



Technical Report

NetApp SolidFire Storage for OpenStack Configuration Guide

For Element OS Version 10.0

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1 Introduction

This document explains how to configure and connect an OpenStack software Cinder host to a NetApp® SolidFire® storage system. It also provides best practices and implementation recommendations.

This document makes the following assumptions:

- You have an OpenStack software cluster running the Mitaka release or later.
- You have a hypervisor installed and integrated with OpenStack software. This document only covers configuration with a kernel-based virtual machine (KVM).
- The storage array is running, and you have access to the SolidFire Element® OS web UI.
- The OpenStack software controllers are running the Cinder volume services, and services can access both the management virtual IP (MVIP) and the storage management virtual IP (SVIP) of the storage system. In addition, OpenStack software compute nodes can access the SVIP.

Note: As a best practice, isolate the MVIP and SVIP on separate networks.

2 Getting Started

Before you begin, you must gather information from the SolidFire storage system and prepare it for integration with the OpenStack software. To do so, you must complete the following tasks:

- Create a cluster admin account to use with the OpenStack software to manage the storage cluster. Optionally, you can use an existing cluster admin account for integration.
- Make note of the storage cluster MVIP and SVIP information.

2.1 Required OpenStack Software Components

You must install certain components of the OpenStack software before you can connect a virtual machine instance to a SolidFire cluster volume.

You need the following OpenStack software components:

- **Nova.** Used to create and boot virtual machines.
- **Keystone.** Used as an identity service for the token, catalog, and policy services for OpenStack software components. After installation, refer to the [Keystone documentation](#) for configuration information.
- **Cinder.** Used to create volumes on the SolidFire storage system from virtual machine images.
- **Glance.** Used to discover, register, and retrieve virtual machine images.
- **Horizon.** Used for web-based management of OpenStack projects using OpenStack software APIs.

For more details about each component, see the [OpenStack software documentation](#).

2.2 Accessing MVIP and SVIP Information

You must record the MVIP and the SVIP to properly configure the SolidFire storage system driver. The cluster's web interface is hosted from the MVIP IP address. To record the necessary IP addresses, complete the following procedure:

Procedure

1. Go to the Reporting > Overview page.
2. Note the SVIP listed in the Cluster Information pane.
3. Note the IP address you are using to access the web UI; this is the MVIP IP address.

2.3 Adding a Cluster Admin Account

You can create new cluster admin accounts to manage a storage cluster. You can configure each cluster admin account to allow access to only a specific area of the storage system.

NetApp recommends creating a cluster admin account for each OpenStack software instance to help you audit API requests from the OpenStack software. It is also a good security practice to limit account access to only necessary services. OpenStack software instances do not need access to individual SF-Series nodes or drives.

Procedure

1. Log in to the Element OS web UI.
2. Go to Users > Cluster Admins.
3. Click Create Cluster Admin.
4. To create the account as a local account, complete the following steps:
 - a. Select Cluster.
 - b. Enter a username in the Username field.
 - c. Enter a password in the Password field.
 - d. (Optional) To show the password text as you type, select Show Password.
 - e. Enter the password again in the Confirm Password field.
 - f. Enable the Accounts, Reporting, and Volumes permissions for the account.

Note: The account is granted administrative privileges for the permissions you select and view-only privileges for permissions you do not select.

- g. Read the end-user license agreement and select I Agree to the SolidFire End User Licensing Agreement.
 - h. Click Create Cluster Admin.
5. To create the account as an LDAP account, complete the following steps:
 - a. Select Create as LDAP User.
 - b. Enter the full distinguished name for the account in the Distinguished Name box.
For example: `CN=firstname lastname,OU=Sales,DC=LDAP,DC=Solidfire,DC=ORG`
 - c. Select the user permissions required for the account.

Note: The account is granted administrative privileges for the permissions you select and view-only privileges for permissions you do not select.

- d. Read the end-user license agreement and select I Agree to the SolidFire End User Licensing Agreement.
- e. Click Create Cluster Admin.

3 Configuring the OpenStack Software Driver

The OpenStack software driver enables communication between the OpenStack software and a SolidFire storage system. You can use information from the SF-Series cluster to configure the driver. You can configure the driver by modifying the `/etc/cinder/cinder.conf` service configuration file on the controller host. The OpenStack Cinder software uses the cluster admin account you created in the section “Adding a Cluster Admin Account” to manage storage on the cluster.

Table 1 lists the storage system attributes used in the `/etc/cinder/cinder.conf` configuration file.

Table 1) Storage system attributes.

SolidFire Storage System Attribute	OpenStack cinder.conf Software Equivalent
MVIP	san_ip Cluster
Admin account name	san_login
Cluster admin password	san_password

Procedure

1. Open a CLI on the OpenStack software controller host.
2. Open the `/etc/cinder/cinder.conf` file in a text editor.
3. Add the following lines to the file, replacing login and password with the cluster admin login credentials:

```
[solidfire]
volume_driver=cinder.volume.drivers.solidfire.SolidFireDriver
san_ip=172.17.1.182
san_login=login
san_password=password

[DEFAULT]
enabled_backends=solidfire
```

If the `enabled_backends` line already exists and contains a value, separate the existing value from the new SolidFire value with a comma.

4. Restart the OpenStack Cinder service by issuing one of the following commands:
 - `service cinder-volume restart`
 - `systemctl restart openstack-cinder-volume`
5. Restart the OpenStack Cinder scheduler service by issuing one of the following commands:
 - `service cinder-scheduler restart`
 - `systemctl restart openstack-cinder-scheduler`

The OpenStack software should now be able to use the SolidFire storage cluster.

3.1 Optional Cinder Configuration Attributes

You can optionally use the following attributes specific to SolidFire in the `[solidfire]` section of the `/etc/cinder/cinder.conf` configuration file to control the interaction between the storage system and the OpenStack Cinder service. (See Table 2.)

Table 2) SolidFire attributes.

SolidFire Attribute	Default	Description
<code>sf_account_prefix</code>	None	Create storage system accounts with this prefix. The default is no prefix.
<code>sf_allow_template_caching</code>	True	Create an internal cache of image copies when a bootable volume is created to eliminate the fetch from OpenStack Glance and QEMU conversion on subsequent calls.

SolidFire Attribute	Default	Description
sf_allow_tenant_qos	False	Allow individual tenants to specify QoS on volume creation. Not recommended.
sf_api_port	443	The SolidFire storage system API port. Change this value if the device API is behind a proxy on a different port.
sf_emulate_512	True	Set 512-byte emulation on volume creation. Note: The default is to enable 512 emulation. Required for KVM hypervisors.
sf_enable_vag	False	Use volume access groups on a per-tenant basis instead of using CHAP secrets.
sf_enable_volume_mapping	True	Create an internal mapping of volume IDs and accounts. This option optimizes lookups and performance at the expense of memory. Use with caution; for very large deployments, this can cause performance issues.
sf_svip	None	Overrides the default cluster SVIP with the one specified. This option should only be used when multiple OpenStack software instances are accessing the storage cluster from nondefault VLANs.
sf_template_account_name	openstack-vtemplate	The account name on the SF-Series cluster to use as the owner of the template and cache volumes.
sf_volume_prefix	UUID-	Create volumes on the cluster with this prefix. Volumes use the prefix format <code><sf_volume_prefix><cinder-volume-id></code> . The default is to use the prefix UUID-.

3.2 Enabling Multiple Back-End Support

OpenStack software is capable of integrating with multiple storage systems at the same time (also known as volume back ends). To do this, enable the `enabled_backends` option in the `/etc/cinder/cinder.conf` configuration file and assign a name to each storage service.

When using multiple back ends, you can associate a SolidFire storage system back end with a particular volume type when configuring QoS values. To associate a back end with a particular volume type, you use the volume type key `volume_backend_name`. The `volume_backend_name` setting is configured for each back end defined in the `/etc/cinder/cinder.conf` configuration file.

Prerequisites

If you need to associate the back end with a volume type, you must already have an existing volume type. See the section “Creating a Volume Type” for more information.

Procedure

1. Open the `/etc/cinder/cinder.conf` file in a text editor.
2. Make the following changes to the `[lvm]`, `[solidfire]`, and `[DEFAULT]` sections:

```
[lvm]
volume_group=lvm cinder volumes
volume_driver=cinder.volume.drivers.lvm.LVMISCSIDriver
volume_backend_name=LVM_iSCSI
[solidfire]
volume_driver=cinder.volume.drivers.solidfire.SolidFireDriver
san_ip=172.17.1.182
san_login=openstack-admin
san_password=superduperpassword
volume_backend_name=SolidFire
[DEFAULT]
enabled_backends=lvm,solidfire
```

3. Open a command line terminal on the OpenStack software host.
4. Restart the OpenStack Cinder service by issuing one of the following commands:
 - `service cinder-volume restart`
 - `systemctl restart openstack-cinder-volume`
5. Restart the OpenStack Cinder scheduler service by issuing one of the following commands:
 - `service cinder-scheduler restart`
 - `systemctl restart openstack-cinder-scheduler`
6. To associate the back end with a particular volume type (for example, SF-slow), run the following command, replacing `<backend_name>` with the desired `volume_backend_name` value in the `cinder.conf` file:

```
cinder type-key SF-slow set volume_backend_name=<backend_name>
```

7. To verify the new settings, run the following command:

```
cinder extra-specs-list
```

This procedure produces an output similar to the following:

ID	Name	extra_specs
29e8a995-9a21-4540-87a5-bc1c47958ddc	solidfire	{u'volume_backend_name': u'SolidFire'}
78aa349f-743e-436a-8ca0-0a181d946db2	lvmdriver-1	{u'volume_backend_name': u'lvmdriver-1'}

For more details about configuring multiple back ends, see the [OpenStack multiple back end documentation](#).

4 Volumes

You can use OpenStack software to manage volumes on the SolidFire cluster.

4.1 Creating a Volume Using the OpenStack Software Web UI

You can create a volume on a SolidFire cluster using the SolidFire driver that comes installed with the OpenStack software. However, you must configure the driver before creating a volume using OpenStack software. See the section “Configuring the OpenStack Software Driver” for driver configuration instructions.

Note: OpenStack software uses 1,024-byte kilobytes to calculate volume sizes, whereas SolidFire systems use 1,000-byte kilobytes. Therefore, volumes created using OpenStack software appear slightly larger when displayed on a SolidFire system.

Procedure

1. Go to the Project > Compute > Volumes page.
2. Click Create Volume.
3. Enter a name for the volume in the Volume Name field.
4. Enter a description in the Description field.
5. Select a volume source from the Volume Source list.
6. If applicable, select a source image from the Use Image As a Source list.
7. Select a volume type from the Type list.
8. Choose a volume size from the Size spin box.
9. Choose the correct zone from the Availability Zone list.
10. Click Create Volume.

4.2 Creating a Volume Using a CLI

You can use a CLI to create a volume using OpenStack software commands.

Procedure

1. Open a CLI on the controller node.
2. Enter the following command as an administrator user, replacing `<volume_name>` with the desired name of the volume and `<size>` with the desired volume size:

```
cinder create --display-name <volume_name> <size>
```

This procedure produces an output similar to the following:

Property	Value
attachments	<input type="checkbox"/>
availability_zone	nova
bootable	false
consistencygroup_id	None
created_at	2015-06-01T18:11:36.000000
description	None
encrypted	False
id	88310a9e-7bd1-46d4-8328-c620096c7f0a
metadata	{}
multiattach	False
name	simplevolume
os-vol-tenant-attr:tenant_id	fce9c496407449dcb6a44ef62bf68570
os-volume-replication:driver_data	None
os-volume-replication:extended_status	None
replication_status	disabled
size	10
snapshot_id	None
source_vol_id	None
status	creating
user_id	31bb3a951cf44073ae24cad164f5be4f
volume_type	solidfire

- To view the status of the newly created volume, enter the following command as an administrative user. Replace `<volume_id>` with the ID property of the volume shown in the output of the volume creation command:

```
cinder show <volume_id>
```

4.3 Attaching a Volume to a Virtual Machine Using the OpenStack Software Web UI

You can use the OpenStack software web UI to attach a virtual machine instance to a SolidFire volume.

Procedure

- Go to the Project > Compute > Volumes page.
- In the Actions list for the volume, select Manage Attachments.
- In the Manage Volume Attachments dialog box, select the instance to which the volume should be attached.
- Click Attach Volume. The Volume List window appears with the In Use status displayed after the volume is attached.

4.4 Attaching a Volume to a Virtual Machine Using the OpenStack Software CLI

You can attach a volume to a virtual machine instance using the CLI.

Procedure

- Open a CLI on the controller instance.
- Enter the following command as an administrator user, replacing `<instance_id>` with the virtual machine instance ID and `<volume_id>` with the ID of the volume you want to attach:

```
nova volume-attach <instance_id> <volume_id>
```

This procedure produces an output similar to the following:

Property	Value
device	/dev/vdb
id	88310a9e-7bd1-46d4-8328-c620096c7f0a
serverId	2f209427-71dc-449a-80d2-13f82d5ae816
volumeId	88310a9e-7bd1-46d4-8328-c620096c7f0a

4.5 Creating a Volume Type

You can create volume types to label volumes and associate them with a set of capabilities, such as encryption or the use of a certain storage back end. You can also use volume types to associate the volumes with QoS specs. For more information, see the section “QoS Spec Association with Volume Types.”

Procedure

1. In the OpenStack software web UI, go to Admin > Volumes > Volume Types.
2. Click Create Volume Type.
3. Enter a name for the volume type in the Name field.

The new type appears in the Volume Types table.

5 Quality of Service

You can use quality of service (QoS) to provide a minimum or maximum level of bandwidth to certain volumes in the SolidFire cluster.

5.1 Creating QoS Specs

You can assign QoS values to a SolidFire volume using QoS specs. The driver checks the volume type and QoS spec information when you create a volume.

Complete the following procedure to create new QoS specs. Note that you can choose the name for the volume type, but specific values are required in the QoS specs (minIOPS, maxIOPS, and burstIOPS).

Prerequisites

Make sure that you have administrator access to the OpenStack software web interface.

Procedure

1. Log in to the OpenStack software web UI as an administrative user.
2. Go to the Admin > System > Volumes page.
3. Select the Volume Types tab.
4. In the QoS Specs section, click Create QoS Spec.
5. Enter a name for the QoS spec in the Name field.
6. Select a consumer value from the Consumer list. This indicates where the QoS policy should be enforced (the back end for most environments).
7. Click Create.
8. In the QoS Specs section, click Manage Specs in the Actions column for the QoS spec you just created. The Specs area appears.
9. To create a key/value pair:

- a. Click Create.
 - b. Enter minIOPS in the Key field.
 - c. Enter the desired minIOPS value in the Value field (for example, 4000).
 - d. Click Create.
10. Repeat the previous step to create the remaining key/value pairs. Replace `<value>` with the desired values for each key:
 - `maxIOPS=<value>`
 - `burstIOPS=<value>`
 11. Click Close.

5.2 QoS Spec Association with Volume Types

You can use one of two methods to assign QoS levels to volumes using OpenStack software. The first option is configuring OpenStack software volume types for each disk service offering. This gives administrative users full control and allows tenants to create volumes based on administrator-created types. The second option allows the tenant to either choose from preconfigured values or create new performance types. Use the second option with caution.

5.3 Assigning QoS Specs to Volume Types Using the OpenStack Software Web UI

You can assign QoS specs to a volume type using the OpenStack software web UI.

Procedure

1. Go to Admin > Volumes > Volume Types.
2. Click Create Volume Type.
3. In the Actions column of the Volume Types table, choose a volume type and select the associated Manage QoS Spec Association action.
4. Select a QoS spec from the QoS Spec to Be Associated list.
5. Click Associate.

The QoS spec appears in the Associated QoS Spec column for the volume type.

5.4 Assigning QoS Specs to a Volume Type Using the CLI

You can assign QoS specs to a volume type using OpenStack software commands in the CLI.

Procedure

1. Open a CLI on the OpenStack software host.
2. Run the following command to associate a QoS spec with a volume type, replacing `<qos_spec>` with the ID of the QoS spec and `<volume_type>` with the name of a volume type:

```
cinder qos-associate <qos_spec> <volume_type>
```

This procedure produces an output similar to the following:

ID	Name
9ad12bf8-eeeb-4910-8786-96d04224ebf8	SF-slow

5.5 Setting QoS Spec Values for a Volume Type Using the CLI

You can configure QoS spec values for a volume type using OpenStack software commands in the CLI.

Procedure

1. Open a CLI on the OpenStack software host.
2. Use the following command to configure QoS spec values for a volume type, replacing `<volume_type_name>` with the name of the volume type and `<value>` with the QoS value for each setting:

```
cinder qos-create <volume_type_name> minIOPS=<value> maxIOPS=<value> burstIOPS=<value>
```

This procedure produces an output similar to the following:

Property	Value
consumer	back-end
id	dff90dbf-2ed9-49d2-a697-b706044bec0b
name	SF-slow-100-200-250
specs	{u'burstIOPS': u'250', u'minIOPS': u'100', u'maxIOPS': u'200'}

Note: If you configure multiple storage back ends, you must set the volume type variable `volume_backend_name` to direct the volume creation to the correct storage back end. For more information, see the section “Enabling Multiple Back-End Support.”

5.6 Validating QoS on the SolidFire Cluster

You can validate QoS settings for any volume created with OpenStack software.

Procedure

1. Log in to the Element OS web UI.
2. Go to Management > Volumes.
3. Click the Actions button for the volume you want to validate.
4. In the resulting menu, click View Details.
5. Validate the QoS information for the volume in the Information pane.

6 Multiple OpenStack Cloud Instances

There are several facilities in the SolidFire driver that can accommodate scenarios involving multiple OpenStack cloud instances using a single SolidFire cluster. These features include account prefixes, volume prefixes, virtual networks, and multiple virtual interfaces (VIFs).

You can configure an account prefix using the variable `sf_account_prefix` in the `/etc/cinder/cinder.conf` file. You can set this variable differently for each OpenStack cloud instance, allowing the storage cluster administrator to distinguish between accounts for each OpenStack instance. By default, the `sf_account_prefix` variable is not set, and account names have no prefix.

The OpenStack software Mitaka release introduces the `sf_volume_prefix` variable to allow creation of unique volume prefixes for each OpenStack cloud instance.

The default value of the `sf_volume_prefix` variable is `UUID-`, which automatically configures the driver to work as it has prior to the OpenStack Mitaka release. If you have multiple OpenStack cloud instances

attached to a single SolidFire system, NetApp recommends that you change this variable for each instance using the SolidFire system.

Note: The variable `sf_volume_prefix` should not be changed within a cloud after a volume has been provisioned on the SolidFire storage system with OpenStack software.

You can use VLANs and multiple VIFs to separate multiple OpenStack cloud instances. Element OS supports multiple storage virtual interfaces (SVIPs) on separate virtual networks. Each OpenStack cloud instance accesses the storage system through the shared management port. NetApp recommends that you configure each OpenStack cloud instance with a unique cluster admin account.

Note: When you use a single SVIP with OpenStack software, the SolidFire driver acquires the SVIP by querying the cluster. If multiple SVIP addresses are configured, the query returns the default SVIP on the native virtual network. You can configure an alternate virtual network for the OpenStack cloud instance by modifying the `/etc/cinder/cinder.conf` file. Set the `sf_svip` variable in the `[solidfire]` section of the `/etc/cinder/cinder.conf` file for that OpenStack cloud instance to the IP address you want the iSCSI initiator to use to access volumes on the storage system.

7 Postconfiguration Tasks

You can use the OpenStack software web UI or the CLI to perform certain tasks after you have completed configuration. Refer to the official [OpenStack documentation](#) for specific instructions for each of the following tasks:

- Creating and viewing virtual machine instances
- Creating and viewing volumes and volume types
- Modifying existing volume types
- Securing and restricting access to virtual machine instances
- Configuring instance networking settings
- Configuring QoS settings for virtual machine instances
- Creating Snapshot™ copies using OpenStack software
- Configuring quotas for volumes

8 Contacting NetApp Support

If you have any questions or comments about SolidFire documents or products in general, contact [NetApp support](#) or e-mail support@solidfire.com.

Refer to the [Interoperability Matrix Tool \(IMT\)](#) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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