Clustered Data ONTAP® 8.3

iSCSI Configuration for Red Hat® Enterprise Linux® Express Guide
Deciding whether to use this guide

This guide describes how to quickly set up the iSCSI service on a Storage Virtual Machine (SVM), provision a LUN, and make the LUN available using an iSCSI initiator on a Red Hat Enterprise Linux server.

This guide is based on the following assumptions:

- You want to use best practices, not explore every available option.
- You do not want to read a lot of conceptual background.
- You want to use OnCommand System Manager, not the Data ONTAP command-line interface or an automated scripting tool.
- You are using the iSCSI software initiator on a Red Hat Enterprise Linux host running a supported version of Red Hat Enterprise Linux Series 6.4 or higher.
- Your network uses IPv4 addressing.
- You want to assign addresses to logical interfaces using any of the following methods:
  - Automatically, from a subnet you define
  - Manually, using an address selected from an existing subnet
  - Manually, using an address that will be added to an existing subnet
- You are not configuring iSCSI SAN boot.

If these assumptions are not correct for your situation, you should see the following resources:

- Clustered Data ONTAP 8.3 SAN Administration Guide
- Clustered Data ONTAP 8.3 SAN Configuration Guide
- Linux Unified Host Utilities 7.0 Installation Guide
- NetApp Documentation: OnCommand Workflow Automation (current releases)

OnCommand Workflow Automation enables you to run prepackaged workflows that automate management tasks such as the workflows described in Express Guides.
iSCSI configuration and provisioning workflow

When you make storage available to a host using iSCSI, you provision a volume and LUN on the Storage Virtual Machine (SVM), and then connect to the LUN from the host.

Verifying that the iSCSI configuration is supported

To ensure reliable operation, you must verify that the entire iSCSI configuration is supported. The Interoperability Matrix lists the supported configurations.

Steps

1. Go to the NetApp Interoperability Matrix Tool to verify that you have a supported combination of the following components:
• Data ONTAP software
• Host computer CPU architecture (for standard rack servers)
• Specific processor blade model (for blade servers)
• Storage protocol (iSCSI)
• Linux operating system version
• DM-Multipath package
• Linux Unified Host Utilities

2. Click the configuration name for the selected configuration. Details for that configuration are displayed in the Configuration Details window.

3. Review the information in the following tabs:

• Notes
  Lists important alerts and information that are specific to your configuration. Review the alerts to identify the packages that are required for your operating system.

• Policies and Guidelines
  Provides general guidelines for all SAN configurations.

Completing the iSCSI configuration worksheet

You require iSCSI identifiers, network addresses, and storage configuration information to perform iSCSI configuration tasks.

iSCSI identifiers

<table>
<thead>
<tr>
<th>Initiator (host) iSCSI node name (IQN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target alias (optional)</td>
</tr>
</tbody>
</table>

Target network addresses

The Storage Virtual Machine (SVM) is the iSCSI target.

You require a subnet with two IP addresses for iSCSI data LIFs for each node in the cluster. There should be two separate networks for high availability. The specific IP addresses are assigned by Data ONTAP when you create the LIFs as part of creating the SVM.

If possible, separate iSCSI traffic on separate physical networks or on VLANs.
Subnet for LIFs: _______________________

<table>
<thead>
<tr>
<th>Node or LIF with port to switch</th>
<th>IP address</th>
<th>Network mask</th>
<th>Gateway</th>
<th>VLAN ID</th>
<th>Home port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node 1 / LIF to switch 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Node 2 / LIF to switch 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Node 3 / LIF to switch 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Node 4 / LIF to switch 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Node 1 / LIF to switch 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Node 2 / LIF to switch 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Node 3 / LIF to switch 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Node 4 / LIF to switch 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Storage configuration**

If the aggregate and SVM are already created, record their names here; otherwise, you can create them as required:

<table>
<thead>
<tr>
<th>Node to own LUN</th>
<th>Aggregate name</th>
<th>SVM name</th>
</tr>
</thead>
</table>

**LUN information**

| LUN size | LUN name (optional) |
SVM information

If you are not using an existing SVM, you require the following information to create a new one:

<table>
<thead>
<tr>
<th>SVM name</th>
<th>SVM IPspace</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aggregate for SVM root volume</th>
<th>SVM user name (optional)</th>
<th>SVM password (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SVM management LIF (optional)</th>
<th>Subnet:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IP address:</td>
</tr>
<tr>
<td></td>
<td>Network mask:</td>
</tr>
<tr>
<td></td>
<td>Gateway:</td>
</tr>
<tr>
<td></td>
<td>Home node:</td>
</tr>
<tr>
<td></td>
<td>Home port:</td>
</tr>
</tbody>
</table>

Installing Linux Unified Host Utilities and optimizing I/O performance

Linux Unified Host Utilities software includes the `sanlun` utility, a NetApp LUN reporting tool that you can use to display information about storage cluster nodes. You must also enable the correct server profile on the Linux host to optimize NetApp storage performance.

Before you begin

You must have identified the supported Linux Unified Host Utilities version for your configuration by using the Interoperability Matrix. You must also have the `tuned` package, which is part of your Linux OS distribution and contains the `tuned-adm` command, which you use to set the server profile on the host.

Steps

1. Download the supported Linux Unified Host Utilities version from the NetApp Support Site.
   
   *NetApp Downloads: Software*

2. Install Linux Unified Host Utilities software by following the instructions in the installation documentation.

3. If the `tuned` package is not installed, enter the following command:
   
   `yum install tuned`

4. For a physical host, ensure that you have set the `enterprise-storage` profile:
   
   `tuned-adm profile enterprise-storage`

5. For a virtual host, ensure that you have set the `virtual-guest` profile:
   
   `tuned-adm profile virtual-guest`

*Linux Unified Host Utilities 7.0 Installation Guide*
**Recording the iSCSI node name**

You must record the iSCSI initiator node name on the Linux host so that you have it when you configure the storage system.

**Steps**

1. Use a text editor to open the `/etc/iscsi/initiatorname.iscsi` file containing the node names.
2. Write down the node name or copy it to a text file.

**Example**

The iSCSI initiator node name looks something like this:

```
iqn.1994-05.com.redhat:127
```

**Setting the iSCSI replacement timeout value**

To support multipathing, you must modify the replacement timeout value in the iSCSI configuration file.

**Step**

1. Change the replacement timeout value in the `/etc/iscsi/iscsid.conf` file from the default of 120 to 5.

**Example**

The replacement timeout value looks like the following in `iscsid.conf`:

```
node.session.timeo.replacement_timeout = 5
```

**Starting the iSCSI service**

After you change the timeout value in the iSCSI configuration file, you must start the iSCSI service so that the host can discover the targets and access LUNs.

**Steps**

1. Start the iSCSI service.
   
a. If it's the first time you are starting the iSCSI service on the Linux host, enter:

   ```
   service iscsid force-start
   ```

   **Note:** You must run the `force-start` command the first time you start the iSCSI service. Running `/etc/init.d/iscsi start` without previously running the `force-start` command could result in an error message.

   b. If you have previously started the iSCSI service on the Linux host, but iSCSI is not configured to start automatically at system boot, you must manually restart the service:

   ```
   /etc/init.d/iscsi start
   ```
2. To ensure that the iSCSI service always starts during system boot, run the following `chkconfig` commands separately (press Enter after each):

```
chkconfig iscsi on
chkconfig iscsid on
```

## Configuring DM-Multipath

DM-Multipath manages multiple paths between the Linux host and the storage cluster. Configuring DM-Multipath on a LUN, which appears to the Linux host as a SCSI device, ensures that your Linux host can access its LUN on the storage cluster if a path or component fails.

**Before you begin**

You must have identified the required version of DM-Multipath from the [NetApp Interoperability Matrix Tool](https://www.netapp.com/support/matrix/).

**Steps**

1. Edit the `/etc/multipath.conf` file as follows:

   a. Determine if there are non-NetApp SCSI devices to exclude (blacklist).

      These are devices that are not displayed when you enter the `sanlun lun show` command.

      - If there are non-NetApp SCSI devices to exclude, enter the WWID for the devices in the blacklist section of the `multipath.conf` file.

         To display the WWID of a non-NetApp SCSI device, enter the following command on the device that you want to exclude, where `<SCSI_device_name>` is a device that you specify:

         ```
         /lib/udev/scsi_id -gud /dev/<SCSI_device_name>
         ```

         For example, if `/dev/sda` is the non-NetApp SCSI device that you want to exclude, you would type:

         ```
         /lib/udev/scsi_id -gud /dev/sda
         ```

         This displays the WWID of the device, which you can copy and paste in the `multipath.conf` file.

      Example

      In the following example showing the blacklist section of the `multipath.conf` file, the non-NetApp SCSI device with WWID `3600508e000000000753250f933cc4606` is excluded:

      ```
      blacklist {
        wwid 3600508e000000000753250f933cc4606
        devnode "^(ram|raw|loop|fd|md|dm-|sr|scd|st)[0-9]*"
        devnode "^hd[a-z]"
        devnode "^cciss.*"
      }
      ```

      - If there are no devices to exclude, remove the `wwid` line altogether from the `multipath.conf` file.

   b. Enable NetApp recommended DM-Multipath settings by appending the following string to the end of the kernel line in the boot loader:

      ```
      rdloaddriver=scsi_dh_alua
      ```
2. Start the DM-Multipath daemon:
   
   `/etc/init.d/multipathd start`

3. To ensure that the multipath daemon always starts during system boot, add the multipath service to the boot sequence:

   `chkconfig multipathd on`

4. Reboot the Linux host.

5. Verify that the `rdloaddriver` setting appears in the output when you run `cat /proc/cmdline`.

   **Example**

   The `rdloaddriver` setting appears as one of several boot options that are passed to the kernel:

   ```
   # cat /proc/cmdline
   ro root=/dev/mapper/vg_ibmx3650210104-lv_root rd_NO_LUKS
   LANG=en_US.UTF-8 rd_NO_MD rd_LVM_LV=vg_ibmx3650210104/lv_root
   SYSFONT=latarcyrheb-sun16 rd_LVM_LV=vg_ibmx3650210104/lv_swap
   crashkernel=129M@0M KEYBOARDTYPE=pc KEYTABLE=us rd_NO_DM rhgb quiet
   rdloaddriver=scsi_dh_alua
   ```

**Creating an aggregate**

If you do not want to use an existing aggregate, you can create a new aggregate to provide physical storage to the volume you are provisioning.

**Steps**

1. Enter the URL `https://IP-address-of-cluster-management-LIF` in a web browser and log in to System Manager using your cluster administrator credential.

2. In the navigation pane, expand the **Cluster** hierarchy and click **Storage > Aggregates**.

3. Click **Create**.

4. Follow the instructions on the screen to create the aggregate using the default RAID-DP configuration, and then click **Create**.

**Result**

The aggregate is created with the specified configuration and added to the list of aggregates in the **Aggregates** window.
Deciding where to provision the volume

Before you provision a volume to contain your LUNs, you need to decide whether to add the volume to an existing Storage Virtual Machine (SVM) or to create a new SVM for the volume. You might also need to configure iSCSI on an existing SVM.

About this task

If an existing SVM is already configured with the needed protocols and has LIFs that can be accessed from the host, it is easier to use the existing SVM.

You can create a new SVM to separate data or administration from other users of the storage cluster. There is no advantage to using separate SVMs just to separate different protocols.

Choices

- If you want to provision volumes on an existing SVM that is already configured for iSCSI, see Verifying that the iSCSI service is running on an existing SVM on page 12.
- If you want to provision volumes on an existing SVM that has iSCSI enabled but not configured, see Configuring iSCSI on an existing SVM on page 14.
  This is the case when you followed another Express Guide to create the SVM while configuring a different protocol.
- If you want to provision volumes on a new SVM, see Creating a new SVM on page 16.

Verifying that the iSCSI service is running on an existing SVM

If you choose to use an existing Storage Virtual Machine (SVM), you must verify that the iSCSI service is running on the SVM.

Before you begin

You must have selected an existing SVM on which you plan to create a new LUN.

Steps

1. From the OnCommand System Manager home page, double-click the appropriate storage system.
2. Expand the Storage Virtual Machines hierarchy in the left navigation pane.
3. In the navigation pane, select the SVM and click Configuration > Protocols > iSCSI.
4. Verify that the iSCSI service is running.
5. Record the iSCSI interfaces listed for the SVM.

**After you finish**

If the iSCSI service is not running, start the iSCSI service or create a new SVM.

If there are fewer than two iSCSI interfaces per node, update the iSCSI configuration on the SVM or create a new SVM for iSCSI.

**Creating a LUN and its containing volume**

You use the Create LUN wizard to create a LUN and the FlexVol volume that contains the LUN. The wizard also creates the igroup and maps the LUN to the igroup, which enables the specified host to access the LUN.

**Before you begin**

- There must be an aggregate with enough free space to contain the LUN.
- There must be a Storage Virtual Machine (SVM) with the iSCSI protocol enabled and the appropriate LIFs created.
- You must have recorded the iSCSI initiator node name of the host.

Starting with clustered Data ONTAP 8.3, LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, Data ONTAP 8.3 uses Selective LUN Map to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
- You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- When moving a volume or a LUN, you must modify the Selective LUN Map reporting-nodes list before moving.

**About this task**

If your organization has a naming convention, you should use names for the LUN, volume, and so on that fit your convention. Otherwise, you should accept the default names.

**Steps**

1. From the OnCommand System Manager home page, double-click the appropriate storage system.
2. Expand the **Storage Virtual Machines** hierarchy in the left navigation pane.
3. In the navigation pane, select the SVM, and then click **Storage > LUNs**.
4. In the **LUN Management** tab, click **Create**, and then type or select information as prompted by the wizard.
5. On the **General Properties** page, select the LUN type **Linux** for LUNs used directly by the Linux host.
Leave the **Thin Provisioned** check box unselected.

6. On the **LUN Container** page, create a new FlexVol volume.

7. On the **Initiators Mapping** page, click **Add Initiator Group**, enter the required information on the **General** tab, and then on the **Initiators** tab, enter the iSCSI initiator node name of the host that you recorded.

8. Confirm the details, and then click **Finish** to complete the wizard.

**Related information**

*Clustered Data ONTAP 8.3 System Administration Guide*

**Configuring iSCSI on an existing SVM**

You can configure iSCSI on an existing Storage Virtual Machine (SVM) and create a LUN and its containing volume with a single wizard. The iSCSI protocol must already be enabled but not configured on the SVM. This information is intended for SVMs for which you are configuring multiple protocols, but have not yet configured iSCSI.

**Before you begin**

You must have enough network addresses available to create two LIFs for each node.

**About this task**

Starting with clustered Data ONTAP 8.3, LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, Data ONTAP 8.3 uses Selective LUN Map to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
• You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.

• When moving a volume or a LUN, you must modify the Selective LUN Map reporting-nodes list before moving.

Steps

1. In the navigation pane, expand the Storage Virtual Machines hierarchy and select the SVM.

2. In the SVM Details pane, verify that iSCSI is displayed with a gray background, which indicates that the protocol is enabled but not fully configured.

   If iSCSI is displayed with a green background, the SVM is already configured.

3. Click the iSCSI protocol link with the gray background.

   The Configure iSCSI Protocol window is displayed.

4. Configure the iSCSI service and LIFs from the Configure iSCSI protocol page:
   a. Optional: Enter a target alias name.
   b. Enter 2 in the LIFs per node field.

      Two LIFs are required for each node, to ensure availability and data mobility.
   c. Select the subnet for the LIFs.
   d. In the Provision a LUN for iSCSI storage area, enter the desired LUN size, host type, and iSCSI initiator name of the host.
   e. Click Submit & Close.
5. Review the Summary page, record the LIF information, and then click OK.

Creating a new SVM

The Storage Virtual Machine (SVM) provides the iSCSI target through which a host accesses LUNs. When you create the SVM, you also create logical interfaces (LIFs) and the LUN and its containing volume. You can create a new SVM to separate data or administration from other users of the storage cluster.

Before you begin

• You must have enough network addresses available to create two LIFs for each node.

About this task

Starting with clustered Data ONTAP 8.3, LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

• By default, Data ONTAP 8.3 uses Selective LUN Map to make the LUN accessible only through paths on the node owning the LUN and its HA partner.

• You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.

• When moving a volume or a LUN, you must modify the Selective LUN Map reporting-nodes list before moving.

Steps

1. Expand the Storage Virtual Machines hierarchy in the left navigation pane.

2. Click Create.

3. In the Storage Virtual Machine (SVM) Setup window, create the SVM:
a. Specify a unique name for the SVM.
   The name must either be a fully qualified domain name (FQDN) or follow another convention that ensures unique names across a cluster.

b. Select the IPspace that the SVM will belong to.
   If the cluster does not use multiple IPspaces, the “Default” IPspace is used.

c. Keep the default volume type selection.
   Only FlexVol volumes are supported with SAN protocols.

d. Select all of the protocols that you have licenses for and that you will ever use on the SVM, even if you do not want to configure all of the protocols immediately.
   Selecting both NFS and CIFS when you create the SVM enables these two protocols to share the same LIFs. Adding these protocols later does not allow them to share LIFs.
   If CIFS is one of the protocols you selected, then the security style is set to NTFS. Otherwise, the security style is set to UNIX.

e. Keep the default language setting C.UTF-8.

f. Select the desired root aggregate to contain the SVM root volume.
   The aggregate for the data volume is selected separately in a later step.

g. Click Submit & Continue.
   The SVM is created, but protocols are not yet configured.

4. If the Configure CIFS/NFS protocol page appears because you enabled CIFS or NFS, click Skip and then configure CIFS or NFS later.

5. Configure the iSCSI service and create LIFs, and the LUN and its containing volume from the Configure iSCSI protocol page:
   a. Optional: Enter a target alias name.
   b. Select the subnet for the LIFs.
   c. Enter 2 in the LIFs per node field.
      Two LIFs are required for each node to ensure availability and data mobility.
   d. Click Submit & Continue.
6. If the Configure FC/FCoE protocol page appears because you enabled FC, click Skip and then configure FC later.

7. When the SVM Administration appears, configure or defer configuring a separate administrator for this SVM:
   - Click Skip and configure an administrator later if desired.
   - Enter the requested information, and then click Submit & Continue.

8. Review the Summary page, record the LIF information, and then click OK.

Related information

NetApp Documentation: Clustered Data ONTAP Express Guides

Starting the iSCSI sessions with the target

The Linux host must have an iSCSI connection with each node (target) in the storage cluster. You establish the sessions from the host.

About this task

In clustered Data ONTAP, the iSCSI host must have paths to each node in the cluster. DM-Multipath selects the best paths to use. If paths fail, DM-Multipath selects alternate paths.

Steps

1. Start the iSCSI service from the Linux host command prompt:
   
   ```
   service iscsid force-start
   ```

2. Discover the iSCSI target:
iscsiadm --mode discovery --op update --type sendtargets --portal targetIP

The IP address of each discovered target displays on a separate line.

3. Establish iSCSI sessions by logging in to each target:
   iscsiadm --mode node -l all

4. You can view a list of the active iSCSI sessions:
   iscsiadm --mode session

Discovering new SCSI devices (LUNs) and multipath devices

LUNs on the storage cluster appear to the Linux host as SCSI devices, which are I/O paths that DM-Multipath aggregates into a new device, called a multipath device. The host does not automatically discover new SCSI devices (LUNs) that you add to your system. You must manually rescan them to discover them.

Before you begin

You must have a copy of the rescan script, which is in the sg3_utils package that is part of your Linux OS distribution.

Steps

1. Discover new SCSI devices (LUNs) and create the corresponding multipath devices for the LUNs:
   /usr/bin/rescan-scsi-bus.sh

2. Verify DM-Multipath configuration:
   multipath -ll

Example

This displays the following type of output, listing the recommended settings for each NetApp LUN:

```
3600a0980324666546e2b443251655177 dm-2 NETAPP,LUN C-Mode
size=10G features='4 queue_if_no_path pg_init_retries 50 retain_attached_hw_handle' hwhandler='1 alua' wp=rw
  -+ policy='round-robin 0' prio=50 status=active
      - 0:0:1:0 sdb 8:16 active ready running
      - 0:0:0:0 sda 8:0 active ready running
      - 1:0:0:0 sde 8:64 active ready running
    -+ 1:0:1:0 sdf 8:80 active ready running
      -+ policy='round-robin 0' prio=10 status=enabled
          - 0:0:2:0 sdd 8:48 active ready running
          - 1:0:3:0 sdd 8:112 active ready running
          - 0:0:2:0 sdc 8:32 active ready running
      - 1:0:2:0 sdg 8:96 active ready running
```

Configuring logical volumes on multipath devices and creating a file system

When the Linux host first accesses a new SCSI device (LUN), there is no partition or file system. If you want to use a partitioned multipath device, you must first partition the underlying SCSI devices.
You might also want to create logical volumes on multipath devices, and optionally create a file system.

**Before you begin**

SCSI devices and corresponding multipath devices must have been discovered by the Linux host.

**About this task**

At a minimum DM-Multipath should be configured on the SCSI devices. Any configuration beyond DM-Multipath is optional. The following steps are general guidelines if you wish to perform additional configuration, such as partitioning, configuring logical volumes on multipath devices, and creating a file system. For details on Linux commands, refer to Red Hat Enterprise Linux documentation and man pages.

**Steps**

1. To use a partitioned multipath device, first partition the underlying SCSI devices using the `fdisk` or `parted` utility.
2. Create corresponding multipath partitions using the `kpartx` utility.
3. Create logical volumes on corresponding multipath devices using Logical Volume Manager (LVM) commands.
4. Create a file system, such as Ext4 or XFS, on logical volumes or multipath devices using the `mkfs` utility.

**Verifying that the host can write to and read from a multipath device**

Before using a multipath device, you should verify that the host can write data to the multipath device and read it back.

**Before you begin**

DM-Multipath must be configured on the Linux host for the storage cluster nodes you are accessing.

**About this task**

If the storage cluster node that the multipath device corresponds to can be failed over to its partner node, you should verify reading the data while the node is failed over. This verification might not be possible if the storage cluster is in production use.

**Steps**

1. Run some I/O on the specified multipath device:
   ```
   dd if=/dev/zero of=<multipath_device_name>
   ```
2. Verify that I/O is running on the multipath device, specifying the number of seconds to refresh statistics (for example, every two seconds, as shown):
   ```
   iostat 2
   ```

**Example**

When I/O is running on the multipath device, you can see the various I/O counters output change dynamically, indicating that I/O is running successfully on the multipath device.
3. If possible, run the `takeover` command on the storage cluster node:
   ```bash
   storage failover takeover -ofnode <node_name>
   ```

4. Verify that I/O is still running on the multipath device by re-running the `iostat` command.

5. Run the `giveback` command on the storage cluster node:
   ```bash
   storage failover giveback -ofnode <node_name>
   ```

6. Check `iostat` output to verify that I/O is still running.

**After you finish**

If any of the tests fail, verify that the iSCSI service is running and re-check the DM-Multipath configuration and the iSCSI paths to the multipath device.
Where to find additional information

After you have successfully tested iSCSI, you can perform advanced iSCSI configuration or add SAN or NAS protocols. There are express guides, comprehensive guides, and technical reports to help you achieve these goals.

SAN configuration

All of the following documentation is available:

- *Clustered Data ONTAP 8.3 SAN Configuration Guide*
  Describes supported FC, iSCSI, and FCoE topologies for connecting host computers to storage controllers in clusters.

- *Clustered Data ONTAP 8.3 SAN Administration Guide*
  Describes how to configure and manage the iSCSI, FCoE, and FC protocols for clustered SAN environments, including configuration of LUNs, iGroups, and targets.

- *Linux Unified Host Utilities 7.0 Installation Guide*
  Describes how to install Linux Unified Host Utilities software and configure DM-Multipath.

  Describes the current best practices for Red Hat virtualized environments.

- Red Hat Enterprise Linux 6 documentation and man pages
  Provides instructions for managing storage devices, file systems, and Linux commands.

Additional protocol configuration

If you want to provide additional SAN or NAS access to the SVM, you can use any of the protocol configuration express guides.

*NetApp Documentation: Clustered Data ONTAP Express Guides*
Trademark information

NetApp, the NetApp logo, Go Further, Faster, AltaVault, ASUP, AutoSupport, Campaign Express, Cloud ONTAP, Clustered Data ONTAP, Customer Fitness, Data ONTAP, DataMotion, Fitness, Flash Accel, Flash Cache, Flash Pool, FlashRay, FlexArray, FlexCache, FlexClone, FlexPod, FlexScale, FlexShare, FlexVol, FPolicy, GetSuccessful, LockVault, Manage ONTAP, Mars, MetroCluster, MultiStore, NetApp Insight, OnCommand, ONTAP, ONTAPI, RAID DP, RAID-TEC, SANtricity, SecureShare, Simplicity, Simulate ONTAP, Snap Creator, SnapCenter, SnapCopy, SnapDrive, SnapIntegrator, SnapLock, SnapManager, SnapMirror, SnapMover, SnapProtect, SnapRestore, Snapshot, SnapValidator, SnapVault, StorageGRID, Tech OnTap, Unbound Cloud, and WAFL and other names are trademarks or registered trademarks of NetApp, Inc., in the United States, and/or other countries. All other brands or products are trademarks or registered trademarks of their respective holders and should be treated as such. A current list of NetApp trademarks is available on the web at http://www.netapp.com/us/legal/netapptmlist.aspx.
How to send comments about documentation and receive update notifications

You can help us to improve the quality of our documentation by sending us your feedback. You can receive automatic notification when production-level (GA/FCS) documentation is initially released or important changes are made to existing production-level documents.

If you have suggestions for improving this document, send us your comments by email to doccomments@netapp.com. To help us direct your comments to the correct division, include in the subject line the product name, version, and operating system.

If you want to be notified automatically when production-level documentation is released or important changes are made to existing production-level documents, follow Twitter account @NetAppDoc.

You can also contact us in the following ways:

• NetApp, Inc., 495 East Java Drive, Sunnyvale, CA 94089 U.S.
• Telephone: +1 (408) 822-6000
• Fax: +1 (408) 822-4501
• Support telephone: +1 (888) 463-8277
Index

A

about this guide
deciding whether to use 4
additional information, where to find
iSCSI configuration 22
aggregates
creating 11
audience
for this guide 4
automatically starting
  DM-Multipath at system boot 10

B

blacklisting
  excluding devices in multipath.conf 10

C

clusters
  starting iSCSI sessions with 18
comments
  how to send feedback about documentation 25
configuration
  iSCSI workflow 5
  where to find information about iSCSI 22
configuring
  DM-Multipath 10
  iSCSI on existing SVMs 14
  iSCSI worksheet for 6
creating
  a file system 19
  aggregates 11
  logical volumes on multipath devices 19
  LUNs and their containing volumes 13
  SVMs 16

D

devices
  excluding (blacklisting) in multipath.conf 10
discovering
  new SCSI devices and multipath devices 19
DM-Multipath
  configuring on Red Hat Enterprise Linux hosts 10
documentation
  how to receive automatic notification of changes to 25
  how to send feedback about 25

E

editing
  iscsid.conf 9
  multipath.conf 10
excluding
  devices in multipath.conf 10

express guides
  requirements for using iSCSI with Red Hat
  Enterprise Linux 4

F

feedback
  how to send comments about documentation 25
file system
  creating on new multipath devices 19
FlexVol volumes
  creating 13
flowcharts
  iSCSI configuration 5
formatting
  a new SCSI device (LUN) 19

G

guides, express
  requirements for using iSCSI with Red Hat
  Enterprise Linux 4

H

hosts
  installing host utilities on 8
  setting the server profile 8
  verifying writing to and reading from multipath
devices 20

I

igroups
  creating and mapping the LUN to 13
information
  how to send feedback about improving
documentation 25
  where to find additional iSCSI configuration 22
initiator node names
  recording iSCSI 9
initiators
  recording the iSCSI node name 9
  starting sessions with targets 18
installing
  host utilities 8
Interoperability Matrix
  verifying supported iSCSI configurations using 5
IQN
  iSCSI configuration worksheet for 6
  recording iSCSI 9
iSCSI
  configuration workflow 5
  configuration worksheet for 6
  configuring on existing SVMs 14
  connecting initiators to targets 18
  recording the initiator node name 9
  starting sessions with targets 18
verifying that configuration is supported 5
where to find additional information about configuring 22
iSCSI replacement timeout value
modifying 9
iSCSI service
starting 9
verifying running on SVM 12
iSCSI targets
creating as part of configuring SVMs 14
creating as part of creating SVMs 16
iscsid.conf
modifying the replacement timeout value in 9

L
LIFs
creating as part of configuring SVMs 14
creating as part of creating SVMs 16
Linux hosts, Red Hat
packages required for DM-Multipath 5, 19
starting iSCSI sessions with targets 18
verifying supported iSCSI configurations 5
Linux hosts, Red Hat Enterprise
configuring DM-Multipath on 10
requirements for using iSCSI 4
logical interfaces
See LIFs
LUNs
creating 13
deciding where to provision the containing volume on a new or existing SVM 12
discovering and creating multipath devices on 19
See also SCSI devices (LUNs)
discovering new 19
ensuring access to with DM-Multipath 10
how they appear to a Linux host 19
mapping to an igroup 13
partitioning and creating a file system on 19
requirements for using iSCSI with Red Hat Enterprise Linux 4

M
mapping
LUNs to an igroup 13
multipath devices
creating logical volumes and a file system on 19
discovering new 19
verifying that the host can write to and read from 20
multipath.conf
editing 10

N
network addresses
iSCSI configuration worksheet for 6
nodes
starting iSCSI sessions with 18

P
packages
required for DM-Multipath 5, 19
required to set the server profile 8
partitions
creating for new SCSI devices (LUN) 19
provisioning
iSCSI workflow 5
iSCSI worksheet for 6
where to find information about iSCSI 22

R
read/write
verifying that the host can write to and read from multipath devices 20
Red Hat hosts
See Linux hosts, Red Hat
replacement timeout value, iSCSI
modifying 9
requirements
for using iSCSI with Red Hat Enterprise Linux 4
verifying supported iSCSI configurations 5

S
SCSI devices (LUNs)
discovering and creating multipath devices on 19
See also LUNs
discovering new 19
partitioning and creating a file system on 19
server profile
setting 8
starting
DM-Multipath 10
the iSCSI service 9
storage configurations
iSCSI configuration worksheet 6
suggestions
how to send feedback about documentation 25
supported configurations
verifying iSCSI 5
SVMs
configuring iSCSI on existing 14
creating 16
deciding whether to provision a volume on a new or existing 12
verifying iSCSI service is running 12

targets
creating iSCSI as part of configuring SVMs 14
creating iSCSI as part of creating SVMs 16
starting iSCSI sessions with 18
timeout value, iSCSI
modifying 9
twitter
how to receive automatic notification of documentation changes 25
U
updates, Linux
   See packages

V
volumes
   creating 13
   deciding whether to provision on a new or existing SVM 12

W
wizards
   running the Create LUN 13
workflows
   iSCSI configuration 5
worksheets
   iSCSI configuration 6
write/read
   verifying that the host can write to and read from multipath devices 20