

# White Paper

## The Storage System Best Suited for OpenStack FUJITSU Storage ETERNUS AF and ETERNUS DX series

When designing a system that uses OpenStack, the FUJITSU Storage ETERNUS AF series and ETERNUS DX series provide advantages in terms of costs and functions compared to other companies' storage systems. This document explains these advantages and briefly shows the interoperability of OpenStack and the FUJITSU Storage ETERNUS AF series or ETERNUS DX series.



## Table of Contents

Preface	3
1. OpenStack Overview	4
2. Interoperability with the ETERNUS AF/DX	6
3. Criteria for Selecting Storage Systems	19
Related Links	19

## Preface

In recent years, a growing number of companies have considered the use of cloud-based systems. Some of the reasons are "to improve the agility of their business" and "to reduce operational costs" by making use of features such as flexibility and swiftness in the cloud.

Following this trend, OpenStack is receiving attention as software that easily configures the cloud.

OpenStack which was released in 2010 by Rackspace Hosting and NASA as Open Source Software (hereinafter called "OSS") is software for the IaaS cloud management infrastructure. It features swift and flexible resource procurement, application portability between different environments, and freedom from being bound by existing assets.

For the standard development language, many parts are written in Python and the Apache license is employed.

This document shows that OpenStack can be applied in FUJITSU Storage ETERNUS AF series and ETERNUS DX series environments.

Although the ETERNUS DX S3 series is used in the description for "2.4 Volume Connections in the ETERNUS Storage Systems" and later, the procedures are the same for other ETERNUS AF series and ETERNUS DX series.

The contents of "2.3 ETERNUS OpenStack VolumeDriver Installation" and "2.4 Volume Connections in the ETERNUS Storage Systems" are current as of August 2015.

The information stated in this document is current as of November 2019.

### ■ Target Readers

This document targets readers who are looking to configure cloud environments that use OpenStack.

### ■ Naming Conventions

The following abbreviation is used in this document.

- FUJITSU Storage ETERNUS AF series and ETERNUS DX series..... ETERNUS AF/DX

## 1. OpenStack Overview

### 1.1 OpenStack

#### ■ OpenStack development

OpenStack has been released about every six months since the first version (code name: Austin) was released in October, 2010. Code names are ordered alphabetically for each release.

Figure: Release history

Designed as an integration engine to manage bare metal, virtual machines, and containers with a single API set, each release of OpenStack offers greater manageability, scalability, and enhanced end-user experience.

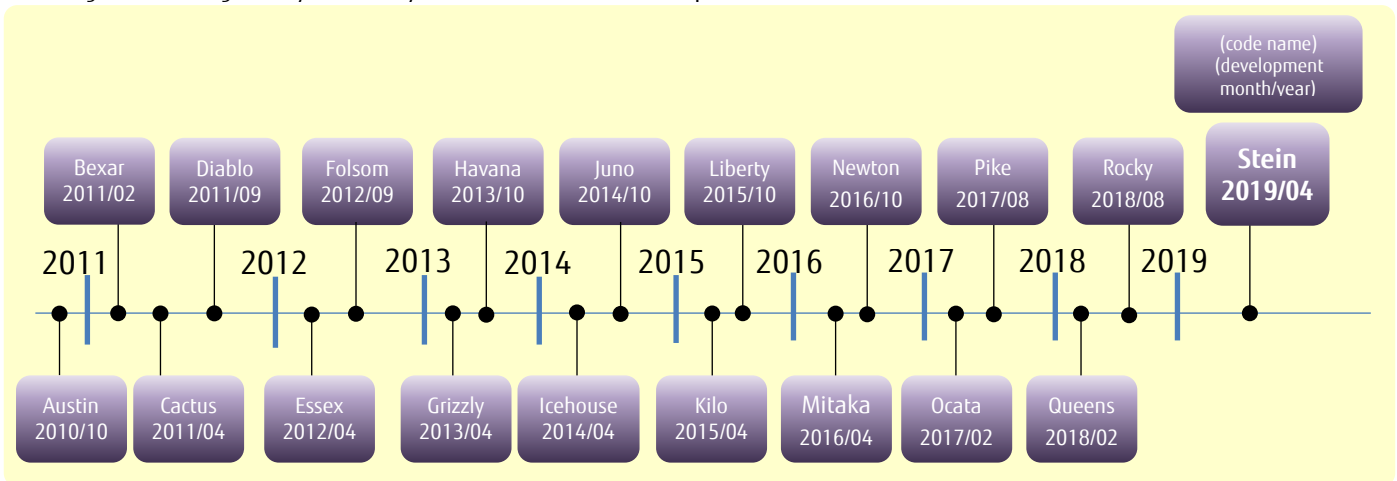
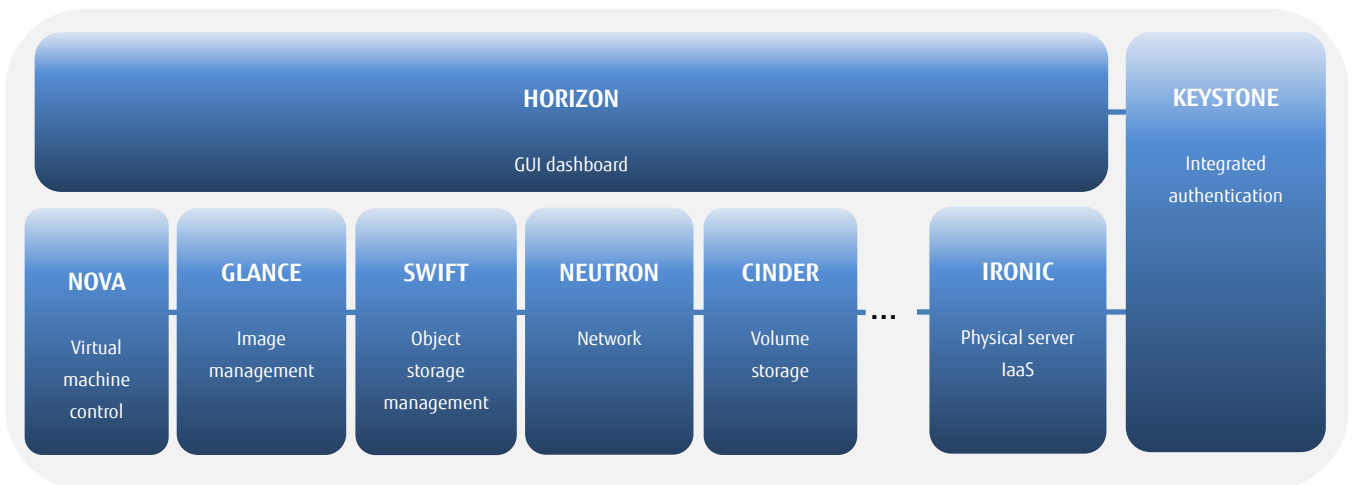


Figure: Component overview in OpenStack



In response to functional enhancements with each release, major vendors such as Yahoo, IBM, Hewlett-Packard Enterprise (HPE), and Dell are now actively participating in the OpenStack community.

Further, Oracle unifies and provides OpenStack as a standard function from Solaris 11.2 and all the functions are available without the trouble of additional costs and installation.

In consideration of the above, and also because of the decrease in implementation difficulty, OpenStack is more often recommended.

■ Fujitsu's approach

- Fujitsu is a Gold Member of the OpenStack Foundation (a non-profit organization that has a central function in the OpenStack community).
- In June 2014, Fujitsu started providing OpenStack-compatible APIs in "FUJITSU Software ServerView Resource Orchestrator (ROR)", which is private cloud infrastructure software developed by Fujitsu.
- In February 2015, Fujitsu announced a policy to move all internal systems (approximately 640 systems and 13,000 servers) that are running domestically and internationally in the Fujitsu group to a next-generation cloud infrastructure that is configured using OpenStack within five years.

By taking the above approaches, Fujitsu has taken a positive stance on OpenStack.

■ Status of the ETERNUS AF/DX

Fujitsu's ETERNUS AF/DX can be used from the OpenStack management interface with the ETERNUS OpenStack VolumeDriver program (provided for free) for OpenStack Cinder.

A detailed explanation about the ETERNUS OpenStack VolumeDriver is provided later in this document.

■ OpenStack distribution

Various vendors such as SUSE, Red Hat, and Oracle sell and support OpenStack as a package adding functions of their own.

Table: Distribution by each vendor (partial list)

Distribution name	Developer	License	Remarks
RDO	Red Hat	Free	Compatible with all Red Hat Linux such as Fedora and CentOS
Red Hat Enterprise Linux OpenStack Platform	Red Hat	Not free	Product where non-free support is added to "RDO"
Rackspace Private Cloud Software	Rackspace	Free	
SUSE OpenStack Cloud	SUSE	Not free	Exclusive for private clouds
Oracle OpenStack for Oracle Linux	Oracle	Free	
HPE Helion OpenStack	HPE	Free	
VMware Integrated OpenStack	VMware	Not free	

The following section provides an overview of RDO provided by Red Hat that is described in the above table.

1.2 RDO Overview

RDO is an OpenStack distribution in the RPM package format provided by the RDO development community that was founded by Red Hat. RDO is provided free of charge for the purpose of evaluation. On the other hand, Red Hat Enterprise Linux OpenStack Platform is a product with non-free support for businesses that assures quality and certifies operations.

RDO was developed with less vendor specific functions compared with other distributions. Instead, product differentiation is achieved with the above-mentioned support service and a tool called "Packstack". "Packstack" is a tool that is used for automatic installation and settings, aimed at simplifying environmental configurations. In all-in-one configurations such as demonstration environments, the installation is assumed to be completed using three commands.

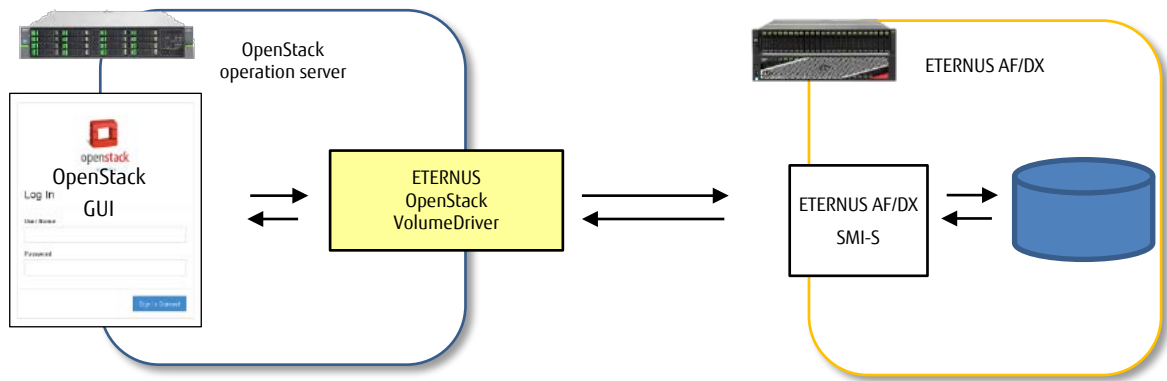
## 2. Interoperability with the ETERNUS AF/DX

### 2.1 Overview of ETERNUS OpenStack VolumeDriver

ETERNUS OpenStack VolumeDriver is a program that supports the interoperability between the ETERNUS AF/DX and OpenStack. This program uses ETERNUS AF/DX SMI-S (which is a storage management interface) to control volumes in the ETERNUS AF/DX using the standard interface (dashboard) of OpenStack.

This document provides explanations using a configuration with OpenStack Otaca and ETERNUS OpenStack VolumeDriver 1.4.

Figure: Operation overview of ETERNUS OpenStack VolumeDriver



#### ■ Features

The major features of this product are described below.

- This product can be downloaded for free.
- Fibre Channel (FC) and iSCSI are supported as connection protocols.
- ETERNUS OpenStack VolumeDriver is updated to support new OpenStack releases as necessary.
- The supported storage systems are as follows:

ETERNUS AF S3/S2 series

ETERNUS DX S5/S4 series and later\*1

\*1 The ETERNUS DX8100 S4 is excluded.

## 2.2 Features of ETERNUS OpenStack VolumeDriver

By installing this product in the controller node, the volumes in the ETERNUS AF/DX can be used as OpenStack block storage. The volumes are operated from the OpenStack dashboard.

Operations from OpenStack are more integrated and simplified compared with conventional operations from the ETERNUS AF/DX.

Table: Relationship between the ETERNUS OpenStack VolumeDriver functions and the ETERNUS AF/DX functions

ETERNUS OpenStack VolumeDriver functions	ETERNUS AF/DX functions
Create Volume	Creating volumes
Delete Volume	Deleting volumes
Attach Volume	Setting access paths to volumes <ul style="list-style-type: none"> <li>- Adding FC hosts/iSCSI hosts</li> <li>- Creating/modifying LUN groups</li> <li>- Setting host affinities</li> </ul>
Detach Volume	Deleting access paths to volumes <ul style="list-style-type: none"> <li>- Modifying/deleting LUN groups</li> <li>- Deleting host affinities</li> </ul>
Create Snapshot	Creating snapshots <ul style="list-style-type: none"> <li>- Creating Snap Data Volumes</li> <li>- Starting SnapOPC</li> </ul>
Delete Snapshot	Deleting snapshots <ul style="list-style-type: none"> <li>- Stopping SnapOPC</li> <li>- Deleting Snap Data Volumes</li> </ul>
Create Volume from Snapshot	Creating volumes from snapshots <ul style="list-style-type: none"> <li>- Creating a new volume</li> <li>- Copying from a snapshot volume to a volume (Starting OPC)</li> </ul>
Get Volume Stats	Obtaining free space information in the storage pool (or a RAID group/Thin Provisioning Pool)
Clone Volume	Cloning volumes <ul style="list-style-type: none"> <li>- Starting OPC from an existing volume to the newly created volume</li> </ul>
Copy Image to Volume	Creating a volume and copying the image managed in Glance to the volume <ul style="list-style-type: none"> <li>- ETERNUS AF/DX functions</li> <li>Creating volumes and setting/deleting access paths (Using Create Volume, Attach Volume, and Detach Volume)</li> <li>- Cinder operation</li> <li>Downloading an image from Glance and writing it in the volume</li> </ul>
Copy Volume to Image	Uploading volume data as an image to Glance <ul style="list-style-type: none"> <li>- ETERNUS AF/DX functions</li> <li>Setting/deleting access paths (Using Attach Volume and Detach Volume)</li> <li>- Cinder operation</li> <li>Reading data from a volume and uploading the image to Glance</li> </ul>
Extend Volume	Modifying the volume size (executable only for Thin Provisioning Volumes [TPVs])
Migrate Volume	Moving volumes to a different storage pool <ul style="list-style-type: none"> <li>- ETERNUS AF/DX functions</li> <li>Creating migration destination volumes/setting access paths to migration destination volumes,</li> <li>Deleting migration source volumes/deleting access paths to migration source volumes (Using Create Volume, Delete Volume, Attach Volume, and Detach Volume)</li> <li>- Cinder operation</li> <li>Copying data in the migration source volume to the migration destination volume</li> </ul>
Retype Volume	Changing the volume type <ul style="list-style-type: none"> <li>- When the "--migration-policy on-demand" option is specified, Migrate Volume is used</li> <li>- No action is performed on the ETERNUS AF/DX side for cases other than above</li> </ul>
Manage Volume	Registering information for ETERNUS AF/DX volumes in the OpenStack controller <ul style="list-style-type: none"> <li>- Searching volumes</li> </ul>
Unmanage Volume	Deleting only volume information that is registered in the OpenStack controller without deleting volumes from the ETERNUS AF/DX <ul style="list-style-type: none"> <li>- No action is performed on the ETERNUS AF/DX side</li> </ul>

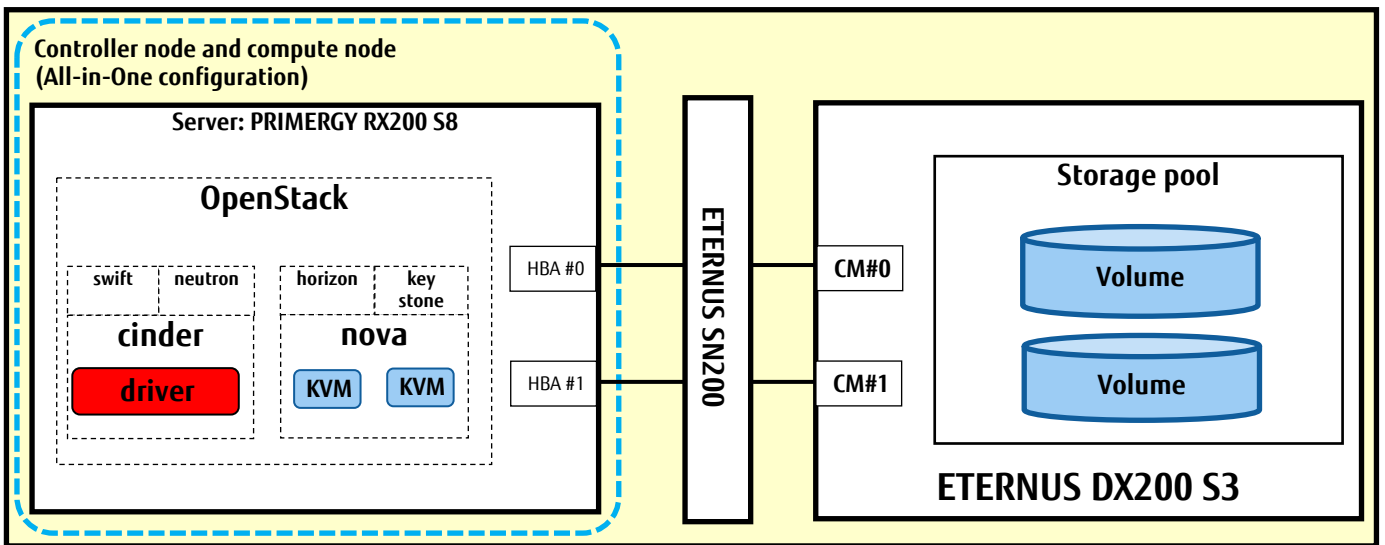
\* To execute the functions that use OPC/SnapOPC, a separate Advanced Copy Feature license is required.

To use the snapshot function, a Snap Data Pool Volume (SDPV) must be created and a Snap Data Pool (SDP) must be enabled.

A RAID group is also required because SDVs are created in RAID groups.

### 2.3 ETERNUS OpenStack VolumeDriver Installation

Figure: Configuration example



\* To install OpenStack, use the package (Otaca) that is provided by the RDO community.  
Use Red Hat Enterprise Linux (RHEL) as the server OS.  
RAID groups or Thin Provisioning Pools can be used as the storage pool.

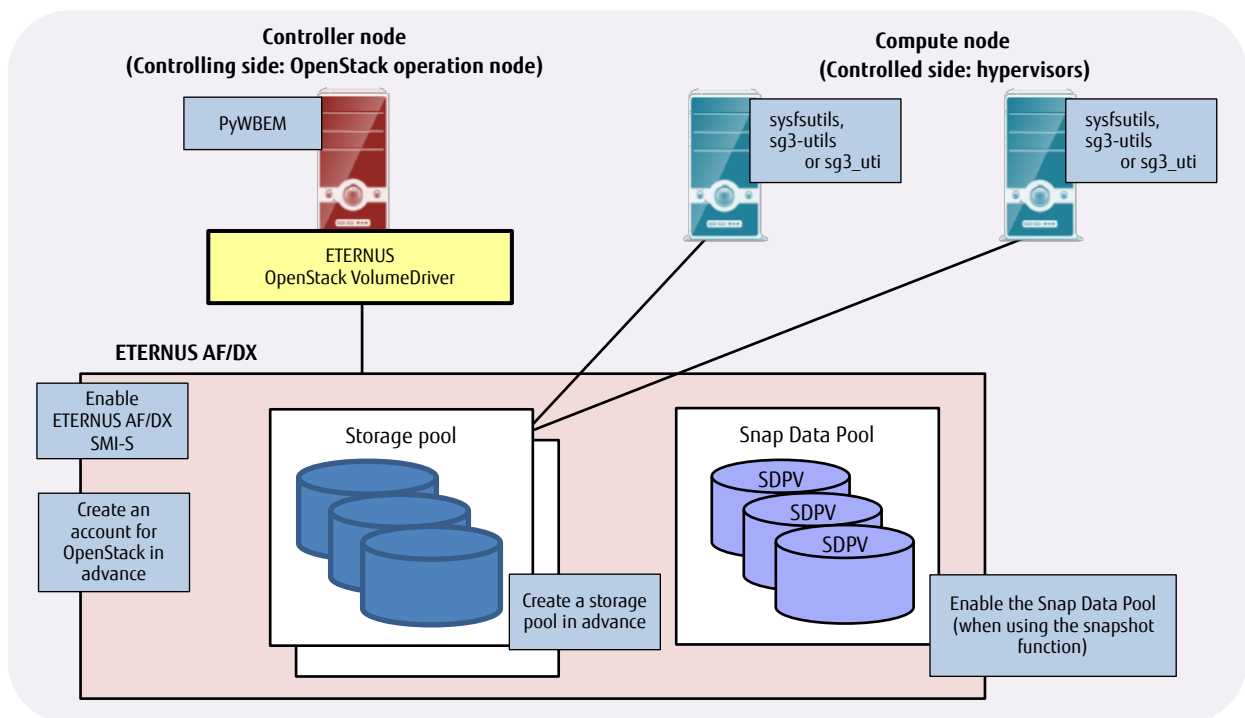


■ Preparation before Installation

Perform the following operations as preparation for installation of this product.

- Install PyWBEM (Python library) in the controller node (or the controlling node). (PyWBEM is required for the ETERNUS OpenStack VolumeDriver.)
- Install the "sysfsutils" package and either the "sg3-utils" package or the "sg3\_uti" package in the compute node (or the controlled node). (These packages are required for Fibre Channel connections. Refer to "Fibre Channel support in Compute" in "OpenStack Configuration Reference".)
- Enable ETERNUS AF/DX SMI-S in the ETERNUS AF/DX.
- Create a user account in the ETERNUS AF/DX to use functions from OpenStack. The account role must be set to "Software".
- Create a storage pool in the ETERNUS AF/DX to register the target volume to be operated. To use the snapshot function, create a Snap Data Pool Volume (SDPV) and enable the Snap Data Pool.

Figure: Overview of the preparation before installation



■ Installation

Install OpenStack and the ETERNUS OpenStack VolumeDriver.

For the installation procedure of ETERNUS OpenStack VolumeDriver, refer to the user's guide for the ETERNUS OpenStack VolumeDriver.

■ Post-installation

To use the ETERNUS AF/DX from OpenStack virtual machines, virtual machines and a virtual network must be created after the installation. (This procedure is performed using the OpenStack dashboard.)

The creation process for virtual machines and virtual networks is omitted in this document.

## 2.4 Volume Connections in the ETERNUS Storage Systems

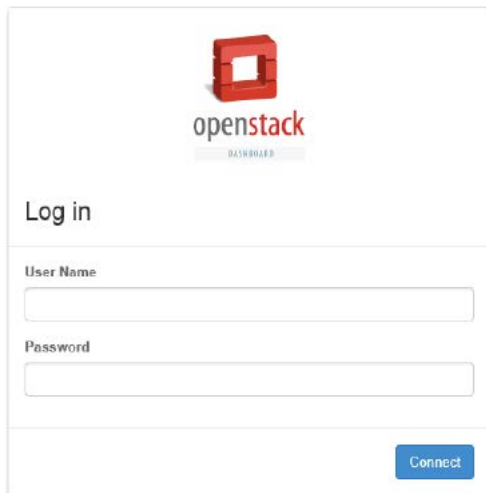
This section explains how the volumes in the ETERNUS AF/DX can be used with OpenStack. Storage operations with OpenStack are performed from the OpenStack dashboard "Horizon" (as well as from Command Line Interface). The dashboard can be used after installing OpenStack and connecting to the controller node via HTTP.

### 2.4.1 Volume Creation

This section explains that when a virtual volume is created using OpenStack, a corresponding real volume is created on the storage side.

- (1) Dashboard login  
Log in to the dashboard.

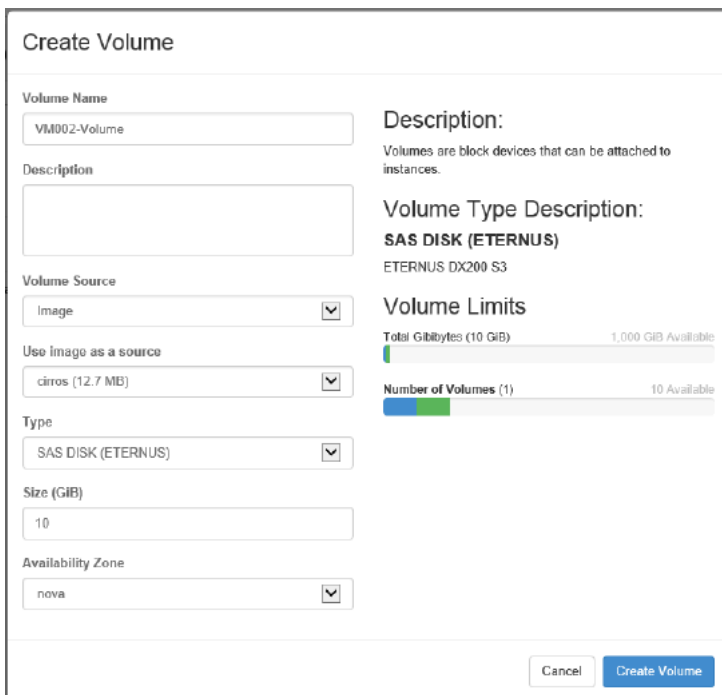
Figure: Login screen



The image shows the OpenStack Dashboard login screen. At the top center is the OpenStack logo, which consists of a red square with a white 'O' inside, and the text 'openstack' below it, with 'DASHBOARD' in smaller letters underneath. Below the logo is the heading 'Log in'. There are two input fields: 'User Name' and 'Password'. At the bottom right of the form is a blue button labeled 'Connect'.

- (2) Volume creation  
Create a volume in the OpenStack dashboard.

Figure: Volume creation



The image shows the 'Create Volume' form in the OpenStack dashboard. The form is titled 'Create Volume' and contains several sections:

- Volume Name:** A text input field containing 'VM002-Volume'.
- Description:** A large text area for entering a description.
- Volume Source:** A dropdown menu with 'Image' selected.
- Use image as a source:** A dropdown menu with 'cirros (12.7 MB)' selected.
- Type:** A dropdown menu with 'SAS DISK (ETERNUS)' selected.
- Size (GiB):** A text input field containing '10'.
- Availability Zone:** A dropdown menu with 'nova' selected.

On the right side of the form, there is a 'Description:' section with the text: 'Volumes are block devices that can be attached to instances.' Below that is a 'Volume Type Description:' section with the text: 'SAS DISK (ETERNUS)' and 'ETERNUS DX200 S3'. At the bottom right, there are two progress bars: 'Total Gigabytes (10 GiB)' with '1,000 GiB Available' and 'Number of Volumes (1)' with '10 Available'. At the bottom of the form are two buttons: 'Cancel' and 'Create Volume'.

(3) Checking the volume

The volume name on the storage system side is set for the volume source of the created volume.

Figure: Checking the volume (OpenStack)

The screenshot shows the OpenStack interface for a volume named 'VM002-Volume'. The volume details include:

- Name: VM002-Volume
- ID: 45aa61a9-b505-48d1-b934-ca6300eff6d6e
- Status: Available
- Size: 10 GiB
- Type: SAS DISK (ETERNUS)
- Bootable: Yes
- Encrypted: No
- Created: June 8, 2016, 1:27 a.m.
- Attached To: Not attached
- Volume Source: OpenStackPool
- Image: cirros

The metadata section shows the following details:

FJ_Pool_Type	Thinprovisioning_POOL
FJ_Volume_No	0x000D
FJ_Volume_Name	FJ_Josv_MMYdrtwOgCbSXLwFKbvLdQ==
FJ_Pool_Name	OpenStackPool
FJ_Backend	ET203A4601346006

A callout box highlights the 'FJ\_Volume\_Name' field with the text: "Actual volume name that was created by OpenStack (automatically determined by the driver)".

The created volume can also be checked using the volume name from ETERNUS Web GUI.

In addition, the volume can be checked using the volume number of either "FJ\_Volume\_No" (in hexadecimal) with OpenStack or "No." (in decimal) with ETERNUS Web GUI.

Figure: Checking the volume (on the ETERNUS Web GUI screen)

The screenshot shows the ETERNUS Web GUI interface for Thin Provisioning Pools. The 'Thin Provisioning Pool Information' table is displayed:

No.	Name	Status	Type	Allocation	Capacity	Used Capacity	Used Rate	Threshold	Pro
12	FJ_Josv_rBhXoVKzEKzXv1MUle7IEQ==	Available	TPV	Thin	10.00 GB	10.00 GB	100 %	80 %	-
13	FJ_Josv_MMYdrtwOgCbSXLwFKbvLdQ==	Available	TPV	Thin	10.00 GB	10.00 GB	100 %	80 %	-
34	FJ_Josv_AUdXzZKpp33RQfsezs20g==	Available	TPV	Thin	20.00 GB	20.00 GB	100 %	80 %	-
46	FJ_Josv_6TSFX9npp99uSKHhOLupBq==	Available	TPV	Thin					

A callout box highlights the volume with No. 13 and the name 'FJ\_Josv\_MMYdrtwOgCbSXLwFKbvLdQ==', with the text: "Actual volume name that was created by OpenStack (automatically determined by the driver)".

## 2.4.2 Volume Backups

This section provides the procedure for creating clones of a source volume.

- (1) Checking the source volume for a clone  
Check the source volume using the OpenStack dashboard.

Figure: Checking the source volume

The screenshot shows the OpenStack dashboard interface for a volume named 'VM002-Volume'. The volume is in an 'Available' state. The metadata section is highlighted with a red box and contains the following information:

FJ_Pool_Type	Thinprovisioning_POOL
FJ_Volume_No	0x000D
FJ_Volume_Name	FJosv_MMYdrtwOgCbSXLwFKbvLdQ==
FJ_Pool_Name	OpenStackPool
FJ_Backend	ET203A4601346006

Callouts in the image identify the 'Virtual source volume name' as 'VM002-Volume' and the 'Source volume name' as 'FJosv\_MMYdrtwOgCbSXLwFKbvLdQ=='. The 'Volume Source' field in the dashboard is also highlighted with a red box and points to the 'FJ\_Volume\_Name' metadata field.

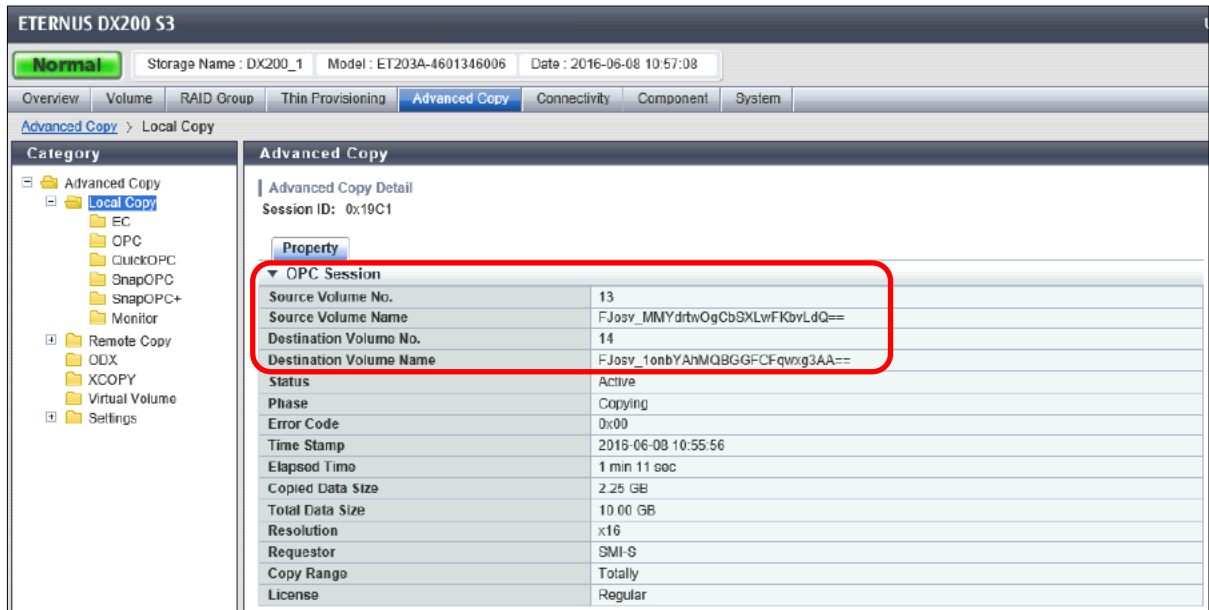
- (2) Creating a clone  
Create a clone volume using the OpenStack dashboard.

Figure: Creating a clone

The screenshot shows the 'Create Volume' form in the OpenStack dashboard. The 'Volume Name' field contains 'VM002-Volume-clone'. The 'Volume Source' dropdown is set to 'Volume'. The 'Use a volume as source' dropdown is set to 'VM002-Volume (10 GiB)'. The 'Size (GiB)' field is set to '10'. A callout box explains: 'When creating a volume, the clone for the target volume is created by specifying the existing volume as a source.'

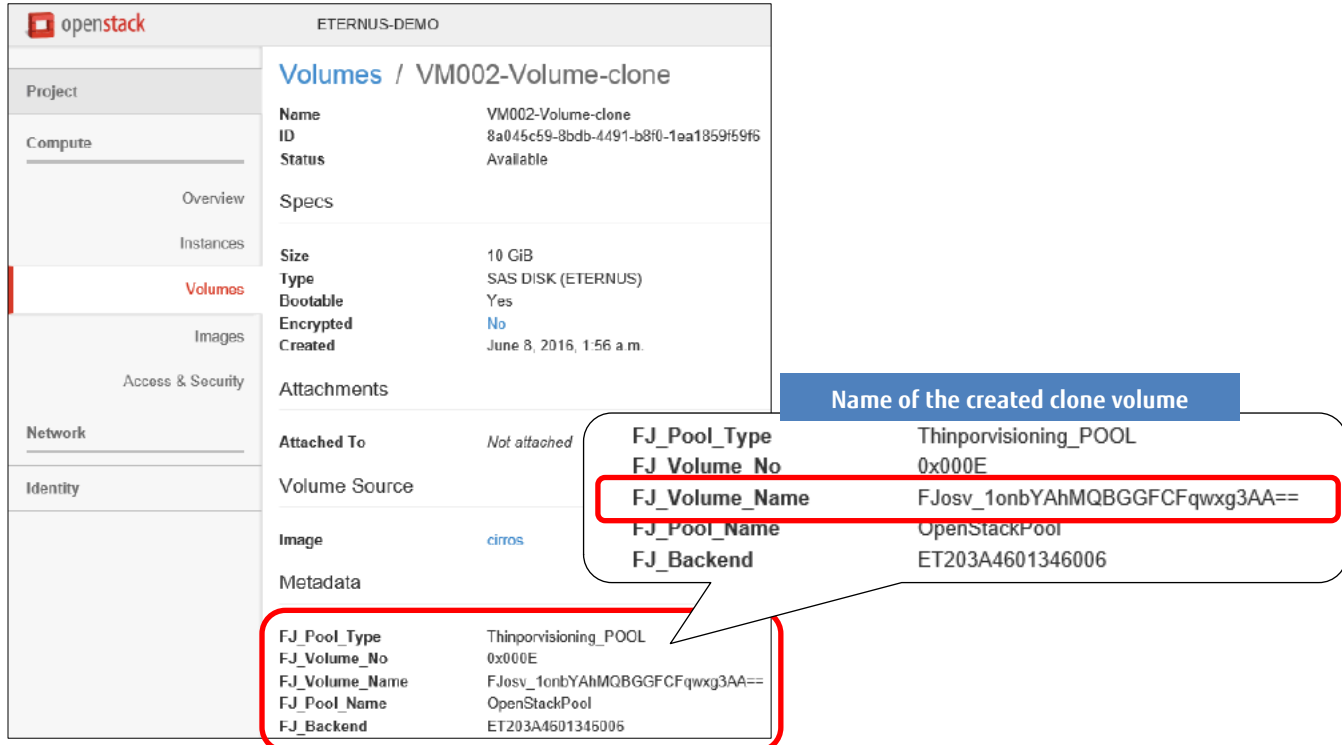
- (3) Checking OPC on the storage system side  
While creating a clone, the OPC process is executed on the storage system side.

Figure: Checking OPC on the storage system side (on the ETERNUS Web GUI screen)



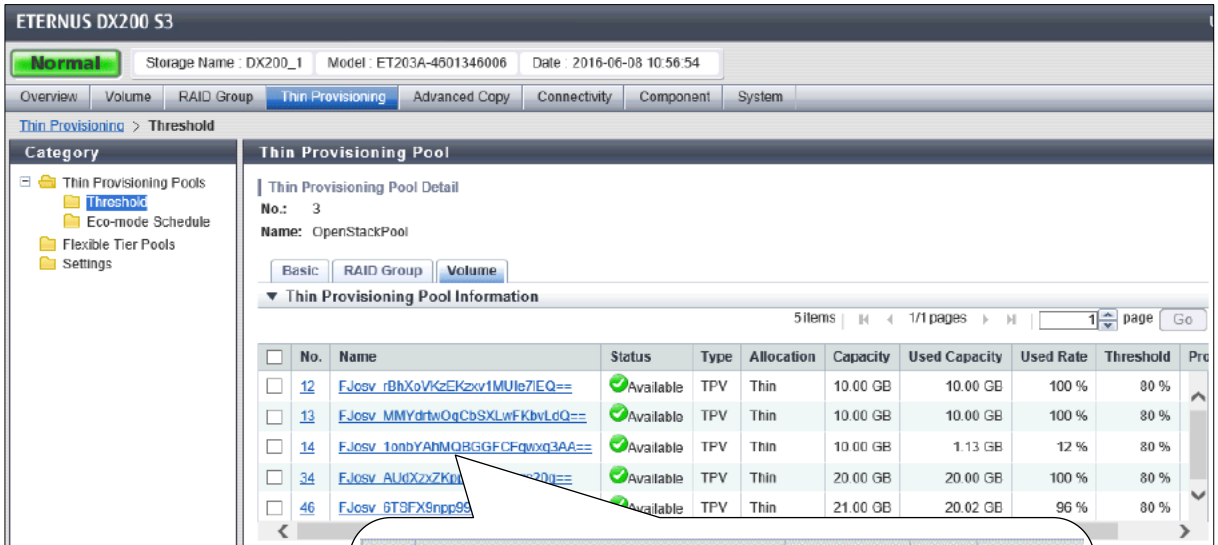
- (4) Completing the clone creation  
Check the clone volume using the OpenStack dashboard.

Figure: Completing the clone creation



- (5) Checking the clone (on the storage system side)  
Check the clone using ETERNUS Web GUI.

Figure: Checking the clone (on the ETERNUS Web GUI screen)



No.	Name	Status	Type	Allocation
12	FJosv_rBhXoVKzEKzv1MUle7IEQ==	Available	TPV	Thin
13	FJosv_MMYdrwOqCbSXLwFKbvLdQ==	Available	TPV	Thin
14	FJosv_1onbYAhMQBGGFCFqwxq3AA==	Available	TPV	Thin
34	FJosv_AUdXzvZKnn33R0fsezs20n==	Available	TPV	Thin

The clone volume can also be checked on the storage system side.

Volume (source)  
Volume (destination)

### 2.4.3 Snapshot Creation and Restore

This section provides the procedure for acquiring a snapshot of a volume and restoring the snapshot.

- (1) Checking the snapshot source volume  
Check the snapshot source volume using the OpenStack dashboard.

Figure: Checking the snapshot source volume

The screenshot shows the OpenStack dashboard for 'ETERNUS-DEMO' under the 'Volumes / VM002-Volume' page. The volume details are as follows:

<b>Name</b>	VM002-Volume
<b>ID</b>	45aa61a9-b505-48d4-b934-ca5300ef6d6e
<b>Status</b>	Available
<b>Specs</b>	
<b>Size</b>	10 GiB
<b>Type</b>	SAS DISK (ETERNUS)
<b>Bootable</b>	Yes
<b>Encrypted</b>	No
<b>Created</b>	June 8, 2016, 1:27 a.m.
<b>Attachments</b>	
<b>Attached To</b>	Not attached
<b>Volume Source</b>	
<b>Image</b>	cirros
<b>Metadata</b>	
<b>FJ_Pool_Type</b>	Thinprovisioning_POOL
<b>FJ_Volume_No</b>	0x000D
<b>FJ_Volume_Name</b>	FJosv_MMYdrtwOgCbSXLwFKbvLdQ==
<b>FJ_Pool_Name</b>	OpenStackPool
<b>FJ_Backend</b>	ET203A4601346006

The 'FJ\_Volume\_Name' field is highlighted with a red box, and a callout box points to it with the text 'Snapshot source volume name'.

- (2) Creating a volume snapshot  
Create a volume snapshot using the OpenStack dashboard.

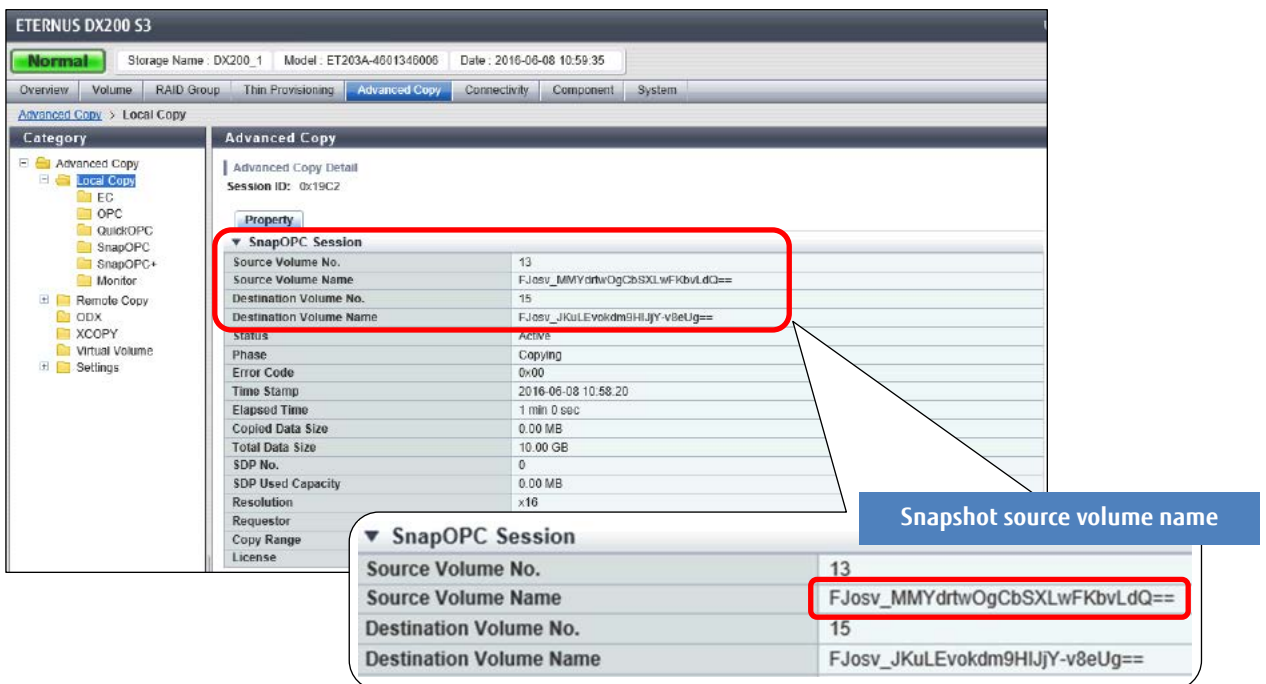
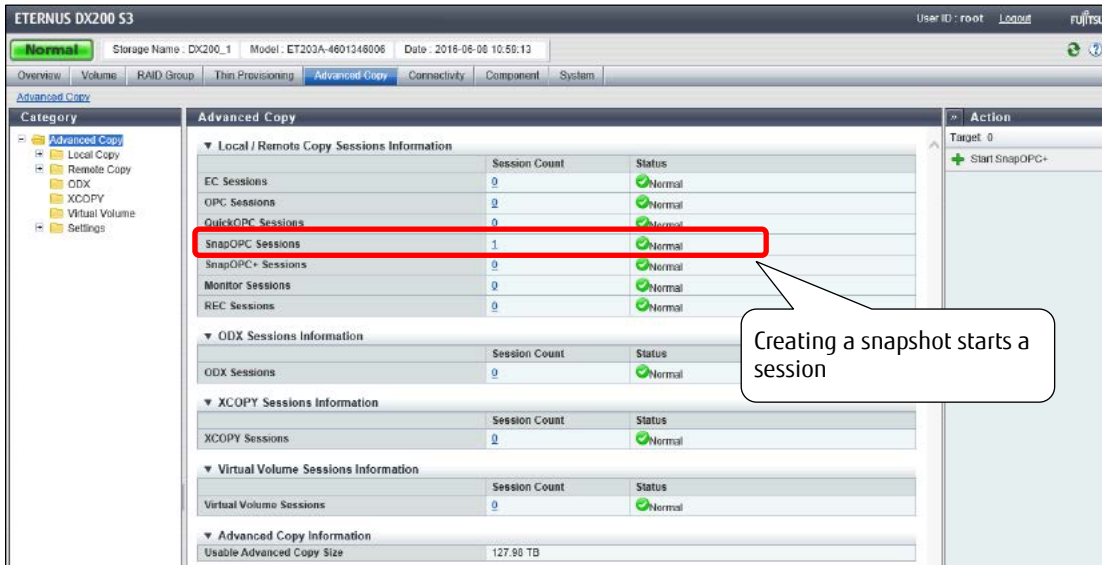
Figure: Creating a volume snapshot

The 'Create Volume Snapshot' form is shown with the following details:

- Snapshot Name:** VM002-Volume-snapshot
- Description:** Volumes are block devices that can be attached to instances.
- Volume Type Description:** (Empty field)
- Snapshot Limits:**
  - Total GiBbytes (30 GiB): 1,000 GiB Available
  - Number of Snapshots (0): 10 Available
- Buttons:** Cancel, Create Volume Snapshot

- (3) Checking SnapOPC on the storage system side  
 Creating a volume snapshot starts SnapOPC on the storage system side.

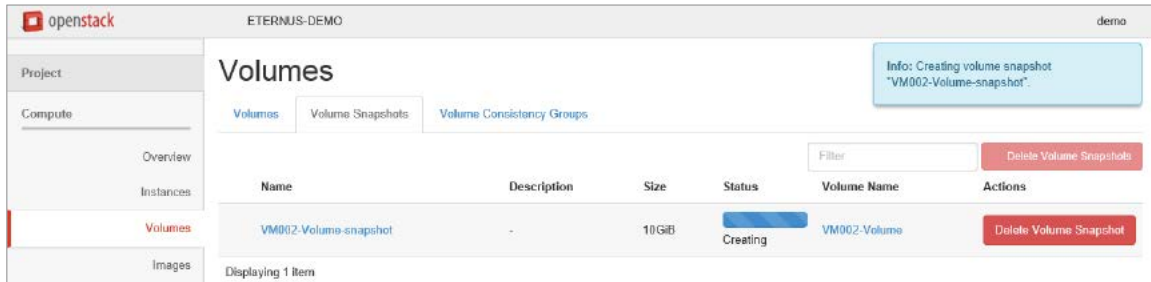
Figure: Checking SnapOPC on the storage system side (on the ETERNUS Web GUI screen)





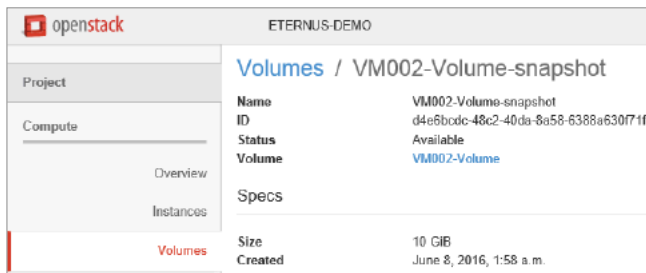
- (4) Checking a volume snapshot  
Check a volume snapshot creation using the OpenStack dashboard.

Figure: Volume snapshot list



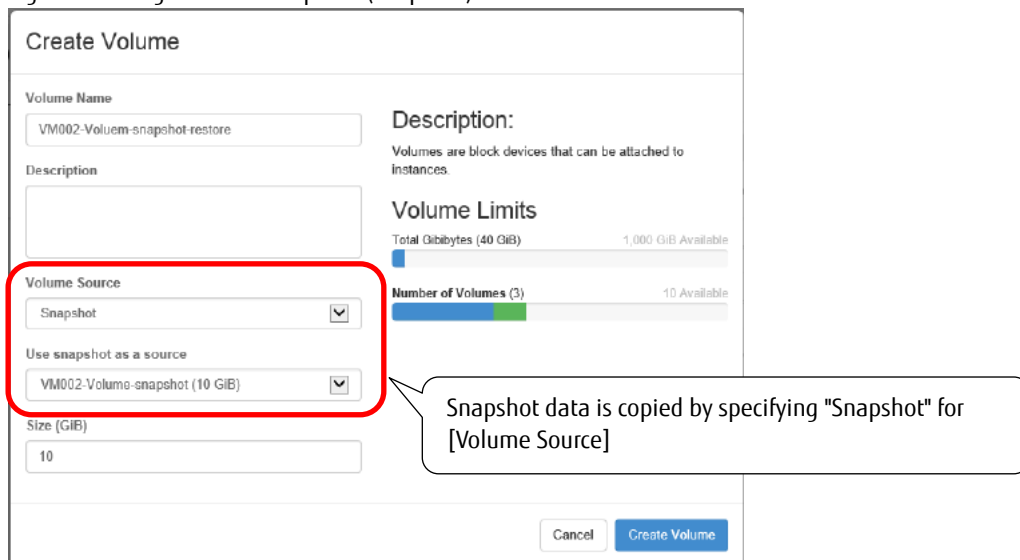
Snapshot creations finish quickly.

Figure: Volume snapshot



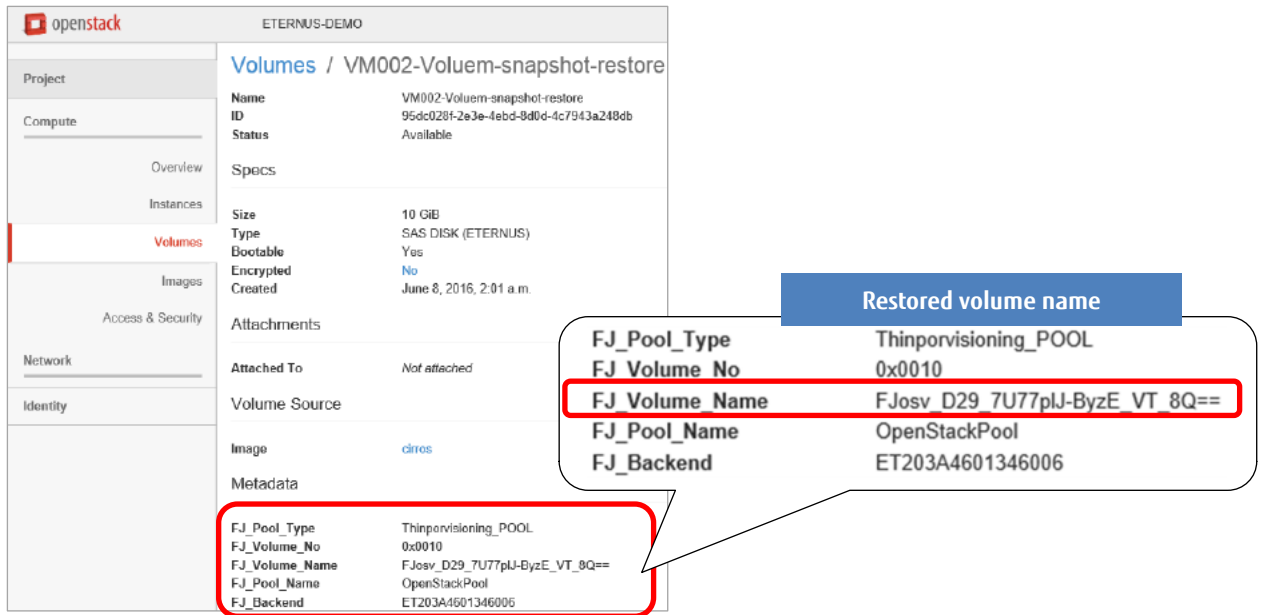
- (5) Restoring the volume snapshot to a volume  
In the [Create Volume] screen, create a volume from the volume snapshot.

Figure: Creating a volume snapshot (snapshot)



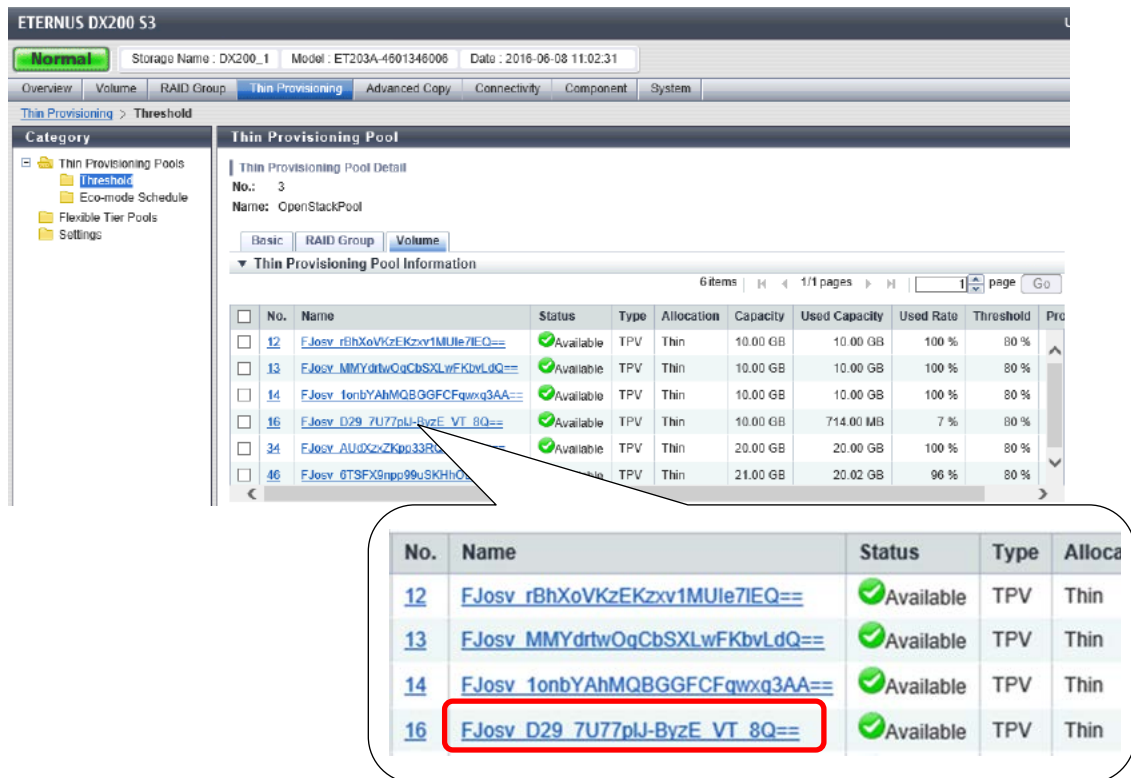
- (6) Completing the volume creation  
Check the restored volume using the OpenStack dashboard.

Figure: Checking the restored volume



- (7) Checking the volume (on the storage system side)  
Check the restored volume using ETERNUS Web GUI.

Figure: Checking the restored volume (on the ETERNUS Web GUI screen)



### 3. Criteria for Selecting Storage Systems

#### 3.1 Functional Comparison

Fujitsu "ETERNUS OpenStack VolumeDriver" supports all the major API functions that are required for storage system operations. For details about the supported functions of other companies' drivers, click the "OpenStack Configuration Reference" link that is provided below in "Related Links" and check the OpenStack community pages.

#### 3.2 Summary

For storage system operations using OpenStack, the combination of the ETERNUS AF/DX and the ETERNUS OpenStack VolumeDriver is the best choice for the following reasons:

- The ETERNUS OpenStack VolumeDriver is provided free of charge.
- The ETERNUS OpenStack VolumeDriver has equivalent or more functions when compared to other companies' driver software for storage systems.
- Fujitsu expresses a positive stance on OpenStack.
- The ETERNUS AF/DX can definitely be implemented in systems where OpenStack is used.

#### Related Links

OpenStack Configuration Reference

<https://docs.openstack.org/newton/config-reference/>

Fujitsu's website for downloading software related to storage systems

<https://www.fujitsu.com/global/support/products/computing/storage/download/index.html>

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#### Contact

FUJITSU Limited

Website: <https://www.fujitsu.com/eternus/>

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