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## EXPLORING DATA ONTAP STORAGE FUNDAMENTALS

**EXERCISE 1: DATA ONTAP STORAGE**

In this exercise, you use the CLI and NetApp OnCommand System Manager to understand how to manage a cluster.

**OBJECTIVES**

By the end of this exercise, you should be able to:

* Connect to the clustershell and explore the command hierarchy
* Review command options
* Compare privilege levels
* Use complete commands and use partial commands with the Tab key
* Explore NetApp OnCommand System Manager for your cluster

### TASK 1: CONNECT TO THE CLUSTERSHELL

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| **STEP** | **ACTION** |
| **1.** | From your Windows desktop, start the PuTTY application. |

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| **2.** | In the PuTTY Configuration window, in the Saved Sessions area, select **cluster1**, click the **Load** button, and notice the IP address.  C:\Users\ciro.bessa\Documents\ebooks\NetApp\Apostila_Curso_Netapp\Apostilas_editadas\imagens_leonel\putty_configuration.PNG |
| **9.** | Click **Open** to start the Secure Shell (SSH) session. |
| **10.** | In the SSH key alert window, click **Yes** to continue. |
| **11.** | Log in to cluster1 with the user name **admin** and the password **Netapp1!** |
| **12.** | Remove the timeout threshold for sessions to the cluster.  **system timeout modify -timeout 0** |

### TASK 2: CONNECT TO THE CLUSTERSHELL AND EXPLORE THE COMMAND HIERARCHY

|  |  |
| --- | --- |
| **STEP** | **ACTION** |
| **1.** | Type a question mark (**?)** to review the commands and command directories at the top level of the command hierarchy.  **?**  **NOTE:** You don’t need to press **Enter** after typing a question mark.  **NOTE:** 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. |
| **2.** | Review the objects in the **storage** command directory.  **storage ?** |
| **3.** | Open the cluster directory.  **cluster**  **NOTE:** 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’re in. |
| **4.** | Look at the available commands and directories at this level.  **?** |
| **5.** | Open the statistics directory.  **statistics**  You’re now in the cluster statistics context. |
| **6.** | See what is available at this level.  **?** |
| **7.** | Go back (up) one level by typing two periods and then pressing the **Enter** key.  **..** |
| **8.** | Notice that you’re back at the cluster directory level.  **NOTE:** From any level, you can enter top to go directly to the top of the entire command hierarchy. |
| **9.** | Examine the manual page for the storage command directory.  **man storage** |
| **10.** | Enter **q** to exit the manual page. |
| **11.** | Examine the manual page for the storage aggregate directory and compare the output with the output of the man storage command in the previous step.  **man storage aggregate** |

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| **12.** | Enter **q** to exit the manual page. |
| **13.** | Examine the manual page for the storage aggregate create directory.  **man storage aggregate create** |
| **14.** | Enter **q** to exit the manual page. |

### TASK 3: REVIEW COMMAND OPTIONS

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| **STEP** | **ACTION** |
| **1.** | Go to the storage aggregate directory level within the clustershell.  **storage aggr** |
| **2.** | From the storage aggregate level, run this command:  **modify ?**  **NOTE:** Square brackets ([]) indicate optional command elements. The output of this command shows the parameter –aggregate with brackets around the parameter name but not around the parameter value. This 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 because, if you provide one, you must provide the other. (The value cannot be specified based on position.)  In this case, the aggregate name is required to determine which aggregate will be modified. Although the other parameters are technically optional, at least one of them should be specified for this command to be meaningful (that is, to actually modify an attribute of this aggregate). |
| **3.** | Review the options for the storage aggregate scrub command.  **scrub ?**  **NOTE:** As with the modify command, the aggregate name is required, but the parameter name is optional. In addition, the action value is required, but the parameter name (–action) is optional. These are two possible forms of the command:   * storage aggregate scrub –aggregate aggr0\_cluster1\_01 –action start * storage aggregate scrub aggr0\_cluster1\_01 start |
| **4.** | Review the possible keyword values for the –state parameter.  **modify –state ?** |
| **5.** | Return to the top of the command hierarchy.  **top** |

### TASK 4: COMPARE PRIVILEGE LEVELS

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| **STEP** | **ACTION** |
| **1.** | Look at the volume directory.  **volume ?**  The default privilege level is admin. |
| **2.** | Notice the commands that are available in this directory context at this privilege level. |
| **3.** | Switch to the advanced privilege level.  **set –privilege advanced**  **NOTE:** Because –privilege is an optional positional parameter of the set command, you can also specify the desired privilege level as a positional parameter: set advanced. |
| **4.** | While you are in the advanced privilege level, look again at the volume directory.  **volume ?** |
| **5.** | Notice the additional commands that are available.  Each command and directory that is available for nonadmin privilege levels has an asterisk (\*) in front of its description. |
| **6.** | Switch back to the admin privilege level.  **set admin** |
| **7.** | Return to the top of the command hierarchy.  **top** |

### TASK 5: USE PARTIAL COMMANDS AND COMPLETE COMMANDS WITH THE TAB KEY

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| **STEP** | **ACTION** |
| **1.** | Display the logical interfaces.  **network interface show** |
| **2.** | Try the following command:  **net int sho**  The command fails because this form of the command is ambiguous. Multiple verbs in this command hierarchy begin with the letters “sho.” |
| **3.** | Retype the command using the full verb, show.  **ne in show** |
| **4.** | Type the first two letters of the network command directory (**ne**) and press **Tab**.  If the substring that you type is unambiguous, when you press Tab, the clustershell completes the substring. |
| **5.** | Continue the command by entering **in** and pressing **Tab** and then entering **sho** and pressing  **Tab**.  sho is ambiguous in the context. The clustershell displays the options for sho. |

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| **6.** | This time, enter **ne**, press **Tab**, enter **in**, press **Tab**, and then enter **show**. |

### TASK 6: LOG IN TO CLUSTER1 WITH ONCOMMAND SYSTEM MANAGER

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| **STEP** | **ACTION** |
| **1.** | On your Windows Server desktop, open Google Chrome. |
| **2.** | Type the IP address of the cluster1 cluster management interface and press **Enter**. |

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| **STEP** | **ACTION** |
| **4.** | Log in as **admin**, enter the password, and click **Sign In**.  C:\Users\ciro.bessa\Documents\ebooks\NetApp\Apostila_Curso_Netapp\Apostilas_editadas\imagens_leonel\oncommand_system_center_login.PNG  System Manager is now logged in to cluster1.  C:\Users\ciro.bessa\Documents\ebooks\NetApp\Apostila_Curso_Netapp\Apostilas_editadas\imagens_leonel\osc_cluster.PNG |

|  |  |
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| **STEP** | **ACTION** |
| **5.** | Examine the System Manager interface layout:   * Expand and collapse each category in the navigation pane on the left: Cluster, Storage Virtual Machines (formerly Vservers), and Nodes. * Compare the results with what you find in the CLI. * Expand the Cluster category and note the configuration items that are available.   C:\Users\ciro.bessa\Documents\ebooks\NetApp\Apostila_Curso_Netapp\Apostilas_editadas\imagens_leonel\osc_cluster_storage_aggregates_01.PNG |
| **6.** | In the navigation pane, expand **Nodes** and explore the available configuration items. |

|  |  |
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| **STEP** | **ACTION** |
| **7.** | Expand **Storage Virtual Machines** and view the available items. |

**END OF EXERCISE**

## STORAGE MANAGEMENT

**EXERCISE 2: CREATING AND GROWING AN AGGREGATE**

In this exercise, you use the CLI and NetApp OnCommand System Manager to create and add disks to an aggregate. You also create flexible volumes.

**OBJECTIVES**

By the end of this exercise, you should be able to:

* Create an aggregate
* Add disks to an aggregate
* Create a flexible volume

### TASK 1: CREATE A NEW AGGREGATE

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| --- | --- |
| **STEP** | **ACTION** |
| **1.** | Log in to **cluster1** by using PuTTY. |
| **2.** | From the command line, show the aggregates.  **stor aggr show** |
| **3.** | Show the volumes.  **volume show** |
| **4.** | View the disks that are attached to each node, noticing the disks that belong to aggregates and the spare disks that are available to create additional aggregates.  **storage disk show –owner cluster1-01 storage disk show –owner cluster1-02** |
| **5.** | Look at the usage information of the storage aggregate create command.  **stor aggr create ?**  **NOTE:** To help familiarize yourself with a command, you can type the command without parameters, followed by a question mark (?). |
| **6.** | Create an aggregate with the unique name **n1\_aggr1** (as an abbreviation of aggregate 1 on the cluster1-01 node).  **stor aggr create -aggr n1\_aggr1 –node cluster1-01 -diskcount 5**  **NOTE:** The aggregate will have the storage capacity of three disks. (Two of the disks are used for parity for RAID-DP, which is the default RAID type.) This aggregate is only an example. In a production environment, a RAID-DP aggregate of this size is a very inefficient use of disks. Also, note that the –diskcount parameter cannot exceed the available number of spare disks. |
| **7.** | Review the list of aggregates again.  **stor aggr show** |

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| **STEP** | **ACTION** |
| **8.** | Review the details for the new aggregate, noticing that the new aggregate has a high-availability (HA) policy of sfo.  **stor aggr show –aggregate n1\_aggr1** |

### TASK 2: ADD DISK TO THE AGGREGATE

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| **STEP** | **ACTION** |
| **1.** | Add two disks to the aggregate.  **aggr add-disks -aggr n1\_aggr1 -diskcount 2**  The aggregate now has two parity disks and five data disks. |
| **2.** | Verify the number of disks in the aggregate and the expanded disk capacity.  **aggr show -aggregate n1\_aggr1** |

### TASK 3: USE SYSTEM MANAGER TO CREATE AN AGGREGATE

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| **STEP** | **ACTION** |
| **1.** | In System Manager, select **Cluster > cluster1 > Storage > Aggregates**.  You can see aggr0 for each of the nodes in your cluster in addition to the aggregate that you created by using the CLI. |

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| **STEP** | **ACTION** |
| **2.** | On the Aggregates toolbar, click **Create**. The Create Aggregate Wizard appears. |
| **3.** | In the **name** field, type **n2\_aggr1**. |
| **4.** | Click **Browse**, select **VMDISK** on cluster1-02, and then click **OK**.  C:\Users\ciro.bessa\Documents\ebooks\NetApp\Apostila_Curso_Netapp\Apostilas_editadas\imagens_leonel\create_aggregate_02.PNG |
| **5.** | For now, leave the number of disks at 10. |

|  |  |
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| **STEP** | **ACTION** |
| **6.** | For RAID Configuration, click **Change**. |
| **7.** | Notice the RAID allocation. In a real-world environment, would this allocation be an efficient use of disks? |
| **8.** | Click the up and down arrows to adjust the RAID Group size to 10, then adjust it back down to  5. Observe the effect on how the disks are distributed in the RAID groups and how many parity disks are used. |
| **9.** | Return the RAID Group size to 16, then click **Save**. |

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| **STEP** | **ACTION** |
| **10.** | Select seven disks for the new aggregate, leave RAID configuration as RAID-DP, and then click  **Create**. |
| **11.** | Examine the new aggregate. |

### TASK 4: CREATE A FLEXIBLE VOLUME

In this task and the task that follows, you create flexible volumes. FlexVol volumes for user data reside in a data storage virtual machine (SVM). In this task, you create a volume in the existing SVM on cluster1.

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| **STEP** | **ACTION** |
| **1.** | Go to your clustershell session with cluster1. |
| **2.** | For testing purposes, create a new SVM Called SVM5.  **vserver create -vserver svm5 -rootvolume  vol0\_svm5 -aggregate n1\_aggr1 -rootvolume-security-style mixed** |
| **3.** | In your svm5, on the aggregate aggr1, create a volume.  **volume create -vserver svm5 -volume volume1 -aggr n1\_aggr1 -junction-path**  **/vol1**  *A FlexVol volume is a storage resource, but it is a virtual resource that is owned by a single storage virtual machine (SVM).* |
| **4.** | View the volumes.  **vol show** |
| **5.** | View the details of the new volume.  **vol show -vserver svm5 -volume volume1** |

### TASK 5: USE SYSTEM MANAGER TO CREATE A FLEXIBLE VOLUME

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| **STEP** | **ACTION** |
| **1.** | On your cluster1 System Manager, select **Storage Virtual Machines > cluster1 > svm5 > Storage > Volumes**. |
| **2.** | On the Volumes toolbar, click the **Create** button. |
| **3.** | Name the volume **volume2**. |

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| **STEP** | **ACTION** |
| **4.** | To select a home aggregate for the new volume, click the **Choose** button and select **n1\_aggr1**. **NOTE: To host a user volume, never choose a node’s aggr0 aggregate.** |
| **5.** | Set the Total Size to **400 MB**. |
| **6.** | Leave the Snapshot Reserve percentage at the default. |
| **7.** | Select the **Thin Provisioned** checkbox. |
| **8.** | Click **Create**. |
| **9.** | After the wizard is finished, verify that the new volume appears in the volume list. |

**END OF EXERCISE**

## NETWORK MANAGEMENT

**EXERCISE 3: NETWORK MANAGEMENT**

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

**OBJECTIVES**

By the end of this exercise, you should be able to:

* Explore IPspaces, subnets, and broadcast domains
* Create an interface group
* Create a VLAN
* Create a subnet for the default IPspace on cluster1
* Create a new IPspace on cluster1

### TASK 1: ON CLUSTER1 EXPLORE NETWORK RESOURCES AND CREATE AN INTERFACE GROUP

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| **STEP** | **ACTION** |
| **1.** | In NetApp OnCommand System Manager, in the navigation pane, select **Cluster** > **cluster1** >  **Configuration *>* Network**. |

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| **STEP** | **ACTION** |
| **2.** | Click the **Ethernet Ports** tab and notice that all ports belong to the Default broadcast domain. On a multi-node cluster, there would be also ports assigned to the Cluster broadcast domain. |
| **3.** | On the Ethernet Ports tab, click **Create Interface Group**. |
| **4.** | Review the content of the error message that appears. Can you create an interface group? Why not? |
| **5.** | Click **OK** and then **Cancel**. |

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| **STEP** | **ACTION** |
| **6.** | Go back to the Broadcast Domain tab and select the **Default** broadcast domain. |
| **7.** | Click **Edit**. |
| **8.** | In the list of port names, clear the **e0e** and **e0f** checkboxes, and leave the rest of the ports in the broadcast domain. |

|  |  |
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| **STEP** | **ACTION** |
| **9.** | Click **Save and Close**. |
| **10.** | Click the **Ethernet Ports** tab and notice the broadcast domain that is associated with e0e and e0f. |
| **11.** | Click **Create Interface group**. |

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| **STEP** | **ACTION** |
| **12.** | Enter these properties for the interface group:   * Interface Group Name: **a0a** * Node: **cluster1-01** * Ports: **e0e** and **e0f** * Mode: **Multiple** * Load distribution: **IP based** * ***>> Do not assign!!! <<*** a **broadcast domain** at this time. |
| **13.** | Click **Create**. |

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| **STEP** | **ACTION** |
| **14.** | Click the **Refresh** button, and then examine your interface groups in the list of Ethernet ports. |

### TASK 2: ON CLUSTER1 CREATE A VLAN

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| --- | --- |
| **STEP** | **ACTION** |
| **1.** | On the Ethernet Ports tab, click **Create VLAN**. |
| **2.** | Choose port **a0a** on node **cluster1-01** to host the VLAN. |

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| **STEP** | **ACTION** |
| **3.** | Select a list of VLAN tags to identify each VLAN that is hosted on this port:   1. Type **11**, and then click **Add**. 2. Repeat with **22** and **33**. 3. Assign the VLAN to the **Default** broadcast domain. |
| **4.** | Click **Create** to create the VLAN. |

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| **STEP** | **ACTION** |
| **5.** | Click the **Refresh** button and examine your VLANs in the list of Ethernet ports. |
| **6.** | Return to the Broadcast Domains tab. |
| **7.** | To add the interface group a0a to the Default broadcast domain, select the **Default** broadcast domain and click the **Edit** button. |

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| **STEP** | **ACTION** |
| **8.** | Select **a0a** on column (**cluster1-01**) to add it to the Default broadcast domain. Notice that ports e0e, e0f (from cluster1-01)& a0a (from cluster1-02) are not in the list of ports eligible to be added to the broadcast domain. Why not? |
| **9.** | Click **Save and Close**. |
| **10.** | To add a subnet to the Default IPspace, click the **Subnets** tab and click the **Create** button. |
| **11.** | Name the subnet **sub-default**. |
| **12.** | Specify Subnet IP/Subnet mask: **192.168.1.0/255.255.255.0** |
| **13.** | Type an IP addresses range of **192.168.1.100-192.168.1.149**. |
| **14.** | Use **192.168.1.1** as the Gateway address. |

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| **STEP** | **ACTION** |
| **15.** | Select the **Default** broadcast domain. |
| **16.** | Click **Create**. |

### TASK 3: ON CLUSTER1 CREATE A NEW IPSPACE

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| --- | --- |
| **STEP** | **ACTION** |
| **1.** | Click the **Broadcast Domains** tab.  To create a new Broadcast Domain, you first must free a port from the Default broadcast domain to use as part of our new Broadcast Domain. You will use this Broadcast Domain in your new IPspace. |
| **2.** | Select the **Default** broadcast domain and click **Edit**. |
| **3.** | Click **e0d** to remove it from the Default broadcast domain and click **Save and Close**. |
| **4.** | Verify that **e0d** is no longer in the Default broadcast domain. |
| **5.** | Leave System Manager open and, from your PuTTY session with cluster1, type:  **ipspace show**  You must create the new IPspace container from the clustershell. |
| **6.** | Create the new IPspace.  **ipspace create -ipspace ips-xyz ipspace show** |

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| **STEP** | **ACTION** |
| **7.** | In System Manager, click the **Broadcast Domains** tab and then click the **Create** button. |
| **8.** | Name the new broadcast domain **bd-xyz**. |
| **9.** | Set MTU size to **1500**. |
| **10.** | Select the new IPspace **ips-xyz** that you created earlier. |
| **11.** | Select port **e0d**. |
| **12.** | Click **Create**. |

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| **STEP** | **ACTION** |
| **13.** | Click the **Subnets** tab and click **Create**.    You will add a new subnet to the IPspace. |
| **14.** | Name the subnet **sub-xyz**. |
| **15.** | Specify Subnet IP/Subnet mask: **192.168.1.0/255.255.255.0** |
| **16.** | Type an IP addresses range of **192.168.1.120-192.168.1.219**. |
| **17.** | Use **192.168.1.1** as the Gateway address. |
| **18.** | Select the broadcast domain **bd-xyz**. |
| **19.** | Click **Create**. |

|  |  |
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| **STEP** | **ACTION** |
| **20.** | Examine the subnets that you created. What do you notice about the IP address ranges? Do they overlap? Why is this allowed? |
| **21.** | Close your System Manager and PuTTy windows for cluster1. |

### TASK 4: ON CLUSTER1 CREATE A SUBNET FOR THE DEFAULT IPSPACE

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| --- | --- |
| **STEP** | **ACTION** |
| **1.** | Open a new browser and log on to System Manager on cluster1. |
| **2.** | In the Network content area, click the **Subnets** tab. |
| **3.** | Click **Create**. |

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| **STEP** | **ACTION** |
| **4.** | Enter these properties for the subnet:   * Name: **sub60**    Subnet IP and Subnet mask: **192.168.0.0/255.255.255.0**   IP address range: **192.168.0.80-192.168.0.119**   * Gateway address: **192.168.0.1** * Broadcast Domain: **Default** |
| **5.** | Click **Create**. |

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| **STEP** | **ACTION** |
| **6.** | Examine the number of available and used IP addresses in your subnet. |

### TASK 5: EXPLORE FAILOVER GROUPS AND POLICIES

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| **STEP** | **ACTION** |
| **1.** | Use PuTTY to log in to cluster1, and then display logical interface (LIF) failover groups.  **network interface failover-groups show** |
| **2.** | Display information about broadcast domains.  **network port broadcast-domain show** |
| **3.** | Examine the failover groups and the ports that are included in each and notice that they align with the broadcast domains that are defined in the cluster.  If you create multiple broadcast domains for multiple physical networks, there will be a failover group for each domain. |
| **4.** | Display the failover policies of the LIFs on the cluster.  **net int show -fields failover-policy**  Failover policies are assigned to LIFs by default, depending on each LIF’s role. What policy is  assigned to node management LIFs? Why? |
| **5.** | Examine the list of available failover policies.  **net int show -failover-policy ?**  In the next exercise, you will create NAS data LIFs with data SVMs. What failover policy do you expect to be assigned to a NAS data LIF? |

**END OF EXERCISE**

## IMPLEMENTING NAS PROTOCOLS

**EXERCISE 4: ENABLING CIFS AND NFS CLIENT ACCESS**

In this exercise, you create a storage virtual machine (SVM), configure CIFS and NFS, and access the SVM namespace with CIFS and NFS clients.

**OBJECTIVES**

By the end of this exercise, you should be able to:

* 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 the namespace from an NFS client

### TASK 1: CONFIGURE AN SVM TO SERVE CIFS AND NFS

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| **STEP** | **ACTION** |
| **1.** | Use System Manager to log in to cluster1. |
| **2.** | In the System Manager navigation pane, expand **Storage Virtual Machines**. |
| **3.** | On the toolbar, click **Create** to create a new SVM. |
| **4.** | Enter **svm1** as the name for your new SVM. |
| **5.** | Use the Default IPspace. |
| **6.** | Select **FlexVol volumes** as the volume type. |

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| **STEP** | **ACTION** |
| **7.** | To complete the SVM Details page of the wizard, enter this information:   1. Data protocols: **CIFS** and **NFS** 2. Language: **C[c]** 3. Security style: **UNIX** 4. Root aggregate: **n2\_aggr1** 5. DNS configuration: **Leave defaults** |
| **8.** | Click **Submit & Continue.** |

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| **9.** | On the Configure CIFS/NFS protocol page, enter the following information:   1. Retain the CIFS data LIFs: **selected**   **NOTE**: This option specifies that the data logical interface (LIF) supports CIFS and NFS sessions.   1. Subnet: **sub60** 2. Home Port: **cluster1-01:e0c** 3. CIFS Server Name: **ntapsvm1** 4. Active Directory: **demo.netapp.com** 5. Administrator name: **administrator** 6. Administrator password: **Netapp1!** 7. Share name: **svm1\_vol1** 8. Size: **1 GB** 9. Permission: **Everyone – Full Control**   **NOTE**: This exercise configures a simple NFS server authenticating users via local users and groups. Be sure to clear the default NIS configuration (steps k and l) so that NIS doesn’t get in the way. **Do not skip this step.**   1. Expand **NIS Configuration**   Domain Names: Clear the domain name field   1. IP Addresses: Clear the IP Addresses field |

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| **STEP** | **ACTION** |
| **10.** | Click **Submit and Continue**. |
| **11.** | On the SVM Administration page, click **Skip**. |

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| **STEP** | **ACTION** |
| **12.** | Review the configuration summary and click **OK**. |
| **13.** | In System Manager, select **Storage Virtual Machines > cluster1 > svm1 > Configuration > Protocols > NFS**. |

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| **STEP** | **ACTION** |
| **14.** | Make sure the NFS server status is enabled. If not, click the **Enable** button. |
| **15.** | In System Manager, select **Storage Virtual Machines > cluster1**. |
| **16.** | In the list of SVMs, select **svm1** and, on the SVM toolbar, click the **Edit** button. |
| **17.** | Click the **Resource Allocation** tab. |

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| **STEP** | **ACTION** |
| **18.** | Select **Delegate volume creation**, 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.  Best practices suggest that data volumes should never be stored on a node’s aggr0 aggregate. |
| **19.** | Click **Save and Close**. |

### TASK 2: CREATE A NAS DATA LIF

In the previous task, the SVM Setup wizard configured a data LIF. In this task, you create a second LIF on the opposite node.

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| **STEP** | **ACTION** |
| **1.** | Select **Cluster > cluster1 > Configuration > Network**. |
| **2.** | Click the **Network Interfaces** tab. |
| **3.** | Inspect the NAS data LIF that the SVM creation wizard created.  What is the IP address? Where does the IP address fall within the sub60 subnet address range? |
| **4.** | Click the **Create** button to begin creating a data LIF. |
| **5.** | Name the LIF **]cifs\_nfs\_lif2** and select the **Serves Data** role. |
| **6.** | Choose **svm1** and protocols **CIFS** and **NFS**. |

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| **STEP** | **ACTION** |
| **7.** | Select subnet **sub60** and port **e0c** on ***cluster1\_02***, and then click **Create**. |
| **8.** | Verify creation of the data LIF. |

### TASK 3: MIGRATE AND REHOME A NAS DATA LIF

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| **STEP** | **ACTION** |
| **1.** | Click **svm1\_cifs\_nfs\_lif2**, and then click the **Migrate** button. |
| **2.** | Click **Yes** to clear the CIFS warning. |
| **3.** | Notice the current port at the top of the Migrate Interface window. |

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| **STEP** | **ACTION** |
| **4.** | Select **cluster1-01:e0g** as the destination port.  You could re-home the LIF on the destination port by selecting the Migrate Permanently checkbox. For now, leave the Migrate Permanently checkbox cleared (not selected). |
| **5.** | Click **Migrate**. |
| **6.** | Observe that the LIF is now hosted on **cluster1-01:e0g**.  The red warning icon means that the LIF is not running on its home port. |

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| **STEP** | **ACTION** |
| **7.** | Select svm1\_cifs\_nfs\_lif2 again, and click **Send to Home**. The LIF is now hosted on its home port. |
| **8.** | Open a PuTTY session with the cluster1 cluster shell. |
| **9.** | Verify the current location of the data LIFs.  **net int show -vserver svm1** |
| **10.** | Reassign the home port of svm1\_cifs\_nfs\_lif1 to port e0g and leave the home node on cluster1- 01.  **net int modify -vserver svm1 -lif svm1\_cifs\_nfs\_lif1 -home-port e0g** |
| **11.** | Check the home port again. Did the LIF move? What is the status of its home?  **net int show -vserver svm1** |
| **12.** | Issue a revert command to send the LIF to its new home port.  The asterisk (\*) is a positional parameter representing the LIF name. This command reverts all LIFs that are not on their home ports.  **net int revert \*** |
| **13.** | Check the status of the LIFs again.  **net int show -vserver svm1** |

### TASK 4: CREATE AN EXPORT POLICY

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| **STEP** | **ACTION** |
| **1.** | Select **Storage Virtual Machines > cluster1 > svm1 > Policies > Export Policies**. |
| **2.** | Click the **Create** button. |
| **3.** | Name the policy **exp\_svm1**, and click **Add** to add a rule. |

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| **STEP** | **ACTION** |
| **4.** | For the Client Specification, enter **0.0.0.0/0**. |
| **5.** | Select **CIFS** and **NFS** for protocols. |
| **6.** | Click **OK**. |
| **7.** | Click **Create**. |

### TASK 5: EXPORT A VOLUME

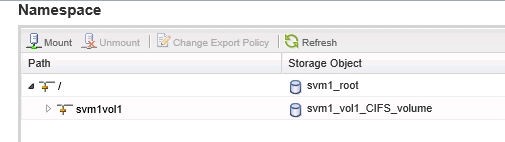
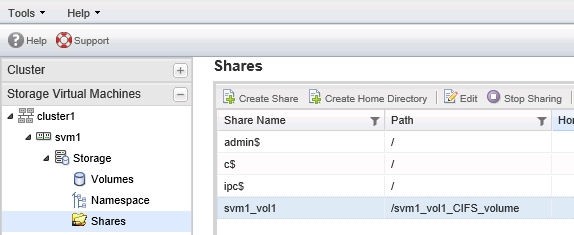
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| --- | --- |
| **STEP** | **ACTION** |
| **1.** | Select **Storage Virtual Machines > cluster1 > svm1 > Storage > Volumes**. |
| **2.** | Select **svm1\_vol1\_CIFS\_volume**. |

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| **STEP** | **ACTION** |
| **3.** | Click **Edit**. |
| **4.** | Perform these actions to modify permissions on the volume that was created at the beginning of this task:   1. Select all the **Read**, **Write**, and **Execute** checkboxes for **Owner**, **Group**, and **Others**. 2. Clear the **Thin Provisioned** checkbox. 3. Click **Save and Close**. |
| **5.** | **Repeat** the previous step for the **”svm1\_root”** volume. |
| **6.** | Select **Storage Virtual Machines > cluster1 > svm1 > Storage > Namespace** and verify where the new volume has been mounted in the namespace. |

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| **STEP** | **ACTION** |
| **7.** | Select the volume on the **Namespace** page, click **Unmount** and, *without* selecting the “Force volume unmount operation” checkbox, click **Unmount**. |
| **8.** | On the Namespace toolbar, click **Mount**. |
| **9.** | Perform the following actions:   1. Select volume **svm1\_vol1\_cifs\_volume**. 2. Type the junction name **svm1vol1**. 3. Click **Browse** and select **the root directory** as the junction path. 4. Click **OK**. 5. Click **Mount.**   **NOTE:** In this exercise, the junction name is slightly different from the volume name. It is not necessary for the names 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. |

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| **STEP** | **ACTION** |
| **10.** | Verify that the junction path in the svm1 namespace is correct. |
| **11.** | Select the volume **svm1\_root** and click **Change Export Policy**. |
| **12.** | Select export policy **exp\_svm1** and click **Change**. |
| **13.** | Repeat the process for **svm1\_vol1\_cifs\_volume**. |

### **TASK 6: VERIFY AND CREATE CIFS SHARES**



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| **STEP** | **ACTION** |
| **1.** | Select **Storage Virtual Machines > cluster1 > svm1 > Storage > Shares** and verify that the svm1\_vol1\_cifs\_volume share was created by the SVM Setup wizard. |
| **2.** | Check the path of the CIFS share and compare it to the namespace.  The path of the share should reflect the volume’s path in the namespace. |
| **3.** | Select the **svm1\_vol1** share and click the **Stop Sharing** button.  Remember that 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. |
| **4.** | Select the **OK to stop sharing the selected share(s)** checkbox and click **Stop** to verify. |

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| **STEP** | **ACTION** |
| **5.** | Click **Create Share** to configure a new share. |
| **6.** | Click **Browse** to select a folder to share. |
| **7.** | Click the root volume to expand the tree, and then select **svm1vol1**. Note that this is the junction path of the volume. |
| **8.** | Click **OK**. |

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| **STEP** | **ACTION** |
| **9.** | Enter the share name **vol1**. |
| **10.** | Click **Create**. |
| **11.** | Verify the new share name. |
| **12.** | To create a second CIFS share click **Create Share**. |
| **13.** | Choose “**/**” to share the SVM root directory and name the share **rootdir**. |
| **14.** | Click **Create.** |

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| **STEP** | **ACTION** |
| **15.** | Again, verify your share names. |

### TASK 7: ACCESS YOUR CIFS SHARE FROM A WINDOWS CLIENT

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| **STEP** | **ACTION** |
| **1.** | From the Windows server, click the folder icon in the task bar to start Windows Explorer. |
| **2.** | Right-click **Network** and select **Map Network Drive**. |

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| **STEP** | **ACTION** |
| **3.** | Select Drive **Z**, and specify your CIFS server name and shared folder **\\ntapsvm1\vol1**. |
| **4.** | Click **Finish**. |
| **5.** | When your share folder opens, create files and folders on the share.  **Note**: You will use these files and folders later in the course. |
| **6.** | Map the **rootdir** share to drive **Y**. |
| **7.** | When the share folder opens, what do you see? |

### TASK 8: ACCESS YOUR DATA VOLUME FROM AN NFS CLIENT

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| **STEP** | **ACTION** |
| **1.** | From a clustershell session on cluster1, verify the export policy that was created for your volume.  **vserver export-policy rule show -vserver svm1** |
| **2.** | Log in to the Linux machine ***rhel1***  User ID is root. Password is Netapp1!  **mkdir /mnt/svm1 mkdir /mnt/vol1** |
| **3.** | Using the IP address of either data LIF within svm1, access svm1 exports through NFS.  Remember, you are not mounting CIFS shares or volume names, but rather paths in the namespace.  **mount -t nfs 192.168.0.80:/ /mnt/svm1**  **mount -t nfs 192.168.0.81:/svm1vol1 /mnt/vol1** |

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| **STEP** | **ACTION** |
| **4.** | Explore both NFS mounts, which are mounted at different points in the svm1 namespace, and locate the directories and files that you created earlier in the exercise.  **cd /mnt/svm1/svm1vol1** |

**END OF EXERCISE**

## IMPLEMENTING SAN PROTOCOLS

**EXERCISE 5: CONFIGURING SCALABLE SAN**

In this exercise, you experiment with scalable SAN by configuring a storage virtual machine (SVM) as an iSCSI target and connecting a LUN to a Windows host.

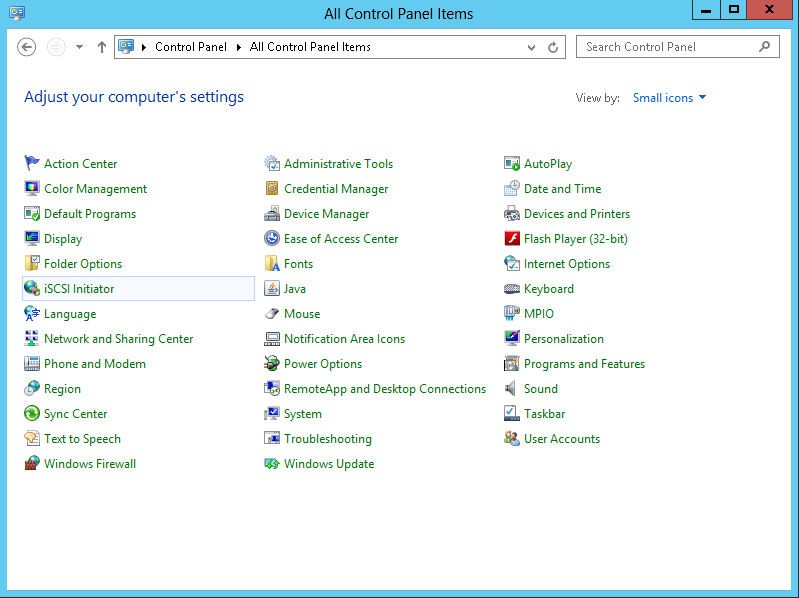
**OBJECTIVES**

By the end of this exercise, you should be able to:

* 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: CHECK THE ISCSI SOFTWARE INITIATOR NAME

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| **STEP** | **ACTION** |
| **1.** | On your Windows desktop, open the Control Panel. |



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| **STEP** | **ACTION** |
| **2.** | Select **View by small icons** and click **iSCSI Initiator**. |
| **3.** | If an error message appears, indicating that the Microsoft iSCSI service is not running, click **Yes**  to start the service. |
| **4.** | If a message asks if you want to unblock the Microsoft iSCSI service through the Windows Firewall, click **Yes**. |

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| **STEP** | **ACTION** |
| **5.** | When the iSCSI Initiator Properties dialog box appears, click the **Configuration** tab. |
| **6.** | Record the Initiator Name (IQN): |
| **7.** | Leave the iSCSI Initiator Properties window open. |

### TASK 2: USE NETAPP SYSTEM MANAGER TO CREATE AN SVM FOR ISCSI

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| **STEP** | **ACTION** |
| **1.** | On cluster1 in the OnCommand System Manager navigation pane, expand **Storage Virtual Machines**. |

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| **STEP** | **ACTION** |
| **2.** | On the System Manager Storage Virtual Machines page, click **Create** to create an SVM for iSCSI. |
| **3.** | On the SVM Details page, enter the following information:   * SVM Name: **svm2** * IPspace: **Default** * Volume Type: **Flexible volumes** * Data Protocols: **iSCSI** * Language: **C[c]** * Security Style: **UNIX** * Aggregate: **n1\_aggr1** |
| **4.** | Leave DNS options at the default settings, and then click **Submit & Continue**. |

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| **STEP** | **ACTION** |
| **5.** | On the Configure iSCSI protocol page, enter the following information, and then click **Submit**  **& Continue**.   * Target Alias: **svm2\_target** * LIFs Per Node: **1** * Subnet: **sub60** * “**Review or Modify LIFs configuration**” checkbox: Select * Number of portsets: **0** * Lun Size: **1 GB** * LUN OS Type: **Windows 2008 or later** * Host initiator: <insert the initiator that you recorded earlier> |
| **6.** | Click “**Submit & Continue**” |
| **7.** | On the SVM administration page, click **Skip**. |
| **8.** | Review the summary and click **OK**. |

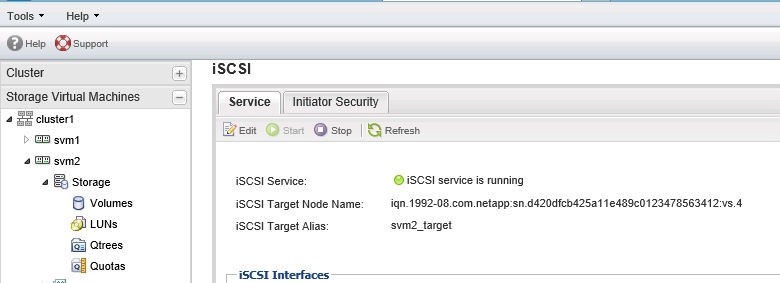
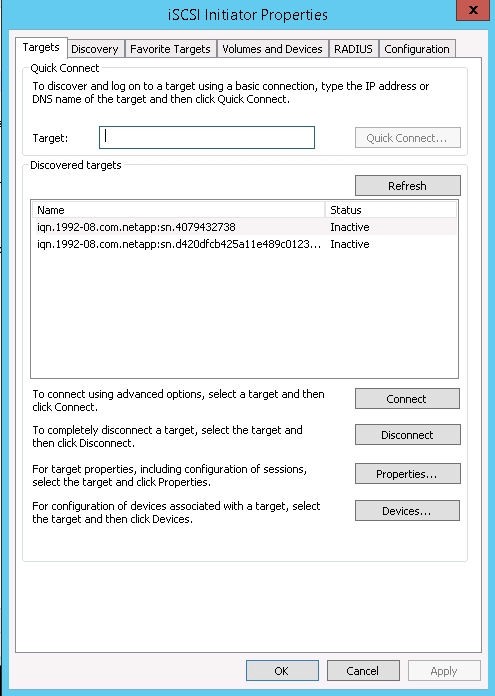
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| **STEP** | **ACTION** |
| **8.** | Select **Storage Virtual Machines > cluster1 > svm2 > Configuration > Protocols > iSCSI** to review your iSCSI configuration. |
| **9.** | From System Manager, explore **svm2** by selecting **cluster/cluster1/Configuration/Network**  and then find the new iSCSI LIFs and record the IP addresses for use in the next task. |
| **10.** | Select **Storage Virtual Machines/cluster1/svm2/storage/LUNs** and find the LUN that was created for you. |

TASK 3: CONFIGURE THE ISCSI SOFTWARE INITIATOR (IN WINDOWS**)**

In this task, you use the MPIO instead of Multiple Connections per Session (MCS) technique for multipathing.

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| **STEP** | **ACTION** |
| **1.** | Return to the **iSCSI Initiator Properties** window. |

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| **STEP** | **ACTION** |
| **2.** | Click the **Discovery** tab. |
| **3.** | Click **Discover Portal**, enter the *IP address* of one of the ports in the SVM2 port set, and click  **OK**. |



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| **STEP** | **ACTION** |
| **4.** | Click the **Targets** tab.  This list should include an IQN name that matches the iSCSI Target Node Name that you discover in the next step. |
| **5.** | Navigate to **Storage Virtual Machine > cluster1 > svm2 > Configuration > Protocols > iSCSI** and verify that the iSCSI Target Node Name matches a node name the Discovered Targets list in Windows. |

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| **STEP** | **ACTION** |
| **6.** | Return to the iSCSI Initiator Properties dialog box on your Windows machine, select the correct target in the list, and then click **Connect**. |
| **7.** | In the Connect To Target dialog box, select the **Enable multi-path** checkbox and click  **Advanced**. |

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| **STEP** | **ACTION** |
| **8.** | In the Advanced Settings dialog box, in the **Target portal IP** list, select the *lowest* target portal IP address, and click **OK**. |
| **9.** | Click **OK** to close the Connect To Target dialog box and start a new iSCSI session between the initiator and target. |
| **10.** | In the iSCSI Initiator Targets tab, make sure that the correct target is in a Connected status. |

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| **STEP** | **ACTION** |
| **11.** | Click **Properties** to begin creating additional sessions with all the iSCSI LIFs in the port set. |
| **12.** | In the Properties dialog box, on the Sessions tab, ensure that there is only one current session. |

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| **STEP** | **ACTION** |
| **13.** | Click the **Portal Groups** tab and review the other IPs that are currently available for sessions. |
| **14.** | Click the **Sessions** tab again. |
| **15.** | Click **Add session**. |
| **16.** | In the Connect To Target dialog box, select the **Enable multi-path** checkbox and click  **Advanced**. |

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| **STEP** | **ACTION** |
| **17.** | In the Advanced Settings dialog box, from the Target portal IP list, select the target portal IP address of one of the iSCSI LIFs that you have not yet assigned. |
| **18.** | Click **OK**. |
| **19.** | In the Connect To Target dialog box, click **OK**. |

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| **STEP** | **ACTION** |
| **20.** | In the Properties dialog box, on the Sessions tab, verify that a new session has been created. |
| **21.** | Click **OK** to close the Properties window. |
| **22.** | Click **OK** to close the iSCSI Initiator Properties window. |

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| **STEP** | **ACTION** |
| **23.** | Close the Control Panel. |

### TASK 4: ACCESS THE ISCSI-ATTACHED LUN ON THE WINDOWS HOST

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| **STEP** | **ACTION** |
| **1.** | In Windows, open Server Manager. |
| **2.** | On the toolbar in the upper-right corner of the window, click **Tools**, and then select **Computer Management**. |
| **3.** | In the navigation pane on the left, expand the **Storage** node and select **Disk Management**. The LUN appears as a single disk object. All paths are merged into this object. |

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| **STEP** | **ACTION** |
| **4.** | If you do not see the LUN disk in the bottom section of the center pane, right-click the **Disk Management** node in the left pane and select **Rescan Disks**. |
| **5.** | Right-click the disk header and, if the disk is offline, select **Online**. |
| **6.** | Right-click the disk header again and select **Initialize Disk**. |
| **7.** | Review the Initialize Disk dialog box and click **OK**. The disk should come online. |

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| **STEP** | **ACTION** |
| **8.** | In the Disk Management pane, right-click the **Unallocated** partition and select **New Simple Volume**. |
| **9.** | On the introduction page of the New Simple Volume Wizard, click **Next**. |
| **10.** | On the Specify Volume Size page, click **Next**. |
| **11.** | On the Assign Drive Letter or Path page, click **Next**. |
| **12.** | On the Format Partition page, choose a volume label of **svm2\_lun** for the LUN, select a quick format, and click **Next**. |
| **13.** | Review the Completing page and click **Finish**. |

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| **STEP** | **ACTION** |
| **14.** | Verify that the new LUN is now provisioned and, when you are finished, close the Computer Management window. |
| **15.** | Close Server Manager. |
| **16.** | In Windows Explorer, navigate to the mount location of the LUN and verify that you can create a file in the LUN. |

**END OF EXERCISE**

## SNAPSHOT COPIES

**EXERCISE 6: WORKING WITH SNAPSHOT COPIES**

In this exercise, you explore NetApp Snapshot technology by using NetApp OnCommand System Manager and an NFS client computer.

**OBJECTIVES**

By the end of this exercise, you should be able to:

* Explore Snapshot configuration in OnCommand System Manager
* Navigate the .snapshot directory from an NFS client

**TASK 1: EXPLORE SNAPSHOT CONFIGURATION IN SYSTEM MANAGER**

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| **STEP** | **ACTION** |
| **1.** | In OnCommand System Manager on cluster1, select **Storage Virtual Machines > cluster1 > svm1 > Storage > Volumes**. |
| **2.** | Select **svm1\_vol1\_CIFS\_volume** and click the **Snapshot Copies** tab at the bottom of the window.    **NOTE:** In the lower pane, you should already have some Snapshot copies based on the default Snapshot schedule. |
| **3.** | On the toolbar at the top of the page, click **Snapshot Copies**, and then select **Configure**. |

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| **STEP** | **ACTION** |
| **4.** | In the Configure Volume Snapshot Copies dialog box, ensure that the **Make Snapshot directory visible** checkbox is selected, and then click **OK**.  In this dialog box, you can change the Snapshot copy reserve or choose policies and schedules. |
| **5.** | Select **Storage Virtual Machines > cluster1 > svm1 > Policies > Snapshot Policies**, and click the **Create** button to create a new Snapshot policy. |
| **6.** | Name the policy **svm1\_every5**. |
| **7.** | Click the **Add** button. |

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| **STEP** | **ACTION** |
| **8.** | Enter the schedule name **5min**, a maximum of **20** Snapshot copies, and leave the SnapMirror Label box blank. |
| **9.** | Click **OK**. |
| **10.** | Click **Create**. |
| **11.** | Select **Cluster > cluster1 > Configuration > Schedules**, and select the **5min** schedule to look at the schedule that is assigned to the policy.  The schedule is triggered at five-minute intervals, all day. |

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| **STEP** | **ACTION** |
| **12.** | Return to **Storage Virtual Machines > cluster1 > svm1 > storage > volumes**.  Can you remember how to change the Snapshot policy for **svm1\_vol1\_CIFS\_volume** to  **svm1\_every5**? |

**TASK 2: NAVIGATE THE .SNAPSHOT DIRECTORY FROM AN NFS CLIENT**

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| **STEP** | **ACTION** |
| **1.** | Start a PuTTY session with the Linux machine. |
| **2.** | Browse the mount to **svm1\_vol1\_CIFS\_volume**. What do you see?  **cd /mnt/vol1 ls** |
| **3.** | Check the directory contents again, but this time include hidden directories. Now what do you see?  **ls -la** |
| **4.** | View the contents of the .snapshot directory.  **ls –la .snapshot** |

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| **STEP** | **ACTION** |
| **5.** | Delete some of the files that you created on this volume earlier, and then view the contents of some of your recent Snapshot copies.  Can you find your deleted files?  **ls –la .snapshot/*5min.2014-09-16\_1535***  **NOTE:** Replace the Snapshot directory name with the name of a directory on your system. |
| **6.** | From PuTTY, log in to the cluster1 clustershell and check to see how much of the Snapshot copy reserve is used.  **vol show -vserver svm1 -volume svm1\_vol1\_CIFS\_volume -fields snapshot- space-used** |
| **7.** | On your Linux machine, ensure that you’re at the **vol1** mount point.  **pwd**  /mnt/vol1 |
| **8.** | Enter this command on the Linux machine to place a large file on the volume:  **dd if=/dev/zero of=bigfile bs=4K count=5000** |
| **9.** | Wait for the next scheduled Snapshot copy to be created, or force one by entering this command on cluster1:  **snapshot create -vserver svm1 -volume svm1\_vol1\_CIFS\_volume -snapshot extra\_snapshot** |
| **10.** | Check the Snapshot copy reserve usage again.What do you notice? Has the usage changed?  **vol show -vserver svm1 -volume svm1\_vol1\_CIFS\_volume -fields snapshot- space-used** |
| **11.** | Using the Linux machine, delete **bigfile** from the volume, and if you’re asked to confirm, reply  **Y**.  **rm bigfile** |
| **12.** | Check the Snapshot copy reserve usage one more time. Has is changed? Can you explain this behavior?  **vol show -vserver svm1 -volume svm1\_vol1\_CIFS\_volume -fields snapshot- space-used** |
| **13.** | Find a backup of bigfile from the Linux machine in the .snapshot directory. You can restore the file from there.  **find . -name bigfile** |
| **14.** | From one of the Snapshot copies that you found has a backup copy of bigfile, restore the file to the root of the volume, giving the file the name **bigfile\_restored**.  **snapshot restore-file -vserver svm1 -volume svm1\_vol1\_CIFS\_volume**  **-snapshot 5min.2014-09-16\_1600 -path /bigfile -restore-path**  **/bigfile\_restored** |

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| **15.** | From the Linux machine, find the restored file at the root of the volume.  **ls /mnt/vol1** |

### END OF EXERCISE

## TASK (OPTIONAL 1): STORAGE TAKEOVER GIVEBACK

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| **STEP** | **ACTION** |
| **1.** | Log in to **cluster1** by using PuTTY. |
| **2.** | Enter in the command line.  **storage failover takeover –ofnode cluster1-02** |
| **3.** | Display the takeover status  **storage failover show** |
| **4.** | Display the takeover progress  **storage failover show-takeover** |
| **5.** | Check on the WebUI the status of node cluster1-02 |
| **6.** | Display the cluster health on command line  **cluster show** |
| **6.** | Wait 2minutes. Check if takeover runs good. Start the giveback process  **storage failover giveback –ofnode cluster1-02** |
| **7.** | Display the giveback progress  **storage failover show-giveback** |
| **8.** | Wait 2 minutes, Display the giveback status  **storage failover show** |
| **9.** | Check on the WebUI the status of node cluster1-02 |

**END OF EXERCISE**

## TASK (OPTIONAL 2): FLEX VOLUME CLONE

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| **STEP** | **ACTION** |
| **1.** | On your cluster1 System Manager, select **Storage Virtual Machines > cluster1 > svm1 > Storage > Volumes**. |
| **2.** | Select volume name **svm1vol1** |
| **3.** | Click “**CLONE**” button |
| **4.** | Click “**Volume**” option |
| **5.** | On the pop-up “Create FlexClone Volume” type:   * Name: * Thin Provisioning: in Blank * Select “Use an existing snapshot copy:”: any copy * Click “Clone” |
| **6.** | Check de Volumes list, search for the created Clone volume |
| **7.** | The new clone volume is ready to use. |

**END OF EXERCISE**

## TASK (OPTIONAL 3): MANAGING STORAGE SPACE

**EXERCISE: CONFIGURING ADVANCED VOLUME FEATURES**

In this exercise, you create a volume so that you can learn about configuring storage efficiency.

**OBJECTIVES**

By the end of this exercise, you should be able to:

* Explore thin provisioning of volumes
* Enable deduplication and data compression
* Perform a volume move

### TASK 1: EXPLORE THIN PROVISIONING AND STORAGE EFFICIENCY

In this task, you create two new aggregates on cluster1, enable svm1 to access them, create a new volume in each of the new aggregates, thin provision a volume, and enable deduplication and compression.

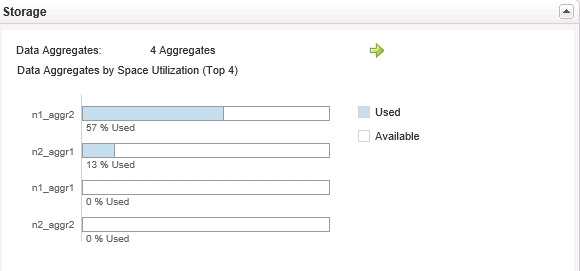
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| **STEP** | **ACTION** |
| **1.** | Use NetApp OnCommand System Manager to create a new aggregate on cluster1 with these parameters:   * Name: **n1\_aggr2** * Disk Type: **FCAL** on **cluster1-01** * Number of disks: **5** |

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| **STEP** | **ACTION** |
| **2.** | Create another new aggregate on cluster1 with these parameters:   * Name: **n2\_aggr2** * Disk Type: **FCAL** on **cluster1-02** * Number of disks: **5** |
| **3.** | To give access to your new aggregates to svm1, select **Storage Virtual Machines > cluster1**, select **svm1**, and click the **Edit** button. |

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| **STEP** | **ACTION** |
| **4.** | Click the **Resource Allocation** tab, select **n1\_aggr2** and **n2\_aggr2**, and then click **Save and Close**. |
| **5.** | In System Manager, select **Storage Virtual Machines > cluster1 > svm1 > Storage > Volumes**, and then click **Create**. |

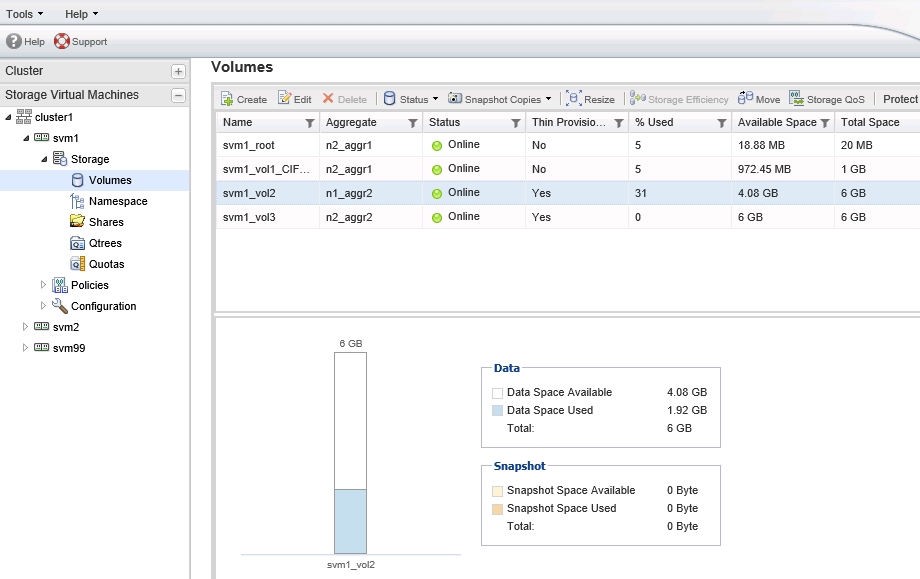
|  |  |
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| **STEP** | **ACTION** |
| **6.** | In the Create Volume window, enter these volume attributes, and then click the **Create** button:   * Name: **svm1\_vol2** * A**g**gregate: **n1\_aggr2** * Total Size: **6 GB** * Snapshot Reserve: **0**% * Thin Provisioned checkbox: *Not* selected |

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| **STEP** | **ACTION** |
| **7.** | In the Create Volume window, enter these volume attributes to create a thin-provisioned volume, and then click the **Create** button.   * Name: **svm1\_vol3** * Aggregate: **n2\_aggr2** * Total Size: **6 GB** * Snapshot Reserve: **0**% * Thin Provisioned checkbox: Selected |
| **8.** | At the bottom of the Volumes page, click the **Space Allocation** tab. |
| **9.** | Select each of the two new volumes and view the space allocation data in the lower pane. Is there any difference between the two? |



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| **STEP** | **ACTION** |
| **10.** | Select **Cluster > cluster1** and inspect the **Storage** report. Record your results, so that you can reference them later. |
| **11.** | Consider these facts:   * Aggregates **n1\_aggr2** and **n2\_aggr2** are identical. * Each aggregate contains one volume. * Those two volumes are identical except that one is thin-provisioned, and the other isn’t. * Neither volume contains user data.   With all that in mind, why is there a difference in the space utilization of the two aggregates? |
| **12.** | Display the Namespace page to see where the new volumes were mounted. Remember that System Manager automatically mounts new volumes at */<volname>*. |
| **13.** | Select the **svm1\_vol2** volume from the list, click **Change Export Policy**, and change the export policy to **exp\_svm1**. |
| **14.** | Repeat the process for svm1\_vol3. |
| **15.** | Navigate to the Volumes page for svm1, select the volume **svm1\_vol2**, and click **Edit**. |

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| **STEP** | **ACTION** |
| **16.** | In the Edit Volume window, on the General tab, give the Group and Others read, write, and execute permissions, activate thin provisioning, and then click **Save and Close**. |
| **17.** | From your Linux system, mount svm1\_vol2.  **mkdir /mnt/vol2/**  **mount –t nfs 192.168.0.80:/svm1\_vol2 /mnt/vol2/** |
| **18.** | Create a 2-GB file on svm1\_vol2.  The write operation can take five to ten minutes.  **cd /mnt/vol2**  **dd if=/dev/zero of=hugefile bs=4K count=500000** |



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| **STEP** | **ACTION** |
| **19.** | Use System Manager to check space usage on the volume. Notice that the size of svm1\_vol2 is 6 GB and recall that the size of hugefile is 2 GB.  What percentage of the space available in svm1\_vol2 is used? |
| **20.** | In System Manager, on the Shares page, click **Create Share** to create a CIFS share for  **svm1\_vol2**. |
| **21.** | Select **svm1\_vol2** and click the **Edit** button. |
| **22.** | Click the **Storage Efficiency** tab. |

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| **STEP** | **ACTION** |
| **23.** | To enable on-demand deduplication and data compression for this volume, select **Enable Storage Efficiency**, **On Demand**, and **Enable Compression**, and then click **Save and Close**. |
| **24.** | With **svm1\_vol2** still selected, click the **Storage Efficiency** button to run on-demand deduplication. |

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| **STEP** | **ACTION** |
| **25.** | Select **Scan Entire Volume**, and then click the **Start** button. |
| **26.** | Click the **Storage Efficiency** tab at the bottom of the page and review the storage efficiency statistics. |
| **27.** | After several minutes, return to this page and compare the statistics. In the meantime you can continue with the next task. |

### TASK 2: PERFORM A VOLUME MOVE

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| **STEP** | **ACTION** |
| **1.** | In System Manager, on cluster1, navigate to the list of aggregates on the cluster and notice the amount of space that is available on the aggregate.  **Note**: Your capacity can vary depending on how your lab kit is configured. |
| **2.** | On your Linux system, mount svm1\_vol3.  **mkdir /mnt/vol3/**  **mount –t nfs 192.168.0.80:/svm1\_vol3 /mnt/vol3/** |
| **3.** | Write a 2-GB file into volume svm1\_vol3. The dd operation can take several minutes to complete; continue to the next step while it runs.  **cd /mnt/vol3**  **dd if=/dev/zero of=hugefile bs=4K count=500000** |
| **4.** | In the svm1 volume list, select **svm1\_vol3** and click the **Move** button to move volume svm1\_vol3 to another aggregate across the cluster interconnect.  **NOTE:** Moving the volume while the file “hugefile” is being written will not interrupt the write  operation. |

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| **STEP** | **ACTION** |
| **5.** | Select **n1\_aggr1** as the destination aggregate and click the **Move** button. |
| **6.** | Click **OK** to acknowledge the job in progress. |
| **7.** | Click the **Refresh** button to monitor the creation of the temporary file on the destination aggregate and the progress of the move operation. |
| **8.** | Check the Linux system to verify progress and the eventual completion of the write operation. |

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| **STEP** | **ACTION** |
| **9.** | When the move is complete, verify that the volume now resides on n1\_aggr1. |

**END OF EXERCISE**

## DATA PROTECTION (OPTIONAL: 4)

**EXERCISE: WORKING WITH SNAPMIRROR TECHNOLOGY**

In this exercise, you create and initialize load-sharing and data-protection SnapMirror replications, add volumes and files to a replicated namespace, schedule periodic SnapMirror replications, and promote a load- sharing mirror.

**OBJECTIVES**

By the end of this exercise, you should be able to:

* Create and initialize load-sharing and data-protection SnapMirror replications
* Add volumes and files to a replicated namespace
* Schedule periodic SnapMirror replications
* Promote a load-sharing mirror

### TASK 1: CREATE AND INITIALIZE SNAPMIRROR REPLICATIONS

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| **STEP** | **ACTION** |
| **1.** | Use PuTTY to log on to cluster1. |
| **2.** | Create a mirror for the root volume of svm1 on the same aggregate as the root volume.  **vol create -vserver svm1 -volume svm1\_root\_ls1 -aggregate n2\_aggr1**  **-type dp**  **NOTE:** Although this is a load-sharing mirror, it must be created as a data-protection mirror volume and then changed. |
| **3.** | Establish the mirror relationship between the source volume and the destination volume and change the destination to a load-sharing mirror.  **snapmirror create -source-cluster cluster1 -source-vserver svm1 -source-volume svm1\_root -destination-cluster cluster1 -destination-vserver svm1 -destination-volume svm1\_root\_ls1 -type ls** |
| **4.** | Create another load-sharing mirror of the same volume on the other node and establish the mirror relationship with the same source.  **vol create -vserver svm1 -vol svm1\_root\_ls2 -aggr n1\_aggr1 -type dp**  **snapmirror create -source-path cluster1://svm1/svm1\_root -destination- path cluster1://svm1/svm1\_root\_ls2 -type ls** |
| **5.** | Use a summary view and then an instance (detailed) view to view the mirrors.  **snapmirror show snapmirror show -instance**  The state of each mirror is “Uninitialized.” No data has been transferred to the mirrors. |

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| **STEP** | **ACTION** |
| **6.** | Perform the initial (baseline) replication to the set of load-sharing mirrors of this source volume. **snapmirror initialize-ls-set -source-path cluster1://svm1/svm1\_root snapmirror show**  **NOTE:** Now that the first replication of the load-sharing mirrors has occurred, all requests that  are sent through existing NFS mounts or CIFS shares to the storage virtual machine (SVM) root volume are transparently routed to one of the load-sharing mirrors of this SVM root volume rather than to the read and write volume. This includes write requests, which will fail, because mirrors are read-only. |
| **7.** | Create two data-protection mirrors.  **volume create –vserver svm1 -volume svm1\_root\_dp1 –aggr n1\_aggr1 -type dp**  **volume create –vserver svm1 -volume svm1\_root\_dp2 –aggr n2\_aggr1 -type dp** |
| **8.** | Establish the data-protection mirror relationships.  **snapmirror create -source-path cluster1://svm1/svm1\_root -destination- path cluster1://svm1/svm1\_root\_dp1 -type dp**  **snapmirror create -source-path cluster1://svm1/svm1\_root -destination- path cluster1://svm1/svm1\_root\_dp2 -type dp**  **snapmirror show** |
| **9.** | Perform the initial (baseline) replication to one of the data-protection mirrors.  **snapmirror initialize -source-path cluster1://svm1/svm1\_root -destination-path cluster1://svm1/svm1\_root\_dp1** |
| **10.** | View the volume Snapshot copies of the source volume.  **volume snapshot show –vserver svm1 -volume svm1\_root**  **NOTE:** You see Snapshot copies that are named with a prefix of “snapmirror.” These Snapshot copies are specifically for the mirrors and are kept so that future replications to the mirrors can determine which data is new after the last replication. Two SnapMirror Snapshot copies of this volume exist. One is for the set of two load-sharing mirrors. The other is for the data-protection mirror. |
| **11.** | Review the mirrors.  **snapmirror show -inst**  **NOTE:** The mirror root\_dp1 has the state “Snapmirrored,” and the Mirror Timestamp field shows the date and time of that replication. Because this is asynchronous mirroring, mirrors are only as up to date as the manual replications or the scheduled replications keep them. |

### TASK 2: COMPARE DATA-PROTECTION MIRROR REPLICATION TIMES

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| **STEP** | **ACTION** |
| **1.** | Replicate the data-protection mirror that has not been replicated.  **snapmirror initialize -source-path cluster1://svm1/svm1\_root -destination-path cluster1://svm1/svm1\_root\_dp2** |
| **2.** | Review the mirrors.  **snapmirror show -inst**  The two data-protection mirrors have different replication times. |
| **3.** | View the volume Snapshot copies of the source volume.  **volume snapshot show -vserver svm1 -volume svm1\_root**  **NOTE:** Three SnapMirror Snapshot copies of this volume exist. They enable SnapMirror software to perform incremental transfers to the mirrors of this source volume. One of these SnapMirror Snapshot copies is for the set of two load-sharing mirrors. The other two are for the two independent data-protection mirrors. |
| **4.** | Replicate to both data-protection mirrors.  **snapmirror update -source-path cluster1://svm1/svm1\_root -destination- path cluster1://svm1/svm1\_root\_dp1**  **snapmirror update -source-path cluster1://svm1/svm1\_root -destination- path cluster1://svm1/svm1\_root\_dp2** |
| **5.** | Review the mirrors.  **snapmirror show -inst** |
| **6.** | Review the volume Snapshot copies of the source volume.  **volume snapshot show -vserver svm1 -volume svm1\_root**  Three SnapMirror Snapshot copies of this volume still exist. |

### TASK 3: ADD VOLUMES AND FILES TO A REPLICATED NAMESPACE

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| **STEP** | **ACTION** |
| **1.** | On svm1, on the aggregate n2\_aggr1, create a volume.  **volume create -vserver svm1 -volume svm1\_new -aggr n2\_aggr1 -junction-path /svm1new –policy exp\_svm1** |
| **2.** | Access your Linux client. |

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| **STEP** | **ACTION** |
| **3.** | Assuming that your data LIF is still mounted from that NFS client, view the root of your namespace.  **cd /mnt/svm1 ls**  The new volume doesn’t appear in the file list. The new volume is in the namespace, but  because the requests for your SVM root volume are routed to one of its load-sharing mirrors, you still see the contents of the root volume as of its last replication, which does not include the junction for svm1new. |
| **4.** | From your clustershell, perform an incremental replication to the set of load-sharing mirrors of the SVM root volume.  **snapmirror update-ls-set -source-path cluster1://svm1/svm1\_root** |
| **5.** | After the mirror jobs are finished, from your NFS client, review the mirror of the root of your namespace.  **ls /mnt/svm1**  The junction for svm1new appears. |
| **6.** | In the root of the namespace, create a file called “myfile.”  **touch /mnt/svm1/myfile**  Because the NFS client references one of the load-sharing mirrors, which is read-only, the file creation fails. No writes can be made to a load-sharing mirror. |
| **7.** | Using the special .admin path, mount (as “root”) your namespace.  **mkdir /mnt/svm1rw**  **mount 192.168.0.60:/.admin /mnt/svm1rw**  The .admin path forces your mount to use the source volume, which is read and write, rather than allowing automatic routing to load-sharing mirrors. |
| **8.** | In the read and write root of the namespace, create a file called “myfile.”  **touch /mnt/svm1rw/myfile ls /mnt/svm1rw/myfile** The new file should appear. |
| **9.** | Using the “normal” path that is routed to the load-sharing mirrors, view the SVM root.  **ls /mnt/svm1/myfile**  Because the new file is on the read/write volume and the load-sharing mirrors have not been re- replicated, the “myfile” file is not visible. |
| **10.** | From your clustershell, perform an incremental replication to the set of load-sharing mirrors of the SVM root volume.  **snapmirror update-ls-set –source-path cluster1://svm1/svm1\_root** |

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| **STEP** | **ACTION** |
| **11.** | From your NFS client, review the mirror of the root of your namespace.  **ls /mnt/svm1/myfile**  The file should appear. |

### TASK 4: SCHEDULE PERIODIC SNAPMIRROR REPLICATIONS

For this exercise, you use the 5-minute schedule for load-sharing mirrors and the hourly schedule for a data-protection mirror.

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| **STEP** | **ACTION** |
| **1.** | View the schedules that were created by default.  **job schedule show** |
| **2.** | Modify one of the load-sharing mirrors to use the 5-minute schedule.  **snapmirror modify -destination-path cluster1://svm1/svm1\_root\_ls1 -schedule 5min** |
| **3.** | View the details of the load-sharing mirrors.  **snapmirror show -destination-path cluster1://svm1/svm1\_root\_ls\* -instance**  **snapmirror show -destination-path cluster1://svm1/svm1\_root\_ls\* -fields schedule**  The SnapMirror schedule of each load-sharing mirror is now set to 5min. |
| **4.** | Modify one of the data-protection mirrors to use the hourly schedule.  **snapmirror modify -destination-path cluster1://svm1/svm1\_root\_dp1 -schedule hourly** |
| **5.** | View the details of the data-protection mirrors.  **snapmirror show –fields schedule**  **NOTE:** Only the schedule for the data-protection mirror that you explicitly modified is set to use this schedule. Each data-protection mirror of a read and write volume is separate from the other data-protection mirrors, except that they’re associated with the same read and write. They can each have separate replication schedules, or one data-protection mirror can have a schedule although another does not. |
| **6.** | Check the time on a node.  **system date show** |
| **7.** | While waiting for the scheduled mirror update to run, continue to run the system date show command and watch for the system clock to reach a multiple of five, which triggers the replication of all the load-sharing mirrors of this volume. |
| **8.** | To determine which mirrors were replicated, view the summary of the mirrors.  **snapmirror show –instance**  **snapmirror show -fields newest-snapshot-timestamp** |

### TASK 5: PROMOTE A LOAD-SHARING MIRROR

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| **STEP** | **ACTION** |
| **1.** | Examine the read and write copy of the SVM root volume and all its mirrors.  **volume show -volume svm1\_root\***  The Type field shows the values RW, LS, and DP. |
| **2.** | Promote one of the load-sharing mirrors.  **snapmirror promote -source-path cluster1://svm1/svm1\_root -destination-path cluster1://svm1/svm1\_root\_ls2** |
| **3.** | At the prompt to proceed, type **y**. |
| **4.** | While the command runs in the foreground, wait for the command to finish. |
| **5.** | Review this volume family.  **volume show -volume svm1\_root\***  The old read and write volume (svm1\_root) is gone, and the volume svm1\_root\_ls2 has the type RW. The name of the volume didn’t change, but it is the read and write volume now, and all the mirrors replicate from that volume. |
| **6.** | Review the SnapMirror relationships.  **snapmirror show**  Only one load-sharing mirror (svm1\_root\_ls1) exists. |
| **7.** | From the newly appointed read/write volume, replicate everything again.  **snapmirror update-ls-set –source-path cluster1://svm1/svm1\_root\_ls2** |
| **8.** | Rename the new svm1 root volume to **svm1\_root**.  **vol rename -vserver svm1 -volume svm1\_root\_ls2 -newname svm1\_root** |
| **9.** | Verify the change.  **vol show –volume svm1\_root\*** |

**END OF EXERCISE**

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| HISTORICO DE REVISÕES |  |  |
| DATA | **VERSÃO ASSUNTO** | **AUTOR** |
| 20/09/2015 | 1.0 Versão inicial | Ciro Bessa |
| 28/09/2015 | 2.5 – Takeover give back, volclone | Ciro Bessa |
| 05/09/2015 | 2.6 – Storage Efficiency, snapshot | Ciro Bessa |
| 26/10/2015 | 2.7 – VolMove | Ciro Bessa |