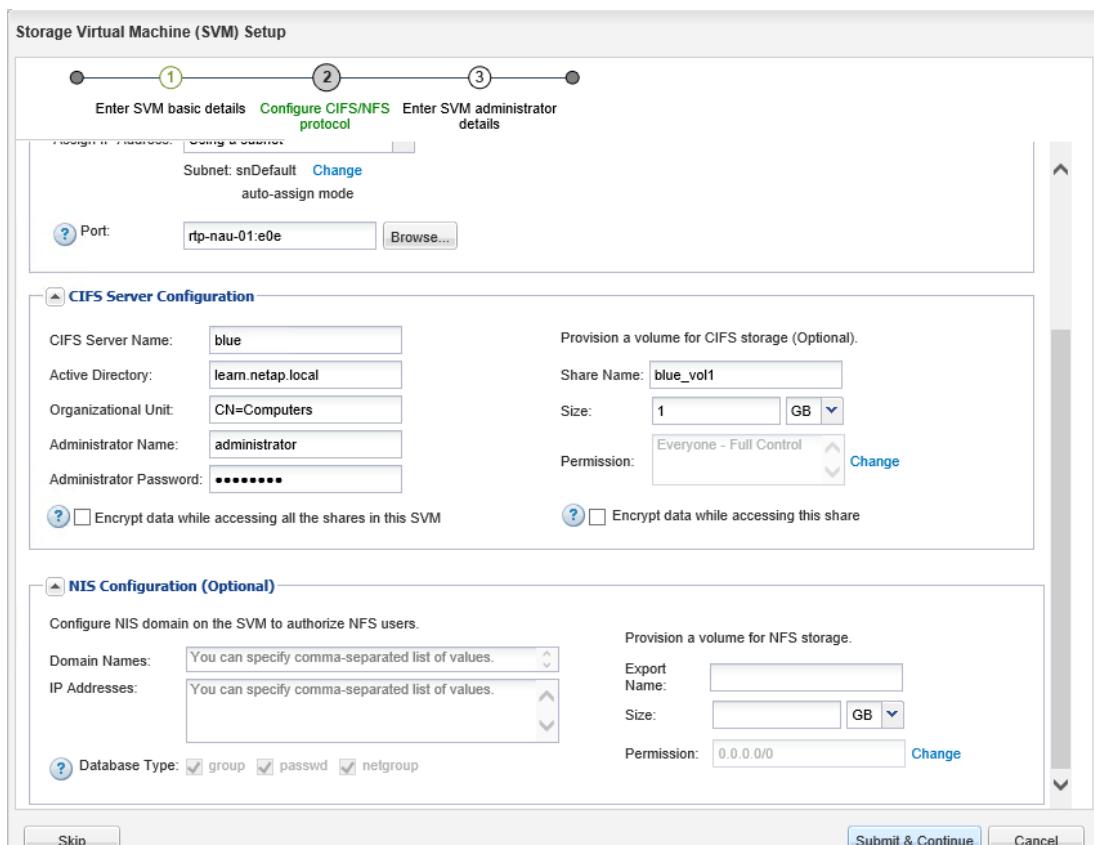
STEP	ACTION
14.	Reassign the home port of svm_green_cifs_nfs_lif1 to port e0f, leaving the home node on cluster1-01:  <code>net int modify -vserver svm_green -lif svm_green_cifs_nfs_lif1 -home-port e0f</code>
15.	Check the home port again:  <code>net int show -vserver svm_green</code>
16.	Answer the following questions: <ul style="list-style-type: none"><li>▪ Did the LIF move? _____</li><li>▪ What is the status of its home? _____</li></ul>
17.	Issue a <code>revert</code> command to send the LIF to its new home port:  <code>net int revert *</code>
18.	 The asterisk (*) is a positional parameter that represents the LIF name. The <code>revert</code> command reverts all LIFs that are not on their home ports.
19.	Recheck the status of the LIFs:  <code>net int show -vserver svm_green</code>

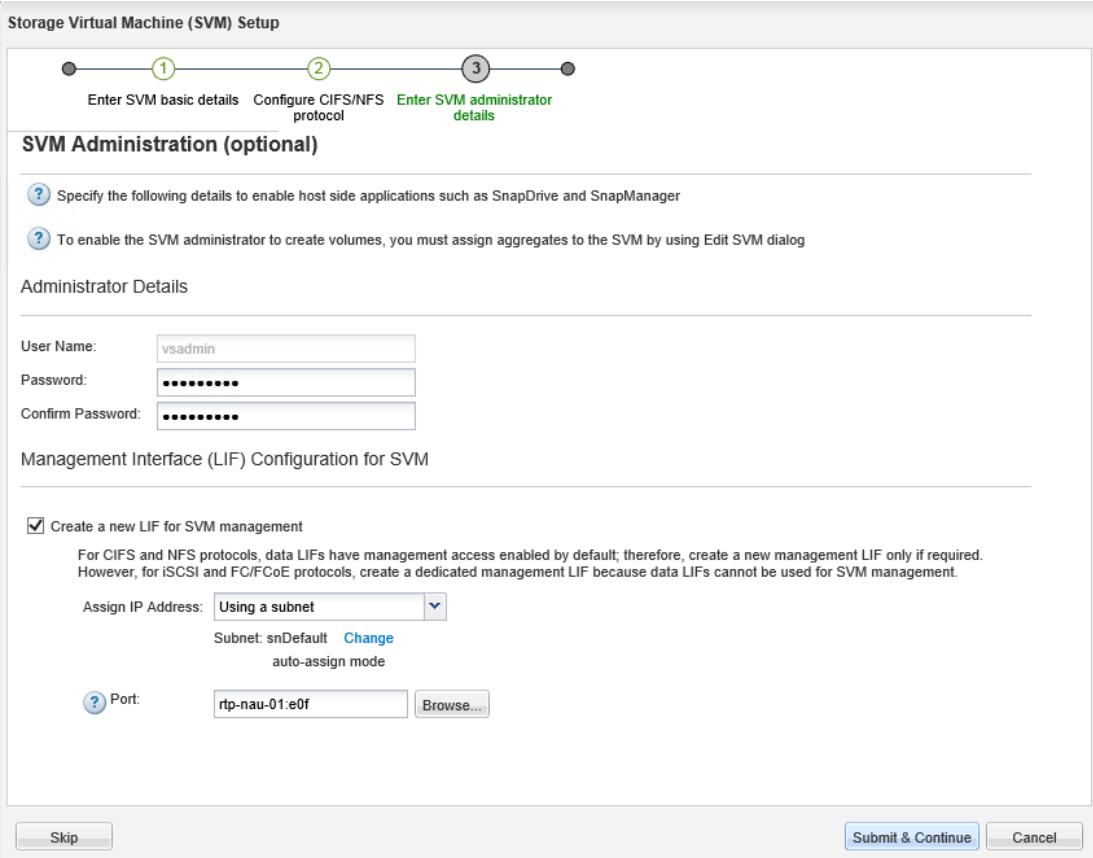
## TASK 2: CONFIGURE AN SVM TO HOST NFS AND SMB PROTOCOLS

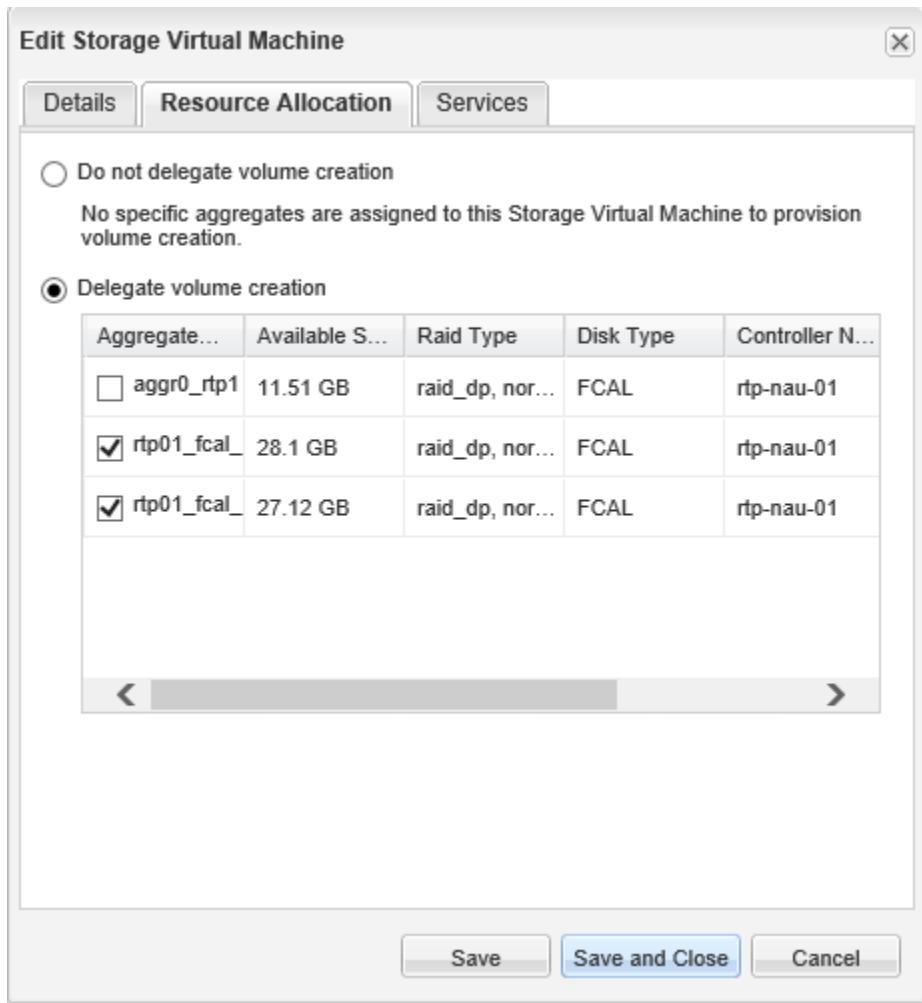
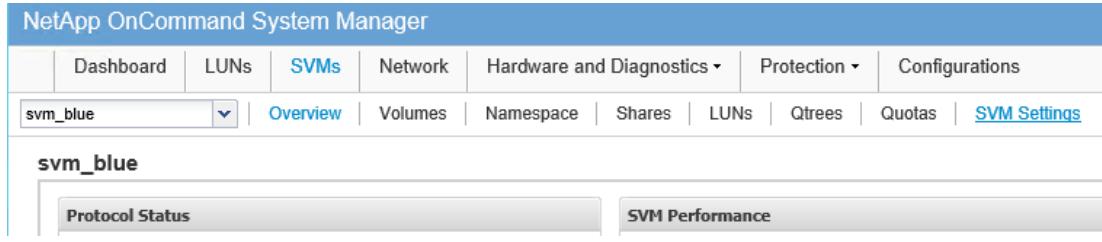
STEP	ACTION
1.	Open System Manager on rtp-nau.
2.	 Be sure to log in to the correct cluster.
3.	On the System Manager menu bar, select <b>Hardware and Diagnostics</b> , and then select <b>Aggregates</b> .
4.	Click <b>Create</b> .

STEP	ACTION
5.	<p>Create an aggregate with the following attributes:</p> <ul style="list-style-type: none"> <li>▪ <b>Name:</b> rtp01_fcral_001</li> <li>▪ <b>Disk Type:</b> FCAL</li> <li>▪ <b>Number of Disks:</b> 10</li> <li>▪ <b>RAID Configuration:</b> RAID-DP</li> </ul> 
6.	<p>Create a second aggregate with the following attributes:</p> <ul style="list-style-type: none"> <li>▪ <b>Name:</b> rtp01_fcral_002</li> <li>▪ <b>Disk Type:</b> FCAL</li> <li>▪ <b>Number of Disks:</b> 10</li> <li>▪ <b>RAID Configuration:</b> RAID-DP</li> </ul>
7.	On the System Manager menu bar, select <b>SVMs</b> .
8.	Click <b>Create</b> to create an SVM.

STEP	ACTION
9.	<p>On the Enter SVM Basic Details page of the wizard, set the following parameters:</p> <ul style="list-style-type: none"> <li>▪ <b>SVM Name:</b> svm_blue</li> <li>▪ <b>IPspace:</b> Default</li> <li>▪ <b>Volume Type:</b> FlexVol</li> <li>▪ <b>Data Protocols:</b> CIFS and NFS</li> <li>▪ <b>Default Language:</b> C.UTF-8 [ c.utf_8 ]</li> <li>▪ <b>Security Style:</b> UNIX</li> <li>▪ <b>Root Aggregate:</b> rtp01_fcsl_001</li> <li>▪ <b>DNS Configuration:</b> Accept defaults</li> </ul> 
10.	Click <b>Submit &amp; Continue</b> .

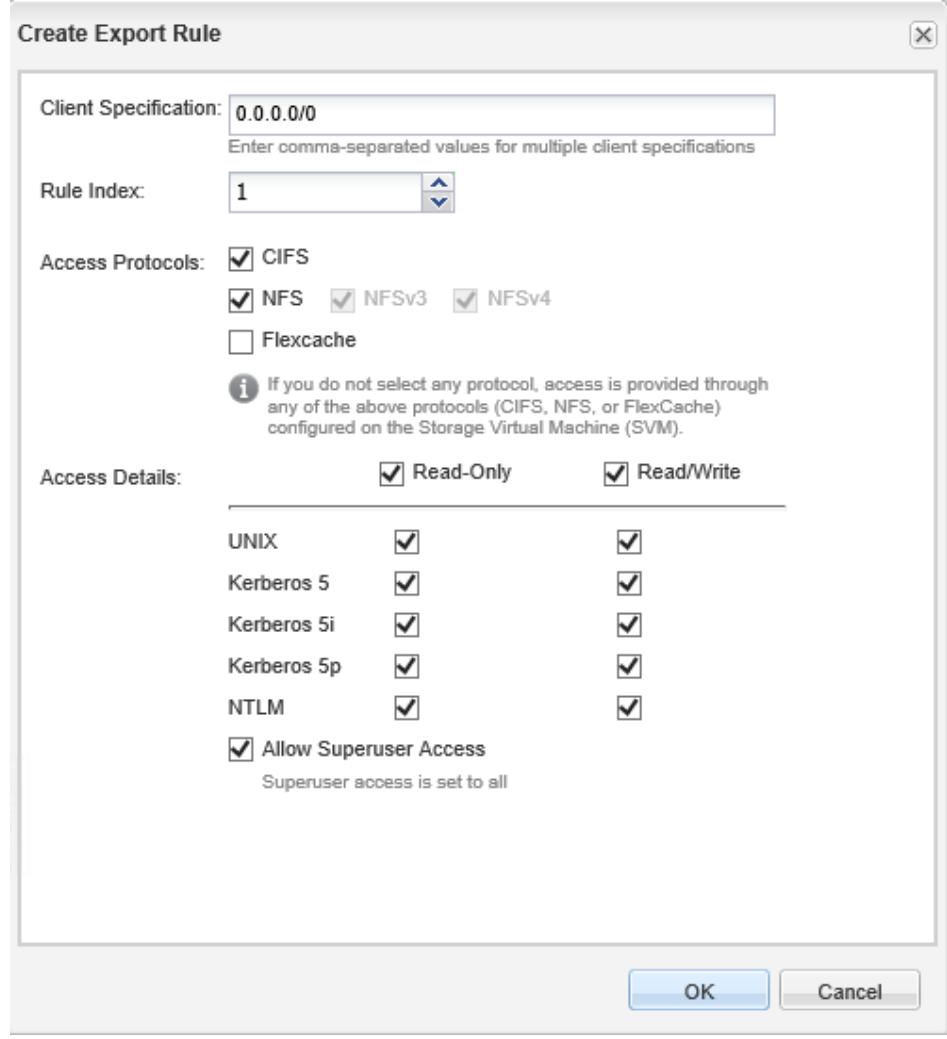
STEP	ACTION
11.	<p>On the Configure CIFS/NFS Protocol page, set the following parameters:</p> <ul style="list-style-type: none"> <li>▪ <b>Retain the CIFS data LIFs:</b> Selected <b>Note:</b> This setting specifies that the data LIF supports CIFS and NFS sessions.</li> <li>▪ <b>Assign IP Address:</b> Using a subnet</li> <li>▪ <b>Subnet:</b> snDefault</li> <li>▪ <b>auto-assign mode:</b> Selected</li> <li>▪ <b>Port:</b> rtp-nau-01:e0e</li> <li>▪ <b>CIFS Server Name:</b> blue</li> <li>▪ <b>Active Directory:</b> learn.netapp.local</li> <li>▪ <b>Administrator Name:</b> administrator</li> <li>▪ <b>Administrator Password:</b> Netapp123</li> <li>▪ <b>Share Name:</b> blue_vol1</li> <li>▪ <b>Size:</b> 1 GB</li> <li>▪ <b>Permission:</b> Everyone – Full Control</li> <li>▪ <b>NIS Configuration:</b> Leave blank</li> </ul> 
12.	Click <b>Submit &amp; Continue</b> .

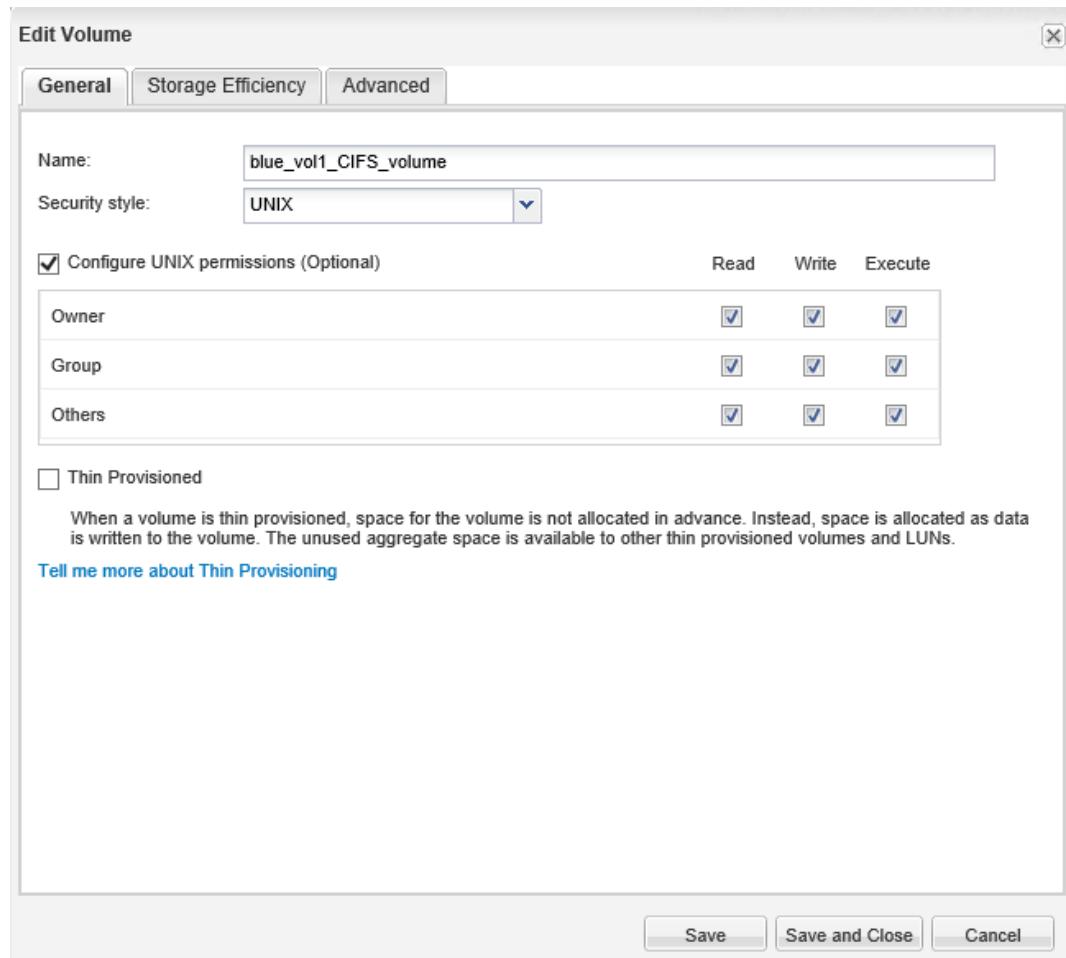
STEP	ACTION
13.	<p>On the Enter SVM Administrator Details page, set the following parameters:</p> <ul style="list-style-type: none"> <li>▪ <b>User Name:</b> vsadmin</li> <li>▪ <b>Password:</b> Netapp123</li> <li>▪ <b>Confirm Password:</b> Netapp123</li> <li>▪ <b>Create a new LIF for SVM management:</b> Selected</li> <li>▪ <b>Assign IP Address:</b> Using a subnet</li> <li>▪ <b>Subnet:</b> snDefault</li> <li>▪ <b>auto-assign mode:</b> Selected</li> <li>▪ <b>Port:</b> rtp-nau-01:e0f</li> </ul> 
14.	Click <b>Submit &amp; Continue</b> .
15.	Review the configuration summary, and then click <b>OK</b> .
16.	In the list of SVMs, select <b>svm_blue</b> ,
17.	On the SVM toolbar, click <b>Edit</b> .
18.	Click the <b>Resource Allocation</b> tab.

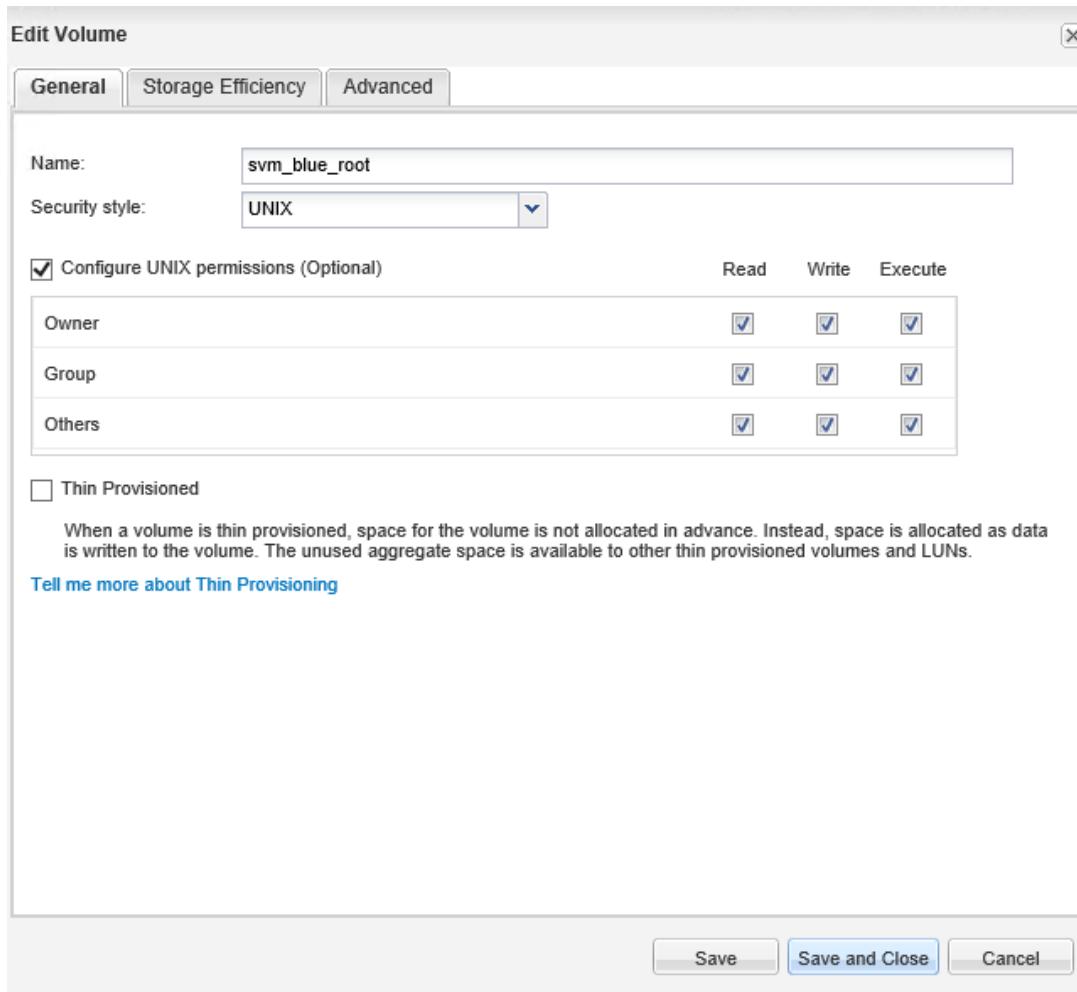
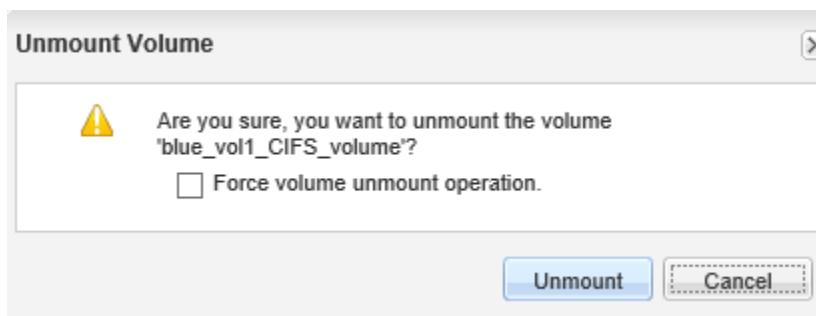
STEP	ACTION
19.	<p>Select <b>Delegate volume creation</b>, and then choose aggregates that are available to host volumes for this SVM, by clearing the checkboxes for the aggr0 aggregates and selecting the rest of the aggregate checkboxes.</p> <p>Best practices suggest that data volumes should never be stored on a node's aggr0 aggregate.</p> 
20.	Click <b>Save and Close</b> .
21.	In the SVMs pane, select <b>svm_blue</b> , and then on the toolbar, click <b>Manage</b> .
22.	On the SVMs menu bar, click <b>SVM Settings</b> .
	
23.	In the left pane, under Policies, click <b>Export Policies</b> .

STEP	ACTION
24.	Select the Default policy, and then click Add.
25.	For the Client Specification, enter 0.0.0.0/0.

STEP	ACTION
26.	<p>For Protocols, select <b>CIFS</b> and <b>NFS</b>.</p> <p>For Access Details, select Read-Only and Read-Write for all options.</p>
27.	Click <b>OK</b> .
28.	On the SVM toolbar, click <b>Volumes</b> .

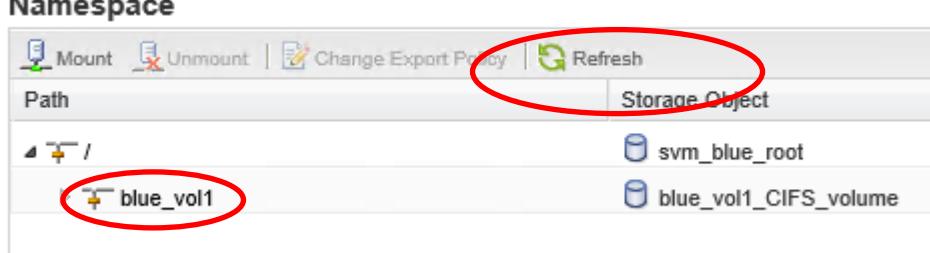
STEP	ACTION																		
29.	<p>Select <b>blue_vol1_CIFS_volume</b>, and then click <b>Edit</b>.</p>  <p>The dialog box contains the following settings:</p> <ul style="list-style-type: none"> <li><b>Client Specification:</b> 0.0.0.0/0</li> <li><b>Rule Index:</b> 1</li> <li><b>Access Protocols:</b> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> CIFS</li> <li><input checked="" type="checkbox"/> NFS</li> <li><input checked="" type="checkbox"/> NFSv3</li> <li><input checked="" type="checkbox"/> NFSv4</li> <li><input type="checkbox"/> Flexcache</li> </ul> <p><b>Note:</b> If you do not select any protocol, access is provided through any of the above protocols (CIFS, NFS, or FlexCache) configured on the Storage Virtual Machine (SVM).</p> </li> <li><b>Access Details:</b> <table border="1"> <thead> <tr> <th></th> <th><input checked="" type="checkbox"/> Read-Only</th> <th><input checked="" type="checkbox"/> Read/Write</th> </tr> </thead> <tbody> <tr> <td>UNIX</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>Kerberos 5</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>Kerberos 5i</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>Kerberos 5p</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>NTLM</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </tbody> </table> <p><input checked="" type="checkbox"/> Allow Superuser Access Superuser access is set to all</p> </li> </ul>		<input checked="" type="checkbox"/> Read-Only	<input checked="" type="checkbox"/> Read/Write	UNIX	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Kerberos 5	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Kerberos 5i	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Kerberos 5p	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NTLM	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	<input checked="" type="checkbox"/> Read-Only	<input checked="" type="checkbox"/> Read/Write																	
UNIX	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																	
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Kerberos 5i	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																	
Kerberos 5p	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																	
NTLM	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																	

STEP	ACTION																
30.	<p>Complete the following steps actions to modify permissions on the volume that you created at the beginning of this task:</p> <ol style="list-style-type: none"> <li>Select the <b>Configure UNIX permissions (Optional)</b> checkbox.</li> <li>Select the <b>Read</b>, <b>Write</b>, and <b>Execute</b> checkboxes for <b>Owner</b>, <b>Group</b>, and <b>Others</b>.</li> <li>Clear the <b>Thin Provisioned</b> checkbox.</li> </ol>  <p><b>Name:</b> blue_vol1_CIFS_volume</p> <p><b>Security style:</b> UNIX</p> <p><input checked="" type="checkbox"/> Configure UNIX permissions (Optional)</p> <table border="1"> <thead> <tr> <th></th> <th>Read</th> <th>Write</th> <th>Execute</th> </tr> </thead> <tbody> <tr> <td>Owner</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>Group</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>Others</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </tbody> </table> <p><input type="checkbox"/> Thin Provisioned</p> <p>When a volume is thin provisioned, space for the volume is not allocated in advance. Instead, space is allocated as data is written to the volume. The unused aggregate space is available to other thin provisioned volumes and LUNs.</p> <p><a href="#">Tell me more about Thin Provisioning</a></p>		Read	Write	Execute	Owner	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Group	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Others	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Read	Write	Execute														
Owner	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>														
Group	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>														
Others	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>														
31.	Click <b>Save and Close</b> .																

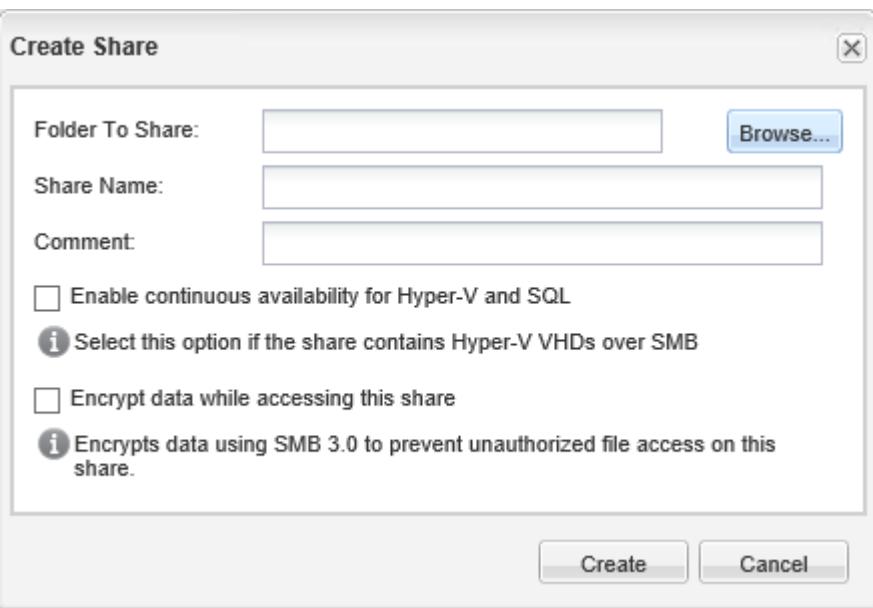
STEP	ACTION
32.	<p>Repeat steps 28-30 for svm_blue_root.</p> 
33.	Click <b>Namespace</b> .
34.	<p>In the <b>Namespace</b> pane, complete the following steps:</p> <ol style="list-style-type: none"> <li>Select <b>blue_vol1_CIFS_volume</b>.</li> <li>Click <b>Unmount</b>.</li> <li><i>Without</i> selecting the “Force volume unmount operation” checkbox, click <b>Unmount</b>.</li> </ol> 
35.	On the Namespace toolbar, click <b>Mount</b> .

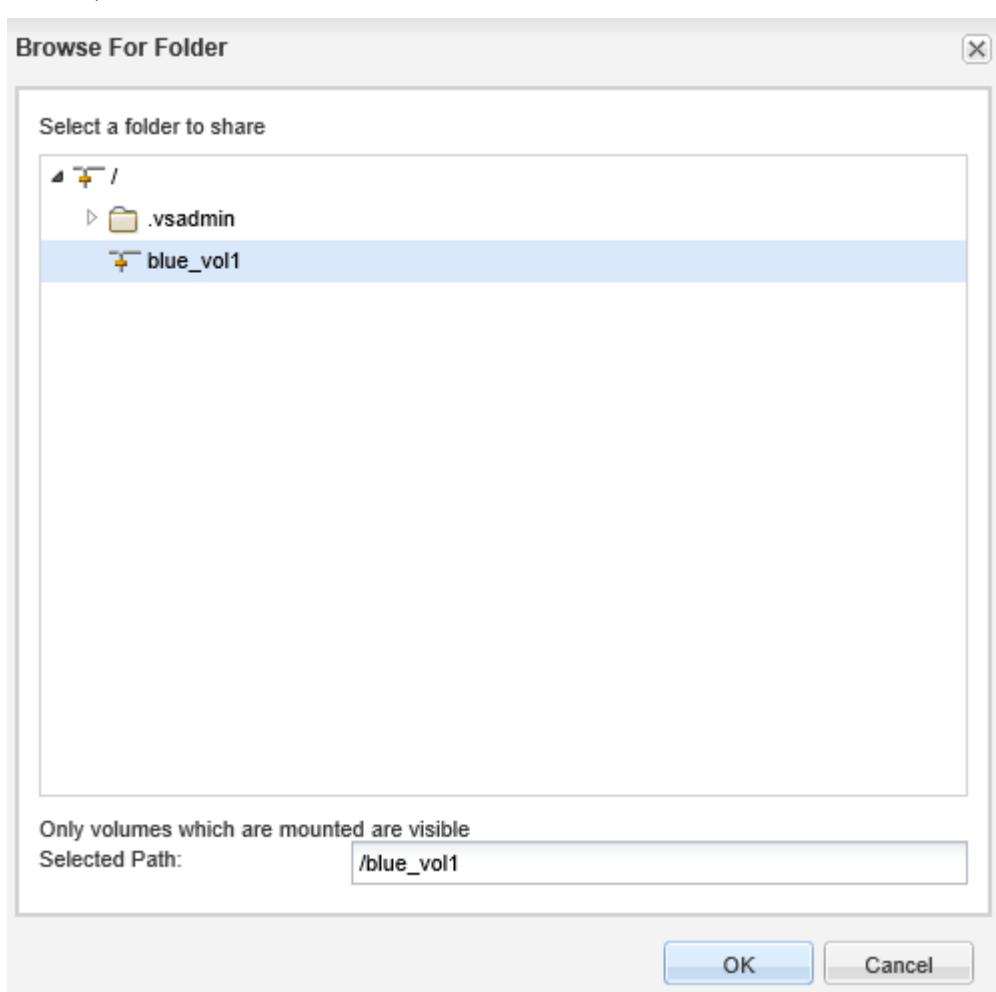
STEP	ACTION
36.	<p>Complete the following steps:</p> <ol style="list-style-type: none"> <li>In the Volume Name list, select <b>blue_vol1_CIFS_volume</b>.</li> <li>In the Junction Name field, type <b>blue_vol1</b>.</li> <li>In the Junction Path field, leave the root directory.</li> <li>Click <b>Mount</b>.</li> </ol> 
37.	 <p>In this exercise, the junction name is slightly different from the volume name. The names do not need to be the same. The volume name is used to reference the volume within the cluster. The junction name is used to reference the root of the volume in the namespace.</p>

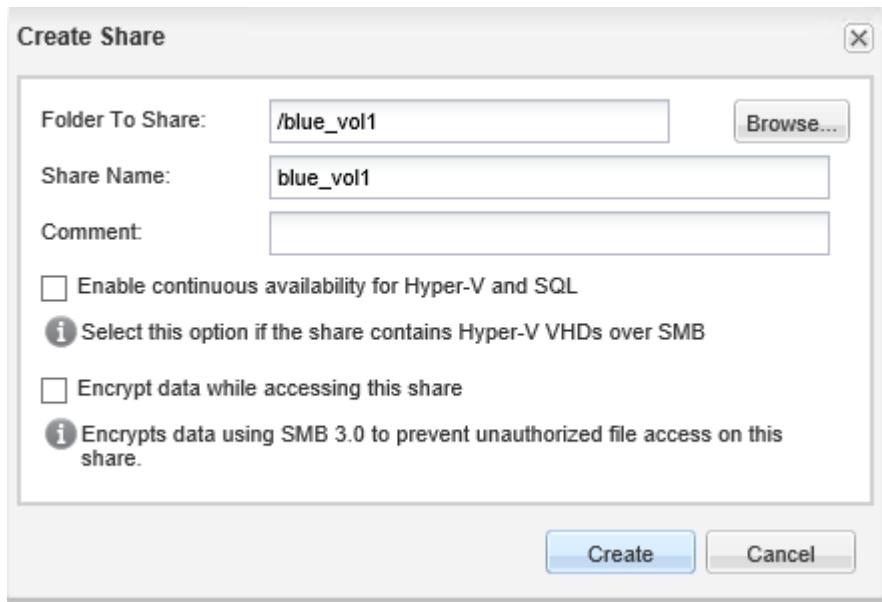
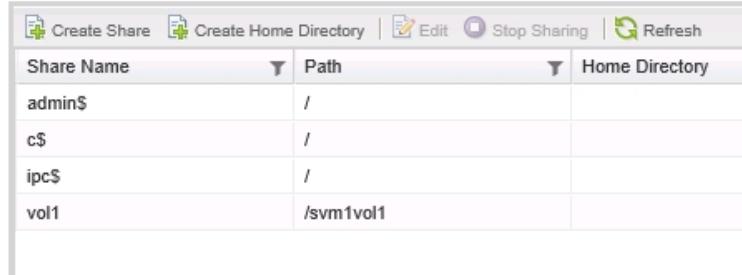
### TASK 3: VERIFY AND CREATE SMB SHARES

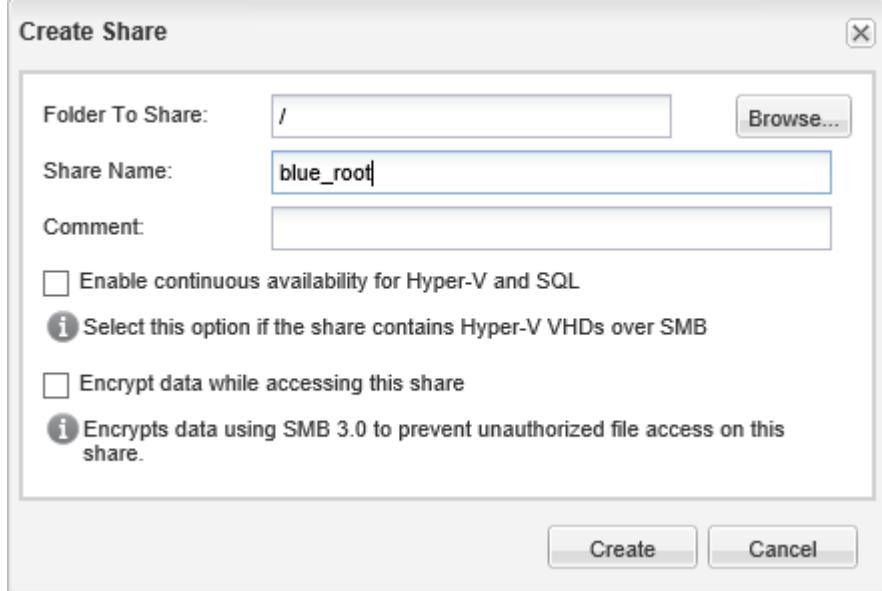
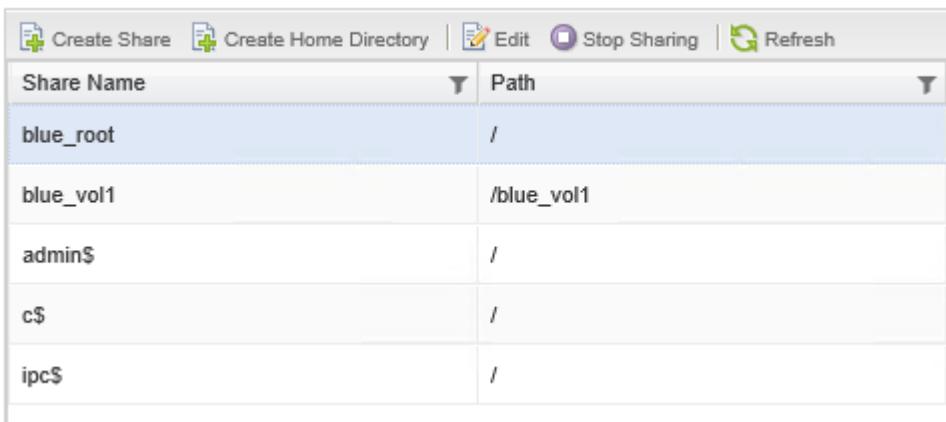
STEP	ACTION
1.	In the Namespace pane, click <b>Shares</b> .
2.	<p>Compare the path of the CIFS share to the namespace. The path of the share should reflect the volume path in the namespace.</p> 
3.	Select the <b>blue_vol1</b> share, and then on the toolbar, click <b>Stop Sharing</b> .
4.	 <p>After the SVM Setup wizard created this CIFS share, you changed the junction path of the volume, which changed its place in the namespace. Therefore, you must create a new share for the new path.</p>

STEP	ACTION
5.	Select the <b>OK to stop sharing the selected share(s)</b> checkbox, and then click <b>Stop</b> .
6.	Click <b>Create Share</b> to configure a new share.
7.	Click <b>Browse</b> to select a folder to share.



STEP	ACTION
8.	<p>Click the root volume to expand the tree, and then select <b>blue_vol1</b> (the junction path of the volume).</p> 
9.	Click <b>OK</b> .

STEP	ACTION															
10.	<p>In the Share Name field, type <b>blue_vol1</b>.</p> 															
11.	Click <b>Create</b> .															
12.	<p>Verify the new share name.</p>  <table border="1"> <thead> <tr> <th>Share Name</th> <th>Path</th> <th>Home Directory</th> </tr> </thead> <tbody> <tr> <td>admin\$</td> <td>/</td> <td></td> </tr> <tr> <td>c\$</td> <td>/</td> <td></td> </tr> <tr> <td>ipc\$</td> <td>/</td> <td></td> </tr> <tr> <td>vol1</td> <td>/svm1vol1</td> <td></td> </tr> </tbody> </table>	Share Name	Path	Home Directory	admin\$	/		c\$	/		ipc\$	/		vol1	/svm1vol1	
Share Name	Path	Home Directory														
admin\$	/															
c\$	/															
ipc\$	/															
vol1	/svm1vol1															
13.	Click <b>Create Share</b> to create a second CIFS share.															

STEP	ACTION												
14.	<p>In the Create Share window, complete the following steps:</p> <ol style="list-style-type: none"> <li>To the right of the Folder To Share field, click <b>Browse</b>.</li> <li>Select / to share the SVM root directory.</li> <li>In the Share Name field, type <b>blue_root</b>.</li> <li>Click <b>Create</b>.</li> </ol> 												
15.	<p>Verify the share names.</p>  <table border="1"> <thead> <tr> <th>Share Name</th> <th>Path</th> </tr> </thead> <tbody> <tr> <td>blue_root</td> <td>/</td> </tr> <tr> <td>blue_vol1</td> <td>/blue_vol1</td> </tr> <tr> <td>admin\$</td> <td>/</td> </tr> <tr> <td>c\$</td> <td>/</td> </tr> <tr> <td>ipc\$</td> <td>/</td> </tr> </tbody> </table>	Share Name	Path	blue_root	/	blue_vol1	/blue_vol1	admin\$	/	c\$	/	ipc\$	/
Share Name	Path												
blue_root	/												
blue_vol1	/blue_vol1												
admin\$	/												
c\$	/												
ipc\$	/												

END OF EXERCISE

## EXERCISE 2: ACCESSING NAS DATA FROM CLIENT COMPUTERS

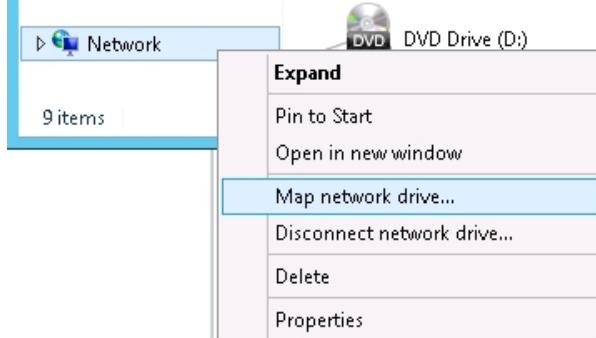
In this exercise, you use Windows to map an SMB share, and you use Linux to mount an NFS export.

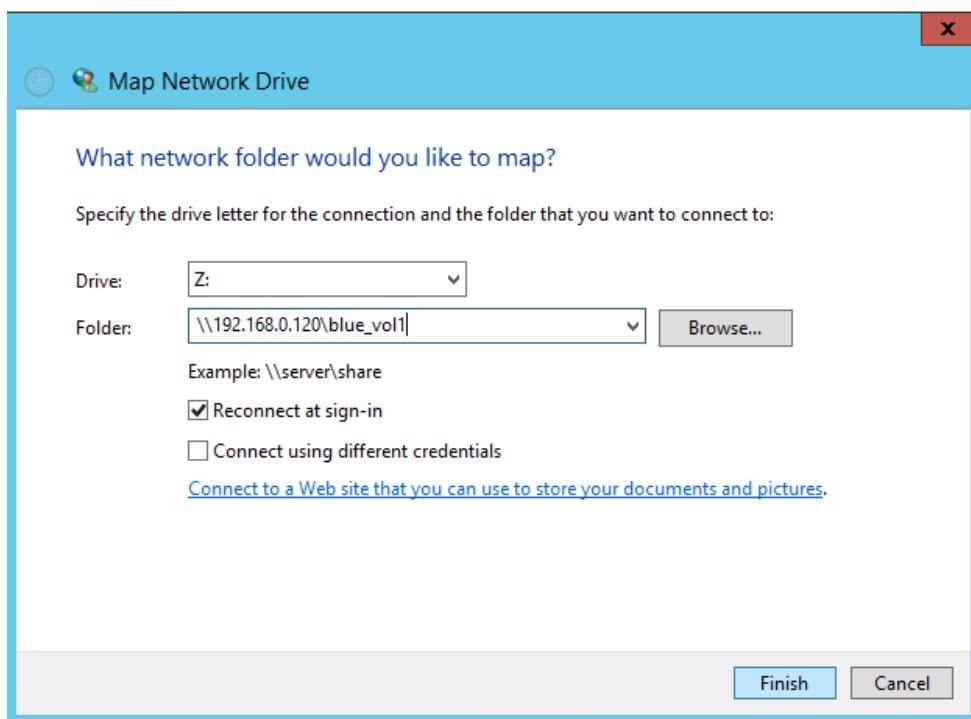
### OBJECTIVES

This exercise focuses on enabling you to do the following:

- Access an SMB share from a Windows client
- Access an NFS export from a Linux client

### TASK 1: ACCESS SMB SHARES FROM A WINDOWS CLIENT

STEP	ACTION
1.	Browse the available data LIFs and find the IP address for an svm_blue LIF that supports CIFS.
2.	On the Windows Server, in the taskbar, click the folder icon to start Windows Explorer. 
3.	Right-click Network, and then select <b>Map network drive</b> . 

STEP	ACTION
4.	In the Map Network Drive windows, complete the following steps: a. In the Drive list, select <b>Z</b> . b. In the Folder list, select your CIFS server name and shared folder <b>\&lt;LIF_IP_address&gt;\blue_vol1</b> . c. Click <b>Finish</b> .
	
5.	When the share folder opens, create files and folders on the share. <b>Note:</b> You will use these files and folders later in the course.
6.	Map the blue_root share to drive Y.
7.	Answer the following question: When the share folder opens, what do you see? _____

## TASK 2: ACCESS THE NFS EXPORT FROM A LINUX CLIENT

STEP	ACTION
1.	Log in to the linux machine, using the following credentials: <ul style="list-style-type: none"><li>▪ User name: <b>root</b></li><li>▪ Password: <b>Netapp123</b></li></ul>
2.	Create directories for the NFS mounts: <b>mkdir /mnt/blue</b> <b>mkdir /mnt/vol1</b>

STEP	ACTION
3.	<p>Using the IP address of either data LIF within svm1, access svm1 exports through NFS:</p> <pre>mount -t nfs 192.168.0.120:/ /mnt/blue mount -t nfs 192.168.0.120:/blue_vol1 /mnt/vol1</pre>
4.	 You are not mounting CIFS shares or volume names, but rather paths in the namespace.
5.	<p>Explore both NFS mounts, which are mounted at different points in the svm_blue namespace, and locate the directories and files that you created earlier in the exercise.</p> <pre>cd /mnt/blue cd /mnt/vol1</pre>

END OF EXERCISE

## MODULE 9: SAN PROTOCOLS

### EXERCISE 1: CONFIGURING iSCSI

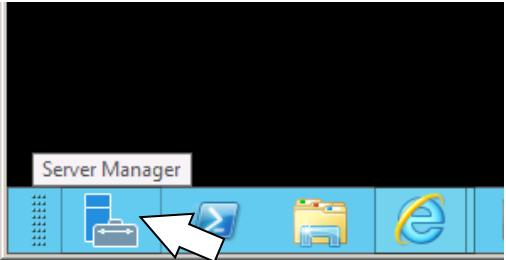
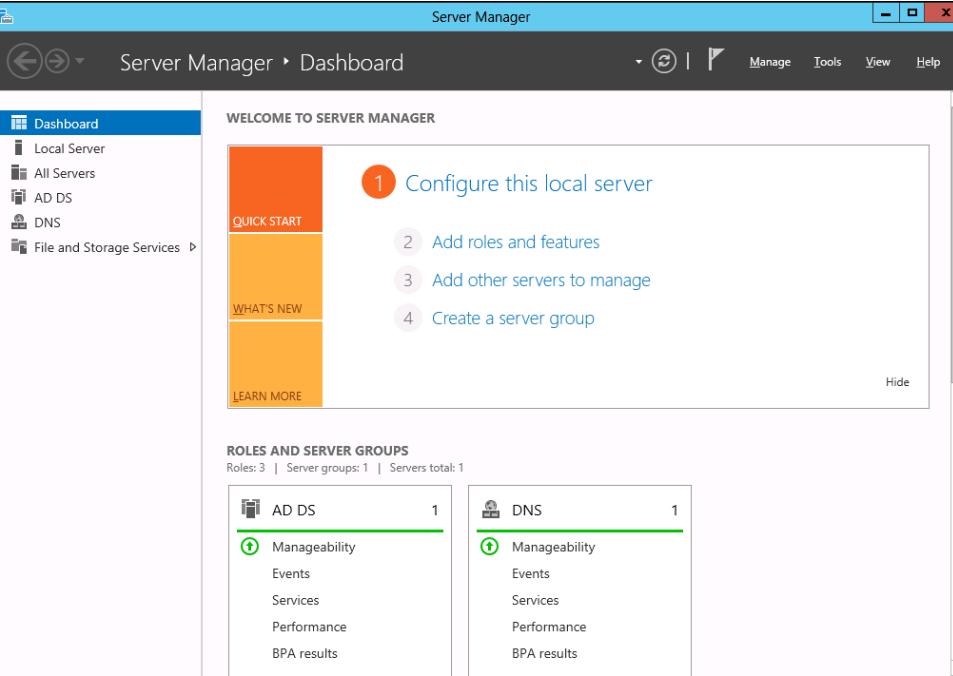
In this exercise, you use best practice tools to create a simple iSCSI server in a storage virtual machine (SVM).

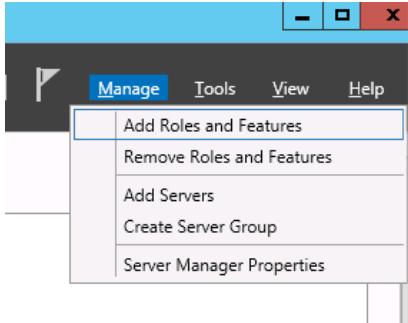
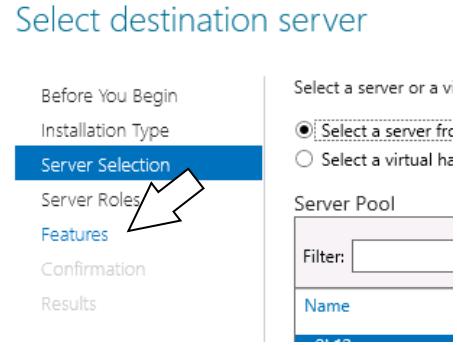
#### OBJECTIVES

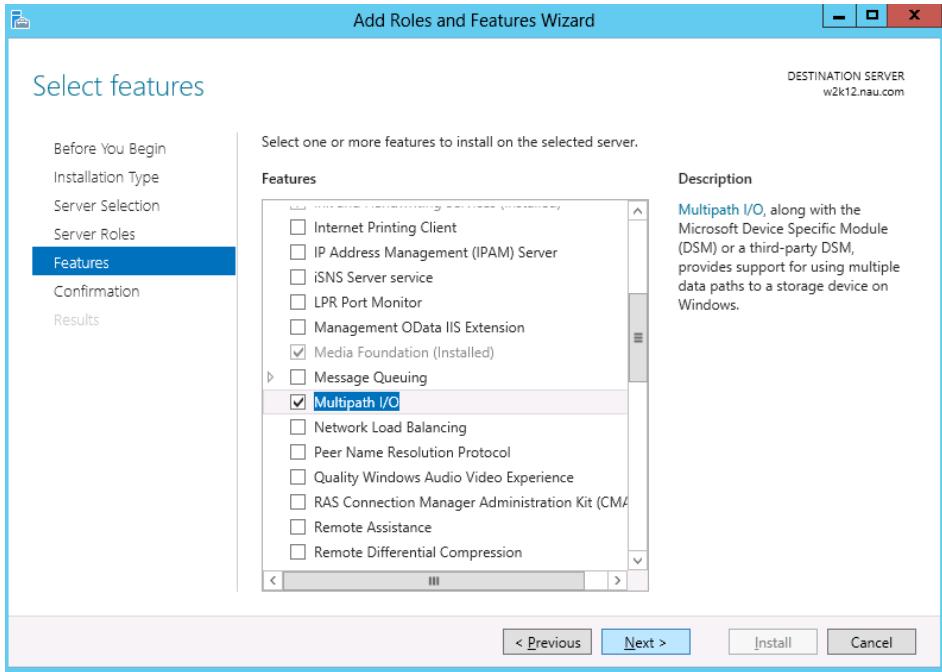
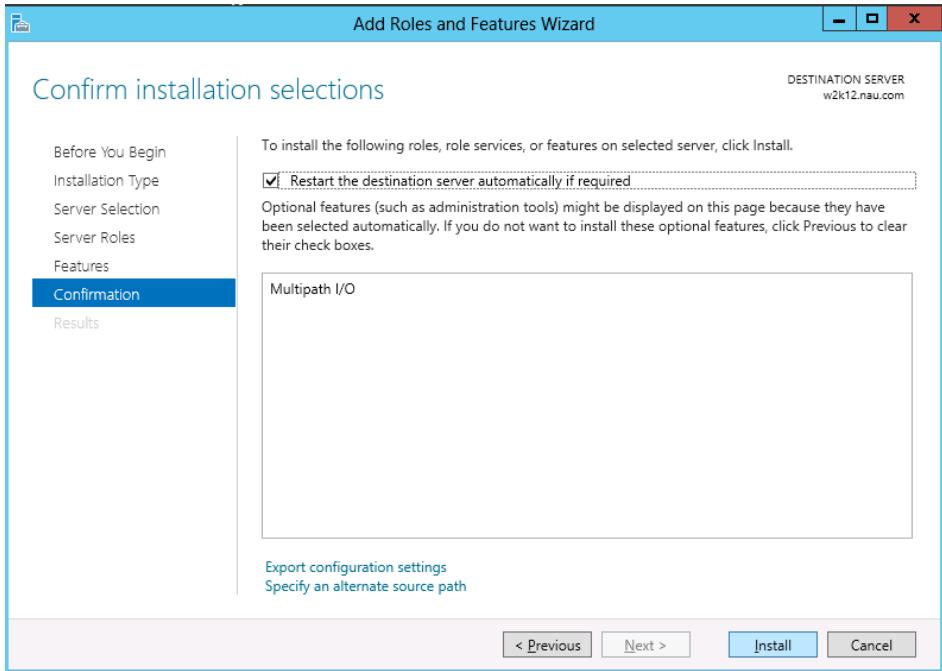
This exercise focuses on enabling you to do the following:

- Verify Windows Microsoft Multipath I/O (MPIO) configuration
- Use NetApp OnCommand System Manager to create an SVM and LUN for iSCSI
- Configure the iSCSI Software Initiator in Windows
- Access the iSCSI-attached LUN on the initiator

#### TASK 1: VERIFY MPIO CONFIGURATION

STEP	ACTION
1.	<p>On the Windows desktop, click the Server Manager icon.</p> 
2.	<p>Wait while Server Manager opens.</p> 

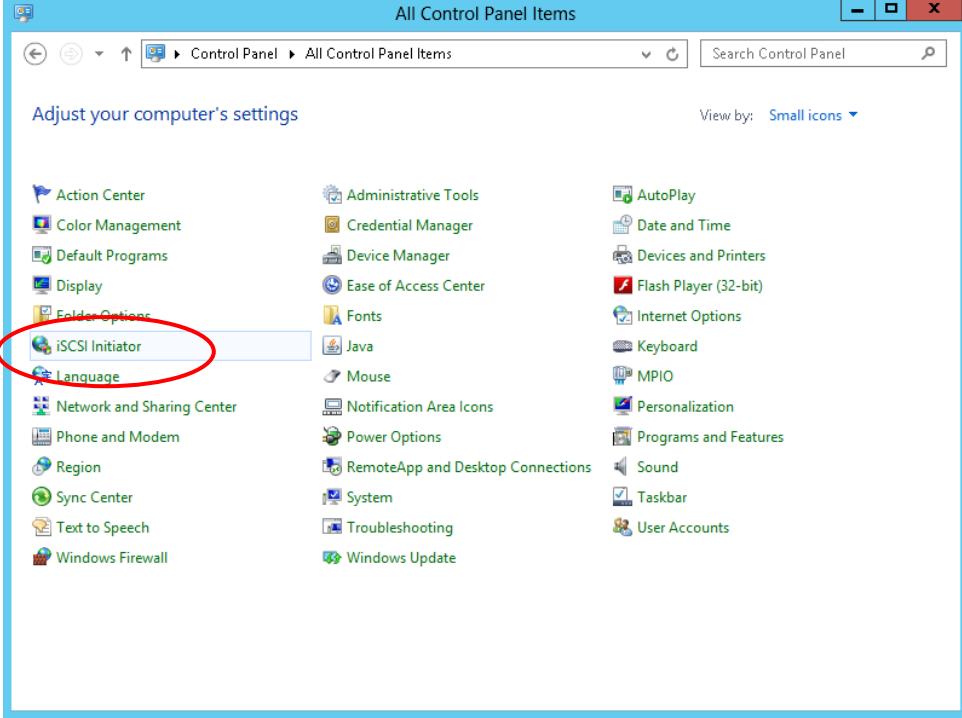
STEP	ACTION
3.	On the toolbar at the top right of the page, click <b>Manage</b> , and then select <b>Add Roles and Features</b> .
	
4.	Click <b>Next</b> twice.
5.	In the left pane of the Select destination server page, click <b>Features</b> .
	

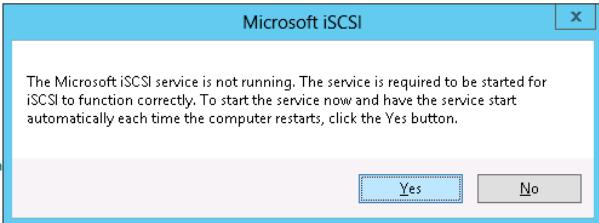
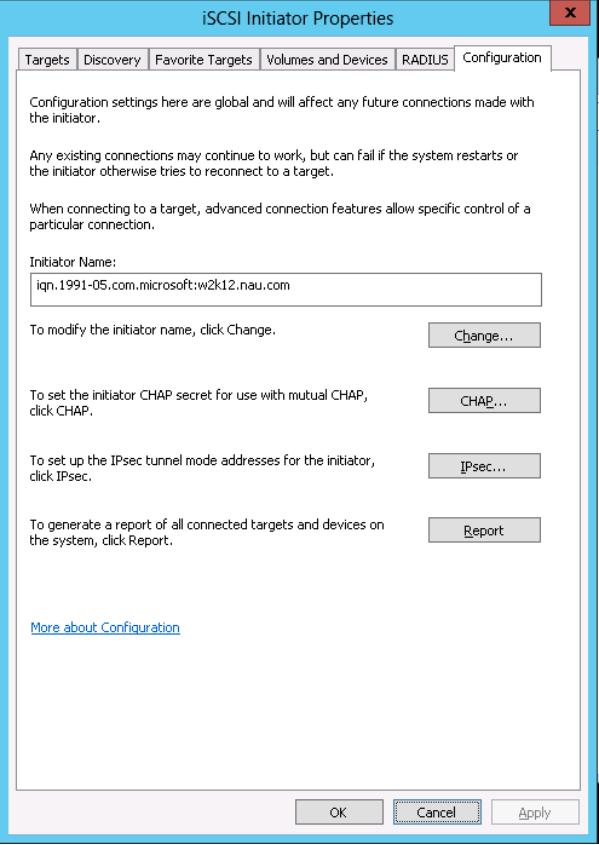
STEP	ACTION
6.	<p>On the Select features page, verify that <b>Multipath I/O</b> is installed and configured:</p> <p>If the <b>Multipath I/O</b> checkbox is selected, click <b>Cancel</b>, and then proceed to Task 2.</p> <ul style="list-style-type: none"> <li>▪ If the checkbox is cleared, click <b>Next</b>.</li> </ul> 
7.	<p>On the Confirm installation selections page, complete the following steps:</p> <ol style="list-style-type: none"> <li>a. Select the <b>Restart the destination server automatically if required</b> checkbox.</li> <li>b. When a warning appears, click <b>Yes</b>.</li> <li>c. Click <b>Install</b>.</li> </ol> 

STEP	ACTION
8.	After the feature is installed and the Results window appears, confirm that the installation was successful, and then click <b>Close</b> .
9.	Close Server Manager.

## TASK 2: CHECK THE iSCSI SOFTWARE INITIATOR NAME

STEP	ACTION
1.	On your Windows desktop, open the Control Panel.
2.	In the View by field, select <b>Small icons</b> , and then click <b>iSCSI Initiator</b> .



STEP	ACTION
3.	If an error message appears, indicating that the Microsoft iSCSI service is not running, click <b>Yes</b> to start the service.  
4.	If a message asks if you want to unblock the Microsoft iSCSI service through the Windows Firewall, click <b>Yes</b> .
5.	When the iSCSI Initiator Properties dialog box appears, click the <b>Configuration</b> tab.  
6.	Record the Initiator Name (IQN): _____
7.	Leave the iSCSI Initiator Properties window open.

### TASK 3: USE ONCOMMAND SYSTEM MANAGER TO CONFIGURE AN SVM FOR ISCSI

STEP	ACTION
1.	Open OnCommand System Manager on rtp-nau.
2.	In the System Manager menu bar, select <b>SVMs</b> .

STEP	ACTION
3.	Click <b>Create</b> to create an SVM for iSCSI.
4.	On the SVM Details page, set the following parameters: <ul style="list-style-type: none"> <li>▪ <b>SVM Name:</b> svm_black</li> <li>▪ <b>IPspace:</b> Default</li> <li>▪ <b>Volume Type:</b> Flexible volumes</li> <li>▪ <b>Data Protocols:</b> iSCSI</li> <li>▪ <b>Default Language:</b> C.UTF-8 [ c.utf_8 ]</li> <li>▪ <b>Security Style:</b> UNIX</li> <li>▪ <b>Root Aggregate:</b> rtp01_fcal_001</li> </ul>
5.	Leave the DNS Configuration options at the default settings, and then click <b>Submit &amp; Continue</b> .

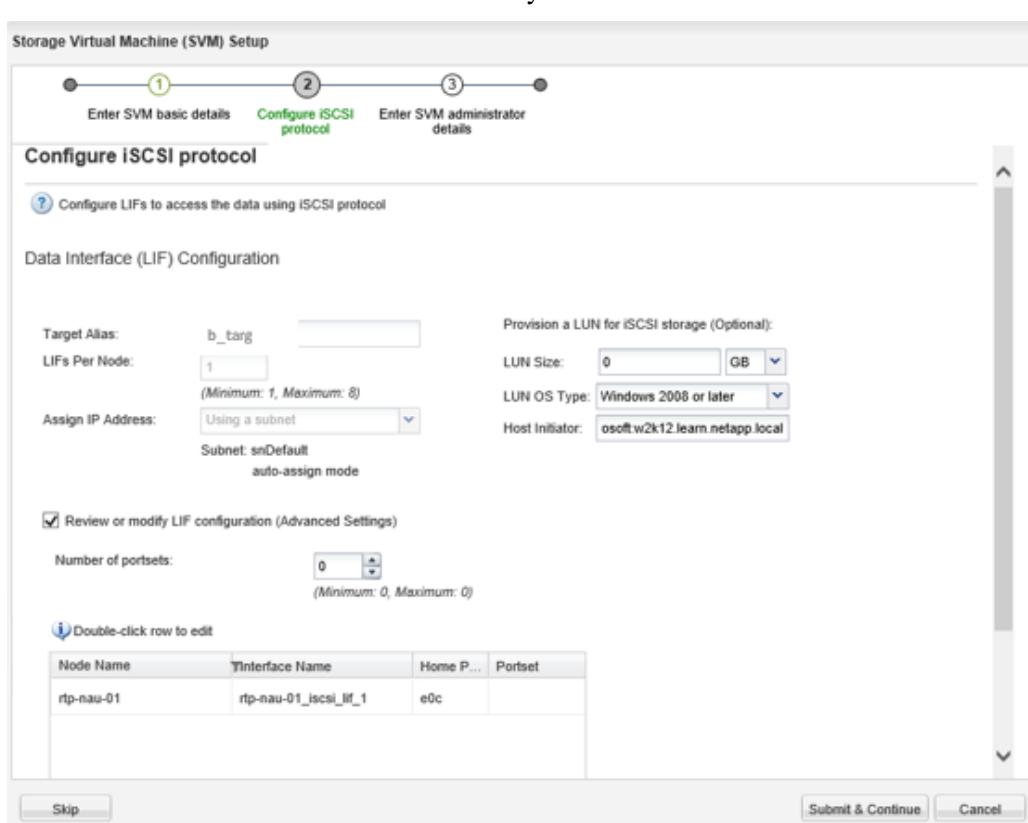
The screenshot displays the 'Storage Virtual Machine (SVM) Setup' dialog box. The 'SVM Details' section contains the following configuration:

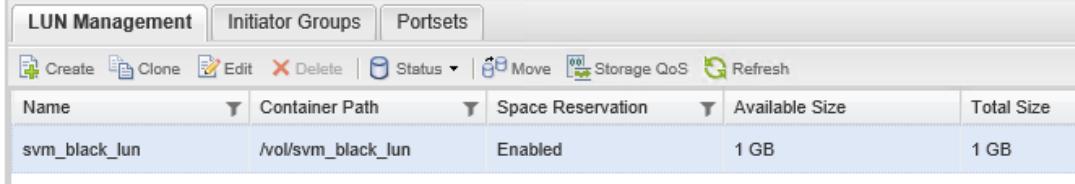
- SVM Name: svm\_black
- IPspace: Default
- Volume Type: FlexVol volumes (selected)
- Data Protocols: CIFS, NFS, iSCSI (iSCSI is checked)
- Default Language: C.UTF-8 [ c.utf\_8 ]
- Security Style: UNIX
- Root Aggregate: rtp01\_fcal\_001

The 'DNS Configuration' section specifies the following:

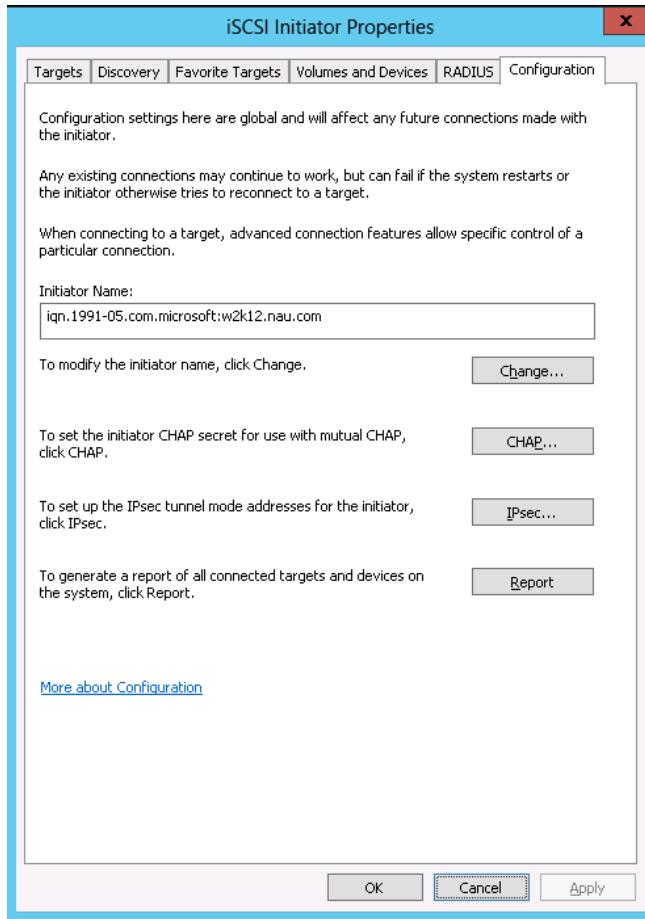
- Search Domains: learn.netapp.local
- Name Servers: 192.168.0.11

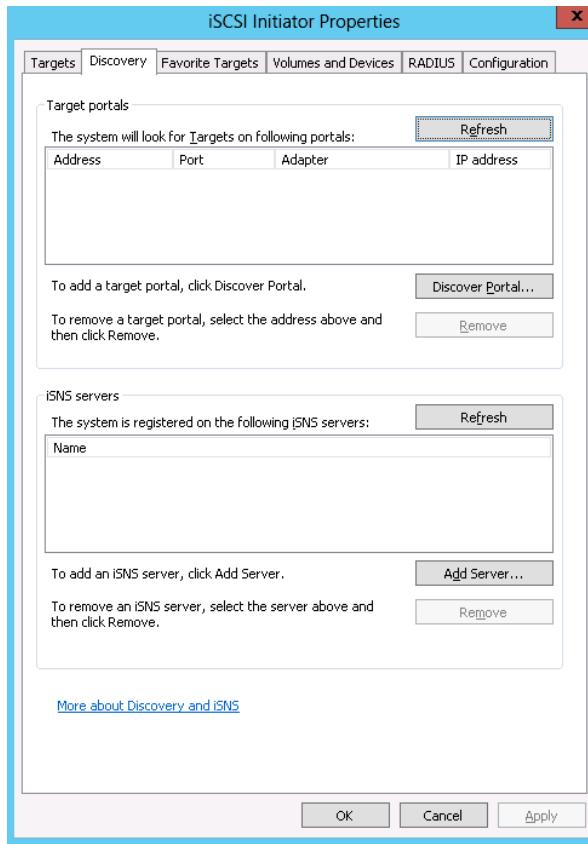
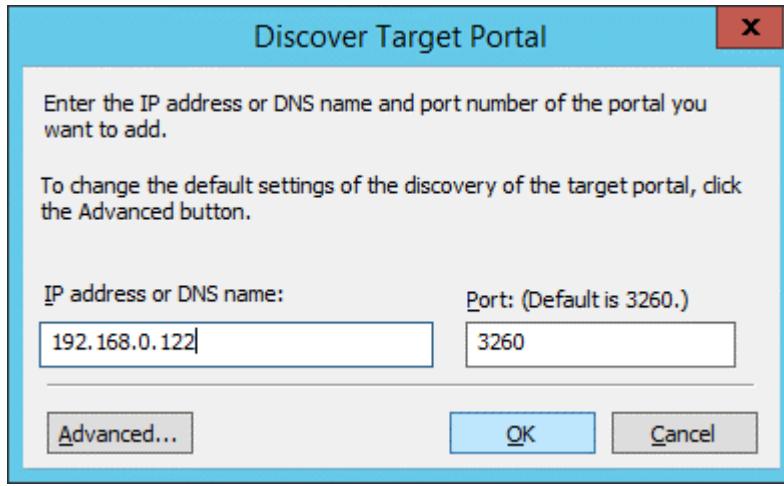
At the bottom right of the dialog are the 'Submit & Continue' and 'Cancel' buttons.

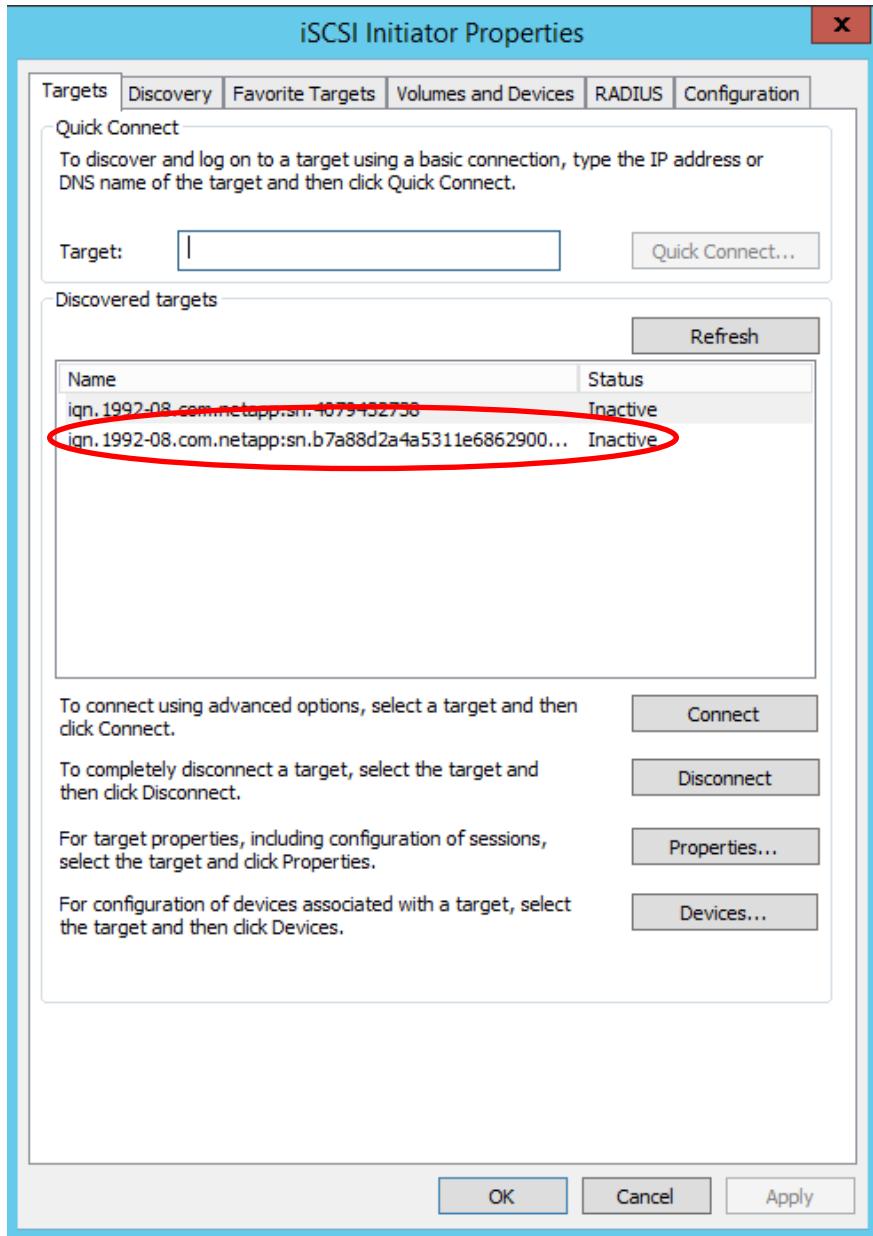
STEP	ACTION
6.	<p>On the Configure iSCSI protocol page, set the following parameters:</p> <ul style="list-style-type: none"> <li>▪ <b>Target Alias:</b> b_targ</li> <li>▪ <b>LIFs Per Node:</b> 1</li> <li>▪ <b>Assign IP Address:</b> Using a subnet</li> <li>▪ <b>Subnet:</b> snDefault</li> <li>▪ <b>auto-assign mode:</b> Selected</li> <li>▪ <b>Review or Modify LIFs configuration (Advanced Settings) checkbox:</b> Selected</li> <li>▪ <b>Number of portsets:</b> 0</li> <li>▪ <b>LUN Size:</b> 1 GB</li> <li>▪ <b>LUN OS Type:</b> Windows 2008 or later</li> <li>▪ <b>Host initiator:</b> &lt;Insert the initiator that you recorded earlier.&gt;</li> </ul> 
7.	Click <b>Submit &amp; Continue</b> .
8.	On the SVM administration page, click <b>Skip</b> .
9.	Review the summary, and then click <b>OK</b> .

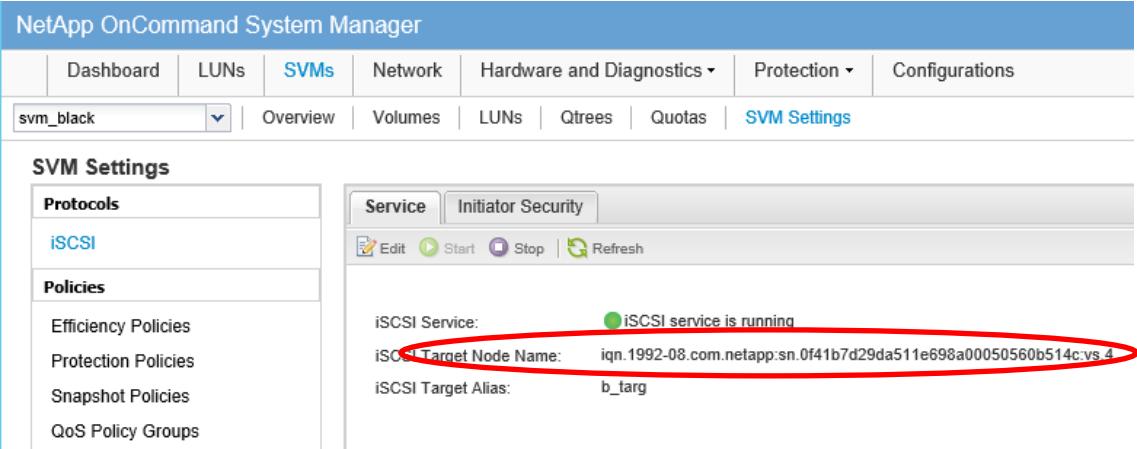
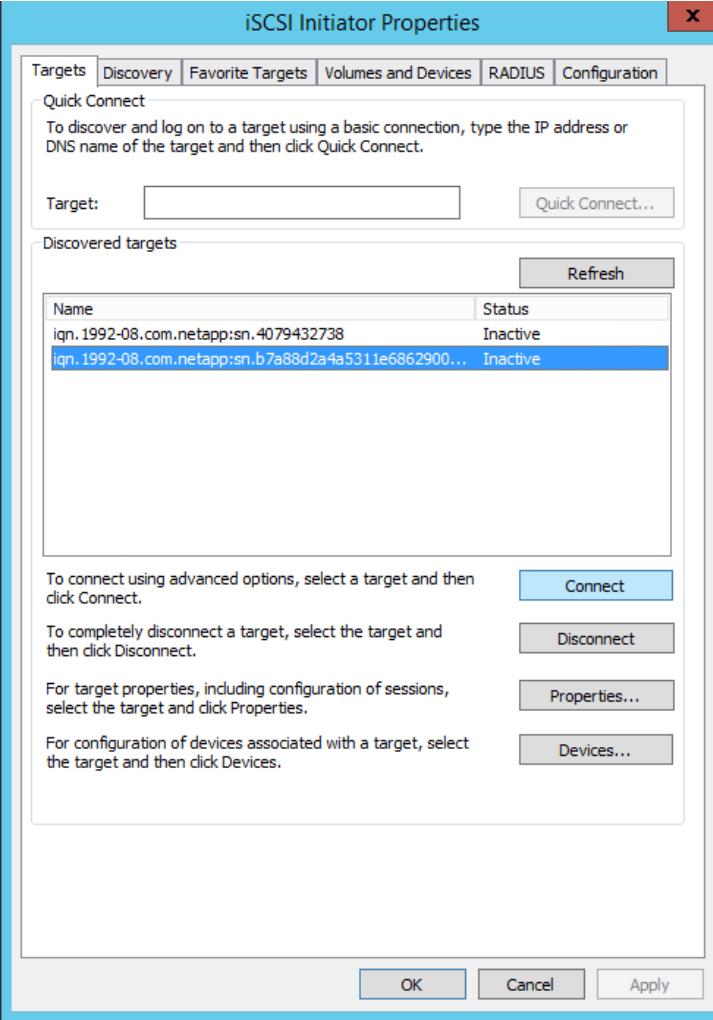
STEP	ACTION										
10.	<p>In the Protocol Status pane, click iSCSI to review the configuration.</p>  <p>The screenshot shows the 'Protocol Status' interface with the 'iSCSI' tab selected. It displays the following information:</p> <ul style="list-style-type: none"> <li>iSCSI Service: iSCSI service is running (green)</li> <li>iSCSI Target Node Name: iqn.1992-08.com.netapp.sn.b7a88d2a4a5311e686290050560b40cd:vs.6</li> <li>iSCSI Target Alias: black_target</li> </ul> <p>Below this, the 'iSCSI Interfaces' section shows a table with the following data:</p> <table border="1"> <thead> <tr> <th>Network Interface</th> <th>Target Portal Group</th> <th>IP Address</th> <th>Current Port</th> <th>Enabled for iSCSI</th> </tr> </thead> <tbody> <tr> <td>rtp-nau-01_iscsi_lif_1</td> <td>1028</td> <td>192.168.0.121</td> <td>rtp-nau-01.e0c</td> <td>Yes</td> </tr> </tbody> </table>	Network Interface	Target Portal Group	IP Address	Current Port	Enabled for iSCSI	rtp-nau-01_iscsi_lif_1	1028	192.168.0.121	rtp-nau-01.e0c	Yes
Network Interface	Target Portal Group	IP Address	Current Port	Enabled for iSCSI							
rtp-nau-01_iscsi_lif_1	1028	192.168.0.121	rtp-nau-01.e0c	Yes							
11.	Record the IP address of the iSCSI logical interface (LIF) for use in the next task.										
12.	<p>Proceed to the LUNs page to view the LUN that the wizard created.</p>  <p>The screenshot shows the 'LUNs' page with the 'LUN Management' tab selected. It displays a table with the following data:</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Container Path</th> <th>Space Reservation</th> <th>Available Size</th> <th>Total Size</th> </tr> </thead> <tbody> <tr> <td>svm_black_lun</td> <td>/vol/svm_black_lun</td> <td>Enabled</td> <td>1 GB</td> <td>1 GB</td> </tr> </tbody> </table>	Name	Container Path	Space Reservation	Available Size	Total Size	svm_black_lun	/vol/svm_black_lun	Enabled	1 GB	1 GB
Name	Container Path	Space Reservation	Available Size	Total Size							
svm_black_lun	/vol/svm_black_lun	Enabled	1 GB	1 GB							

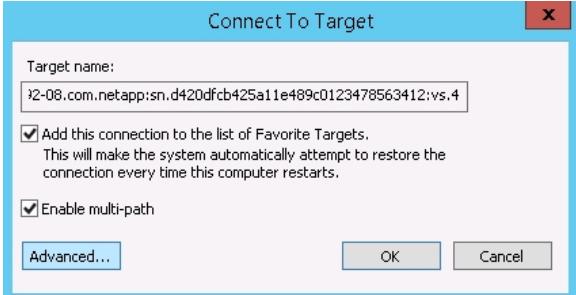
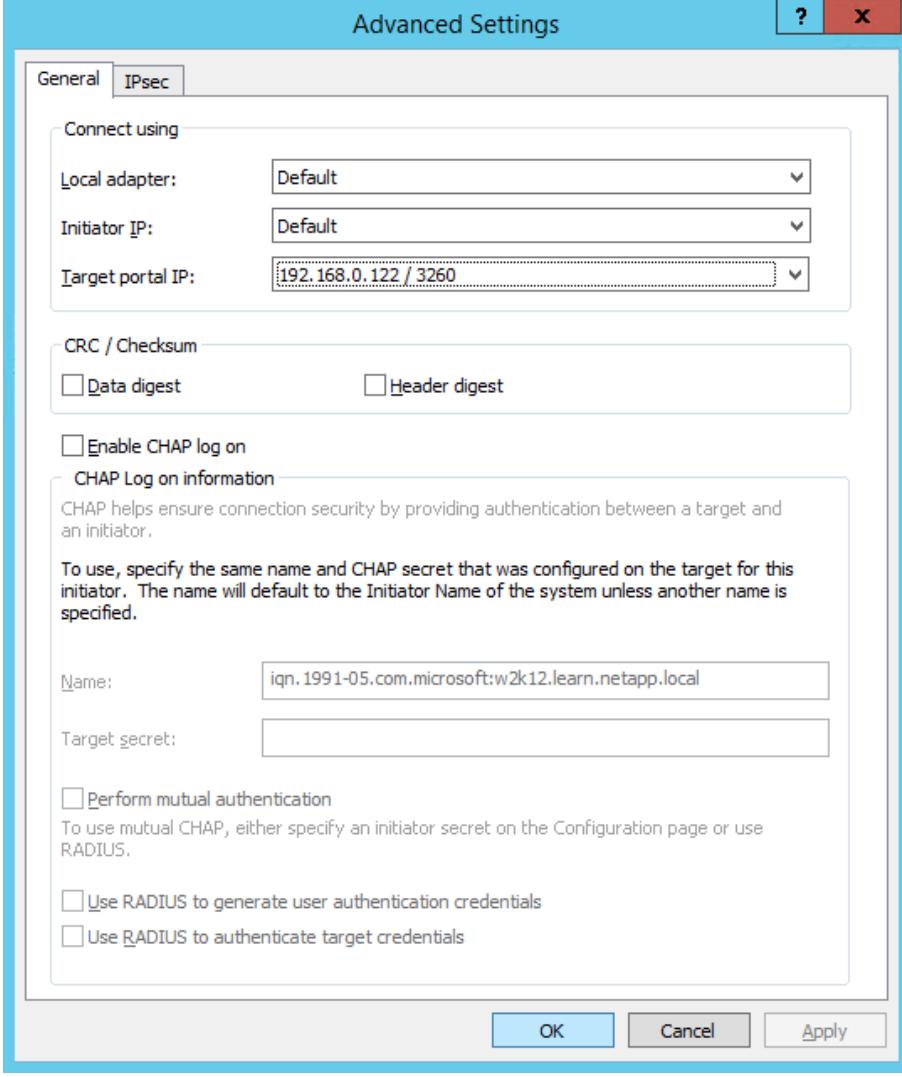
## TASK 4: CONFIGURE THE iSCSI SOFTWARE INITIATOR ON THE WINDOWS HOST

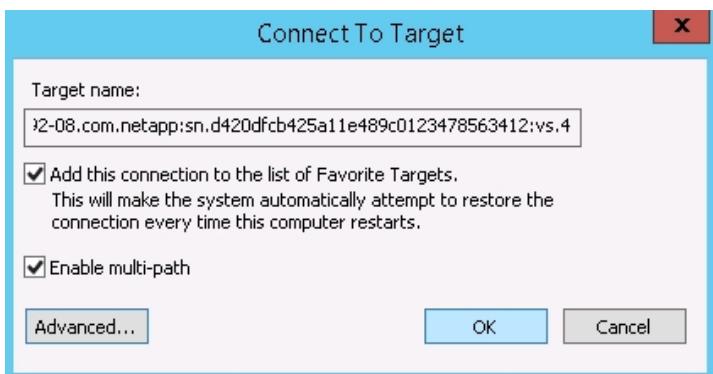
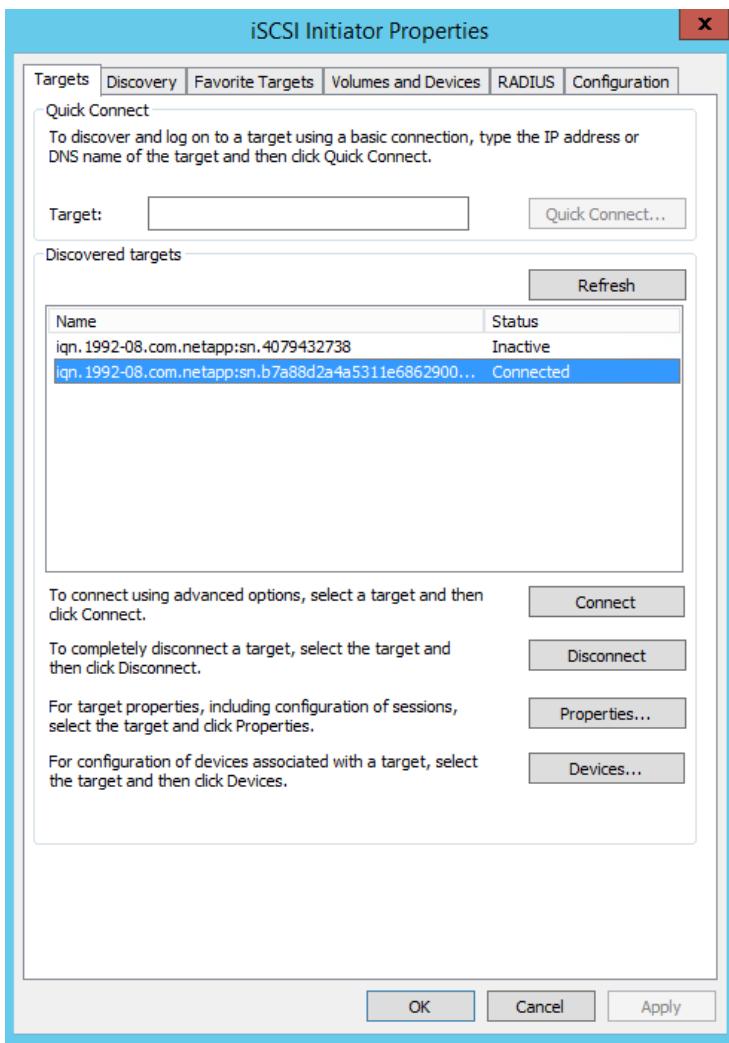
STEP	ACTION
1.	<p>Return to the iSCSI Initiator Properties window.</p>  <p>The screenshot shows the 'iSCSI Initiator Properties' dialog box. The 'Configuration' tab is selected. It displays global configuration settings that affect future connections. Key sections include:</p> <ul style="list-style-type: none"> <li><b>Initiator Name:</b> Set to 'iqn.1991-05.com.microsoft:w2k12.nau.com'.</li> <li><b>CHAP...</b>: To set the initiator CHAP secret for mutual CHAP.</li> <li><b>IPsec...</b>: To set up IPsec tunnel mode addresses.</li> <li><b>Report</b>: To generate a report of connected targets and devices.</li> <li><b>More about Configuration</b>: A link for detailed information.</li> </ul> <p>At the bottom are 'OK', 'Cancel', and 'Apply' buttons.</p>

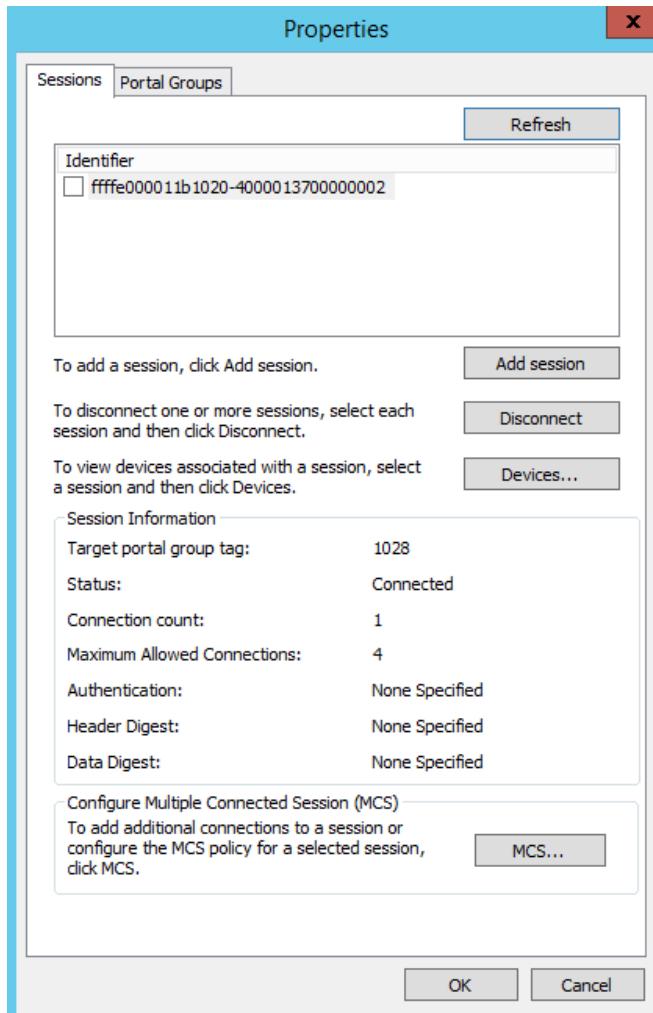
STEP	ACTION
2.	<p>Click the <b>Discovery</b> tab.</p> 
3.	Click <b>Discover Portal</b> .
4.	<p>In the Discover Target Portal dialog box, complete the following steps:</p> <ol style="list-style-type: none"> <li>In the IP address or DNS name field, enter the IP address of the iSCSI data LIF in <code>svm_black</code>.</li> <li>Click <b>OK</b>.</li> </ol> 

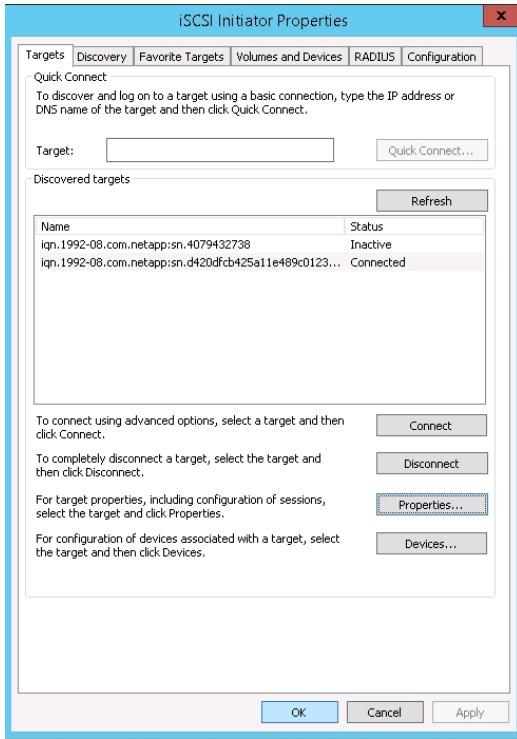
STEP	ACTION						
5.	<p>Click the <b>Targets</b> tab.</p> <p>The list on this tab should include an IQN name that matches the iSCSI Target Node Name that you discover in the next step.</p>  <table border="1"> <thead> <tr> <th>Name</th> <th>Status</th> </tr> </thead> <tbody> <tr> <td>iqn.1992-08.com.netapp:sn.1079452736</td> <td>Inactive</td> </tr> <tr> <td>iqn.1992-08.com.netapp:sn.b7a88d2a4a5311e6862900...</td> <td>Inactive</td> </tr> </tbody> </table>	Name	Status	iqn.1992-08.com.netapp:sn.1079452736	Inactive	iqn.1992-08.com.netapp:sn.b7a88d2a4a5311e6862900...	Inactive
Name	Status						
iqn.1992-08.com.netapp:sn.1079452736	Inactive						
iqn.1992-08.com.netapp:sn.b7a88d2a4a5311e6862900...	Inactive						

STEP	ACTION
6.	In System Manager, click <b>SVM Settings</b> , and then verify that the iSCSI Target Node Name matches a node name in the Discovered targets list in the previous step.  
7.	Return to the iSCSI Initiator Properties dialog box on your Windows machine.
8.	Select the correct target in the list, and then click <b>Connect</b> .  

STEP	ACTION
9.	<p>In the Connect To Target dialog box, select the <b>Enable multi-path</b> checkbox, and then click <b>Advanced</b>.</p> 
10.	<p>In the Advanced Settings dialog box, in the <b>Target portal IP</b> list, select the target portal IP address, and then click <b>OK</b>.</p> 

STEP	ACTION
11.	<p>Click <b>OK</b> to close the Connect To Target dialog box and start a new iSCSI session between the initiator and target.</p> 
12.	<p>In the iSCSI Initiator Properties dialog box, verify that the correct target is in a Connected status.</p> 
13.	<p>Click <b>Properties</b>.</p>

STEP	ACTION
14.	<p>In the Properties dialog box, on the Sessions tab, verify that a new session was created.</p>  <p>The screenshot shows the 'Properties' dialog box with the 'Sessions' tab selected. A new session entry is listed under 'Identifier': fffffe000011b1020-4000013700000002. Below the list, there are instructions and buttons for managing sessions: 'Add session', 'Disconnect', and 'Devices...'. A section titled 'Session Information' provides details about the session, including its target portal group tag (1028), status (Connected), connection count (1), maximum allowed connections (4), authentication (None Specified), header digest (None Specified), and data digest (None Specified). A 'Configure Multiple Connected Session (MCS)' section includes a 'MCS...' button. At the bottom are 'OK' and 'Cancel' buttons.</p>
15.	Click <b>OK</b> to close the Properties window.

STEP	ACTION
16.	<p>Click <b>OK</b> to close the iSCSI Initiator Properties window.</p> 
17.	Close the Control Panel.

**END OF EXERCISE**

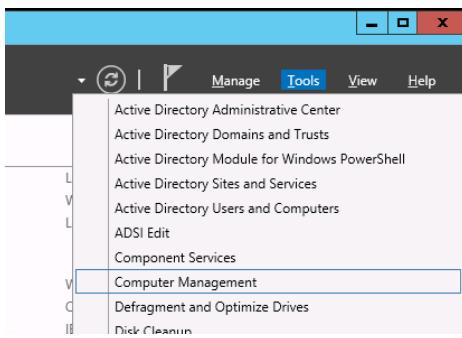
## EXERCISE 2: ACCESSING A LUN FROM A WINDOWS HOST

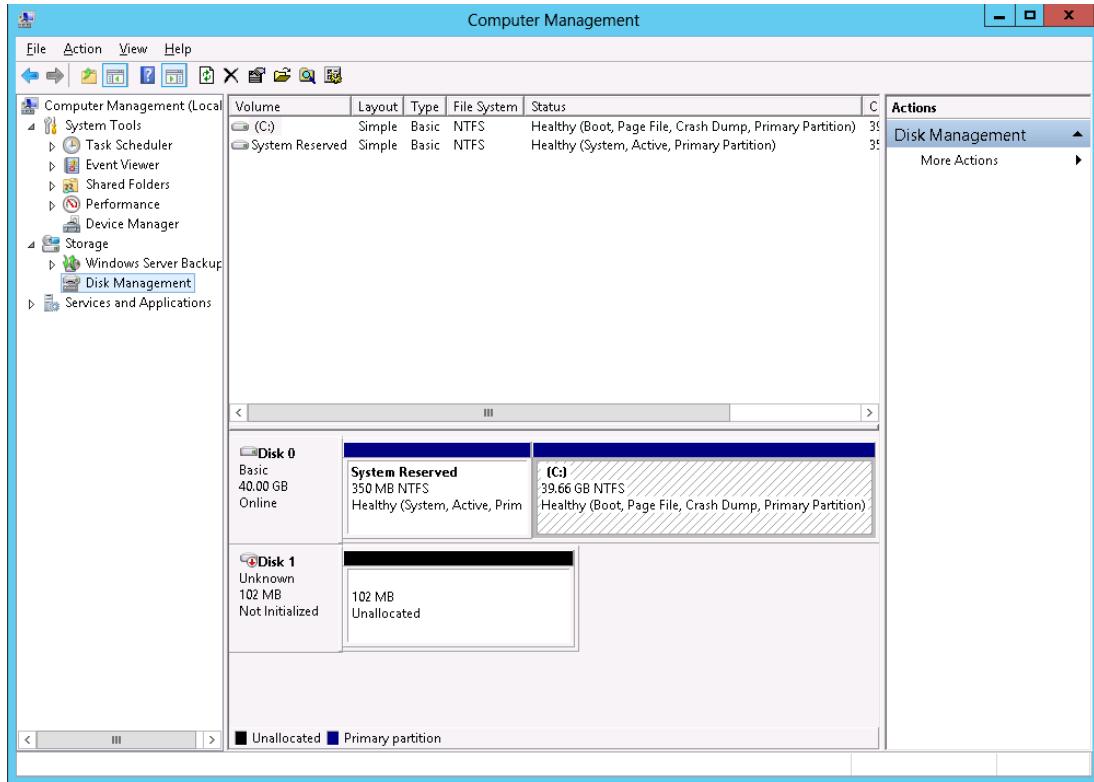
In this exercise, you access and prepare an iSCSI-attached LUN on the Windows host.

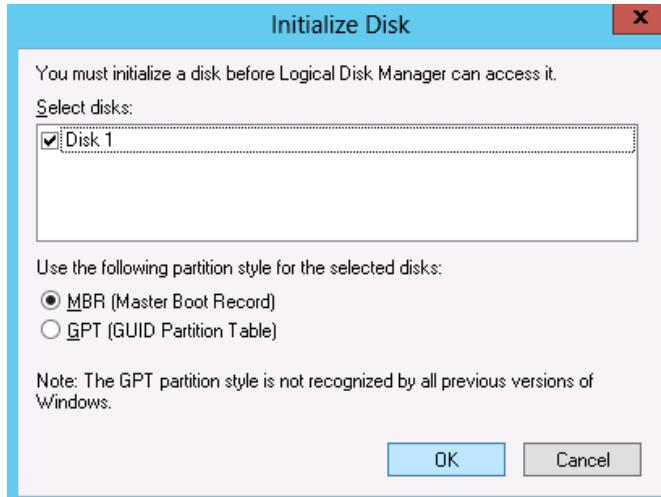
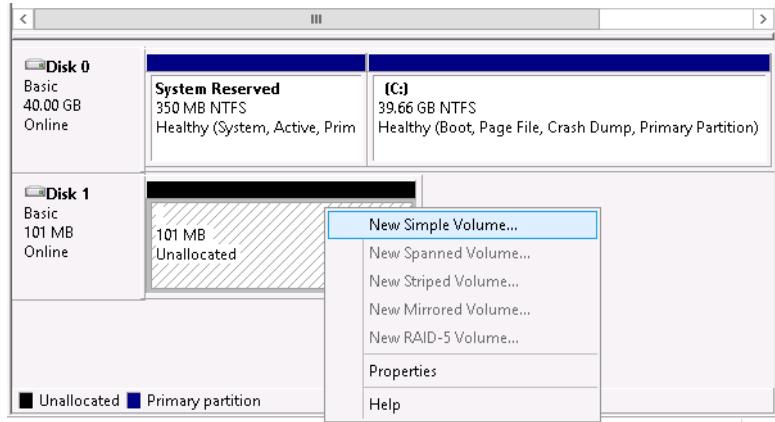
### OBJECTIVES

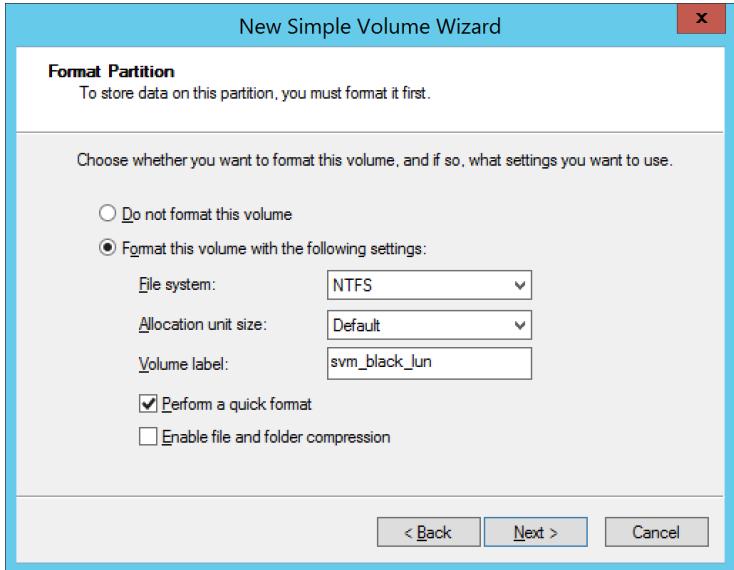
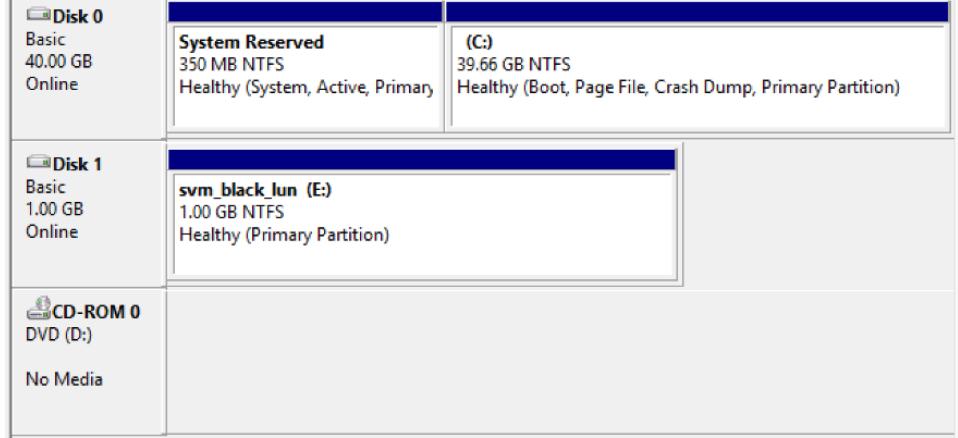
This exercise focuses on enabling you to access the iSCSI-attached LUN on the initiator.

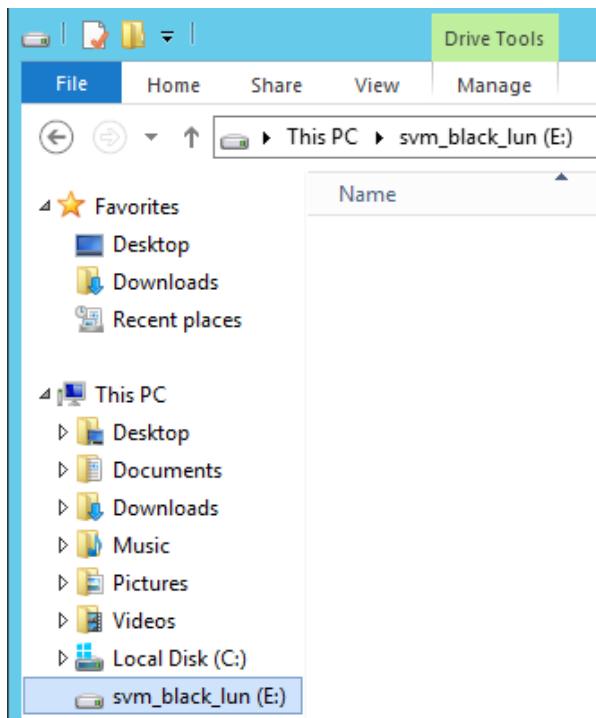
### TASK 1: ACCESS THE ISCSI-ATTACHED LUN FROM THE WINDOWS HOST

STEP	ACTION
1.	In Windows, open Server Manager. 
2.	On the toolbar in the upper-right corner of the window, click <b>Tools</b> , and then select <b>Computer Management</b> . 

STEP	ACTION
3.	<p>In the left navigation pane, expand the <b>Storage</b> node, and then select <b>Disk Management</b>.</p> <p>The LUN appears as a single disk object. All paths are merged into this object.</p> 
4.	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> .
5.	If the disk is Offline, right-click the disk header, and then select <b>Online</b> .
6.	Right-click the disk header again, and then select <b>Initialize Disk</b> .

STEP	ACTION
7.	<p>Review the Initialize Disk dialog box, and then click <b>OK</b>.</p> <p>The disk should come online.</p>  <p>The dialog box has a title bar "Initialize Disk" with a close button "X". Inside, it says "You must initialize a disk before Logical Disk Manager can access it." Below is a section "Select disks:" with a checkbox "Disk 1" which is checked. Underneath, it says "Use the following partition style for the selected disks:" with two radio buttons: "MBR (Master Boot Record)" (selected) and "GPT (GUID Partition Table)". A note at the bottom states "Note: The GPT partition style is not recognized by all previous versions of Windows." At the bottom right are "OK" and "Cancel" buttons.</p>
8.	<p>In the Disk Management pane, right-click the <b>Unallocated</b> partition, and then select <b>New Simple Volume</b>.</p>  <p>The screenshot shows the Windows Disk Management interface. On the left, there are two drives: "Disk 0" (Basic, 40.00 GB, Online) and "Disk 1" (Basic, 101 MB, Online). Disk 1 has one partition: "101 MB Unallocated". A context menu is open over this unallocated space, with the option "New Simple Volume..." highlighted. Other options in the menu include "New Spanned Volume...", "New Striped Volume...", "New Mirrored Volume...", "New RAID-5 Volume...", "Properties", and "Help".</p>
9.	On the introduction page of the New Simple Volume Wizard, click <b>Next</b> .
10.	On the Specify Volume Size page, click <b>Next</b> .
11.	On the Assign Drive Letter or Path page, click <b>Next</b> .

STEP	ACTION
12.	<p>On the Format Partition page, complete the following steps:</p> <ol style="list-style-type: none"> <li>In the Volume label field, enter <b>svm_black_lun</b>.</li> <li>Select the <b>Perform a quick format</b> checkbox.</li> <li>Click <b>Next</b>.</li> </ol> 
13.	Review the Completing page, and then click <b>Finish</b> .
14.	Verify that the new LUN is provisioned, and then close the Computer Management window. 
15.	Close Server Manager.

STEP	ACTION
16.	In Windows Explorer, navigate to the mount location of the LUN, and then verify that you can create a file in the LUN.  

END OF EXERCISE

## MODULE 10: CLUSTER MAINTENANCE

### EXERCISE 1: EXPLORING THE EVENT LOG

#### OBJECTIVES

- This exercise focuses on enabling you to explore the event log.
- Configure and demonstrate storage quality of service (QoS)
- Explore the headroom feature

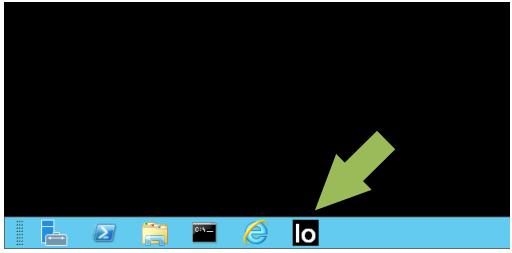
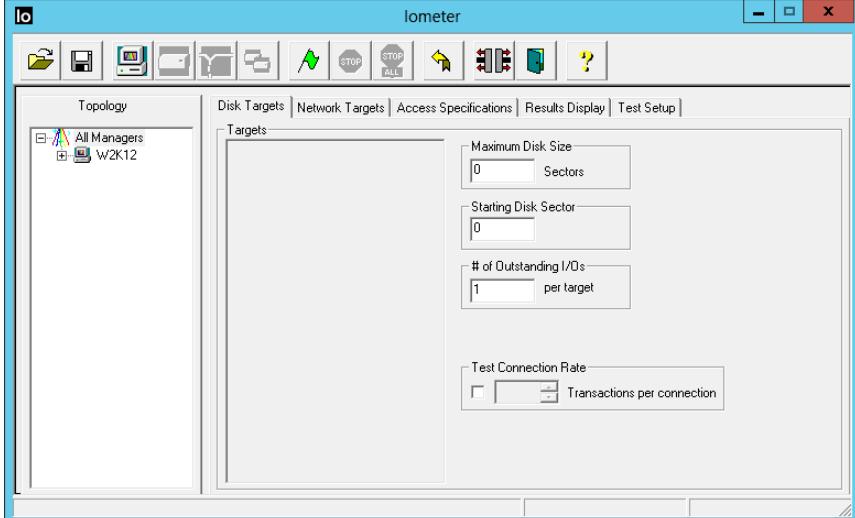
#### TASK 1: EXPLORE THE EVENT LOG

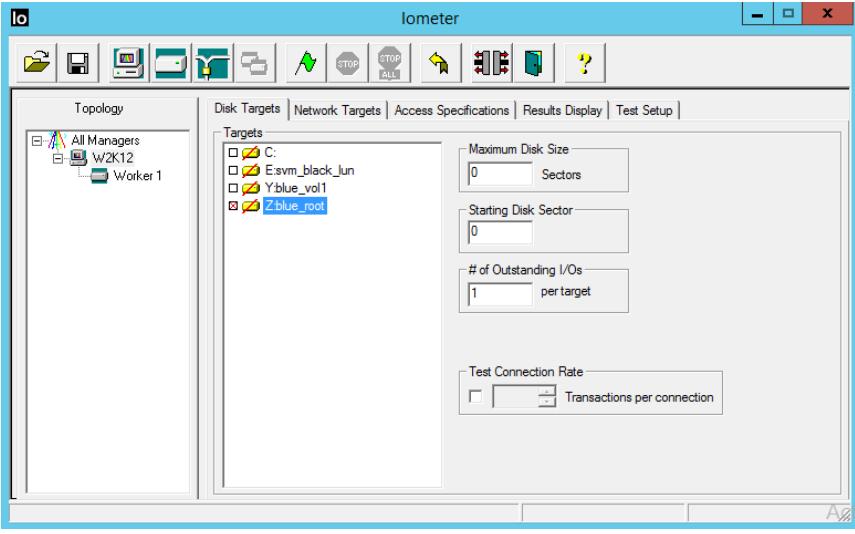
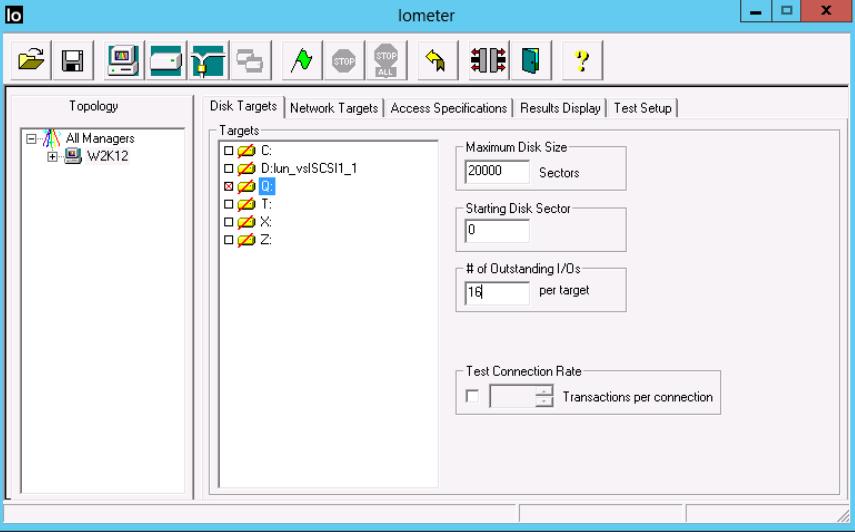
STEP	ACTION
1.	Use PuTTY to start a clustershell session with svl-nau.
2.	View the event log: <code>event log show</code>
3.	Press <b>q</b> to exit the display.
4.	 Set the PuTTY window as wide as possible to make log viewing easier.
5.	View the options of the <code>event log show</code> command: <code>event log show ?</code>
6.	View events that occurred within the past 4 hours: <code>event log show -time &gt;4h</code>
7.	View events that occurred within a specific time range: <code>event log show -time "08/25/2016 06:00:00".."08/25/2016 12:00:00"</code>
8.	 Use a time frame from today's date.
9.	Display any Emergency events: <code>event log show -severity EMERGENCY</code>
10.	Display events with a severity level of Error or more severe: <code>event log show -severity ERROR</code>
11.	 Severity levels sort in an order opposite of what you might expect.
12.	Display events from the past 48 hours that contain the word "disk": <code>event log show -event *disk* -time &gt;4h</code>

## TASK 2: COLLECT STATISTICS FOR THE HEADROOM FEATURE

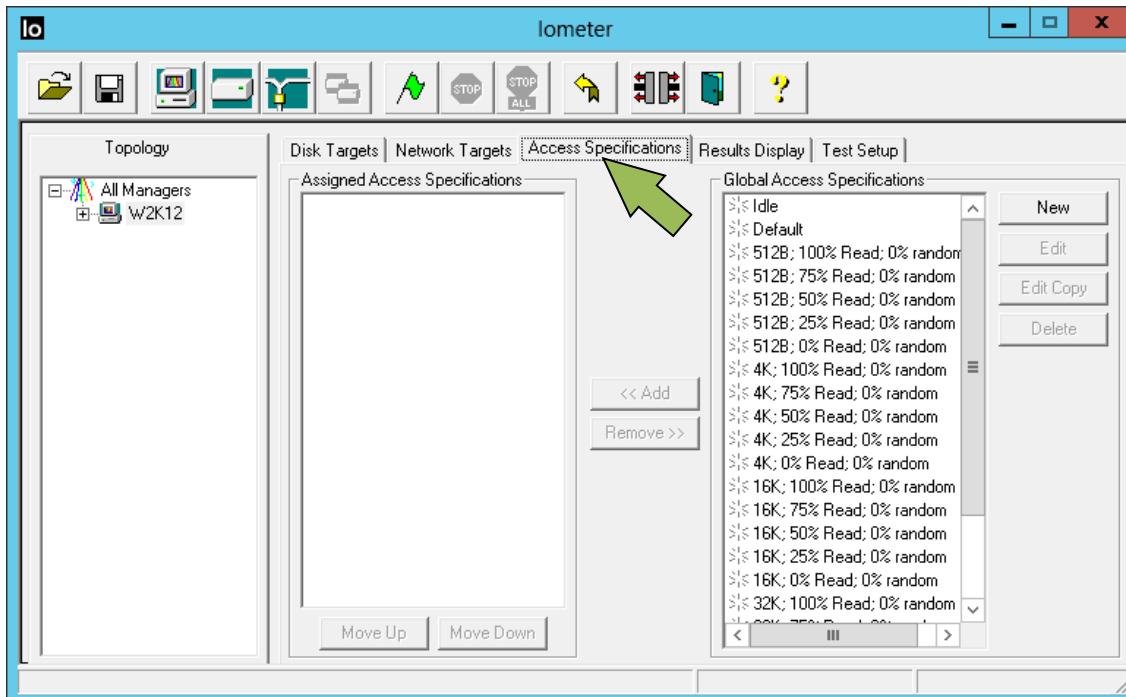
STEP	ACTION
1.	From the PuTTY session with cluster rtp-nau, start statistics collection for CPU headroom analysis later in the exercise:  <code>statistics start -sample-id hr_cpu -object resource_headroom_cpu</code>
2.	 Be sure that you logged on to the correct cluster.

## TASK 3: CREATE A WORKLOAD ON AN SVM BY USING IOMETER

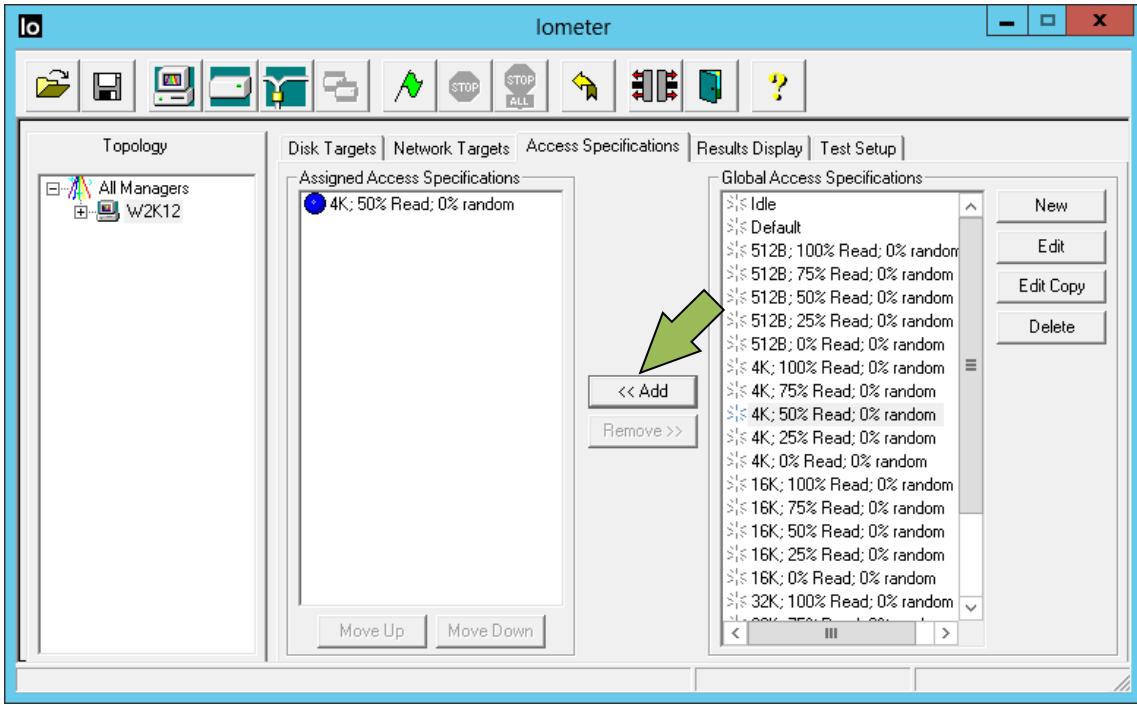
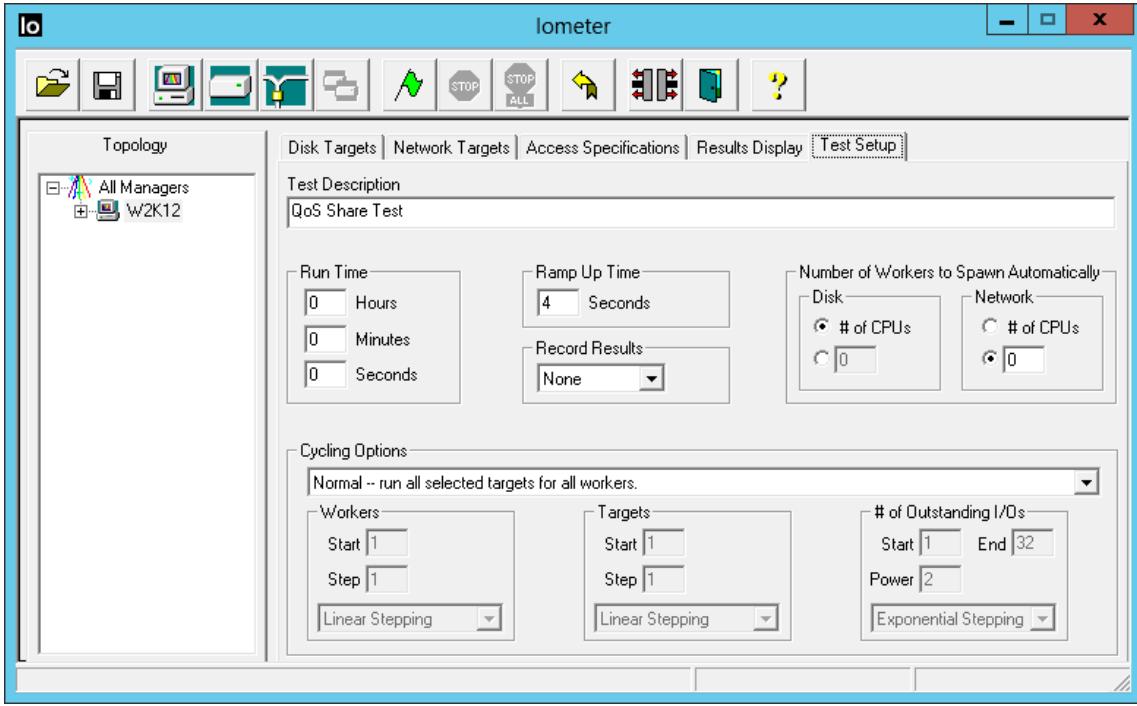
STEP	ACTION
1.	Open <b>Iometer</b> by double-clicking its icon in the taskbar and, if prompted, approving the Iometer EULA.  
2.	Wait for the Iometer dialog box to open.  

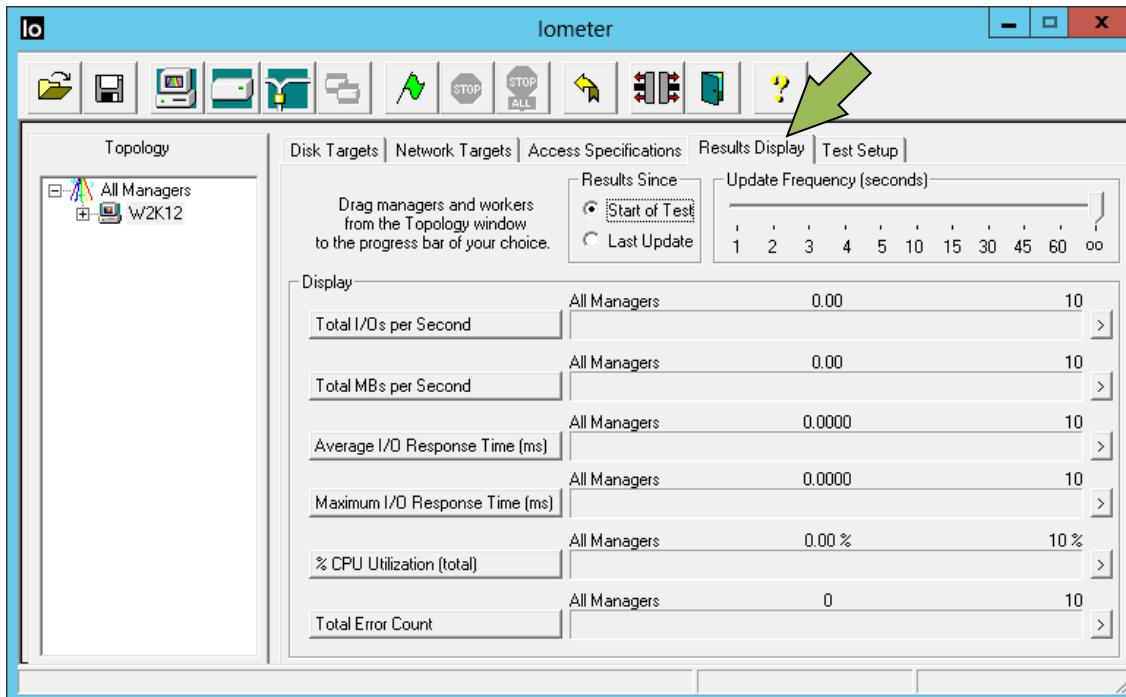
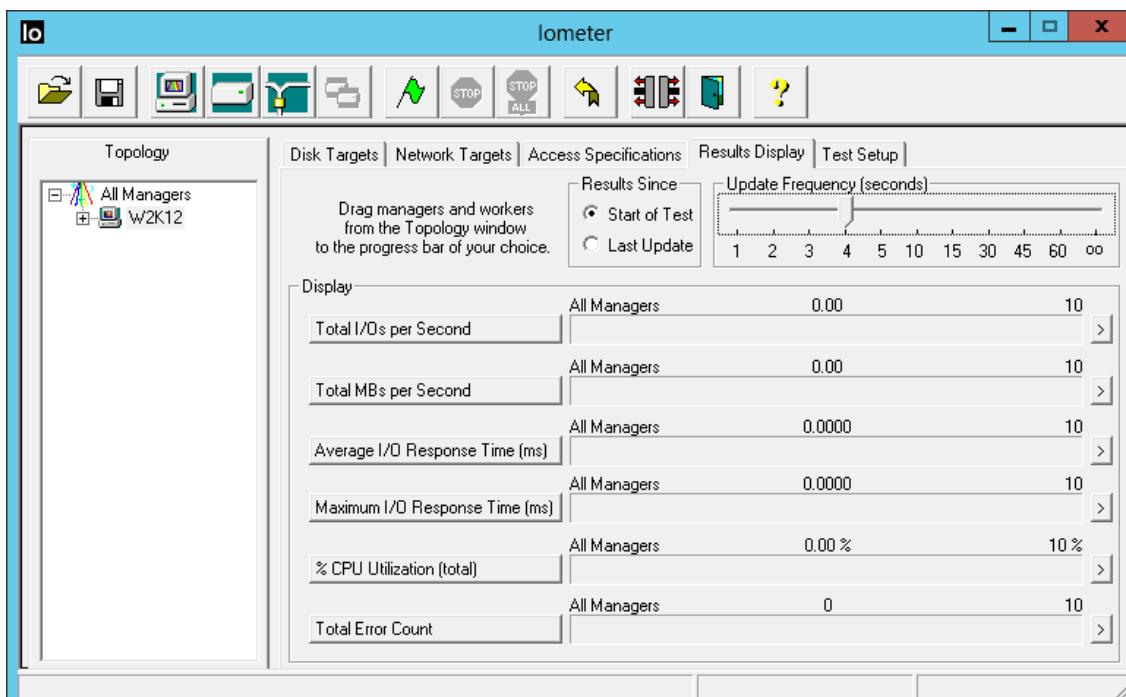
STEP	ACTION
3.	In the left pane, select the <b>W2K12</b> node.
4.	<p>On the Disk Targets tab, set the following parameters:</p> <ul style="list-style-type: none"> <li>▪ <b>Targets: Z</b></li> <li>▪ <b>Maximum Disk Size: 20000</b></li> <li>▪ <b>Starting Disk Sector: 0</b></li> <li>▪ <b># of Outstanding I/Os: 16</b></li> </ul>  

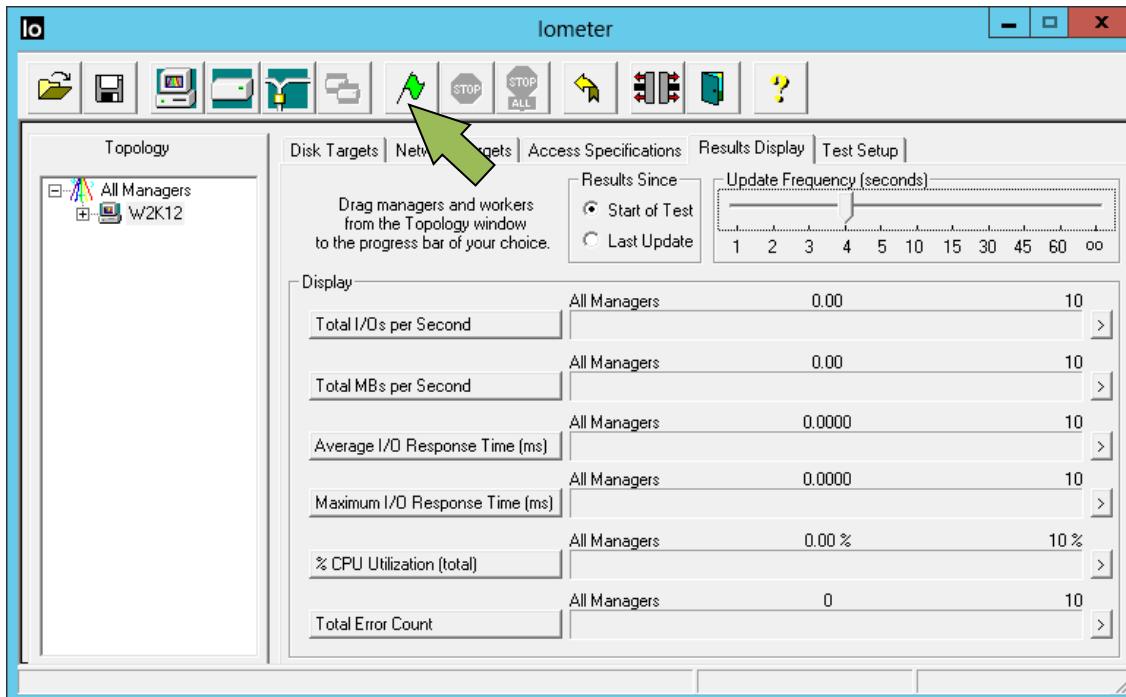
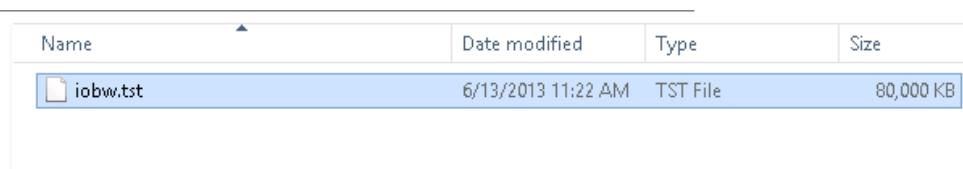
STEP	ACTION
5.	Click the Access Specifications tab.
6.	In the Global Access Specifications list, select <b>4k; 50% Read; 0% random</b> .

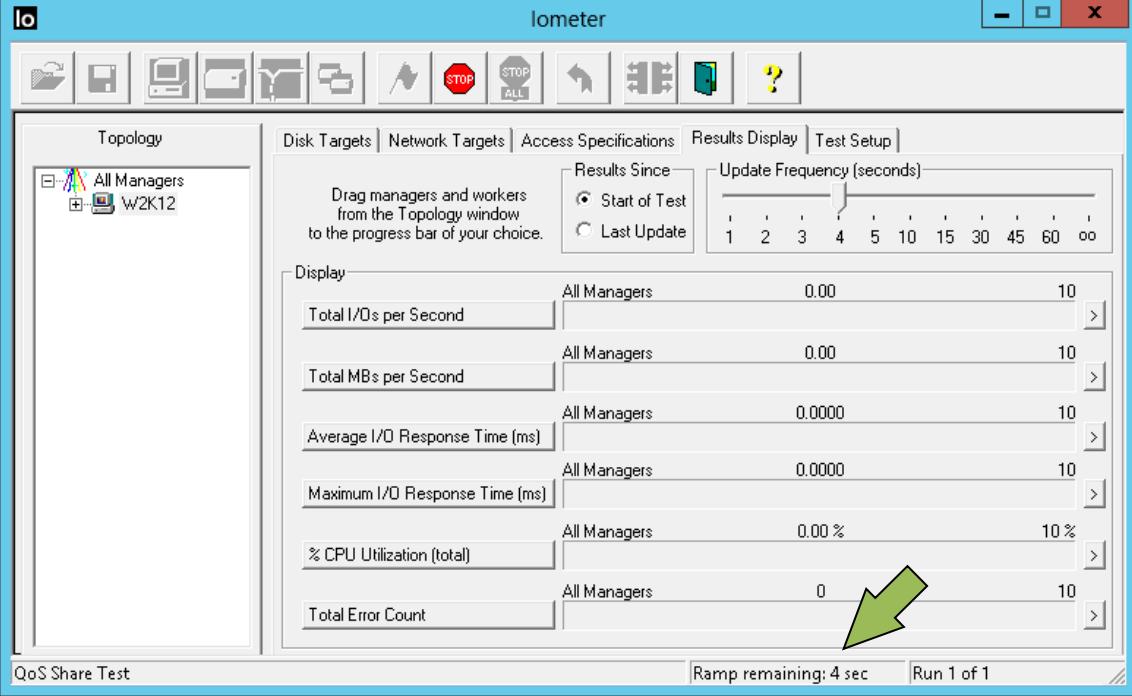
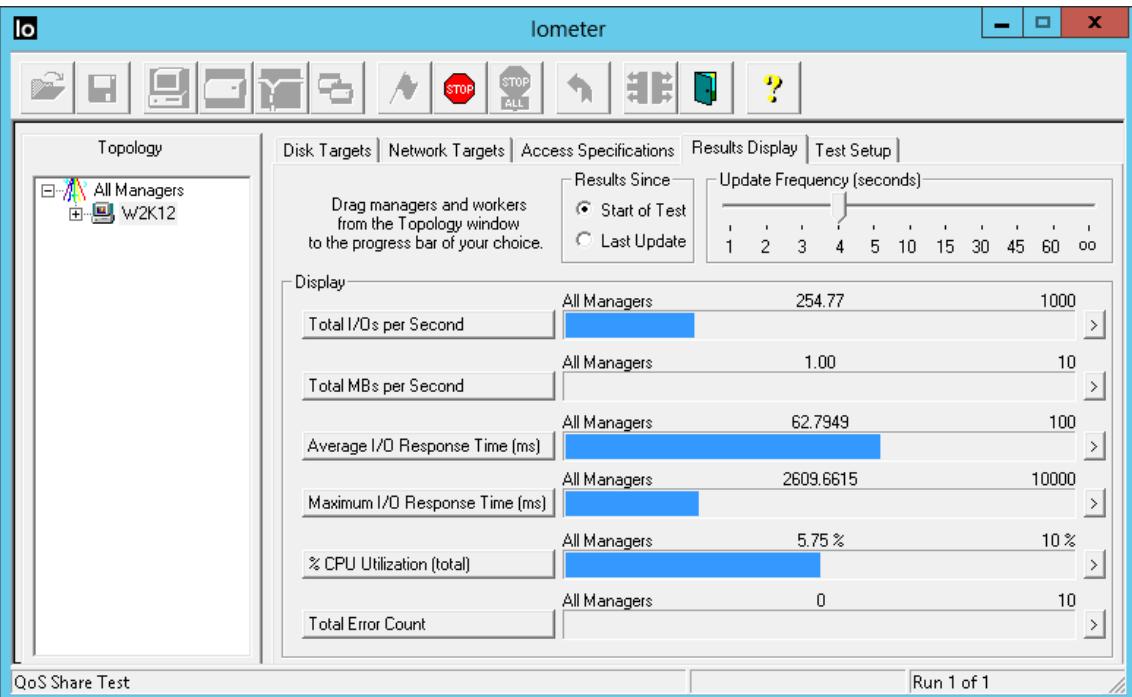


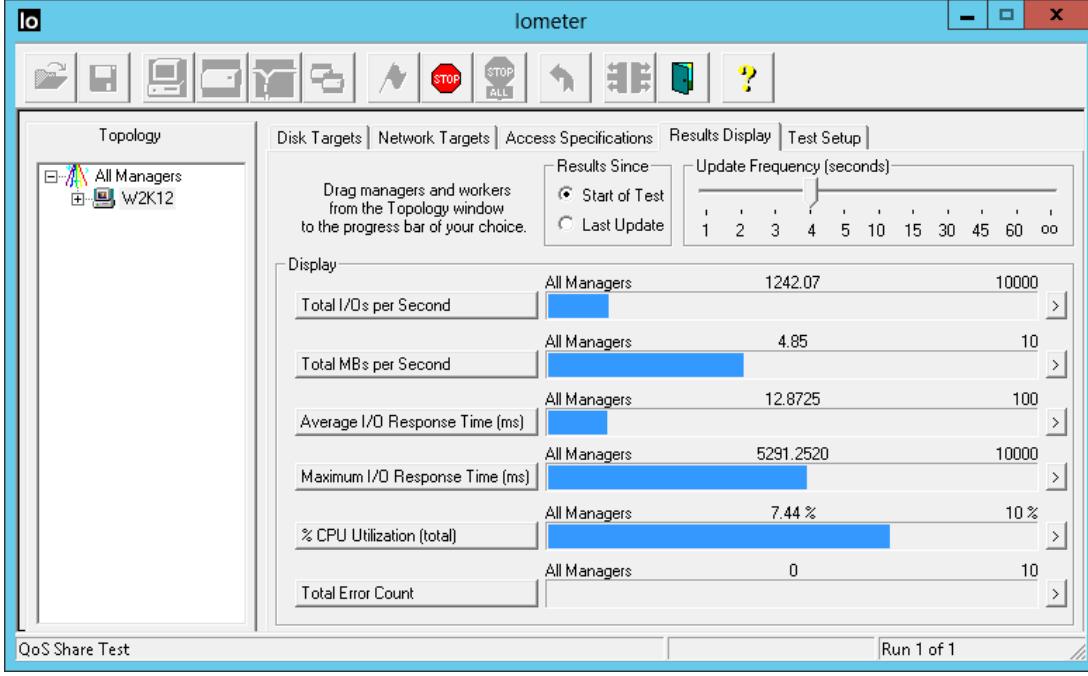
The screenshot shows the Iometer application window. The 'Access Specifications' tab is active. On the left, there's a 'Topology' pane showing 'All Managers' and 'W2K12'. In the center, there's an 'Assigned Access Specifications' pane which is currently empty. On the right, the 'Global Access Specifications' pane lists several access patterns. One pattern, '4K; 50% Read; 0% random', is highlighted with a blue background. A green arrow points to the 'Access Specifications' tab at the top of the window.

STEP	ACTION
7.	Click the <b>Add</b> button.
	 <p>The screenshot shows the Iometer software window with the 'Access Specifications' tab selected. On the left, under 'Assigned Access Specifications', there is a list containing one item: '4K; 50% Read; 0% random'. Below this list are two buttons: '&lt;&lt; Add' and 'Remove &gt;&gt;'. To the right of the assigned list is a larger 'Global Access Specifications' list containing many items, such as 'Idle', 'Default', and various sizes and percentages of reads and writes. On the far right of the interface are four buttons: 'New', 'Edit', 'Edit Copy', and 'Delete'.</p>
8.	Click the <b>Test Setup</b> tab.
9.	<p>On the Test Setup tab, set the following parameters:</p> <ul style="list-style-type: none"> <li><b>Test Description:</b> QoS Share Test</li> <li><b>Ramp Up Time:</b> 4</li> <li><b>Record Results:</b> None</li> </ul>  <p>The screenshot shows the Iometer software window with the 'Test Setup' tab selected. In the 'Test Description' field, 'QoS Share Test' is entered. Under 'Ramp Up Time', the value is set to 4. In the 'Record Results' dropdown, 'None' is selected. The 'Number of Workers to Spawn Automatically' section contains two groups: 'Disk' (radio buttons for '# of CPUs' and '0') and 'Network' (radio buttons for '# of CPUs' and '0').</p>

STEP	ACTION
10.	<p>Click the <b>Results Display</b> tab.</p> 
11.	<p>Set the Update Frequency (seconds) slider to <b>4</b>.</p> <p>The setting reduces the load on the Windows machine to update the Iometer interface.</p> 

STEP	ACTION
12.	In the toolbar, click the Start Tests button (a green flag).
13.	<p>Open File Explorer to the Z drive and notice the new file, iobw.tst.</p> <p>This file is the test file and grows until it is 80,000 KB (20,000 x 4 KB).</p>  

STEP	ACTION
14.	<p>Notice that, when the file reaches its maximum size, the ramp up time begins to count down for 4 seconds.</p> <p>The ramp up time helps to ensure that the storage is stable before the tests begin.</p> 
15.	<p>When the 50% read and 50% write test results begin to appear, notice that the total I/Os per second are recorded on the top row of the display output.</p> 

STEP	ACTION																					
16.	 On the test system, the Total I/Os per second range from 110 to 1245. The system is a Windows machine and a cluster running in shared virtualized environment.																					
17.	Leave the test running.																					
18.	Open a PuTTY session with svl-nau.																					
19.	Show the current storage QoS policies: <pre>qos policy-group show</pre> Sample output: This table is currently empty.																					
20.	Switch back to the Iometer to see the current total I/Os per second.  <p>The screenshot shows the Iometer interface with the following data:</p> <table border="1"> <thead> <tr> <th>Metric</th> <th>Value</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>Total I/Os per Second</td> <td>1242.07</td> <td>10000</td> </tr> <tr> <td>Total MBs per Second</td> <td>4.85</td> <td>10</td> </tr> <tr> <td>Average I/O Response Time (ms)</td> <td>12.8725</td> <td>100</td> </tr> <tr> <td>Maximum I/O Response Time (ms)</td> <td>5291.2520</td> <td>10000</td> </tr> <tr> <td>% CPU Utilization (total)</td> <td>7.44 %</td> <td>10 %</td> </tr> <tr> <td>Total Error Count</td> <td>0</td> <td>10</td> </tr> </tbody> </table>	Metric	Value	Unit	Total I/Os per Second	1242.07	10000	Total MBs per Second	4.85	10	Average I/O Response Time (ms)	12.8725	100	Maximum I/O Response Time (ms)	5291.2520	10000	% CPU Utilization (total)	7.44 %	10 %	Total Error Count	0	10
Metric	Value	Unit																				
Total I/Os per Second	1242.07	10000																				
Total MBs per Second	4.85	10																				
Average I/O Response Time (ms)	12.8725	100																				
Maximum I/O Response Time (ms)	5291.2520	10000																				
% CPU Utilization (total)	7.44 %	10 %																				
Total Error Count	0	10																				

#### TASK 4: CONFIGURE STORAGE QOS FOR AN SVM

STEP	ACTION
1.	Start a PuTTY session with rtp-nau.
2.	Verify the current throughput from storage: <pre>qos statistics performance show -iterations 4</pre>
3.	Create a storage QoS policy: <pre>qos policy-group create -policy-group pg-blue -vserver svm_blue -max-throughput 100iops</pre>
4.	Show the current storage QoS policies: <pre>qos policy-group show</pre>

STEP	ACTION
5.	Associate the policy to the SVM: <code>vserver modify -vserver svm_blue -qos-policy-group pg-blue</code>
6.	 You can associate a storage QoS policy to an SVM, LUN, volume, or file.
7.	Verify the current throughput from storage: <code>qos statistics performance show -iterations 4</code>
8.	Wait a few moments, and watch the Iometer Total I/Os per second drop.
9.	 You can continue to run the previous command to observe the current storage readings. The I/Os need nearly an hour to drop from 1500 to 100.
10.	When your testing is complete, on the toolbar, click the <b>Stop</b> button to stop the Iometer test.
11.	Close Iometer.

## TASK 5: EXPLORE HEADROOM STATISTICS FOR CPU

STEP	ACTION
1.	From the PuTTY session with cluster rtp-nau, stop the collection of statistics: <code>statistics stop -sample-id hr_cpu</code>
2.	View headroom statistics for CPU usage: <code>statistics show -object resource_headroom_cpu -sample-id hr_cpu</code>
3.	Review the statistics, especially the optimal_point stats and confidence factors. The ranges that you see are the optimal performance ranges to maintain a healthy cluster.
4.	 To learn more about the headroom feature and how to collect and interpret statistics, refer to the <i>ONTAP Performance Monitoring Power Guide</i> .

END OF EXERCISE

## MODULE 11: DATA PROTECTION FEATURES

There is no hands-on exercise for Module 11.