



Technical Report

SnapDrive 5.0 for UNIX Best Practices

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1 Introduction

This document is a best practices guide for NetApp storage systems using the SnapDrive for UNIX (SDU) solution. It also provides recommendations on various configuration options available with the solution in addition to providing guidelines for when and where to use the options.

1.1 Intended Audience

This guide provides guidelines for deploying and using SnapDrive for UNIX with NetApp storage appliances and supporting software.

This guide is for storage and server administrators and experts managing storage provisioning and Snapshot copies and NetApp storage systems using the SnapDrive for UNIX solution.

1.2 Prerequisites

NetApp recommends that you refer to the following guides before reading this technical report.

- [SnapDrive for UNIX Installation and Administration Guide](#)
- [Data ONTAP 8.1 Cluster-Mode System Administration Guide](#)
- [Data ONTAP Block Access Management Guide for iSCSI and FCP](#)
- [Host Utilities Installation and Setup Guide](#)

You should have a good understanding of UNIX file system administration as well as FCP and iSCSI concepts. The recommendations found in this document are guidelines to assist storage and server administrators while configuring SnapDrive for UNIX.

2 Overview

SnapDrive for UNIX is an enterprise-class storage and data management solution that simplifies storage management and increases the availability and reliability of application data. The key functionality includes error-free application storage provisioning, consistent data Snapshot copies, and rapid application recovery; it provides the ability to easily manage data residing on NetApp NFS shares or NetApp LUNs. SnapDrive for UNIX complements the native file system and volume manager and integrates seamlessly with the clustering technology supported by the host operating system. SnapDrive for UNIX is supported on the following platforms.

- Solaris
- IBM AIX
- HP-UX
- Linux®
 - Red Hat Enterprise Linux
 - SUSE Linux Enterprise Server
 - Oracle® Enterprise Linux/Oracle Linux

2.1 Key Features

Following are the key features of SnapDrive for UNIX.

- **Advanced storage virtualization.** Virtualizes NetApp storage systems and integrates with native disk and volume management.
- **Automated mapping and management of new storage resources.** Provisions new storage resources smoothly and efficiently, without application or server downtime.

- **Dynamic storage allocation.** Reallocates storage systems quickly and easily in response to shifts in application or server demand.
- **Host file system consistent Snapshot copies.** Implements a mechanism by which Snapshot copies that are created are file system consistent.
- **Backup and restore.** Provides a quicker way to create and restore storage from backups using NetApp Snapshot technology.
- For more details about SnapDrive for UNIX features, refer to [SnapDrive for UNIX Installation and Administration Guide](#).

2.2 SnapDrive for UNIX Deployments

SnapDrive for UNIX can be used either as a standalone product or as part of other NetApp solutions. For example, it can be deployed along with SnapManager® for Oracle. In both types of deployment, SnapDrive for UNIX serves as a tool to create and manage storage. It also manages storage backups and restores storage from those backups using Snapshot technology.

For a complete list of supported platforms, refer to NetApp [Interoperability Matrix](#).

3 New Features in Version 4.2 and 5.0

Following are the new features in version 4.2 and 5.0.

- **Clone split.** SnapDrive for UNIX 4.2 introduced this feature. A clone is a writable point-in-time copy of a parent flexible volume or LUN. NetApp Data ONTAP® software allows instant replication of data volumes or LUNs without requiring additional storage space at creation time. Each clone can be used during product testing, bug fixes, and upgrade checks. FlexClone® technology is supported in both SAN and NAS environments starting from SDU 4.1. These clones require a backing Snapshot copy, and this Snapshot copy cannot be deleted until the clone exists. To detach the coupling between the clone and the backing Snapshot copy, a clone-split operation is used.

SnapDrive for UNIX 4.2 allows the user to estimate the space available for splitting the clone using the SnapDrive clone split estimate command. The SnapDrive clone split start command starts the split of the clone after displaying the estimate space needed for the clone. The SnapDrive clone split start can be used as a synchronous or an asynchronous command.

- **Raw device mapping (RDM) LUN support for ESX.** SnapDrive for UNIX 4.2 introduces RDM LUN support for VMware® ESX FCP initiators in the virtualization environment. SnapDrive for UNIX interacts with the ESX layer during storage provisioning and Snapshot operations to drive functionalities such as LUN discovery, device creation, and so on. For VMware environments, SnapDrive for UNIX in the VMware guest OS interacts with the virtualization service provided by SnapManager for Virtual Infrastructure (SMVI), which in turn interacts with the core OS.

RDM LUN support is available for the following ESX guest platforms only.

- Red Hat Enterprise Linux
- Solaris

- **Data ONTAP Cluster-Mode support on Linux.** SnapDrive for UNIX Cluster-Mode support on Linux is available only with Data ONTAP 8.1 RC3 or later releases. SnapDrive 5.0 for UNIX supports port sets for Vserver in Data ONTAP operating in Cluster-Mode. Port sets consist of all SAN data interfaces that define the paths available to the host.

Note: Support for Data ONTAP 8.1 operating either in 7-Mode or Cluster-Mode is available only with Data ONTAP 8.1 RC3 or later releases. For more information on new features in the Data ONTAP 8.1 RC3 release, refer to [SnapDrive for UNIX Installation and Administration Guide](#).

4 Installation and Basic Configuration

Download SnapDrive for UNIX software from the [NetApp Support](#) site. Make sure that the required UNIX platform is selected and then read the corresponding description and download pages. The software also can be obtained from a media kit. Before installing SnapDrive for UNIX, use the following checklists to avoid potential errors or delays during or after the installation.

4.1 Checklist for Storage System

The checklist for storage systems is described in Table 1.

Table 1) Checklist for storage system.

Step	Action
1	<p>Verify the licenses on the storage system.</p> <ul style="list-style-type: none"> • FCP, iSCSI, or NFS license, depending on your configuration • FlexClone • SnapRestore® software • MultiStore® software (vFiler® unit environment only) <p>On Data ONTAP operating in 7-Mode, use the <code>license</code> command on the command line interface (CLI) to verify installed licenses.</p> <p>On Data ONTAP 8.1 operating in Cluster-Mode, run the <code>license show</code> command on the command line interface.</p>
2	<p>Enable, configure, and test RSH or SSH access on the storage systems for administrative access. NetApp recommends SSH because it is more secure. For detailed information to help you complete these tasks, refer to the Data ONTAP Storage Management Guide.</p>
3	<p>For an NFS environment:</p> <ul style="list-style-type: none"> • Make sure storage system directories are exported correctly to the host. • Make sure that all the host interfaces to storage have read-write permission to access the directory or at least read-only permission for <code>snapdrive snap connect</code> with the <code>-readonly</code> option. <p>Refer to the Data ONTAP File Access and Protocols Management Guide for how to manage NFS protocol.</p>
4	<p>For an FC or iSCSI environment, verify whether FCP or iSCSI is enabled on the storage system.</p> <ol style="list-style-type: none"> 1. On Data ONTAP operating in 7-Mode, run <code>fcv status</code> or <code>iscsi status</code> 2. If the status is disabled, start the service running <code>fcv start</code> or <code>iscsi start</code> 3. On Data ONTAP 8.1 operating in Cluster-Mode, run <code>vserver fcv</code> or <code>vserver iscsi show</code> 4. If no configuration exists, create the configuration for Vserver using the command: <code>vserver fcv create -vserver <vserver></code> or <code>vserver iscsi create -vserver <vserver></code>
5	<p>Note down the storage system target address using these commands on the storage system CLI:</p> <ol style="list-style-type: none"> 1. On Data ONTAP operating in 7-Mode, run <code>fcv nodename</code> or <code>iscsi nodename</code> 2. On Data ONTAP 8.1 operating in Cluster-Mode, run <code>vserver fcv show -vserver <vserver></code> or <code>vserver iscsi show -vserver <vserver></code>
6	<p>On Data ONTAP operating in 7-Mode, make sure that the Fibre Channel port on the NetApp storage system is configured as the target using the <code>fcadmin config</code> command.</p> <p>For more details, refer to the Data ONTAP Storage Management Guide.</p>

Best Practices

By default, the iSCSI service is enabled on all Ethernet interfaces after you enable the license. Do not use a 10/100Mb Ethernet interface for iSCSI communication. The e0 management interface on many storage

systems is a 10/100 interface. So that all iSCSI commands are processed by the appropriate interfaces, disable iSCSI processing on a particular Ethernet interface by using the following command:

```
iscsi interface disable <interface_name>
```

Example:

```
iscsi interface disable e0b
```

On Data ONTAP Cluster-Mode, a particular data logical interface can be disabled for an iSCSI service using the following command:

```
vserver iscsi interface disable -vserver <vserver> -lif <data_lif>
```

Note: Do not run these commands while there are active iSCSI sessions connected to the Ethernet or logical interface. First disconnect the active sessions from the host; otherwise, the storage system will display a warning message when the command is issued.

4.2 Checklist for Host Before SnapDrive Installation

Follow the checklist in this section for the host before installing SnapDrive.

Preinstallation Checks Using the SnapDrive Configuration Checker

Before using or installing SnapDrive for UNIX, make sure that the host supports all the dependent components, such as native OS version, multipath solution, cluster solution, and so on, by referring to product support matrices and product documentation. As SnapDrive for UNIX expands the supported platforms, the combination of supported configurations grows exponentially and it becomes a major task for administrators to validate the environment. Administrators do not know which components to check and how to get their versions released, and these instances often end up as support cases.

The configuration checker is aimed at addressing the manual reference task by allowing the user to check if the host has all the supported components of SnapDrive for UNIX to run. The configuration checker is bundled along with SnapDrive for UNIX software; however, the configuration checker is independent software and can be downloaded from [ToolChest](#) on the [NetApp Support](#) site. It can be installed and executed irrespective of whether SnapDrive for UNIX is already installed on the host.

In the case of a new installation, NetApp recommends running the configuration checker before installing SnapDrive for UNIX to confirm that all necessary components and correct versions are available.

```
Host#/opt/NetApp/snapdrive/bin/sdconfcheck check
```

The administrator can also use an existing `snapdrive.conf` file from other hosts and validate that the new host is ready with the current working configuration. This is helpful in a disaster recovery (DR) scenario in which the host on the DR site can be verified with the primary site configuration file and it is known that both are identical.

```
DR-Host#/opt/NetApp/snapdrive/bin/sdconfcheck check -conf /snapdrive.conf
```

If SnapDrive for UNIX is already installed and adding a new configuration (for example, MPIO for high availability) is planned, then the configuration checker helps to validate if SnapDrive for UNIX will support the new environment.

```
Host#/opt/NetApp/snapdrive/bin/sdconfcheck check -mptype nativempio
```

Manual Preinstallation Steps

Before installing SnapDrive for UNIX, it is a best practice to check for the prerequisites. Refer to the [Interoperability Matrix](#) and confirm that SnapDrive for UNIX supports your environment.

For specific information on requirements, such as patches that are required for the operating system, see the [Compatibility and Configuration Guide for NetApp FCP and iSCSI](#).

Table 2 describes the manual preinstallation steps.

Table 2) Manual preinstallation steps.

Step	Action
1	<ol style="list-style-type: none"> 1. Identify if the host operating system version is supported by SnapDrive for UNIX: <ol style="list-style-type: none"> a. Solaris: <code>cat /etc/release</code> b. HP-UX: <code>uname -srv</code> c. AIX: <code>oslevel -s</code> d. Linux: <code>cat /etc/issue</code>
2	<ol style="list-style-type: none"> 1. For FCP environments: <ol style="list-style-type: none"> a. Check that you are using the SnapDrive for UNIX supported host utility version from the Interoperability Matrix. b. Verify if NetApp host utilities are present on the host by running <code>sanlun</code> version. c. If host utilities are not installed, download and install the correct version from the NetApp Support site and refer to the Host Utilities Installation and Setup Guide to install (or upgrade) and configure host utilities. d. Identify the HBA adapters on the host and verify that the ports are enabled by running <code>sanlun fcp show adapter -v</code>. 2. For Veritas™ environments: <ol style="list-style-type: none"> a. Check that you are using Veritas Storage Foundation for multipathing, installing, and configuring the Symantec™ Array Support Library (ASL) for NetApp storage systems. b. To determine which version of the Veritas Storage Foundation and ASL to use, check the Compatibility and Configuration Guide for NetApp's FCP and iSCSI Products. c. For more information about obtaining ASL and installing ASL, see the Host Utilities Installation and Setup Guide. 3. For iSCSI environments: <ol style="list-style-type: none"> a. Check that you are using the SnapDrive for UNIX supported host utility version from the Interoperability Matrix. b. Verify that NetApp host utilities are present on the host by running <code>sanlun</code> version. c. If host utilities are not installed, download and install the correct version from the NetApp Support site and see the Host Utilities Installation and Setup Guide to install (or upgrade) and configure host utilities.

Note: SnapDrive for UNIX does not support simultaneous use of both FC and iSCSI on the same host. However, SnapDrive for UNIX allows coexistence of an NFS configuration with either iSCSI or FCP on the same host. A host utilities kit is not required for pure NFS environments. It is essential that:

- The HBA and its utility software are installed properly.
- An iSCSI initiator is already installed on the system.
- All patches required by Veritas are installed on the host.

Best Practices

Download the latest package of the configuration checker tool from [ToolChest](#) on the [NetApp Support](#) site.

Execute configuration checker postinstallation and preinstallation of the SnapDrive for UNIX tool to validate and confirm the presence of dependent components.

NetApp recommends that you have a minimum of 1GB to 2GB spare space for SnapDrive for UNIX operation in the root directory (/) to avoid the root volume running out of space. SnapDrive for UNIX maintains audit and trace and recovery log files whose default locations are specified in the `snapdrive.conf` file and that can be modified to have SnapDrive create the logs in a different directory. SnapDrive for UNIX rotates audit and trace files when they reach maximum size, as defined in the `snapdrive.conf` file. A recovery file rotates only after an operation is completed, and hence no default size is allotted for this file.

Once the preceding checklist is verified, follow the steps in the [SnapDrive for UNIX Installation and Administration Guide](#) for details on how to install SnapDrive for UNIX on different operating systems.

NetApp recommends that you use the default path for the SnapDrive for UNIX installation and add the SnapDrive for UNIX directory to your `$PATH` environment variable.

4.3 snapdrive.conf File

The `snapdrive.conf` configuration file in SnapDrive for UNIX holds the default values of all configurable variables. The entries in the `snapdrive.conf` file can be manually modified using a text editor. The modified values will take effect after the SnapDrive daemon restarts.

To change the entries in `snapdrive.conf`, follow these steps.

1. Copy the line that is commented out to another line.
2. Modify the new copied line to remove only the first # and to set the new value for the variable.
3. Save the file and exit.
4. Restart the SnapDrive daemon.
5. Run the `snapdrive config show` command to check current values of the configurable variables.

Example:

To set the `autosupport-enabled` variable to `off` and `contact-http-port` to 80 in `snapdrive.conf` file:

- Valid format:

```
autosupport-enabled="off" #Enable autosupport (requires autosupport-filer be set)
contact-http-port=80 #HTTP port to contact to access the filer
```

- Invalid format:

```
autosupport-enabled="off"
autosupport-enabled=off #Enable autosupport (requires autosupport-filer be set)
autosupport-enabled="off" Enable autosupport (requires autosupport-filer be set)
contact-http-port=80a #HTTP port to contact to access the filer
contact-http-port=80
```

4.4 Using the SnapDrive Daemon

Most NetApp SnapManager products such as SnapManager for Oracle and SnapManager for SAP® leverage SnapDrive for UNIX to create application-consistent backups, performing fast restores and quick clones. Prior to version 4.0 of SnapDrive for UNIX, the SnapManager products communicated with SnapDrive for UNIX using the SnapDrive CLI. SnapDrive for UNIX provides a Web service with a uniform interface for all NetApp SnapManager products to integrate seamlessly with SnapDrive for UNIX using APIs. While using the SnapDrive for UNIX daemon, all the SnapDrive commands will work as a unique process in the background.

Common Daemon Operations

The SnapDrive daemon must be running for any SnapDrive for UNIX command or API to work. Table 3 lists some of the most common daemon operations.

Table 3) SnapDrive daemon operations.

Daemon Operation	Command	OS User
Starting or restarting the daemon	snapdrived start/restart	Root
Verifying the status of the daemon	snapdrived status	Root
Stopping the daemon	snapdrived stop	Root
Changing the default daemon password	snapdrived passwd	Root

4.5 Setting Up SnapDrive to Communicate with a NetApp Storage System

Follow these steps for SnapDrive to communicate with NetApp storage systems.

1. Verify the SnapDrive for UNIX version:

```
snapdrive version
```

2. Check the connectivity from the host to the storage system:

```
ping <storage_system_ipaddress / storage_system_name>
```

Make sure that the correct storage system name is registered with the domain name server (DNS) or is in /etc/hosts file.

3. Execute `snapdrive config` and verify that the storage system is already configured. If it is not configured, execute the following command:

```
snapdrive config set <userid> <storage_system_IPaddress /storage_system_name >
```

4. To access the storage system, when prompted, enter the password of <userid>.
5. Edit the `snapdrive.conf` file and verify that the default settings conform to your environment.
 - a. Transport-type setting.

```
default-transport="iscsi" | "fcp"
```

Note: If NFS configuration alone is used with SnapDrive for UNIX, the default transport variable needs to be commented out.

- b. HTTPS setting.

```
use-https-to-filer="on" | "off"
```

Starting from SnapDrive 3.0 for UNIX, the value for http/https is `on` for Solaris, AIX, Red Hat, and SUSE platforms, and `off` for the HP-UX platform.

- c. Volume managers and file systems:

SnapDrive for UNIX supports more than one volume manager and file system on the same host.

For FCP

- Solaris: `vmtype="vxvm" | "svm"`
- HP-UX: `vmtype="vxvm" | "lvm"`
- AIX: `vmtype="vxvm" | "lvm"`
- Linux: `vmtype="lvm"`

For iSCSI

- Solaris: `vmtype="svm"`

- HP-UX: `vmtype="lvm"`
- AIX: `vmtype="lvm"`
- Linux: `vmtype="lvm"`

For FCP

- Solaris: `fstype="vxfst" | "ufs"`
- HP-UX: `fstype="vxfst"`
- AIX: `fstype="jfs2" | "vxfst"`
- Linux: `fstype="ext3" | "ext4"`

For iSCSI

- Solaris: `fstype="ufs"`
- HP-UX: `fstype="vxfst"`
- AIX: `fstype="jfs2"`
- Linux: `fstype="ext3" | "ext4"`

Note: SnapDrive for UNIX supports all commands on any AIX system with the JFS2 or VxFS file systems. However, it only supports creating, renaming, restoring, and deleting Snapshot copies for an existing storage device with the JFS file system.

d. Multipath

Following are the supported multipathing types on different platforms.

For FCP

- Solaris: `multipathing-type="DMP" | "mpxio" | "none"`
- HP-UX: `multipathing-type="PVLlinks" | "DMP" | "NativeMPIO" | "none"`
- AIX: `multipathing-type="NativeMPIO" | "DMP" | "none"`
- Linux: `multipathing-type="NativeMPIO" | "none"`

For iSCSI

- Solaris: `multipathing-type="mpxio" | "none"`
- HP-UX: `multipathing-type="PVLlinks" | "NativeMPIO" | "none"`
- AIX: `multipathing-type="NativeMPIO" | "none"`
- Linux: `multipathing-type="NativeMPIO" | "none"`Note

Note: All values are case sensitive.

SnapDrive for UNIX does not support user-friendly names and aliasing in Linux multipathing environments.

Multi Subnet Configurations

To manage network traffic, SnapDrive for UNIX allows numerous subnet configurations to split up management and data traffic. SnapDrive for UNIX sends all management communication using NetApp APIs over the management interface, and data interface is used to exchange data between systems. The `snapdrive config set` command with the `-mgmt` option can be used to configure numerous subnets.

Usage:

```
snapdrive config set -mgmtpath mgmt_interface data_interface [mgmt_interface data_interface ...]
```

In pure SAN environments the concept of a data path does not exist; hence, you need to configure the management interface and data interface with the same IP. In mixed SAN and NFS environments,

interfaces are mapped so that one management interface and data interface pair must be the same as the ones in pure SAN environments.

View all the data interfaces configured for a management interface by executing the `snapdrive config list` command with the `-mgmtpath` option.

The following example configures 10.72.199.42 as the management interface and 10.73.68.142 as the data interface in an NFS environment:

```
snapdrive config set -mgmtpath 10.72.199.42 10.73.68.142
```

In a pure SAN environment, both management and data interfaces are set with the same IP 192.168.10.10.

```
snapdrive config set -mgmtpath 192.168.10.10 192.168.10.10
```

In a mixed SAN and NFS environment:

```
snapdrive config set -mgmtpath 10.72.199.42 10.72.199.42 10.72.199.42 10.73.68.142
```

The first two interfaces in the preceding command are for SAN configurations; hence, they have the same value for the IP addresses. The third and the fourth interfaces are the management and data interfaces for NFS configurations.

For Cluster-Mode, run the command `snapdrive config set vsadmin <vserver>` before configuring the management interface. Make sure that `vsadmin` user is unlocked and administration privilege is delegated to `vsadmin` user. For more information, refer to the [Data ONTAP 8.1 Cluster-Mode System Administration Guide](#).

Example:

```
snapdrive config set vsadmin vs1
snapdrive config set -mgmtpath vs1 10.72.199.188
```

5 Security Features

SnapDrive for UNIX provides the following basic levels of security.

- **Access control.** Allows you to specify the operations that a host running SnapDrive for UNIX can perform on a storage system. You need to set the access control permissions individually for each host.
- **HTTPS.** Allows all interactions with the storage system and host through the Data ONTAP interface, including sending the passwords in a secure fashion.

Note: For more information on how to set up and view access control permissions, see the [SnapDrive for UNIX Installation and Administration Guide](#).

5.1 Best Practices

Use HTTPS instead of HTTP for host to storage system communication to provide added security. To use HTTPS, follow these steps.

1. Enable HTTPS on the storage system side.
2. Set configuration variables `contact-ssl-port=443` and `use-https-to-filer=on` in the `snapdrive.conf` file.

Note: Starting from SnapDrive for UNIX 3.0, the value is on for variable `use-https-to-filer` on Solaris, AIX, Red Hat, and SUSE platforms and off for the HP-UX platform.

NetApp recommends that you practice using Operations Manager for Role-Based Access Control (RBAC), as described in section 5.2, "Configuring SnapDrive for Role-Based Access Control."

In an environment in which Operations Manager is not used for RBAC, take the following steps.

1. Create a directory `sdprbac` (SnapDrive permissions role-based access control) under the root volume of the storage system.
2. Create a `prbac` file under the `sdprbac` directory. The file name will be `/vol/vol0/sdprbac/sd<hostname>.prbac`, where the host name is the name of the SnapDrive host found by the `hostname` command.
3. Specify only one level in the `sd<hostname>.prbac` file among the list of permissions listed below.
 - a. `NONE`: The host has no access to the storage system.
 - b. `SNAP CREATE`: The host can create Snapshot copies.
 - c. `SNAP USE`: The host can delete and rename Snapshot copies.
 - d. `SNAP ALL`: The host can create, restore, delete, and rename Snapshot copies.
 - e. `STORAGE CREATE DELETE`: The host can create, resize, and delete storage.
 - f. `STORAGE USE`: The host can connect and disconnect storage.
 - g. `STORAGE ALL`: The host can create, delete, connect, and disconnect storage.
 - h. `ALL ACCESS`: The host has access to all the preceding SnapDrive for UNIX operations.
4. The permission level string must be on the first line of the permission file.
5. Set the value of the `all-access-if-rbac-unspecified` option to `off` in the `snapdrive.conf` file for security.
6. Restart the SnapDrive daemon.
7. If the permission file is not on the storage system, SnapDrive for UNIX checks the variable `all-access-if-rbac-unspecified` in `snapdrive.conf` file. If this variable is set to `on`, the host has access to all SnapDrive commands.
8. Verify access permission through the `snapdrive config access show <NetApp Controller Name>` command.

After you configure and verify the preceding tasks based upon your environment and needs, you can perform the following tasks using the SnapDrive CLI commands.

1. Create storage entities such as LUNs, disk groups, logical volumes, and file systems.
2. Create Snapshot copies and restoration file systems, LUNs, disk groups, and NFS files.
3. Connect and disconnect from the Snapshot copy on the host.

For more information on the access privileges, refer to the [SnapDrive for UNIX Installation and Administration Guide](#).

5.2 Configuring SnapDrive for Role-Based Access Control

RBAC is implemented using the Operations Manager infrastructure. Limited access control was observed in versions earlier than SnapDrive for UNIX 4.0, and only the root user could perform SnapDrive for UNIX operations. SnapDrive for UNIX 4.0 and later versions provide support for the nonroot local user and NIS users by using the RBAC infrastructure of Operations Manager. SnapDrive for UNIX does not require a root password of the storage system; it communicates with the storage system using `sd-<hostname> user`.

The following steps need to be performed to set up RBAC.

1. The Operations Manager administrator creates a user, `sd-admin user`, with a capability `core access check over global group (global DFM.Core.AccessCheck)`. After the Operations Manager

administrator configures the `sd-admin` user, the administrator has to manually send the credential information to the SnapDrive for UNIX administrator.

2. The Operations Manager administrator can also grant (`global DFM.Database.Write`) to `sd-admin`, to enable SnapDrive for UNIX to refresh storage system entities on Operations Manager.
3. The Operations Manager administrator needs to create the `sd-<hostname>` user on the storage system.
4. The SnapDrive for UNIX administrator receives user credentials for `sd-admin` and `sd-<hostname>` from the Operations Manager administrator.
5. The UNIX administrator needs to turn on RBAC functionality by setting the variable `rbac-method=dfm` in `snapdrive.conf` file and restarting the SnapDrive for UNIX daemon.

RBAC with Operations Manager is not supported for Data ONTAP operating in Cluster-Mode. The Operations Manager administrator needs to grant privileges to the invoker of SnapDrive to execute SnapDrive commands. For more information on the mapping of privileges compared with commands, see the [SnapDrive for UNIX Installation and Administration Guide](#).

SnapDrive for UNIX uses the following formats to check if a user is authorized to perform these tasks.

- If you are an NIS user running the `snapdrive` command, then SnapDrive for UNIX uses the format `<nisdomain>\<username>`. For example, `netapp.com\marc`.
- If you are a local user of a UNIX host such as `lnx197-141`, then SnapDrive for UNIX uses the format `<hostname>\<username>`. For example, `lnx197-141\john`.
- If you are an administrator (`root`) of a UNIX host, then SnapDrive for UNIX treats the administrator as a local user and uses the format `lnx197-141\root`.

Preconfigured roles simplify the task of assigning roles to users. Table 4 lists the predefined roles on the Operations Manager server.

Table 4) Predefined roles on the Operations Manager server.

Role Name	Description
GlobalSDStorage	Manage storage with SnapDrive for UNIX.
GlobalSDConfig	Manage configurations with SnapDrive for UNIX.
GlobalSDSnapshot	Manage Snapshot copies with SnapDrive for UNIX.
GlobalSDFullControl	Fully use SnapDrive for UNIX.

6 Storage Provisioning

SnapDrive for UNIX allows you to create and delete LUNs on a storage system or connect to the storage that is already created using command line options from the host. If you need to perform these tasks without SnapDrive for UNIX, you must log in to the storage system to create and map a LUN, identify the LUN on the host using the host commands, create a file system, and mount it. SnapDrive for UNIX achieves all these tasks with one command, reducing the time needed and the errors made during this process. While SnapDrive for UNIX can create storage using a minimum of options, NetApp recommends that you understand the default values and use them appropriately.

SnapDrive for UNIX lets you access LUNs, file systems, disk groups, and logical volumes on a host other than the one used to create it. This might be useful in scenarios in which the storage has to be migrated to a new server or when you want to back up a storage entity from a different server to another medium. SnapDrive for UNIX does this by executing the `snapdrive storage connect/disconnect` command.

Example: The following command removes LUN mapping from server1 and exports the disk groups or file systems that LUNs contain.

Server1:

```
snapdrive storage disconnect -fs /mnt/test
```

The following command maps, identifies the LUN, imports the underlying disk group, activates the disk group, and mounts the file system on a new server.

Server2:

```
snapdrive storage connect -fs /mnt/test -lvol test_SdDg/test_SdHv -lun btc-ppc-158:/vol/src_vol/lun4
```

Using SnapDrive for UNIX, you can even export/import disk groups or file systems without unmapping the LUNs from the server using the `snapdrive host disconnect/connect` command.

SnapDrive for UNIX also allows you to increase the size of your disk group by using the `snapdrive storage resize` command with the `-addlun` option. Use the `snapdrive storage resize` command with the `-growby` option to increase the size of the volume group by adding a LUN of specified size to the volume group.

```
snapdrive storage resize -vg vg1 -growby 10g -addlun
```

To avoid space contentions, do not have LUNs on the same storage system volume as other data; for example, an NFS share.

Note: For Data ONTAP operating in Cluster-Mode, the junction path name should be the same as the volume name. For example, if the volume name is `vol11`, then the junction path should be `/vol11`.

7 Snapshot Copy Management

SnapDrive for UNIX integrates with NetApp Snapshot technology to make stored data reliable to host applications. The ability to create and manage Snapshot copies from the host makes SnapDrive for UNIX attractive to users.

Snapshot copies record the state of the blocks in your file system at a given point of time and provide read-only access to that image of the NetApp LUN or NetApp NFS share. SnapDrive for UNIX enables you to create, restore, and delete Snapshot copies of the file system, volume group, host volume, or LUN and to clone storage entities from Snapshot copies. For more information on the commands used to perform these tasks, see the [SnapDrive for UNIX Installation and Administration Guide](#).

SnapDrive for UNIX Snapshot copies are widely used because of the following distinct advantages.

- Hosts consistent Snapshot copies (restorable copy)
- Has faster restore times
- Creates backups of larger amounts of data much quicker

7.1 Best Practices for Snapshot Copy Management

Disable automatic Snapshot copy creation on the storage system for the volume on which the LUNs are created and set the Snapshot space reservation to 0 using the following commands on the storage system.

```
vol options <vol-name> nosnap {on | off}  
snap reserve <vol_name> 0
```

Certain SnapDrive for UNIX operations restore LUNs by creating a clone based on Snapshot technology, and then split that clone into an independent object. For Data ONTAP 7.1 and later, SnapDrive for UNIX

does not allow Snapshot copy creation or SnapRestore operation until the LUN clone split operation is completed. NetApp recommends monitoring LUN cloning status from the storage system CLI using the LUN clone split status command before taking a Snapshot copy or initiating SnapRestore operations from SnapDrive.

7.2 Consistent Snapshot Copies

Making Snapshot copies in a SAN environment differs from a NAS environment in one fundamental way; that is, in a SAN environment, the storage system does not control the state of the file system.

Snapshot copies of a single storage system volume that contain all the LUNs supporting a particular host file system are consistent. If the LUNs in the host file system span are different from the storage system volumes or storage systems, then the copies might not be consistent unless they are created at exactly the same time across different storage system volumes or storage systems and can be restored successfully. Starting with SnapDrive 2.2 for UNIX, consistent Snapshot copies can be created using the Data ONTAP consistency group feature, which is supported beginning with Data ONTAP 7.2.

A consistency group is a grouping of a set of volumes that must be managed as a single logical entity. The functional objective of a consistency group is to provide storage-based, crash-consistent checkpoints from which an application can restart. These checkpoints are used without interaction or coordination with the source application.

A checkpoint represents a collection of Snapshot copies, one Snapshot copy per volume, for all volumes defined in a consistency group. This collection of Snapshot copies is not the same as a regular group of Snapshot copies, where each copy is created independently of each volume. This special collection of Snapshot copies, the checkpoint, has some distinct characteristics.

- The copy of volumes occurs as an atomic operation.
- The resulting Snapshot copy preserves write ordering across all volumes for dependent writes.

The internal operation of a consistency group can be expressed by the following high-level sequence of actions.

1. SnapDrive issues a start checkpoint call to all participating controllers.
2. The controllers fence write access on volumes in a consistency group.
3. The controllers prepare a Snapshot copy of all volumes.
4. SnapDrive receives fence success from all participating controllers and issues a commit checkpoint to all controllers.
5. Upon receiving a commit checkpoint from SnapDrive, controllers commit the snapshot creates in all volumes.
6. The controllers unfence all volumes in the consistency group.

Example: If a file system `/mnt/fs_multi_vol` resides over LUNs in `storage1:/vol/vol1` and `storage2:/vol/vol1` and Data ONTAP 7.2 or higher is installed on `storage1` and `storage2`, then the following command creates a consistency group for the storage system volumes `storage1:/vol/vol1` and `storage2:/vol/vol1` and takes a Snapshot copy consistent with respect to both the volumes.

Note: `snapdrive snap create -fs /mnt/fs_multi_vol -snapname snap1`. Crash-consistent Snapshot copies are not supported in Data ONTAP operating in Cluster-Mode.

Best Practices for Consistent Snapshot Copies

In an environment in which all participating controllers support consistency groups, SnapDrive uses a Data ONTAP consistency group as the preferred (default) method to capture multicontroller/volume Snapshot copies.

SnapDrive simplifies the use of consistency groups. When the file specs or file system dictates a Snapshot copy that spans multiple volumes and controllers and all target controllers support consistency groups (Data ONTAP 7.2 and higher), SnapDrive automatically recognizes this requirement and creates consistency groups to enable crash-consistent Snapshot copies. No change to the SnapDrive syntax is necessary to take advantage of consistency groups.

When the Data ONTAP consistency group feature is not supported or is not preferred, for instance, when one of the controllers does not support CG or multiple applications share LUNs from a single volume where the volume I/O fencing might affect other applications, a user can specify the `-nofilerfence` option requesting that SnapDrive not use consistency groups in creating Snapshot copies. In this case, SnapDrive uses the best-effort mode to create a consistent Snapshot copy. In a best-effort mechanism, SnapDrive for UNIX takes a Snapshot copy that spans multiple storage system volumes without freezing the target storage and then checks for read-write I/Os that occurred when the Snapshot copy was taken. If any I/Os occurred during Snapshot copy creation, SnapDrive for UNIX discards the Snapshot copy and reports the failure to the user.

SnapDrive for UNIX allows making Snapshot copies of multiple file systems or disk groups using a single command when the file systems or disk groups are independent of each other. NetApp recommends that you use the `-unrelated` option when NFS entities are present with other file specifications in the Snapshot copy. This is because the best-effort mechanism cannot be applied on NFS entities since Data ONTAP does not provide the required statistics as it does for LUNs.

SnapDrive for UNIX creates a Snapshot copy of unrelated storage entities having no dependent writes during Snapshot copy creation. Each of the storage entities are crash consistent individually, but not consistent as a group. In the following example the volume group consists of LUNs residing on one storage system and the file system on LUNs residing on a different storage system.

```
snapdrive snap create -fs /mnt/fs1 -vg vg1 -unrelated -snapname snapfs1_vg1
```

7.3 Snapshot Copy Space Management

Snapshot copy backups occur in a matter of seconds, and each copy typically consumes only the amount of data that has changed since the previous copy was created. Snapshot copies consume minimal disk space while at the same time provide up to 255 online point-in-time images.

The amount of disk space consumed by an individual Snapshot copy is determined by the following factors.

- The rate at which the data changes within the active file systems. The data change can be in megabytes per second or megabytes per hour.
- The amount of time that elapses between creation of Snapshot copies.

Best Practices for Snapshot Copy Space Management

- Disable automatic Snapshot copy creation on the storage system for the volume on which the LUNs are created.
- Periodically use the `snapdrive snap list` command and delete old Snapshot copies, which could unnecessarily occupy space.

7.4 Snap Reserve

Data ONTAP reserves a default of 20% of volume for configuring LUNs or for NFS files to use. This is because Snapshot copies need space, which they consume in the snap reserve area. After the snap reserve area is filled, the Snapshot copies start to take space from the active file system. Because of WAFL[®] technology (Write Anywhere File Layout), snap reserve does not reserve specific physical blocks; rather, it is a logical space accounting mechanism.

For more information on snap reserve, refer to the [Data ONTAP Block Access Management Guide](#).

Best Practices for Snap Reserve

NetApp recommends setting the snap reserve value to 0% on any volume containing LUNs exclusively. Use of any other value does not offer value and may result in wasted space through unintended interaction with fractional reserve policy on the volume.

For example, a fully provisioned 100GB LUN with a 100% space reservation policy will require 100GB of additional space in a volume in order to create a Snapshot copy and support 100% turnover of the LUN data. The result would be 100GB space consumption in the LUN, 100GB fractional reserve space consumption, and a total volume size of 200GB.

If that volume had a 20% snap reserve policy, the volume would require 100GB for the LUN itself, 100GB for the LUN reservation, and an additional 20% for the snap reserve for a total of 220GB.

For more information about understanding fractional reserve, refer to the [Data ONTAP Block Access Management Guide for iSCSI and FCP](#).

8 Restoring a Snapshot Copy Using Volume-Based SnapRestore

For version 3.0 and earlier, SnapDrive for UNIX uses single-file SnapRestore (SFSR) implemented in Data ONTAP. While a restore is in progress for a file using single-file SnapRestore, any operation that tries to change the file is suspended until the restore operation is complete. For LUNs, when a single-file SnapRestore operation is in progress, the LUN is available and I/Os (both reads and writes) are allowed. Single-file SnapRestore for normal files as well as LUNs may take a long time depending on the size of the LUN or the file being restored. Because of the length of time, for some environments single-file SnapRestore may not be the best option.

Starting from version 4.0, SnapDrive for UNIX can leverage volume-based SnapRestore technology. This requires less CPU and fewer storage resources and restores instantaneously all the LUNs or normal files in a volume from the same Snapshot copy or backup.

Volume-based Snapshot technology should be used with caution because all Snapshot copies created after the Snapshot copy that is being used for the restore operation are deleted. All the new files and new LUNs created in this volume are also deleted. Any relationship to secondary storage systems will be broken if the restored Snapshot copy is older than the baseline Snapshot copy in the relationship.

8.1 Using Volume-Based SnapRestore

Use the following command to restore a volume using the volume-based SnapRestore method:

```
snapdrive snap restore [-lun | -dg | -vg | -hostvol | -lvol | -fs | -file]
file_spec [file_spec ...] [{-lun | -dg | -vg | -hostvol | -lvol | -fs | -file} file_spec
[file_spec ...] ...] -snapname snap_name [-force [-noprompt]] [{-reserve | -noreserve}] [-vbsr
[preview|execute]]
```

Examples

- Volume-based SnapRestore in preview mode:

```
snapdrive snap restore -hostvol vgl/lvol1 -snapname snapvg1lvol1 -vbsr
```

- Volume-based SnapRestore without prompting any confirmation message:

```
snapdrive snap restore -fs /mnt/fs1 -snapname snapfs1 -force -noprompt -vbsr execute
```

- Using the `-reserve` or `-noreserve` option with the `snapdrive snap restore` command overrides the space guarantee policy on volumes set with the `space-reservations-volume-enabled` variable in the `snapdrive.conf` file.
- The following command is an attempt to set a space guarantee for volume as volume:

```
snapdrive snap restore -vg vgl -snapname snapvgl -force -reserve -vbsr execute
```

- To set space guarantee as none:

```
snapdrive snap restore -fs /mnt/fsl -snapname snapfsl -force -noprompt -noreserve -vbsr execute
```

Best Practices

- It is a best practice to execute the `-vbsr preview` command before using the `-vbsr execute` command. If the preview option is used, SnapDrive will perform a series of checks on the volume being restored and present a file-by-file analysis of the restore operation before it occurs. The preview analysis will help you decide if you would like to proceed with the volume-based SnapRestore operation.
- Use dedicated volumes for data that will need to be restored quickly using the volume-based SnapRestore method.
- If there are Snapshot copies that were created after the Snapshot copy being used to restore them, then it is a best practice to replicate those Snapshot copies to a secondary storage system using SnapVault® technology and then perform the volume-based SnapRestore operation.

9 Cloning

SnapDrive for UNIX allows you to clone existing file systems from Snapshot copies. The following are scenarios in which you might use the cloning feature.

- When there is an available update for the application running on the storage system LUNs or NFS file system, you can clone the storage, update the software, and verify that the software runs satisfactorily before using it in production.
- You can create a copy from a Snapshot copy backup of an existing file system on the NetApp storage system that can be mounted on the same host or on a different host to separate the upgrade and testing process. After the new application update, the cloned file system can be split from the parent volume or LUN.

Previous versions of SnapDrive for UNIX leveraged FlexClone technology in an NFS environment and LUN clone technology in a SAN environment. Starting from version 4.0, SnapDrive for UNIX can leverage FlexClone technology even in a SAN environment based on the value of the `san-clone-method` option in the `snapdrive.conf` file. Table 5 illustrates the various possible values that can be specified for the `san-clone-method` option in the `snapdrive.conf` file.

Table 5) FlexClone configuration values.

CLI Usage	snapdrive.conf Variable and Value	Description
<code>-clone lunclone</code>	<code>san-clone-method=lunclone</code>	Creates a LUN clone.
<code>-clone unrestricted</code>	<code>san-clone-method=unrestricted</code>	Creates a FlexClone volume that can be used as a back end for provisioning and Snapshot operations, just like normal flexible volumes.
<code>-clone optimal</code>	<code>san-clone-method=optimal</code>	SnapDrive will attempt to create a FlexClone volume. If it is unable to, it will revert to the LUN clone method.

If the `-clone <lunclone|unrestricted|optimal>` option is used with the `snapdrive snap connect` command, it overrides the `san-clone-method` value defined in the `snapdrive.conf` file.

SnapDrive for UNIX verifies the following in order to create a FlexClone volume.

1. The storage system Data ONTAP version is 7.0 or later and FlexClone is licensed.
2. The host filespec residing volume is a flexible volume.
3. A host filespec can be a file system, host volume, disk group, or LUN.
4. The host filespec residing volume is not the root volume.
5. Enough space is available on the aggregate.

If any of these checks fails, SDU will:

1. Error out for an unrestricted FlexClone volume.
2. Fall back to the LUN clone method for a restricted FlexClone volume (if the clone method is optimal).

To use FlexClone in a SAN environment, a FlexClone license is required. No separate license is required for creating LUN clones.

For Data ONTAP operating in Cluster-Mode the LUN clone created will be a SIS clone.

9.1 Benefits of FlexClone

The benefits of FlexClone are:

1. Simplified data management and reduced risk.
2. Flexibility and greater utilization. You can use FlexClone to create numerous copies of data for additional users without giving them access to the original data.
3. It is faster than a LUN clone because a LUN clone requires allocating new inodes.

Examples

- The following command connects to a volume group with two LUNs and one file system. It specifies a destination name for volume group, logical volume, and file system.

```
snapdrive snap connect -fs /tmp/test1 /tmp/test2 -destlv lvoll_dup/vg1_dup -snapname btc-ppe-42:/vol/src_snapmirror_vol:snapvg1
```

- The `-autoexpand` option eliminates the need to specify each logical volume or file system to connect the entire diskgroup. The `-autorename` option along with `-autoexpand` renames the entities when the default name is in use.

```
snapdrive snap connect -fs /tmp/fs2 -snapname btc-ppe-42:/vol/src_snapmirror_vol:snapfs2 -autoexpand -autorename
```

9.2 Best Practice for Cloning

Because you can make several clones from a Snapshot copy, NetApp recommends that you name the Snapshot copy in a way that indicates its usage. One simple naming convention is to prefix the characters `cl_` to the cloned file system name; however, SnapDrive for UNIX does not have a convention for naming Snapshot copies. You can also use the `prefix-clone-name` option in the `snapdrive.conf` file to have SnapDrive automatically prefix a string to the FlexClone copy.

Data ONTAP locks any Snapshot copies used to back up cloned volumes and LUNs until the clone is either split or destroyed. Any disk blocks associated with such a copy remain locked and cannot be reused until the copy is deleted. NetApp recommends that you regularly review your existing Snapshot copies and clones to determine if they need to be destroyed.

By default, SnapDrive for UNIX assumes that no reservation is required for cloned LUNs and sets the space reservation to 0%. If you want to set the space reservation, you can use the `snapdrive snap`

`connect` command with the `-reserve` option to enable the storage reservation. You must consider capacity planning when you use clones.

Starting from SnapDrive for UNIX 3.0, the LUN clone split operation is supported with the `snapdrive snap connect` command. This can be achieved either by having `enable-split-clone=on` in the `snapdrive.conf` file or by using the `-split` option in the `snapdrive snap connect` command.

Starting from SnapDrive for UNIX 4.2, clone split operations can be done using new clone split commands.

Things to consider when doing a clone split are:

1. Before executing the LUN clone split operation, make sure the volume has enough space to accommodate the cloned LUN; otherwise, resize the volume. Starting with SnapDrive for UNIX 4.2, this can be verified using the `snapdrive clone split estimate` command.
2. Plan the clone split operation during a low I/O time period.
3. Use LUN clone split only if you are expecting the cloned LUN to be read-write and are expecting it to impact the original LUN.
4. NetApp recommends using the `-split` option instead of `enable-split-clone=on` so that you can control the behavior per command. Starting with SnapDrive for UNIX 4.2, the `snapdrive clone split start` command can be used for splitting the clones.

SnapDrive for UNIX allows you to start a clone split operation in asynchronous or synchronous mode. In asynchronous mode, the clone split operation runs in the background and a job ID is displayed. The clone split operation runs in the foreground in synchronous mode. The mode can be set either by the `split-clone-async=on|off` in `snapdrive.conf` file or by using the `-splitmode` option as `async|sync` in the `snapdrive clone split` command.

Examples

- The following example estimates storage space for a volume clone using a Snapshot copy:

```
snapdrive clone split estimate -hostvol vg1/lvol1 -snapname btc-ppe-42:/vol/src_snapmirror_vol:snapvg1_lvoll -volclone
```

- The following example estimates the storage to split a LUN clone using a Snapshot copy with the `-fs` option:

```
snapdrive clone split estimate -fs /mnt/fs1 -snapname btc-ppe-42:/vol/src_snapmirror_vol:snapfs1 -lunclone
```

- To split a volume clone in asynchronous mode:

```
snapdrive clone split start -fs /tmp/sfp1 /tmp/sfp2 -splitmode async
```

Note: If you set the `enable-split-clone` configuration variable value to `on` or `sync` during the Snapshot copy connect operation and `off` during the Snapshot copy disconnect operation, SnapDrive for UNIX will not delete the original volume or LUN that is present in the Snapshot copy.

Note: LUN clone split is not supported with MultiStore.

Note: LUN clone split is not possible for Data ONTAP operating in Cluster-Mode because the created clones are SIS clones.

10 SnapDrive for UNIX in a MultiStore Environment

SnapDrive for UNIX doesn't distinguish between a physical storage system and a vFiler unit. So there are no changes in operations on FlexVol[®] volumes when done using SnapDrive for UNIX on a vFiler unit.

Consider the following points when working in a MultiStore unit.

- Verify that a MultiStore license is available on the storage system.

- SnapDrive for UNIX can manage LUNs on MultiStore units using the iSCSI protocol.
- SnapDrive for UNIX does not support FCP on MultiStore units.
- For SnapDrive for UNIX usage with vFiler refer to [KB1011960](#).
- SnapDrive operations on a volume are allowed only when the entire volume is owned by a vFiler unit.

The Data ONTAP configuration option `vfiler.vol_clone_zapi_allow` must be set to on to connect to a copy of a volume or LUN in a vFiler unit.

11 SnapDrive for UNIX and SnapManager for Oracle

One of the major deployments for SnapDrive for UNIX is in coordination with SnapManager for Oracle. SnapManager for Oracle has become one of the most popular tools for making and managing backups for Oracle in a NetApp storage environment. SnapManager for Oracle relies on SnapDrive for UNIX to execute all backup and restore commands on the storage system.

11.1 Best Practices for Backup and Restore in a Cluster Environment

Creating a Snapshot copy of a shared file system makes the underlying shared disk group and file system temporarily unavailable for I/O. You need to verify that the database is placed in hot backup mode before issuing the command to make a Snapshot copy.

1. Execute all commands from the cluster master node. To identify the master node in an SFRAC environment, use the `vxddctl -c mode` command. For example, restoring a shared file system to a previously created Snapshot copy requires disk group deactivation, importation, and then activation after the LUNs have been restored from the Snapshot copy. Such operations on shared disk groups can be performed from the master node only.
2. Use SnapDrive 2.2 for UNIX or above and Data ONTAP 7.2 to automatically get a consistent Snapshot copy across the volumes.

Note: For Data ONTAP operating in Cluster-Mode, consistent Snapshot copy is not supported.

12 Platform and Protocols

12.1 Virtualization Environment

SnapDrive for UNIX is supported on the following virtualization environments.

- SnapDrive for UNIX is supported on Solaris containers (global/local/native zones) for NFS configuration only.
- SnapDrive for UNIX is supported on IBM AIX LPAR/DLPAR.
- SnapDrive for UNIX is supported on HP-UX nPar/VPar.
- SnapDrive for UNIX is supported on the SLES guest operating system on a Hyper-V™ VM in Windows® for iSCSI and NFS protocols only.
- SnapDrive for UNIX is supported on the Red Hat Enterprise Linux® (RHEL®) guest operating system on a KVM hypervisor for iSCSI and NFS protocols only.
- SnapDrive for UNIX supports RDM LUNS for ESX inside the guest VM for FC protocol, storage resizing, and all existing operations of cloning, Snapshot copies, and restore. There are no changes with respect to SnapDrive commands. Refer to the RDM LUN support section for instructions on how to set up SnapDrive for UNIX for use with RDM LUNs within a VM.
- RDM LUN support is available for the following ESX guest platforms only.
 - Red Hat Enterprise Linux
 - Solaris

Note: For a complete list of supported versions, platforms, and configurations, refer to the [Interoperability Matrix](#).

12.2 ALUA Support

Asymmetric Logical Unit Access (ALUA) defines the protocol for how multipath I/O should be managed between hosts and storage devices. This standard understands the performance difference between the paths if multiple paths to the LUN exist.

SnapDrive for UNIX enables ALUA for the igroup if the Data ONTAP version supports the ALUA command set and if the multipath solution in the host understands it.

What are the storage system and host configurations that are needed to enable ALUA from SnapDrive for UNIX?

Answer: SnapDrive for UNIX sets ALUA for the igroup and the storage system if the host uses the following multipath solutions.

- AIX native MPIO with the NetApp PCM installed
- Solaris MPXIO
- HP-UX native MPIO
- Linux native MPIO

Storage system requirements are:

- The storage system should have Data ONTAP version 7.2 or later.
- SnapDrive for UNIX requires the storage system to be configured in single image cluster (SSI) mode.

What are the protocols on which SnapDrive for UNIX enables ALUA?

Answer: SnapDrive for UNIX supports enabling ALUA only for FCP configurations. SnapDrive does not support enabling ALUA for an iSCSI configuration.

Is there a SnapDrive configuration variable to enable ALUA?

Answer: From SnapDrive 5.0 for UNIX onward, the configuration variable `enable-alua` is available to control ALUA.

12.3 RDM LUN Support

Raw device mapping (RDM) allows a special file in a VMFS volume on an ESX host to act as a raw device inside a VM. With RDM, the ESX server accesses the LUN, which in turn passes access directly to a virtual machine for use with its native file system. SnapDrive for UNIX supports RDM LUNs on Linux and Solaris.

While working on RDM LUNs, consider the following.

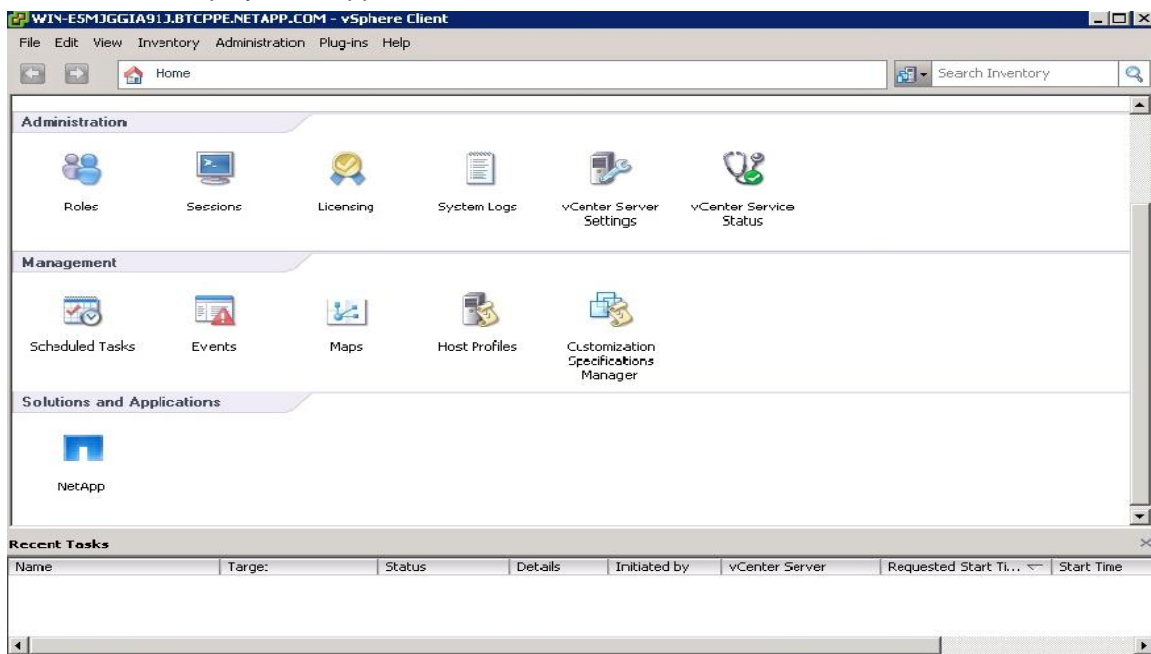
- SnapDrive for UNIX allows creating and provisioning LUNs using the FC protocol on a guest OS in a VMware virtual environment.
- RDM LUNs for Vservers in Data ONTAP operating in Cluster-Mode are not supported.
- RDM LUNs provide all functionalities in a guest OS that are feasible in a physical OS using the FC protocol.
- The NetApp Virtual Storage Console (VSC) needs to be installed and configured with vCenter™ running in a Microsoft® Windows machine.
- SnapManager for virtual interface API calls are used to create/delete igroup mapping of the LUN and export/deport of the LUN to the guest OS.

- For more details on host OS, guest OS, vCenter, and VSC supported versions, refer to the [Interoperability Matrix](#).
- Verify that the ESX server has FC adapters installed.
- Verify that the zoning is configured properly between the ESX server and the storage system.
- Storage system credentials should be configured on the backup and recovery capability of VSC.
- FCP host utilities are not required in a guest OS for RDM LUN support.
- VMware limitations are:
 - Each guest can be configured with 4 SCSI controllers, each of which can be mapped to 16 devices. However, one device is reserved per controller; hence, 60 (16 x 4 - 4) LUNs can be mapped to the guest.
 - Each ESX server can have a maximum of 256 LUNs mapped to it.
 - The maximum supported LUN size is 2TB minus 512B.

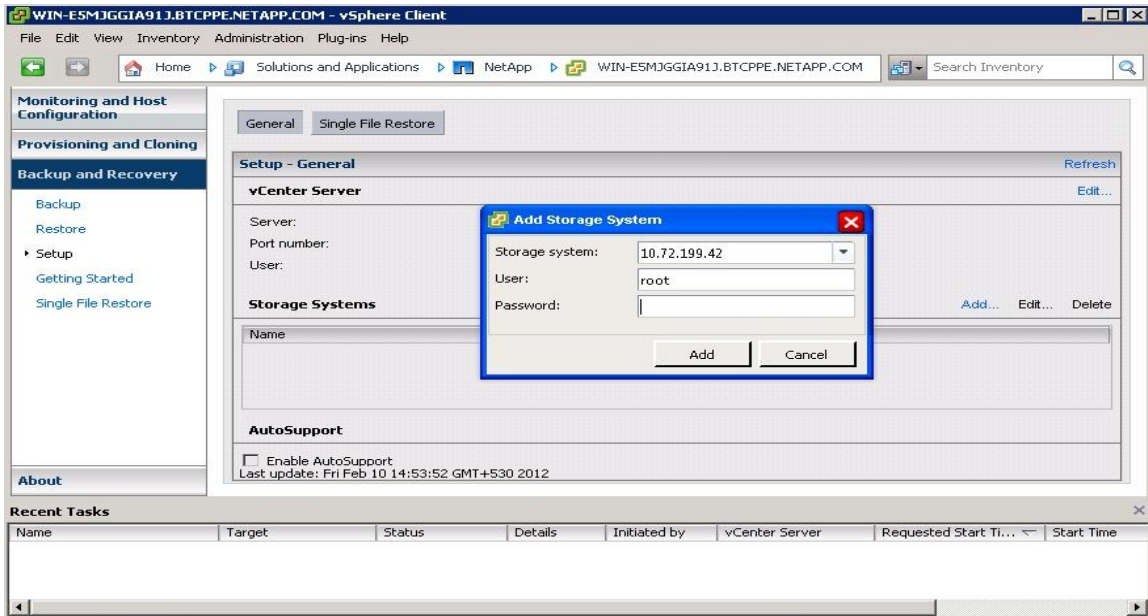
Configuring SnapDrive for UNIX for RDM LUNs

Follow these steps to configure SnapDrive for UNIX for RDM LUNs.

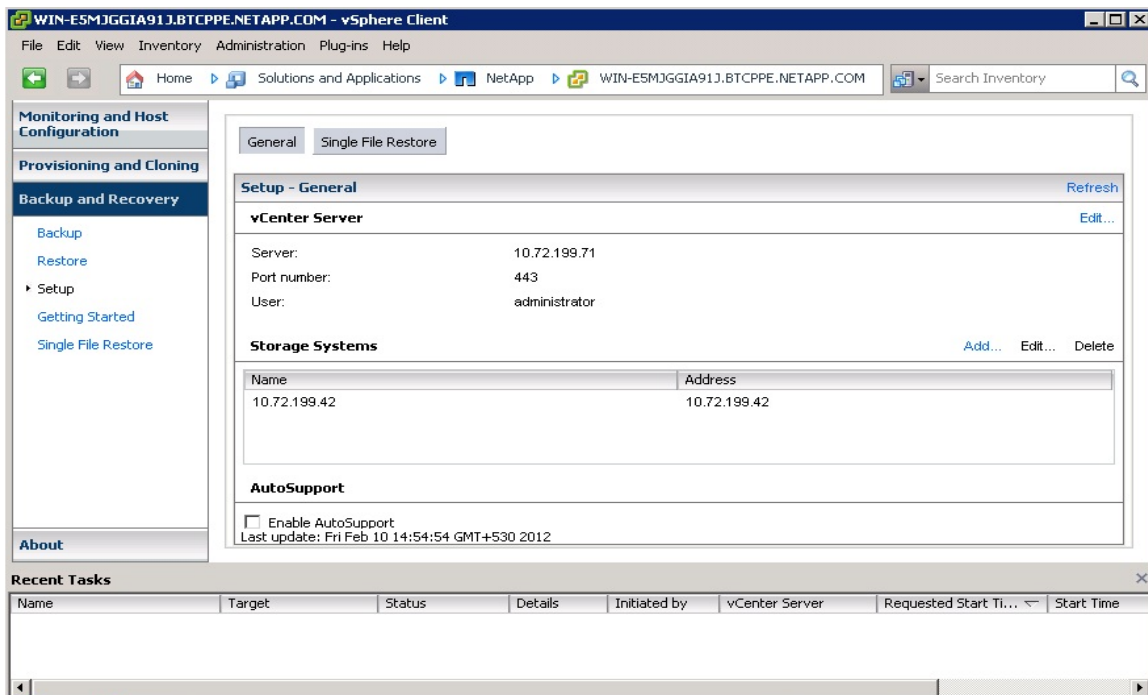
1. After installing the NetApp VSC plug-in on the vCenter, log into the vCenter server through vSphere®, which will display a NetApp icon as shown below.



2. Click the NetApp icon to display the home view for the vSphere NetApp plug-in. Configure the storage system on the Backup and Recovery option.



The configured storage system with backup and recovery capability will appear as shown below.



3. Set `default-transport` as `fcip` in the `snapdrive.conf` file and restart the SnapDrive for UNIX daemon.
4. Other configuration variables in `snapdrive.conf` are:
 - a. `contact-viadmin-port`: Specifies the port on which SMVI service is running: Default 8043
 - b. `use-https-to-viadmin`: Specifies the protocol `http/https` for communicating with SMVI: Default on (`https` for communication)

- c. `virtualization-operation-timeout-secs`: Specifies the number of seconds to wait before timing out a call to SMVI: Default 600 sec
 - d. `vif-password-file`: Specifies the path for the virtual interface password file: Default `/opt/NetApp/snapdrive/vifpw`
5. Use the following command to specify the VSC server with backup and recovery capability.

```
snapdrive config set -viadmin <vi-admin-user> <vi_server>
```

Example:

```
# snapdrive config set -viadmin admin 10.72.199.71
```

Password for admin: < SMVI installed server level user password of 10.72.199.71>

6. Retype password:

Note: User credentials are not validated by the SMVI server.

7. Verify step 6 by using the `snapdrive config` command. The appliance type for the specified SMVI server is `Virtual Interface`.

Example:

```
Snapdrive config list
username      appliance name  appliance type
-----
root          10.72.199.42   StorageSystem
admin         10.72.199.71   VirtualInterface
```

These steps should be performed on each guest OS where RDM LUNs are to be created.

RDM LUN Creation

The following actions are performed while creating RDM LUNs.

- SDU creates the LUN on the storage.
- SDU creates igroup mappings on storage, creates RDM mappings, and exports the LUN to the guest.
- SDU discovers the LUN and creates the host-side file specs.

```
snapdrive storage create -lun 10.72.199.42:/vol/esxvoll/lun1 -lunsize 20m -fs /mnt1 -nolvm
LUN btc-ppe-42:/vol/esxvoll/lun1 ... created
exporting new lun(s) to Guest OS ... done
discovering new lun(s) ... Done
LUN to device file mappings:
- btc-ppe-42:/vol/esxvoll/lun1 => /dev/sdh
file system /mnt1 created
```

RDM LUN Deletion

The following actions are performed while deleting RDM LUNs.

```
SDU deletes the host-side file specs.
SDU deports the LUN, removes the RDM mapping.
SDU deletes the LUN on the storage.
snapdrive storage delete -fs /mnt1
  delete file system /mnt1
    - fs /mnt1 ... deleted
  deporting lun(s) from Guest OS ... done
    - LUN btc-ppe-42:/vol/esxvoll/lun1 ... deleted
```

Limitations

- RDM LUNs for Vservers in Data ONTAP operating in Cluster-Mode are not supported.

- When SDU commands are executed with igroup, SDU will ignore the user-defined igroup with a warning message.
- To migrate a VM using VMware vMotion® across the server, perform the following steps.
 1. Before migration, disconnect the exported filespec/LUN from the guest OS.
 2. Perform VM migration using VMware vMotion.
 3. After VM migration, connect the filespec/LUN to the guest OS.
- Multipathing is not supported in the guest OS.
- Virtual compatibility mode RDM is not supported by SMVI.
- SMVI does not perform any authentication checks that are configured in SDU.

Best Practices

- Creating an RDM LUN in a VMware environment enables the guest OS to perform fast I/O operations. Use SnapDrive for UNIX 4.2 or later to perform Snapshot management and storage provisioning operations.
- Sometimes you may realize that the RDM LUN was not created and behaves as an ordinary LUN. When this happens, verify that the default transport variable is set to FCP in the `snapdrive config` file. Execute the `snapdrive config list` command to validate the presence of the virtual interface.
- When you execute storage provisioning operations for RDM LUN mapping, the entries are listed in the ESX server. To avoid overheads, NetApp recommends removing the stale entries located in the ESX server that are generated due to SnapDrive operations.

13 SnapDrive for UNIX FAQ

13.1 SnapDrive for UNIX Installation FAQ

Why do I see errors during the installation process?

Answer: Verify that you have root privileges. In addition, check the compatibility matrix to confirm that you are using supported platforms and processor architecture.

Do I need to uninstall my existing version of SnapDrive for UNIX before upgrading?

Answer: No; the upgrade process overwrites the existing binaries. But you should stop the SnapDrive daemon before upgrading.

Does the upgrade process affect any of my existing LUNs?

Answer: No.

After upgrading can I restore a Snapshot copy that was created using an older version?

Answer: Yes. Snapshot copy management functionality is compatible with older versions, but the LUN cloning feature in Linux, which is supported beginning with SnapDrive for UNIX 2.2, does not support cloning of LVM disk groups to the same host based on Snapshot copies created by versions earlier than 2.2.

When I upgrade SnapDrive for UNIX is my existing `snapdrive.conf` file overwritten?

Answer: No. When you install a new version, SnapDrive for UNIX checks to see if you already have a version installed. If it detects a SnapDrive for UNIX installation, it preserves the existing `snapdrive.conf` file and renames it to the version of the file that it is installing; for example,

`snapdrive.conf.5.0`. The upgrade process avoids overwriting your existing `snapdrive.conf` file, so you do not lose any customizations you made to the file.

By default, SnapDrive for UNIX includes comment text about the variables in the `snapdrive.conf` file, and automatically uses the default values for all variables except those you have customized. As a result, SnapDrive for UNIX uses the default values for variables that are new, even if you have an earlier version of the `snapdrive.conf` file. If you want to change these values, you must add the variables to your existing `snapdrive.conf` file and specify the values that you want.

You can use the `snapdrive config show` command to view the existing configuration.

What can we do if SDU 5.0 takes a long time to restart?

Answer: With the NetApp AutoSupport™ tool turned on, SDU caches all the volume information available in storage; also, if the volumes contain qtrees it will try to initialize all the information such as volumes, directories, and files. Therefore, disable NetApp AutoSupport and restart the daemon.

In the `snapdrive.conf` file, set the `autosupport-enabled` variable to `off`.

- `autosupport-enabled=off # Enables auto-support (requires autosupport-filer to be set).`

What can we do if SDU 5.0 fails to start because of reported FD leaks in the `vgdisplay` command on the Linux OS?

Answer: As part of a NetApp AutoSupport implementation, SDU queries the entire disk group to figure out the storage. Because of this, Linux reports leaked file descriptors in the `vgdisplay` command.

To suppress this, set the `LVM_SUPPRESS_FD_WARNINGS` environment variable to 1.

export `LVM_SUPPRESS_FD_WARNINGS=1`.

Example:

The SDU log reports the following FD leak errors.

- `16:35:40 02/23/12 [f7476b90]v,9,0,ASSISTANT EXECUTION (at 988.004188): vgdisplay File descriptor 6 (/var/log/sd-trace.log) leaked on vgdisplay invocation. Parent PID 11013`
- `16:35:40 02/23/12 [f7476b90]v,9,0,ASSISTANT EXECUTION (at 988.006523): Output:`
- `16:35:40 02/23/12 [f7476b90]i,2,6,FileSpecOperation::findDiskGroupsByDevices`
- `Volume manager error (6) while identifying all active disk groups could not find a disk group by that name.`

What do we do if following error "WARNING!!! Unable to find a SAN storage stack" appears when installing SnapDrive for UNIX?

Answer: Verify that the appropriate transport protocol, volume manager, file system and multipathing type are installed and configured in the system. If NFS is being used, this warning message can be ignored. Verify that the appropriate transport type, volume manager, file system, and multipathing types are properly installed and configured in the system.

Does SnapDrive for UNIX support AutoSupport?

Answer: The AutoSupport feature is not supported in SnapDrive for UNIX for Data ONTAP Cluster-Mode. SnapDrive for UNIX for Data ONTAP/7-Mode has support for the NetApp AutoSupport feature.

This feature for Data ONTAP 7-Mode can be enabled by using the following option in the `snapdrive.conf` file located in the host system:

- `autosupport-enabled=on #`
This option Enables auto-support (requires autosupport-filer be set)

Does SnapDrive for UNIX support 64-bit platforms?

Answer: Yes. SnapDrive for UNIX supports 64-bit with Solaris, HP-UX, SUSE, Red Hat Enterprise Linux, and OEL operating systems. For more details, refer to the [Interoperability Matrix](#).

Note: Before installing SnapDrive for UNIX on a 64-bit RHEL 6, make sure that the 32-bit version of glibc is installed in your system. If the 32-bit version of glibc is found missing, SnapDrive for UNIX will fail to install in your system.

I am planning to have a host cluster environment. Do I need to install SnapDrive for UNIX on each host manually, or is there a tool that supports installation across multiple hosts?

Answer: In a cluster environment, you have to install SnapDrive for UNIX manually on each host, because no tool or management software is available from NetApp to support installation of software across multiple hosts.

However, you can write scripts easily in addition to quickly installing SnapDrive on the cluster nodes. In the following example, assuming an IBM AIX operating system, SMIT can be used to create a script to install SnapDrive for UNIX on all of the cluster nodes at once.

1. Write the script output from the `smit -s /tmp/install_sd.ksh, -s file to /tmp/install_sd.ksh.`
2. Mount the SnapDrive for UNIX installation directory on a shared mount point.
3. Install SnapDrive for UNIX on the host using SMIT as explained in the [SnapDrive for UNIX Installation and Administration Guide](#).
4. After you successfully install SnapDrive for UNIX, exit the SMIT tool and copy the `install_sd.ksh` file to all cluster nodes and execute it from the host CLI.

What is the default location of the `snapdrive.conf` file?

Answer: You can find the `snapdrive.conf` file in the default installation directory. The default installation directory changes across platforms. See **Error! Reference source not found.** for more information.

Table 6) Default locations for `snapdrive.conf` file.

Host Operating System	Path
AIX, HP-UX, and Linux	<code>/opt/NetApp/snapdrive/snapdrive.conf</code>
Solaris	<code>/opt/NTAP/snapdrive/snapdrive.conf</code>

For more information on the `snapdrive.conf` file, see the [SnapDrive for UNIX Installation and Administration Guide](#).

13.2 Storage Provisioning FAQ

Which file system should I specify when provisioning storage?

Answer: NetApp does not recommend using any specific file system when creating the storage. You should decide which file system might be best for the application. Refer to the [compatibility matrix](#) to understand which file systems are supported by SnapDrive for UNIX.

Before I use the snapdrive storage create command to provision an iSCSI, do I have to make sure that the host already has the target storage system in its iSCSI discovery path, or will SnapDrive for UNIX do that automatically?

Answer: You have to manually enter the target file location on the host system before you provision an iSCSI. The target file varies, depending on the operating system. Table 7 provides the target information and steps involved for different host operating systems.

1. Edit the iSCSI configuration file.

Table 7) Target information for host operating systems.

Host Operating System	File Location	Syntax
AIX	/etc/iscsi/targets	<storage_system_IPAddress/storage_system_name><port number, default is 3260> <iscsi nodename of the storage system> iscsiadm add static=config <iscsi nodename of the storage system>, <storage_system_IPAddress/storage_system_name>
HP-UX	--	iscsiutil -a -l <storage_system_IPAddress/storage_system_name>
Linux (RHEL and SUSE)	/etc/iscsi.conf	HeaderDigest=no DataDigest=no ImmediateData=no DiscoveryAddress=<storage_system_IPAddress/storage_system_name> The HeaderDigest, Data Digest, and ImmediateData entries are required for faster discovery.
Linux (RHEL5 and SUSE 10 onwards)		iscsiadm -m discovery-address -p <ipaddress>:<portno> -t st -l
Solaris	--	iscsiadm add discovery-address <storage_system_IPAddress/storage_system_name> Or Isctsiadm add static-config <iscsi nodename of the storage system>,<new storage_system_IPAddress/storage_system_name>

2. Execute the following command to rescan the iSCSI targets. Table 8 describes the commands to rescan iSCSI targets.

Table 8) Rescan iSCSI targets.

Host Operating System	Command
AIX	cfgmgr
HP-UX	ioscan
Linux (RHEL and SUSE)	<ul style="list-style-type: none"> • /sbin/iscsi-rescan • /etc/init.d/iscsi reload
Linux (RHEL5 and SUSE 10 onward)	iscsiadm -R
Solaris	cfgadm

3. Verify the host iSCSI initiator node name in the command output by using the `iscsi show initiator` command from the storage system CLI.

Are there any special considerations I should be aware of when using SnapDrive in a cluster environment?

Answer: Yes. Make sure that the SnapDrive for UNIX versions and the `snapdrive.conf` files are the same on all of the cluster nodes. NetApp recommends that you execute the SnapDrive for UNIX commands from the master node.

Can SnapDrive resize the disk group and reflect it in the host?

Answer: Not all volume managers support this feature. Use the `-addlun` option to resize the disk group.

Does SnapDrive support iSCSI and FCP in the same machine?

Answer: SnapDrive does not support the coexistence of iSCSI and FCP on the same host. However, the transport type for a given operation is based on the value of the configuration variable `default-transport-type` in the configuration file.

Can I connect to the LUN created using FilerView or storage system CLI commands?

Answer: Yes, by using the `snapdrive storage connect` command.

Can I migrate between a cluster and a nonclustered environment; that is, between shared and dedicated file systems or disk groups?

Answer: Yes, by using the `snapdrive storage connect` or `snapdrive snap connect/restore` commands.

Why does SnapDrive produce an error when I try to use the `snapdrive storage create/connect` command?

Answer: There are many reasons for this error, but for basic troubleshooting you can use the information provided in Table 9.

Table 9) Steps to resolve `snapdrive storage create/connect` command errors.

If...	Then...
SnapDrive storage create fails during LUN creation	Follow the steps in section 4.4 of this report to verify reachability from the host to the storage system. If HTTPS is enabled in SnapDrive, make sure the storage system is configured to accept HTTPS requests.
LUN discovery fails	Follow the steps in sections 4.1 and 4.4 of this report to confirm that the FCP or iSCSI service has started and been configured correctly.

1. Verify that the host environment is supported by SnapDrive for UNIX; see the [Interoperability Matrix](#).
2. Follow the steps in section 4.2 of this report to make sure the host configurations are correct.
3. Follow the steps in section 4.1 of this report to make sure storage system configurations are correct.
4. Verify configuration `snapdrive.conf`, and make sure it is configured for your environment's settings.

Which entity (either cluster name or Vserver) should be mentioned while configuring storage operating in Cluster-Mode with SnapDrive for UNIX?

Answer: You need to mention the Vserver name while configuring storage operating in Cluster-Mode with SDU.

Command:

```
snapdrive config set <username> <vservername>
```

Example:

```
snapdrive config set vsadmin toaster-vserver
```

What can I do if RBAC is enabled and SnapDrive for UNIX operations fail occasionally due to an HTTP post error from the DataFabric® Manager server?

Answer: Increase the `dfm-api-timeout` variable's value in the `snapdrive.conf` file and restart the SnapDrive for UNIX daemon.

13.3 Snapshot Copy Management FAQ

How frequently should I create Snapshot copies?

Answer: The frequency mainly depends on your environment's specific requirements.

Can I schedule the creation of Snapshot copies using SnapDrive?

Answer: No. SnapDrive does not support scheduling Snapshot copy creation. However, you can achieve the same result by manually scripting `snapdrive snap` commands and using `cron` jobs in UNIX environments.

I accidentally deleted the file system on my host. Can I restore it using the Snapshot copy I made previously using SnapDrive for UNIX?

Answer: Yes. It's possible by using the `snapdrive snap restore` command.

Can I restore the file system from a Snapshot copy created from the storage system?

Answer: No. SnapDrive allows you to restore file systems only from the Snapshot copies created by SnapDrive.

Can I manually create igroups in a cluster environment when I use snapdrive storage create?

Answer: No, igroups need not be created manually. They are created by using the `snapdrive storage create` command.

I get the following error message when connecting to the LUN that is part of a volume/disk group but the snapdrive snap list output shows the presence of the LUN: "The following LUNs were not found." How do I resolve this error?

Answer: SnapDrive for UNIX does not allow connecting to a LUN that is created as part of a volume group. You can connect to a Snapshot copy containing a LUN when the Snapshot copy is made only for the LUN, for example, by using the `snapdrive snap connect -lun` command.

How can I create FlexClone volumes using SnapDrive for UNIX?

Answer: You have to pass `-clone <unrestricted or optimal>` through CLI or set the following variable in the `snapdrive.conf` file.

```
san-clone-method=unrestricted | optimal (By default it has lunclone).
```


13.4 SnapDrive for UNIX in an sfrac Environment (Storage Creation) FAQ

Why am I not able to use the `-nolvm` option during storage creation in an SFRAC environment?

Answer: The `-nolvm` option is not valid for cluster-wide or shared resources because the operation requires the CVM to manage shared disk groups.

Why does SnapDrive for UNIX take longer to complete operations in an SFRAC environment?

Answer: This can happen if you provide many `file_specs` with the SnapDrive command in a cluster environment that has many nodes. The delay is mostly due to SnapDrive and cluster requirements to communicate with all cluster nodes during any operation involving a shared disk group or file system. To avoid this delay, NetApp recommends that you provide fewer `file_specs` (shared disk groups/file systems) in one SnapDrive command.

In the VxDMP environment on Solaris, some SnapDrive operations may fail if the paths from the host to the LUNs are changed. For example, if you created LUNs by enabling the primary path and disabling the secondary path and, subsequently, if you enable the secondary path and then disable the primary path, the SnapDrive operations on those LUNs fail because VxDMP does not detect this change. To function properly, VxDMP requires the device path information to be updated after any change is made in the ports state (enabled or disabled). If you change the path to enabled or disabled, NetApp recommends that you execute `devfsadm -Cv` followed by `vxdisk scandisks` manually on the host, to refresh the VxDMP path information before any SnapDrive operation is executed.

13.5 General Queries

Can I have more than one data interface for a port set?

Answer: Yes, you can add more than one data interface for a port set using the `portset add` command on the storage system.

Does port set support iscsi and fc protocols?

Answer: Yes, you can create port set of type iscsi and fc. However, the mixed mode (both iscsi and fc) is not supported by SnapDrive.

Is it possible to map a port set to multiple igroups?

Answer: Yes. You can map a port set to multiple igroups to limit the number of paths available to the host.

Is a port set created automatically during Vserver creation?

Answer: No, a port set has to be created manually depending on your requirement. Creating a port set is an optional requirement.

14 Summary

SnapDrive for UNIX is a complete storage management solution. It helps administrators to execute nearly instantaneous Snapshot copy backups and restorations of application data. It also provisions storage from the host system as required by each application.

The recommendations made in this guide are best practices for most environments. Be sure to familiarize yourself with the prerequisites provided at the beginning of this guide.

References

- SnapDrive for UNIX Installation and Administration Guide
<https://support.netapp.com/documentation/docweb/index.html?productID=60397>
- Data ONTAP 8.1 Cluster-Mode System Administration Guide
<http://support.netapp.com/documentation/productlibrary/index.html?productID=30092>
- Data ONTAP Block Access Management Guide for iSCSI and FCP
<https://support.netapp.com/documentation/productsatoz/index.html>
- Host Utilities Installation and Setup Guide
<https://support.netapp.com/documentation/productlibrary/index.html?productID=61343>
- [Data ONTAP Storage Management Guide](#)
<https://support.netapp.com/documentation/productsatoz/index.html>
- Compatibility and Configuration Guide for NetApp FCP and iSCSI
<https://support.netapp.com/documentation/productsatoz/index.html>
- Data ONTAP File Access and Protocols Management Guide
<https://support.netapp.com/portal/documentation>

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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