EMC Storage Solution with OpenStack

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Introduction

Introduction

Welcome to the **EMC Storage Solutions for OpenStack Lab.**

The Lab demonstrates how to prepare EMC Storage devices (VNX, ScaleIO, XIO) and install, configure and manage block storage in an OpenStack cloud environment. You will get to understand the various storage configuration touchpoints, how to manage the storage lifecycle from volume creations, snapshots, cloning etc and will further touch upon how to troubleshoot and isolate problems.

In this Lab you will review how a Cloud Provider called Code Nebulous is building and managing its cloud infrastructure with OpenStack and EMC storage.

This lab is based on recently announced **EMC Storage Solutions Reference Architecture for Managing EMC Storage Arrays with OpenStack Juno.**

This published **Reference Architecture** supports three major OpenStack distributions:

- Mirantis OpenStack
- Canonical Ubuntu Cloud Server
- RedHat Enterprise OpenStack Platform

Additionally, there are optional labs included:

- Introduction to OpenStack Monitoring & Reporting Solution Pack for EMC ViPR-SRM
- Using EMC ViPR with OpenStack Cinder

Business Challenge

1. Code Nebulous

Code Nebulous provides infrastructure as a service (IaaS) cloud-hosting solutions to 10 of the top 50 Internet sales portal sites in the world. They want to grow the business and penetrate into different geographical locations and verticals to compete with other providers.

Code Nebulous realizes other Cloud Providers today are increasingly driving a new model for the delivery of IT services. As IaaS and PaaS service use expands, cloud providers are faced with an urgency to enable cloud services by reduce complexity, drive automation, deliver secure multi-tenancy, improve TCO, and simplify end to end supply chain so they can get to the market as quickly as possible.

Enterprises are looking to Code Nebulos to provide rich cloud services via a self service portal or via rich APIs in a cost efficient way so they can drive their business transformation.

In advanced cloud delivery models, application owners are quickly changing their thinking from infrastructure-based deployments to service level-based deployments. Less consideration is given to the mechanics of the underlying infrastructure and more to performance levels that can be guaranteed by their business critical applications, regardless of the underlying components.

Code Nebulous need to be able to deliver the service levels Enterprise customers are requesting in the most automated and efficient manner possible. Offering an Infrastucture-as-a-Service (IaaS) platform with pre-engineered service-levels, and providing metering and chargeback reporting in an efficient and automated way, is an extremely important step toward realizing IT-as-a-Service (ITaaS) efficiency.

2. Cloud Challenges

Code Nebulous requires a scalable, tiered, and highly available infrastructure on which to deploy application workloads and provide services in an efficient way. There are several new technologies available to assist in creating a solution but in this new world of OpenSource where both community and vendors eco-system support is growing it opens the door for Code Nebulous to build cloud services in an efficient way. The customer needs to know how to best use these technologies to support service-level agreements, integrate proprietary systems, and minimize cost.

Many Enterprise organizations are under pressure to provide enterprise-quality service levels on demand without paying enterprise prices. As a result, Code Nebulous departments need to create cost-effective alternatives to proprietary cloud services; alternatives that do not compromise enterprise features such as data protection, disaster recovery (DR), and guaranteed service levels.

As IT organizations implement an OpenStack cloud, they must consider the following factors:

- The infrastructure must be deployed quickly so that business value can be recognized quickly.
- The OpenStack cloud infrastructure and operations must be designed to reduce licensing costs.
- Risk of downtime must be controlled through disciplined change control and careful management of component compatibility.
- Support agreements must be established for all elements of the solution.

EMC Storage for OpenStack

The purpose of this solution is to demonstrate integration of OpenStack software with EMC storage systems and validate the environment for performance, scalability, and functionality. Customers will realize:

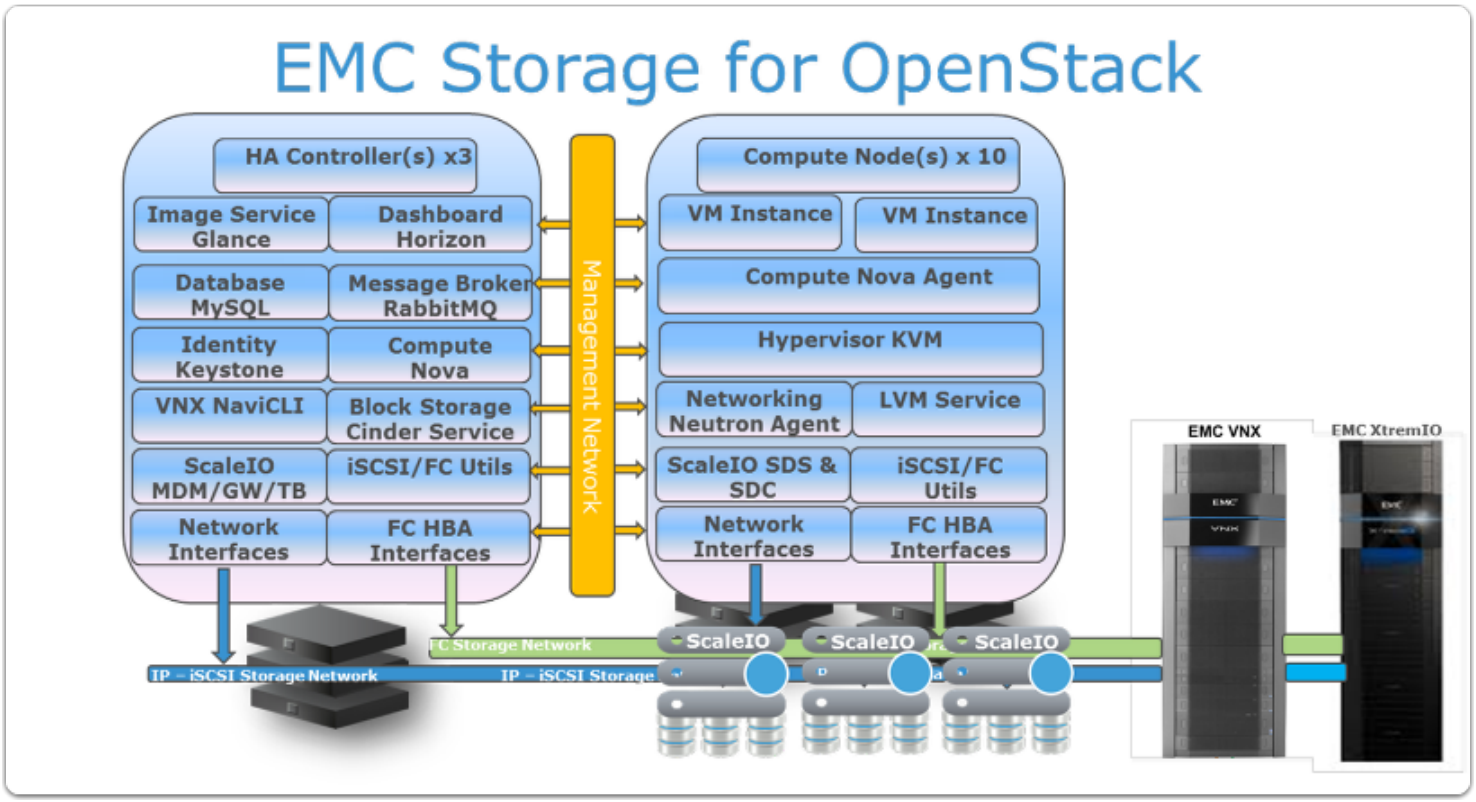
- Decreased costs associated with environment scalability.
- More choices in supported hardware.
- Greater flexibility in cloud migration.
- Lower operational and maintenance costs.

Solution

Code Nebulous team have selected EMC VNX, XtremIO and ScaleIO as their storage technologies to integrate with OpenStack powered cloud.

This solution demonstrates how to use EMC storage arrays and OpenStack Cinder drivers to provide the storage resources for a robust OpenStack environment. This solution incorporates the following components:

- OpenStack Juno release
- EMC VNX - The EMC VNX family delivers a choice of systems ranging from affordable entry-level solutions to high-performance, petabyte-capacity configurations servicing the most demanding application requirements
- EMC ScaleIO - EMC ScaleIO is a software-only server-based storage area network (SAN) that converges storage and compute resources to form a single-layer, enterprise-grade storage product.
- EMC XtremIO - XtremIO is a scale-out clustered design that grows capacity and performance linearly to meet any requirement
- Cinder drivers for EMC VNX and XtremIO (part of Juno release)
- Cinder drivers for EMC ScaleIO (available from EMC Support)



Key Components

OpenStack

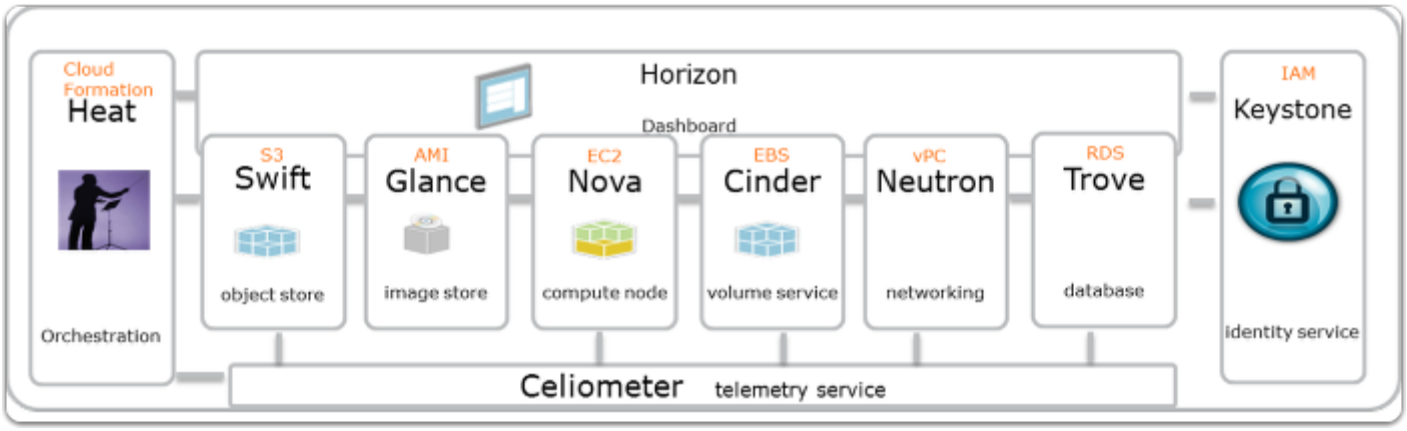
OpenStack is the open source software for creating private and public clouds.

OpenStack software controls large pools of compute, storage, and networking resources throughout a datacenter, managed through a dashboard or via the OpenStack API. OpenStack works with popular enterprise and open source technologies making it ideal for heterogeneous infrastructure.

1. OpenStack Architecture

OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed through a dashboard that gives administrators control while empowering their users to provision resources through a web interface.

In addition to the original code from the OpenStack Foundation (https://www.openstack.org/software/) , there is a number of different OpenStack distributions available. For our lab we have used the Mirantis OpenStack: https://software.mirantis.com/

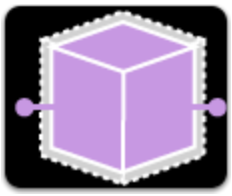


2. OpenStack Compute

OpenStack Compute enables enterprises and service providers to offer on-demand computing resources, by provisioning and managing large networks of virtual machines. Compute resources are accessible via APIs for developers building cloud applications and via web interfaces for administrators and users. The compute architecture is designed to scale horizontally on standard hardware, enabling the cloud economics companies have come to expect.

3. OpenStack Networking

OpenStack Networking is a pluggable, scalable and API-driven system for managing networks and IP addresses. Like other aspects of the cloud operating system, it can be used by administrators and users to increase the value of existing datacenter assets. OpenStack Networking ensures the network will not be the bottleneck or limiting factor in a cloud deployment and gives users real self service, even over their network configurations.



4. OpenStack Storage

In addition to traditional enterprise-class storage technology, many organizations now have a variety of storage needs with varying performance and price requirements. OpenStack has support for both Object Storage and Block Storage, with many deployment options for each depending on the use case. It provides a fully distributed, API-accessible storage platform that can be integrated directly into applications

Object Storage is ideal for cost effective, scale-out storage. Block Storage allows block devices to be exposed and connected to compute instances for expanded storage, better performance and integration with enterprise storage platforms.

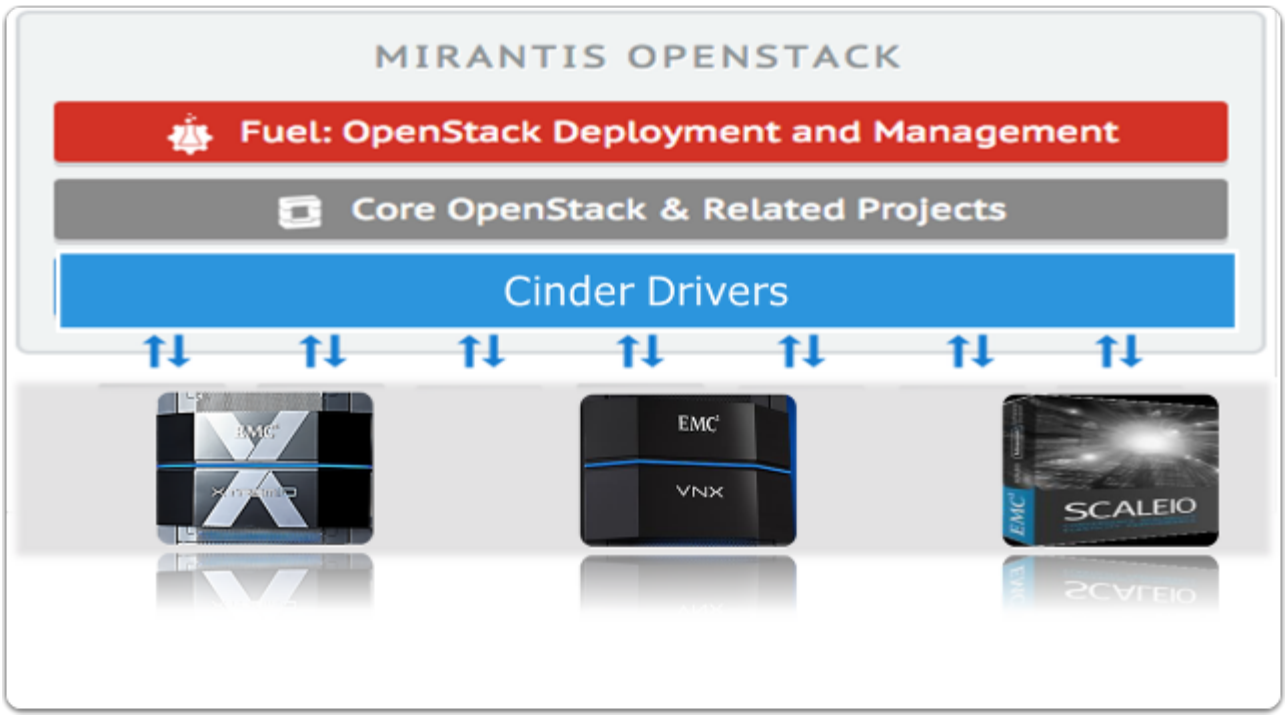
In this lab your primary focus will be on the OpenStack Block Storage backends provided by **EMC VNX, XtremIO and ScaleIO**. An optional lab will focus on EMC ViPR integration with Cinder.

5. OpenStack Cinder Block Storage Service

OpenStack Cinder provides persistent block level storage devices for use with OpenStack compute instances.

The block storage system manages the creation, attaching and detaching of the block devices to servers. Block storage volumes are fully integrated into OpenStack Compute and the Dashboard allowing for cloud users to manage their own storage needs.

In this lab you will learn how EMC storage systems integrate with OpenStack Cinder Block Storage service.

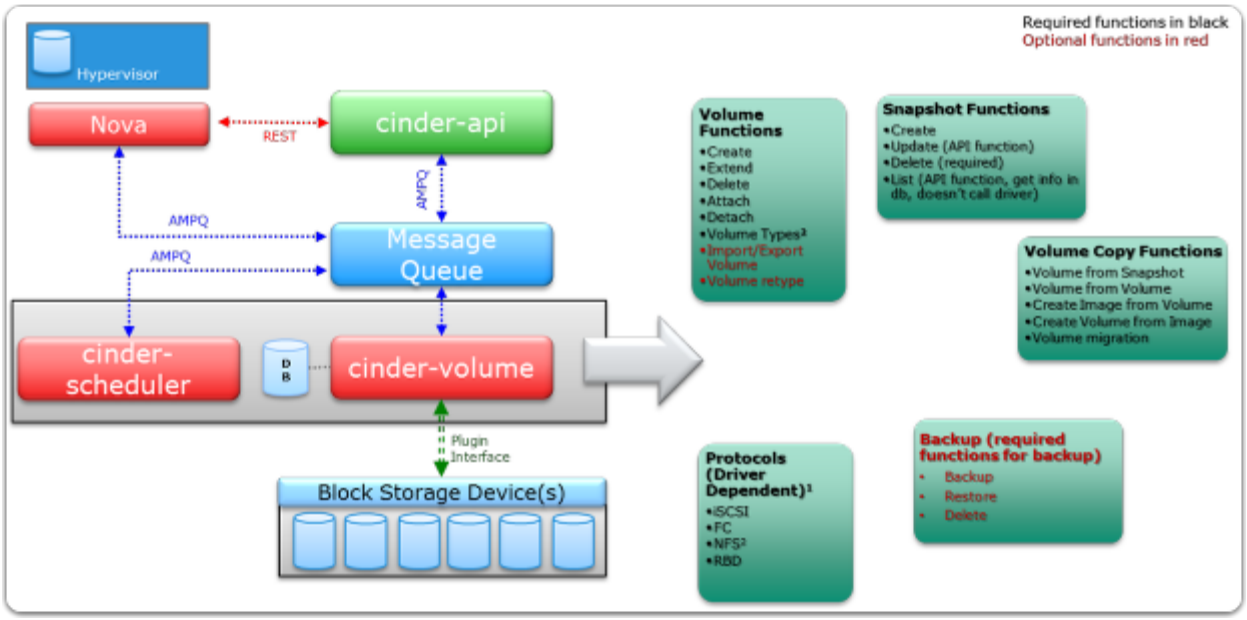


6. Cinder Service Plugins (Drivers)

In addition to using simple Linux server storage, OpenStack Cinder has unified storage support for numerous storage platforms including **EMC VNX, XtremIO and ScaleIO.**

EMC developed plugins for Cinder enable block storage for performance sensitive scenarios, such as database storage, expandable file systems, or providing a server with access to raw block level storage.

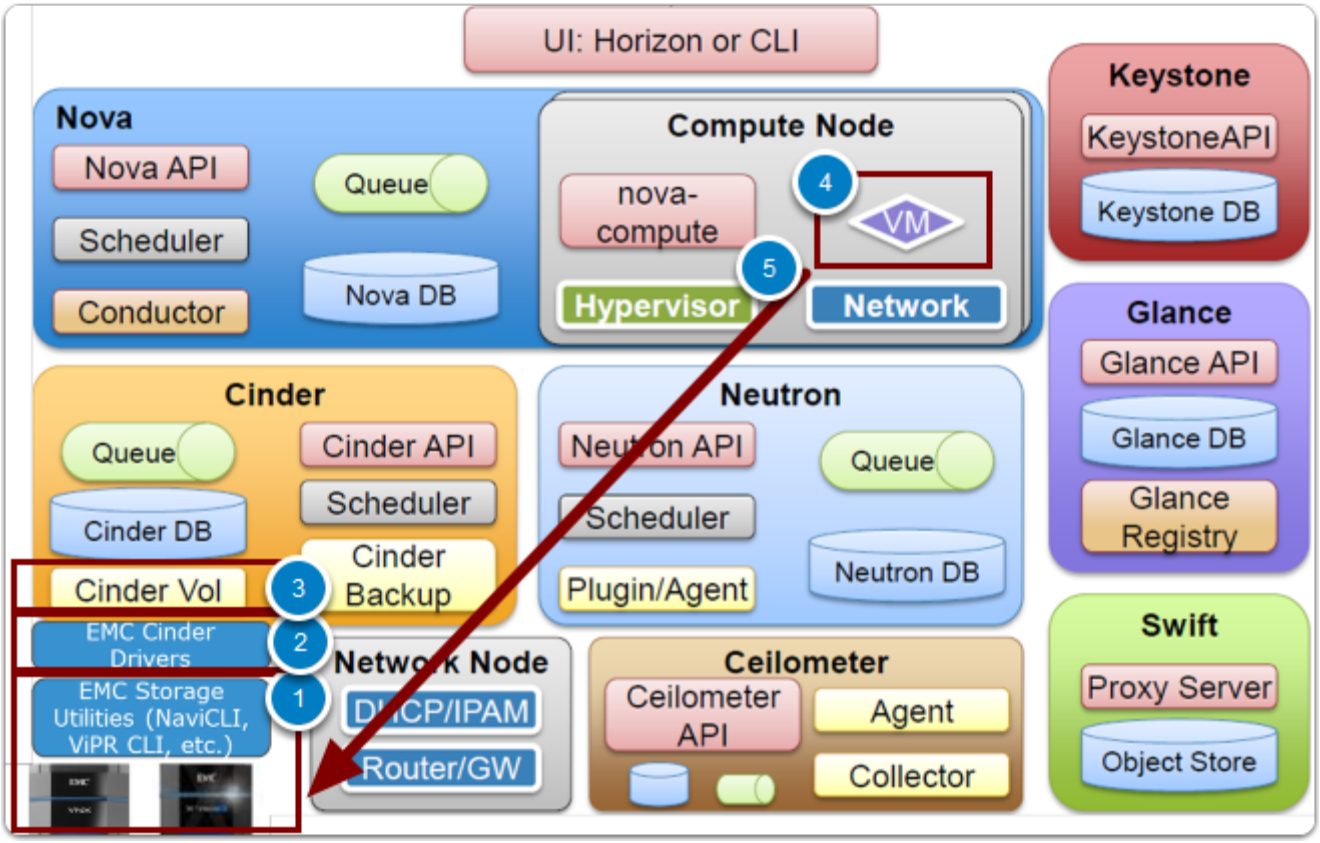
These plugins (drivers) support the entire volume lifecycle, and snapshot management, providing powerful functionality for storing and backing up data.



7. OpenStack Volumes

While the OpenStack process for launching a VM instance and attaching the storage volume to it is fairly complex, in your labs you will focus specifically on the following:

1. Reviewing the EMC Storage settings required for OpenStack integration
2. Installing and configuring the EMC Storage API's and utilities, such as NaviCLI for VNX, ViPR CLI, etc.
3. Installing and configuring the Cinder drivers for EMC Storage systems (VNX, XtremIO, ScaleIO and ViPR)
4. Creating OpenStack Volume Types and Volumes
5. Attaching the newly created Volumes to the VM Instance



EMC VNX

EMC VNX is a high-performing unified storage with unsurpassed simplicity and efficiency, optimized for virtual applications. With the VNX Series, you'll achieve new levels of performance, protection, compliance, and ease of management.

1. VNX Automation and Data Protection

EMC VNX fully automated storage tiering (FAST) simultaneously delivers both the highest performance and the lowest total cost of ownership (TCO).

VNX delivers the highest levels of application availability and data protection with continuous operations and any-point-in-time recovery.

2. VNX Driver for Cinder

EMC VNX direct driver for OpenStack Cinder supports both iSCSI and FC protocol. VNX iSCSI direct driver and VNX FC direct driver are separately based on the ISCSIDriver and FCDriver defined in Block Storage.

VNX Direct driver was made available in the OpenStack Juno release and perform the volume operations by executing Navisphere CLI (NaviSecCLI) which is a command line interface used for management, diagnostics and reporting functions for VNX.

EMC XtremIO

EMC XtremIO is an all-flash purpose-built platform for production, dev/test, BI/analytics, training, rampant cloning, user self-service, predictable performance with scale, lower TCO.

XtremIO in the Cloud

EMC XtremIO provides continuous availability and access for mission-critical, performance-sensitive apps in an app landscape. It consistently delivers reliable, predicable, performance that meets all SLAs for advanced applications while reducing storage and hardware/processor requirements to lower your app storage TCO.

XtremIO Cinder Driver

High performance XtremIO All Flash Array (AFA) offers Block Storage services to OpenStack.

In this lab you will learn how using this driver OpenStack Cinder Block Storage service can connect to an XtermIO Storage cluster.

EMC ScaleIO

EMC ScaleIO: Software-only server-based storage area network (SAN) that converges storage and compute resources to form a single-layer, enterprise-grade storage product. ScaleIO storage is elastic and delivers linearly scalable performance. Its scale-out server SAN architecture can grow from a few to thousands of servers.

1. ScaleIO in the Cloud

Convergence

ScaleIO uses servers' direct-attached storage (DAS) and aggregates all disks into a global, shared, block storage. ScaleIO features single-layer compute and storage architecture without requiring additional hardware or cooling/ power/space

Scalability and Performance

Breaking traditional barriers of storage scalability, ScaleIO scales out to hundreds and thousands of nodes and multiple petabytes of storage. The parallel architecture and distributed volume layout delivers a massively parallel system that deliver I/O operations through a distributed system. As a result, performance can scale linearly with the number of application servers and disks, leveraging fast parallel rebuild and rebalance without interruption to I/O. ScaleIO has been carefully designed and implemented with ScaleIO software components so as to consume minimal computing resources.

Elasticity and Resilience

With ScaleIO, any administrator can add, move, or remove servers and capacity on demand during I/O operations. The software responds automatically to any infrastructure change and rebalances data accordingly across the grid nondisruptively. ScaleIO can add capacity on demand, without capacity planning or data migration and grow in small or large increments and pay as you grow, running on any server and with any storage media

Platform Agnosticism

ScaleIO natively supports all leading Linux distributions and hypervisors. It works agnostically with any solid-state drive (SSD) or hard disk drive (HDD) regardless of type, model, or speed.

2. ScaleIO Components

ScaleIO Data Client (SDC)

- Acts as Block Device Driver
- Exposes volumes to applications
- Service must run to provide access to volumes
- Over TCP/IP

ScaleIO Data Service (SDS)

- Abstracts storage media
- Contributes to storage pools
- Performs I/O operations

ScaleIO Metadata Manager (MDM)

- Not located in the data path
- Provides Monitoring and Configuration management
- Holds cluster-wide component mapping

3. ScaleIO Cinder Driver

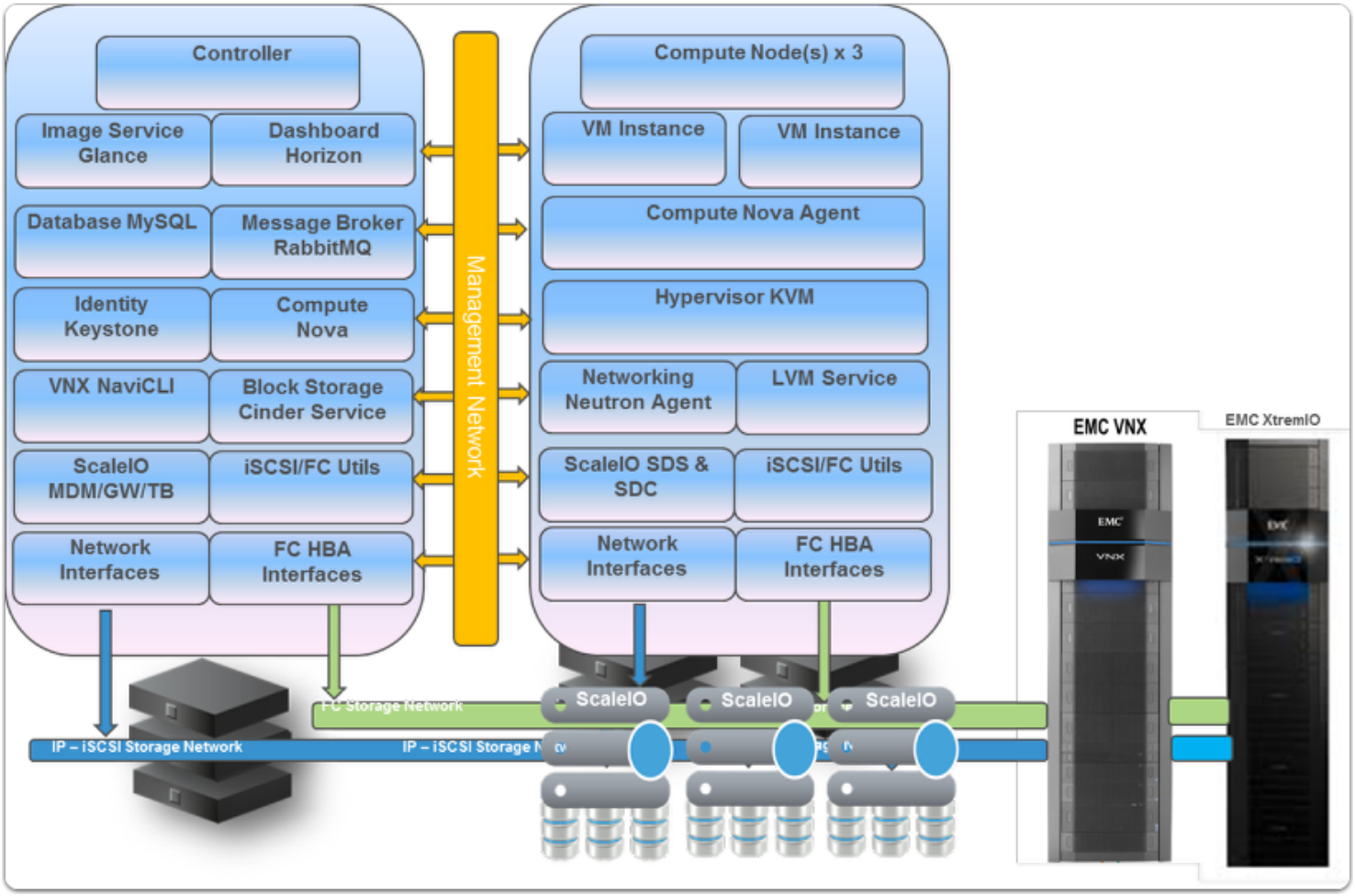
The ScaleIO elastic storage solution includes a Cinder driver, which interfaces between ScaleIO and OpenStack, and presents volumes to OpenStack as block devices which are available for block storage. It also includes an OpenStack Nova driver, for handling compute and instance volume related operations. The ScaleIO driver executes the volume operations by communicating with the backend ScaleIO MDM through the ScaleIO REST Gateway.

Lab Overview

Lab Environment

1. Lab Architecture

This lab's environment has been designed to approximate a typical OpenStack Cloud deployment with a Controller node and several Compute nodes.



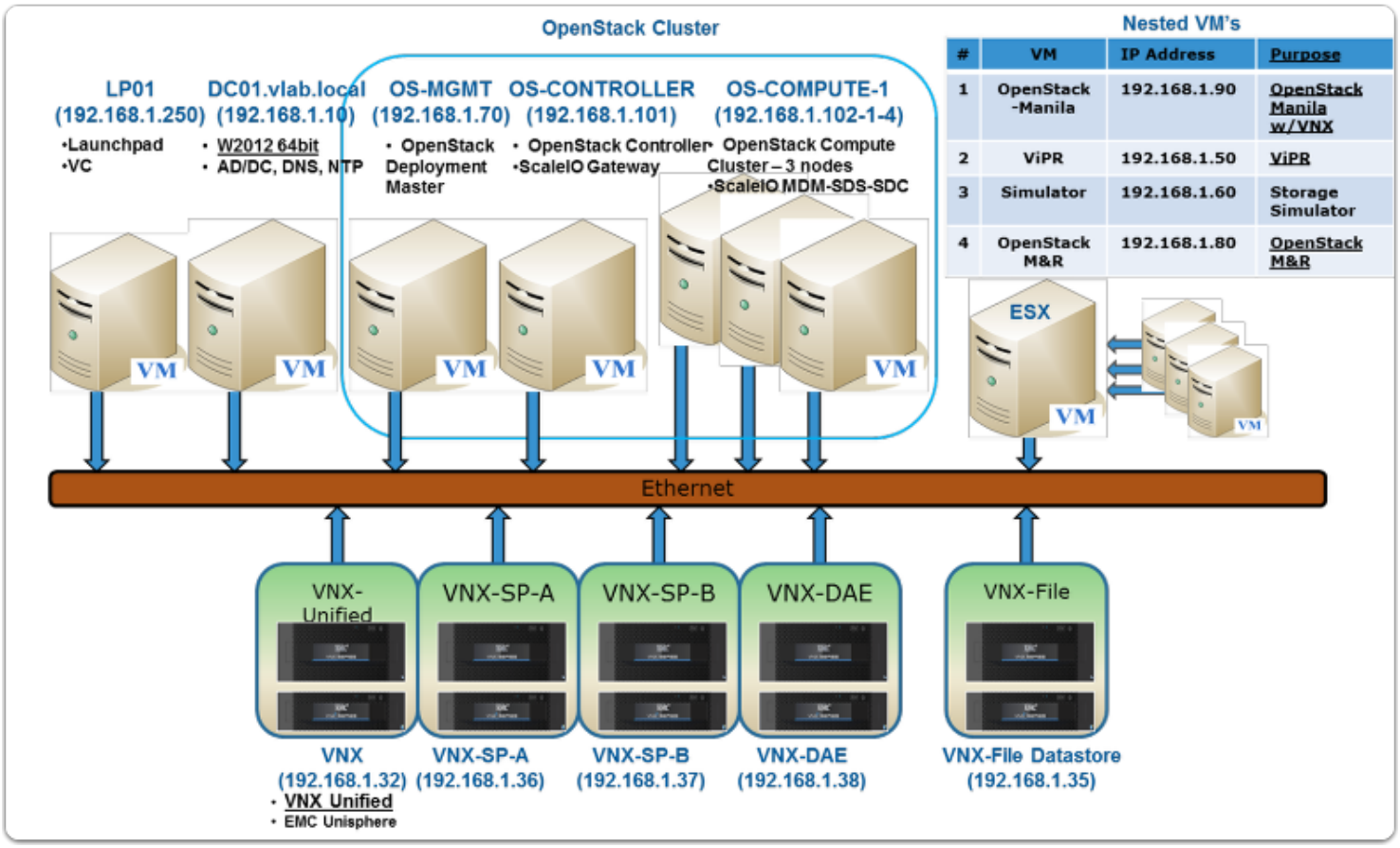
2. Virtualized Lab Environment

The environment for this lab includes the following:

- Domain Controller
- Launchpad VM that also includes VMware vCenter
- OpenStack Cluster with Management Node, Controller Node and three Compute Nodes

- VMware ESX server running "nested" VM's
- Standalone VNX File simulator acting as vSphere Datastore
- VNX Unfied simulator (block & file storage)

Note: While this lab does not include XtremIO simulator, the XtremIO Cinder driver configuration is covered in Lab 2.



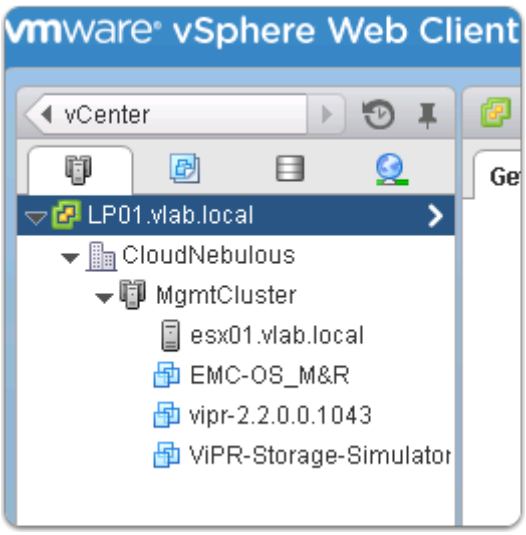
3. Nested Virtual Machines

This lab uses nested VMs for some of the lab scenarios.

Additionally, some storage simulators and other infrastructure-related VM's are running on the same ESX host.

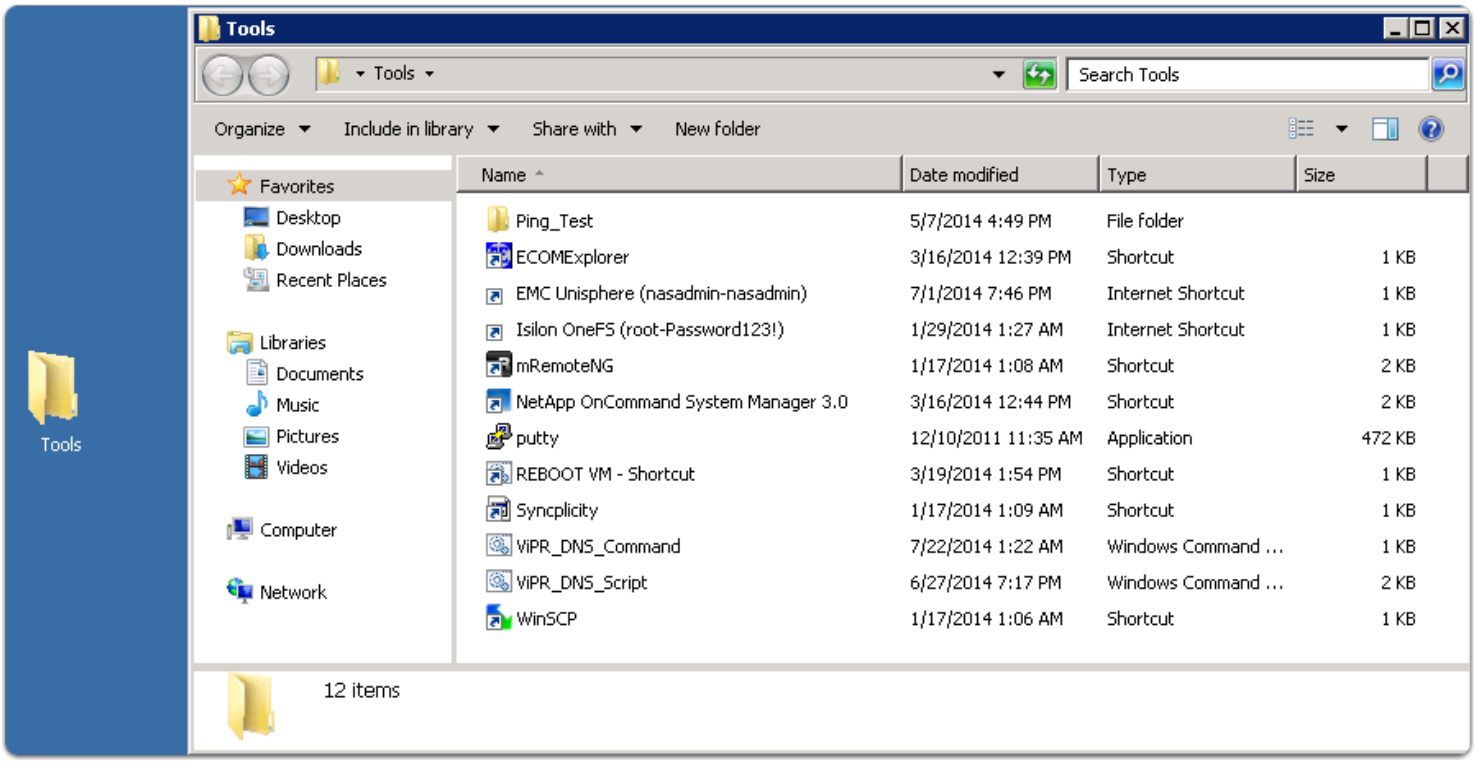
You will need to power on some of these nested VM's using automated scripts as instructed during the lab.

!!! Note: Please DO NOT power up or down any of the VM's until instructed!



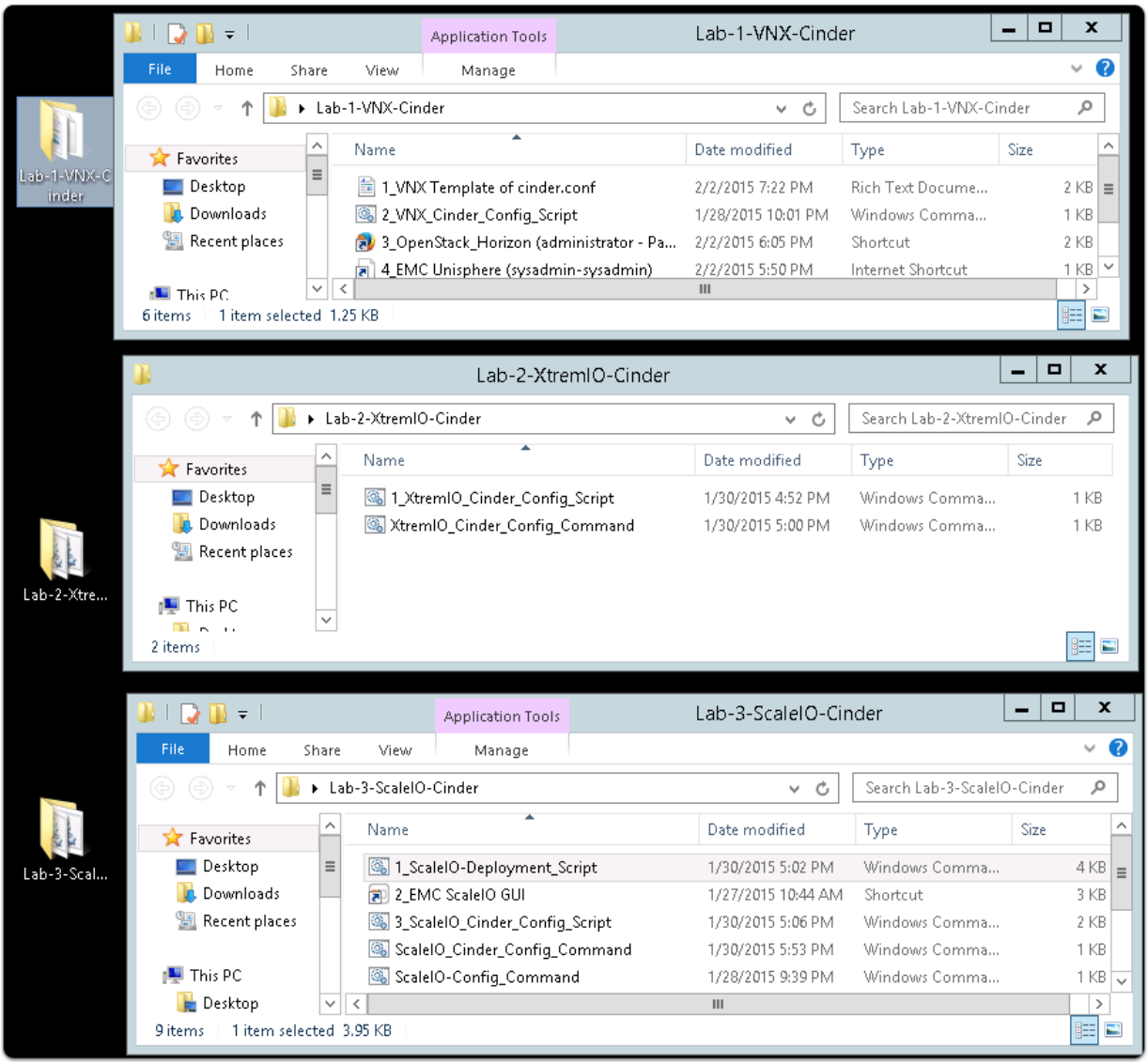
4. Lab Tools

To assist you in executing this lab, a miscellaneous number of tools are located in the Tools folder on the Launchpad Desktop, i.e PuTTY terminal client, WinSCP file transfer utility, etc.:



5. Accessing Labs

Separate folders have been created on the Launchpad Desktop with all relevant scripts and shortcuts for accessing Lab scenarios.



Lab Credentials

- Windows credentials: **VLAB\Administrator - Password123!**
- Linux SSH / CLI credentials: **root - Password123!**
- OpenStack Horizon login: **Administrator - Password123!**
- Unisphere login: **sysadmin - sysadmin**
- ScaleIO UI login: **admin - Password123!**
- ViPR Controller login: **root - Password123!**

Lab Scenario

Stephan is the Cloud Administrator for CodeNebulous Cloud Systems.

One of Stephan's tasks is to sit down with his Tenants and design the storage layout based on the IO profile provided to him. This is time consuming in planning and design. Stephan is also tasked in provisioning storage for all his Tenants which is time consuming.

Stephan has recently overseen the deployment of the OpenStack Cloud platform in one of Code Nebulous Data Centers. Stephan as the IT administrator has been tasked with the following tasks so that he can hand over the environment to his own Tenants so that they can now provision their own storage in a secure and multi tenancy environment:

1. Review the Cinder driver capabilities for several different EMC Storage systems, including extra-specs
2. Review and become familiar the different Cinder drivers configuration steps
3. Follow the configuration steps and implement Cinder integration with EMC Storage backends
4. Identify the Storage Pools pre-created on the EMC Storage systems by Storage Admin
5. Create storage volume types for OpenStack Volumes and associate the Volume Types with Storage Pools
6. Practice creating new volumes for different Volume Types
7. Ensure that new Volumes are created using EMC Storage Element Managers, i.e. Unisphere, ScaleIO and ViPR UI's
8. Verify that new Volumes can be attached to an OpenStack VM instance
9. Ensue that new Storage Volume can be mounted and formatted by logging into VM instance using SSH
10. Practice performing volume life-cycle management tasks (extend, dedup, compress, etc.)

The following Labs will guide Stephan through each step.

Labs

The following is a high level overview of the labs. Each of these labs can be executed independently. You are not required to complete a previous lab before starting another.

Labs and Use Cases

This Hand On Lab covers the following Use Cases:

!!! Note: Each of these labs can be completed independently of one another, unless specifically noted!

Lab 1: Using EMC VNX with OpenStack Cinder Block Storage

This lab takes approximately 15 min to complete. In this lab you, as a Cloud Administrator, will learn how to:

- Install required pre-requisite utilities for VNX Cinder driver
- Configure Cinder to use VNX direct driver
- Create different VNX Block Volume Types and Volumes
- Attach Volumes to OpenStack instances and make them available for data storage
- Manipulate the Volumes through their life-cycle

Lab 2: Using EMC XtremIO with OpenStack Cinder Block Storage

This lab takes approximately 10 min to complete. In this lab you, as a Cloud Administrator, will learn how to:

- Configure Cinder to use XtremIO direct driver
- Create different XtremIO Block Volume Types and review them in OpenStack Horizon UI.

Lab 3: Using EMC ScaleIO with OpenStack Cinder Block Storage

This lab takes approximately 15 min to complete. In this lab you, as a Cloud Administrator, will learn how to:

- Install ScaleIO on Controller and Compute nodes to enable sharing of local disks
- Configure Cinder to use ScaleIO driver
- Create different ScaleIO Block Volume Types and Volumes
- Attach Volumes to OpenStack instances and make them available for data storage
- Manipulate the Volumes through their life-cycle

Lab 4: Optional - Live Migration of OpenStack VM instances & Storage Volumes

This lab is optional. It takes approximately 10 min to complete and requires that you have previously completed the following labs:

- Lab 1 - Using VNX with Cinder Block Storage
- Lab 3 - Using ScaleIO with Cinder Block Storage

In this lab you as a Cloud Administrator will learn how to migrate a "live" active OpenStack virtual machine instance and its associated storage volume. In the course of the Agile development process, Cloud Admins will encounter a situation when the workload and its associated data needs to be moved from a low-cost distributed storage to a high-performance high-availability external storage array.

Lab 5: Optional - Using EMC ViPR with OpenStack Cinder Block Storage

This lab takes approximately 10 min to complete. In this lab you, as a Cloud Administrator, will learn how to:

- Configure Cinder to use ViPR Controller driver

- Create different ViPR Block Volume Types and Volumes
- Attach Volumes to OpenStack instances and make them available for data storage
- Manipulate the Volumes through their life-cycle

Lab 6: Optional - OpenStack Monitoring & Reporting

This lab is optional! It takes approximately 10 min to complete. In this lab you, as a Cloud Administrator, will learn how to:

- Review the OpenStack Capacity and Chargeback reports for Tenants and Projects
- Customize the reports and share them with the Tenants

Lab 1 - Using EMC VNX with Cinder Block Storage Service

Lab 1 - Using EMC VNX with OpenStack Cinder Block Storage

In this lab you, as a Cloud Administrator will become familiar the VNX Cinder drivers configuration steps and implement Cinder integration with EMC VNX.

You will also create Cinder Volume Types associate with the VNX storage pools, create new volumes for different Volume Types and attach them to an OpenStack VM instance.

1. VNX Components

While EMC VNX supports both Block and File storage, this lab focuses on VNX Block storage backend for OpenStack Cinder Block storage service. You will also us EMC Unisphere to verify the block volumes created by OpenStack in the VNX Block storage pool.

2. VNX Cinder Driver Supported operations

As of Juno release of OpenStack cloud software (November 2014), VNX Cinder Driver is included in the trunk code and is distributed with Juno software. VNX Cinder driver supported operations are available at: http://docs.openstack.org/trunk/config-reference/content/emc-vnx-direct-driver.html

- Create, delete, attach, and detach volumes.
- Create, list, and delete volume snapshots.
- Create a volume from a snapshot.
- Copy an image to a volume.
- Clone a volume.
- Extend a volume.
- Migrate a volume.
- Retype a volume.
- Get volume statistics.
- Create and delete consistency groups.
- Create, list, and delete consistency group snapshots.

3. Lab Scenario

In this lab you as a Cloud Admin will:

- Review the Cinder driver capabilities for EMC VNX, including extra-specs
- Review and become familiar with the VNX direct Cinder drivers configuration steps
- Follow the configuration steps and implement Cinder integration with EMC VNX Storage backend
- Identify the Storage Pools pre-created on the EMC VNX using Unisphere created by Storage Admin

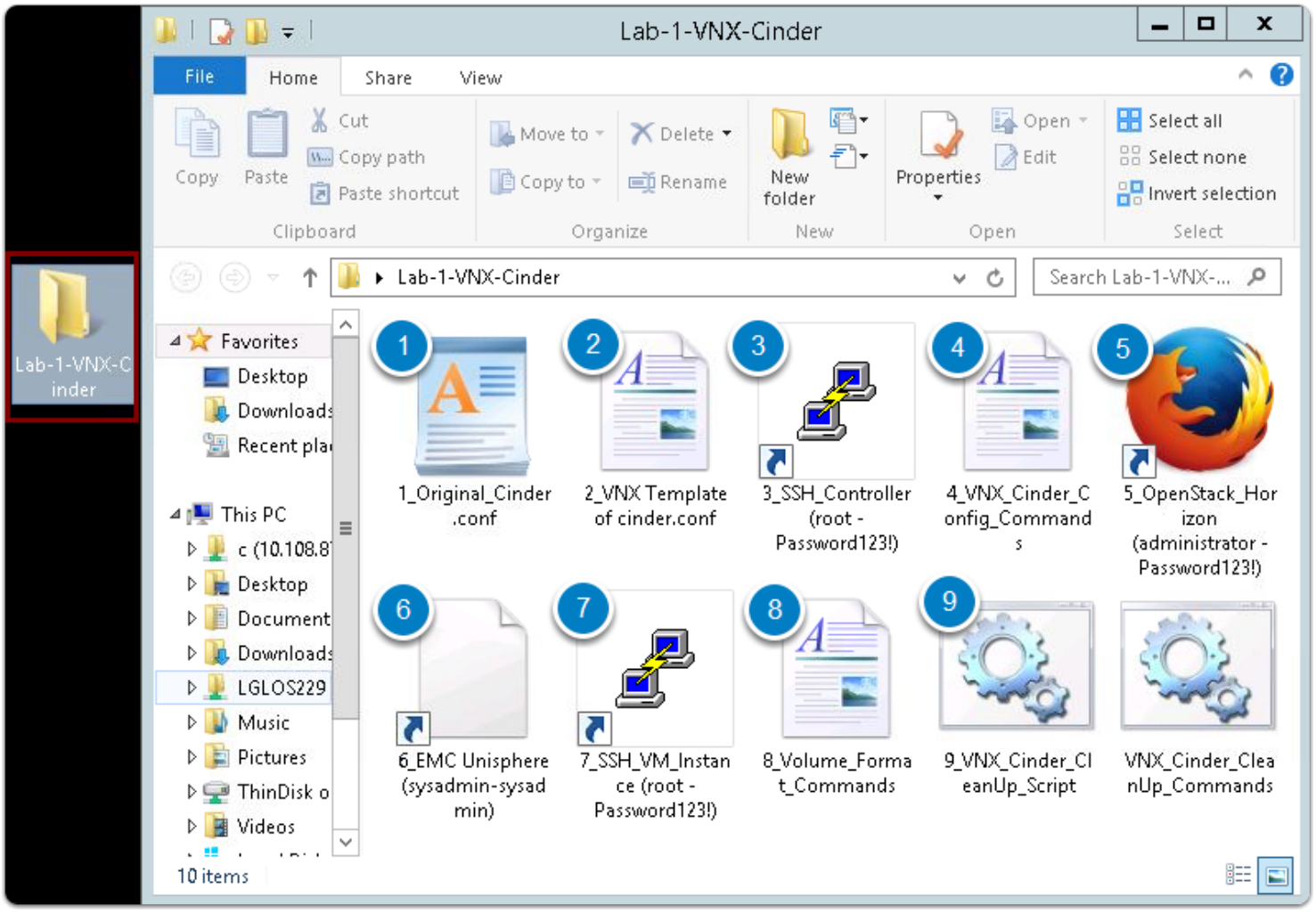
- Create storage volume types for OpenStack Volumes and associate the Volume Types with Storage Pools
- Practice creating new volumes for different Volume Types
- Ensure that new Volumes are created using EMC Unisphere
- Verify that new Volumes can be attached to a OpenStack VM instance
- Ensure that new Storage Volume can be mounted and formatted by logging into VM instance using SSH
- Practice performing volume life-cycle management tasks (extend, dedup, compress, etc.)

4. Lab-1 Folder

Please open and review **Lab-1-VNX-Cinder** folder

Pay attention to the Numbers in the name of the shortcut - for your convenience you will be using these shortcuts in order:

1. Original Cinder Config File
2. VNX Template of Cinder.Conf
3. SSH Utility to access the OpenStack Controller terminal
4. VNX Cinder Configuration Commands, etc.
5. OpenStack Horizon UI
6. EMC Unisphere to view the VNX Storage Pool and created volumes
7. SSH Utility to access OpenStack VM Instance terminal
8. Volume Format Commands
9. Cleanup script to complete this lab and prepare for the next one.



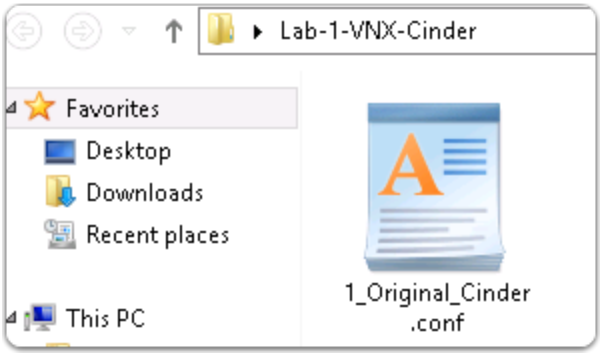
4.1 VNX Cinder Driver Configuration Steps

To implement the VNX backend for Cinder block service, you will now

- Install VNX Command line API - NaviCLI
- Modify Cinder configuration file /etc/cinder/cinder.conf
- Restart Cinder API and Cinder Volume services
- Create VNX Volume types in Cinder

4.2 Cinder.conf file

For your reference, the Cinder.conf configuration file has been provided which contains all necessary information for VNX storage backend. Please open the **1-Original_Cinder.conf** and review it:

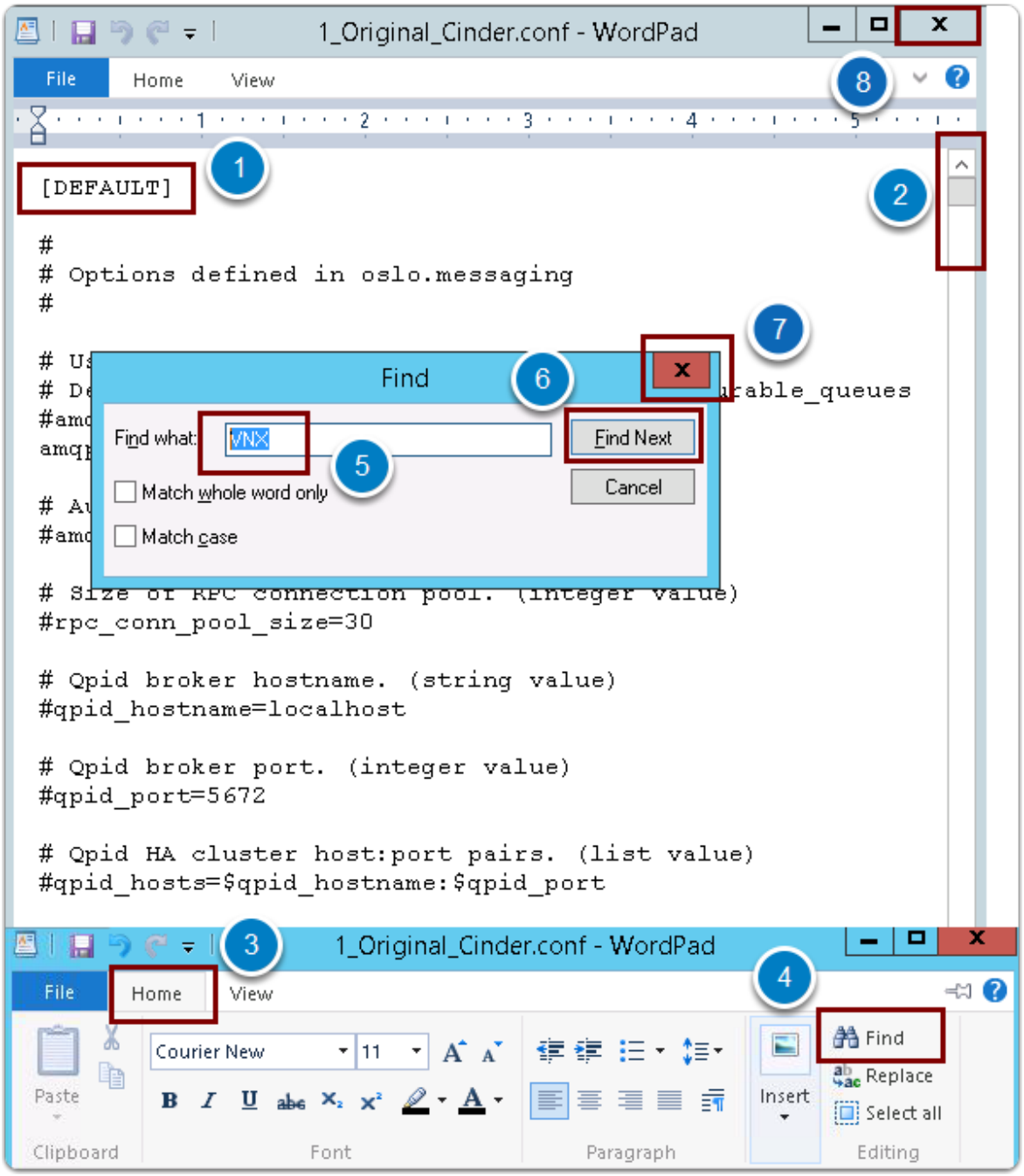


4.3 Cinder.conf Default Section

1. Please review the content of the Cinder.conf file and its **[DEFAULT]** section
2. Scroll down as necessary to find the configuration settings for VNX Storage
3. Click **Home**
4. Then click **Find** menu option
5. Input **VNX**
6. Click **Find Next** as necessary
7. Then close search window
8. Please close **1_Original_Cinder.conf** file after reviewing

As you can see the necessary configuration entries for Cinder integration with VNX are available out of the box.

All necessary configuration settings have been summarized in a single section of a separate sample file.



4.4 Sample Cinder.conf file

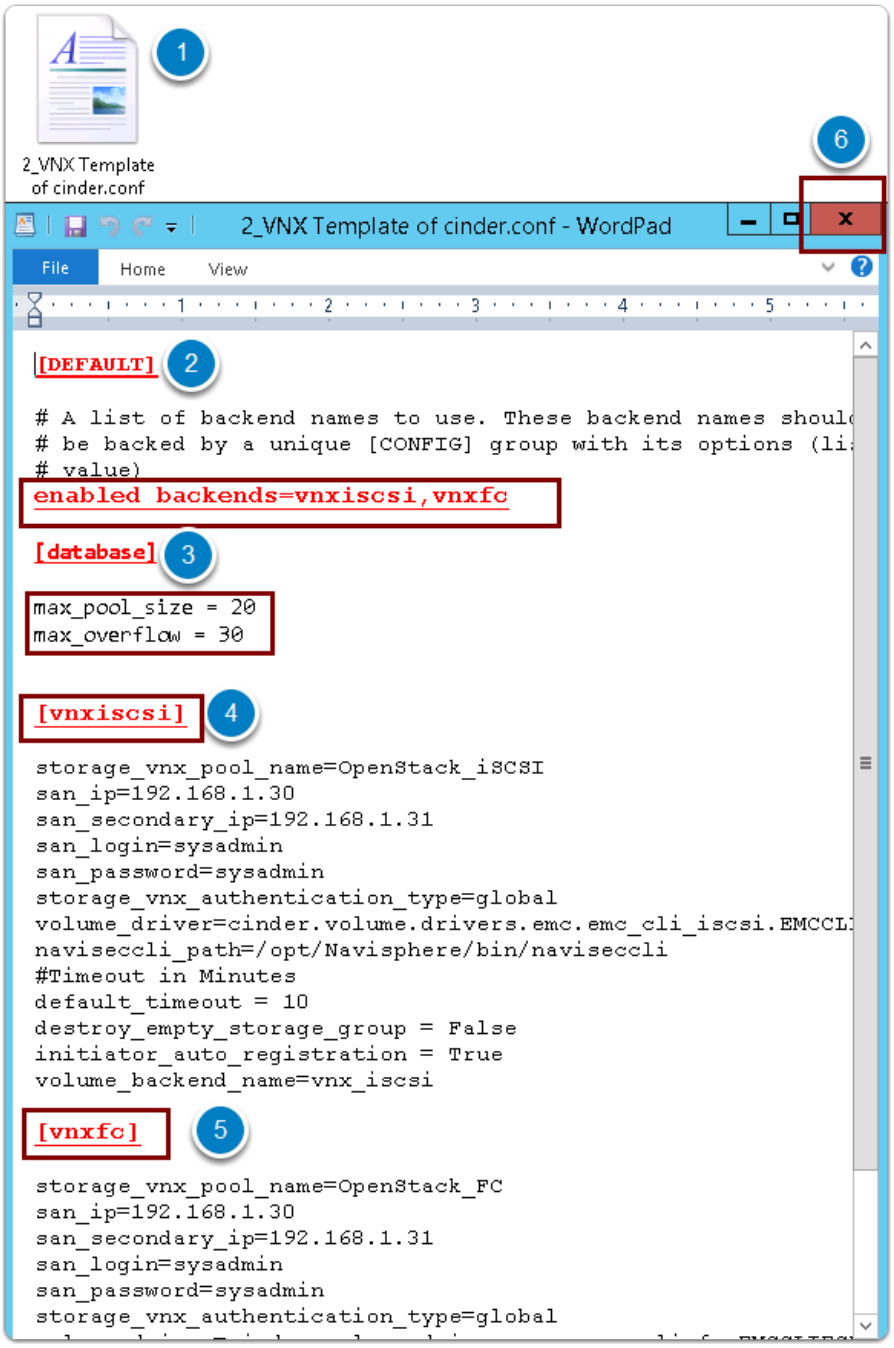
For your convenience all the changes required for configuration of the VNX backend for Cinder block service have been summarized in a sample Cinder.conf file.

The relevant sections are highlighted in Red.

1. Please open a file called 2_VNX Template of Cinder.conf
2. Review the settings in the [DEFAULT] section for enabled backends.
3. Review the settings in the [database] section for Max pool size and overflow
4. Review the section for VNX iSCSI block storage, i.e. VNX system IP address, access credentials, etc.
5. Review the section for VNX FibreChannel block storage, i.e. VNX system IP address, access credentials, etc.

To save you time a cinder.conf file with all the highlighted settings has been precreated. As part of the lab you will simply copy over the modified file.

6. Please close the 2_VNX Template of Cinder.conf


1
2_VNX Template of cinder.conf
6
2_VNX Template of cinder.conf - WordPad
File
Home
View
[DEFAULT]
2
# A list of backend names to use. These backend names should
# be backed by a unique [CONFIG] group with its options (li
# value)
enabled_backends=vnxiscsi,vnxfc
[database]
3
max_pool_size = 20
max_overflow = 30
[vnxiscsi]
4
storage_vnx_pool_name=OpenStack_iSCSI
san_ip=192.168.1.30
san_secondary_ip=192.168.1.31
san_login=sysadmin
san_password=sysadmin
storage_vnx_authentication_type=global
volume_driver=cinder.volume.drivers.emc.emc_cli_iscsi.EMCCLI
naviseccli_path=/opt/Navisphere/bin/naviseccli
#Timeout in Minutes
default_timeout = 10
destroy_empty_storage_group = False
initiator_auto_registration = True
volume_backend_name=vnx_iscsi
[vnxfc]
5
storage_vnx_pool_name=OpenStack_FC
san_ip=192.168.1.30
san_secondary_ip=192.168.1.31
san_login=sysadmin
san_password=sysadmin
storage_vnx_authentication_type=global

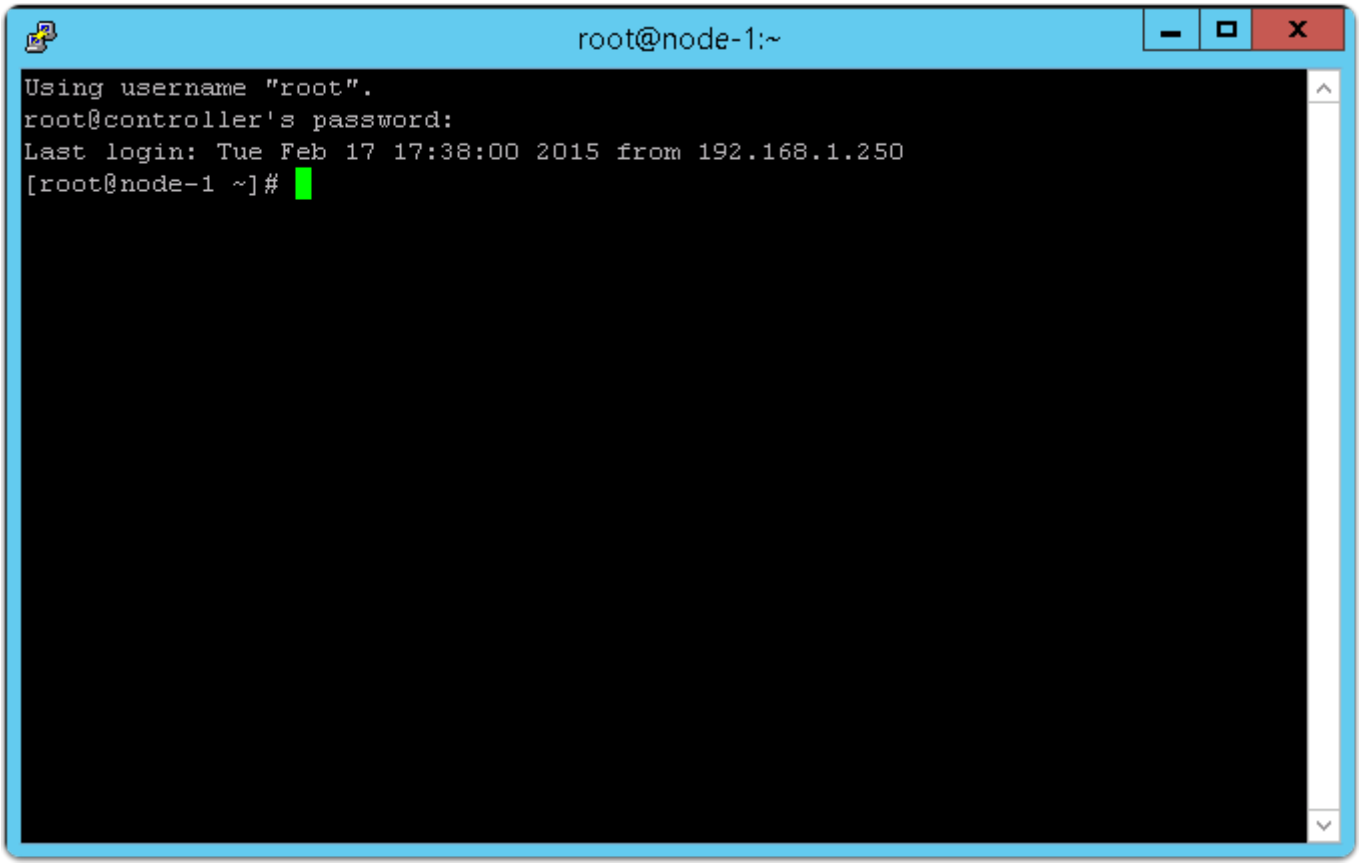
4.5 PuTTY SSH Client

Open **3_SSH_Controller** shortcut - it launches OpenStack Controller remote terminal using PuTTY SSH client.

4.6 Logging into SSH Terminal

The shortcut will automatically log you in. Just in case - the SSH login credentials are *root - Password123!*

DO NOT CLOSE the SSH Terminal window and return back to the Lab-1 folder



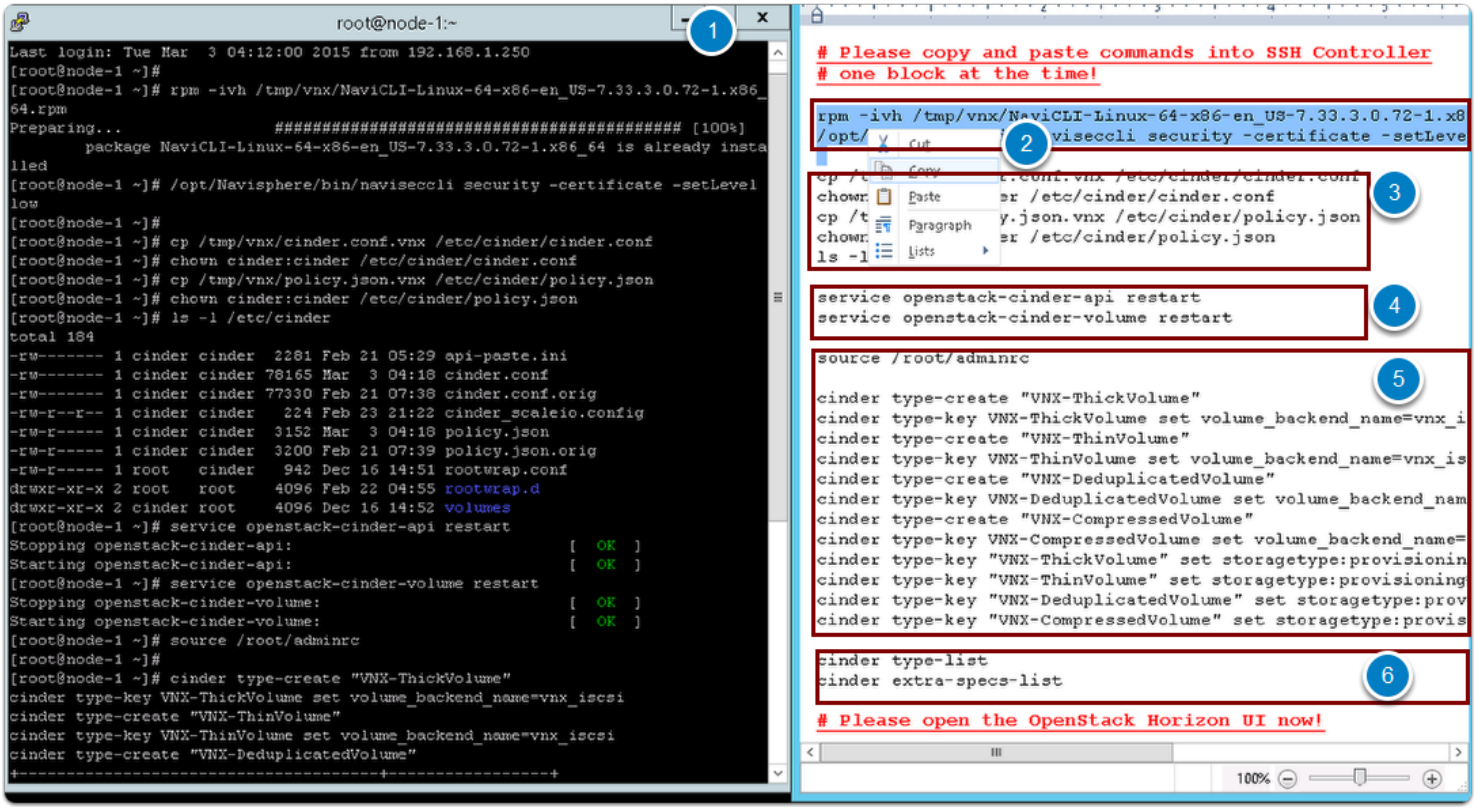
4.7 VNX Driver Configuration Commands File

Please open the **4_VNX_Cinder_Config_Commands** File by double-clicking on it.

This file contains the commands you will be using to configure VNX Cinder driver. You can copy and paste the commands in this file to your PuTTY SSH terminal window by using right click, Copy and Paste.

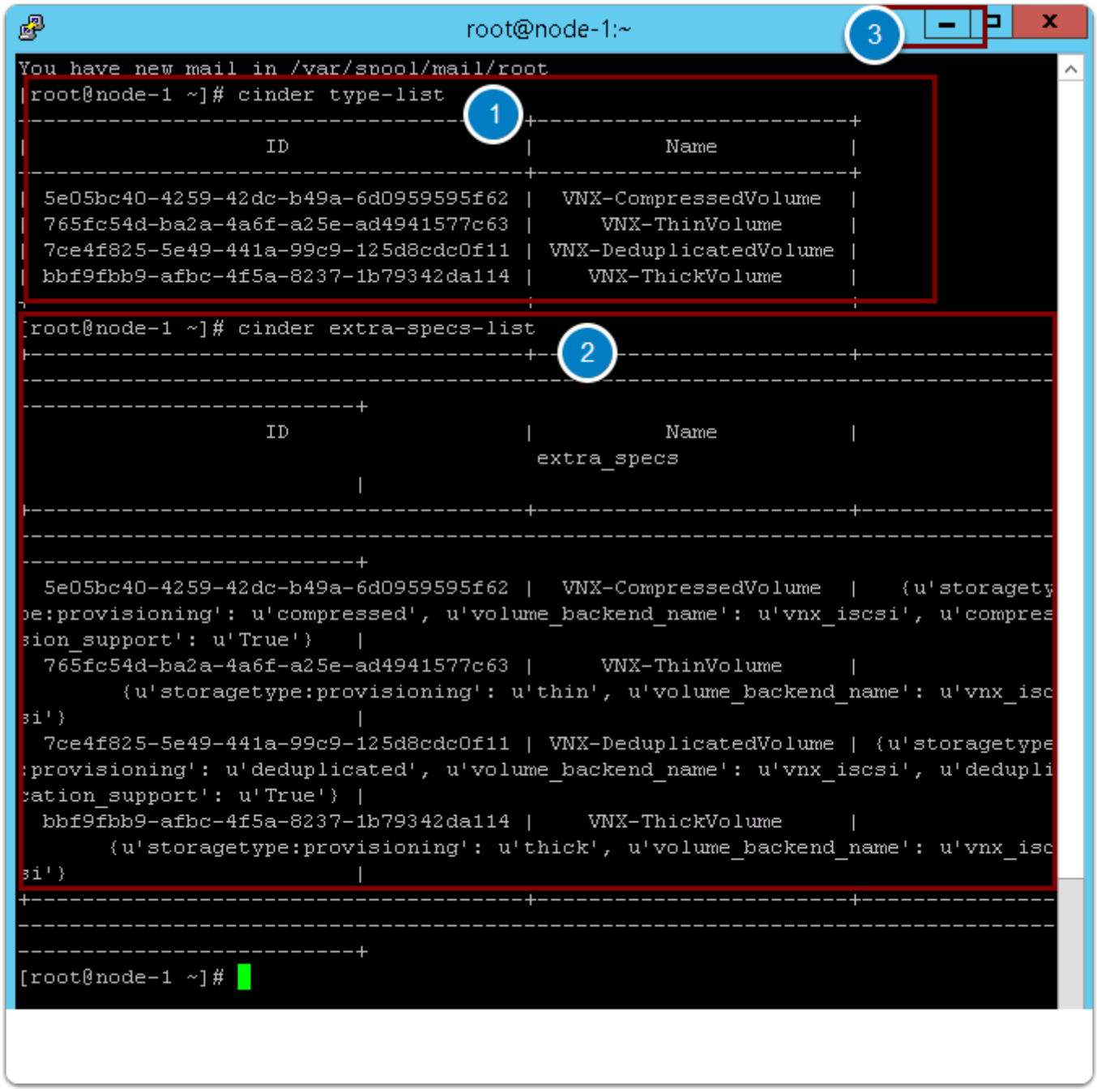
4.8 Configuration Commands

1. Please arrange the **SSH Terminal** window and the **4_VNX_Cinder_Config_Commands** file side-by-side. Please copy and paste the commands in this file to your PuTTY SSH terminal window one command block at the time!
2. Install the NaviCLI and observe the command execution in the SSH Terminal
3. Copy over of pre-configured *cinder.conf* and *policy.json* files
4. Restart Cinder services. **Note:** The openstack-cinder-volume service may not be running before the restart command. This is normal and will not affect you lab execution, as long as it starts successfully.
5. Create Cinder **Volume Types** and assign them to the backends.
6. Review the created **Volume Types** and associated **Extra Specs**.



4.9 Created VNX Volume Types

1. Please review the created Cinder **Volume Types**
2. Please review the created Cinder **Volume Extra Specs.**
3. When finished, please minimize the **SSH Terminal** window.

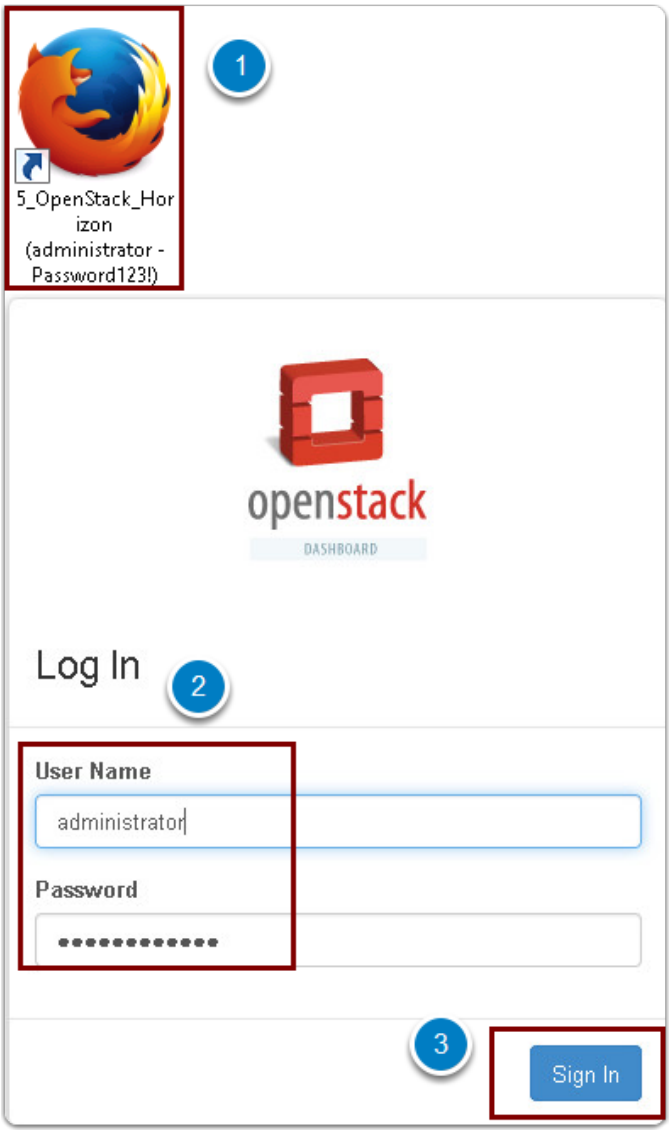


5. Using OpenStack Horizon UI

1. Return to the **Lab-1-VNX-Cinder** folder and launch the **5_OpenStack_Horizon(administrator - Password123!)** shortcut
2. The user credentials should be cached in the browser window. If needed please type the credentials:

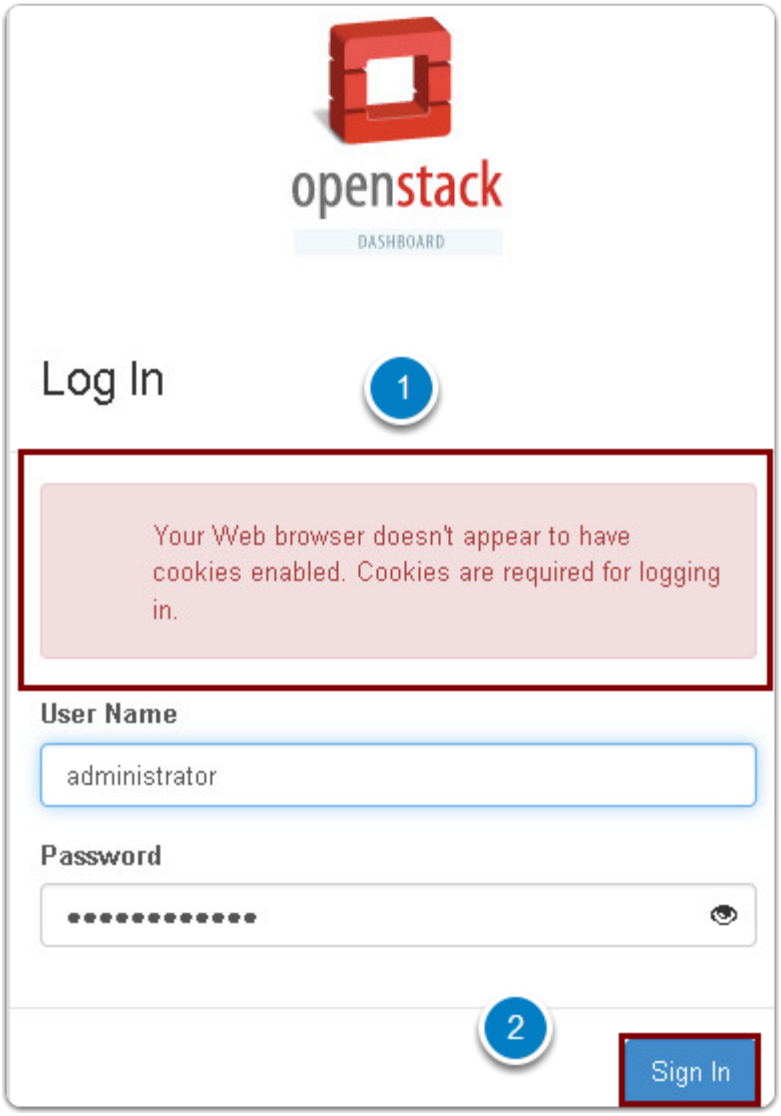
- User Name: **administrator**
- Password: **Password123!**

3. Click **Sign In** to continue



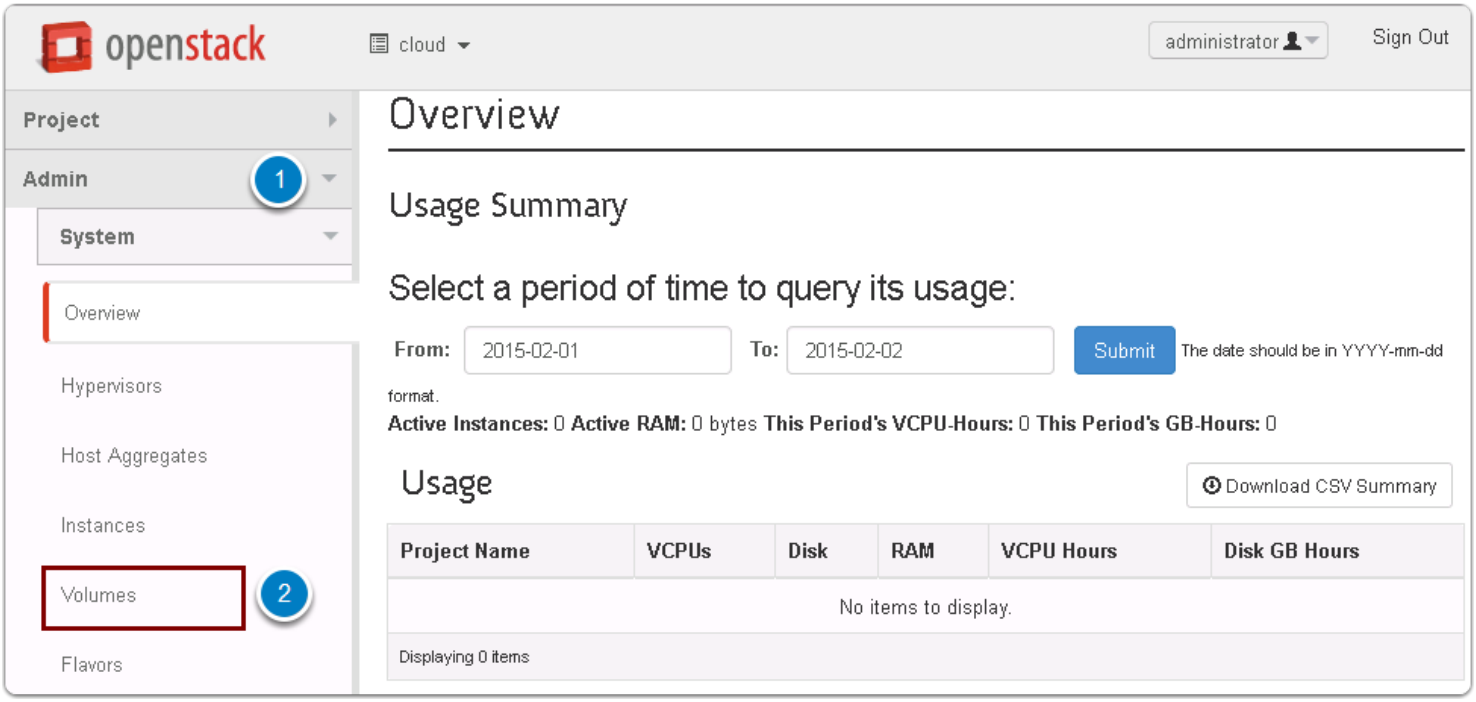
5.1 Browser Cookie Warning

1. Occasionally you may see a browser cookie warning
2. Please disregard it and simply click on **Sign In again** to continue



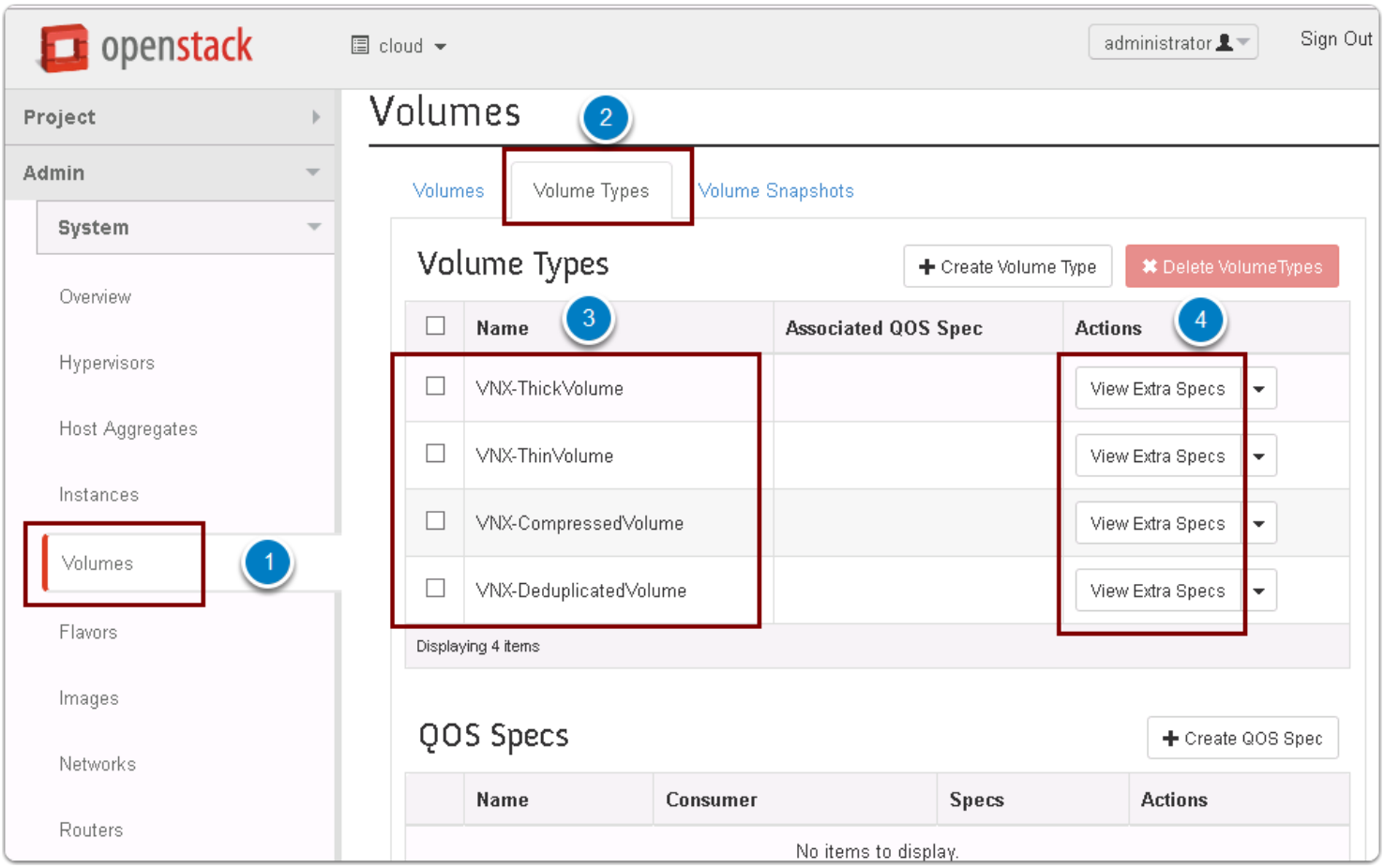
5.2 OpenStack Cloud Overview

1. Please review the **Admin** dashboard
2. Next select the **Volumes** Tab



5.3 OpenStack Volume Types

1. Please review the **Volumes** tab
2. Next select **Volume Types**
3. Review newly created **Volume Types**
4. Next, review **Extra Specs** for each VNX volume types - remember the settings in the Cinder.conf you have reviewed earlier? Please click on the **Extra Specs.**

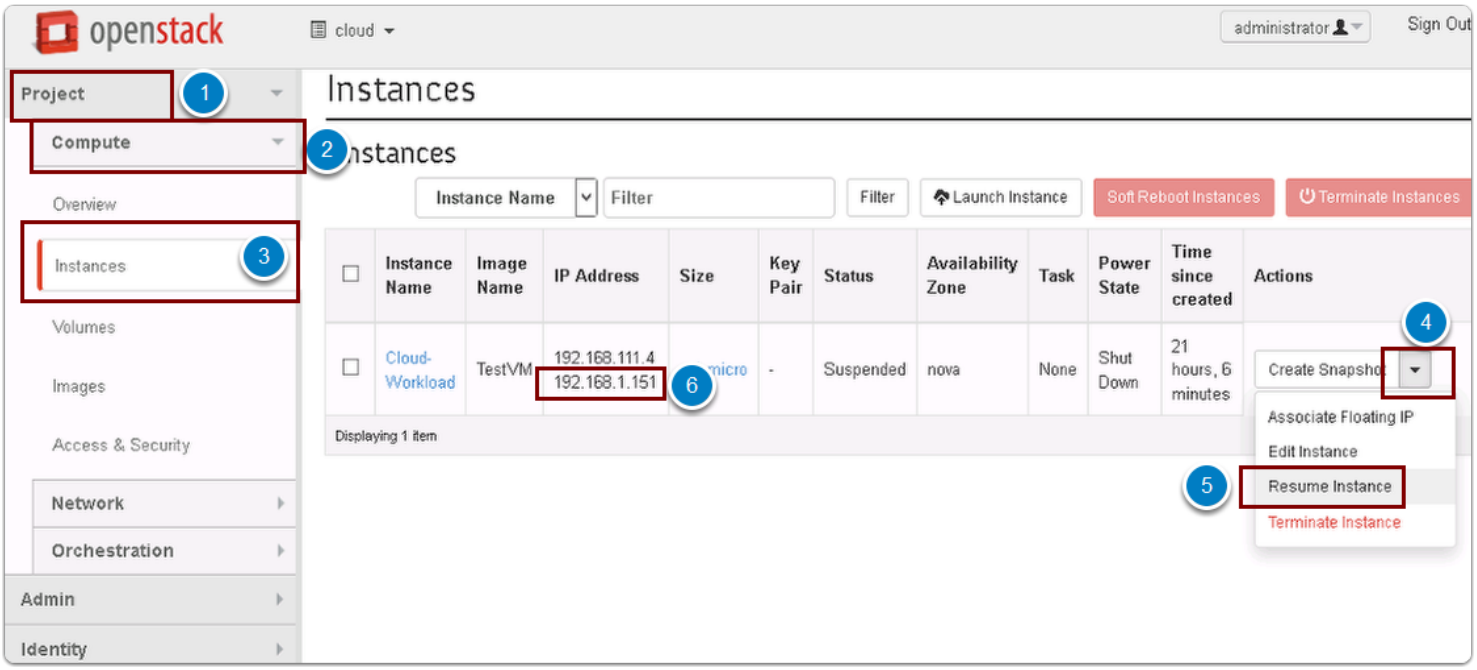


5.4 Volume Type Extra Specs

1. Please review the VNX **Volume Type extra specs** - these were configuration parameters you have provided while creating this **Volume Type**. These parameters correspond to the VNX backend configuration.

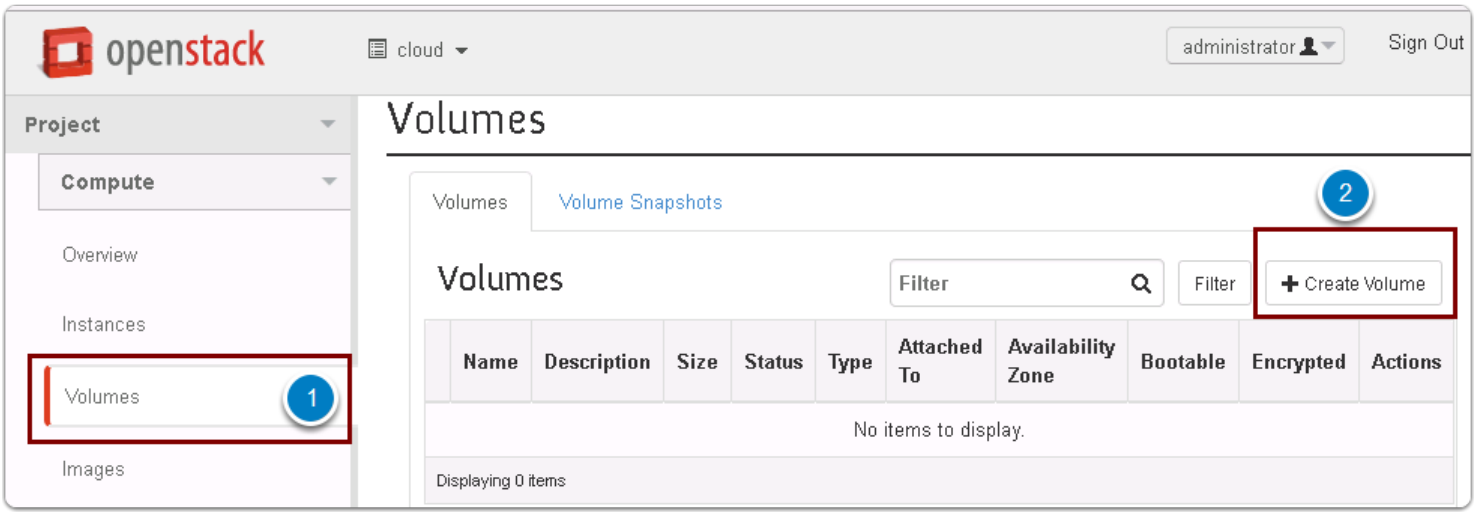
6. OpenStack Project

1. Please switch to the **Project** Tab
2. Expand the **Compute** Tab if necessary
3. Select **Instances** Tab
4. Click on the drop-down menu list
5. Select **Resume Instance**
6. Note this Instance **external IP Address** - we'll be using it to SSH into this instance later in this lab.



6.1 Project Volumes

1. Please select the **Volumes** tab next - you will now create a new Volume using one of the VNX Volume Types created in the earlier steps
2. Select **Create Volume**



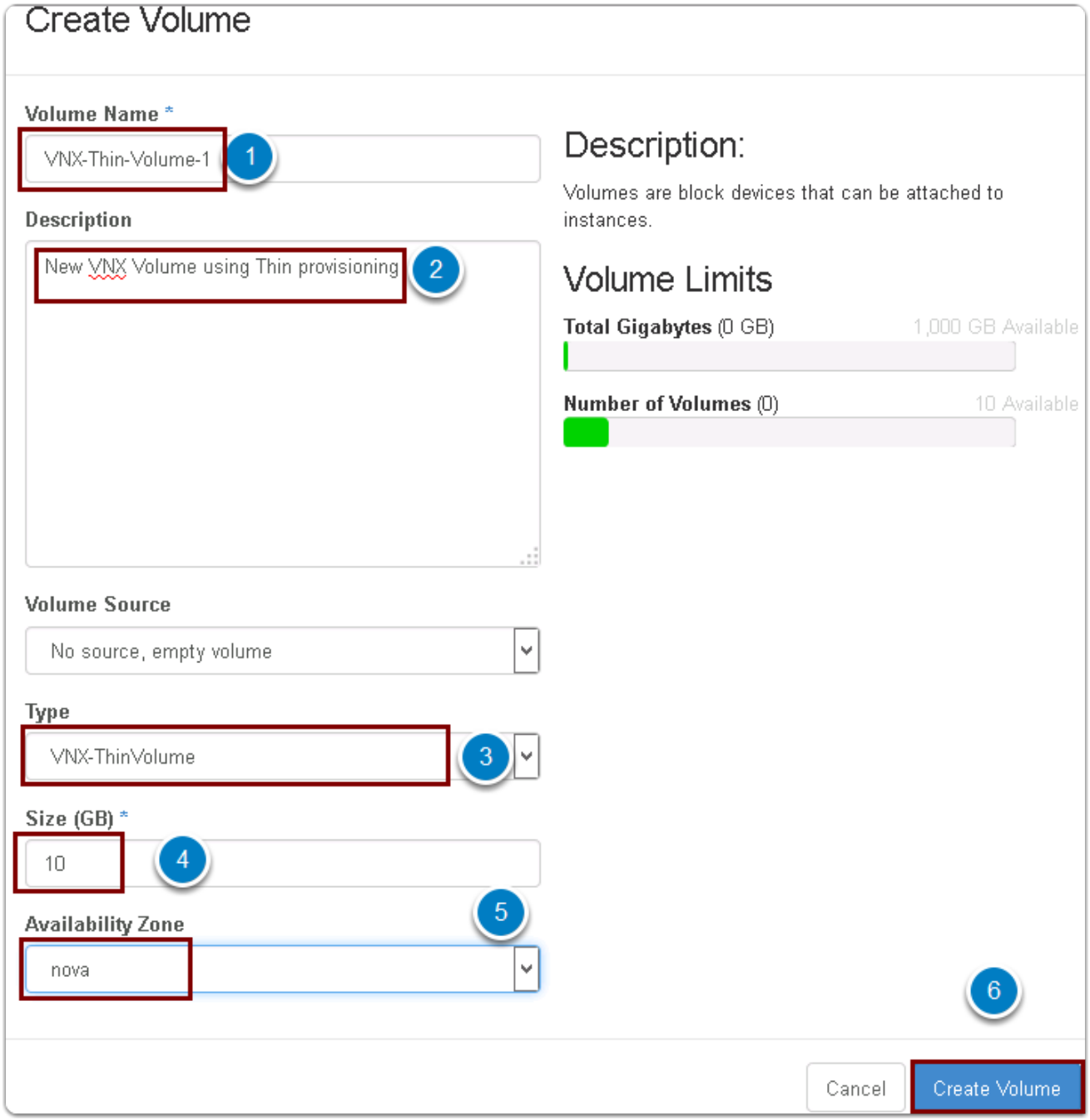
6.2 Creating New Volume

OpenStack volumes are persistent block-storage devices that may be attached and detached from instances, but they can be attached to only one instance at a time. Similar to an external hard drive, they do not provide shared storage in the way a network file system or object store does. It is left to the operating system in the instance to put a file system on the block device and mount it.

You will now create a new Volume using earlier created Volume Types:

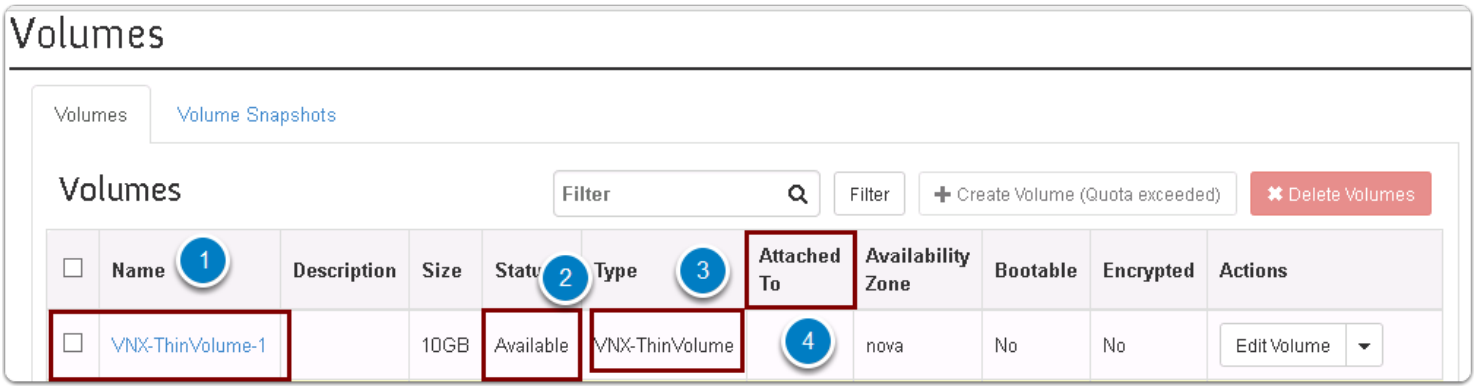
1. Please enter the Volume name: **VNX-Thin-Volume-1**
2. Provide Volume **Description**
3. Select **Volume Type** from the drop-down list - **VNX-ThinVolume**
4. Enter the **Volume Size: 10GB**
5. Please select the **Availability Zone: nova**
6. Click **Create Volume**

Note: Please leave all other fields with default values.


Create Volume
Volume Name *
VNX-Thin-Volume-1
1
Description
New VNX Volume using Thin provisioning
2
Volume Source
No source, empty volume
Type
VNX-ThinVolume
3
Size (GB) *
10
4
5
Availability Zone
nova
6
Description:
Volumes are block devices that can be attached to instances.
Volume Limits
Total Gigabytes (0 GB)
1,000 GB Available
Number of Volumes (0)
10 Available
Cancel
Create Volume

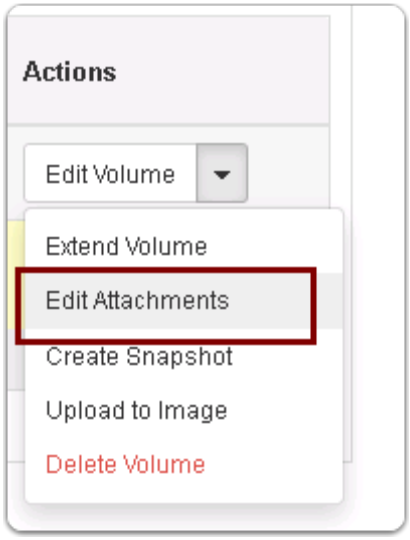
6.3 Newly Created Volume

1. Review the newly created Volume
2. Verify the Volume **Status: Available**
3. Check the Volume **Type - VNX-ThinVolume**
4. Observe that the Volume is not attached to any Instance.



6.4 Edit Volume Attachments

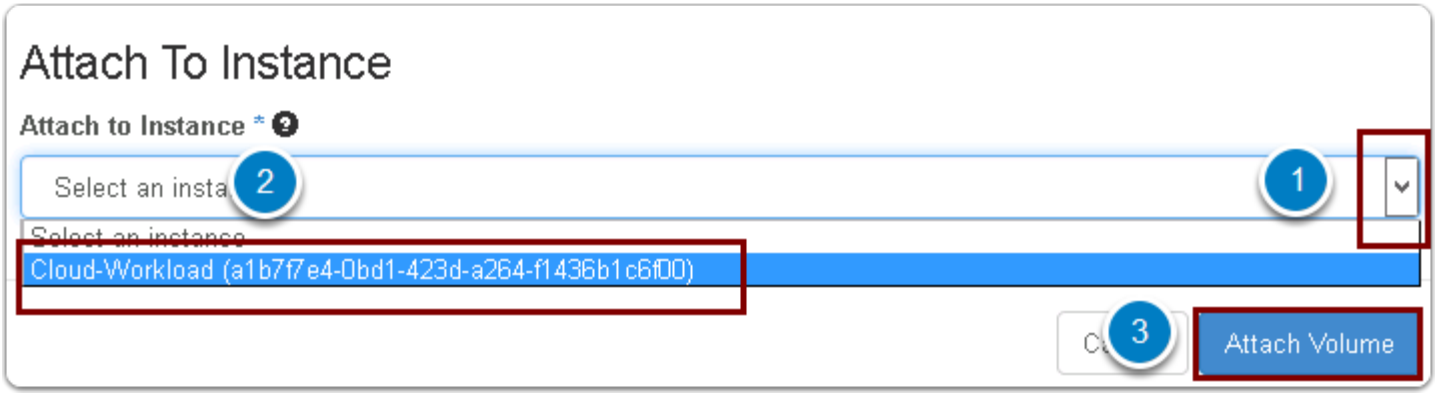
Select **Action** from the drop-down menu - **Edit Attachments.** We will now edit **Volume Attachments**



6.5 Attach Volume to Instance

1. Please click on the drop-down menu

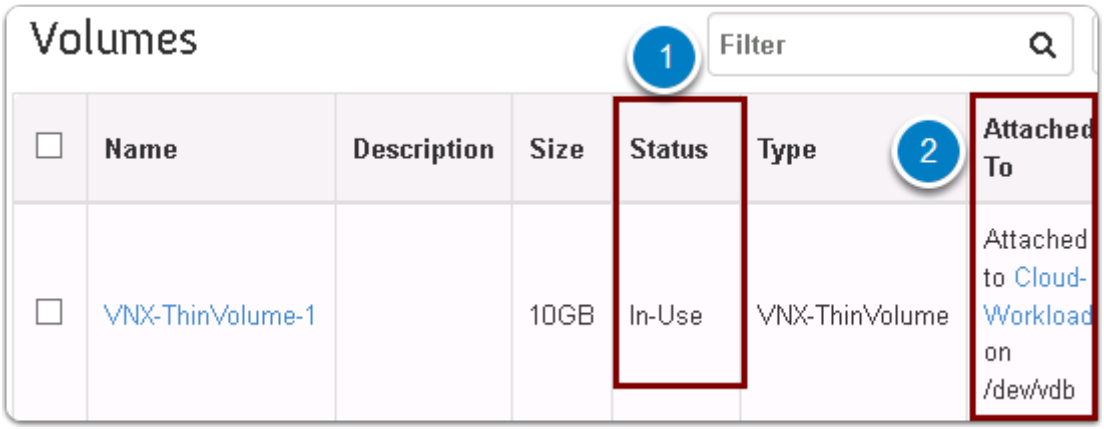
2. Select the the **Cloud-Workload** instance from the list
3. Click **Attach Volume**



6.6 Attached Volume

Please review the attached volume:

1. Review the changed **Volume Status: in-Use**
2. Review the **Attached To** field and the device name - you will need to use it shortly



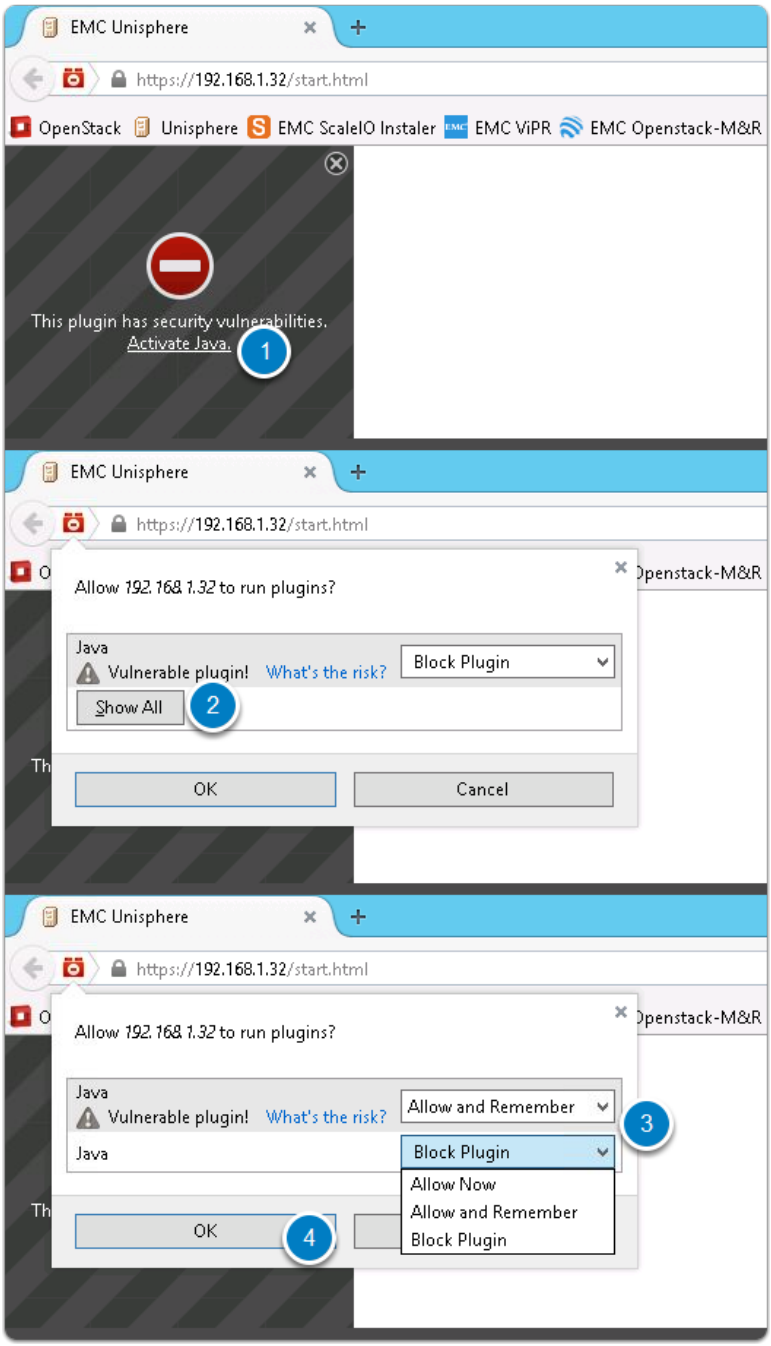
7. Launching EMC Unisphere

Now that the Volume has been created, you can verify the new Volume on the VNX storage system using **EMC Unisphere.** Please double-click on the **6_EMC_Unisphere (sysadmin-sysadmin)** shortcut in the Lab-1 folder.

7.1 Optional Step: Java Security Warning

If you see Java Security warning accept plugin by doing the following:

1. Click **Activate Java** link
2. Click **Show All** button
3. Select **Allow and Remember** for both plugins
4. Click **OK**

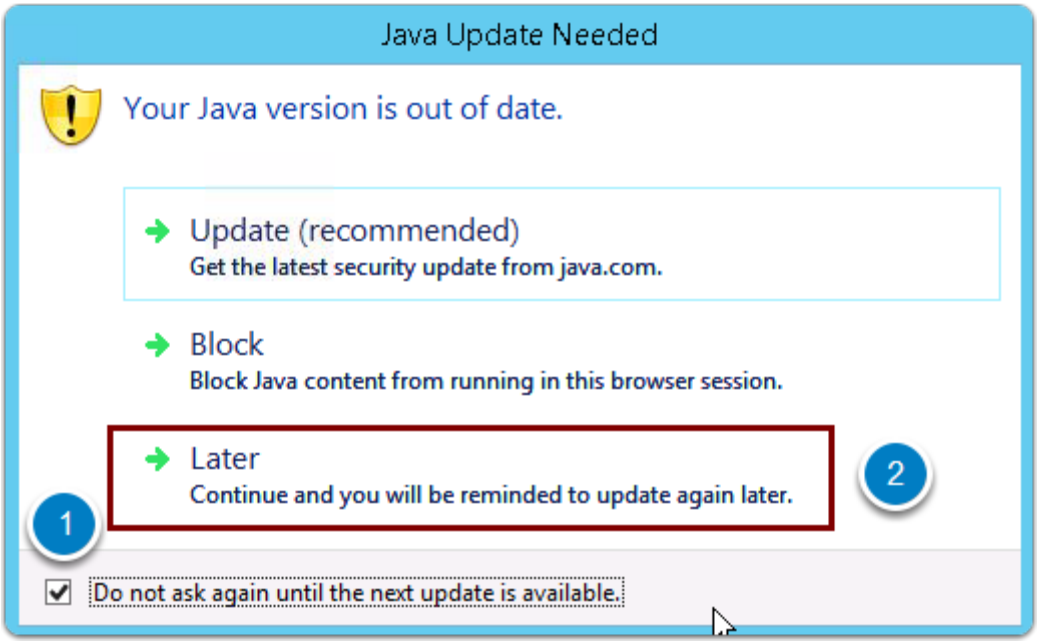


7.2 Optional Step: Java Update

You may see a Java Update Needed window.

1. Click **Do not ask again until the next update is available** checkbox
2. Click **Later**

Note: You may need to repeat these steps twice!

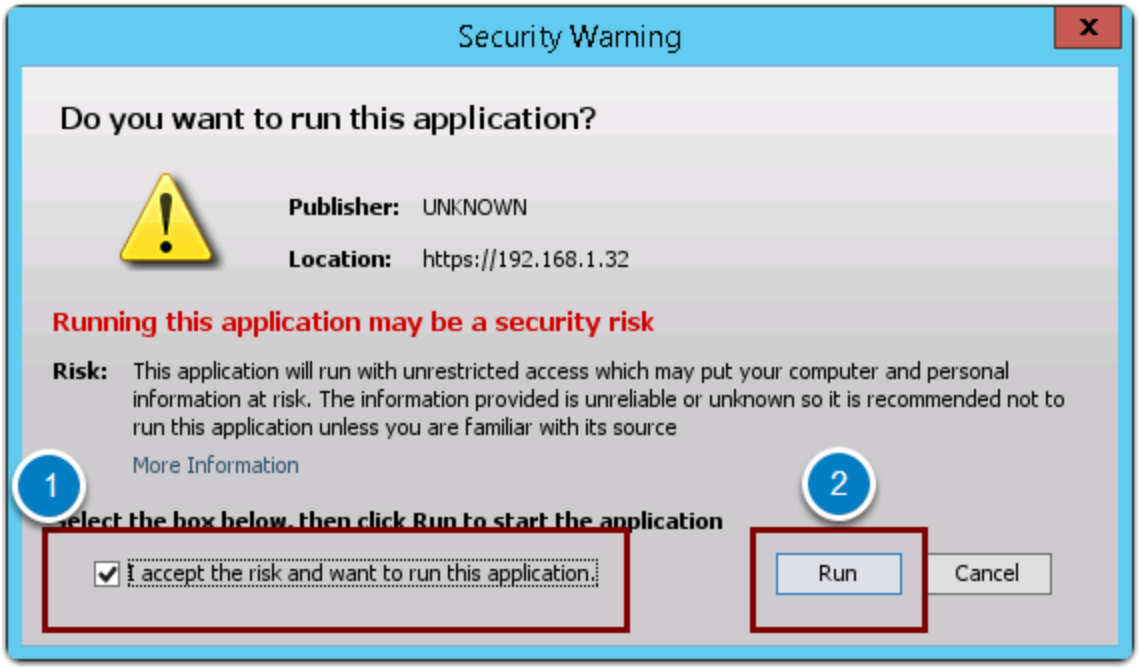


7.3 Accepting Java Security Warning

Please pay attention to the security warning for Java applet:

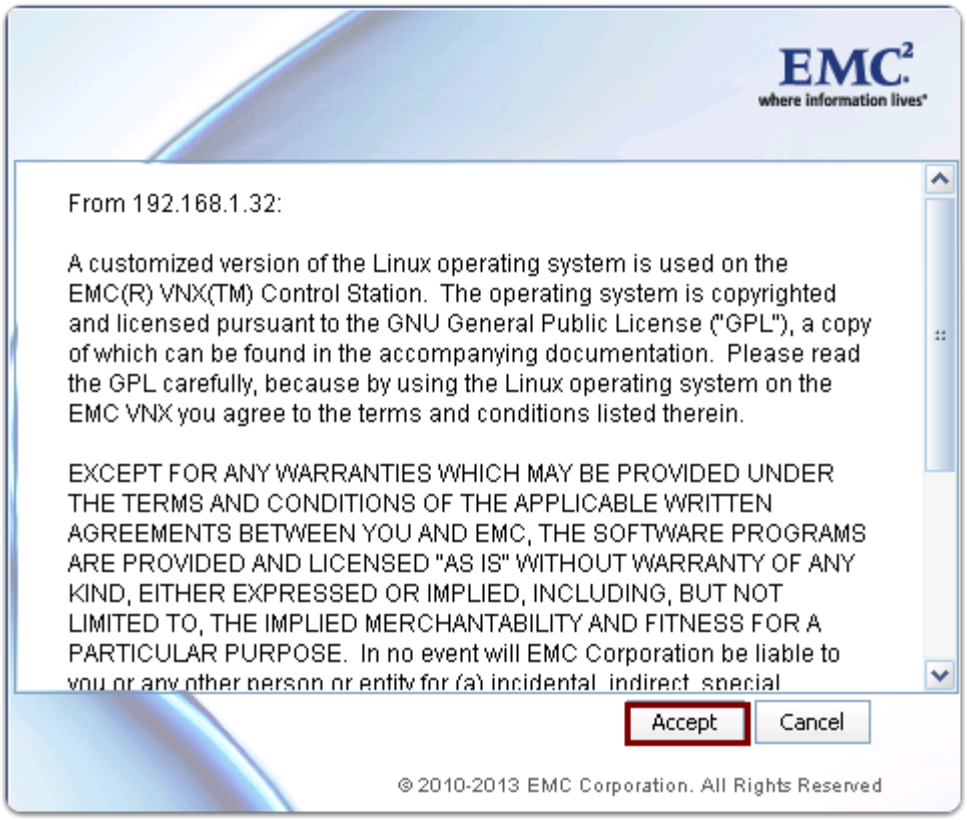
1. Check the box to accept the risk
2. Click Run to continue

Note: You may need to repeat these steps twice!



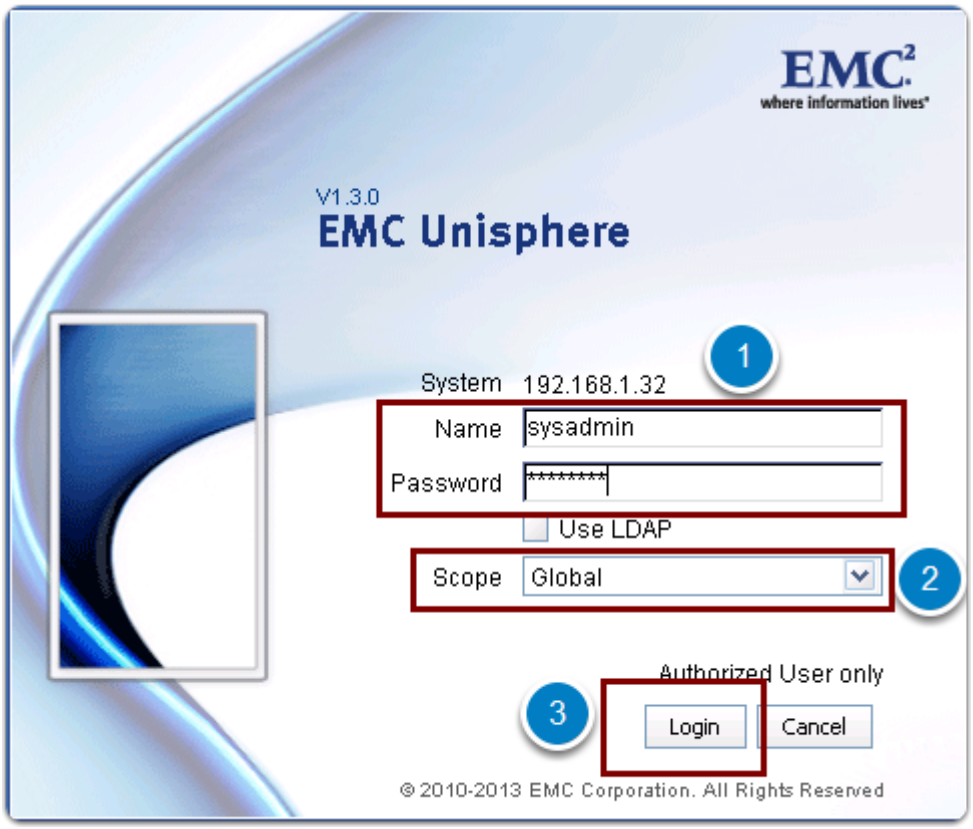
7.4 Accepting EMC License Warning

Please accept EMC Coporation License agreement:



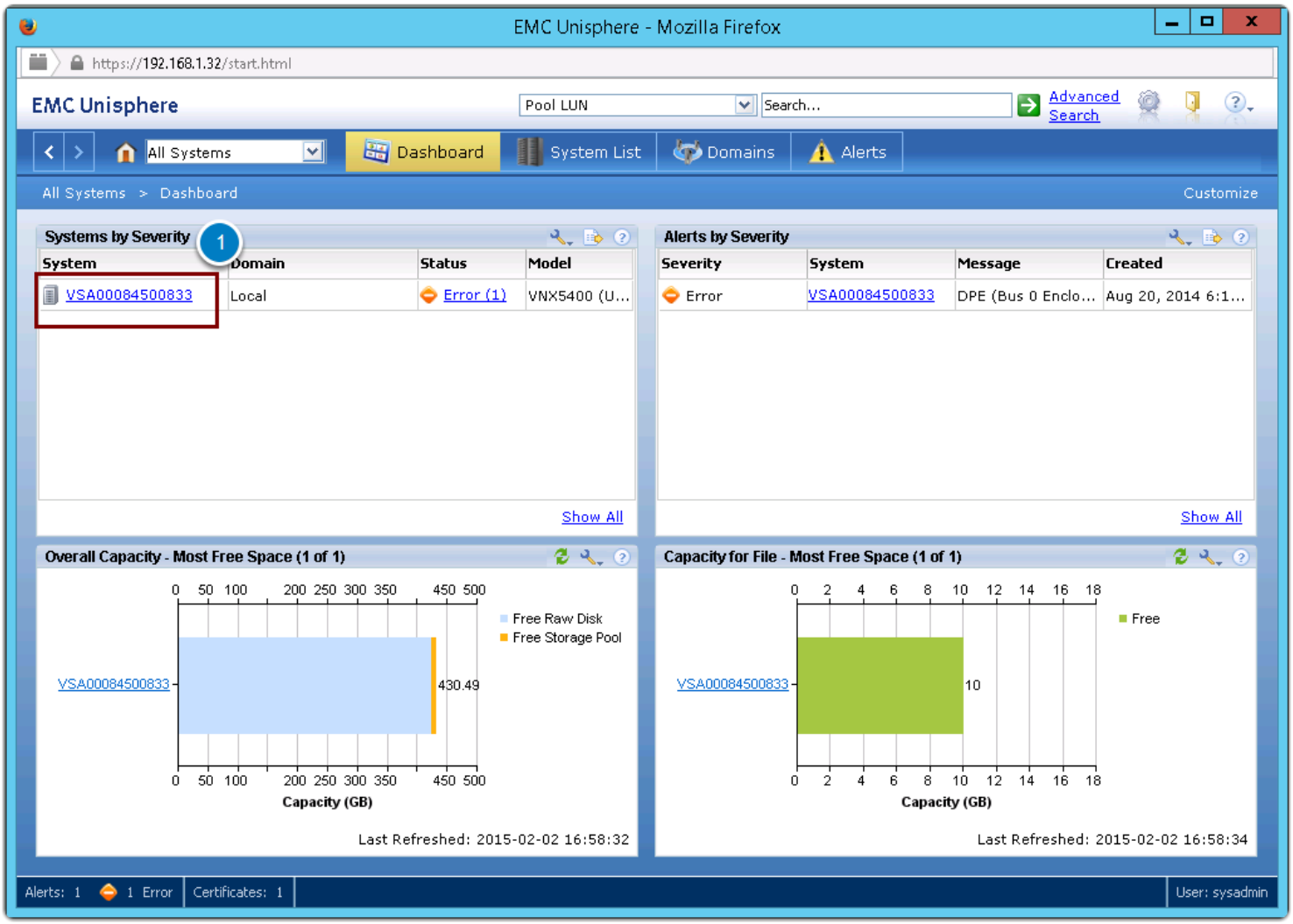
7.5 Logging into Unisphere

1. Please login into Unisphere with credentials: **sysadmin - sysadmin**
2. Make sure your **Scope** is selected as **Global**
3. Click **Login** to continue



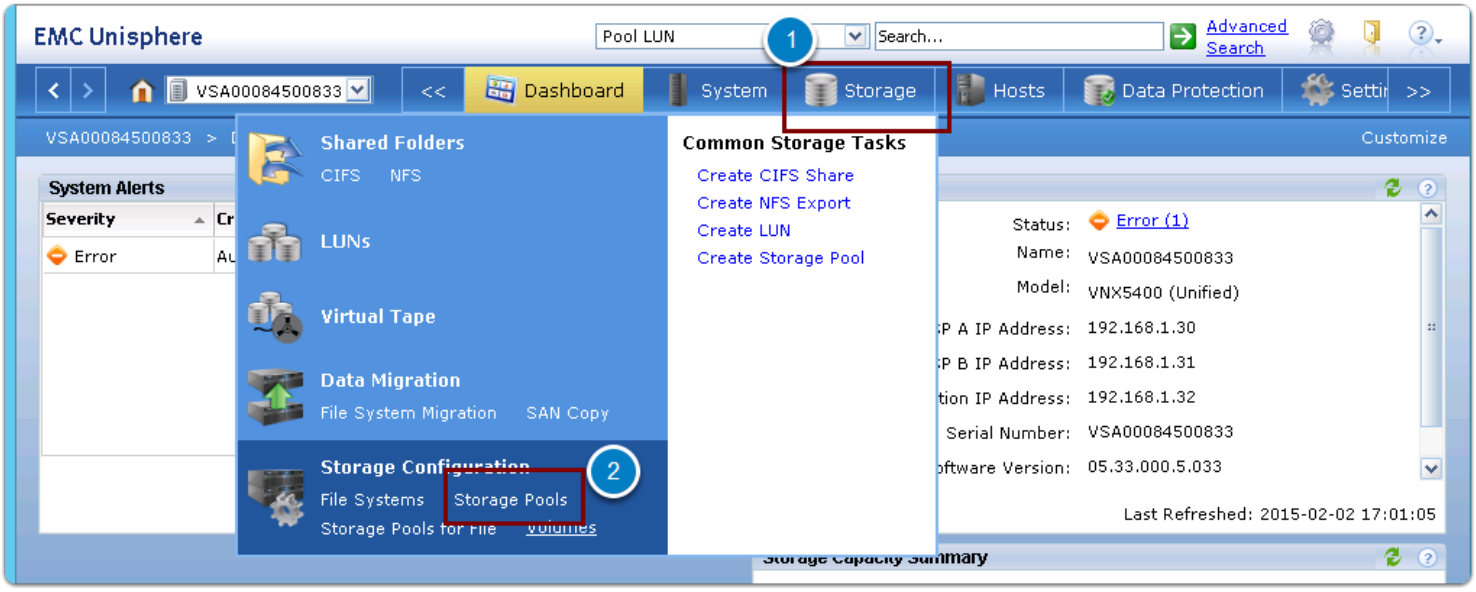
7.6 Unisphere Dashboard

1. In the **Unisphere** Dashboard please select the Storage System called **VSA00084500833**



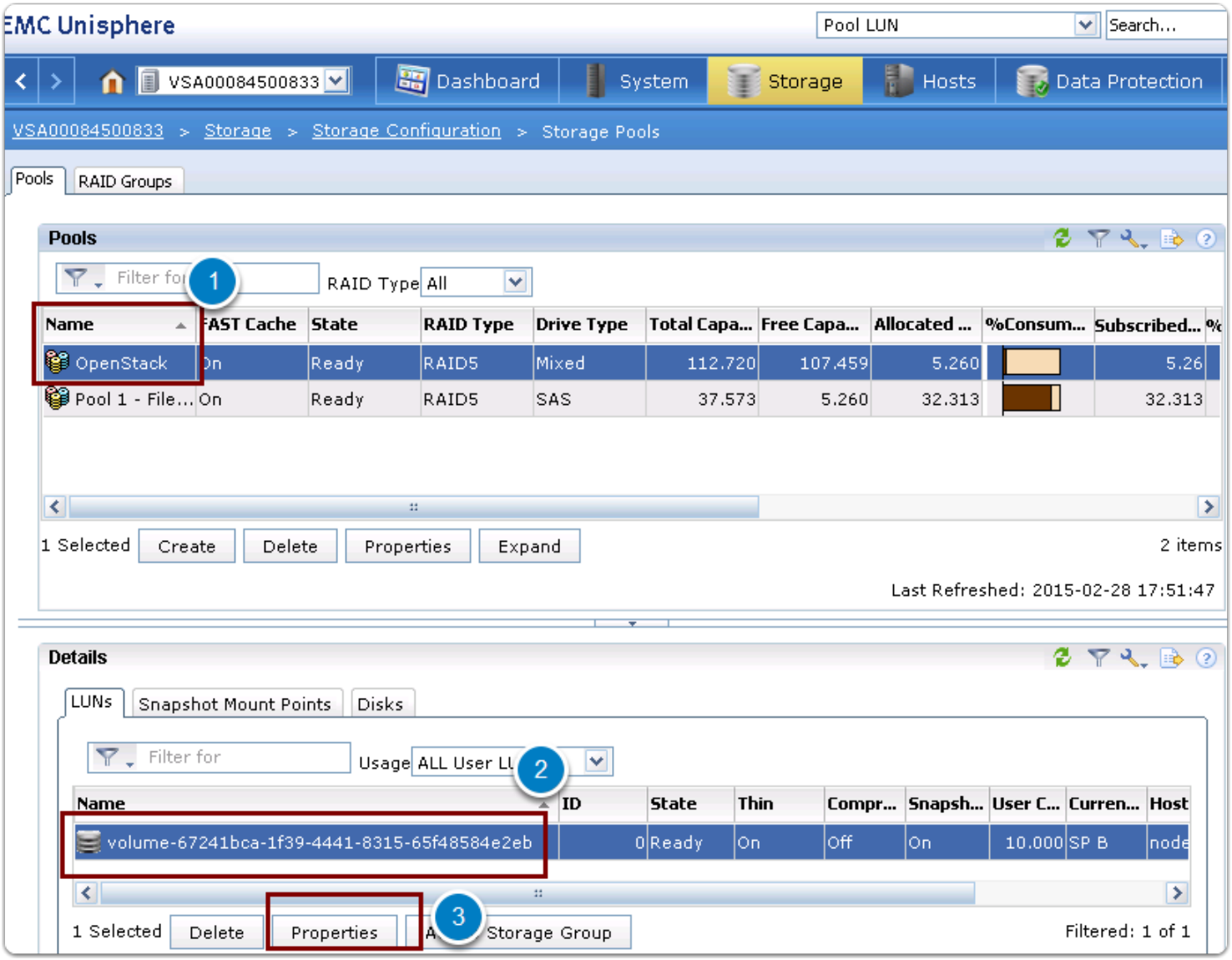
7.7 Block Storage Volumes

1. Next please hover your cursor over the **Storage** menu from the top menu bar
2. Navigate to the **Storage Configuration** options and select **Storage Pools**



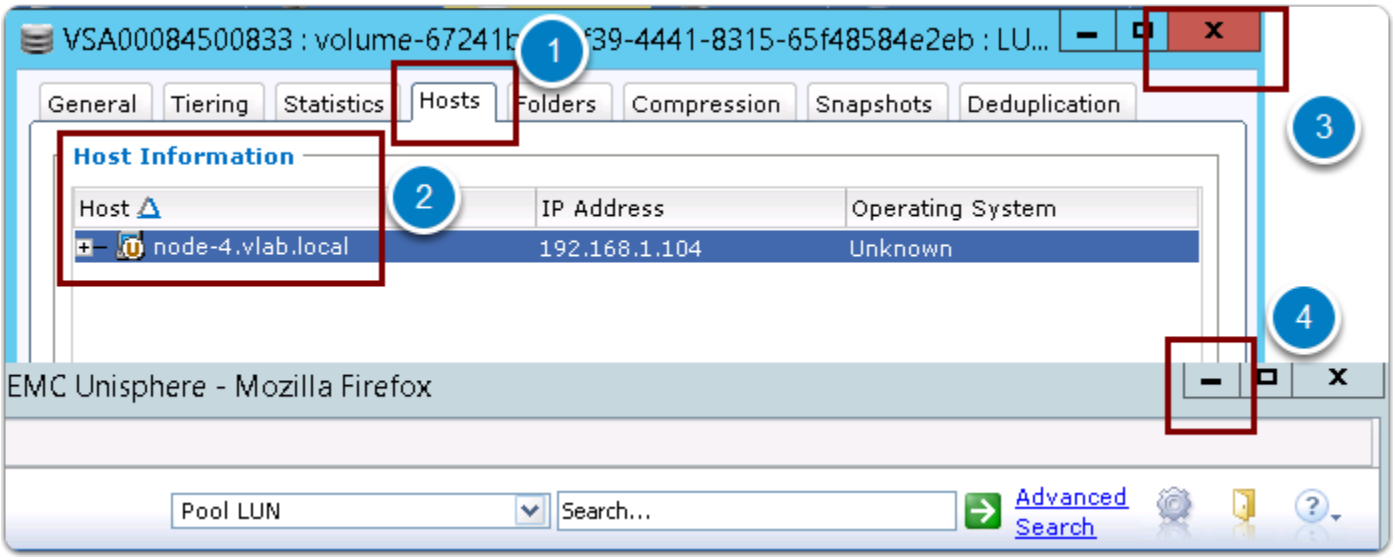
7.8 Newly Created Volume(s)

1. Please select the **OpenStack** Storage Pool - this is the same pool you specified in when creating the Cinder **Volume Type** earlier in this lab
2. Review the **LUNs** - note the volume ID, its size, state and thin provisioning type
3. Next select **Properties** of this newly created LUN



7.9 Volume Properties

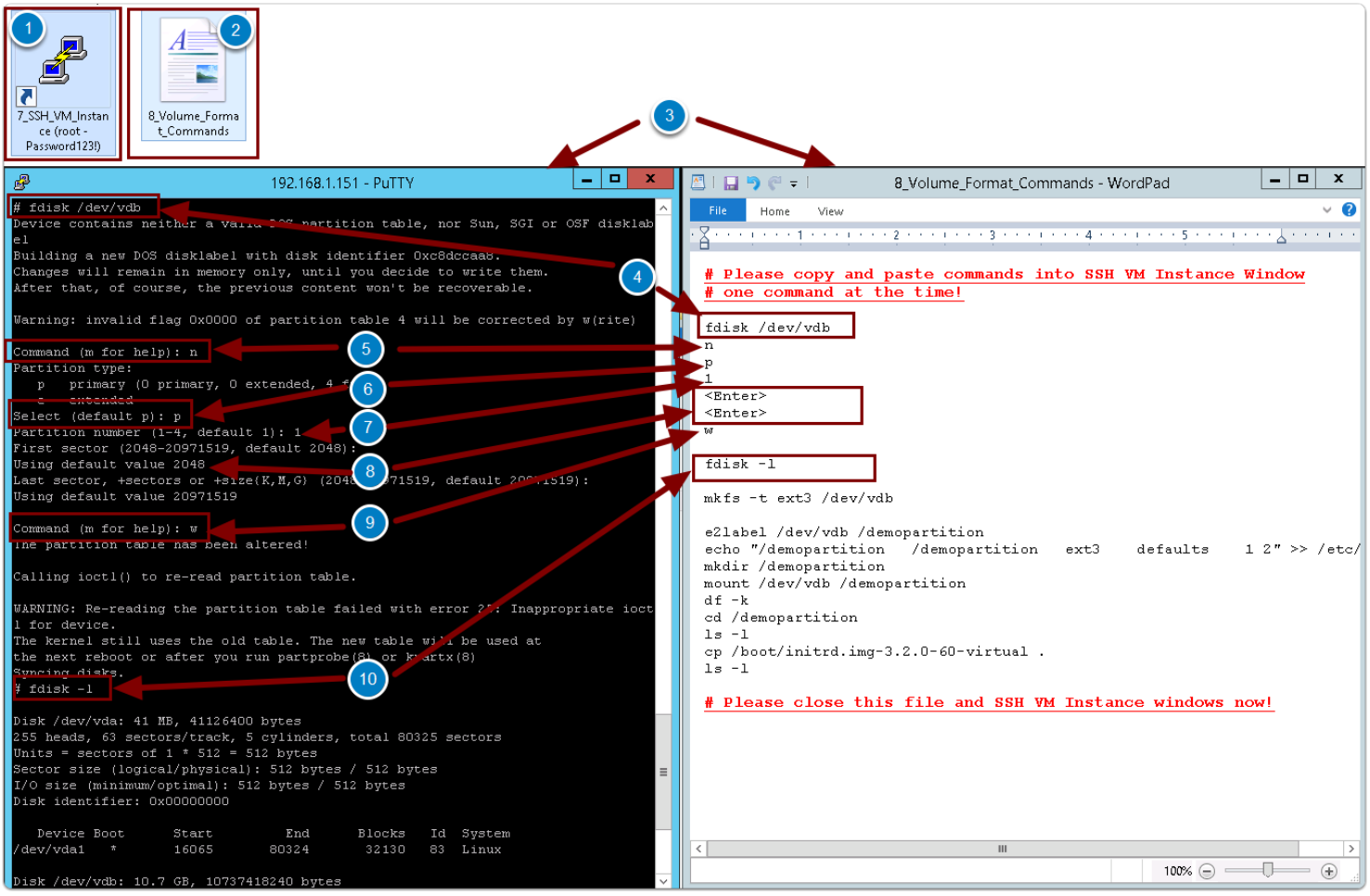
1. Select **Hosts** Tab in the LUN's Properties dialog
2. Review the **Hosts** in this LUN's export group: node-4.vlab.local - this is one of the OpenStack Compute nodes in our cluster
3. Please close the LUN Properties dialog
4. Then minimize EMC Unisphere Browser window.



8. Volume Life-Cycle Management

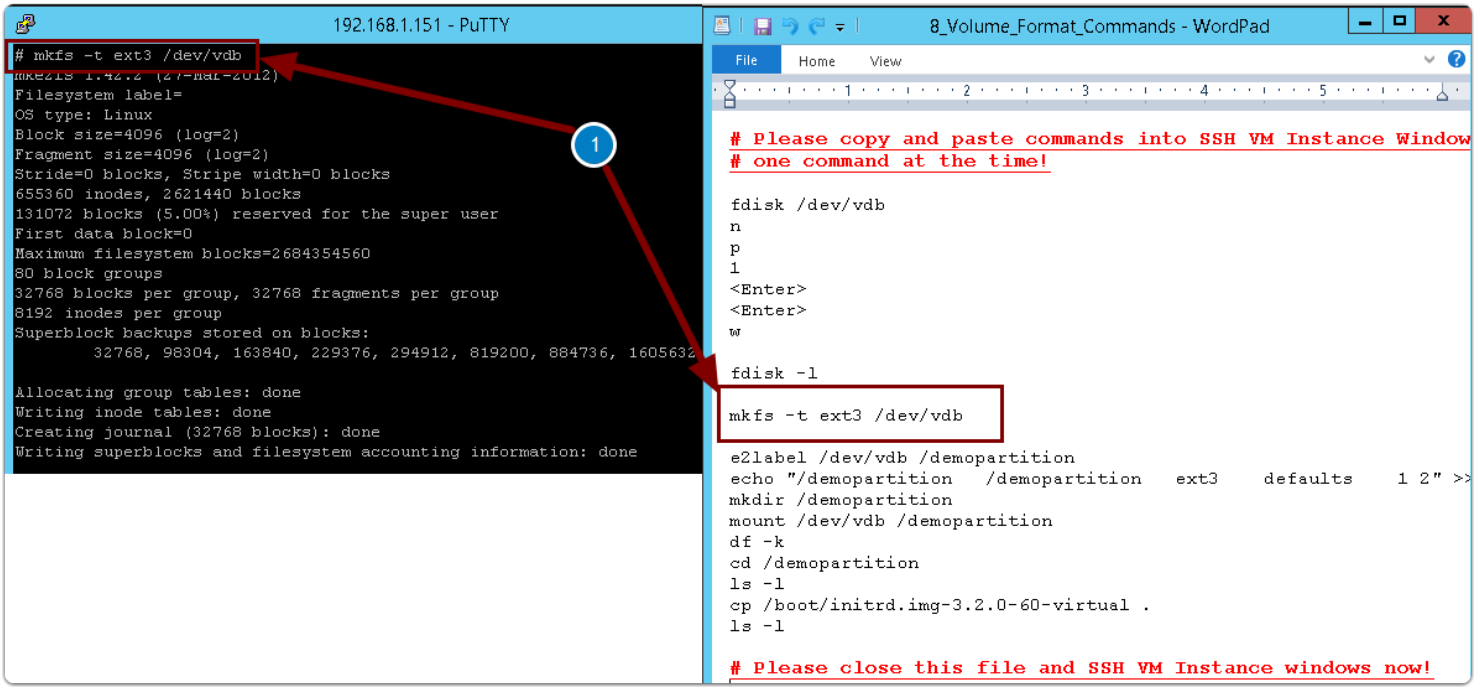
8.1 Creating New Partition

1. Open minimized **Lab-1** Folder and select **7_SSH_VM_Instance (root-Password123!)** - This will open an SSH Terminal connection to the running OpenStack instance using its Floating IP address 192.168.1.151
2. Open shortcut called **8_Volume_Format_Commands.** You can copy the commands from the file into SSH terminal - one command at the time using right click, Copy and Paste.
3. Arrange the opened windows side-by-side as shown
4. Partition the newly created and attached volume: ***fdisk /dev/vdb***
5. Enter command ***n*** (New partition) and press ***Enter***.
6. Select default: **p** (for primary partition)
7. Enter partition number: **1**
8. Accept default initial and end blocks to use the entire volume - Use **Enter**
9. Enter command: **w** (write the information and quit)
10. Check the new partition using command: ***fdisk -l***



8.2 Formatting New Partition

1. Format the new partition as an **ext3** file system type: **mkfs -t ext3 /dev/vdb**

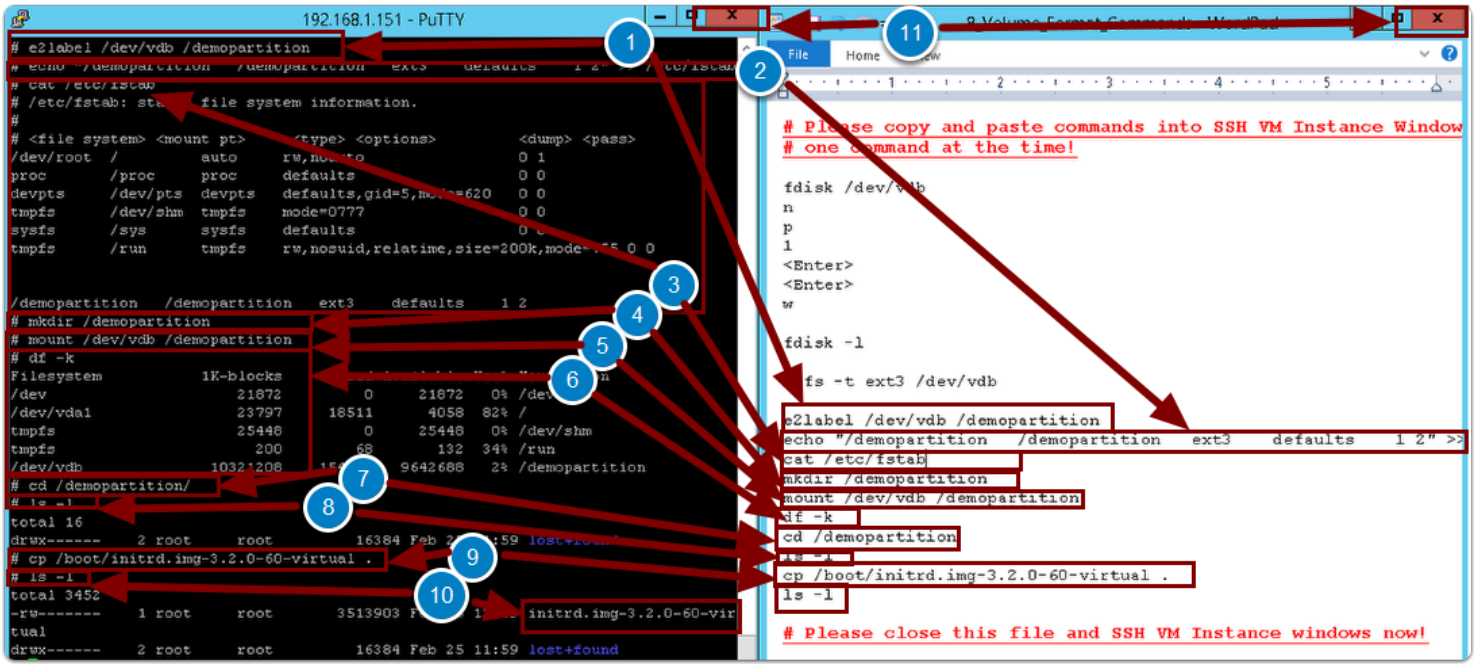


8.3 Mounting New Volume

You will now prepare the new volume and write new data to it. You can copy and paste the commands below directly into the SSH Terminal window using right click, Copy and Paste.

1. Assign a Label with e2label: **e2label /dev/vdb /demopartition**
2. Add the new partition to /etc/fstab: **echo "/demopartition /demopartition ext3 defaults 1 2" ›› /etc/fstab**
3. Verify the new **fstab** entry: **cat /etc/fstab**
4. First create the base directory: **mkdir /demopartition**
5. Mount the new file system: **mount /dev/vdb /demopartition**
6. And check it: **df -k**
7. Change directory to the new volume: **cd /demopartition**
8. List the content: **ls -l**
9. Copy data to a new volume: **cp /boot/initrd.img-3.2.0-60-virtual .** Note: Please do not forget the dot at the end of this command line
10. List its content again: **ls -l** - Please note the new data file placed in the new volume!

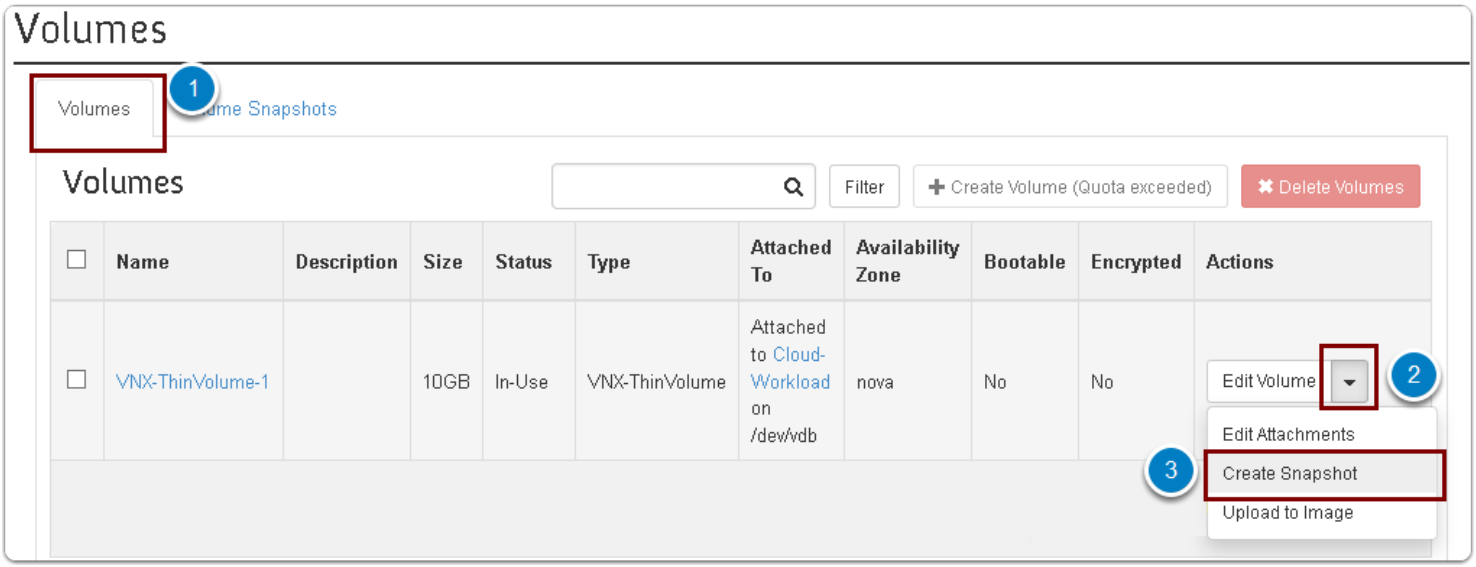
11. When finished, please close the **SSH Terminal to the VM instance** and the **8_Volume_Format_Commands** file. You will no longer need them.



8.4 Creating Volume Snapshot

As part of the data protection requirements, OpenStack Block Storage also allows for creating snapshots of volumes. Block-level volume snapshot is crash-consistent, so it is best if the volume is not connected to an instance when the snapshot is taken. Since you have only written a small amount of static data to the new Volume, you will force the Cinder to create a snapshot of the attached volume.

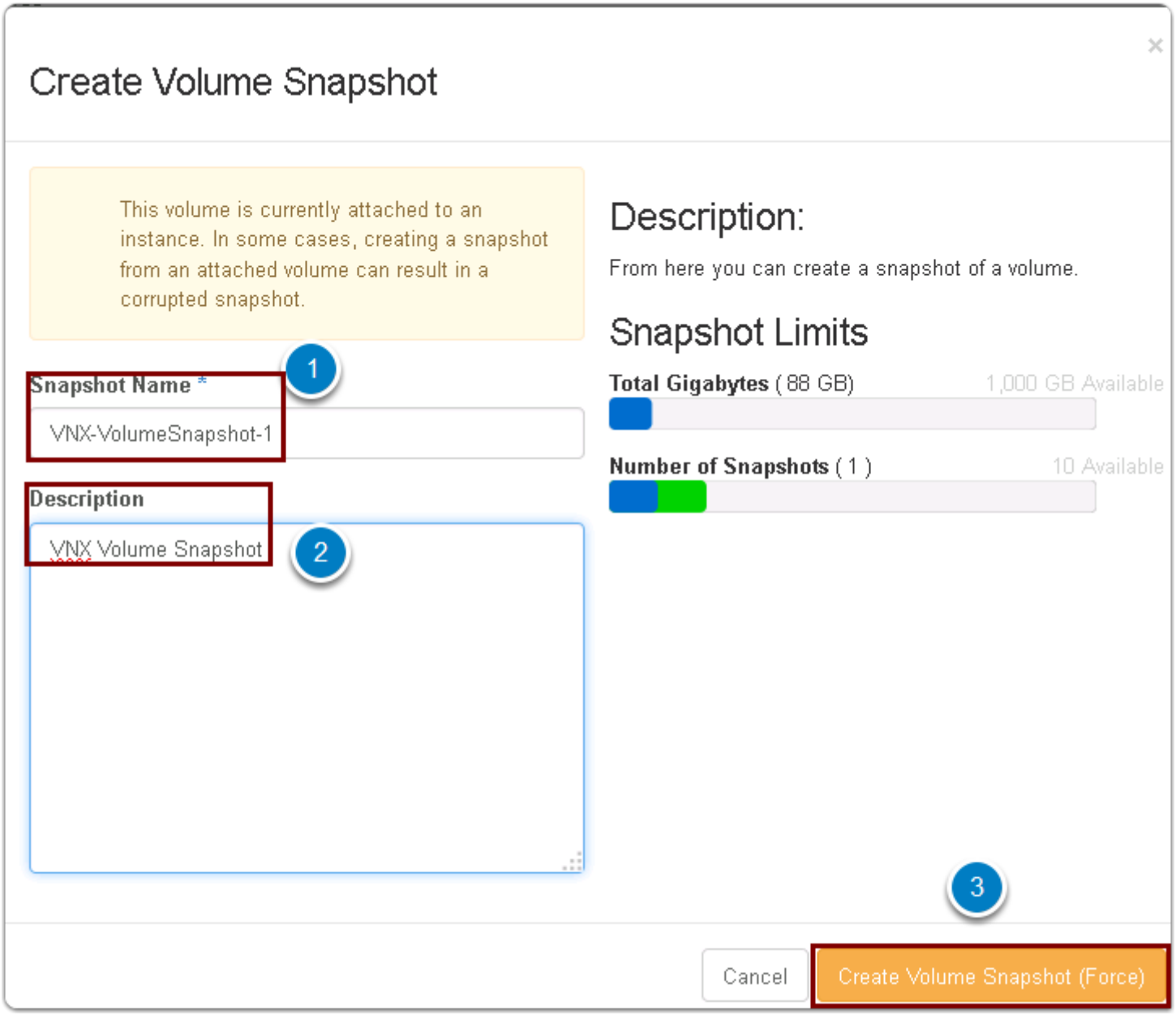
1. Please return to the OpenStack Horizon in your Firefox browser and select the Volumes tab
2. Click on the drop-down menu next to our VNX-ThinVolume-1
3. Select Create Snapshot option



8.5 Snapshot Details

Please provide Snapshot details as needed:

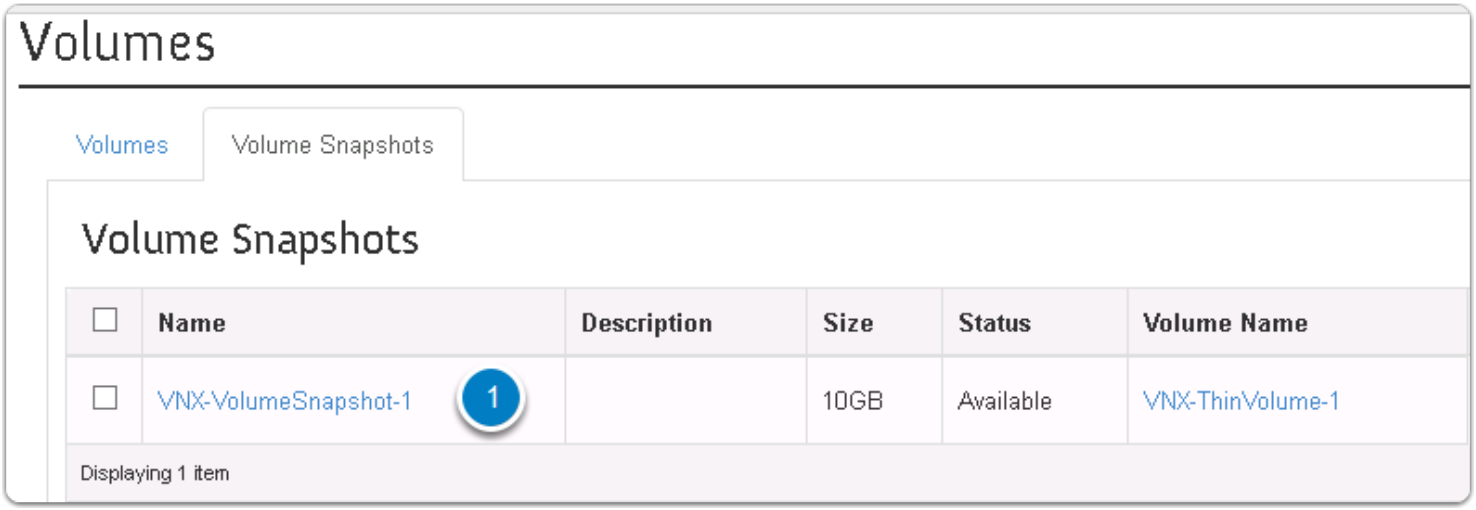
1. Snapshot **Name:** VNX-VolumeSnapshot-1
2. **Description:** VNX Volume Snapshot
3. Click **Create Volume Snapshot (Force)** to continue



8.6 Volume Snapshots

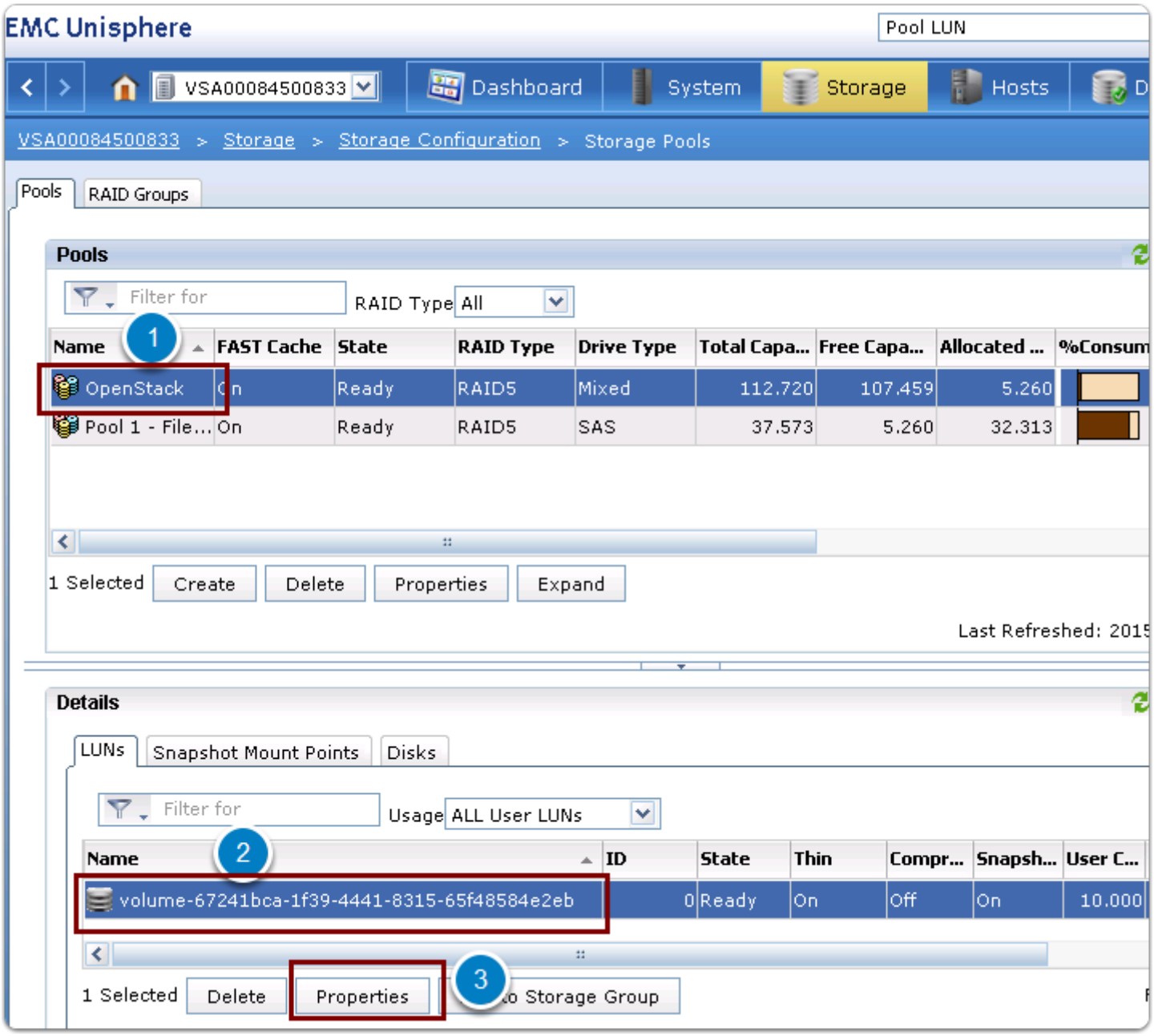
1. Review the details of the newly created Volume Snapshot

Next please switch to the **EMC Unisphere** browser window - you will review the volume snapshot on the VNX storage array.



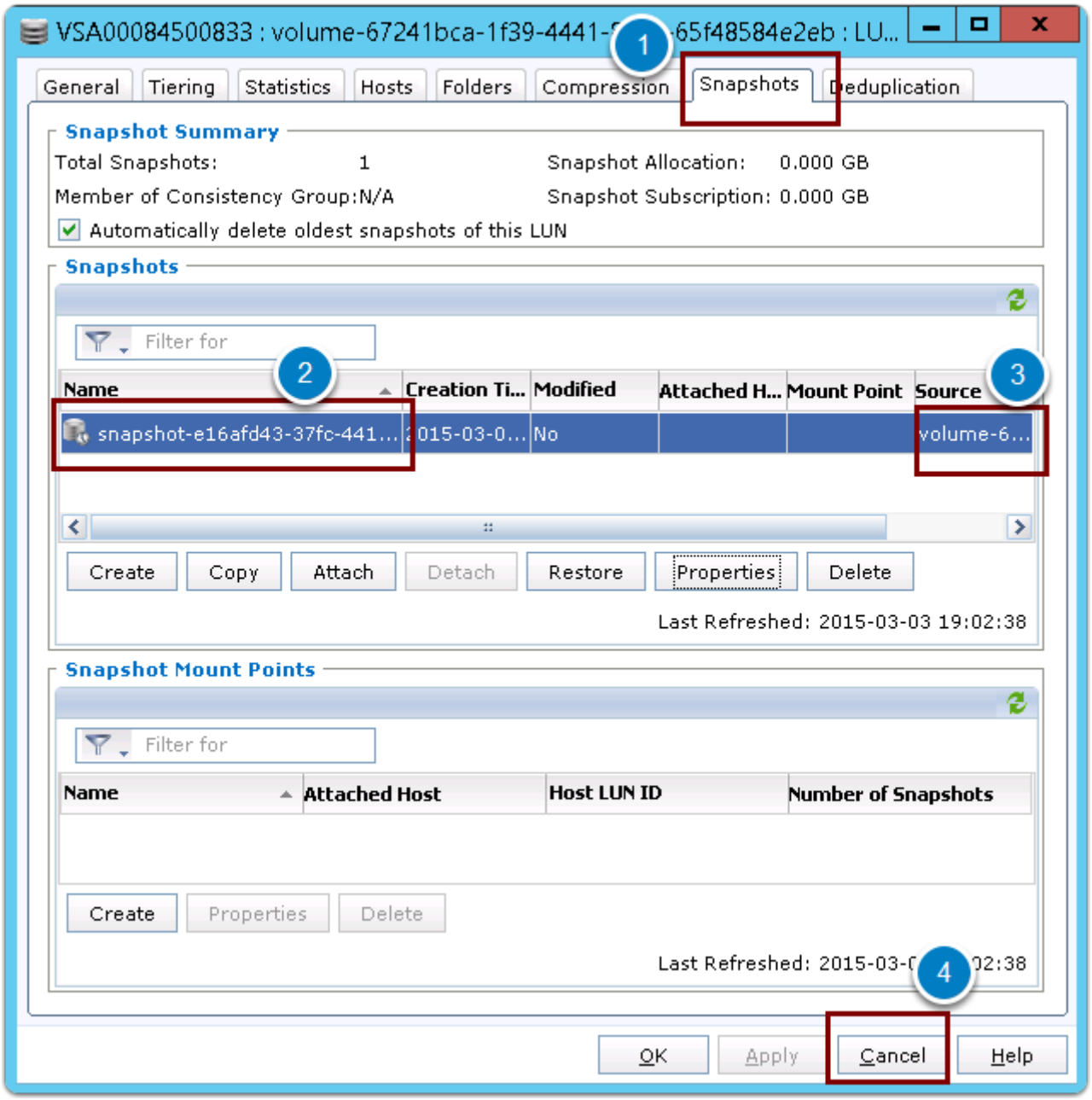
8.7 Volume Snapshot on VNX

1. Please select our **OpenStack** storage pool
2. Then select the **Volume** you created earlier - if you had the volume properties already open, please close this window and then click on the OpenStack storage pool again
3. Select **Properties**



8.8 Snapshot Properties

1. Select the **Snapshot** tab in the the Volume Properties dialog
2. Review the newly created **Snapshot**
3. Review the **Source** - our VNX Volume
4. Click **Cancel** and then minimize the Unisphere browser window.



9. Conclusion

In this lab you, wearing the hat of Code Nebulous Cloud Administrator, have successfully accomplished the following:

- Deployed and configured EMC VNX Cinder driver to use the VNX arrays block storage as a backend
- Created Cinder volume types associated with the VNX storage pools
- Create and attached a new block volume to an active OpenStack instance
- Logged into Cloud-Workload instance to format and mount the newly created volume
- Written applications data into the new volume and take a snapshot.

Now the Code Nebulous Cloud Users can begin building and using the applications running on the Cloud-Workload instance and store its data on the persistent block volume.

This lab is now complete. Please close the following windows as you will not be using them any longer:

- **Lab-1-VNX-Cinder** folder
- **EMC Unisphere** browser window
- **4_VNX_Cinder_Config_Commands** file
- Close **SSH Terminal** Window

Please proceed to the next lab, or select other labs from the list.

Lab 2 - Using EMC XtremIO with Cinder Block Storage Service

Lab 2 - Using EMC XtremIO with OpenStack Cinder Block Storage

EMC XtremIO is an all-flash purpose-built platform for production and dev/test with predictable scaleable performance.

While this lab does not include XtremIO Storage simulator, you will still be able to:

- Deploy an XtremIO Cinder driver
- Perform driver configuration steps
- Create XtremIO Volume types

1. Supported Operations

XtremIO Cinder driver supported operations are available at: http://docs.openstack.org/trunk/config-reference/content/emc-xtremio-driver.html

- Create, delete, clone, attach, and detach volumes
- Create and delete volume snapshots
- Create a volume from a snapshot
- Copy an image to a volume
- Copy a volume to an image
- Extend a volume

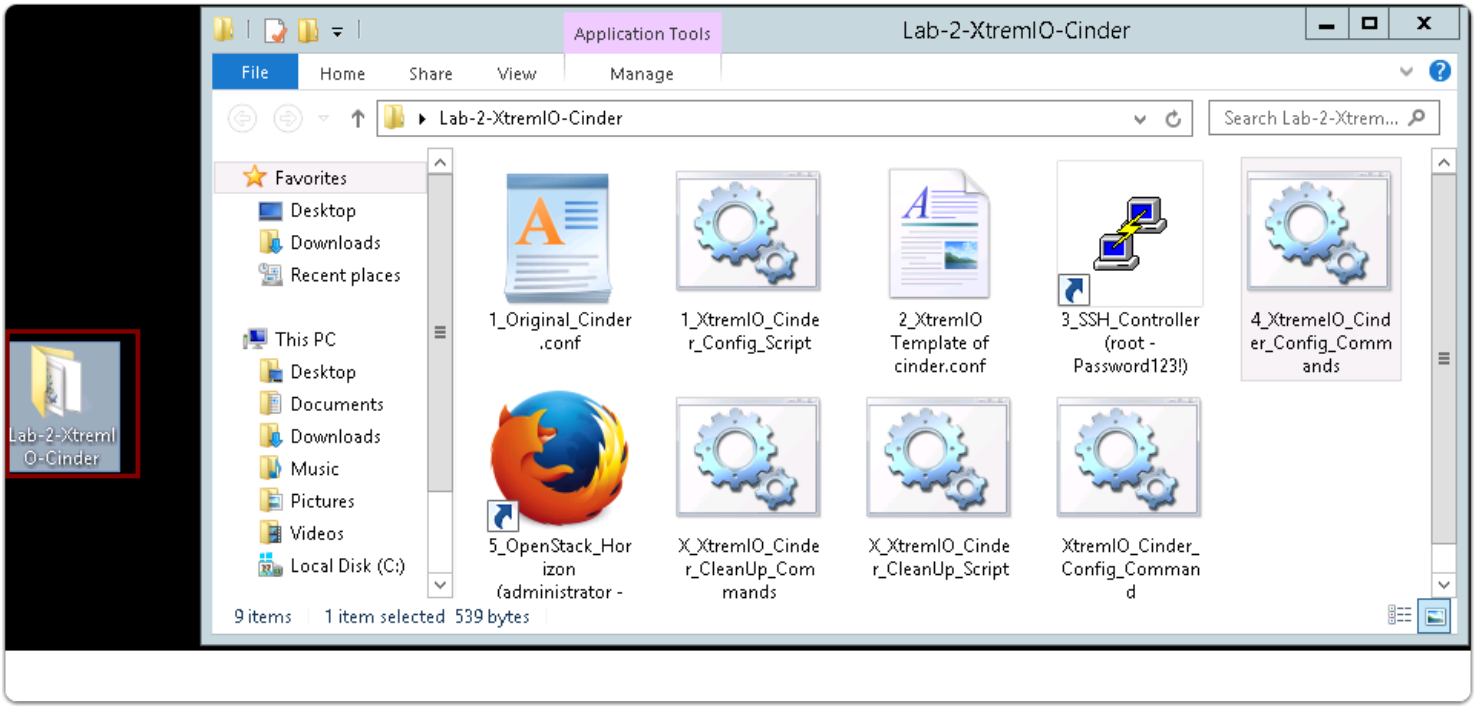
2. Lab Scenario

In this lab as a Cloud Admin will:

- Review the Cinder driver capabilities for EMC XtremIO, including extra-specs
- Review and become familiar with the XtremIO direct Cinder drivers configuration steps
- Follow the configuration steps and implement Cinder integration with EMC XtremIO Storage backend
- Create storage volume types for OpenStack Volumes and associate the Volume Types with Storage Pools
- Review newly available volume types in Horizon

3. Lab-2: XtremIO with Cinder Folder

Review Lab-2 folder



4. XtremIO Cinder Driver

In this section of the lab you will perform configuration steps that are required to enable XtremIO storage backend for OpenStack Cinder service.

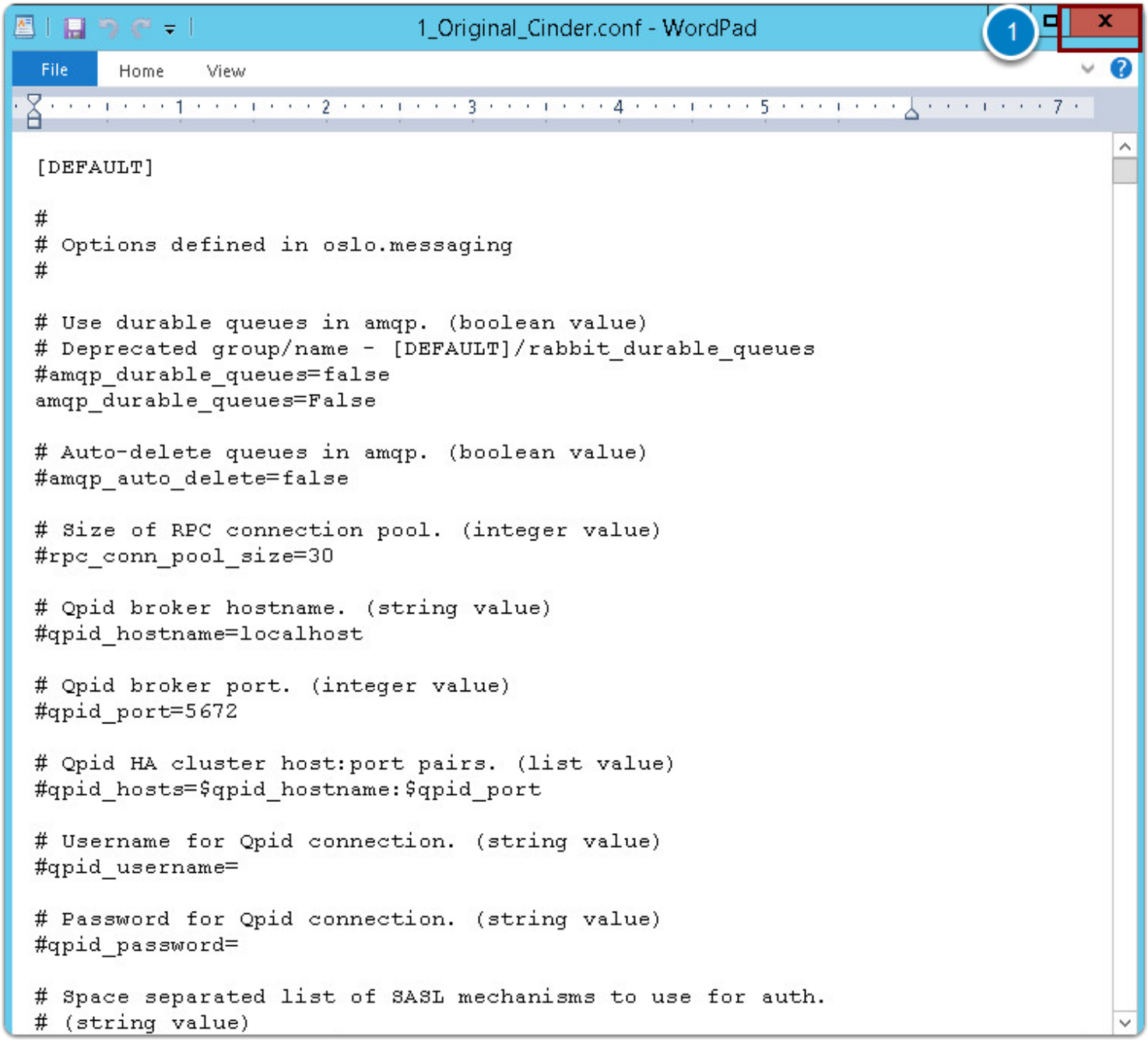
Here are the installation steps - please review these steps ONLY, do NOT perform them, as the lab environment has already been prepared for you.

- XtremIO Cinder driver is available in the trunk of the OpenStack Juno release and is a part of every OpenStack software distribution
- XtremIO driver configuration involved making changes to the file called **/etc/cinder/cinder.conf,** containing parameters for the REST API endpoint and Storage Pool.

Please expand the Lab-2-XtremIO-Cinder folder and double-click on **1_Original_Cinder.conf** file shortcut:

4.1 Cinder Configuration File

1. As you can see, the original Cinder configuration file is fairly large and complex. Please review the the file and then close it.



4.2 XtremIO Cinder Configuration

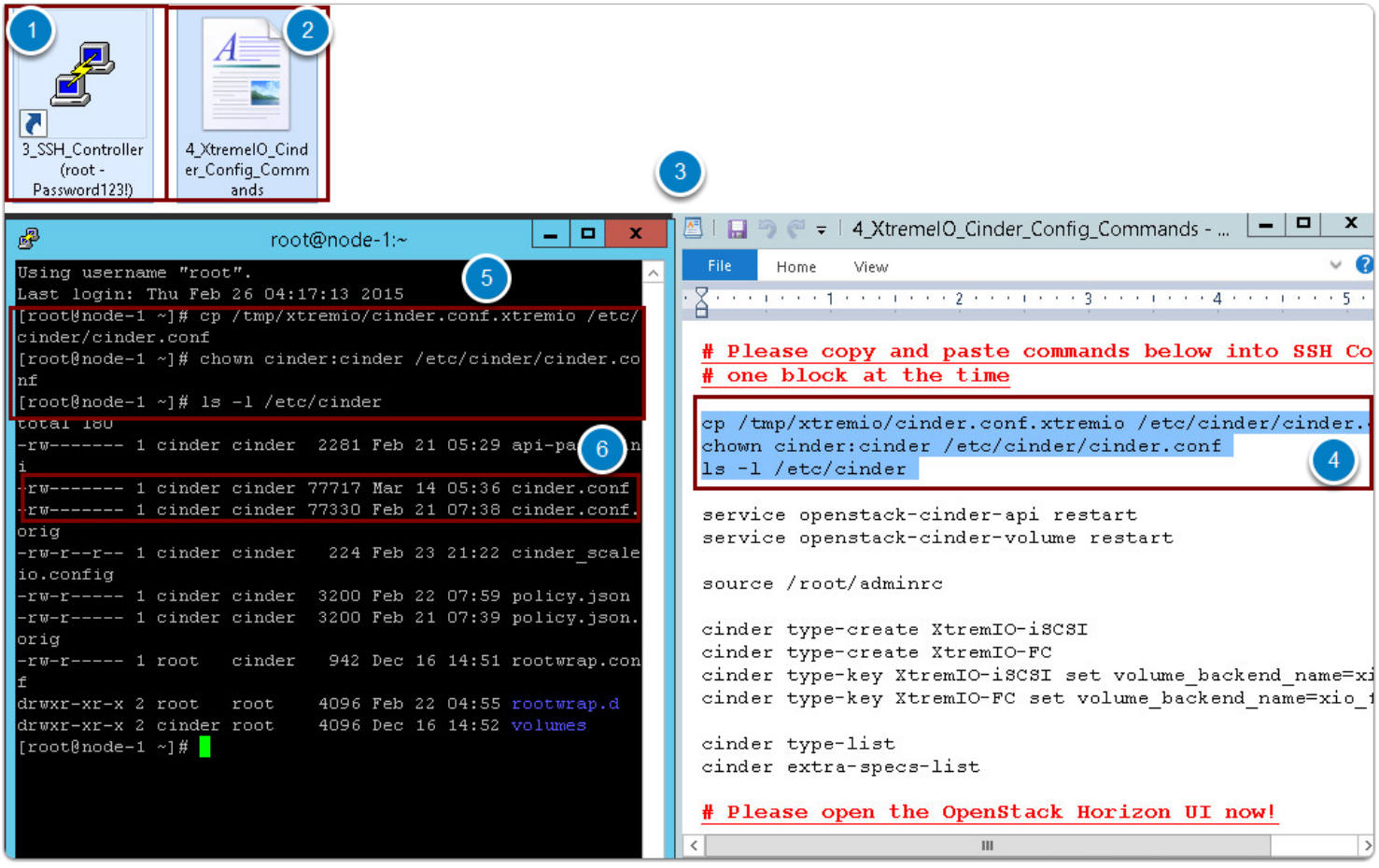
A template has been provided with all necessary settings for enabling XtremIO backend for Cinder.

1. Please open the file called **2_XtremIO_Template_of_Cinder.conf** in the **Lab-2-XtremIO-Cinder folder**
2. Please review the configuration for enabling **XtremIO iSCSI** and **FibreChannel** (FC) backends in the **DEFAULT** section.
3. Review the REST API parameters for **iSCSI** configuration
4. Review the REST API parameters for **FC** configuration
5. Please **close** the file when finished.

4.3 Using PuTTY SSH Client

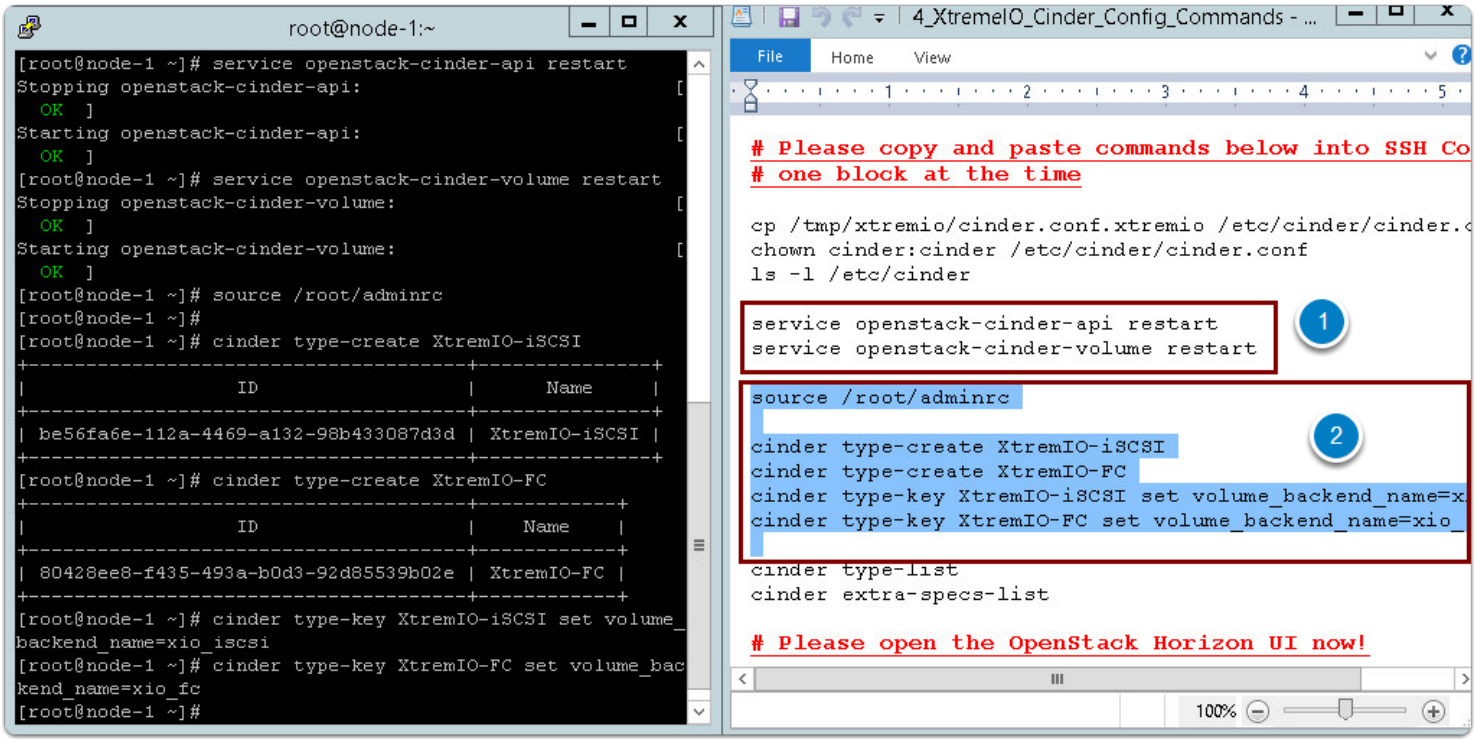
To save you some time in running this lab, a file has been created with the commands to be executed on the OpenStack Controller Node to install and configure XtremIO Cinder driver.

1. Please open PuTTY shortcut to OpenStack Controller Node using shortcut called **3_SSH_Controller**
2. Then open **4_XtremIO_Config_Commands** file
3. Please arrange the open **SSH Terminal** window and the **command** file side by side as shown - you will be copying the commands from the file into terminal window using right click, Copy and Paste.
4. It is recommended to copy and paste commands into **SSH Terminal** window as a block. Blocks are separated by blank lines
5. Please copy the first command block and paste into **SSH Terminal** window using right-click. A copy of the **cinder.conf** file has been created in the **/tmp** directory with all necessary settings you have reviewed earlier - this file is copied over the original **/etc/cinder/cinder.conf** file. It is also necessary to change the ownership of this file to **cinder** user
6. Please review the updated **cinder.conf file**



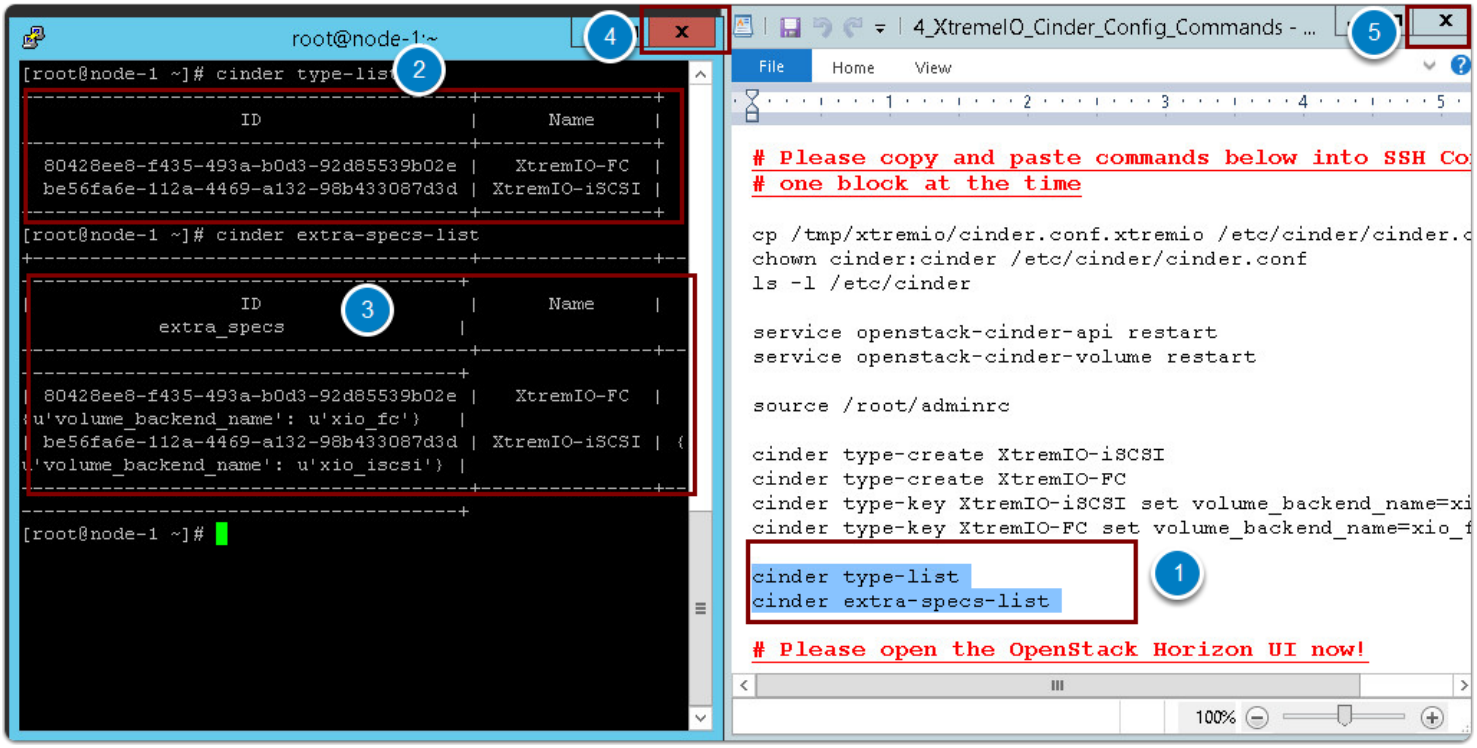
4.4 Running Configuration Commands on the Controller

1. It is necessary to restart the Cinder API and Volume services to read the new configuration files.
2. Next you will create **XtremIO Volume Types** - please copy and paste the command blocks into SSH Terminal window.



4.5 Reviewing XtremIO Volume Types

1. Please copy and paste the last command block into **SSH Terminal** window
2. Review the newly created **XtremIO Volume Types. Note:** you may see other volume types created earlier in the previous labs
3. Review the extra specs assigned to these new **Volume Types.**
4. That's it - the XtremIO Cinder driver configuration is now complete! Please close the **SSH Terminal** window (confirm exit as necessary)
5. Please close the **Config commands** file.

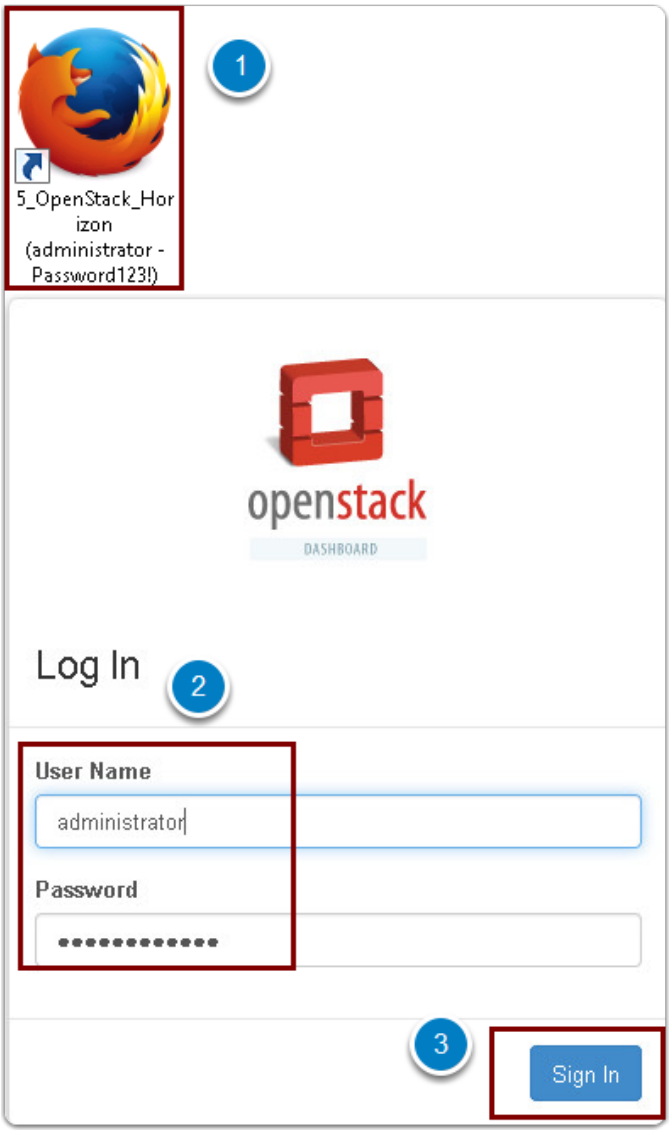


5. Using OpenStack Horizon UI

1. Return to the **Lab-2-XtremIO-Cinder folder** and launch the **5_OpenStack_Horizon(administrator - Password123!)** shortcut
2. The user credentials should be cached in the browser window. If needed please type the credentials:

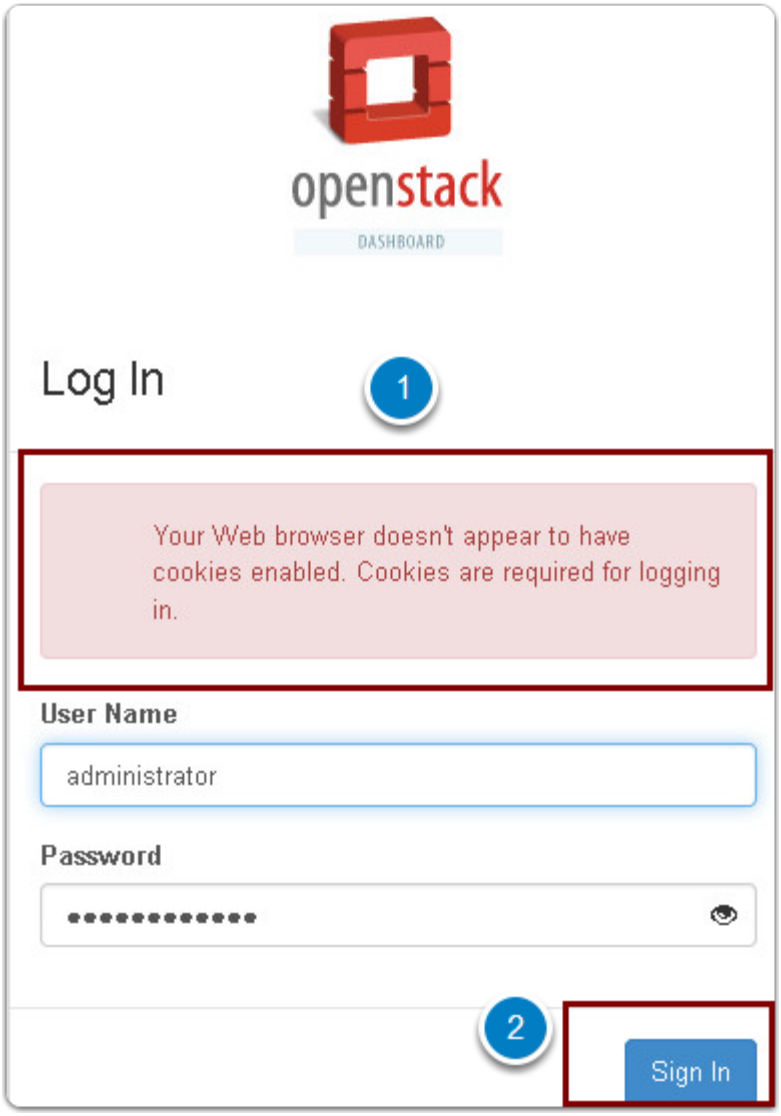
- User Name: **administrator**
- Password: **Password123!**

3. Click **Sign In** to continue



5.1 Browser Cookie Warning

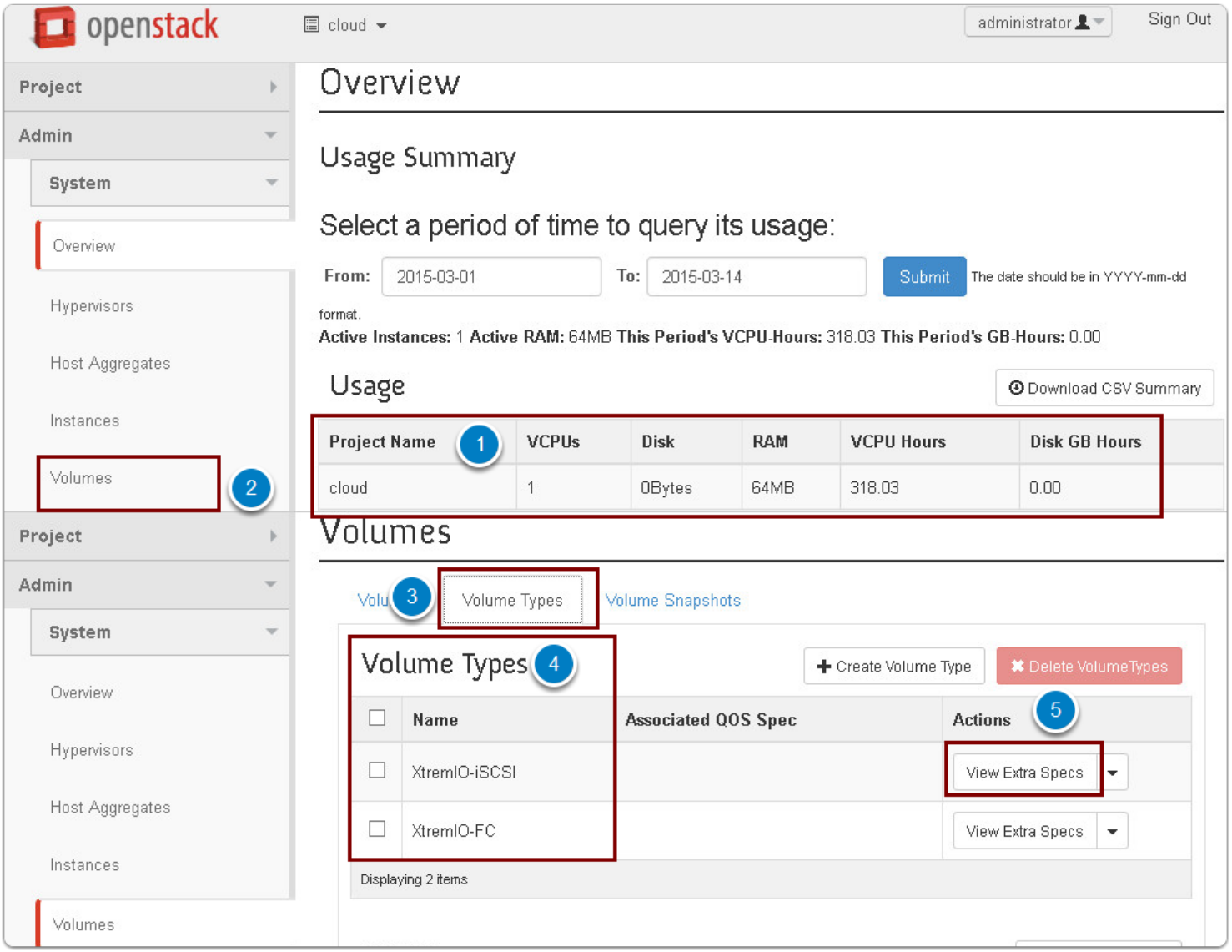
1. Occasionally you may see a browser cookie warning
2. Please disregard it and simply click on **Sign In** again to continue



5.2 Reviewing XtremIO Volume Types

1. Please review the **Dashboard** for OpenStack project - **cloud**
2. Please select **Volumes** In OpenStack Horizon Admin menu on the left hand side
3. Select **Volume Types** tab

4. Review your created **XtremIO volume** types. **Note:** you may see other volume types created earlier in the previous labs
5. Please click on the **Extra Specs** menu to see the volume type details.



5.3 Volume Type Extra Specs

1. Please review the **XtremIO Volume Type extra specs** - these were configuration parameters you have provided while creating this **Volume Type**. These parameters correspond to the XtremIO backend conifguration.

6. Conclusion

Congratulations! In this lab you, wearing the hat of Code Nebulous Cloud Administrator, have successfully accomplished the following:

- Deployed and configured **EMC XtremIO** Cinder driver to use the XtremIO array block storage as a backend
- Created Cinder volume types associated with the XtremIO storage pools

Now Code Nebulous Cloud Users can begin building and using the applications running on the Cloud-Workload instance and store its data on the persistent block volume.

This lab is now complete. Please close the following windows as you will not be using them any longer:

- **Lab-2-XtremIO-Cinder** folder

Please proceed to the next lab, or select other labs from the list.

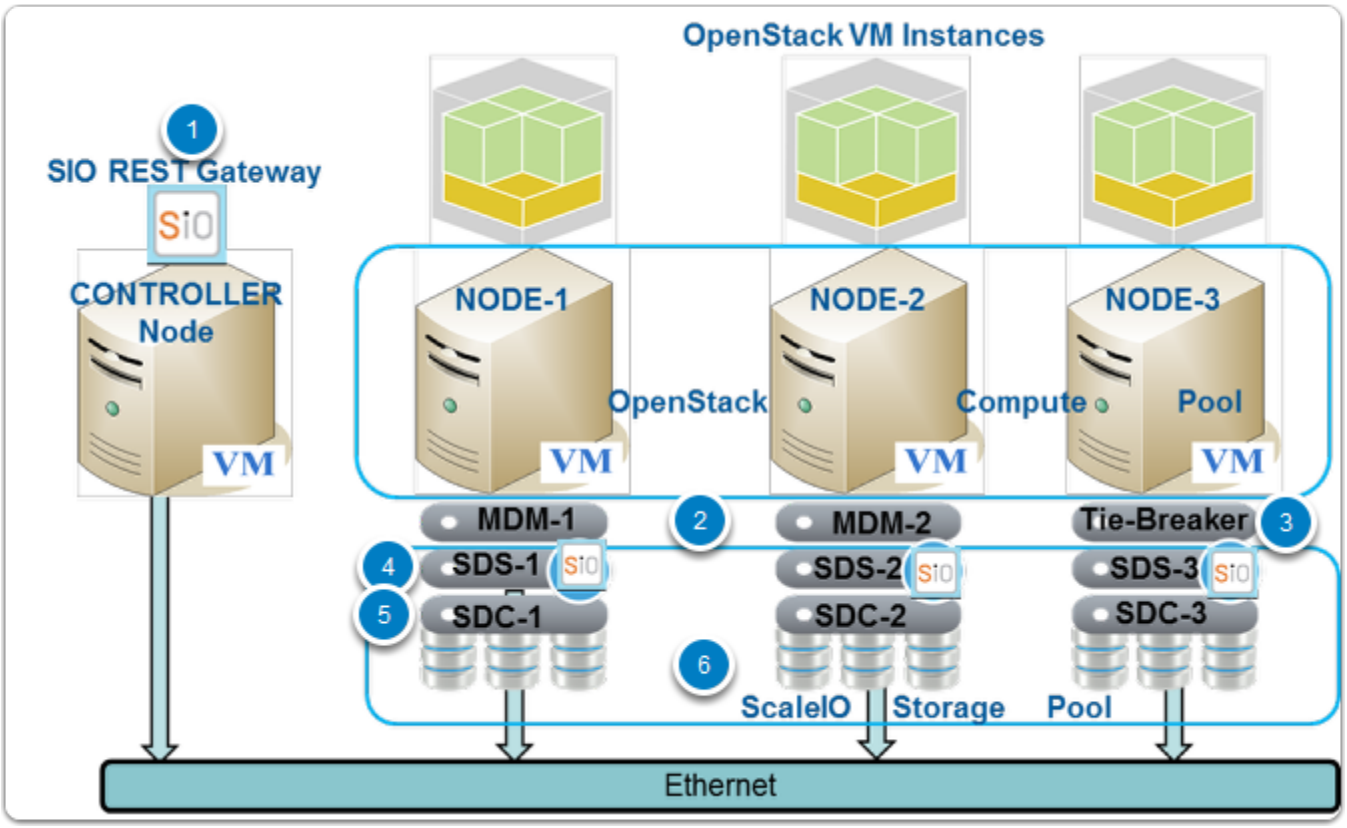
Lab 3 - Using EMC ScaleIO with Cinder Block Storage Service

Lab 3 - Using EMC ScaleIO with OpenStack Cinder Block Storage

1. ScaleIO Components

In this lab environment, a typical ScaleIO deployment architecture has been implemented that includes:

1. **REST API Gateway** deployed on the **OpenStack Controller** node. This gateway also hosts the ScaleIO Installation Manager web application - you will be using it to deploy the ScaleIO cluster components.
2. **Metadata Managers (MDM)** deployed on two of the OpenStack Compute nodes (The MDM's can also be deployed on the Controller nodes in the Highly-Availabile OpenStack envinronment)
3. **Tie-Breaker (TB)** deployed on the third **OpenStack Compute** node
4. **Storage Data Server (SDS)** deployed on each **OpenStack Compute** node
5. **Storage Data Client (SDC)** deployed on each **OpenStack Compute** node
6. **SDC's** present the local disks on Compute nodes as part of the global **ScaleIO Storage Pool**



2. Lab Scenario

In this lab as a Cloud Admin you will:

- Review the Cinder driver capabilities for EMC ScaleIO, including extra-specs
- Review and become familiar with the ScaleIO Cinder drivers configuration steps
- Follow the configuration steps and implement Cinder integration with EMC ScaleIO Storage backend
- Create storage volume types for OpenStack Volumes and associate the Volume Types with Storage Pools
- Practice creating new volumes for different Volume Types
- Ensure that new Volumes are created using EMC ScaleIO User Interface (UI)
- Verify that new Volumes can be attached to an OpenStack VM instance
- Ensure that new Storage Volume can be mounted and formatted by logging into VM instance using SSH
- Practice performing volume life-cycle management tasks (extend, dedup, compress, etc.)

3. Integration with OpenStack

The ScaleIO elastic storage solution includes a Cinder driver, which interfaces between ScaleIO and OpenStack, and presents volumes to OpenStack as block devices which then become available to Cinder block storage.

It also includes an OpenStack Nova driver, for handling compute and instance volume related operations.

In an OpenStack Cloud, the ScaleIO components SDS and SDC can be installed on the Compute Nodes to present their commodity disc as a single (or multiple) elastic storage pool.

The ScaleIO driver executes the volume operations by communicating with the backend ScaleIO MDM through the ScaleIO REST Gateway. This REST API Gateway can be installed on one of the OpenStack Controller nodes, while MDM's and Tie-Breaker can be installed on other Controller nodes.

3.1 Supported Operations

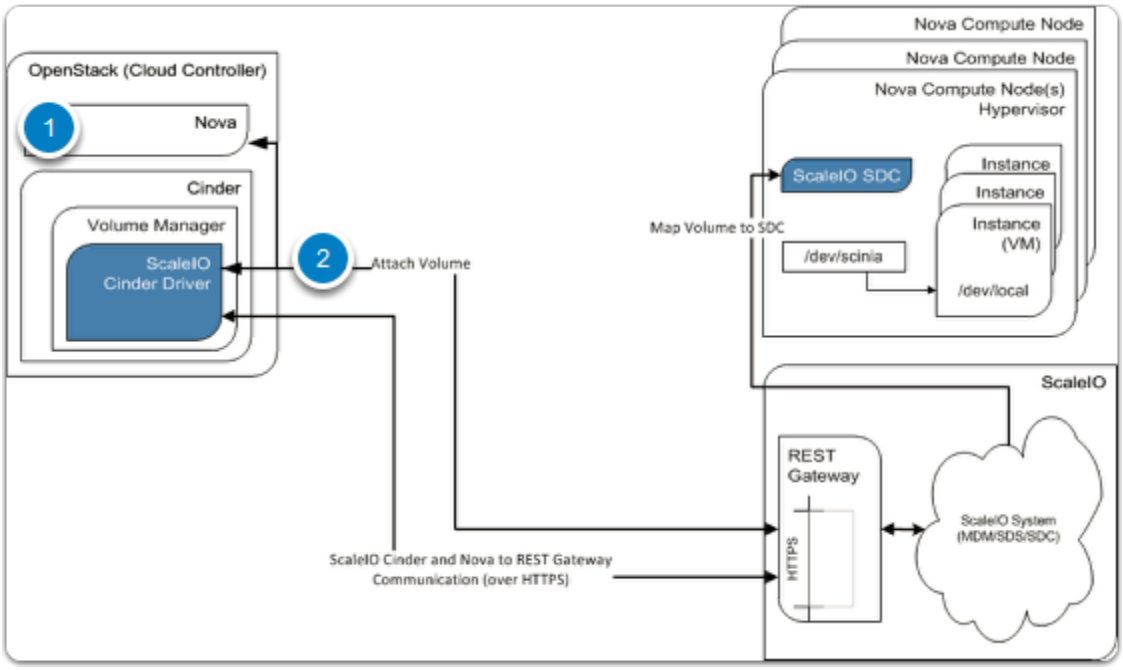
The ScaleIO Cinder driver supports the following operations:

- Create volume
- Delete volume
- Attach volume
- Detach volume
- Create snapshot
- Delete snapshot
- Create volume from snapshot
- Create cloned volume
- Copy image to volume
- Copy volume to image
- Extend volume

3.2 Volume Mapping Flow

The following figure shows a typical flow for mapping a volume. The OpenStack flow is as follows:

1. Create volume (Cinder operation)—calls the ScaleIO add_volume command
2. Attach volume to instance—initiated by Nova compute manager by calling attach_volume
3. Triggers the Cinder driver to perform the volume attach operation at the storage side (initialize_connection)—not needed in the ScaleIO scenario.
4. Nova LibvirtDriver attach_volume is called, which calls the connect_volume of the specific LibvirtVolumeDriver (determined by the volume_driver_type that the Cinder driver returns in the connection information) to finish the attach operation on the Hypervisor side. This calls the ScaleIO map_volume_to _SDC command and then verifies that the volume is exposed to the hypervisor.
5. After the volume is attached to the compute node, it is passed through to the VM by OpenStack.



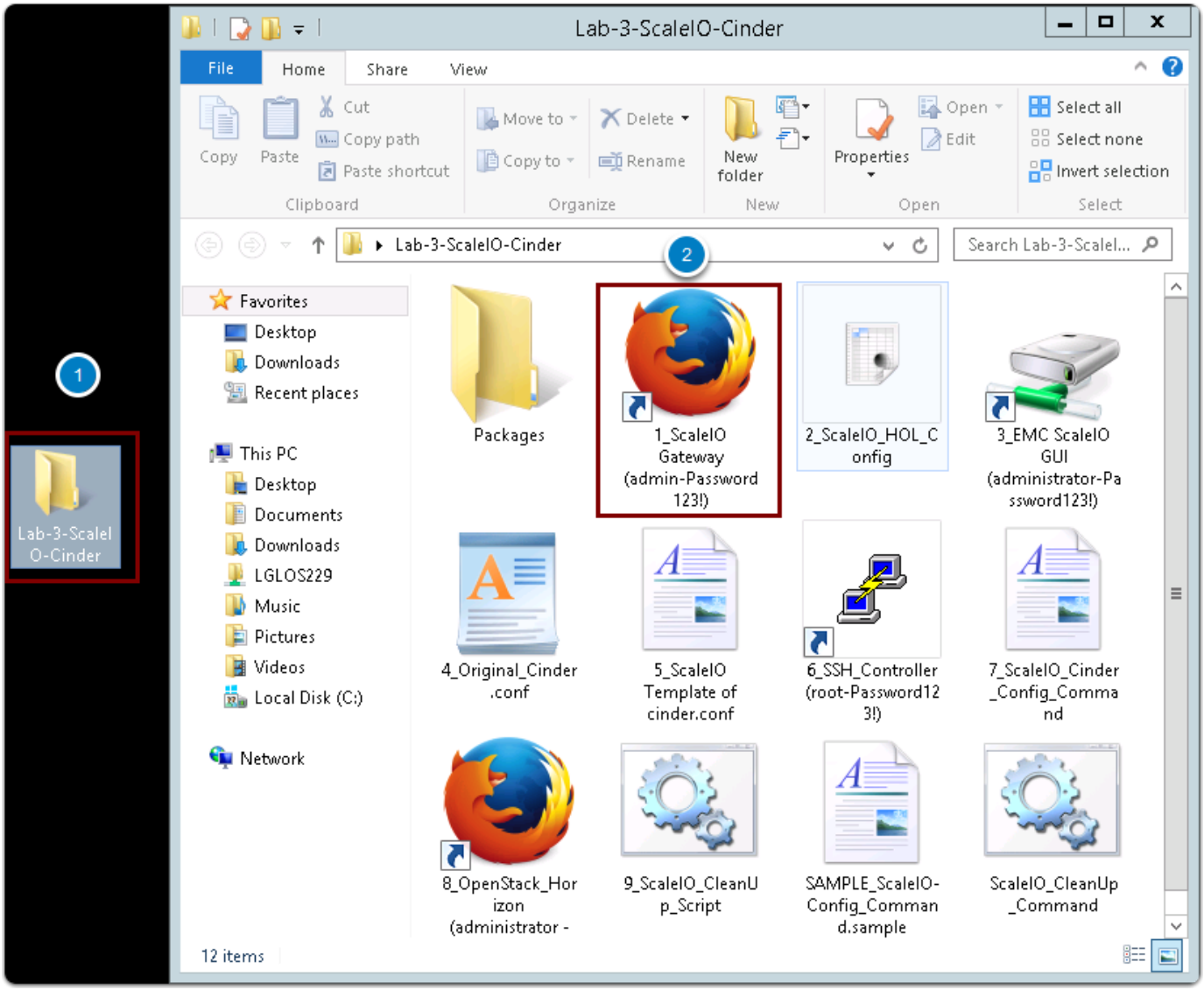
4. Installing ScaleIO on Compute Nodes

For your convenience and in the interests of time, a pre-installed ScaleIO REST API Gateway has been installed on the OpenStack Controller node.

As a Cloud Admin you will now install other ScaleIO Software Defined Storage components on the Compute nodes of the OpenStack Cloud.

1. Please open the **Lab-3-ScaleIO-Cinder** folder on your **Desktop**

2. Select the shortcut in the Lab-3-ScaleIO-Cinder folder called **1_ScaleIO Gateway**

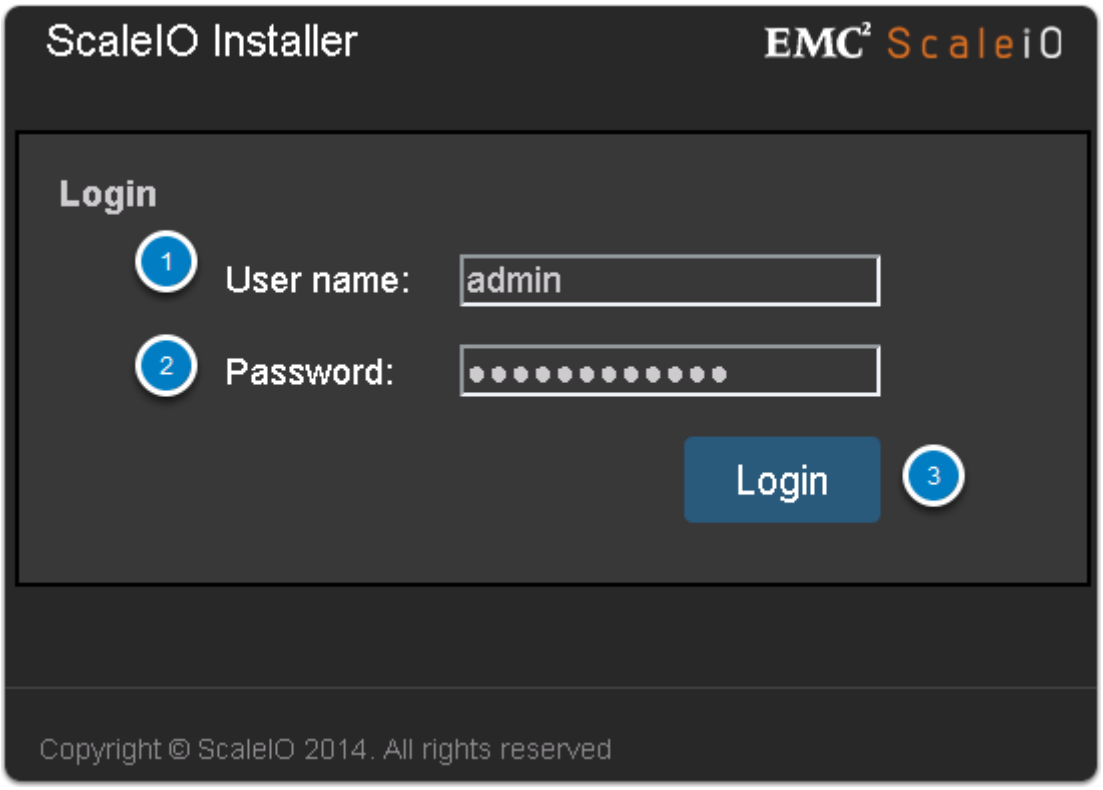


4.1 Logging into ScaleIO Installation Manager (IM)

Please login into **ScaleIO Installation Manager**. The user credentials are cached in your browser.

However, just in case you need to type the credentials in, please use:

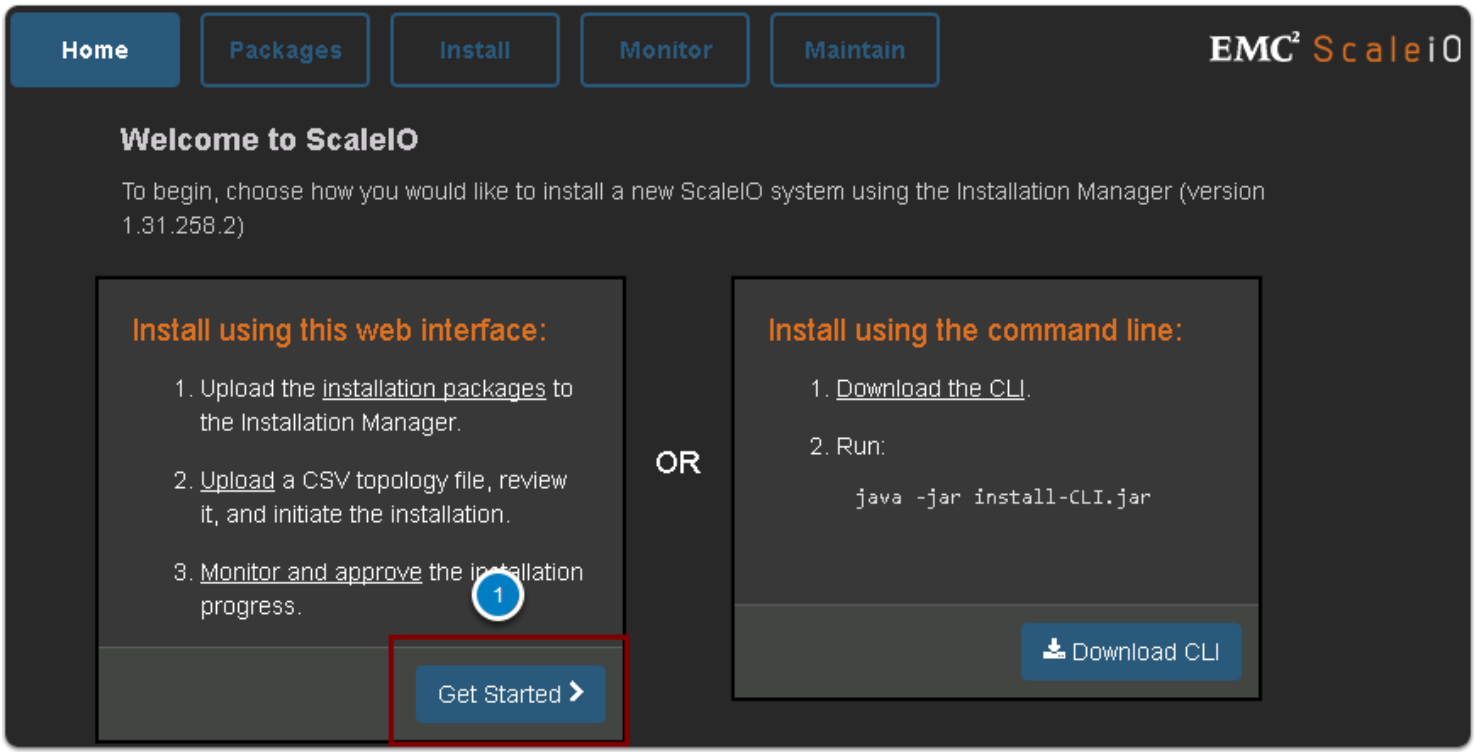
1. User name: *admin*
2. Password: *Password123!*
3. Click **Login** to continue



4.2 Getting Started

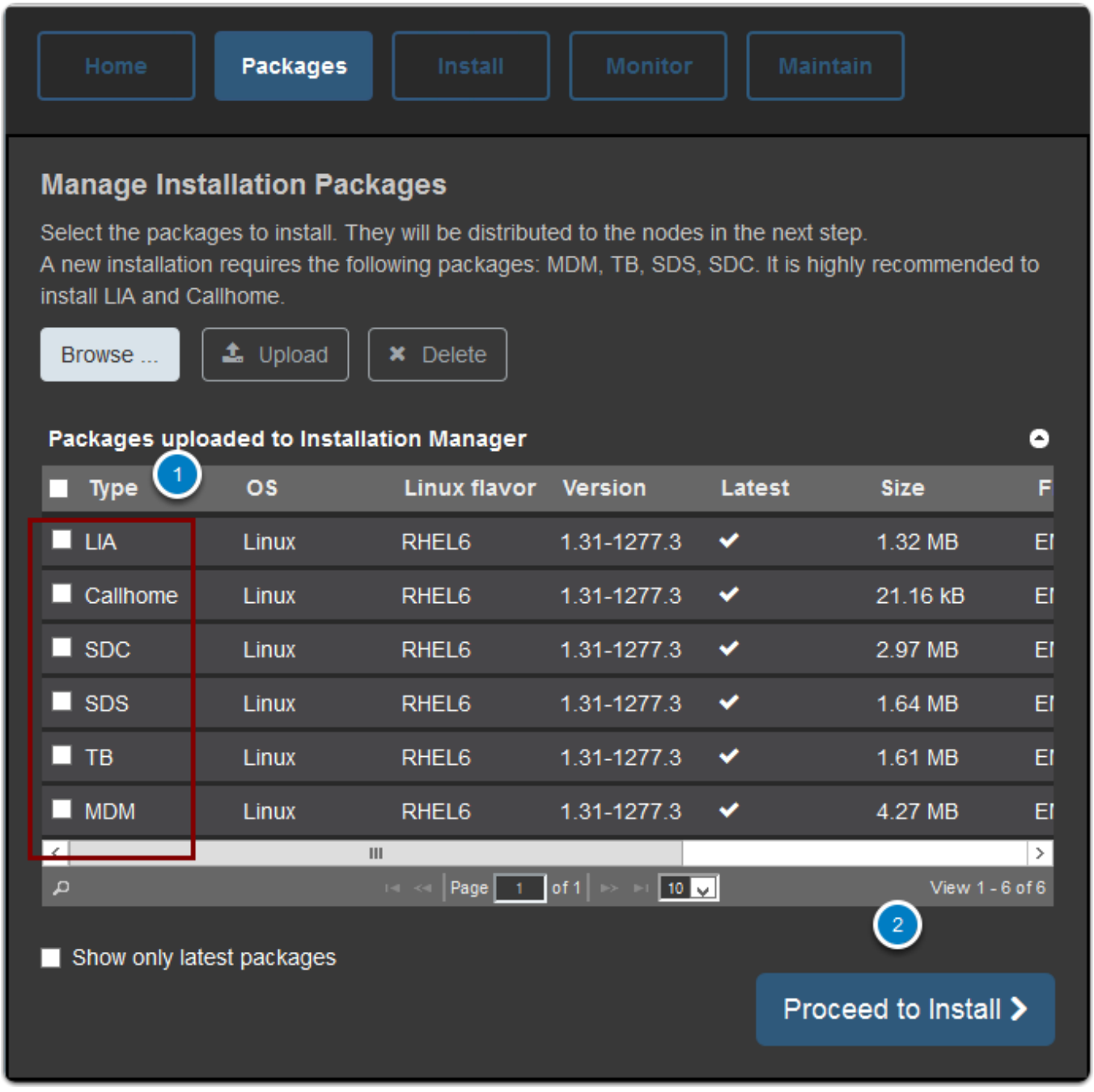
While the ScaleIO installation can be performed manually using CLI, or automated or scripted for deployment in the production cloud environment, for the purpose of this lab you will begin the installation using the **ScaleIO Installation Manager.**

1. Please click on "**Get Started**"



4.3 Installation Packages

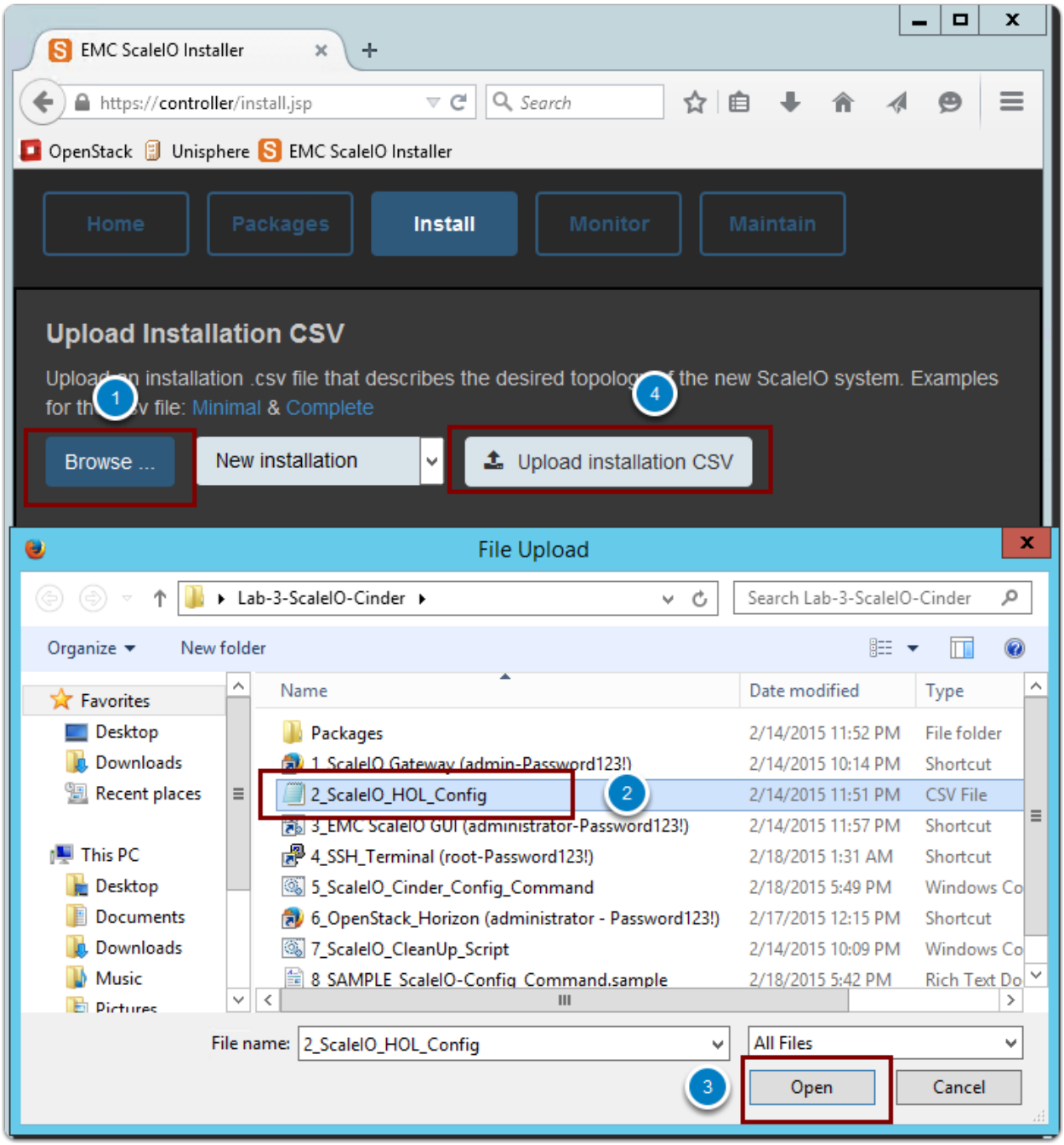
1. Please review all pre-loaded packages - these are the ScaleIO components to be installed on the OpenStack Compute nodes
2. Then click **Proceed to Install.**



4.4 Using Configuration Template

While you can provide all necessary information about Compute nodes, such as the IP addresses and login credentials, the ScaleIO **Installation Manager** can also use a CSV file that contains the information about the intended MDM, SDS and SDC deployment.

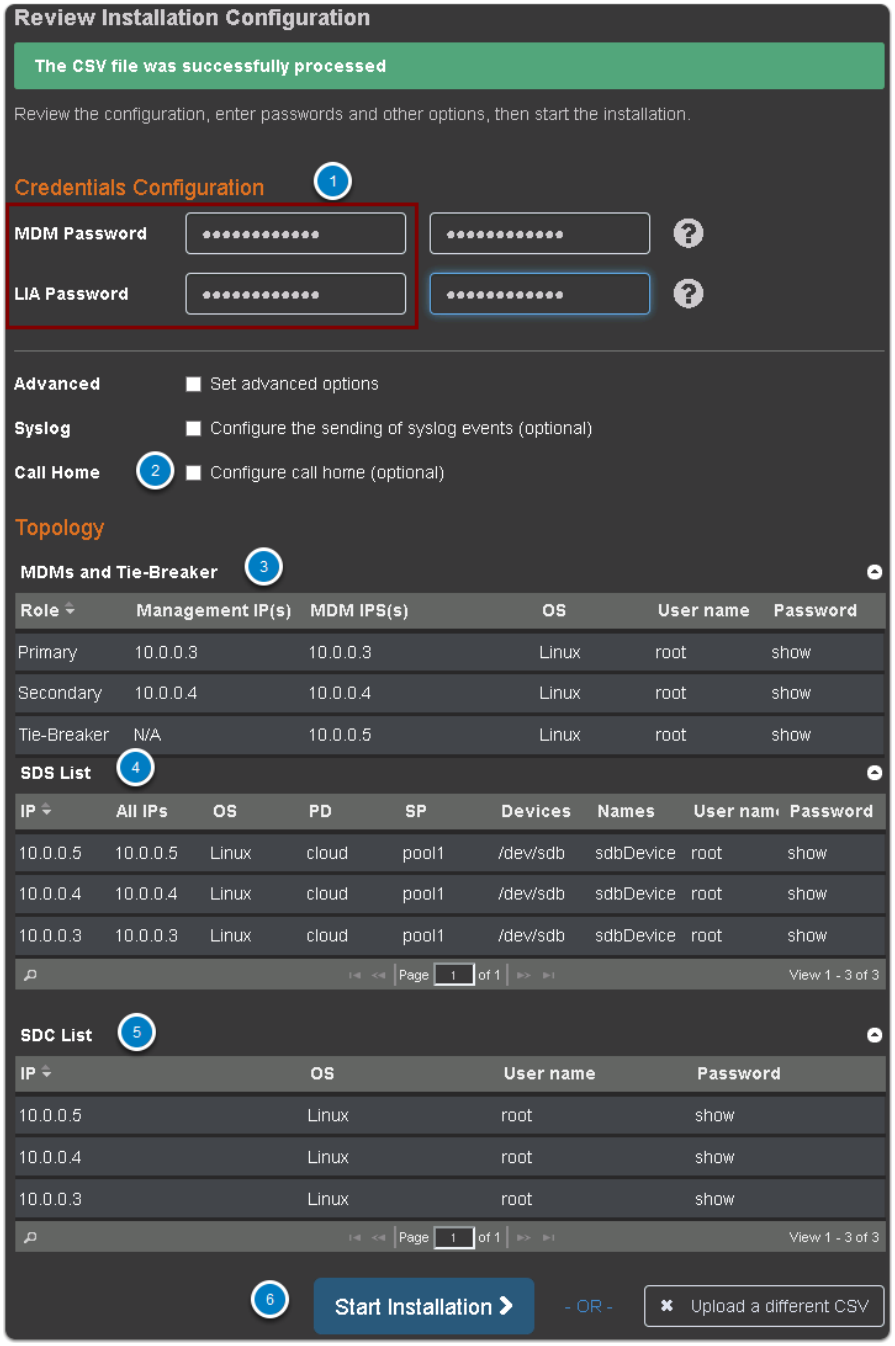
1. Click on **Browse** button to locate the installation.csv file
2. Select **2_ScaleIO_HOL_Config.csv**
3. Click **Open**
4. Then click on **Upload installation CSV** to continue;



4.5 Review Configuration

1. Please type in **MDM** and **LIA** password as shown in the boxes: ***Password123!*** - Please make sure that you type the password **twice** for each credential.
2. Make sure to **uncheck** the **Call Home checkbox** - in the interest of time you will not be installing the **Call Home** package.

3. Please review and verify the installation topology of MDM 's and Tie-Breaker on the provided Compute nodes
4. Review and verify the installation topology of the SDS modules
5. Review and verify the installation topology of the SDC modules
6. Click on **Start Installation** to continue

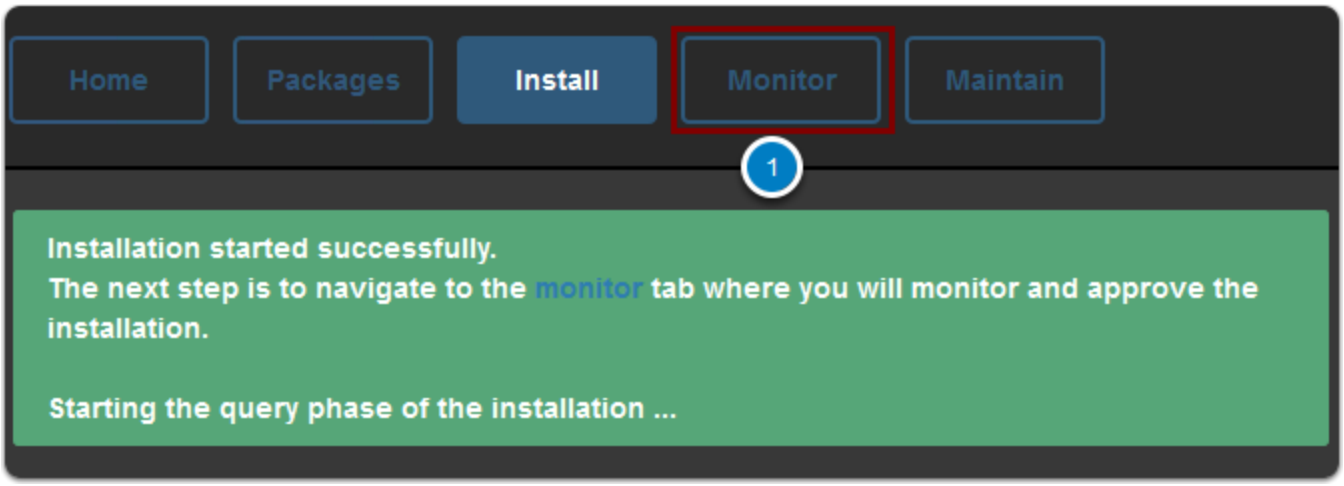


5. ScaleIO Installation Process

The installation process will take you through verification of the compute nodes, uploading the installation packages and configuring the ScaleIO cluster.

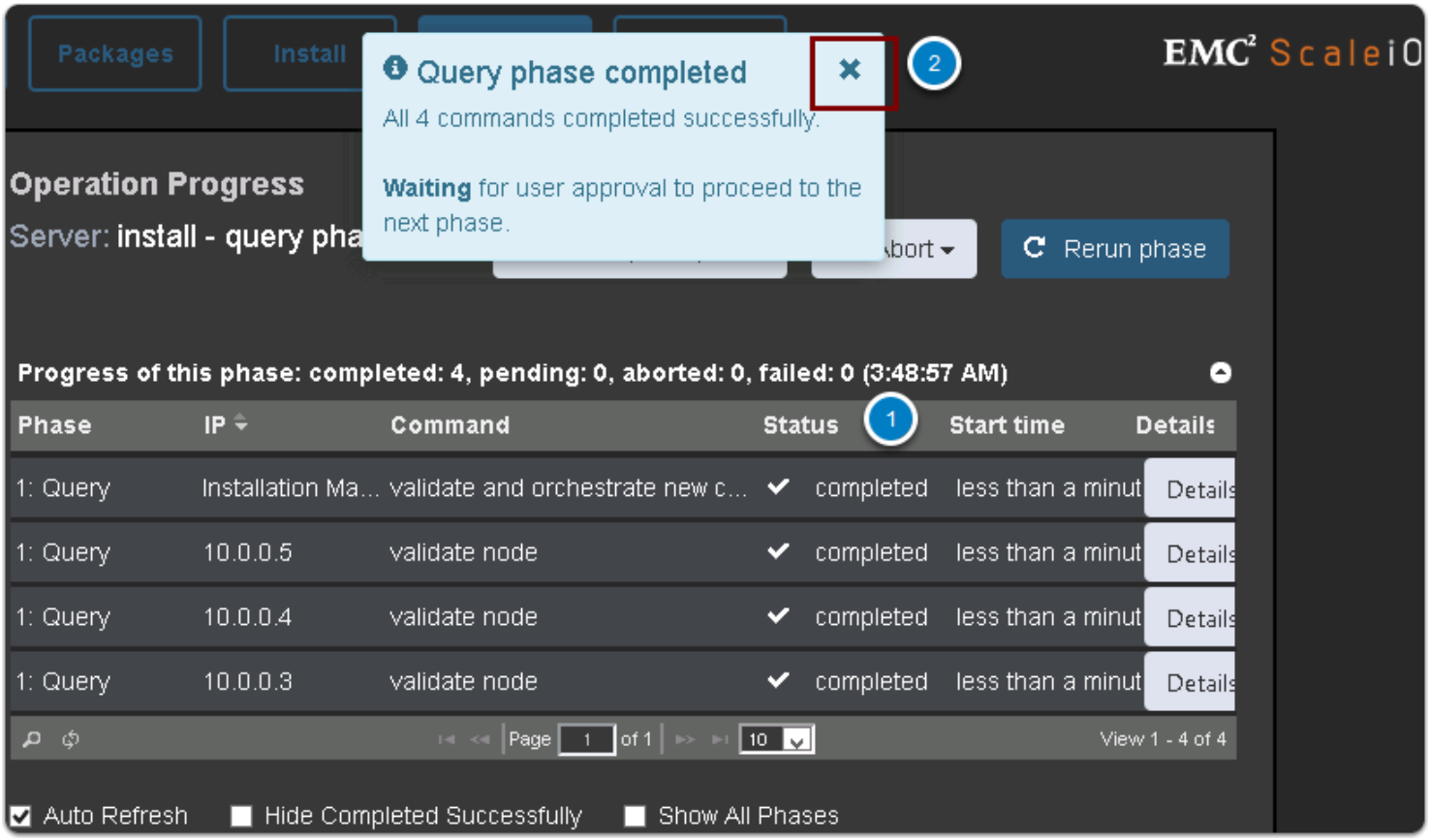
5.1 Monitoring the Installation

Click on **Monitor** tab to observe the installation process and approve the installation phases..



5.2 Query Phase

1. Please review the **Query Phase** - verify that all tasks have completed successfully.
2. Confirm the completion of the **Query phase** by closing the notification window

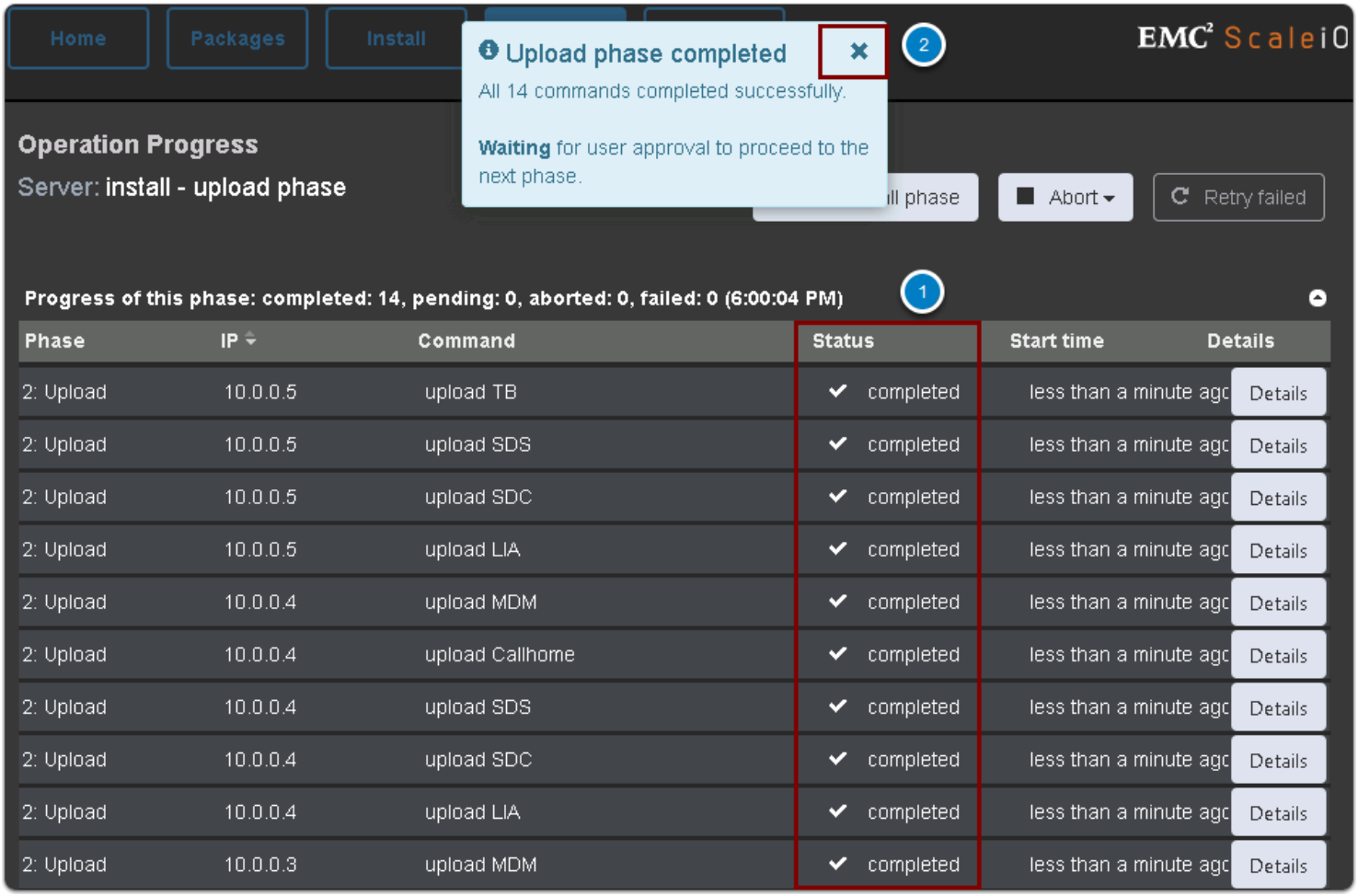


5.3 Starting Upload Phase

Please start the Upload phase by selecting the

5.4 Upload Phase

1. Please review and verify successful completion of the **Upload** phase
2. Close the notification popup window

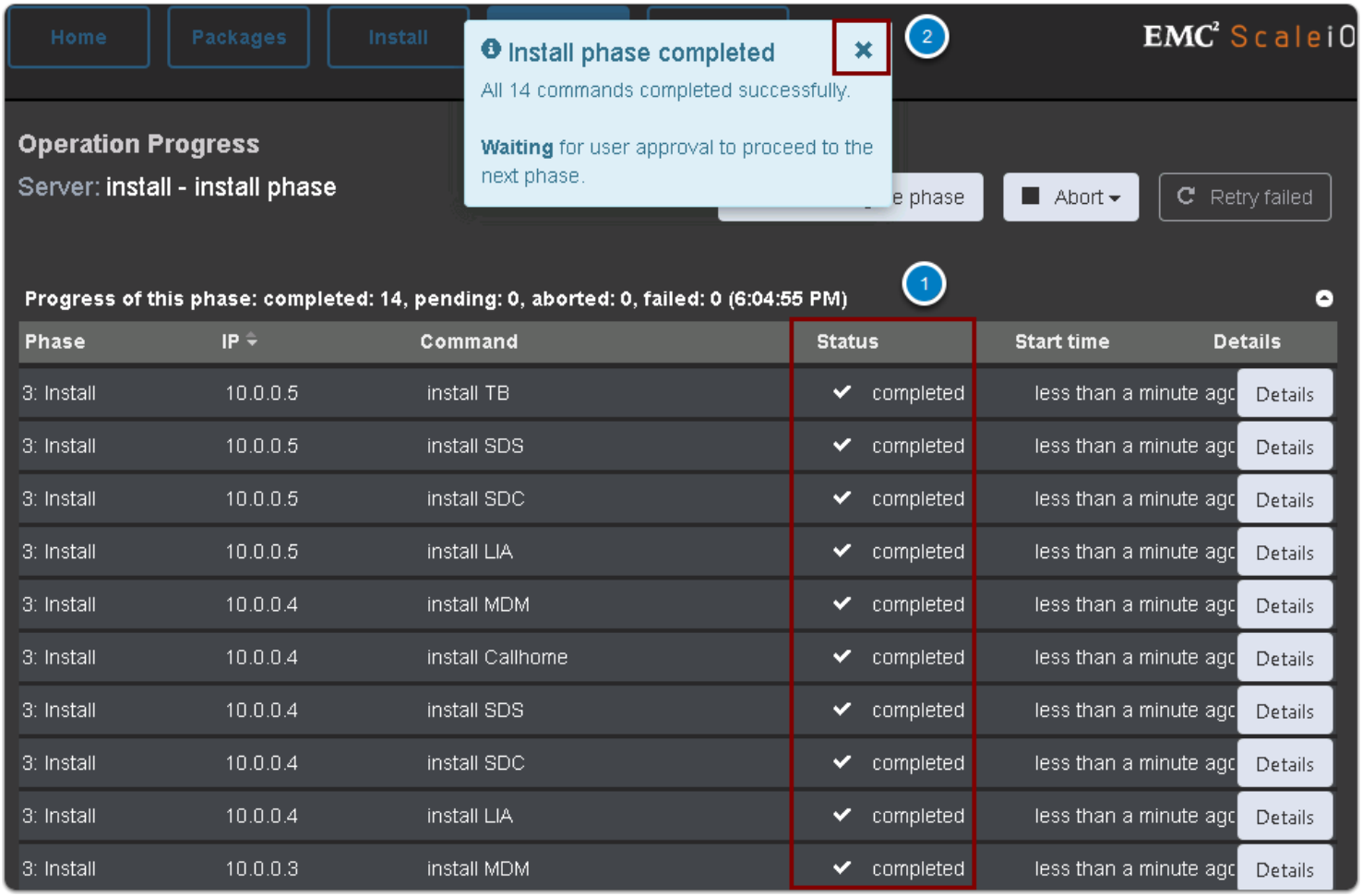


5.5 Starting Install Phase

1. Please start the **Install** phase by clicking on the button.

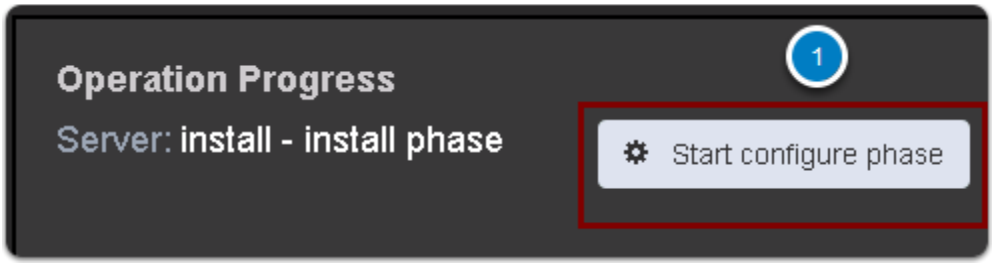
5.6 Install Phase

1. Please review and verify successful completion of the **Install** phase
2. Close the notification popup window



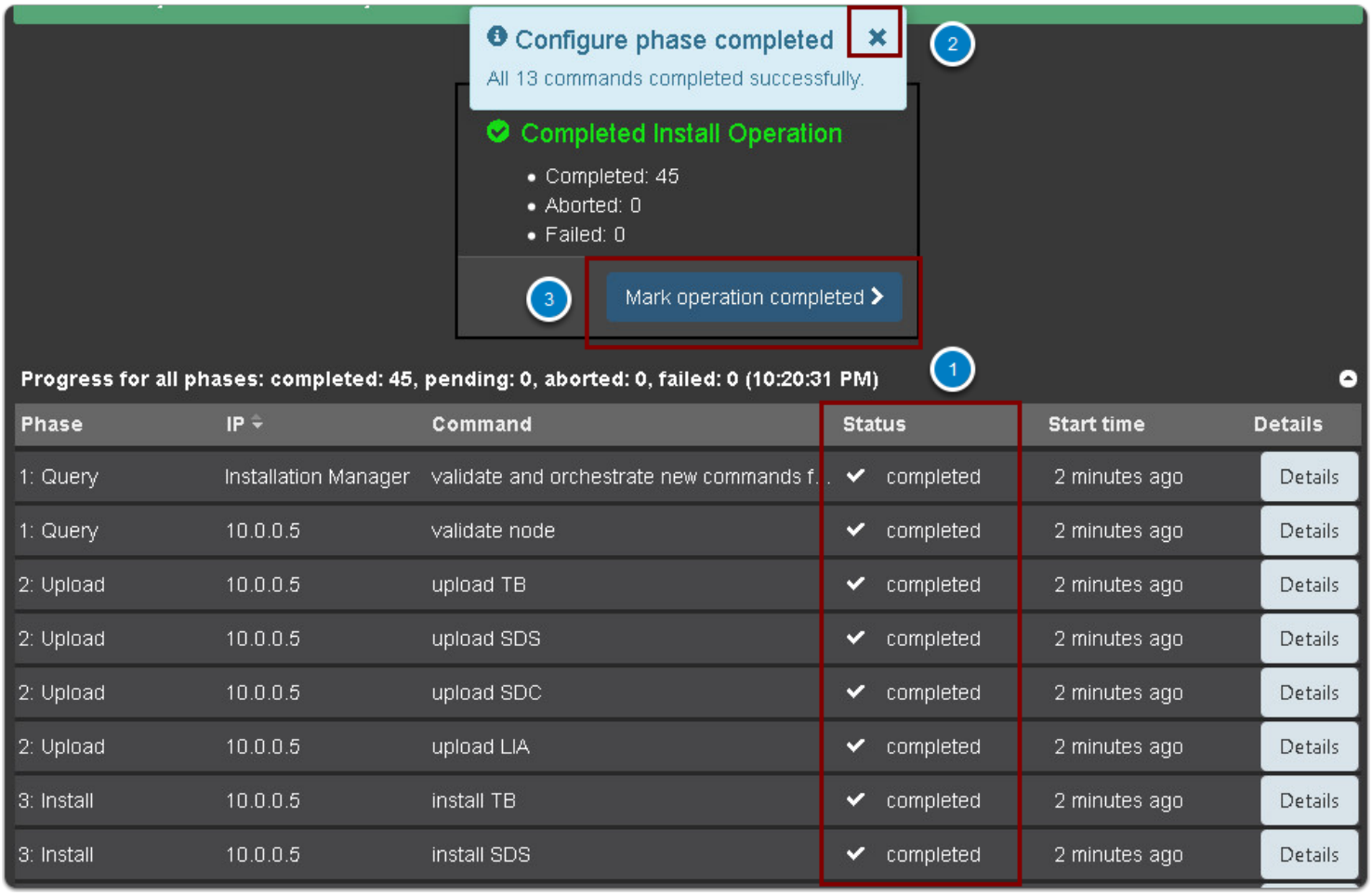
5.7 Starting Configure Phase

1. Please start the Configure phase by clicking on the button



5.8 Completing Configuration Phase

1. Please review the completion status for each configuration task
2. Confirm the completion of the Configure Phase and close the popup notification window
3. Mark Install Operation Complete to proceed to the maintenance of the ScaleIO Cluster

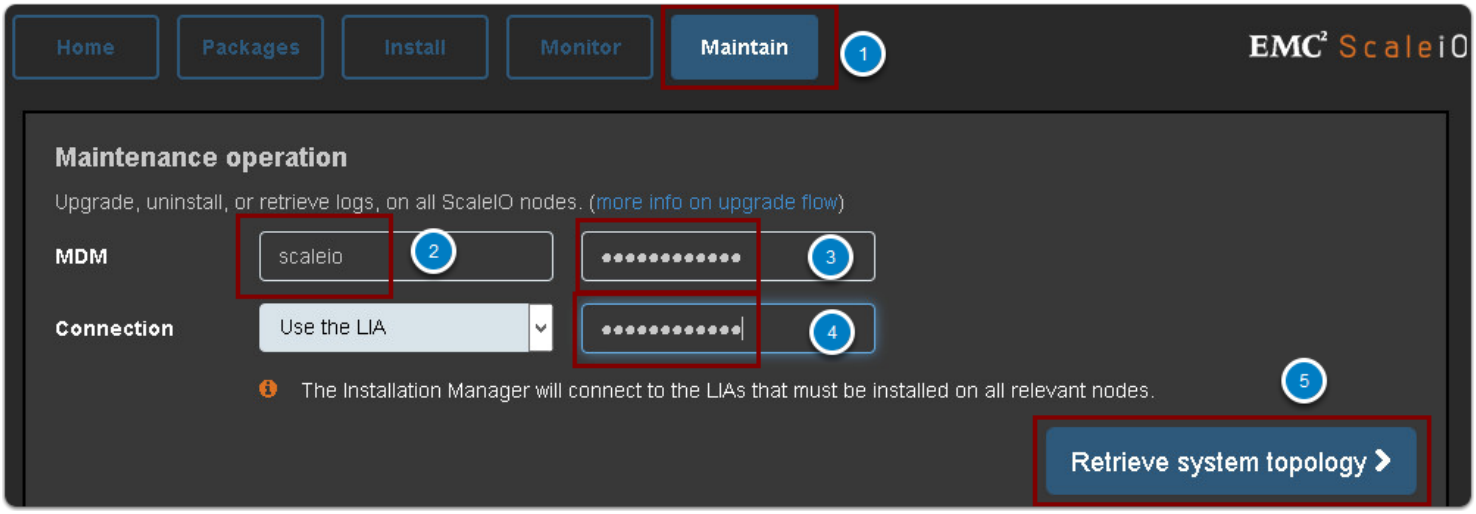


5.9 Maintain Installed ScaleIO Cluster

You will now review the topology of your newly installed ScaleIO cluster.

1. Please click the **Maintain** button
2. Provide the name or IP Address of the MDM - you have created a DNS name for the ScaleIO MDM: **scaleio**
3. Please enter password for MDM - it's the same password you provided while importing the ScaleIO CSV configuration file: *Password123!*
4. Please enter password for LIA connection - same password as above: *Password123!*

5. Click **Retrieve system topology** to continue



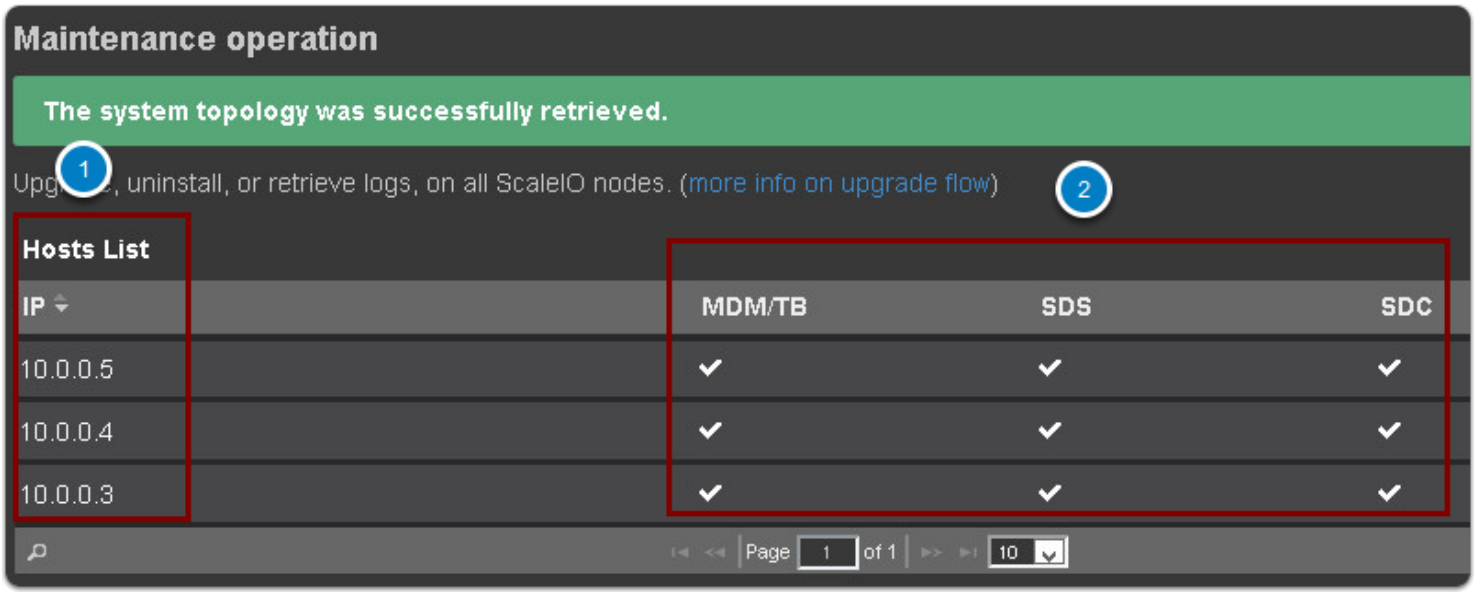
5.10 ScaleIO Cluster Configuration

Please review the ScaleIO cluster topology:

1. The Compute nodes where ScaleIO components are installed (You are seeing the IP addresses assigned to the Compute nodes interfaces connected to the separate Storage Network)
2. Roles and status of the ScaleIO services, i.e. MDM/TB, SDS and SDC.

This is it! You have completed the installation of the **ScaleIO component** services on the **OpenStack Compute** nodes. You will now use the ScaleIO User Interface to review the storage configuration and capacity available in our new ScaleIO Cluster.

Please minimize your browser window.

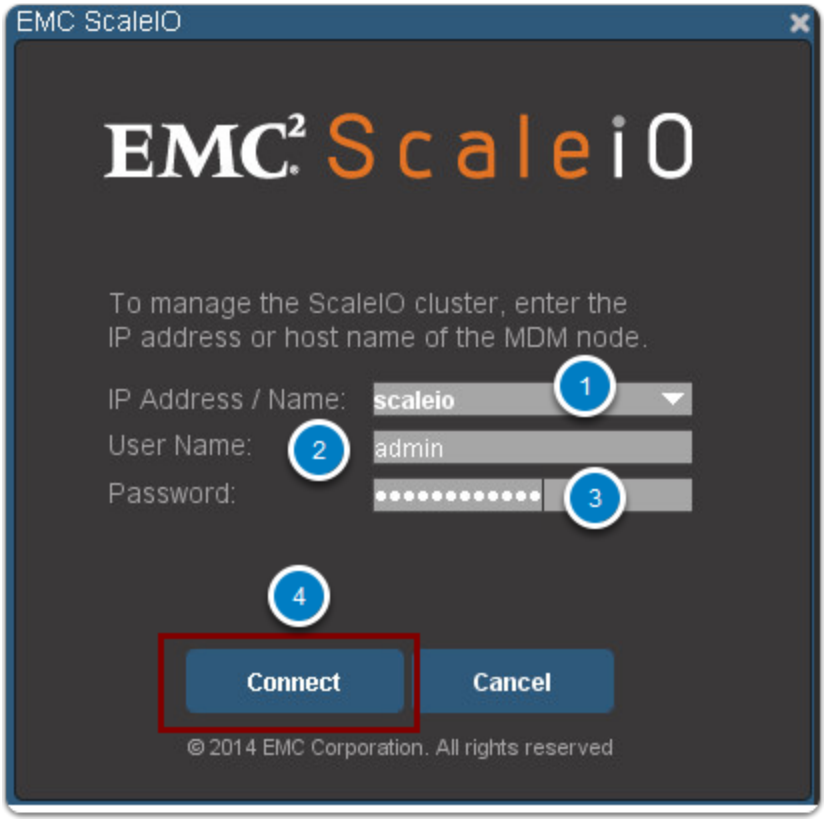


5.11 Starting ScaleIO GUI

Please return to the **Lab-3-ScaleIO-Cinder** folder and double-click on the shortcut called **"3_EMC ScaleIO GUI"**

5.12 Using ScaleIO GUI

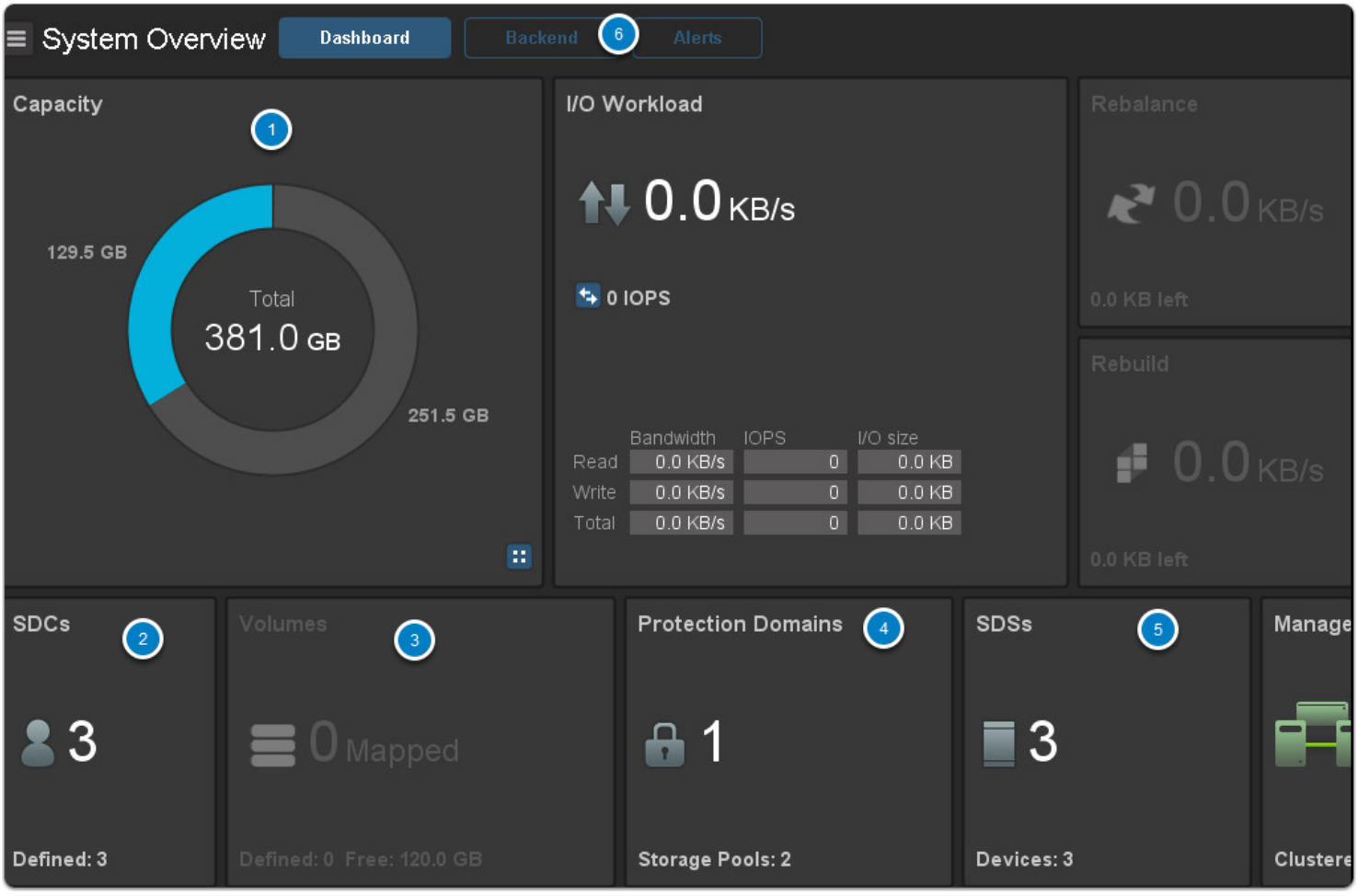
1. Please enter the MDM host name: **scaleio**
2. Enter User Name: ***admin***
3. Enter Password: ***Password123!***
4. Click **Connect** to login into ScaleIO GUI



5.13 Reviewing ScaleIO Cluster

Please review the details of he new ScaleIO Cluster. The ScaleIO dashboard displays:

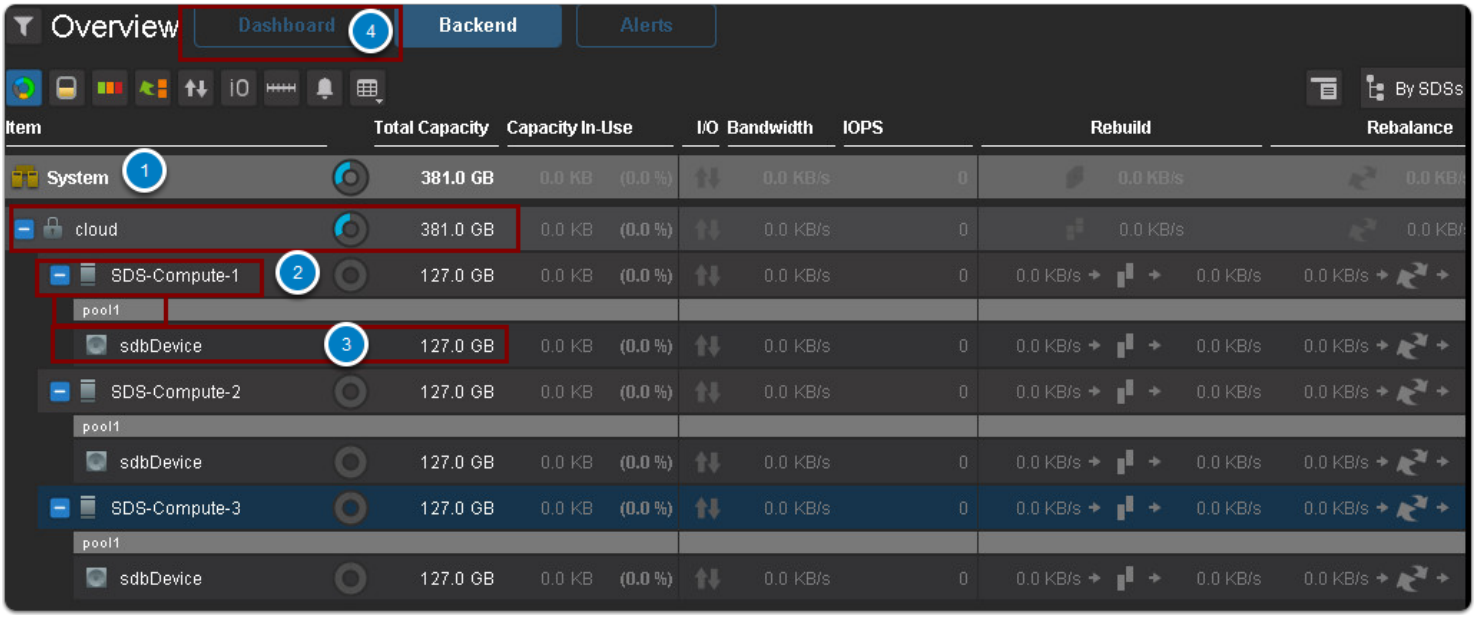
1. **Total** storage capacity - **381 GB**
2. Number of **SDS's** - **3**
3. Number of **Volumes** created - 0. Note: you will use the ScaleIO UI to review the volumes create in the later steps.
4. ScaleIO **Protection** domain - 1
5. Number of **SDC's** - **3.**
6. Next please click on the **Backend** button to review the details of the cluster.



5.14 ScaleIO Cluster Backends

The Backend view displays capacity overview, usage, health, rebuild/rebalance, Application I/O, overall I/O, etc.

1. Please expand the ScaleIO protection domain **cloud** by clicking on the **plus sign**
2. Expand each **SDS** and review the associated global storage pool
3. Review individual **discs** and available physical storage - these are spare physical discs (**/dev/sdb**) in each compute node
4. When finished, please return to the **Dashboard** view in preparation to our next steps and minimize the ScaleIO GUI.



6. ScaleIO Cinder Driver Installation

In this section of the lab you will perform installation and configuration steps that are required to enable ScaleIO storage backend for OpenStack Cinder service.

Here are the installation steps - please review these steps ONLY, do NOT perform them, as the lab environment has already been prepared for you.

- Install ScaleIO Cinder driver - available as a part of the ScaleIO software distribution from https://support.emc.com
- The driver installation Python script copies the volume driver and inserts volume_drivers key in the Nova configuration file **/etc/nova/nova.conf** and **/etc/cinder/cinder.conf**

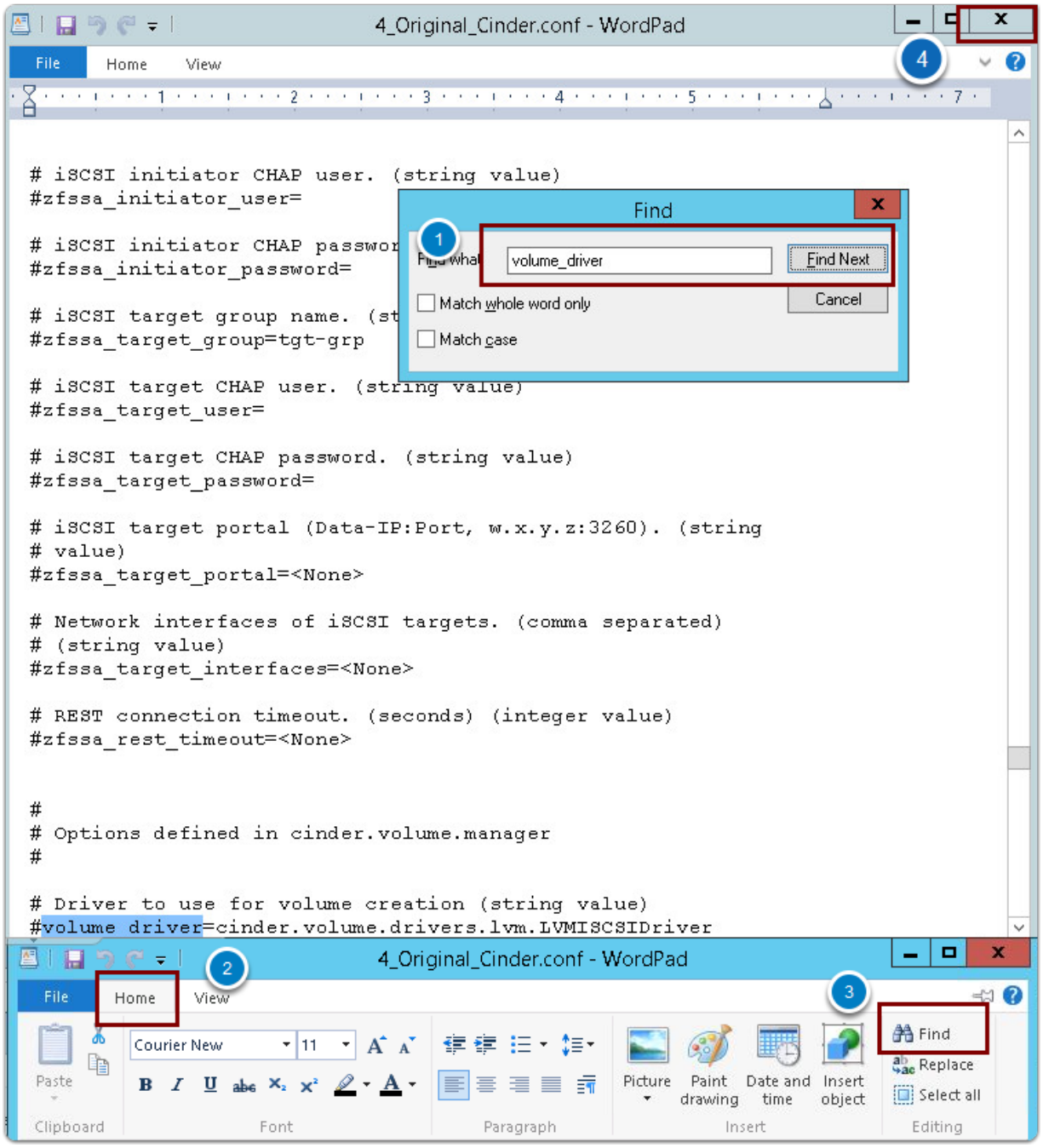
- Creates a ScaleIO driver configuration file called **/etc/cinder/cinder_scaleio.config**, containing parameters for the REST Gateway, Protection Domain and Storage Pool.

Please expand the Lab-3-ScaleIO-Cinder folder and double-click on **4_Original_Cinder.conf** file shortcut:

6.1 ScaleIO Cinder Config File

You will now review the Cinder service configuration file:

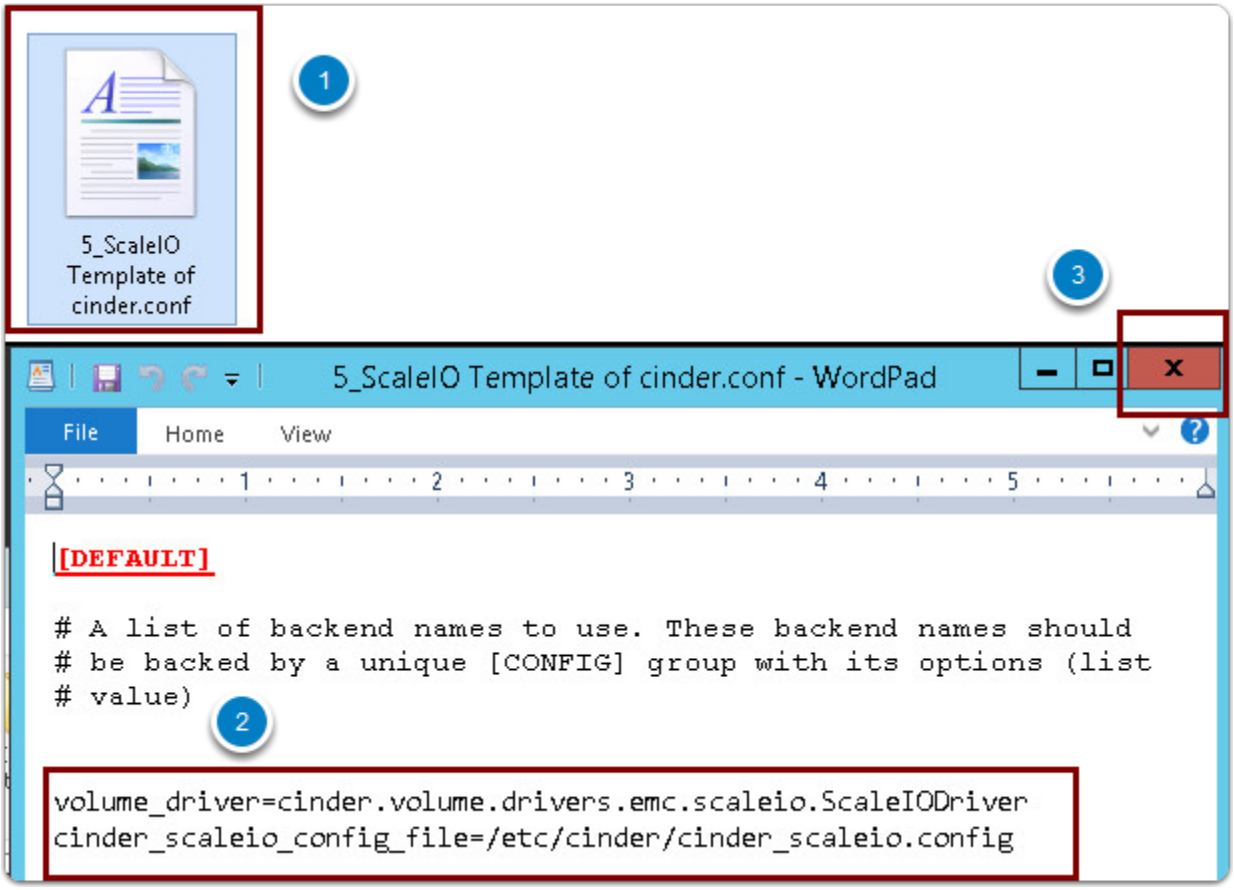
1. Please press Ctrl+F to start search and type in the search pattern **volume_driver** and click **Next** - that's where the ScaleIO Cinder driver will need to be configured.
2. If Ctrl+F doesn't work please click **Home** menu tab.
3. Then select **Find** menu option.
4. Please close the Cinder configuration file at this point - in the interests of time we have created a pre-configured file that you will later copy over this original one.



6.2 Pre-Configured Cinder Conf File

1. Please return to the **Lab-3-ScaleIO-Cinder** folder and open a template file we created for your review called **5_ScaleIO_Template_of_Cinder.conf**
2. Review the content of the pre-configured template of **cinder.conf** file with the volume_driver settings required for ScaleIO storage backend.

3. Please close the file when finished your review and return to the **Lab-3-ScaleIO-Cinder** folder.

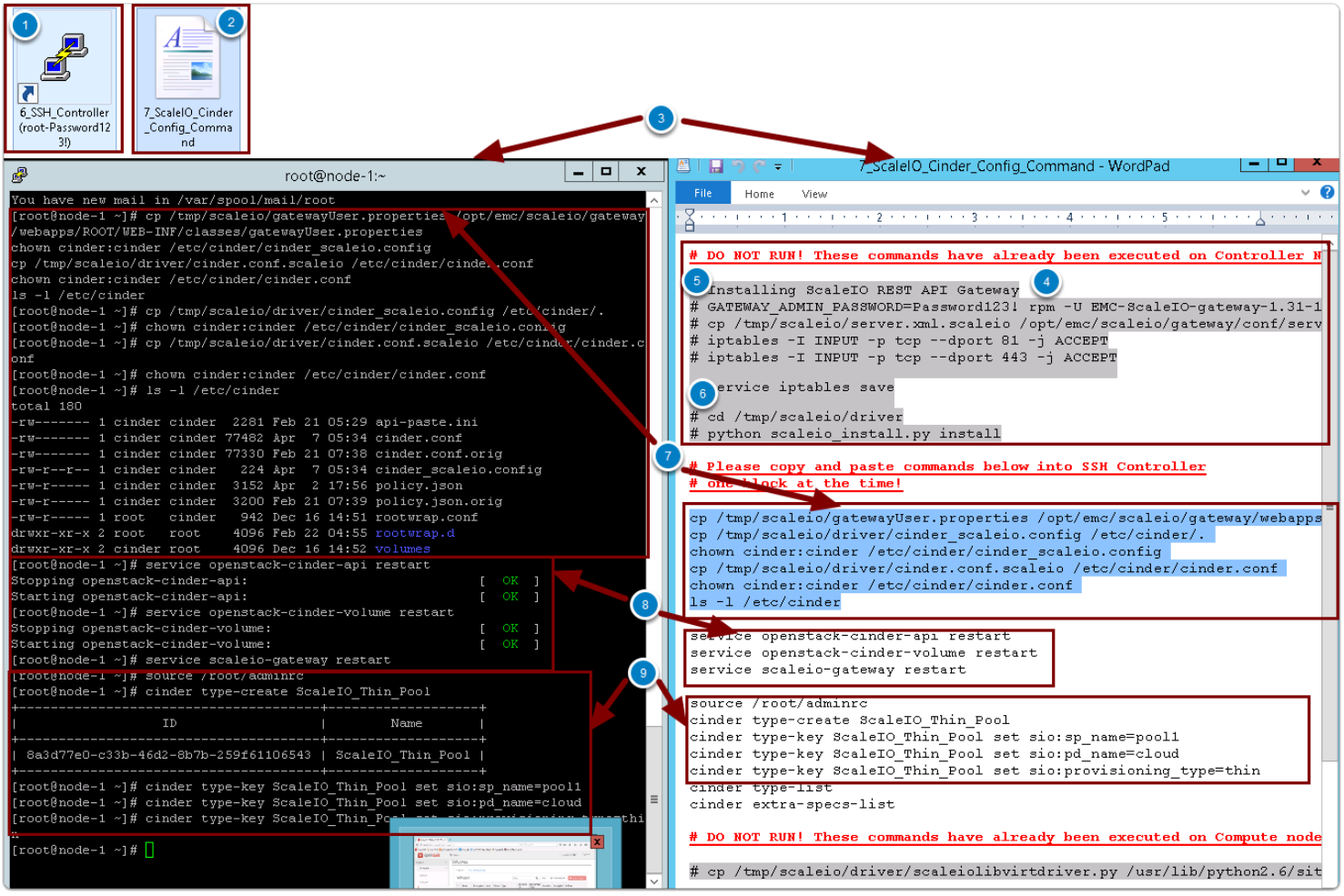


6.3 Using PuTTY SSH Utility

To save you some time in running this lab, a file has been created with the commands to be executed on the OpenStack Controller Node to install and configure ScaleIO Cinder driver.

1. Please open PuTTY shortcut to OpenStack Controller Node using shortcut called **6_SSH_Controller**
2. Then open **7_ScaleIO_Config_Commands** file
3. Please arrange the open SSH Terminal window and the command file side by side as shown - you will be copying the commands from the file into terminal window using right click, Copy and Paste.
4. The grey-shaded areas contain commands that are necessary for installation, but take some time to complete. Please **DO NOT** run these commands, we have already executed them.
5. First greyed-out block installed the ScaleIO Gateway service on the OpenStack Controller node and opened the required ports in the Linux firewall.
6. Second greyed-out block installed the ScaleIO Cinder driver on the Controller node and Nova driver on the Compute nodes

7. It is recommended to copy and paste commands into **SSH Terminal** window as a block. Blocks are separated by blank lines. Please copy the command block and paste into **SSH Terminal** window using right-click. We have created a copy of the ScaleIO **gatewayUser.properties** file in the **/tmp** directory with all necessary settings you have reviewed earlier - this file is copied over the original file. We have also created a copy of the **cinder.conf** file in the **/tmp** directory with all necessary settings you have reviewed earlier - this file is copied over the original **/etc/cinder/cinder.conf** file. It is also necessary to change the ownership of this file to **cinder** user
8. It is necessary to **restart** the ScaleIO and Cinder API and Volume services to read the new configuration files - Please copy the next command block and paste into **SSH Terminal** window using right-click.
9. You will now create ScaleIO Volume types and assign them to Cinder backends. Please copy the next block in the **7_ScaleIO_Cinder_Config.Commands** file and paste it into SSH Terminal window using **right-click**



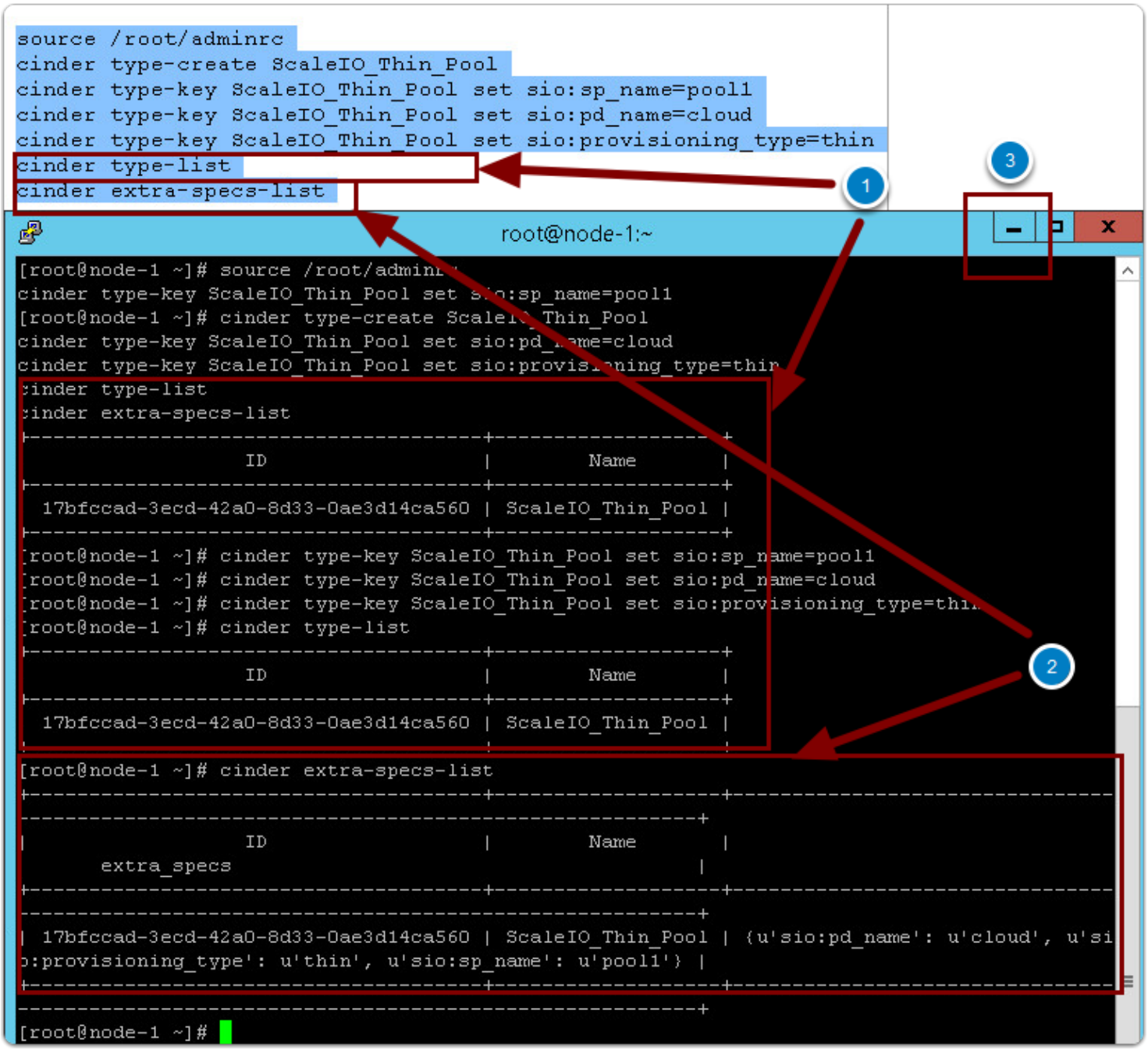
6.4 Creating ScaleIO Volume Types

Now that ScaleIO Cinder driver is installed and configured, you will create ScaleiO Volume Types in OpenStack Cinder service.

1. Please run the **cinder type-list** command and review the created **ScaleIO_Thin_Pool** volume type
2. Please run the **cinder extra-specs-list** command and review the extra specifications for this volume type:

- ScaleIO Storage Pool name: **pool1**
- ScaleIO Protections Domain name: **cloud**
- Volume provisioning type: **thin**

3. Please minimize the **SSH terminal** window - we will now begin using the OpenStack Horizon UI.

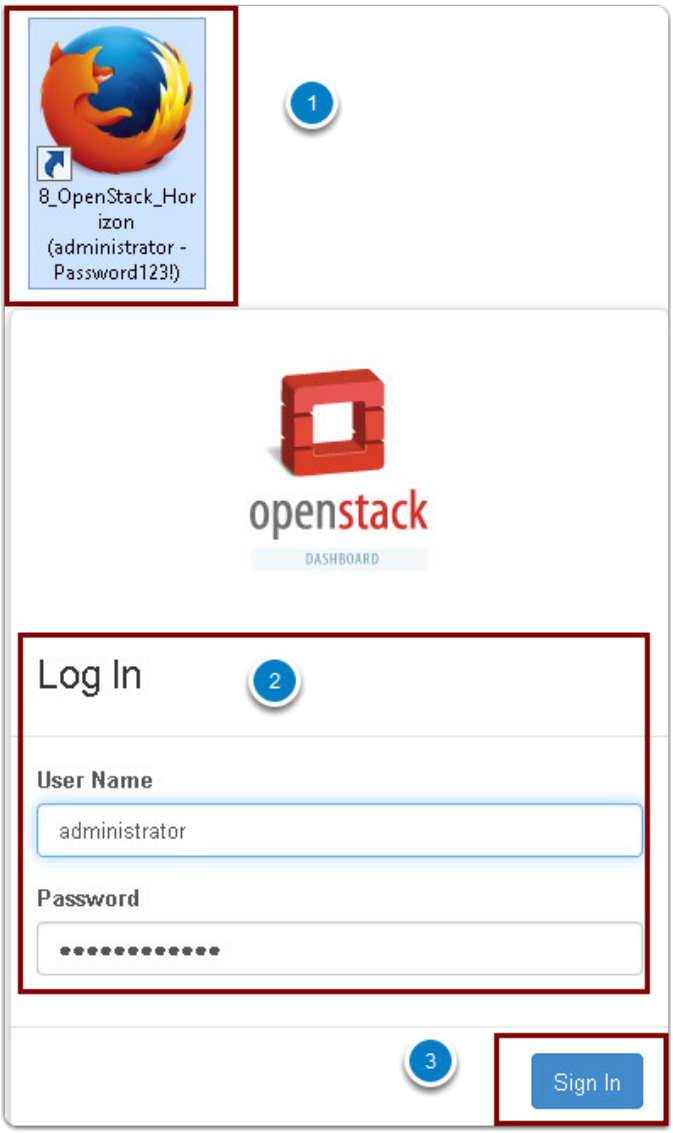


7. Using OpenStack Horizon UI

1. Return to the Lab-3-ScaleIO-Cinder folder and launch the **8_OpenStack_Horizon(administrator - Password123!)** shortcut
2. The user credentials should be cached in the browser window. If needed please type the credentials:

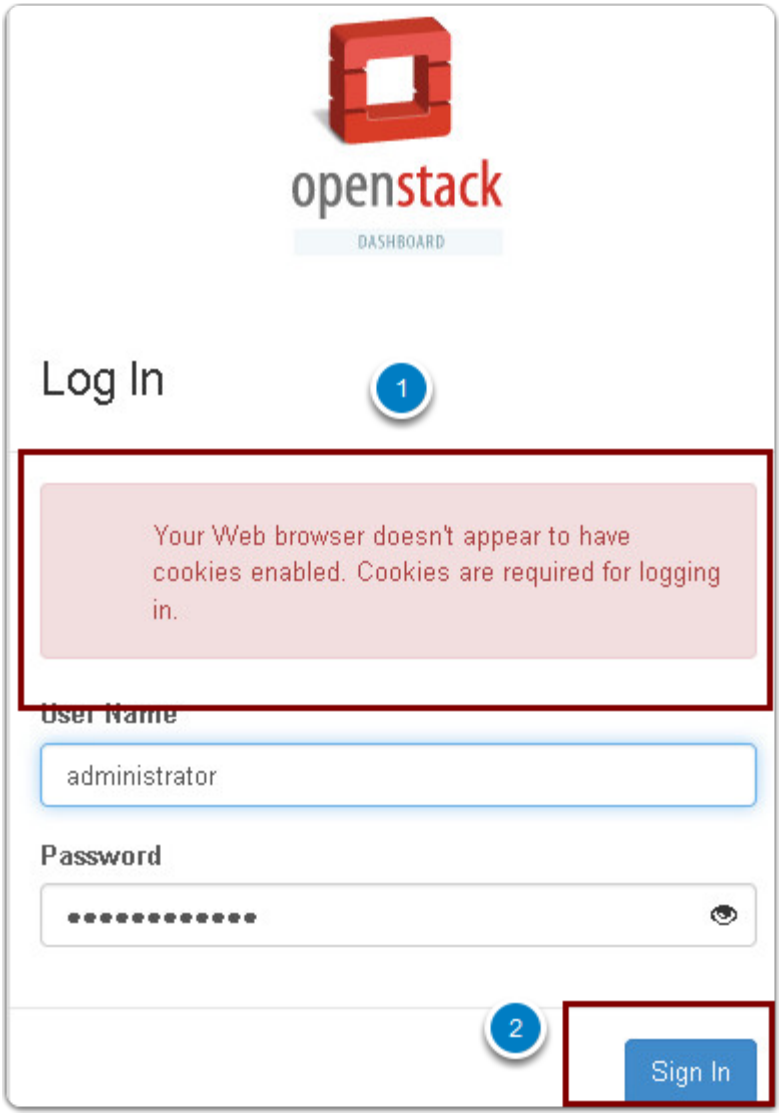
- User Name: *administrator*
- Password: *Password123!*

3. Click **Sign In** to continue



7.1 Browser Cookie Warning

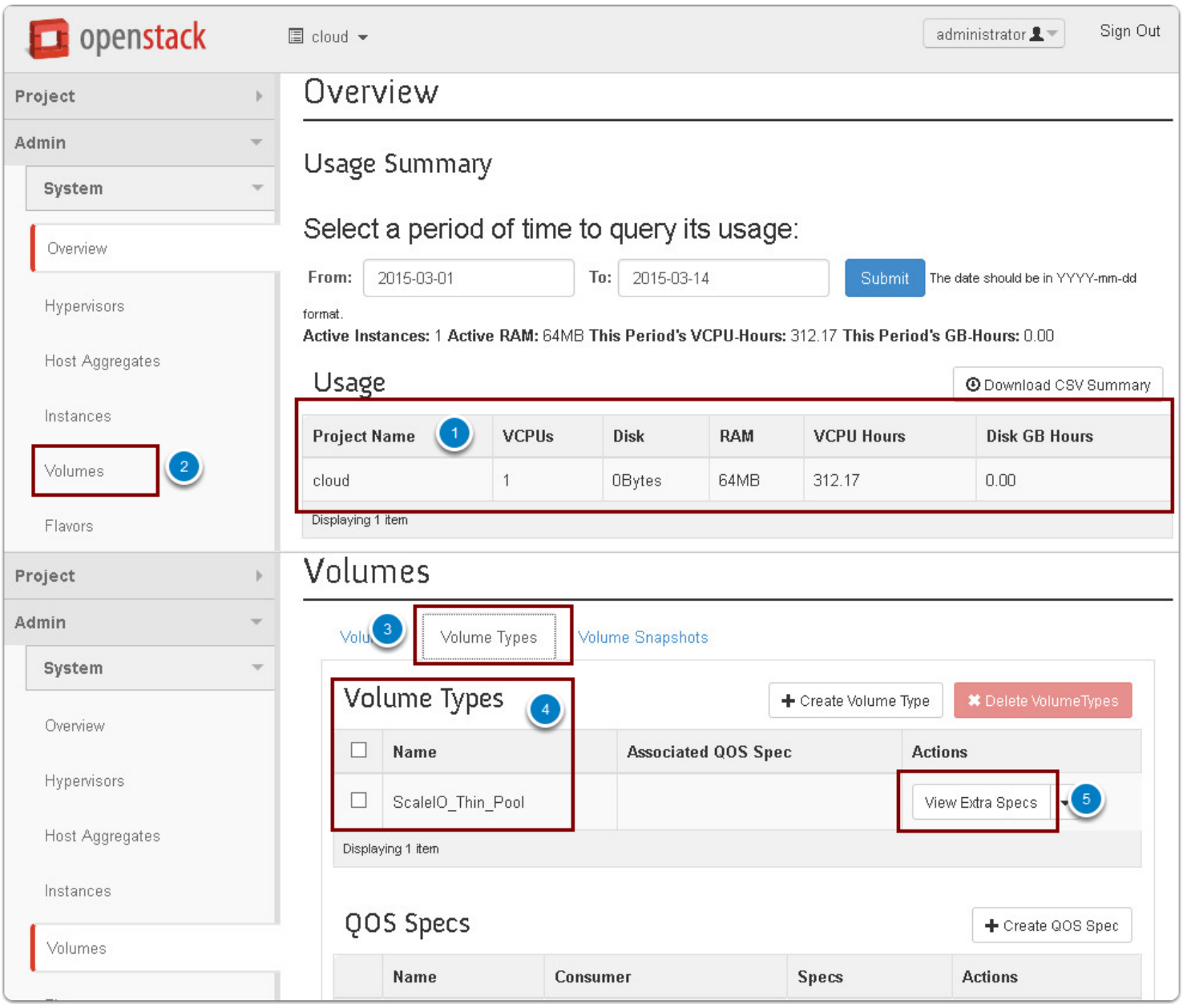
1. Occasionally you may see a browser cookie warning
2. Please disregard it and simply click on **Sign In** again to continue



7.2 Reviewing ScaleIO Volume Types

1. Please review the Dashboard for OpenStack project - **cloud**
2. Please select **Volumes** In OpenStack Horizon Admin menu on the left hand side
3. Click on the **Volume Types** tab

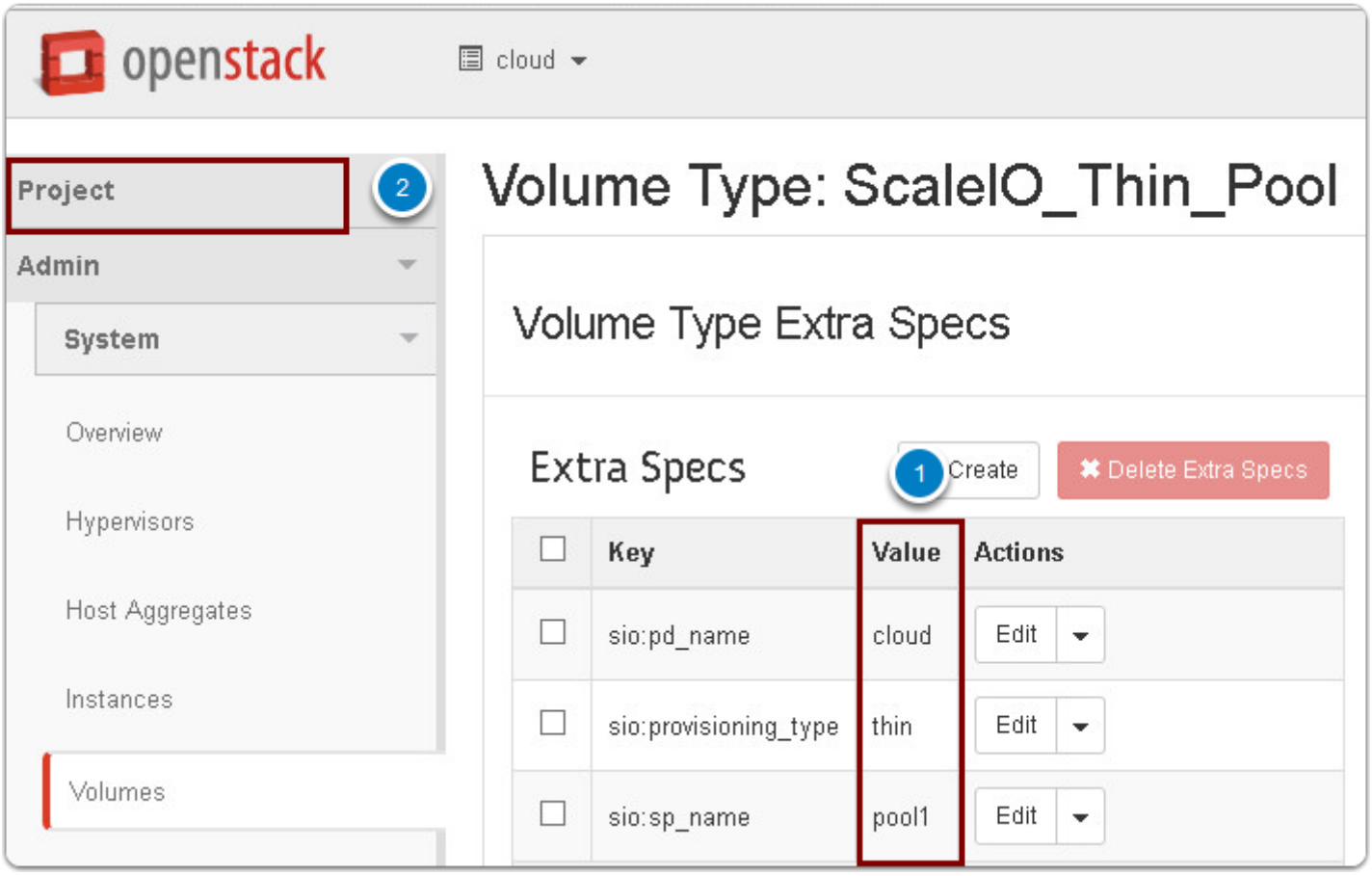
4. Review your created ScaleIO volume type - **ScaleIO_Thin_Pool. Note:** You may see other volume types in this table created earlier in the previous labs.
5. Please click on the **Extra Specs** menu to see the volume type details.



7.3 Volume Type Extra Specs

1. Please review the **ScaleIO Volume Type extra specs** - these were configuration parameters you have provided while creating this **Volume Type.** These parameters correspond to the ScaleIO Cluster conifguration.

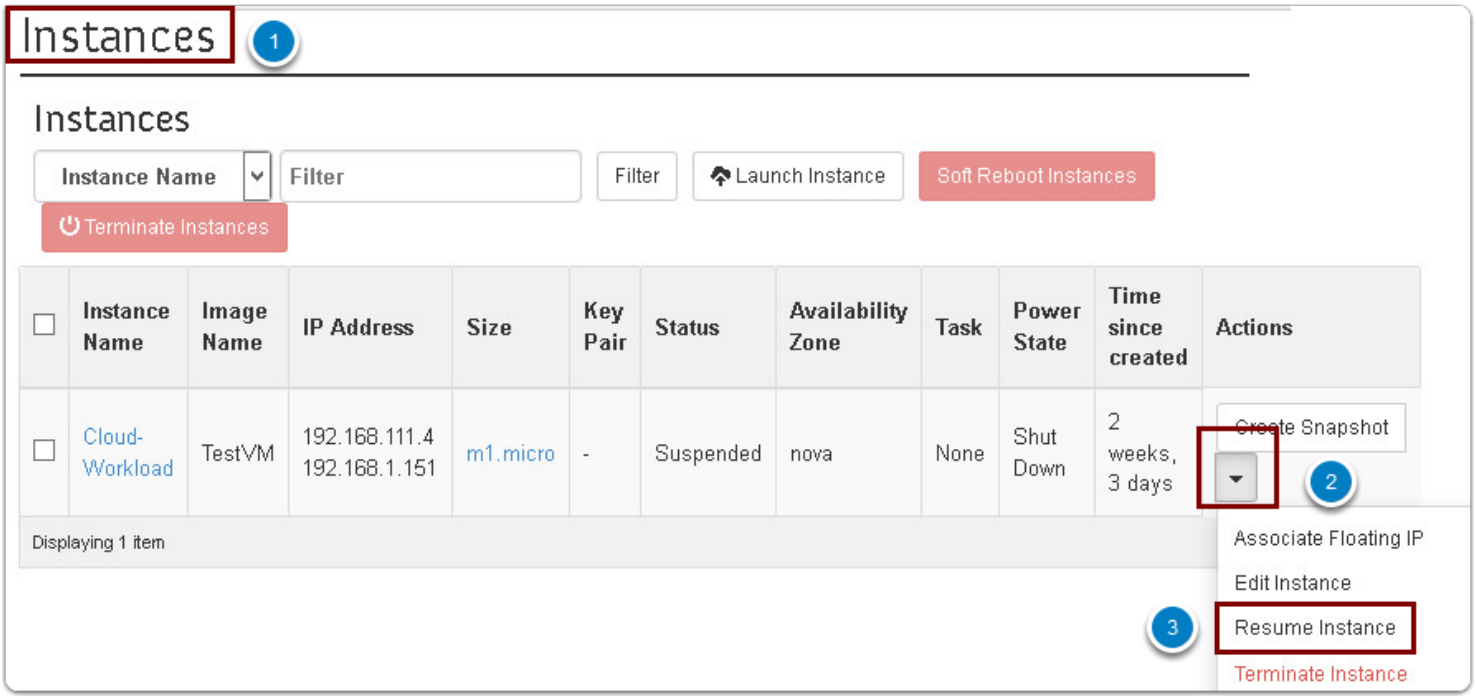
2. Please click on the **Project** Tab - you will now create a new ScaleIO volume



7.4 Optional Step: Activating Instance

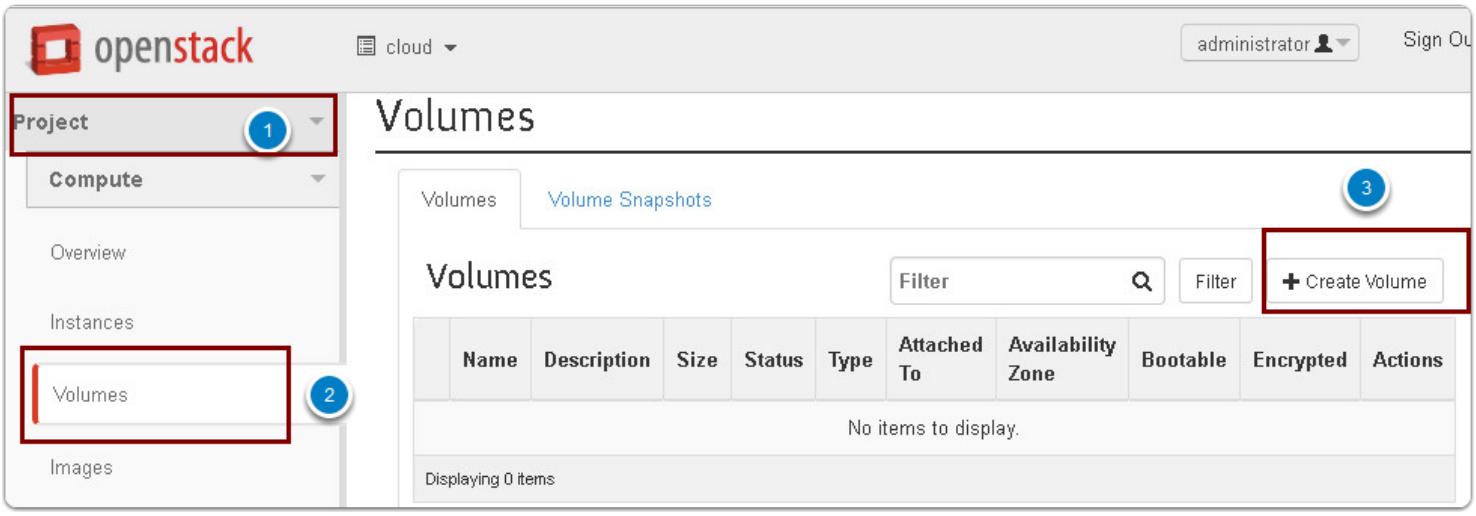
If you have not previously activated a suspended Cloud-Workload VM instance in the earlier labs, please do so now:

1. Select **Instances** tab in the **Project** menu
2. Click on the **drop-down** menu next to the **Cloud-Workload** instance
3. Select **Resume Instance** option, then return to the **Volumes** tab.



7.5 OpenStack Project Menu

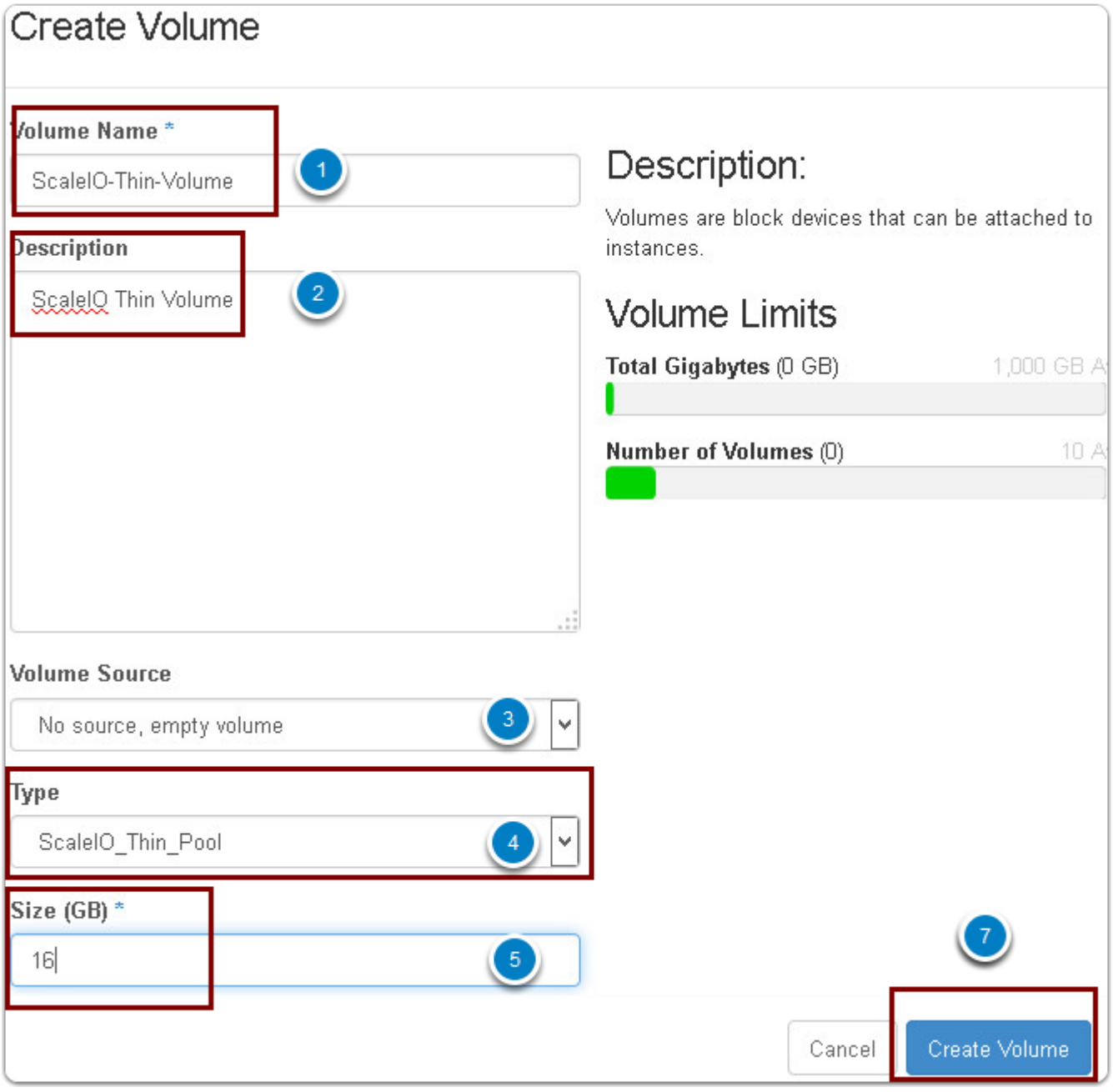
1. Select **Volumes** tab
2. You will now create a new **Volume** using ScaleIO Volume type - please click on **Create Volume** menu



7.6 Creating New Volume

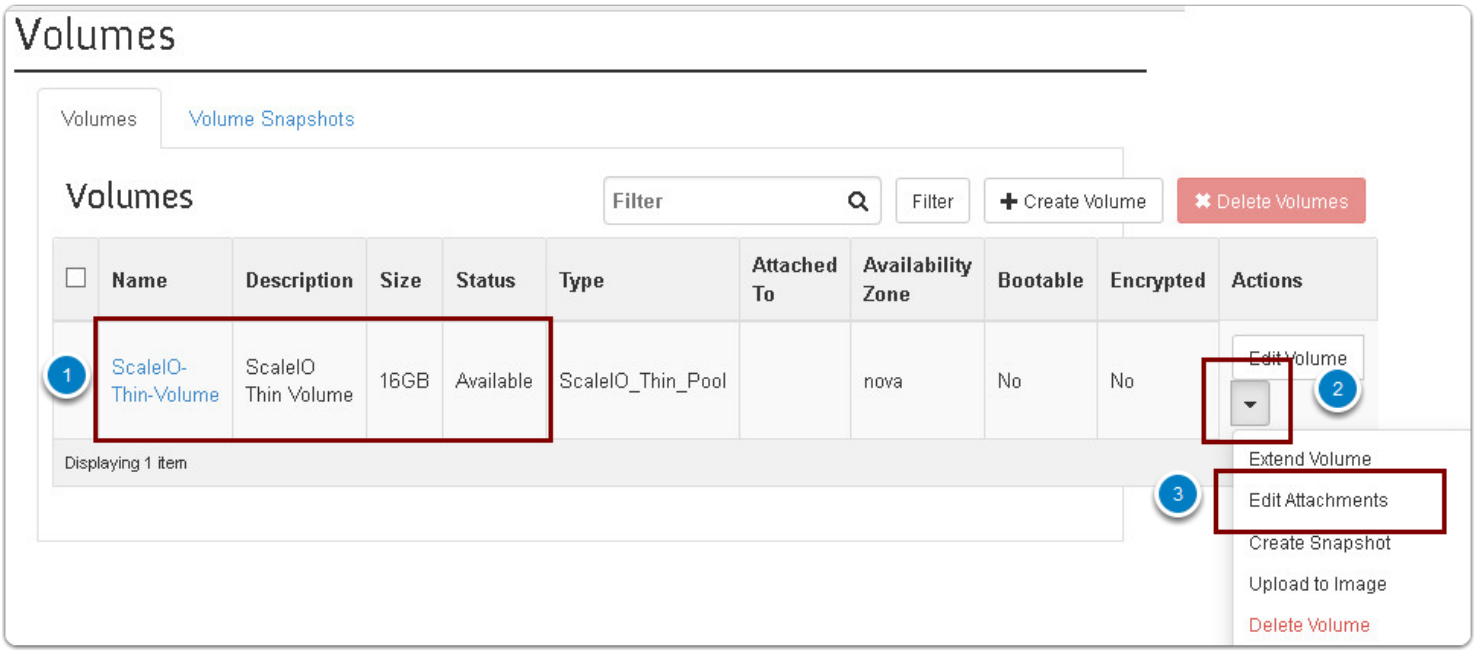
Pleas provide new ScaleIO Volume details:

1. Volume Name - **ScaleIO-Thin-Volume**
2. Provide a Description as you see fit
3. Leave **Volume Source** field with default value
4. Select a **Volume Type** from the drop-down menu - **ScaleIO_Thin_Pool**
5. Specify the **Volume size** in the increments of 8GB - **16GB**
6. Leave **Availability Zone** field with default value - **Any Availability Zone**
7. Click on **Create Volume** to continue


Create Volume
Volume Name *
ScaleIO-Thin-Volume
1
Description
ScaleIO Thin Volume
2
Description:
Volumes are block devices that can be attached to instances.
Volume Limits
Total Gigabytes (0 GB)
1,000 GB A
Number of Volumes (0)
10 A
Volume Source
No source, empty volume
3
Type
ScaleIO_Thin_Pool
4
Size (GB) *
16
5
7
Cancel
Create Volume

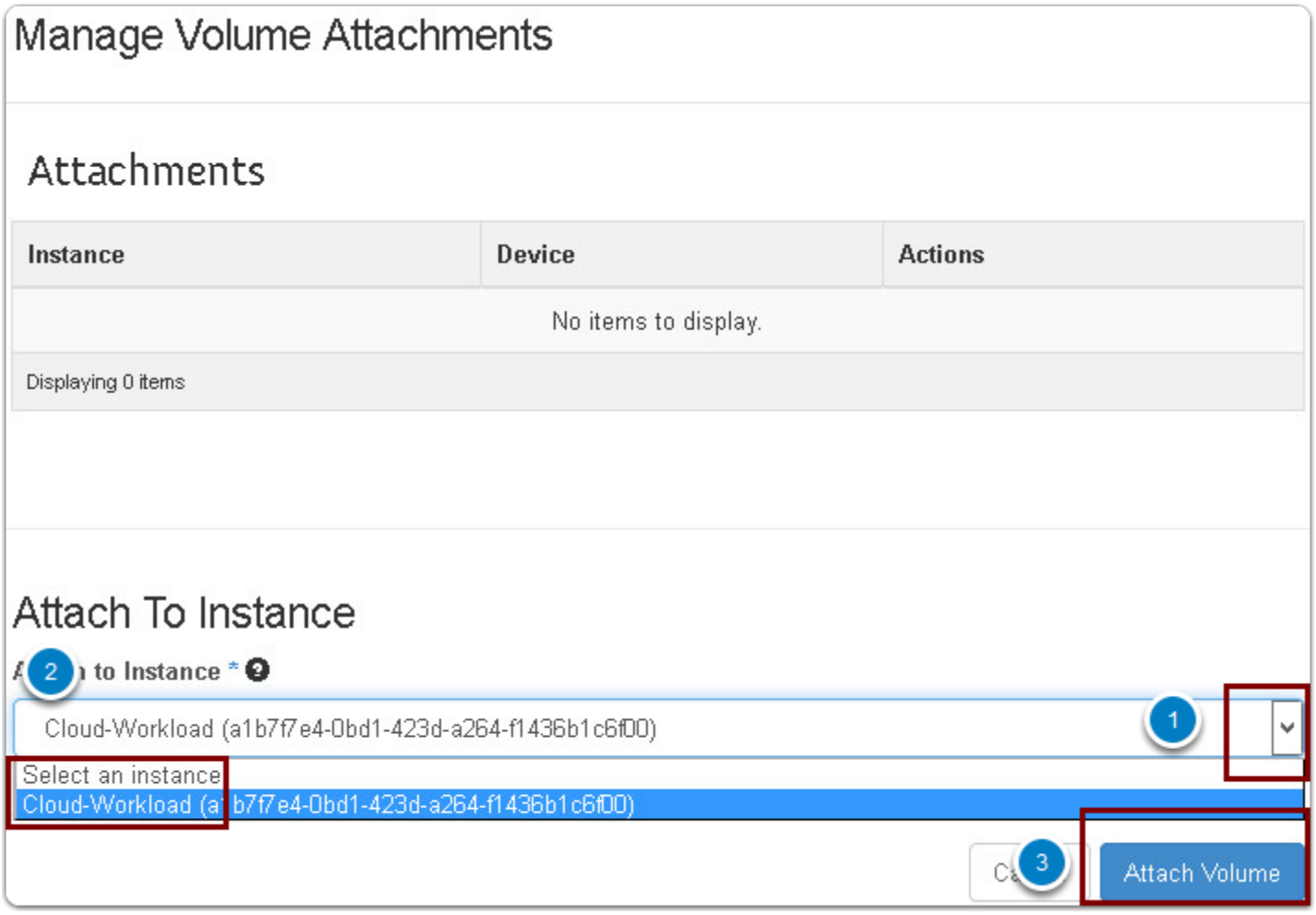
7.7 Created Volume

1. Please verify that the new ScaleIO Volume is available. **Note:** You may see other volume types in this table created earlier in the previous labs - please ignore them.
2. Next you will attach this new Volume to our **cloud-workload** VM instance - please click on the **Edit Volume** drop-down menu
3. Select **Edit Attachments** from the list



7.8 Attaching Volume

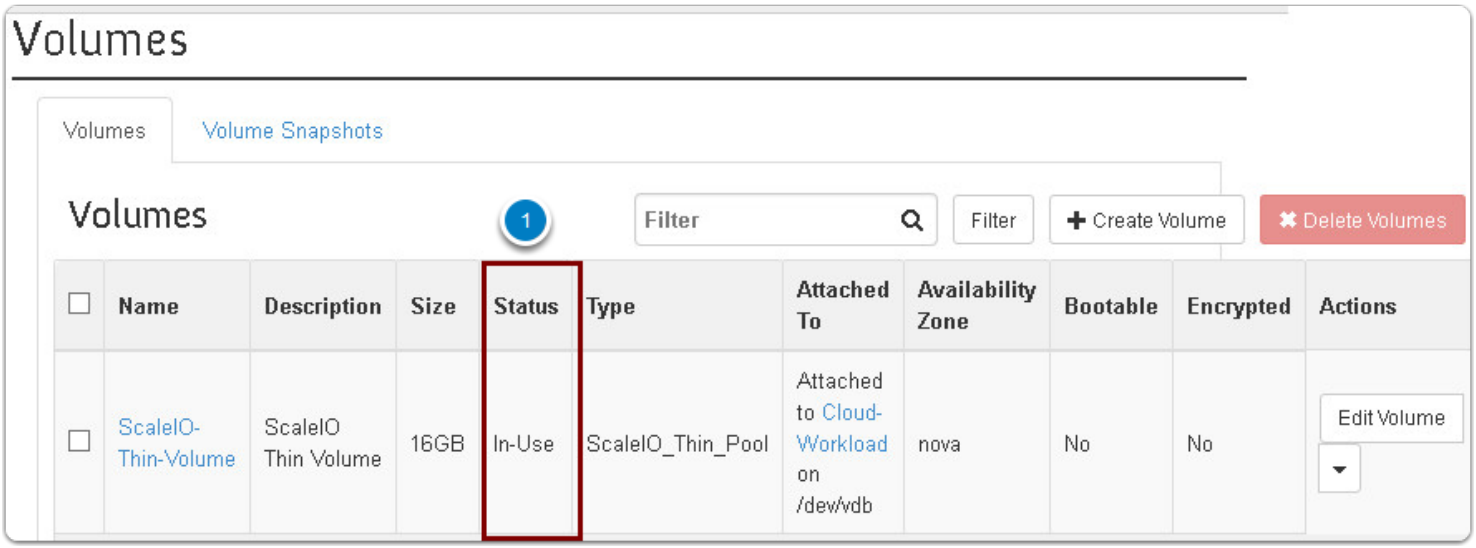
1. Please click on the drop-down menu
2. Select an active instance from the - **Cloud-Workload**
3. Click **Attach Volume** to continue



7.9 Volume In-Use

1. Please review the status of the newly attached volume - **In-Use**

Now please return to the previously minimized **ScaleIO UI Dashboard**



7.10 Created Volume in ScaleIO

Please review the newly created volume in the ScaleIO Dashboard and notice the Volume status - **Mapped**

Note: It may take several minutes for ScaleIO to update the volume information.

8. Conclusion

In this lab you, wearing the hat of Code Nebulous Cloud Administrator, have successfully accomplished the following:

- Deployed and configured the EMC ScaleIO cluster on the OpenStack Compute nodes to take advantage of the commodity spare physical drives available in the Compute nodes
- Deployed and configured ScaleIO Cinder driver to use the ScaleIO block storage cluster as a backend
- Created Cinder volume types associated with the ScaleIO storage pools
- Created and attached a new block volume to an active OpenStack instance.

Now the Code Nebulous Cloud Users can begin building and using the applications running on the Cloud-Workload instance and store its data on the persistent block volume.

Note: In the interests of time you will not be logging into Cloud-Workload instance to format and mount the newly created volume.

This lab is now complete. Please close the following windows as you will not be using them any longer:

- **Lab-3-ScaleIO_Cinder** folder
- **7_ScaleIO_Cinder_Config_Commands** file.
- **ScaleIO GUI**
- **SSH Terminal Window**

Please proceed to the next lab, or select other labs from the list.

Optional Lab 4 - Live Migration of OpentStack Instance & Volume

Lab 4 - Live Migration

In this lab you as a Cloud Administrator will learn how to migrate a "live" active OpenStack virtual machine instance and its associated storage volume. In the course of the Agile development process, Cloud Admins will encounter a situation when the workload and its associated data needs to be moved from a low-cost distributed storage to a high-performance high-availability external storage array.

Upon completion of this lab you will become familiar with the Live Migration configuration steps and use OpenStack CLI commands to migrate an active VM from one compute node to another and its attached volume to a different storage backend (from **ScaleIO** to **VNX**).

This Lab 4 requires that you have previously completed the following labs:

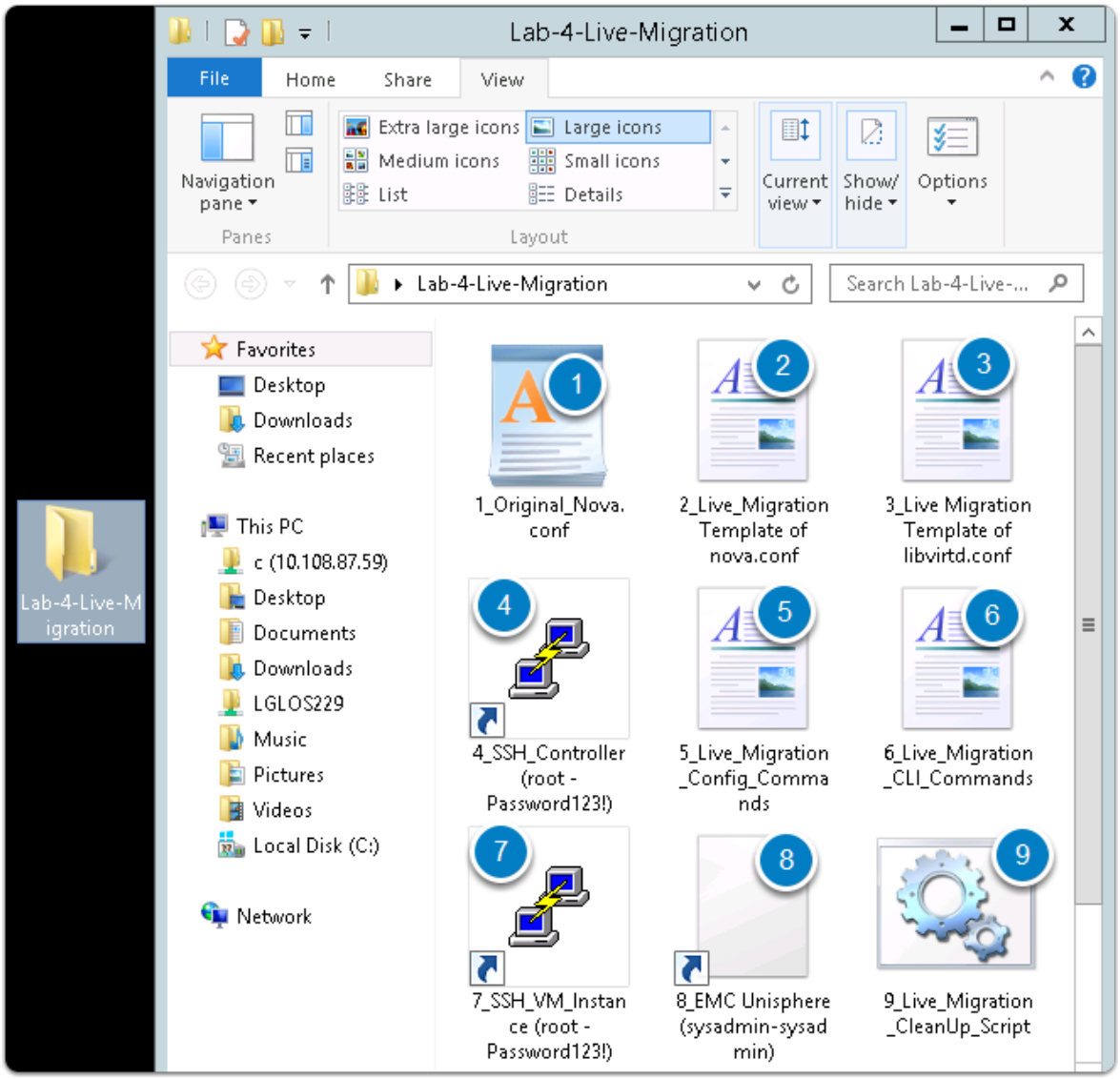
- Lab 1 - Using VNX with Cinder Block Storage
- Lab 3 - Using ScaleIO with Cinder Block Storage

1. Lab-4 Folder

Please open and review **Lab-4-Live-Migration** folder

Pay attention to the Numbers in the name of the shortcut - for your convenience you will be using these shortcuts in order

1. Original Nova Config File
2. Live Migration Template of Nova.Conf
3. Live Migration Template of libvirt.conf file
4. SSH Utility to access the OpenStack Controller terminal
5. Live Migration Configuration Commands
6. Live Migration CLI Commands
7. SSH Utility to access OpenStack VM Instance terminal
8. EMC Unisphere to view the Storage Pool and migrated volumes
9. Cleanup script to complete this lab and prepare for the next one



1.1 Live Migration Configuration Steps

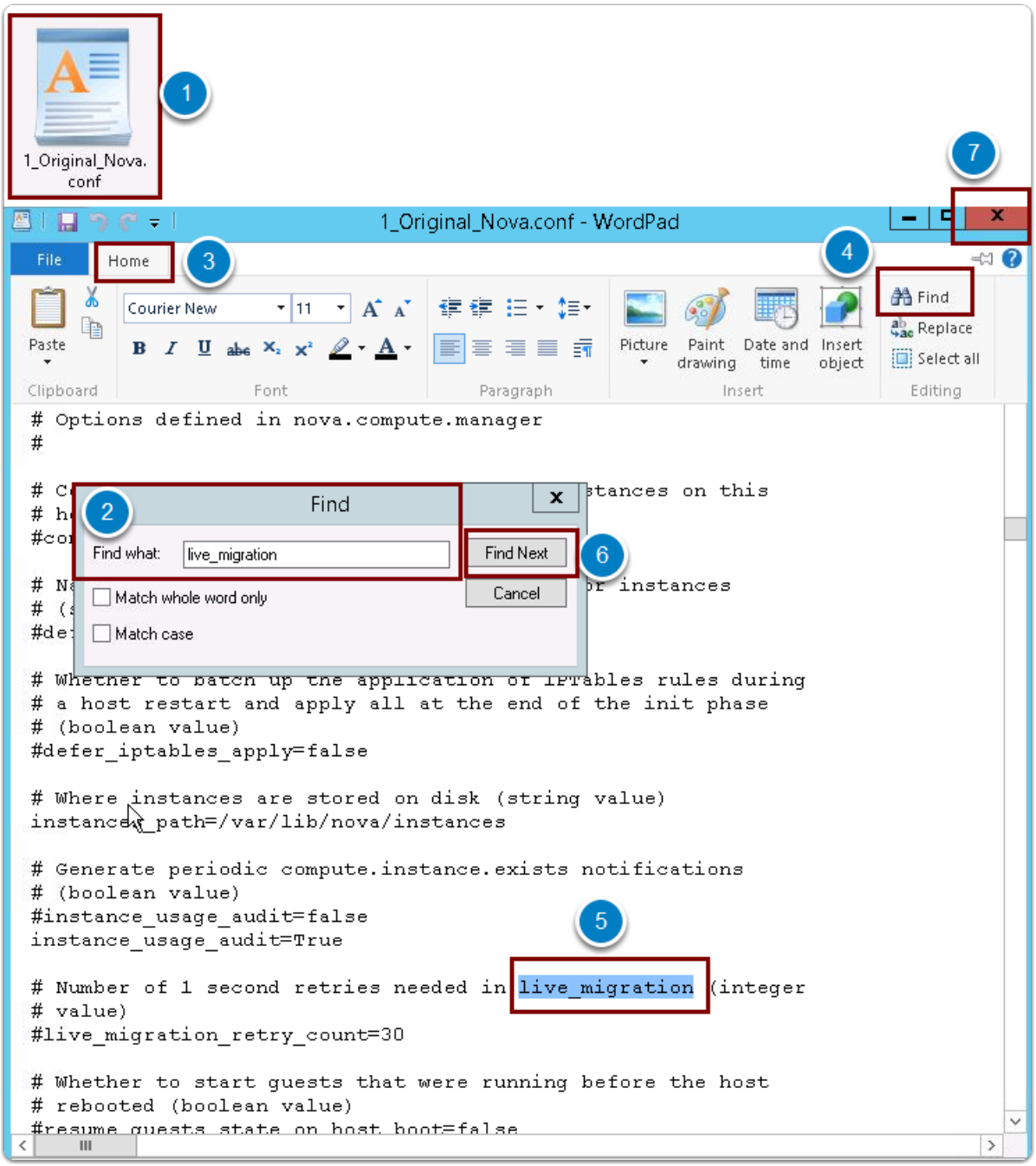
Live Migration capabilities for a VM instance and its attached volume, you will now

- Review the **Nova Compute** service configuration on **Compute** nodes
- Review the **libvirt** service configuration on **Compute** nodes
- Configure **Cinder** service by modifying the Cinder configuration file **/etc/cinder/cinder.conf** on the Controller node
- Restart **Cinder** API and **Cinder** Volume services
- Initiate a live migration of a volume attached to an active VM instance.

1.2 Original Nova. Conf File

For your reference you have been provided with the Nova.conf configuration file where all necessary configuration settings for enabling Live Migration on the Compute Nodes need to be made.

1. Please open the **1-Original_Nova.conf** and review it
2. You will use the search pattern: **live_migration**
3. In WordPad, select **Home**
4. Then select **Find** menu option
5. Review all settings for enabling Live Migration
6. Click **Find Next** as necessary
7. Then close the file to continue



1.3 Sample Nova.conf file

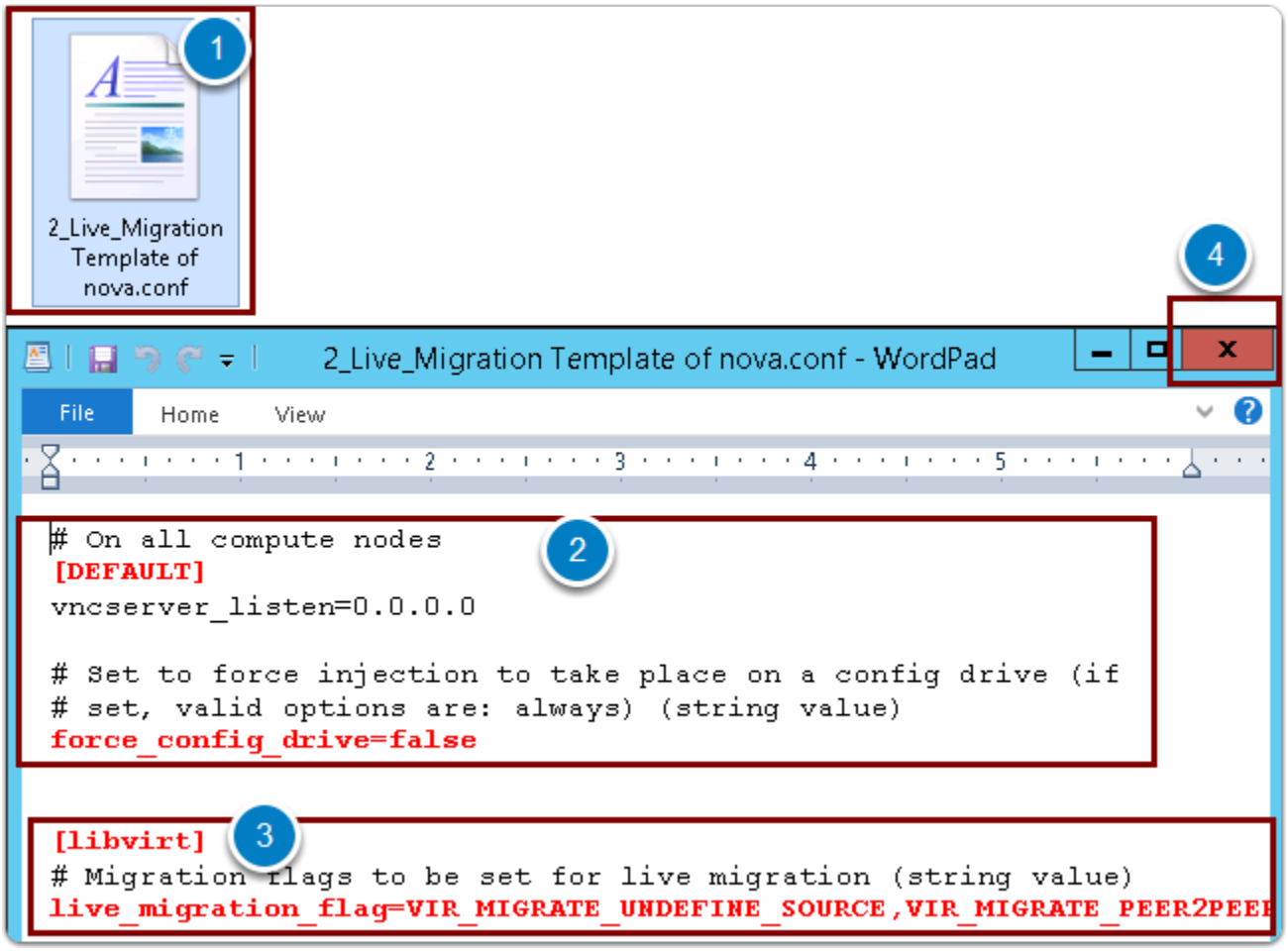
For your convenience, all the changes required for configuration of the Nova Compute service have been summarized in a sample Nova.conf file.

The relevant sections are highlighted in Red.

1. Please open a file called **2_Live_Migration Template of Nova.conf** - these settings should be applied to ALL OpenStack Compute Nodes.
2. Review the settings in the [DEFAULT] section for vncserver and config drive.
3. Review the settings in the [libvirt] section for live migration flags

To save your time a **nova.conf** file with all the highlighted settings has already been created. As part of the lab you will simply copy over the modified file. This has already been completed for you to save you time in completing this lab.

4. Please close the **2_Live_Migration Template of Nova.conf**



1.4 Sample Libvirt Configuration File

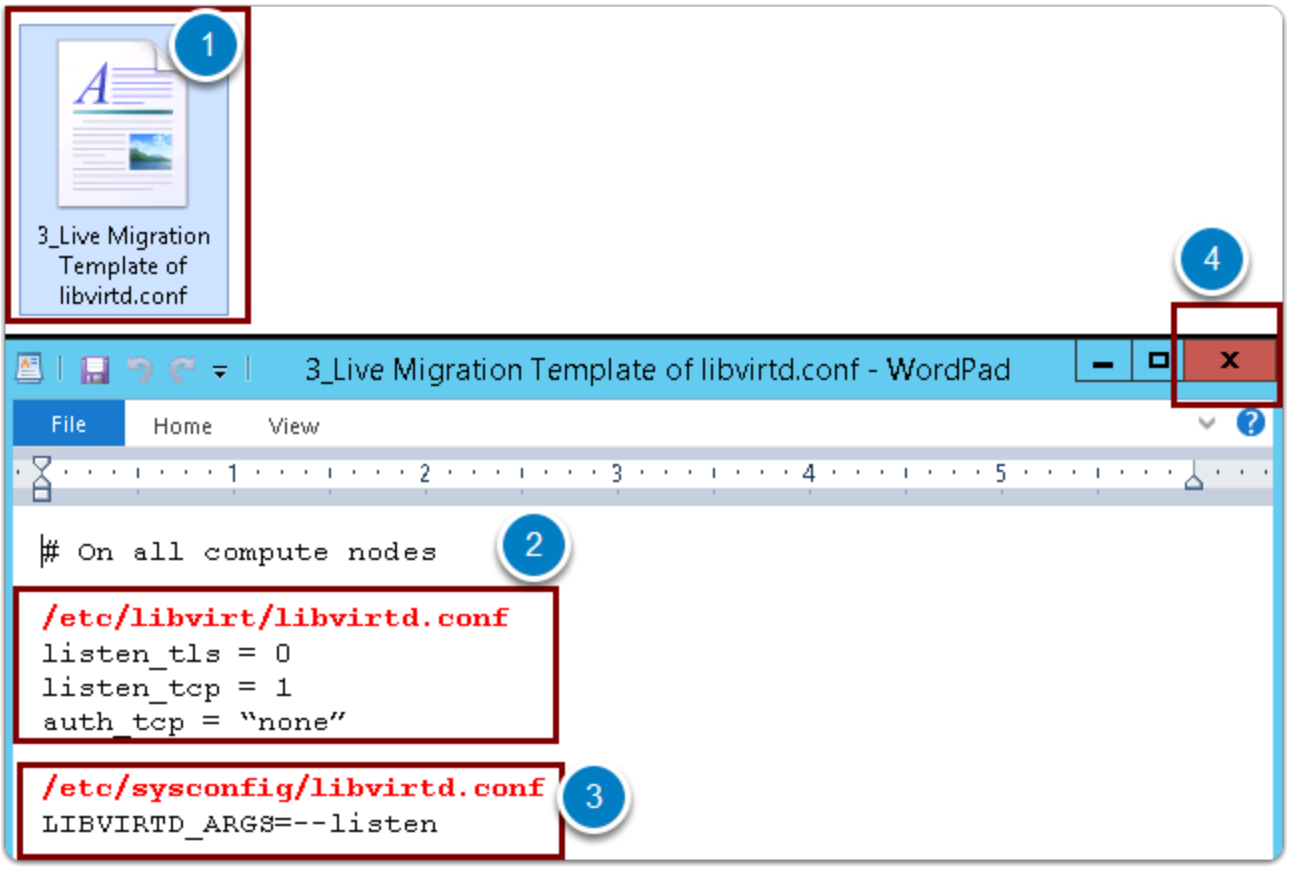
For your convenience, all the changes required for configuration of the Libvirt service have been summarized in a sample Libvirt.conf file.

The relevant sections are highlighted in Red.

1. Please open a file called **3_Live_Migration Template of libvirt.conf** - these settings should be applied to ALL OpenStack Compute Nodes.
2. Review the settings in the /etc/libvirt/libvirtd.conf file for TCP Authentication.
3. Review the settings in the /etc/sysconfig/libvirtd.conf file

To save time, refer to the pre-created **libvirtd.conf** files with all the highlighted settings. As part of the lab you will simply copy over the modified files. This has already been completed for you to save you time in completing this lab.

4. Please close the **3_Live_Migration Template of libvirt.conf**

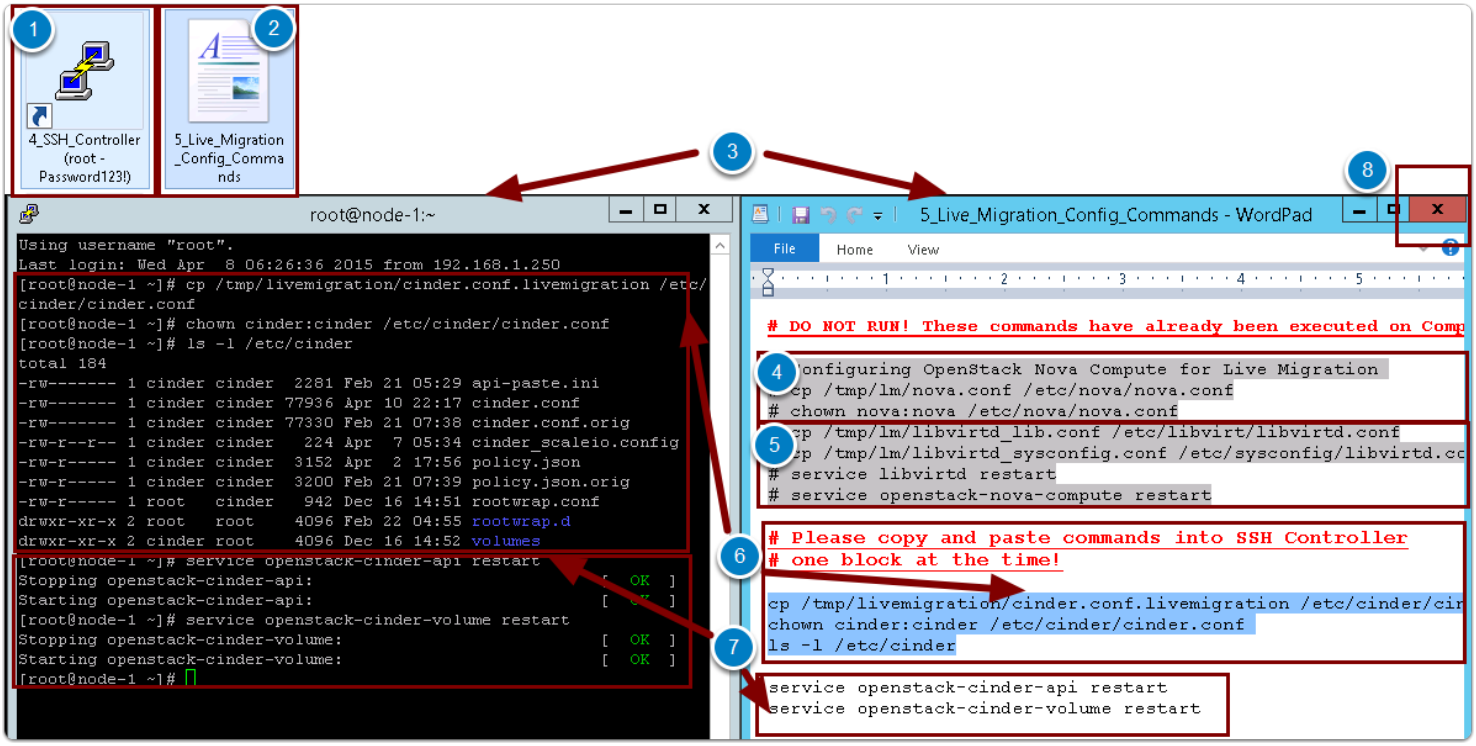


1.5 Using PuTTY SSH Utility

To save you some time in running this lab, a file with the commands to be executed on the OpenStack Compute and Controller Nodes has been created to configure Live Migration:

1. Please open PuTTY shortcut to OpenStack Controller Node using shortcut called **4_SSH_Controller**
2. Then open **5_Live_Migration_Config_Commands** file

3. Please arrange the open SSH Terminal window and the command file side by side as shown - you will be copying the commands from the file into terminal window using right click, Copy and Paste. The grey-shaded areas contain commands that are necessary for installation, but take some time to complete. Please **DO NOT** run these commands, we have already executed them.
4. First greyed-out block was used to configure the Nova Compute service settings on the Compute Nodes
5. Second greyed-out block was used to configure the libvirt service settings on the Compute Nodes
6. It is also suggested to copy and paste commands into **SSH Terminal** window as a block. Blocks are separated by blank lines. Please copy the third command block and paste into **SSH Terminal** window using **right-click.** These commands will configure Cinder Block storage service on the Controller node for Live Migration
7. Then continue with the fourth command block - these commands will restart the Cinder services so the Live Migration settings take effect.
8. When finished, please close the **5_Live_Migration_Config_Commands** file. **!!! Note: Please keep the SSH terminal session for Controller open!**



2. Live Migration

During the Live Migration you, as a Cloud Admin, will:

- Review the sequence of steps and associated commands to migrate a VM instance **Cloud-Workload** from a DevOps Cloud Host (represented by node-2.vlab.local) to a Production Cloud (represented by node-3.vlab.local)

- Migrate Block Volume attached to the above instance from DevOps Cloud storage (represented by ScaleIO backend) to the high-performance Production Cloud Storage (represented by VNX backend).

2.1 Migration Commands

To demonstrate the versatility of the OpenStack integration with EMC Storage, you will be performing the Live Migration using OpenStack Command Line (CLI). For your convenience, a text file with all required commands has been prepared in the Lab-4-Live-Migration folder

- Please open the shortcut called **6_Live_Migration_CLI_Commands** by double-clicking on it.

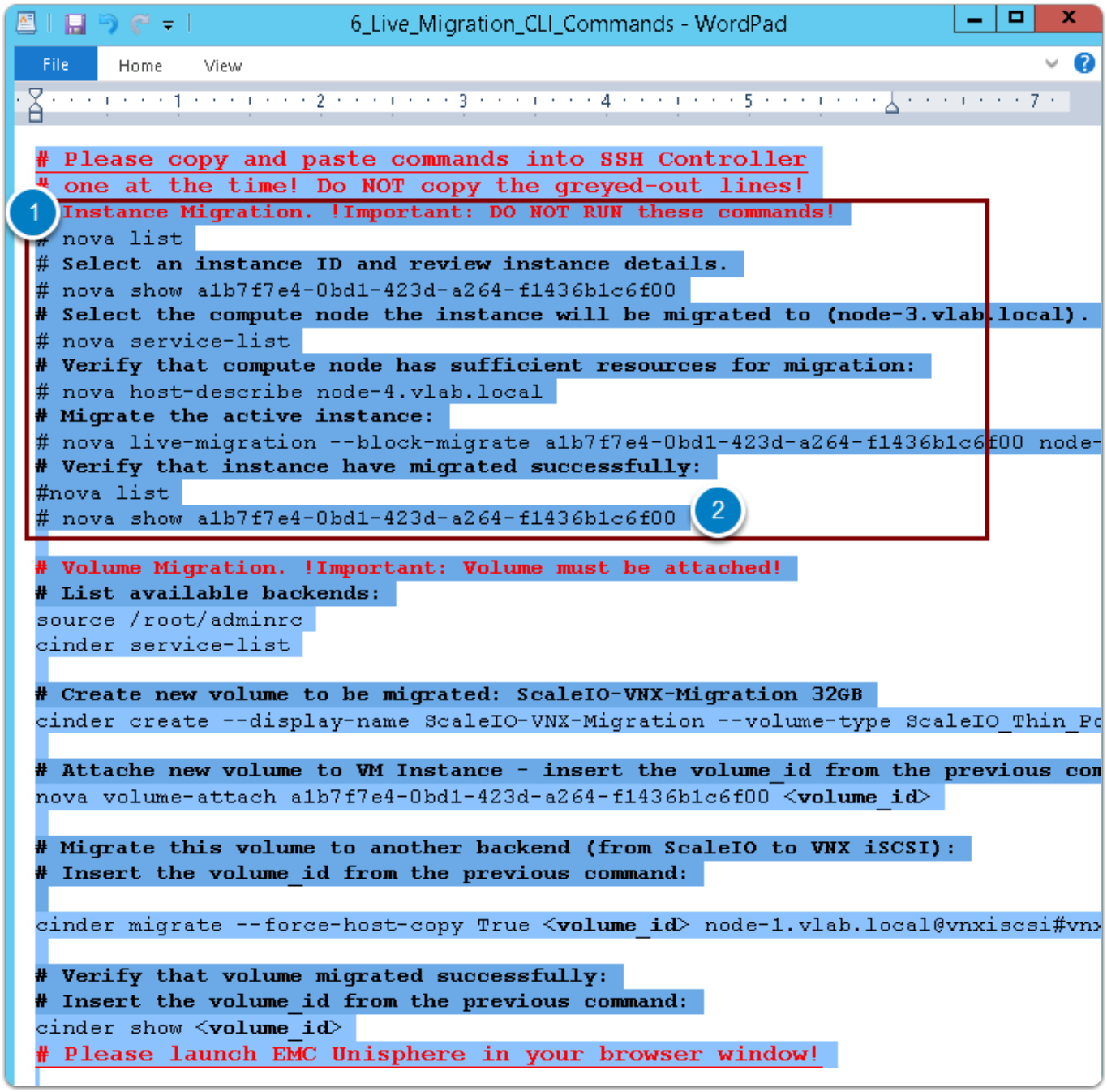
2.2 VM Instance Migration Commands

Please review the VM Instance migration commands in the opened **6_Live_Migration_CLI_Commands** file.

Note: You will **NOT** be executing the **VM instance Live Migration** as it takes some time to complete due to the size of the instance.

1. The greyed-out commands provide you with the overview and details of the **Cloud-Workload** instance and its current and future hosts and commands for the live migration of the **Cloud-Workload** instance.
2. Please note the VM Instance ID - it will be used in the Volume Migration

Note: Please DO NOT execute the live migration of the VM instance as this will take long time!



2.3 Creating Volume for Migration

1. Return to previously opened **6_Live_Migration_CLI_Commands** file arranged side by side with the opened **4_SSH_Controller** terminal window
2. Next command block provides you with the details of the storage backends and service. Copy and paste the command lines from the text file into **SSH terminal** window using **right-click** - please only execute commands

that are not commented out nor greyed-out! Also ensure that you select the **ENTIRE** command line! (use **Shift+End**)!

3. You will now create a new volume to be migrated from ScaleIO to VNX. Please run the command:

cinder create --display-name ScaleIO-VNX-Migration --volume-type ScaleIO_Thin_Pool 32 - You can copy this command from the file and paste into **SSH Terminal** window using **Right-Click.**

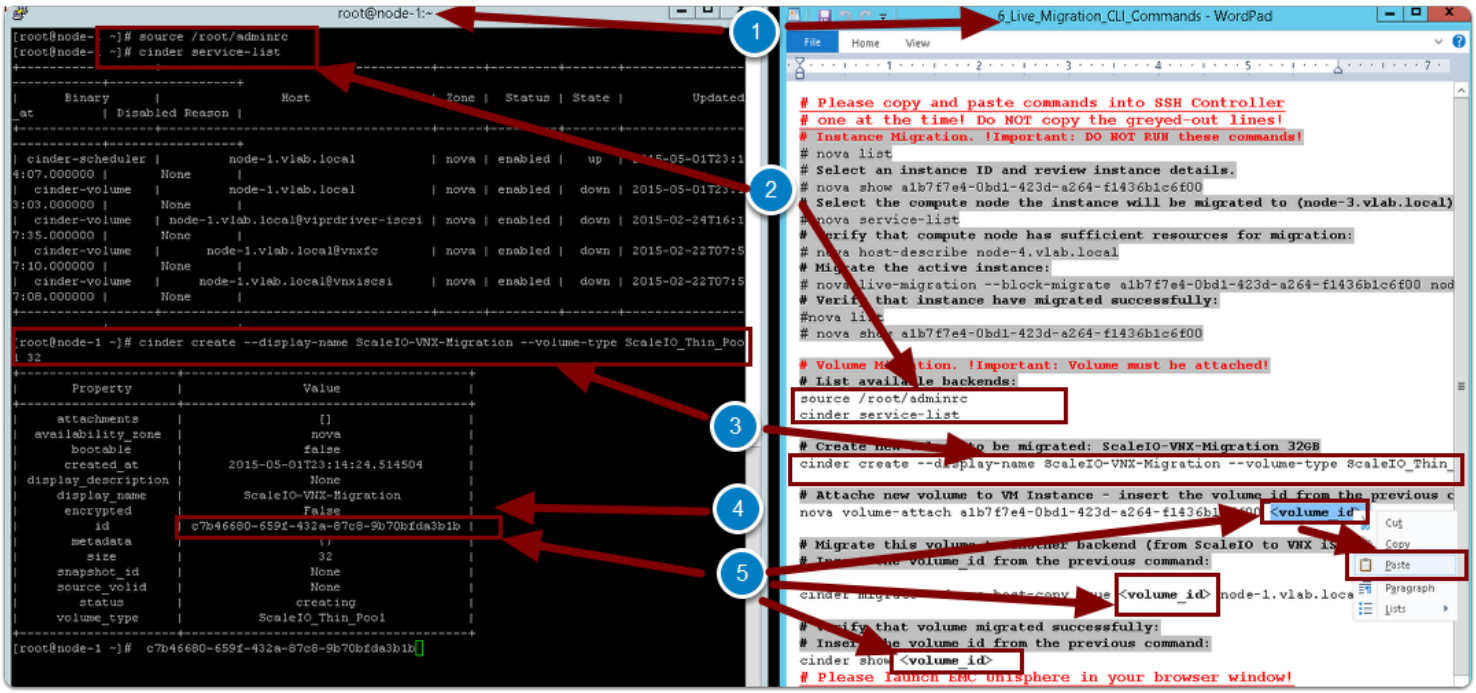
4. Highlight the Volume **ID** in the *cinder* command output and copy it into Clipboard using **Right-Click**

5. Highlight the **‹volume_id›** in the sample commands below and use the **Right-Click** menu **Paste** option to replace the **‹volume_id›** placeholder with the actual volume **ID** from the previous command:

nova volume-attach a1b7f7e4-0bd1-423d-a264-f1436b1c6f00 ‹volume_id›

cinder migrate --force-host-copy True ‹volume_id› node-1.vlab.local@vnxiscsi#vnx_iscsi

cinder show ‹volume_id›



2.4 Volume Migration

You will now attach the volume to the active VM instance and migrate it:

1. Please select the entire command with **‹Volume_ID›** replaced with your actual volume **ID** from the previous command using **Shift-End,** copy it and paste it in the **SSH Terminal** window using **Right-Click.** Run the command:

nova volume-attach a1b7f7e4-0bd1-423d-a264-f1436b1c6f00 ‹volume_id›

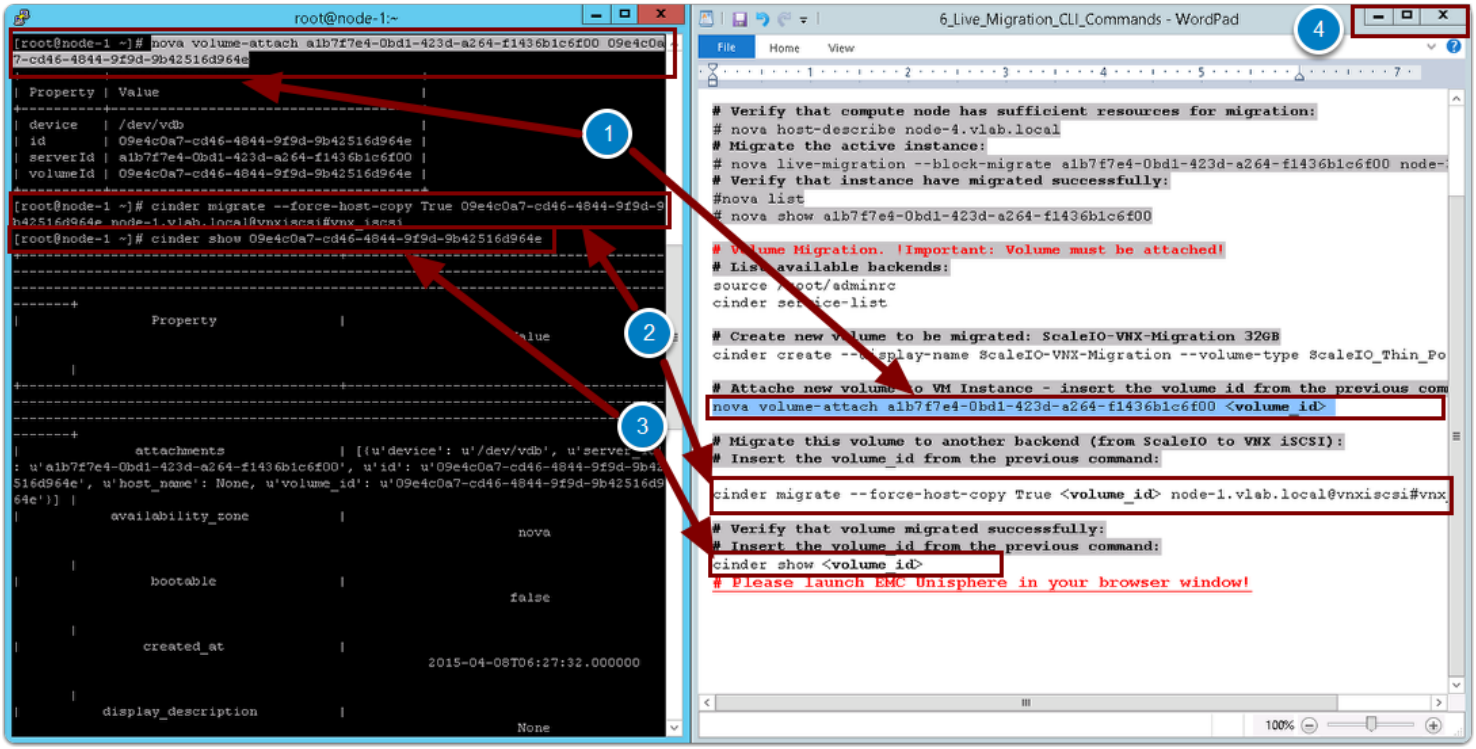
2. Migrate the volume attached to **Cloud-Workload** instance from **ScaleIO** backend to **VNX iSCSI** backend. Select the entire command with **‹Volume_ID›** replaced with your actual volume **ID** using **Shift-End,** copy it and paste it in the **SSH Terminal** window using **Right-Click** and run the command:

cinder migrate --force-host-copy True ‹volume_id› node-1.vlab.local@vnxiscsi#vnx_iscsi

3. Verify the migration by selecting the entire command with **‹Volume_ID›** replaced with your actual volume ID. Select the entire command with **‹Volume_ID›** replaced with your actual volume **ID** using **Shift-End,** copy it and paste it in the **SSH Terminal** window using **Right-Click** and run the command:

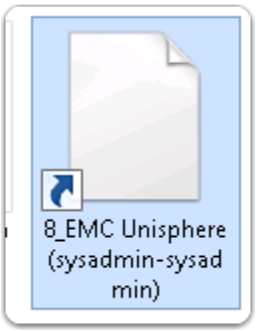
cinder show ‹volume_id› and review the volume details

4. When finished, please close the **6_Live_Migration_CLI_Commands** file, you will not need it again. Click **Don't Save** to confirm closing the file.



3. Launching EMC Unisphere

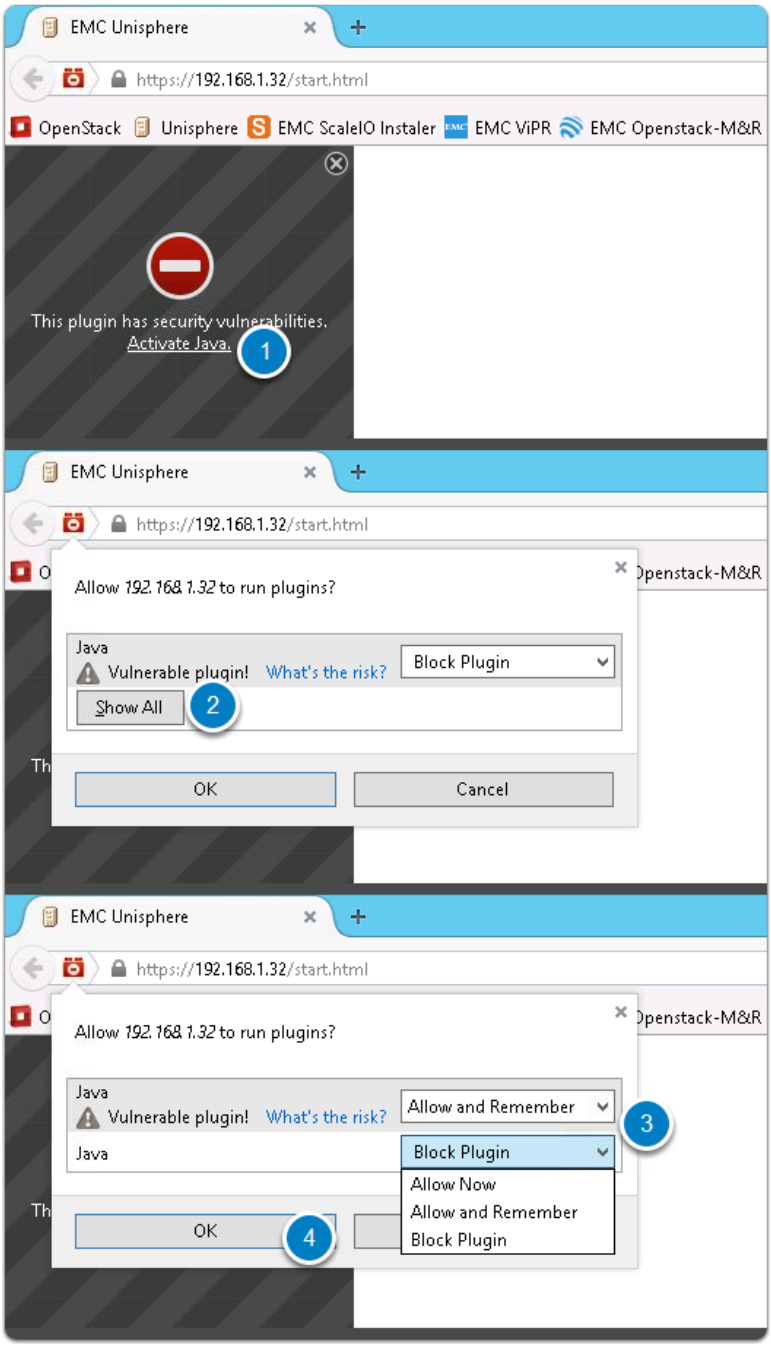
Now that the Volume has been migrated, you can verify the new Volume on the VNX storage system using **EMC Unisphere.** Please double-click on the **8_EMC_Unisphere (sysadmin-sysadmin)** shortcut in the Lab-4-Live-Migration folder.



3.1 Optional Step: Java Security Warning

If you see Java Security warning accept plugin by doing the following:

1. Click **Activate Java** link
2. Click **Show All** button
3. Select **Allow and Remember** for both plugins
4. Click **OK**

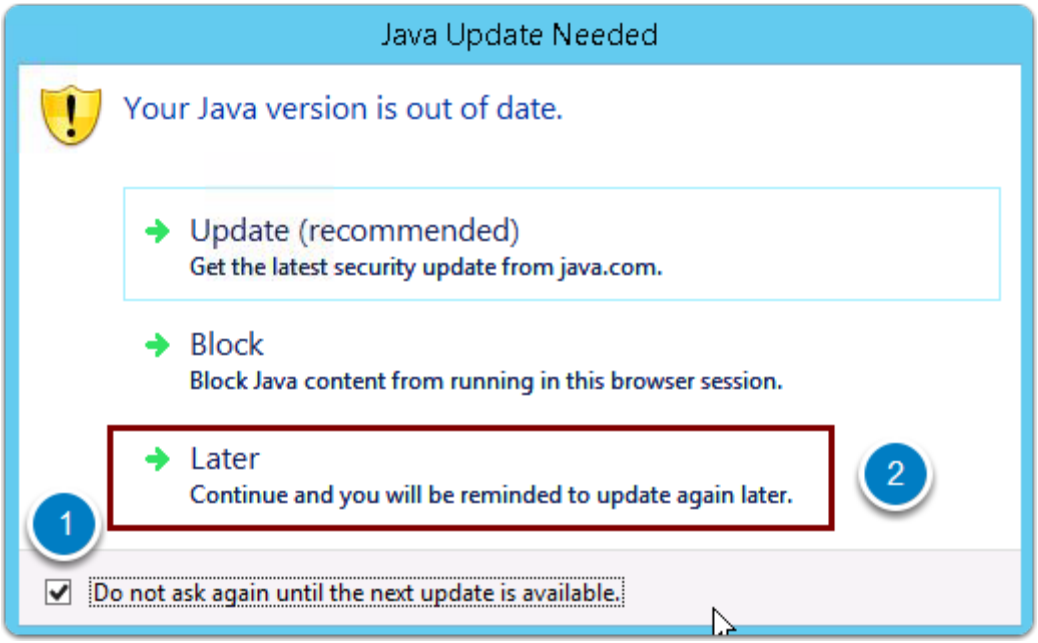


3.2 Optional Step: Java Update

You may see a Java Update Needed window.

1. Click **"Do not ask again until the next update is available"** checkbox
2. Click **Later**

Note: You may need to repeat these steps twice!

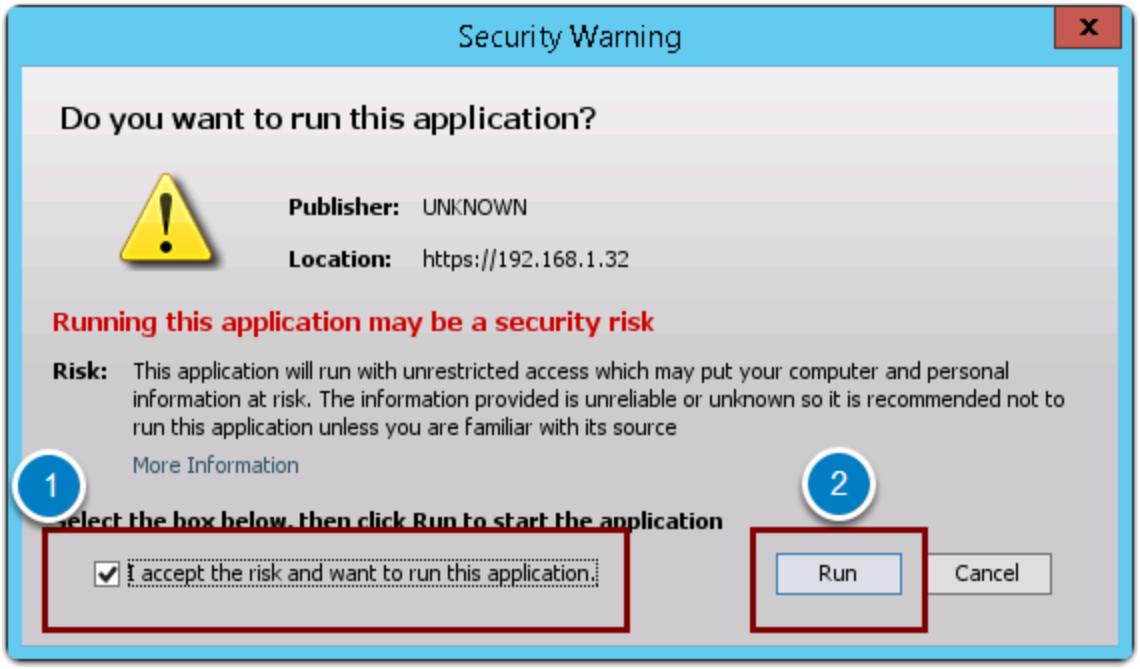


3.3 Accepting Java Security Warning

Please pay attention to the security warning for Java applet:

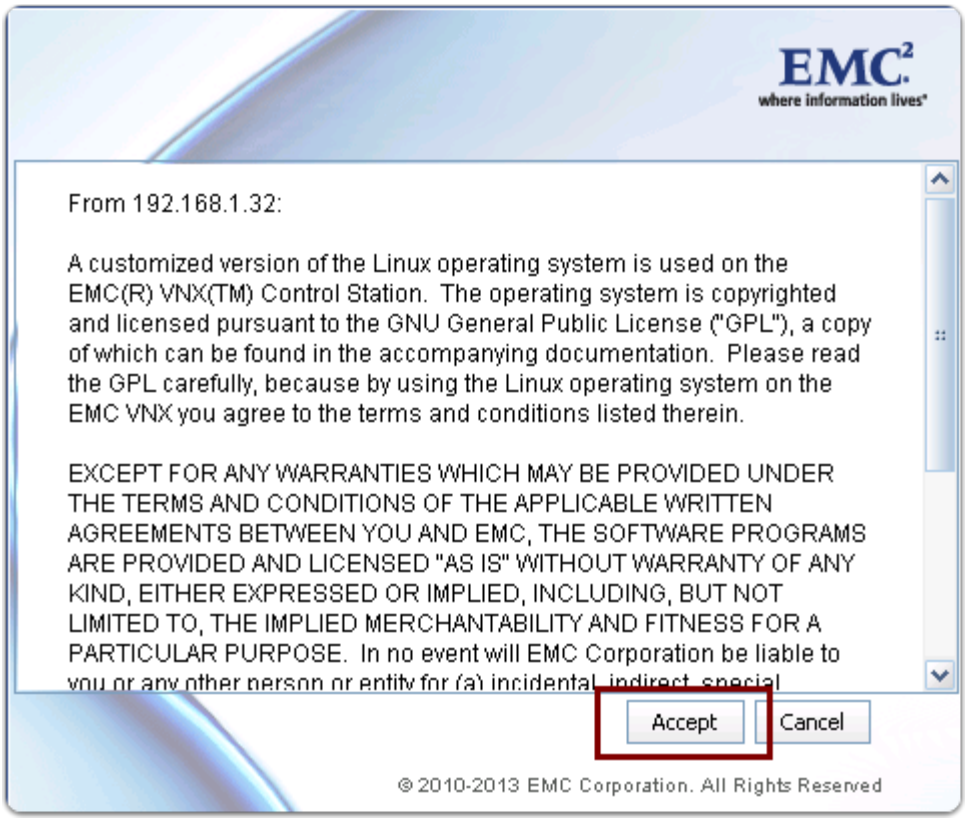
1. Check the box to accept the risk
2. Click Run to continue

Note: You may need to repeat these steps twice!



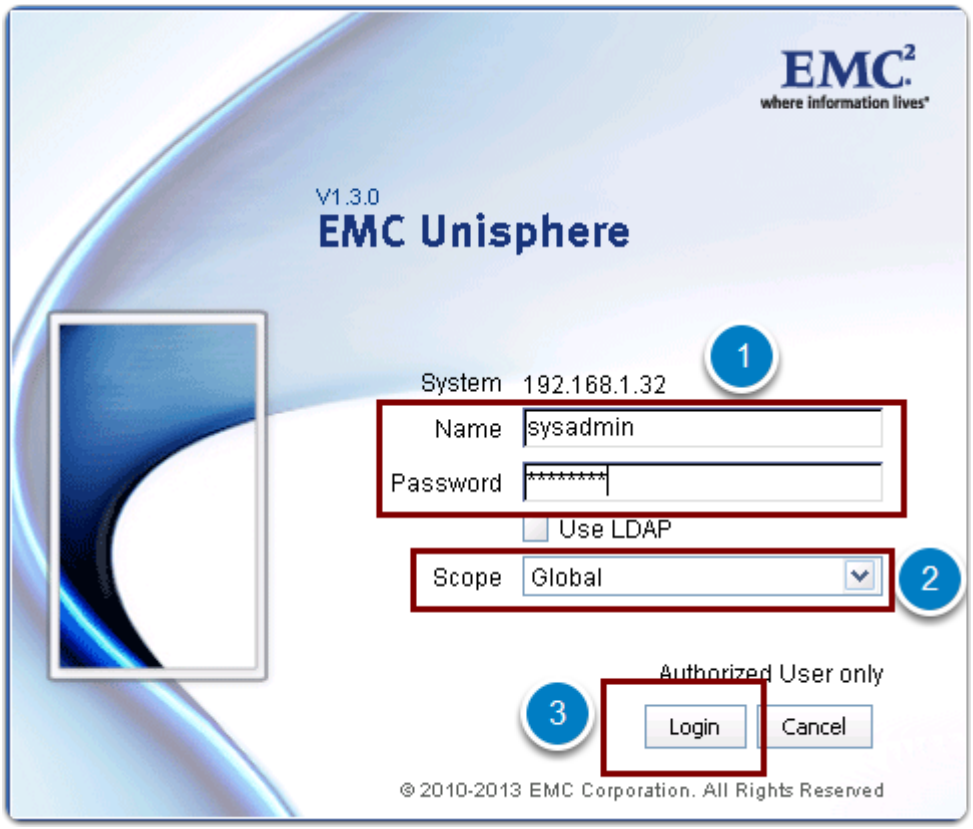
3.4 Accepting EMC License Warning

Please accept EMC Coporation License agreement:



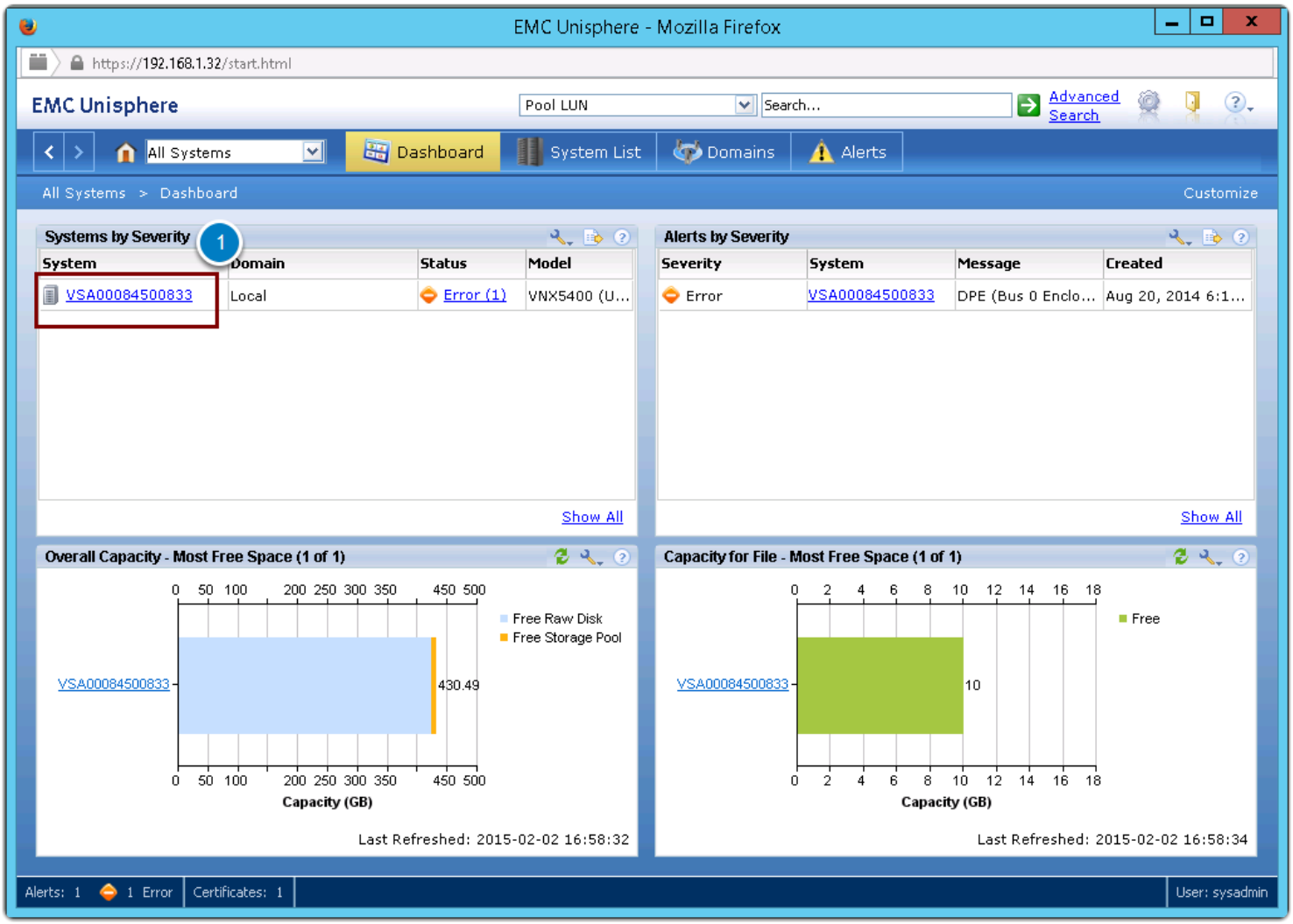
3.5 Logging into Unisphere

1. Please login into Unisphere with credentials: *sysadmin - sysadmin*
2. Make sure your **Scope** is selected as **Global**
3. Click **Login** to continue



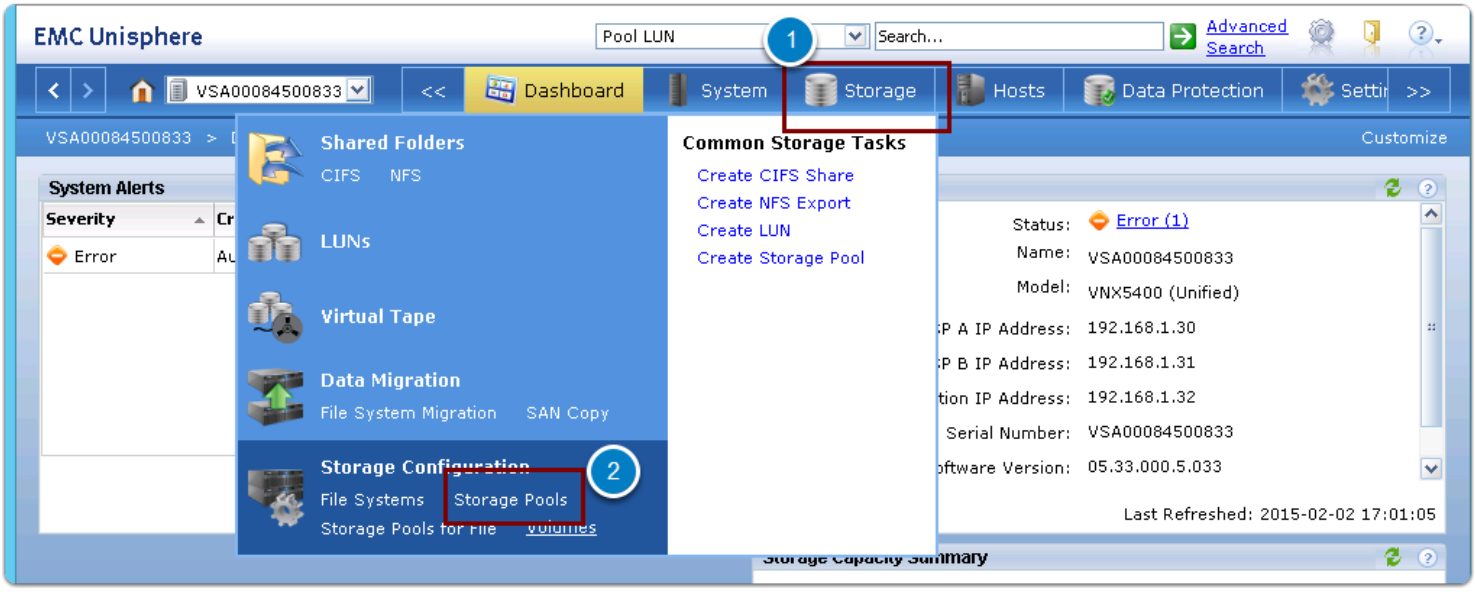
3.6 Unisphere Dashboard

1. In the **Unisphere** Dashboard please select the Storage System called **VSA00084500833**



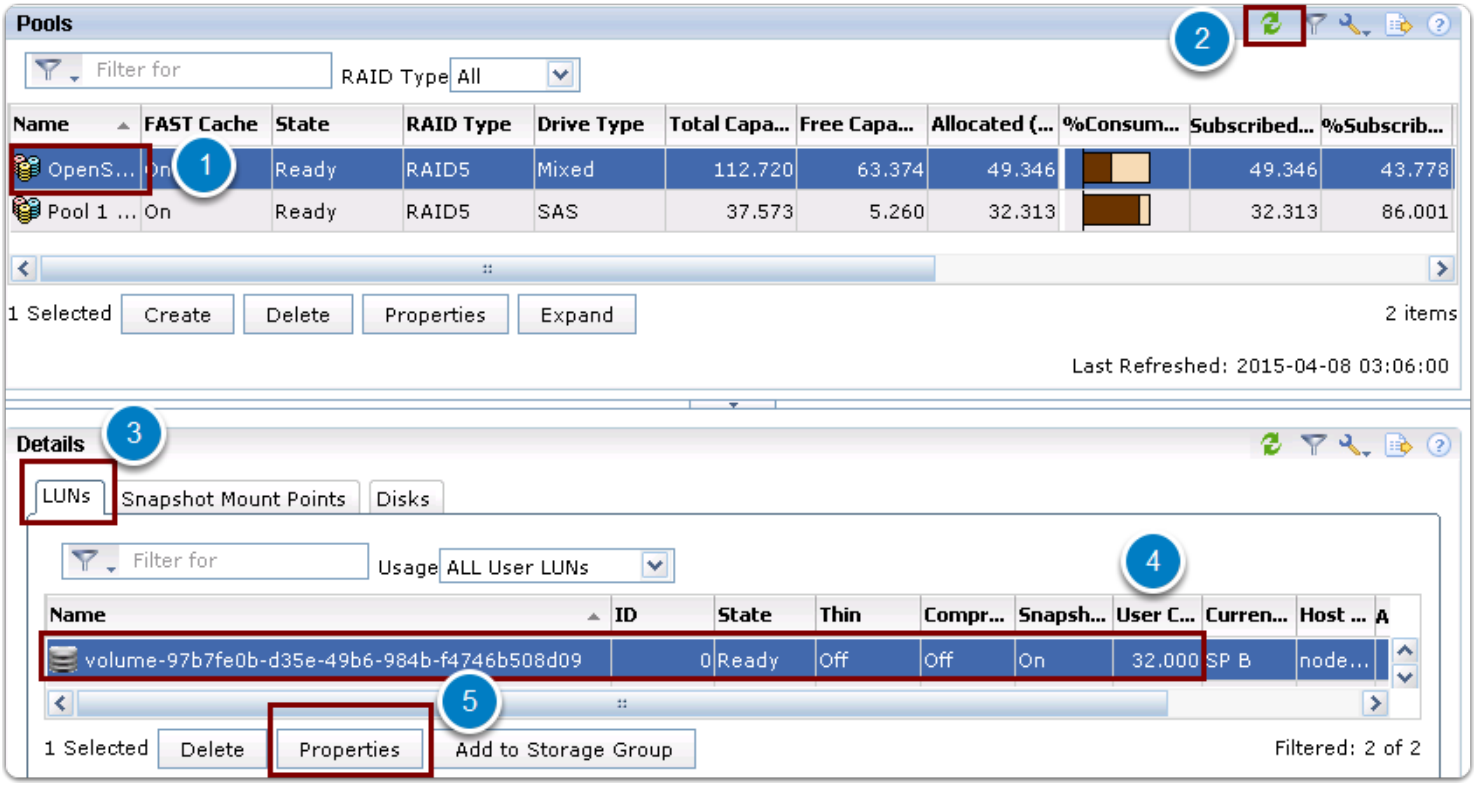
3.7 Block Storage Volumes

1. Next please hover over the **Storage** menu from the top menu bar
2. Navigate to the **Storage Configuration** options and select **Storage Pools**



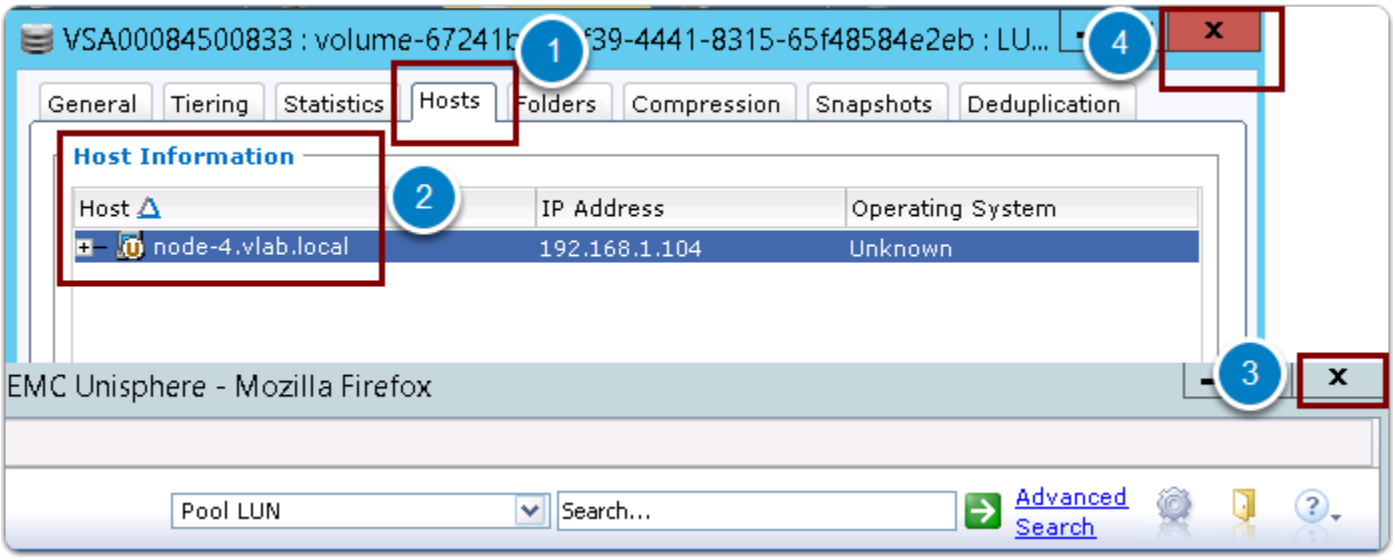
3.8 Newly Migrated Volume

1. Please select the **OpenStack** Storage Pool
2. Click **Refresh** icon to see your newly migrated volume
3. Click on the **LUN Tab**
4. Highlight the newly migrated LUN (volume) - note the **Volume** size **32GB** - this is the same volume you have created earlier.
5. Click on **Properties** to review the details of this newly created LUN



3.9 Volume Attachment

1. Select **Hosts** Tab in the LUN's **Properties** dialog
2. Review the **Hosts** in this LUN's export group: **node-4.vlab.local** - this is the new OpenStack Compute nodes to which you have migrated the **Cloud-Workload** instance earlier in this lab
3. Please close the LUN Properties dialog
4. Then close **EMC Unisphere** Browser window.



4. Note!

Note: when executing the subsequent labs you may see two migration volumes in the OpenStack Horizon UI Volumes tab - the original one and the migrated one. This is normal at this time, as Horizon currently does not support volume migration. Please ignore the second volume and its status."

5. Conclusion

In this lab you, wearing the hat of Code Nebulous Cloud Administrator, have successfully accomplished the following:

- Configured OpenStack Controller and Compute nodes for live migration of a VM instance and its associated block storage volume
- Reviewed the migration process for VM instance from one Compute node to another based on its available CPU and RAM resources
- Migrated an attached block storage volume from ScaleIO storage pool to a VNX array storage pool
- Verified the availability of the migrated storage volume and its attached instances

Now the Code Nebulous Cloud Users can begin using the newly built applications running on the Cloud-Workload instance in a high-performance Production environment!

This lab is now complete. Please close the following windows as you will not be using them any longer:

- Lab-4-Live-Migration folder
- SSH Terminal Window
- EMC Unisphere browser window

Please proceed to the next lab, or select other labs from the list.

Optional Lab 5 - Using EMC ViPR with Cinder Block Storage Service

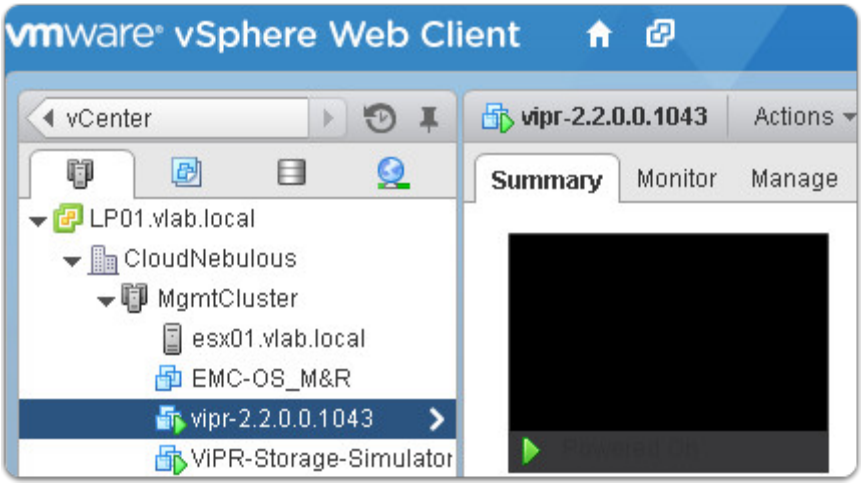
Lab 5 - Using EMC ViPR with Cinder

ViPR Controller includes a Cinder driver, which interfaces between ViPR and OpenStack, and presents Software Defined Storage volumes to OpenStack as block devices which then become available to Cinder block storage.

While ViPR Controller can provision both block and file storage, only the Cinder driver is available for OpenStack Juno release. This driver is available from both EMC Support site as well as the GitHub: https://github.com/emcvipr/controller-openstack-cinder

1. ViPR Components

In this lab the ViPR Controller runs as a vSphere Virtual Machine. It also uses several storage simulators, configured to run on a separate vSphere VM.



2. Lab Scenario

In this lab as a Cloud Admin you will:

- Review the Cinder driver capabilities for EMC ViPR, including extra-specs
- Review and become familiar with the ViPR Cinder drivers configuration steps
- Follow the configuration steps and implement Cinder integration with EMC ViPR Storage backend
- Create storage volume types for OpenStack Volumes and associate the Cinder Volume Types with ViPR Virtual Storage Pools
- Practice creating new volumes for different Volume Types
- Ensure that new Volumes are created using EMC ViPR User Interface (UI).

3. ViPR Cinder Driver Supported operations

ViPR Cinder driver supported operations are available at: https://github.com/emcvipr/controller-openstack-cinder

The EMC ViPR Cinder driver contains both an ISCSIDriver as well as a FibreChannelDriver, with the ability to create/ delete and attach/detach volumes and create/delete snapshots, etc.

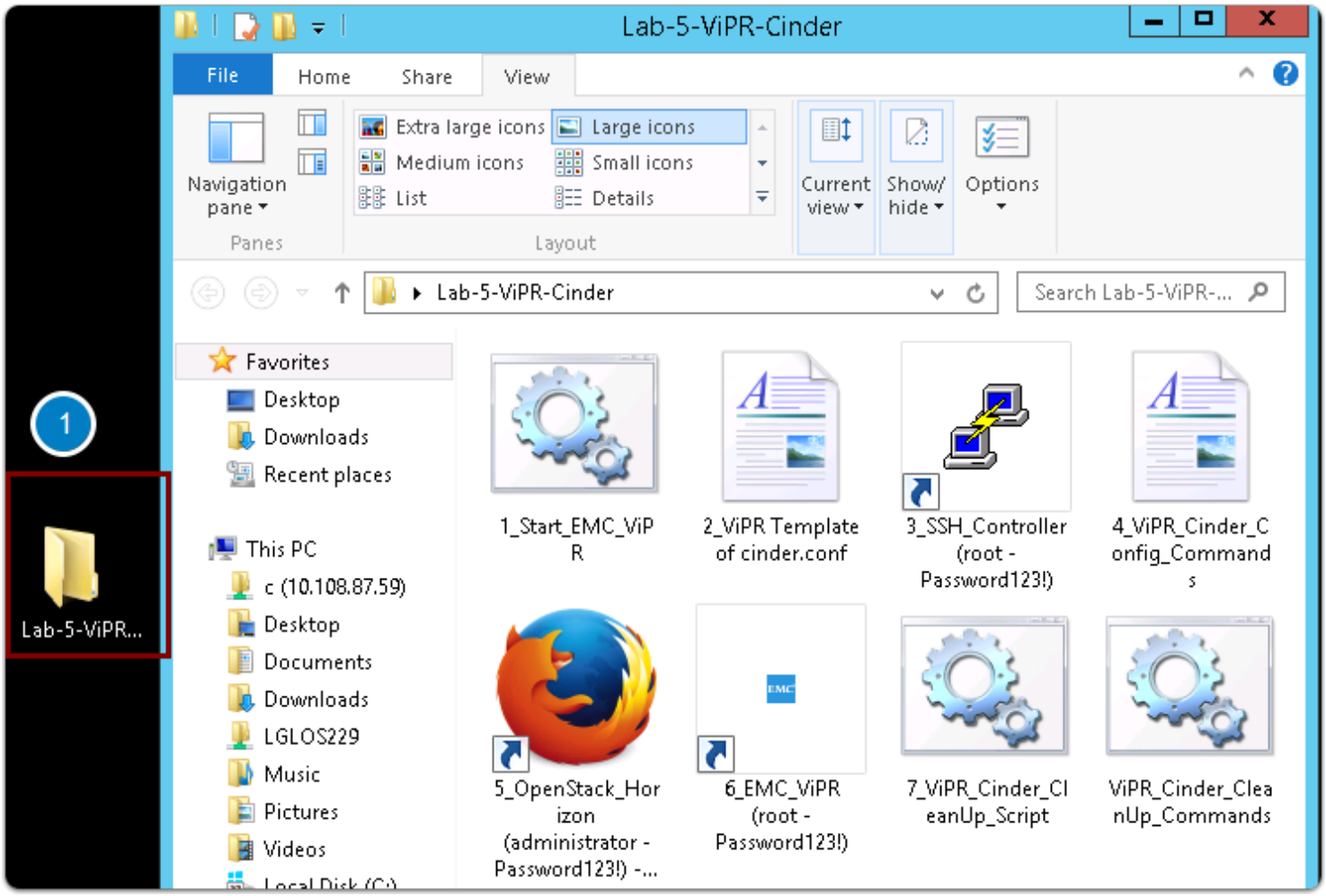
The following operations are supported:

- Create volume.
- Delete volume.
- Attach volume.
- Detach volume.
- Create snapshot.
- Delete snapshot.
- Get Volume Stats.
- Copy image to volume.
- Copy volume to image.
- Clone volume.
- Extend volume.
- Create volume from snapshot.

4. Lab-5 Folder

Please open and review **Lab-5-ViPR-Cinder** folder

Pay attention to the Numbers in the name of the shortcut - for your convenience you will be using these shortcuts in order.



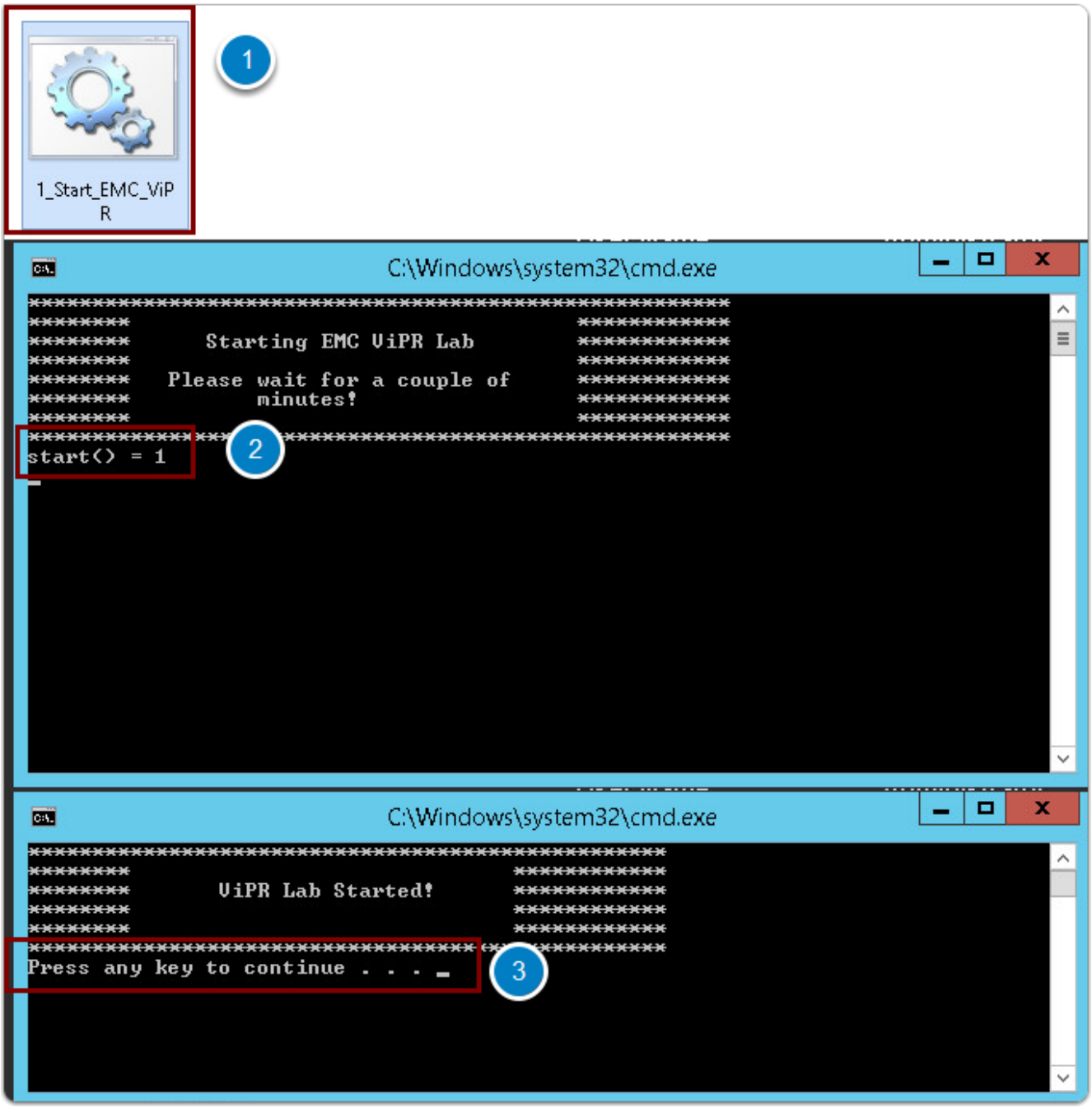
4.1 Starting ViPR

You will first start **ViPR Controller** and the associated storage simulators:

1. Please launch the **1_Start_EMC_ViPR** shortcut by double-clicking on it
2. Verify that the **ViPR Controller** has started - the script output should show: **start() = 1**

3. Please verify that the lab has started and press any key to close the script window and return to the **Lab-4-ViPR-Cinder folder**

Note: Please wait 5 minutes for starting ViPR services.

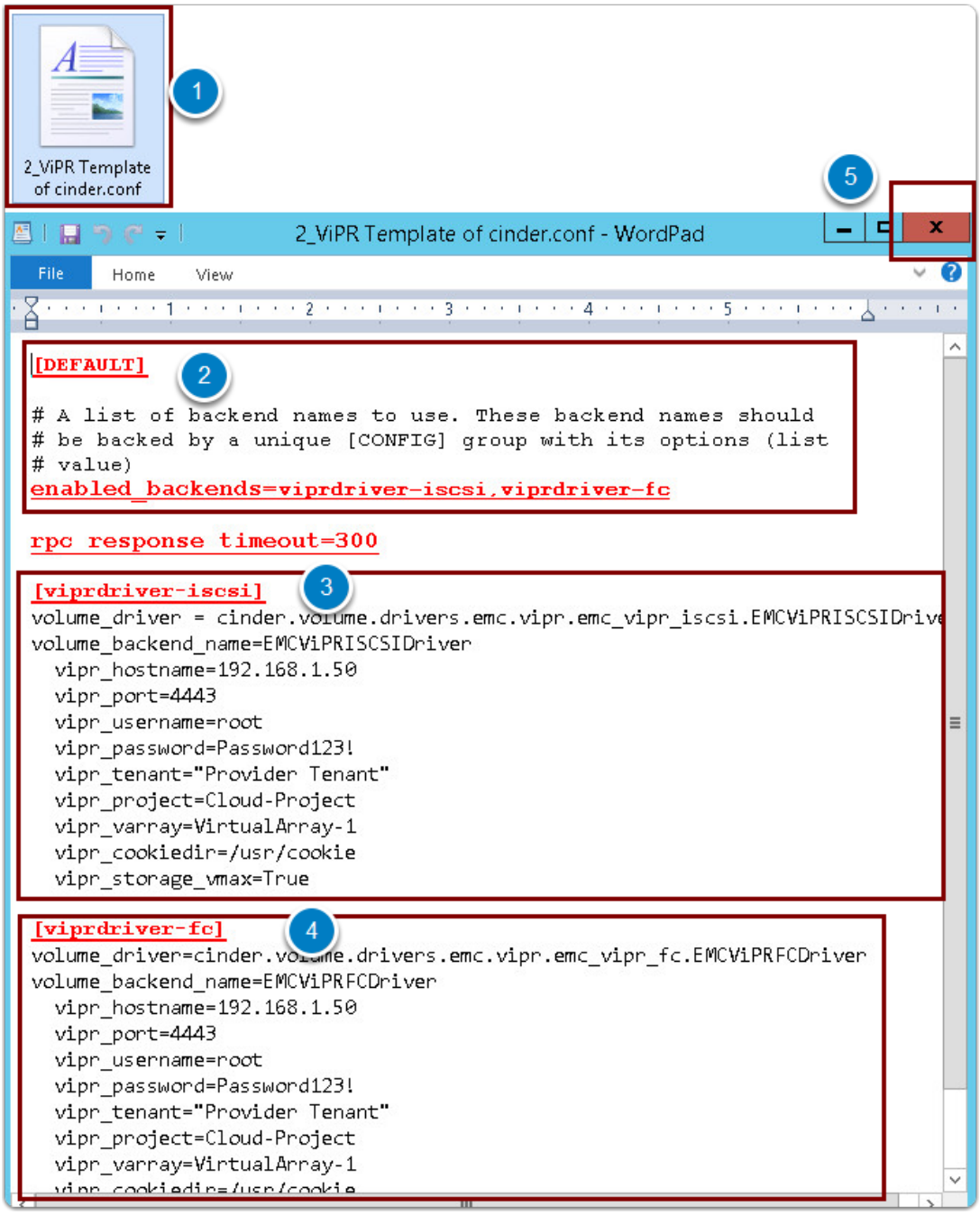


4.2 ViPR Cinder Driver Configuration Steps

ViPR Cinder driver uses ViPR CLI API to communicate with ViPR Controller. Additionally, the OpenStack Cinder service needs to be configured to recognize ViPR as a valid storage backend.

A template has been provided with all necessary configuration changes required by ViPR in the cinder.conf file for your review.

1. Please open the **2_ViPR_Template_of_Cinder.conf** file in the **Lab-5-ViPR-Cinder** folder
2. Review the **enabled_backends** key in the **DEFAULT** section. ViPR Cinder drivers supports both **iSCSI and FibreChannel (FC)** storage protocols.
3. Review the iSCSI driver configuration section
4. Review the FC driver configuration section
5. Please **close** the file to continue

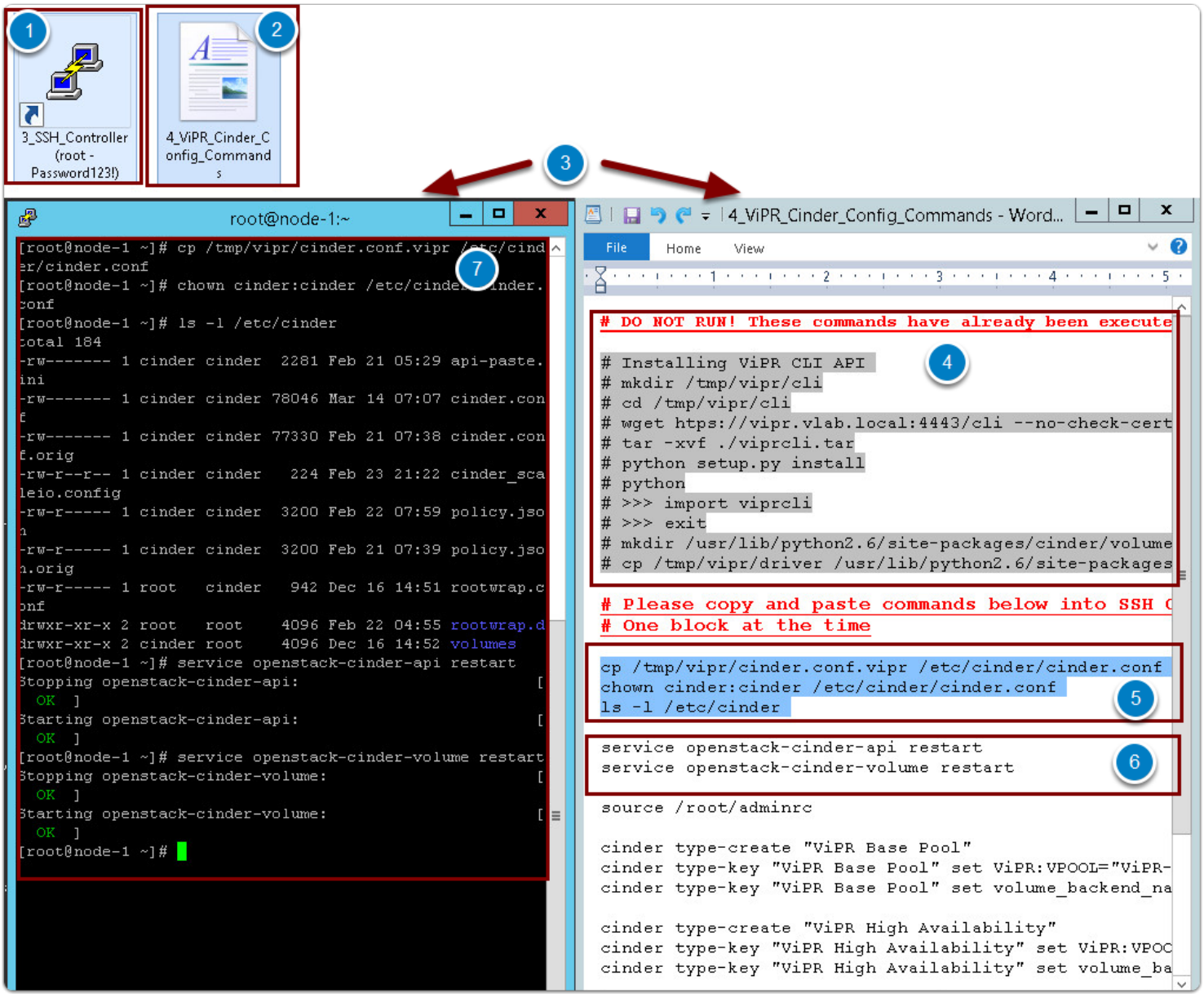


4.3 Using PuTTY SSH Utility

To save you some time in running this lab, a file has been created with the commands to be executed on the OpenStack Controller Node to install and configure ViPR Cinder driver.

1. Please open PuTTY shortcut to OpenStack Controller Node using shortcut called **3_SSH_Controller**

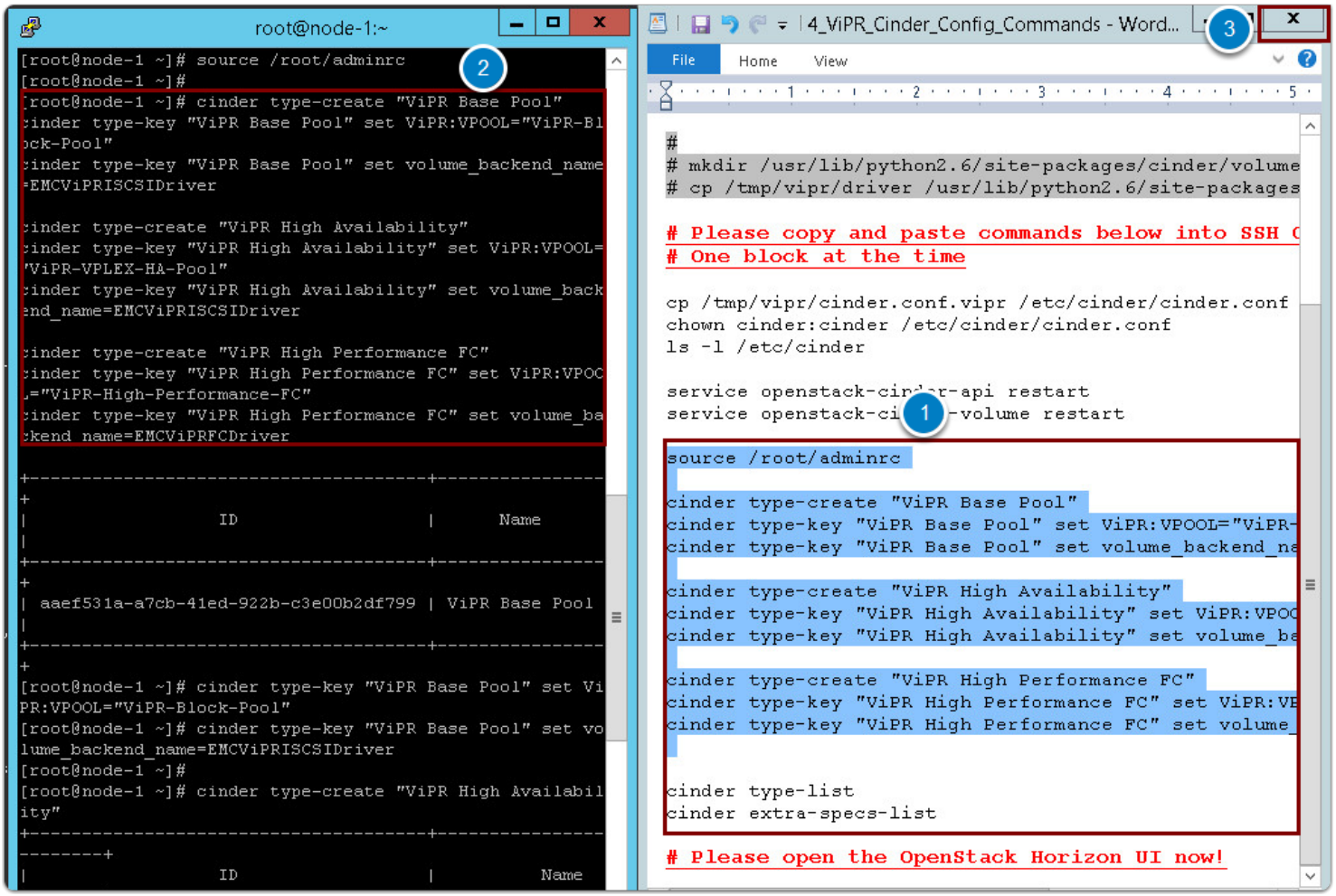
2. Then open **4_ViPR_Config_Commands** file
3. Please arrange the open SSH Terminal window and the command file side by side as shown - you will be copying the commands from the file into terminal window using right click, Copy and Paste.
4. The grey-shaded areas contain commands that are necessary for installation, but take some time to complete. Please **DO NOT** run these commands, we have already executed them. The greyed-out block of commands installed the ViPR CLI API on the OpenStack Controller node and installed the ViPR Cinder driver
5. It is also recommended to copy and paste commands into **SSH Terminal** window as a **block**. Blocks are separated by blank lines. Please copy the first command block and paste into **SSH Terminal** window using right-click. We have created a copy of the **cinder.conf** file in the **/tmp/vipr** directory with all necessary settings you have reviewed earlier - this file is copied over the original **/etc/cinder/cinder.conf** file. It is also necessary to change the ownership of this file to **cinder** user
6. Please highlight, copy and paste the second command block into **SSH Terminal** window - It is necessary to restart the **Cinder API and Volume** services to read the new configuration files.
7. Please review the executed commands in the **SSH Terminal** window.


1
3_SSH_Controller (root - Password123!)
2
4_ViPR_Cinder_Config_Commands
3
root@node-1:~
[root@node-1 ~]# cp /tmp/vipr/cinder.conf.vipr /etc/cinder/cinder.conf
[root@node-1 ~]# chown cinder:cinder /etc/cinder/cinder.conf
[root@node-1 ~]# ls -l /etc/cinder
total 184
-rw------- 1 cinder cinder 2281 Feb 21 05:29 api-paste.ini
-rw------- 1 cinder cinder 78046 Mar 14 07:07 cinder.conf
-rw------- 1 cinder cinder 77330 Feb 21 07:38 cinder.conf.orig
-rw-r--r-- 1 cinder cinder 224 Feb 23 21:22 cinder_scaleio.config
-rw-r----- 1 cinder cinder 3200 Feb 22 07:59 policy.json
-rw-r----- 1 cinder cinder 3200 Feb 21 07:39 policy.json.orig
-rw-r----- 1 root cinder 942 Dec 16 14:51 rootwrap.conf
drwxr-xr-x 2 root root 4096 Feb 22 04:55 rootwrap.d
drwxr-xr-x 2 cinder root 4096 Dec 16 14:52 volumes
[root@node-1 ~]# service openstack-cinder-api restart
Stopping openstack-cinder-api: [OK]
Starting openstack-cinder-api: [OK]
[root@node-1 ~]# service openstack-cinder-volume restart
Stopping openstack-cinder-volume: [OK]
Starting openstack-cinder-volume: [OK]
[root@node-1 ~]#
7
4_ViPR_Cinder_Config_Commands - Word...
File
Home
View
DO NOT RUN! These commands have already been execute
4
Installing ViPR CLI API
mkdir /tmp/vipr/cli
cd /tmp/vipr/cli
wget https://vipr.vlab.local:4443/cli --no-check-cert
tar -xvf ./viprcli.tar
python setup.py install
python
>>> import viprcli
>>> exit
mkdir /usr/lib/python2.6/site-packages/cinder/volume
cp /tmp/vipr/driver /usr/lib/python2.6/site-packages
Please copy and paste commands below into SSH
One block at the time
cp /tmp/vipr/cinder.conf.vipr /etc/cinder/cinder.conf
chown cinder:cinder /etc/cinder/cinder.conf
ls -l /etc/cinder
5
service openstack-cinder-api restart
service openstack-cinder-volume restart
6
source /root/adminrc
cinder type-create "ViPR Base Pool"
cinder type-key "ViPR Base Pool" set ViPR:VPOOL="ViPR-
cinder type-key "ViPR Base Pool" set volume_backend_na
cinder type-create "ViPR High Availability"
cinder type-key "ViPR High Availability" set ViPR:VPOC
cinder type-key "ViPR High Availability" set volume_ba

4.4 Creating ViPR Volume Types

Now that ViPR Cinder driver is installed and configured, we will create ViPR Volume Types in OpenStack Cinder service.

1. Please copy the next block in the 4_ViPR_Cinder_Config.Commands file and paste it into SSH Terminal window using right-click
2. Please review the cinder type-create command and created ViPR volume types
3. Please close the SSH terminal window and the ViPR Config commands file- we will now begin using the OpenStack Horizon UI.



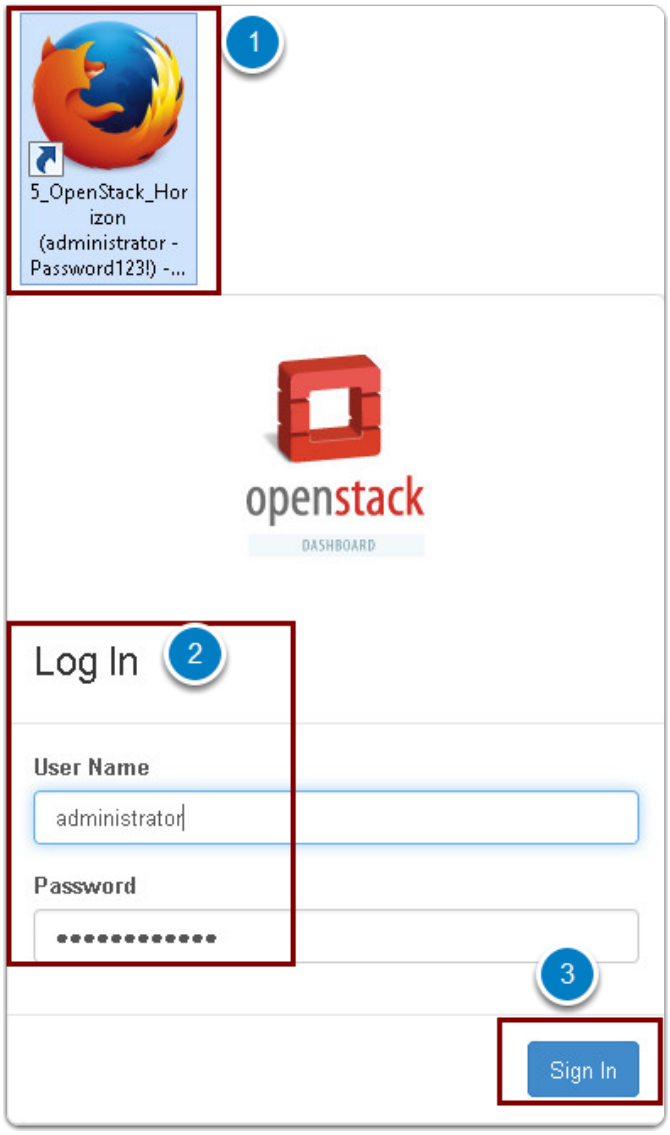
5. Using OpenStack Horizon

1. Return to the Lab-5-ViPR-Cinder folder and launch the 5_OpenStack_Horizon(administrator - Password123!) shortcut

2. The user credentials should be cached in the browser window. If needed please type the credentials:

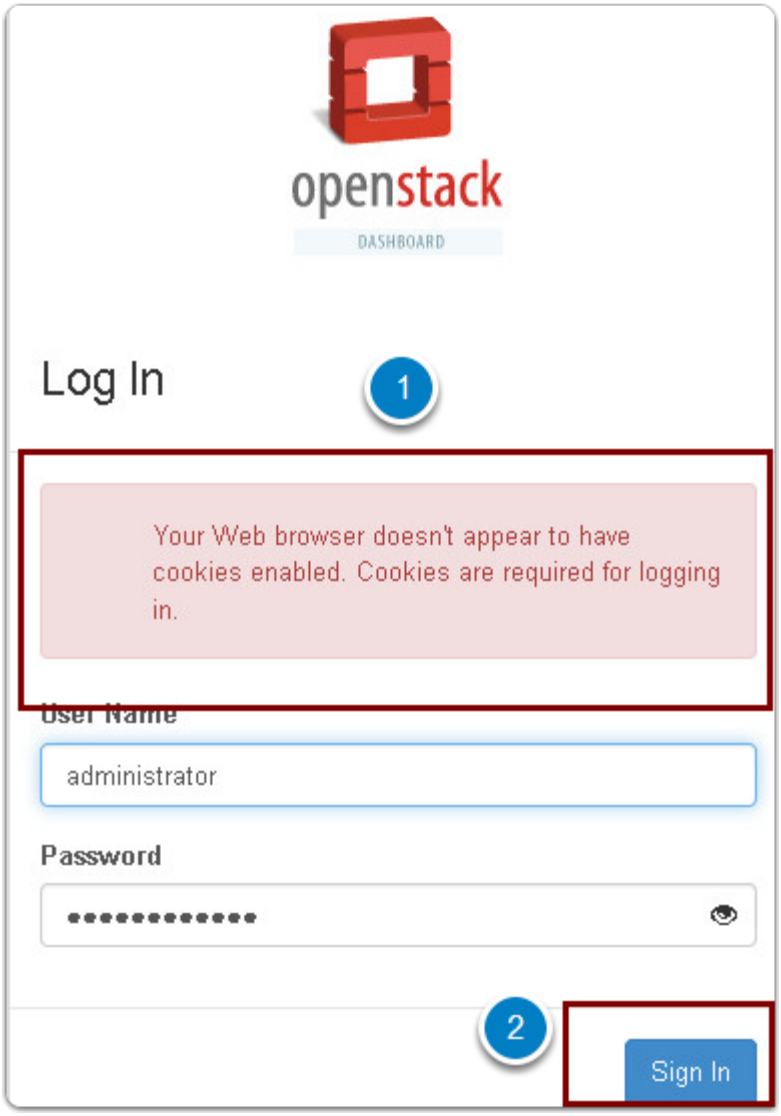
- User Name: *administrator*
- Password: *Password123!*

3. Click **Sign In** to continue



5.1 Browser Cookie Warning

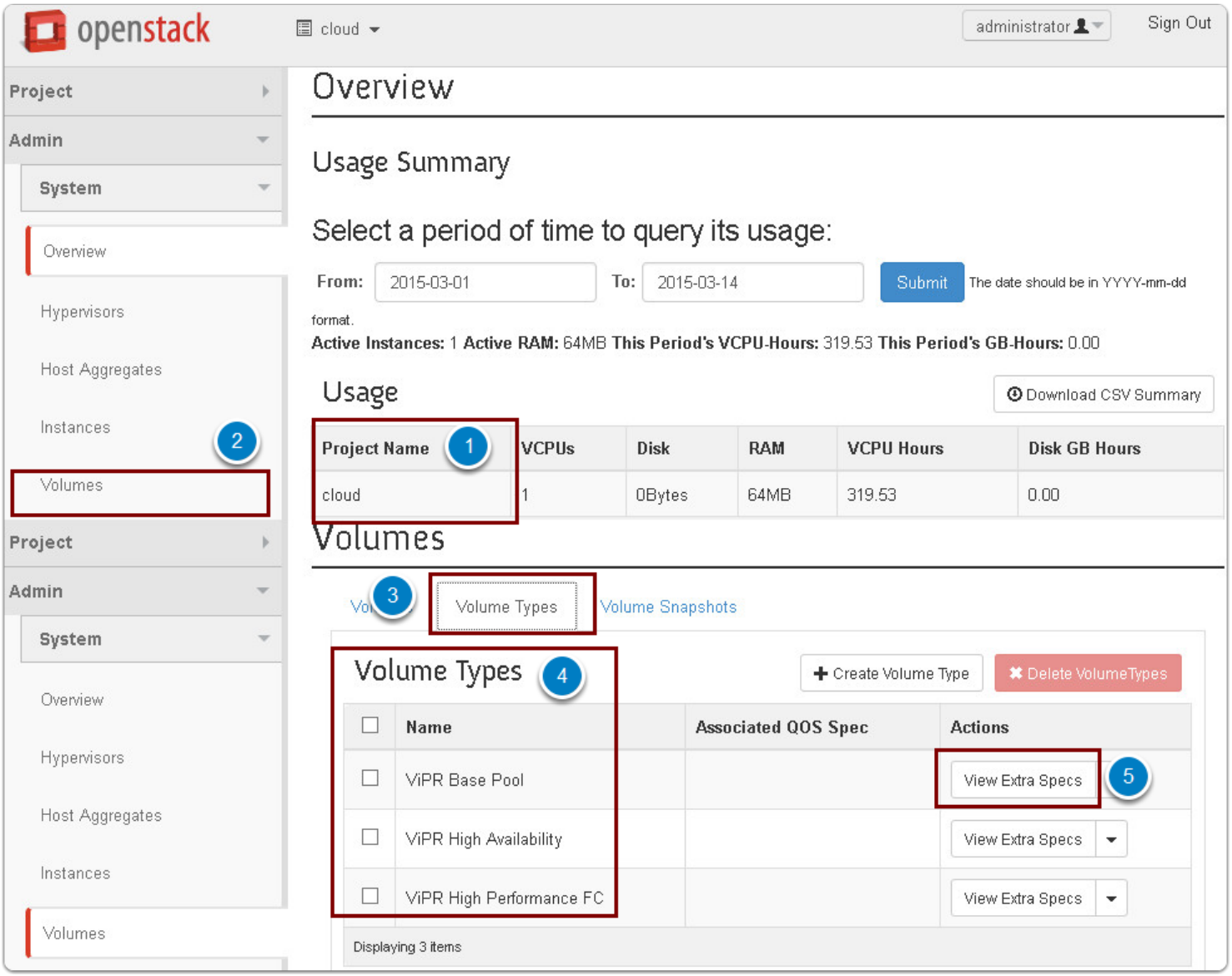
1. Occasionally you may see a browser cookie warning
2. Please disregard it and simply click on **Sign In** again to continue



5.2 Reviewing ViPR Volume Types

1. Please review the **Dashboard** for OpenStack project - **cloud**
2. Please select **Volumes** In OpenStack Horizon Admin menu on the left hand side
3. Click on the **Volume Types** tab

4. Review your created **ViPR** volume types. **Note:** You may see other volume type created earlier in the previous labs - please ignore them.
5. Please click on the **Extra Specs** menu to see the volume type details.

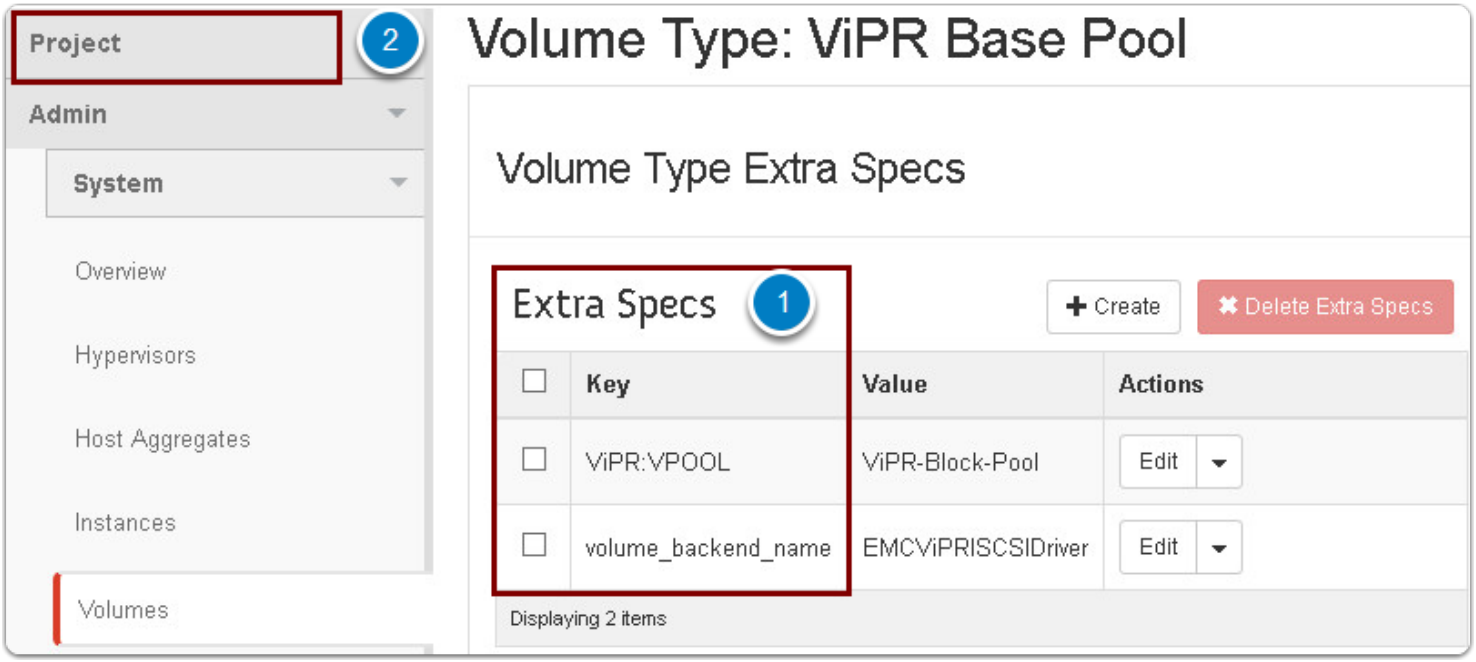


5.3 Volume Type Extra Specs

1. Please review the Extra Specs for a newly created Volume Type: ViPR Base Pool

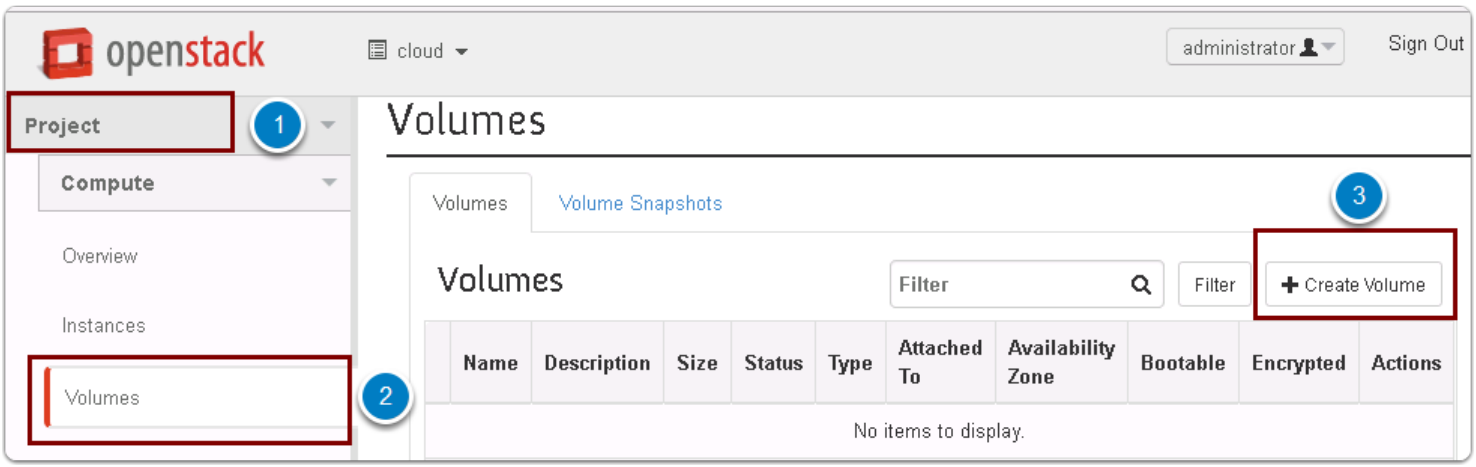
- ViPR Virtual Storage Pool (VSP)
- ViPR Cinder driver - iSCSI

2. Please select the **Project** tab - you will now create new ViPR volume.



5.4 Project View

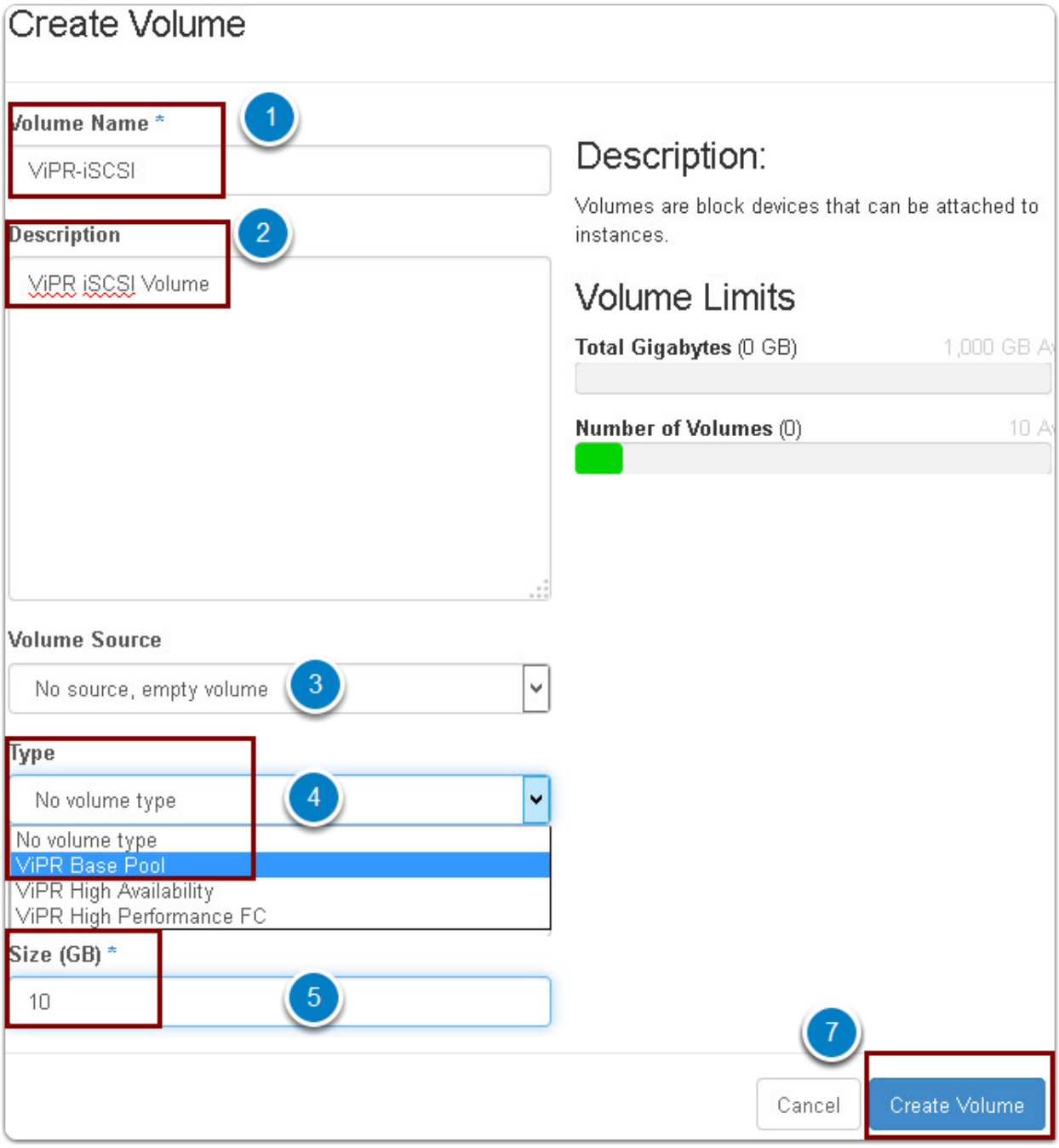
1. Please select **Volumes** tab
2. You will now create a new **Volume** using one of the **ViPR** Volume types - please click on **Create Volume** menu



5.5 Creating ViPR Volume

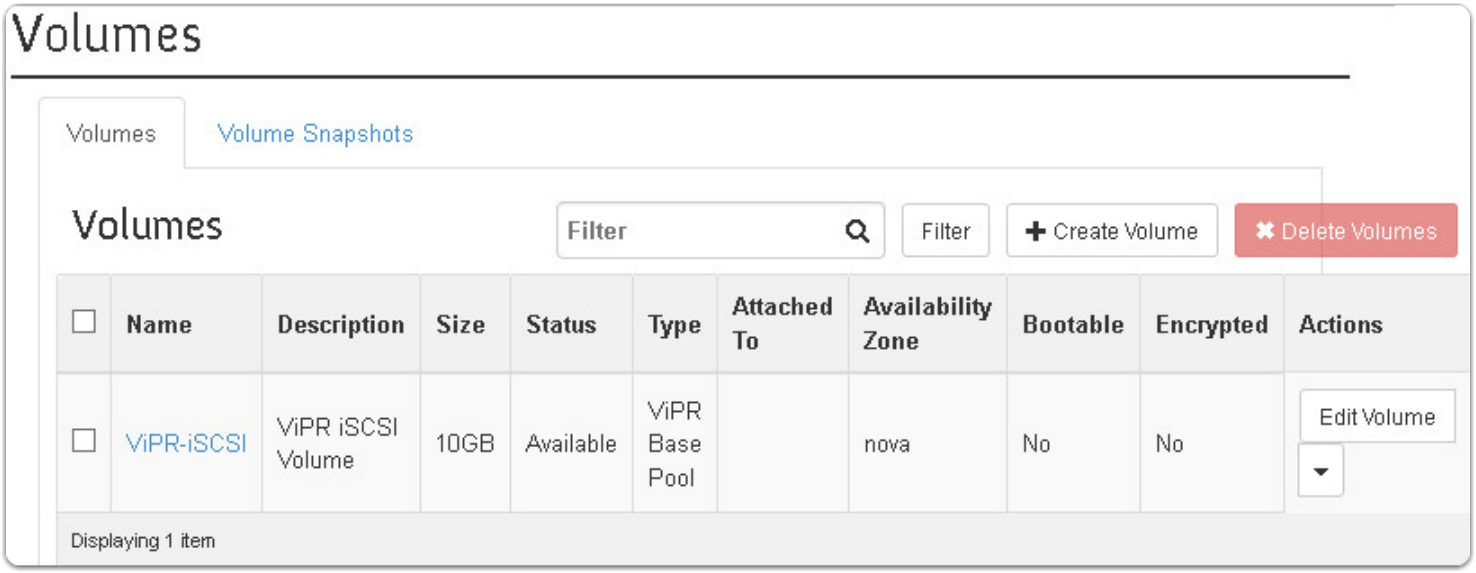
Please provide new ViPR Volume details:

1. Volume Name - **ViPR-iSCSI**
2. Provide a **Description** as you see fit
3. Leave **Volume Source** field with default value
4. Select a **Volume Type** from the drop-down menu - **ViPR Base Pool**
5. Specify the **Volume size - 10GB**
6. Leave **Availability Zone** field with default value - **Any Availability Zone**
7. Click on **Create Volume** to continue



5.6 New ViPR Volume

1. Please verify that the new ViPR Volume is available
2. Next you will review this new Volume in ViPR Controller UI.



6. EMC ViPR

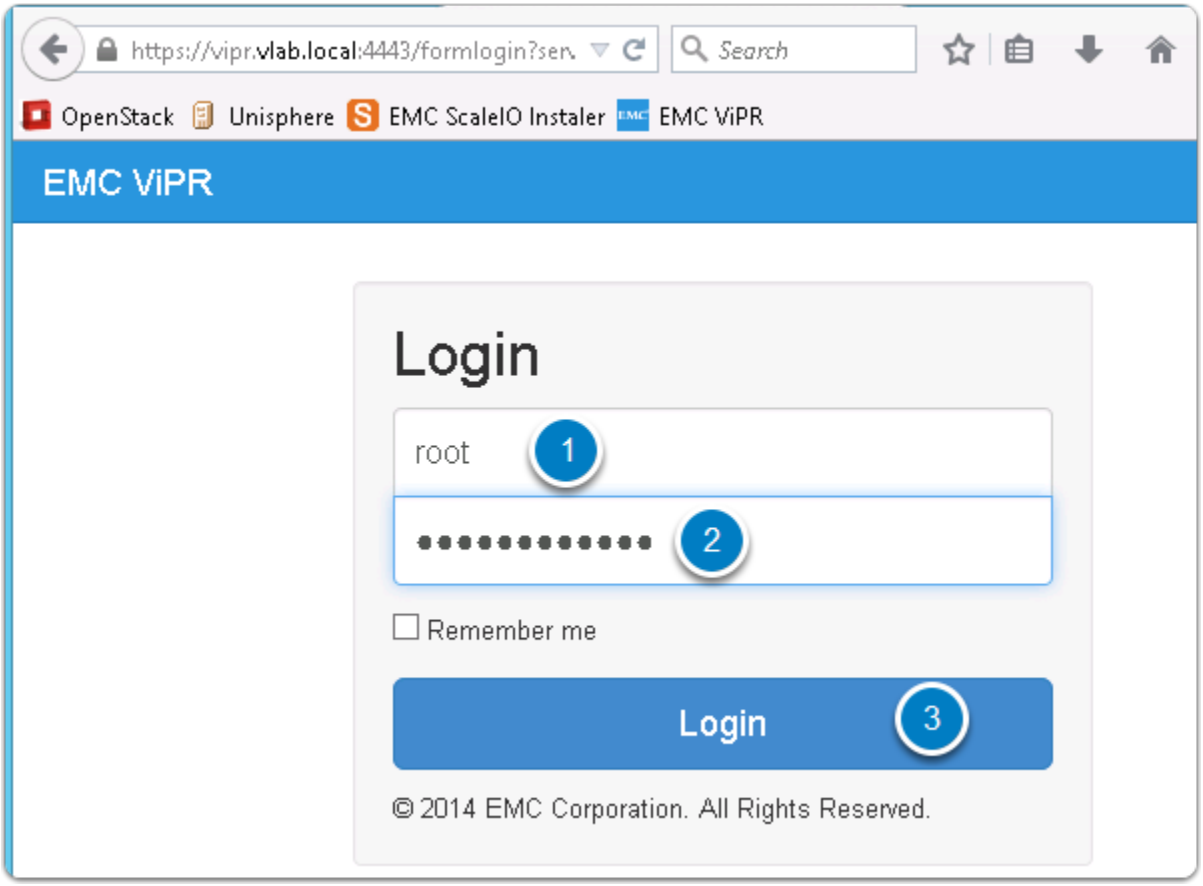
Now review your newly created volume in ViPR - please double-click on the **6_EMC_ViPR (root - Password123!)** icon in the **Lab-5-ViPR-Cinder** folder.

6.1 Logging into ViPR

Please login into EMC ViPR:

1. User name: *root*

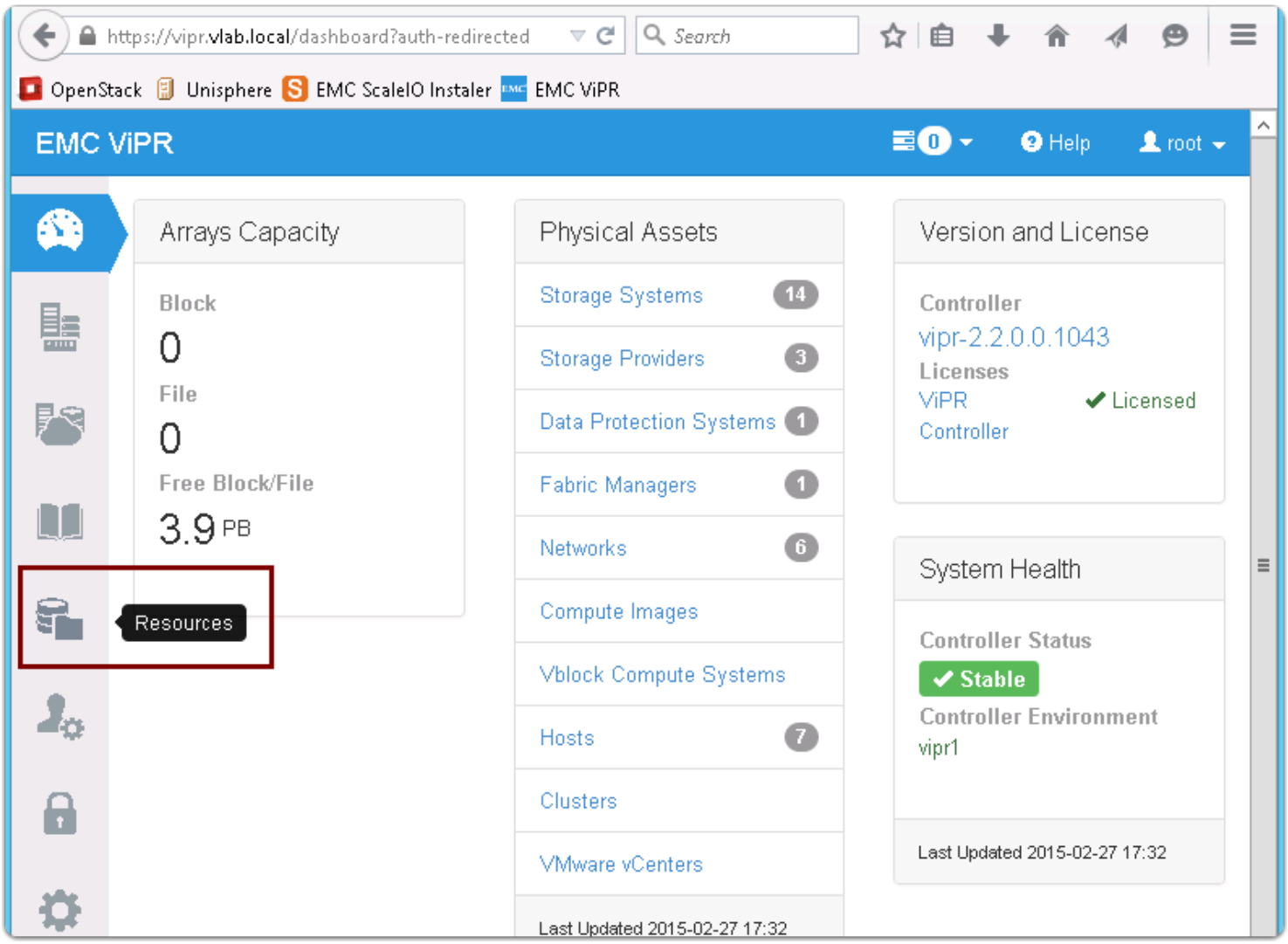
2. Password*: Password123!*
3. Click **Login** to continue



6.2 ViPR Dasboard

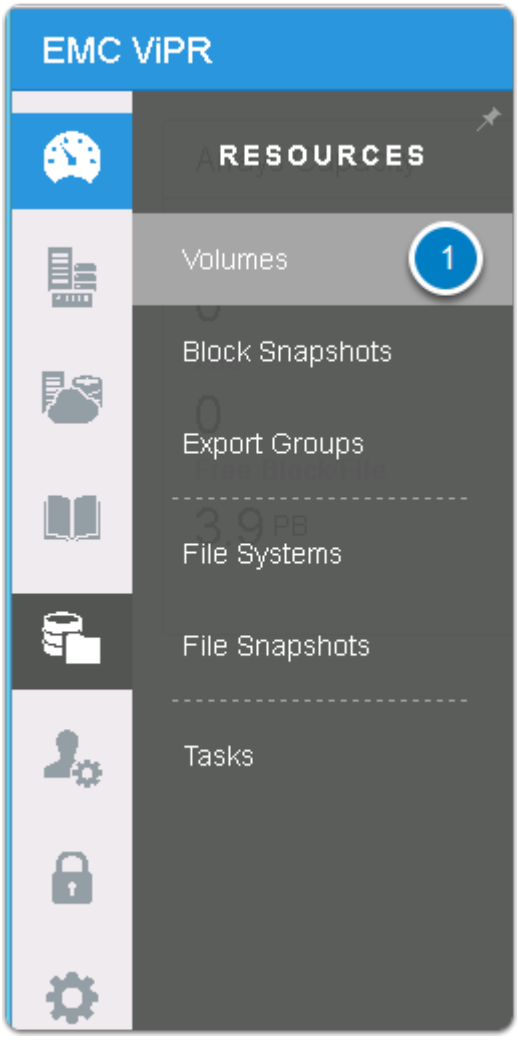
Please review the ViPR Controller administrator **Dashboard**

1. Select **Resources** icon from the left-hand menu - you will now review the newly created ViPR Volume.



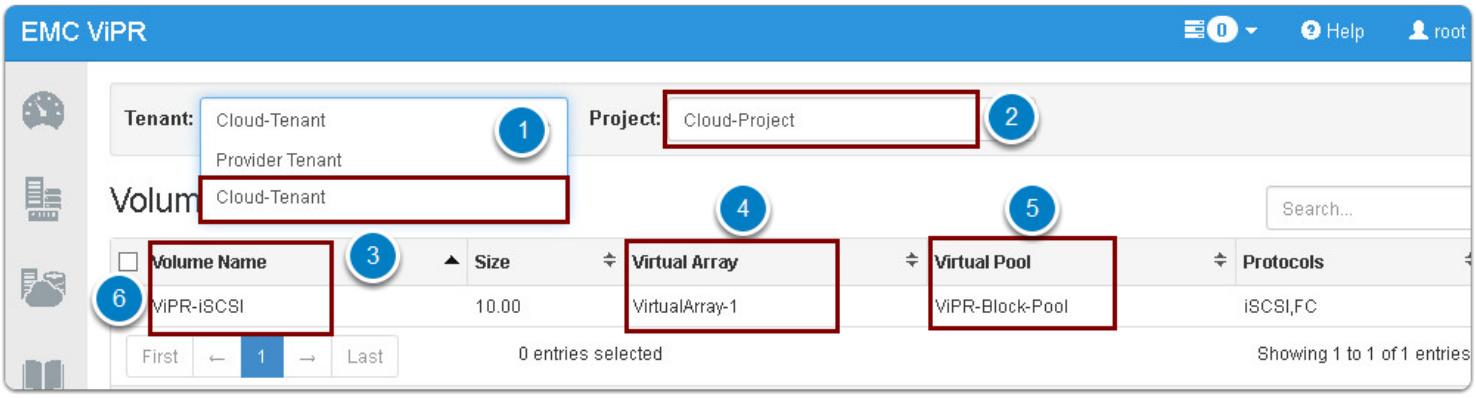
6.3 Block Volumes

Select **Volumes** from the fly-out menu



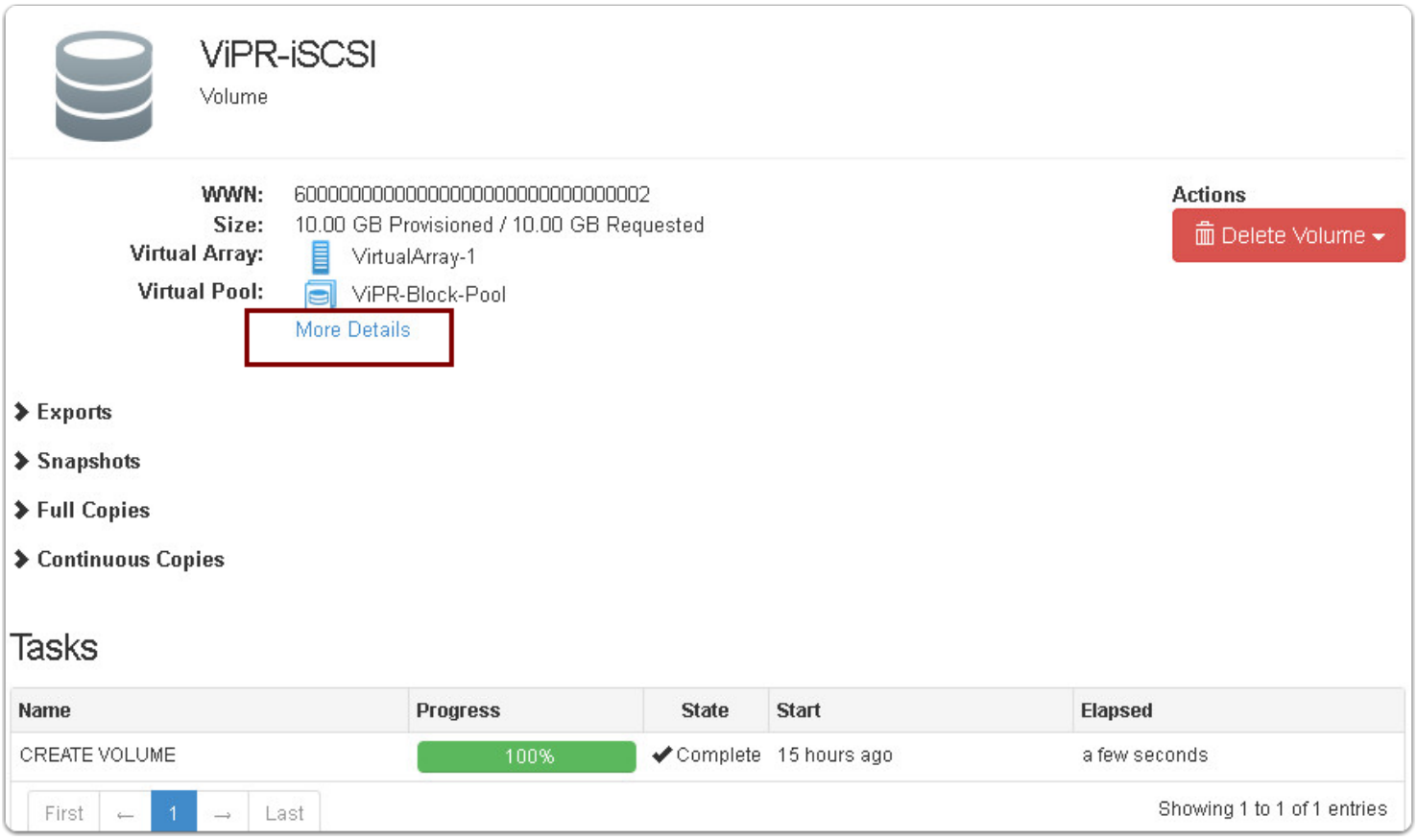
6.4 Tenant Project Volumes

1. Select **Cloud-Tenant** from the drop-down menu list
2. Review the **Cloud-Project**
3. Review the newly created volume - **ViPR-iSCSI**
4. Review ViPR Virtual Storage Array - **VirtualArray-1**
5. Review the ViPR **Virtual Storage Pool** associated with the OpenStack Cinder volume type
6. Please click on the volume to view additional details



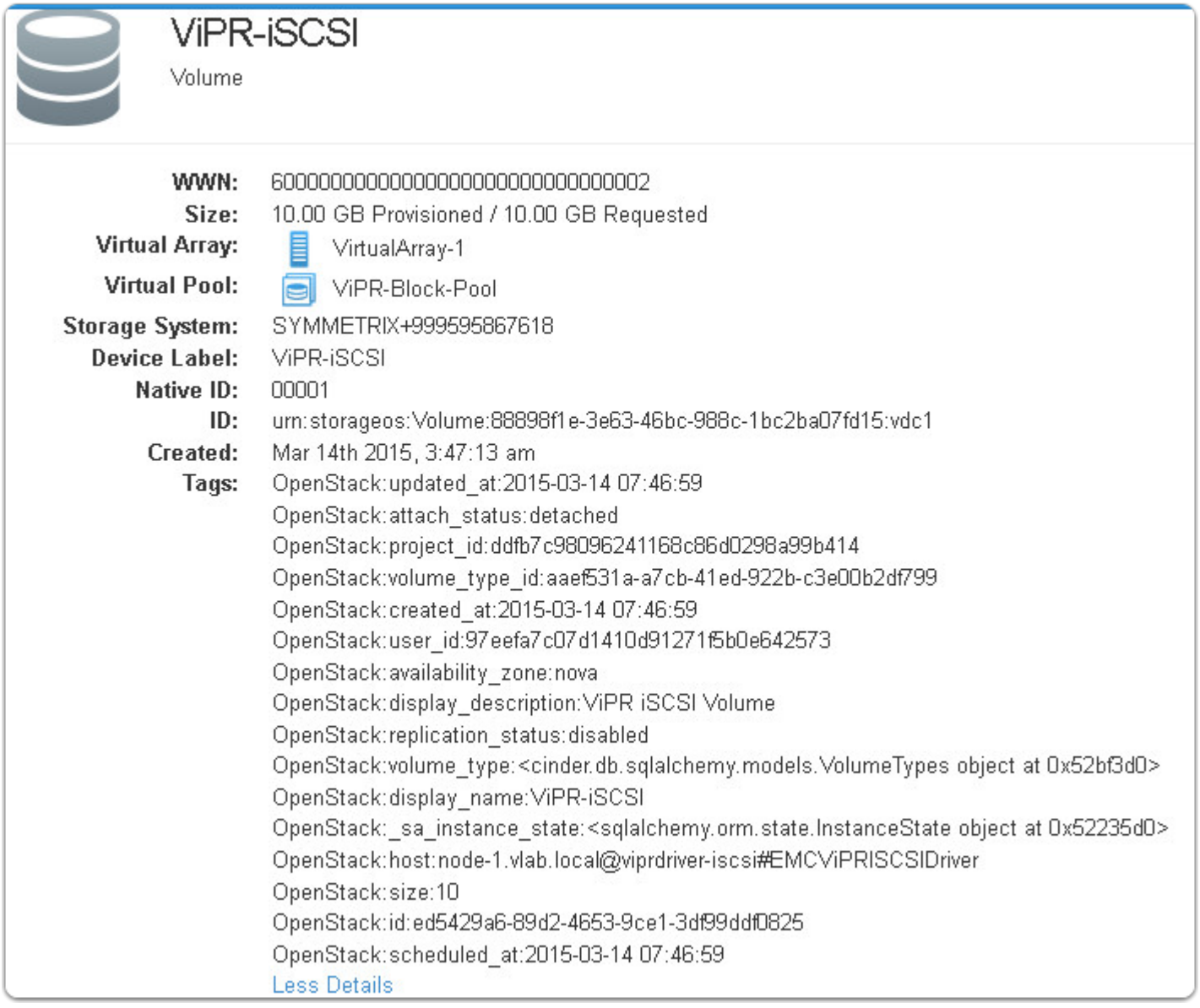
6.5 Volume Details

Please review the ViPR Volume details - click **More Details** to continue



6.6 Additional Volume details

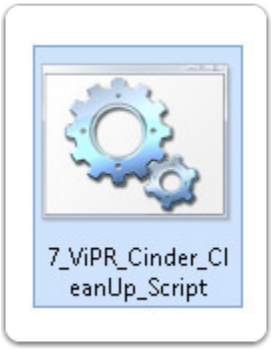
Please review the additional volume details



6.7 Cleaning Up ViPR Lab

This lab is now complete. Please close the ViPR browser window and return to the Lab-5-ViPR-Cinder folder.

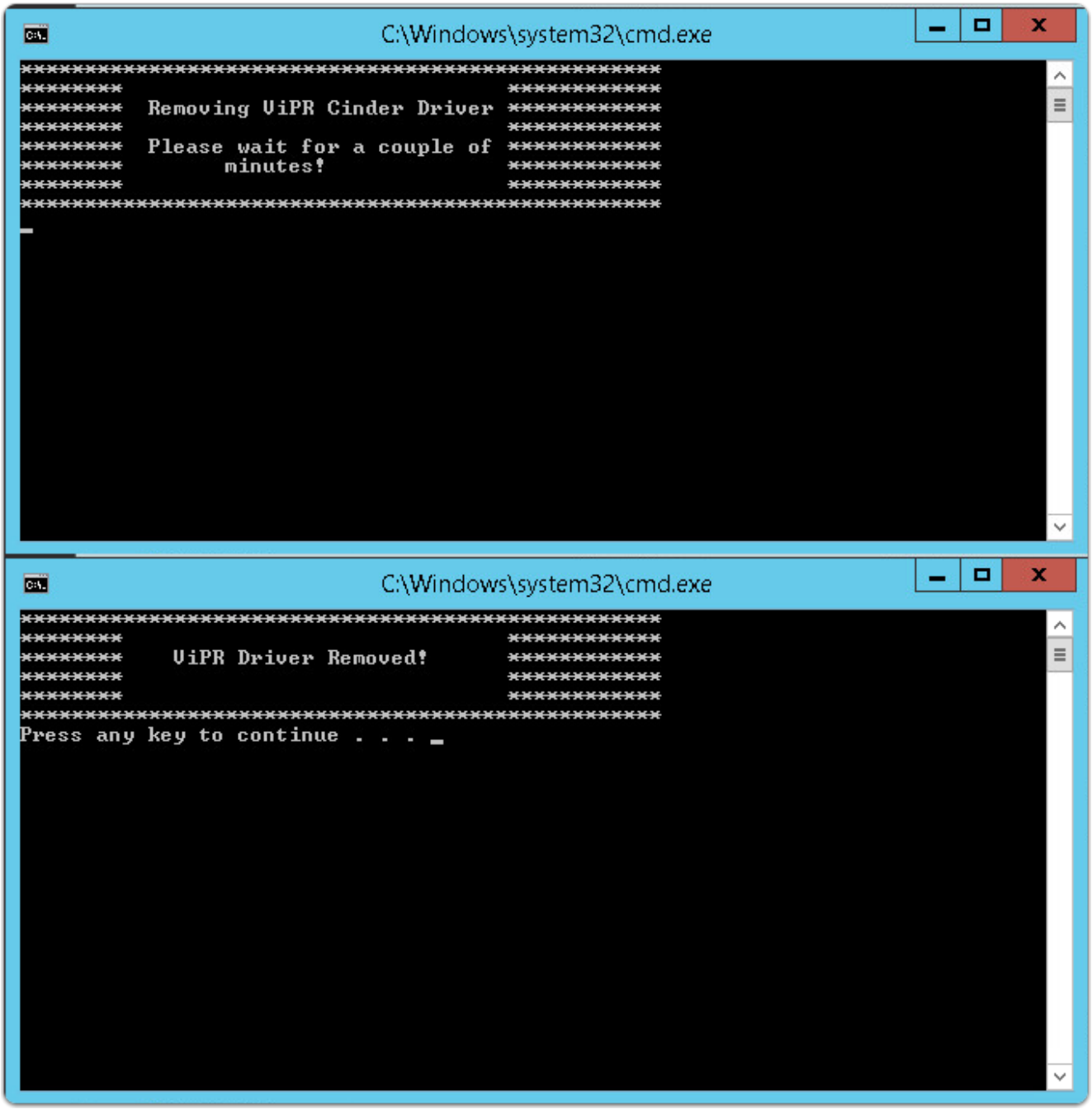
Please launch the shortcut called **7_ViPR_Cinder_CleanUp_Script** by double-clicking on it. This script will stop ViPR and Storage simulator VM's and revert OpenStack Cinder configuration to default in preparation to the next lab.



6.8 Completing the ViPR Lab

Once the ViPR Controller VM has been stop and ViPR Cinder driver removed, press any key to continue - this lab is now complete!

Please close the command window as needed.



7. Conclusion

Congratulations! In this lab you, wearing the hat of Code Nebulous Cloud Administrator, have successfully accomplished the following:

- Deployed and configured ViPR Cinder driver to use the ViPR Software-defined block storage as a Cinder backend
- Created Cinder volume types associated with the ViPR virtual storage pools
- Create a new ViPR block volume.

Now the Code Nebulous Cloud Users can begin building and using the applications running on the Cloud-Workload instance and store its data on the persistent block volume.

Note: In the interests of time you will not be logging into Cloud-Workload instance to format and mount the newly created volume.

This lab is now complete. Please close the following windows as you will not be using them any longer:

- **Lab-5-ViPR-Cinder** folder

Please proceed to the next lab, or select other labs from the list.

Optional Lab 6 - OpenStack Monitoring and Reporting

Lab 6 - OpenStack Monitoring and Reporting

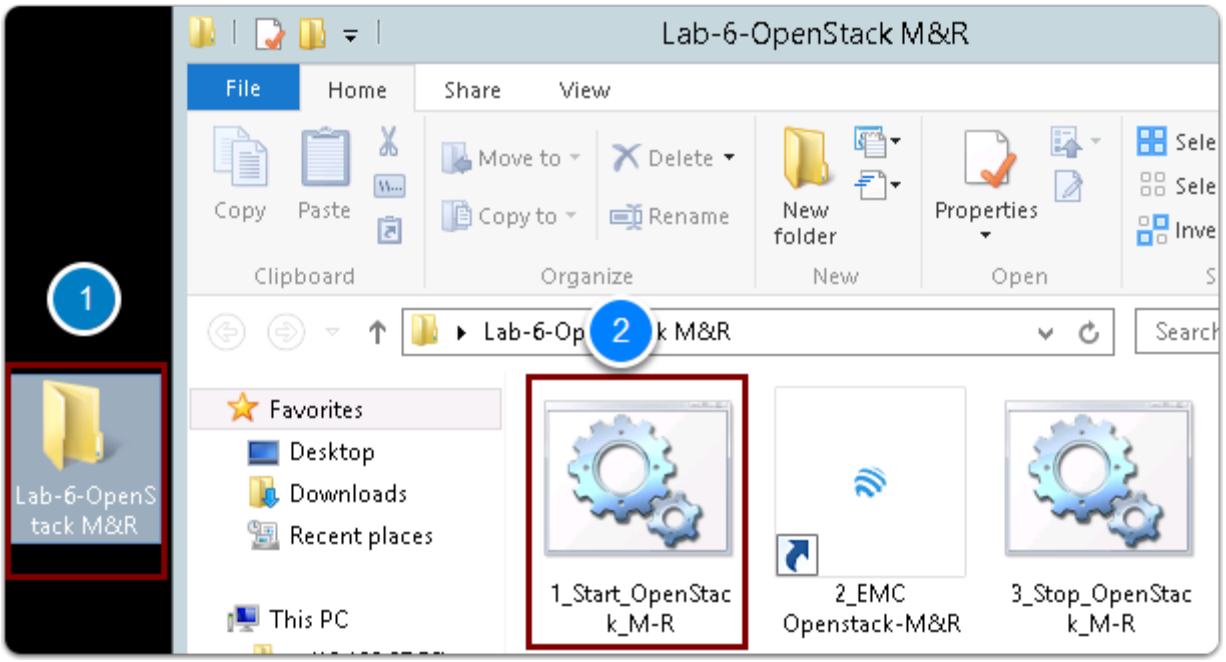
ViPR SRM provides actionable insight into end-to-end data path relationships and topology to understand service dependencies. It displays detailed performance trends across the data path to identify the impact storage has on applications. With addition of the OpenStack Monitoring & Reporting (M&R) Solution Pack, ViPR SRM can now enable Cloud Admin to gather Capacity, Performance and Chargeback data and provide comprehensive reports to the tenants.

In this lab, an historical data sample has been collected in the demo environment. While similar, this sample data may not match your specific lab environment.

1. Lab-6: OpenStack M&R Folder

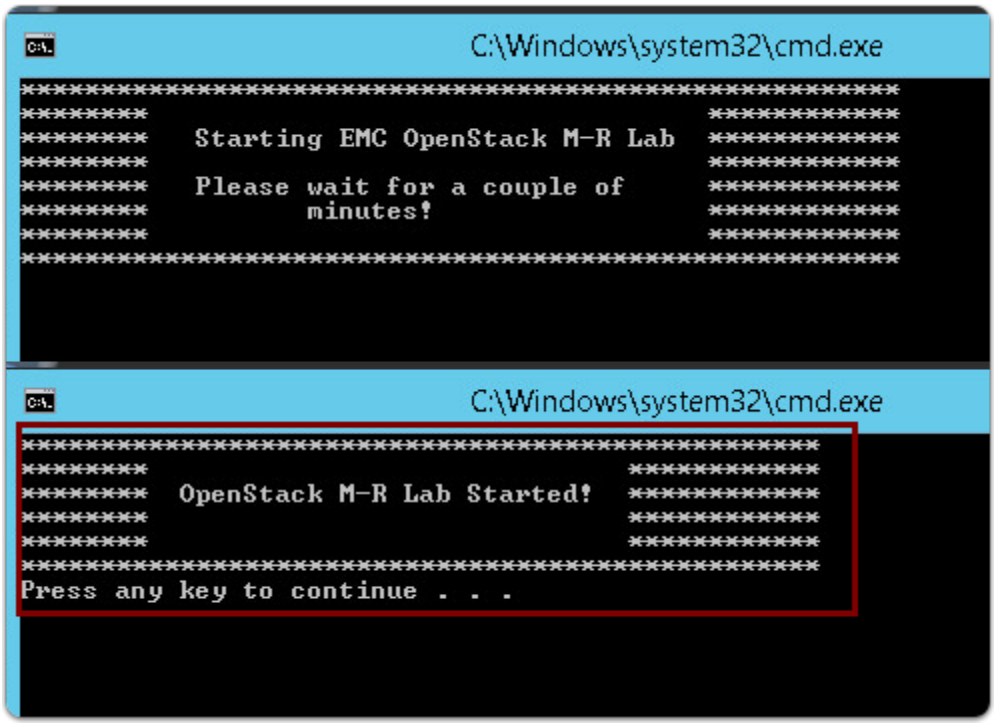
For your convenience, all necessary shortcuts used in this lab have been provided in a Desktop folder called "Lab-6-OpenStack_M&R"

1. Please open the **Lab-6-OpenStack_M&R folder**
2. Launch the lab by double-clicking on the shortcut **1_Start_OpenStack_M-R** - this script will power on the OpenStack_M&R nested Virtual Machine.



2. Powering Up OpenStack_M&R VM

Please verify that the OpenStack_M&R VM has started and press any key to continue.

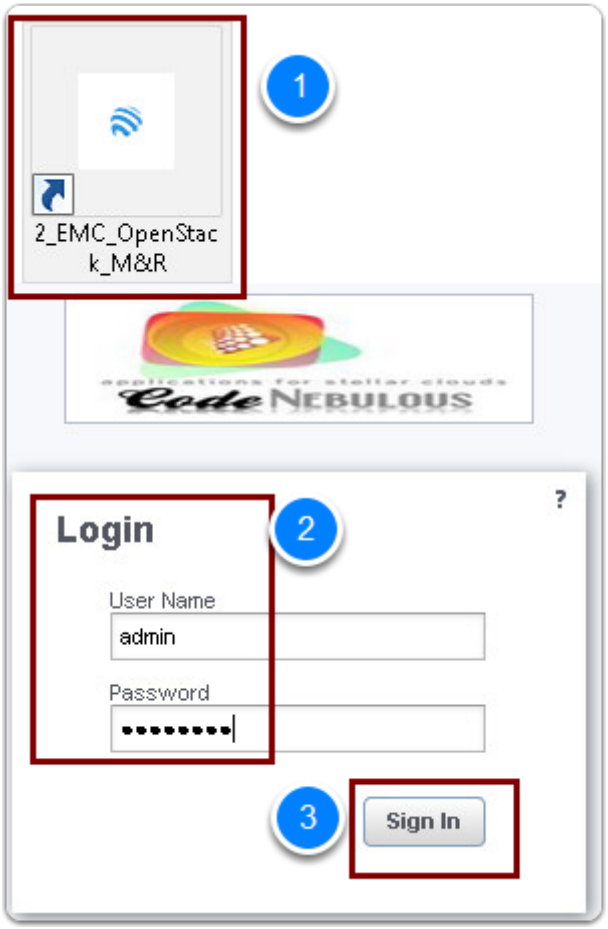


3. Using OpenStack M&R UI

1. Please launch the shortcut to OpenStack M&R from the Lab-6-OpenStack_M&R folder. Note: It may take a couple of minutes for the OpenStack M&R to start. If your browser times out, simply refresh the browser window:
2. Login with credentials:

- User Name: *admin*
- Password: *changeme*

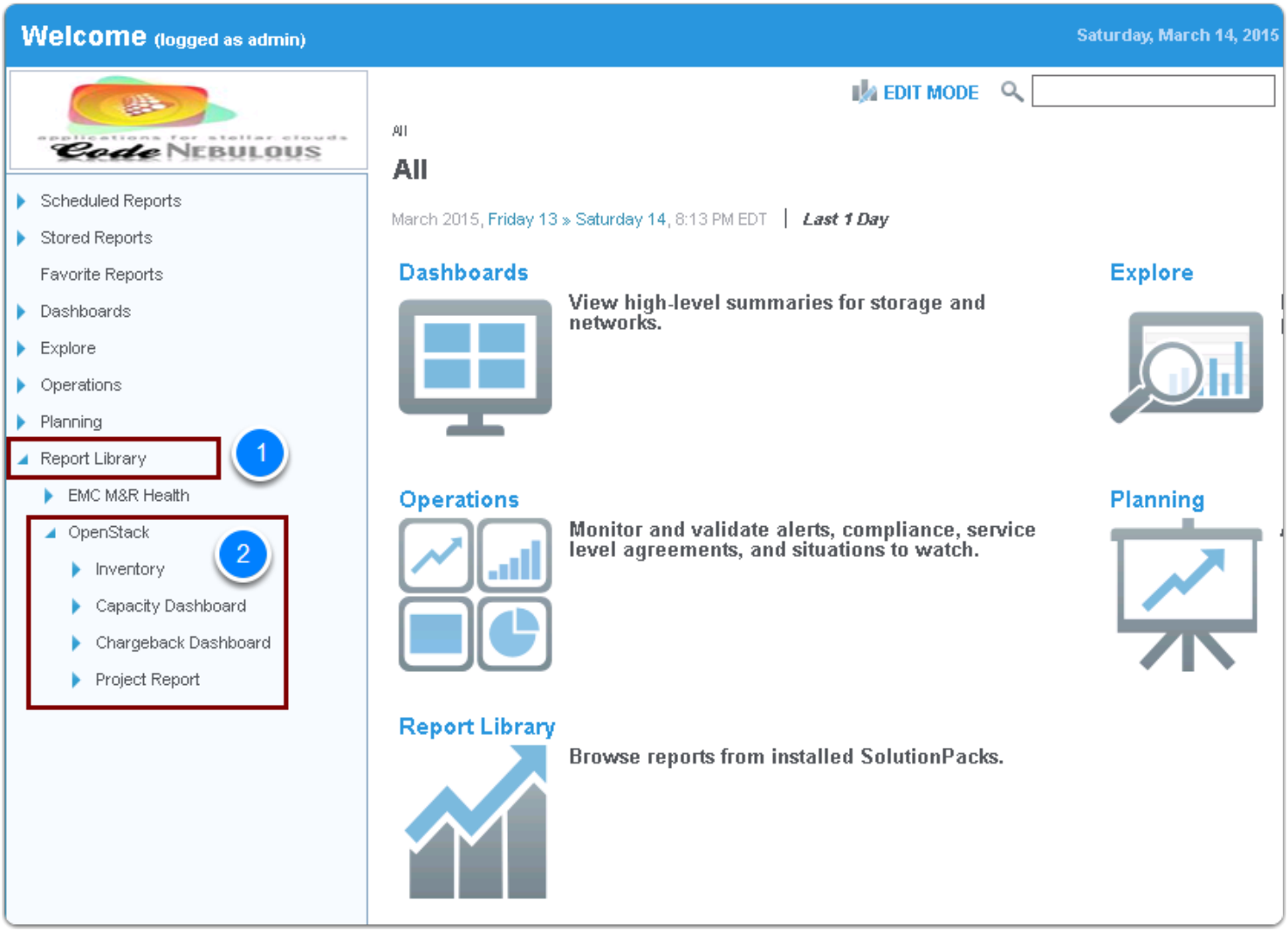
3. Click **Sign In** to continue



4. OpenStack M&R Dashboard

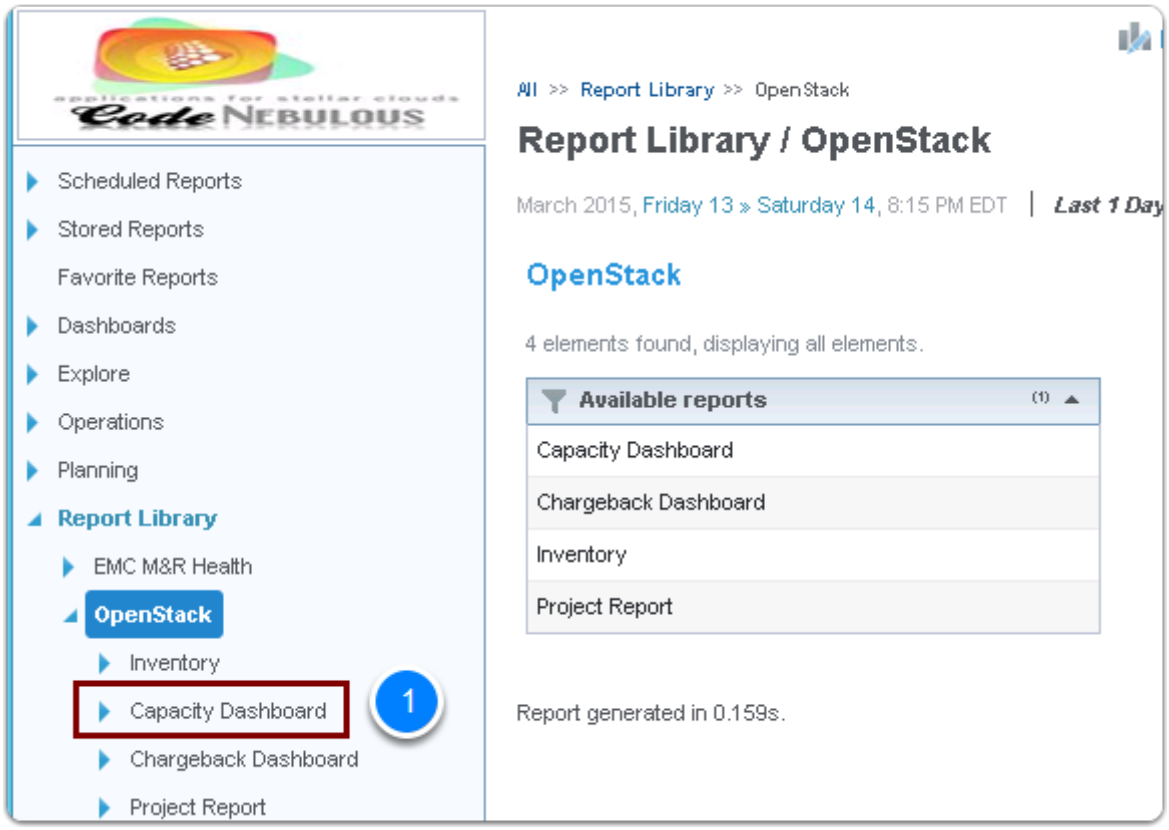
1. Please navigate to the Report Library

2. Then expand the OpenStack Reports



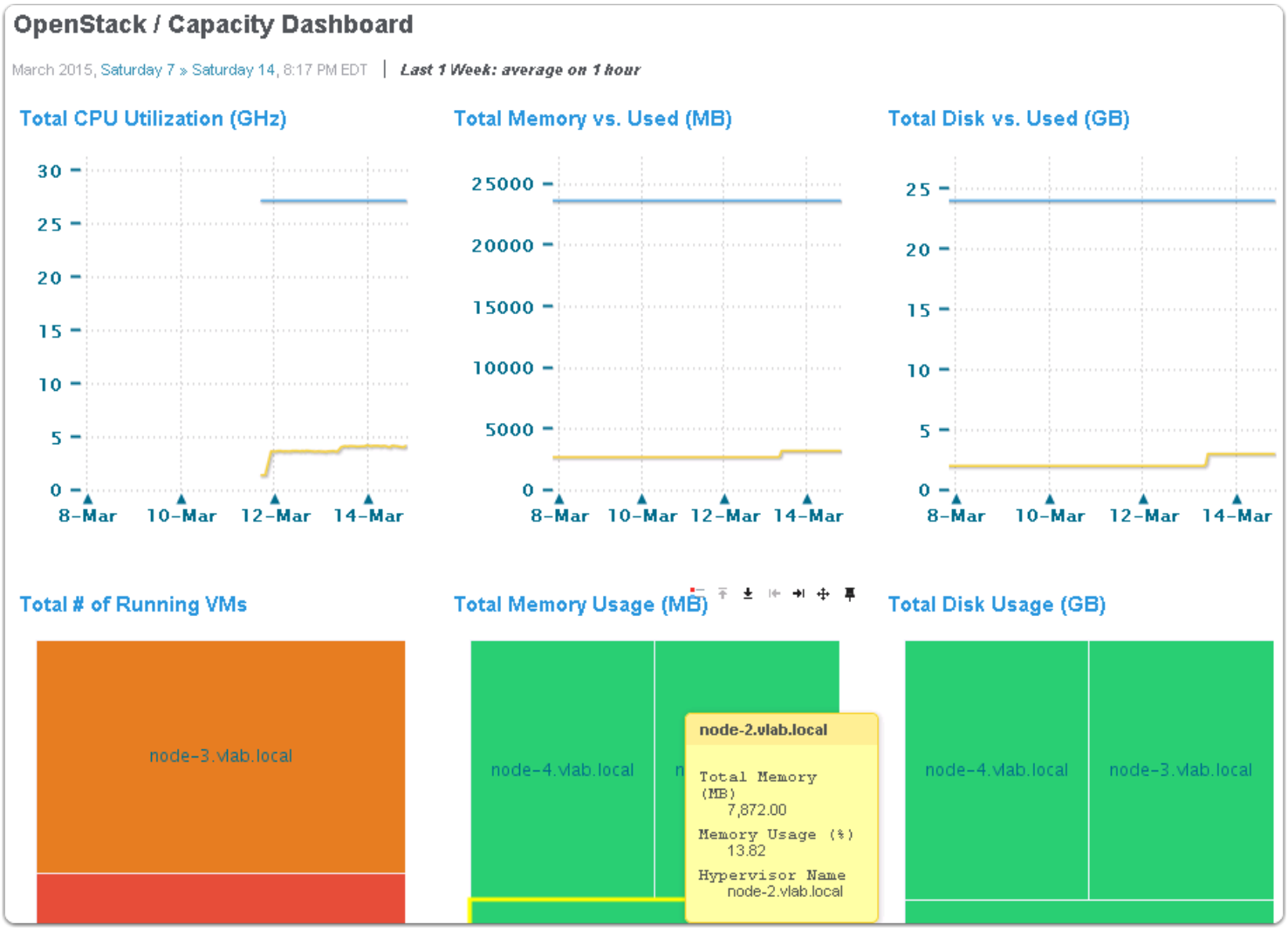
5. Capacity Dashboard

1. Please select **Capacity Dashboard**



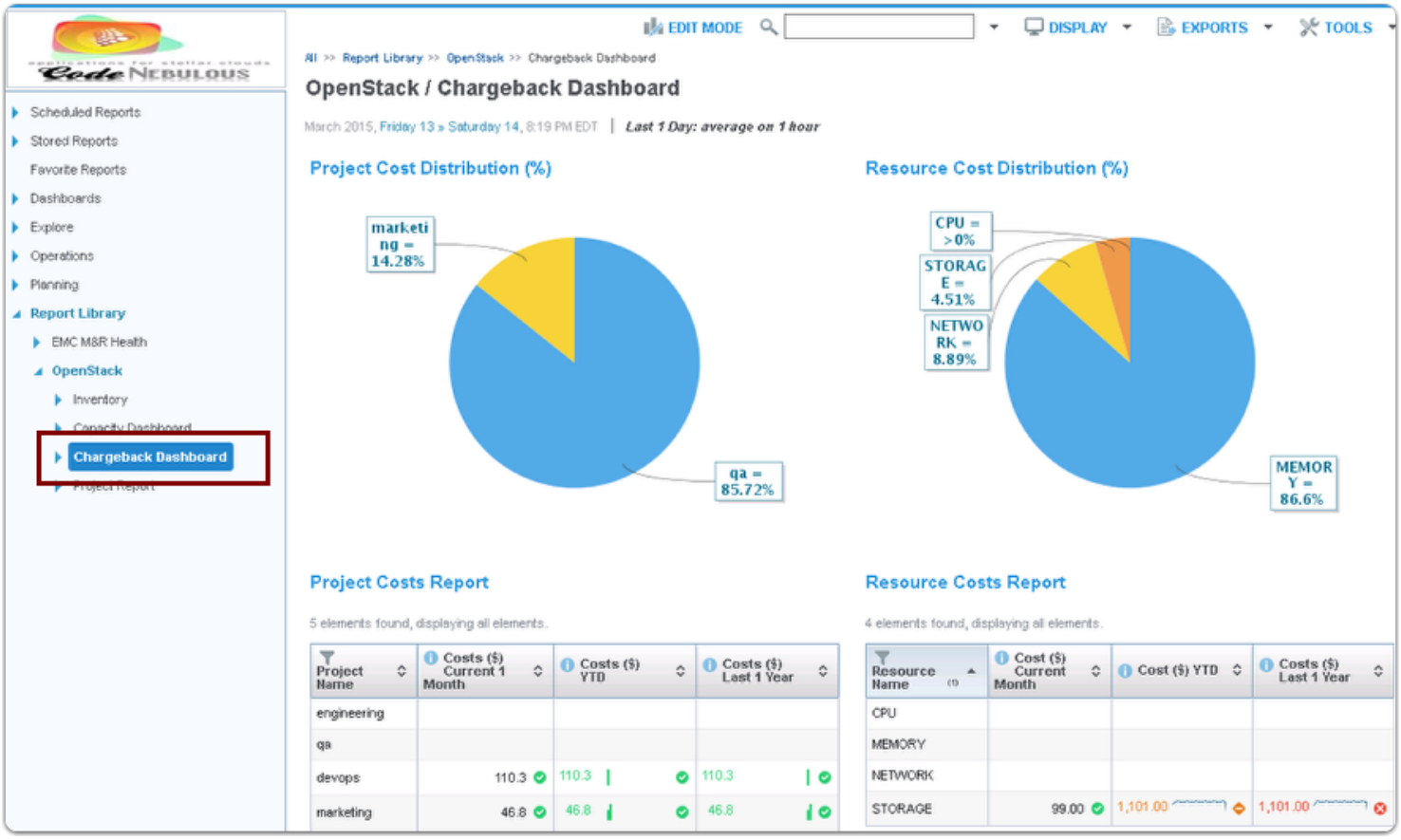
5.1 OpenStack Capacity Reports

Please review the Capacity reports



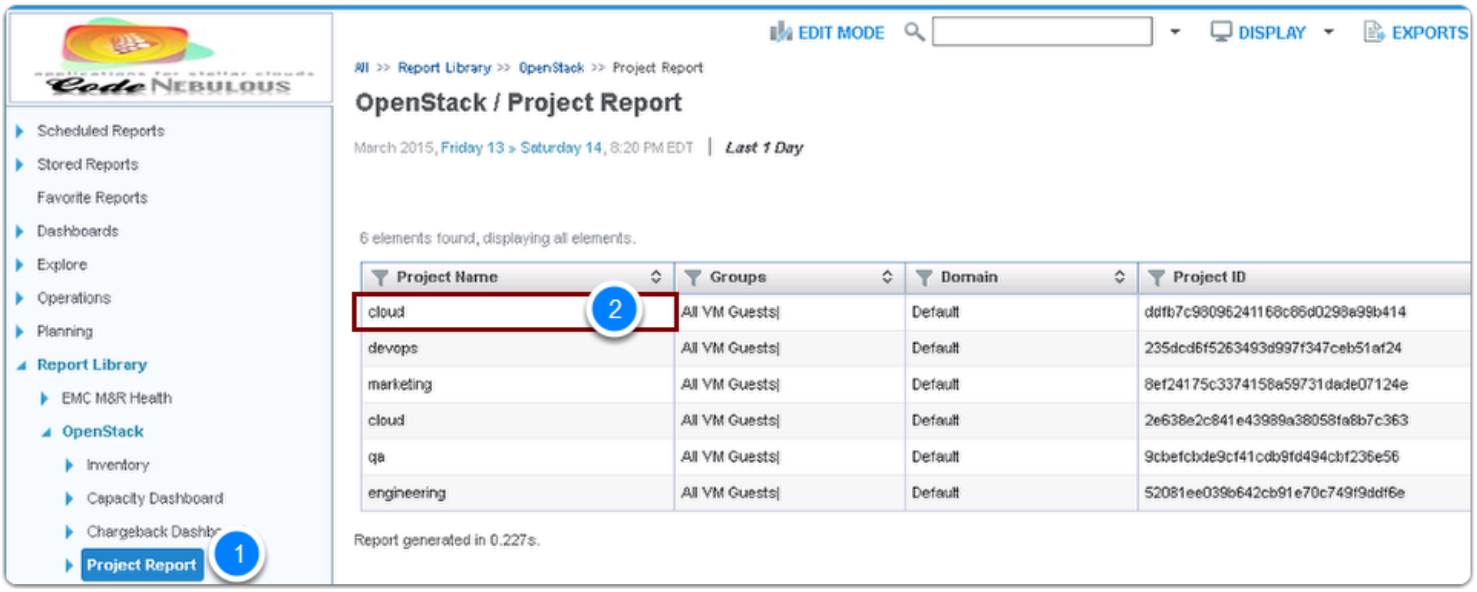
6. Chargeback Dashboard

Please expand and select the **Chargeback Dashboard**



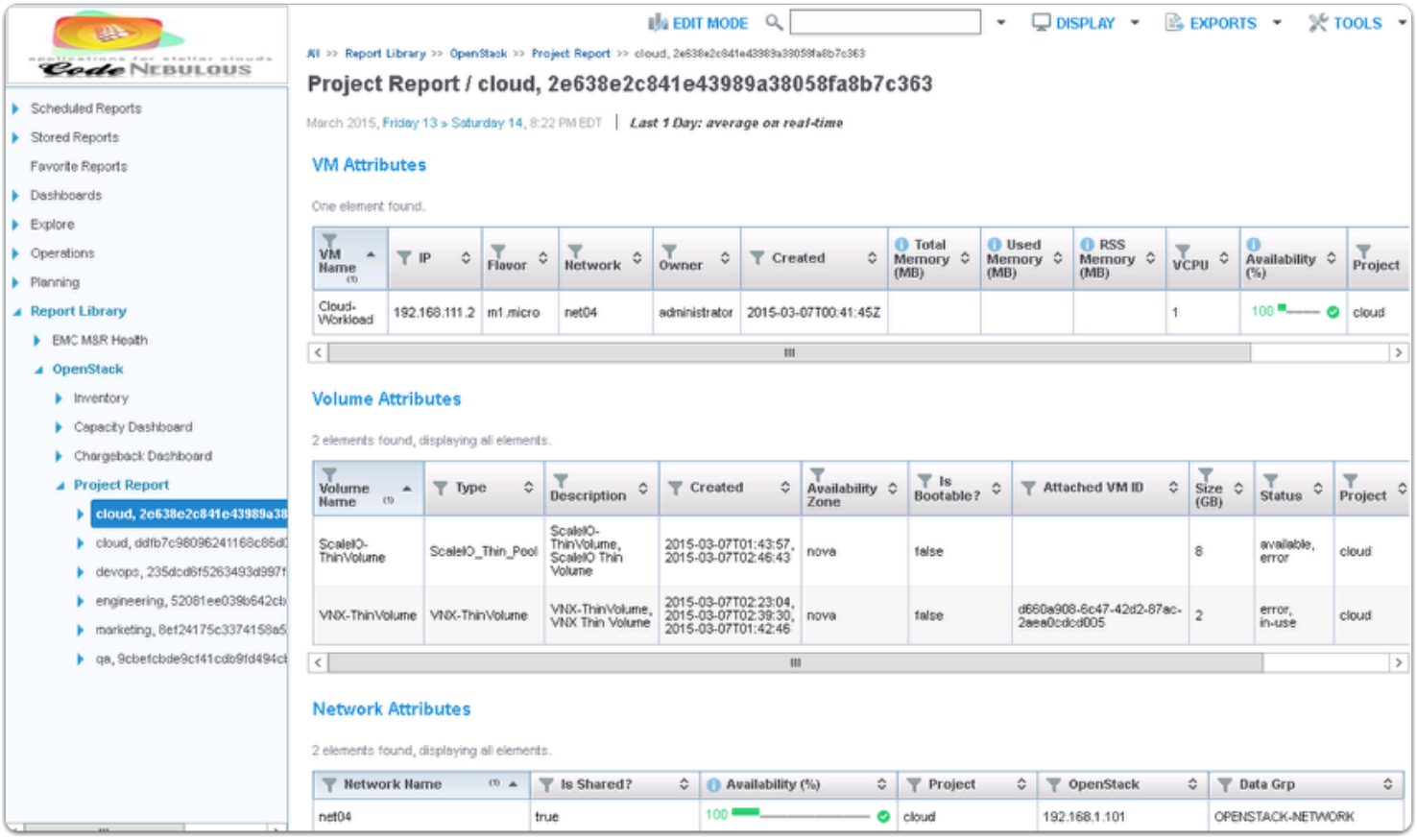
7. Project Report

1. Please review the **Project Report**
2. Select the "cloud" project form the table



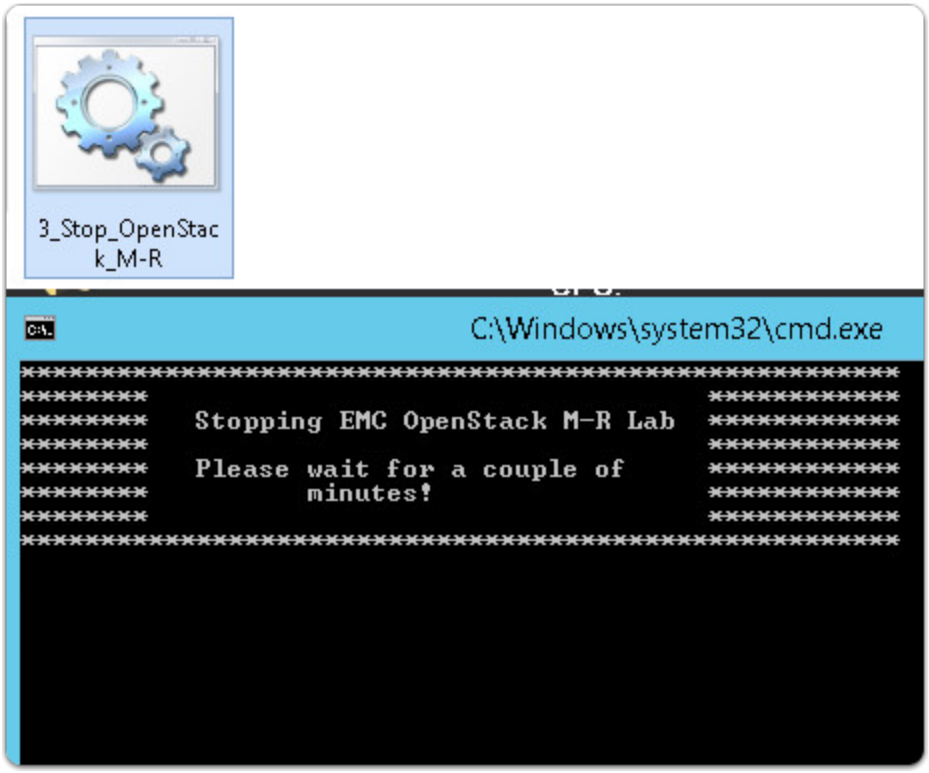
7.1 Project Details

Please review the **Project** details for **cloud** project



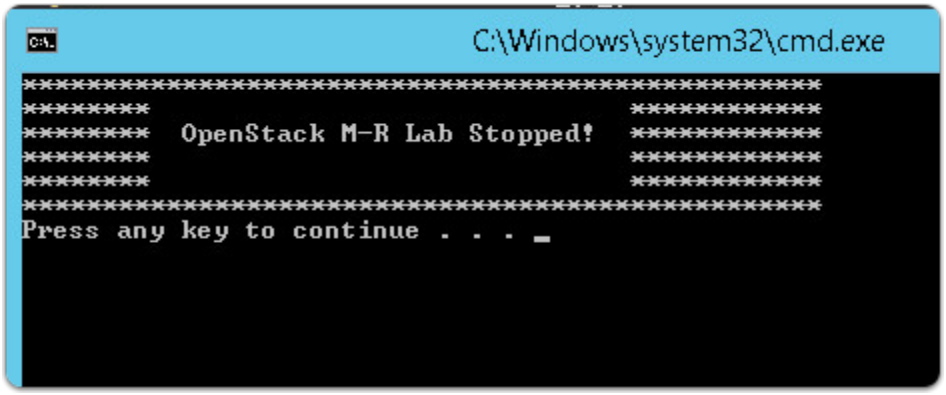
8. Completing the OpenStack M&R Lab

1. Please launch the **3_Stop_OpenStack_M-R** shortcut from the Lab-6-OpenStack_M&R folder
2. Verify that the lab has stopped (OpenStack_M&R VM has been powered off)



8.1 Lab 6 Completed

Press any key to continue



9. Conclusion

Congratulations! In this lab you, wearing the hat of Code Nebulous Cloud Administrator, have successfully accomplished the following:

- Collected and reviewed EMC OpenStack Monitoring & Reporting data for Tenant Chargeback and Cloud Capacity planning.

This lab is now complete. Please close the following windows as you will not be using them any longer:

- Lab-6-OpenStack_M&R folder
- OpenStack M&R Browser Window

Please proceed to the next lab, or select other labs from the list.

Troubleshooting

Troubleshooting & Tips

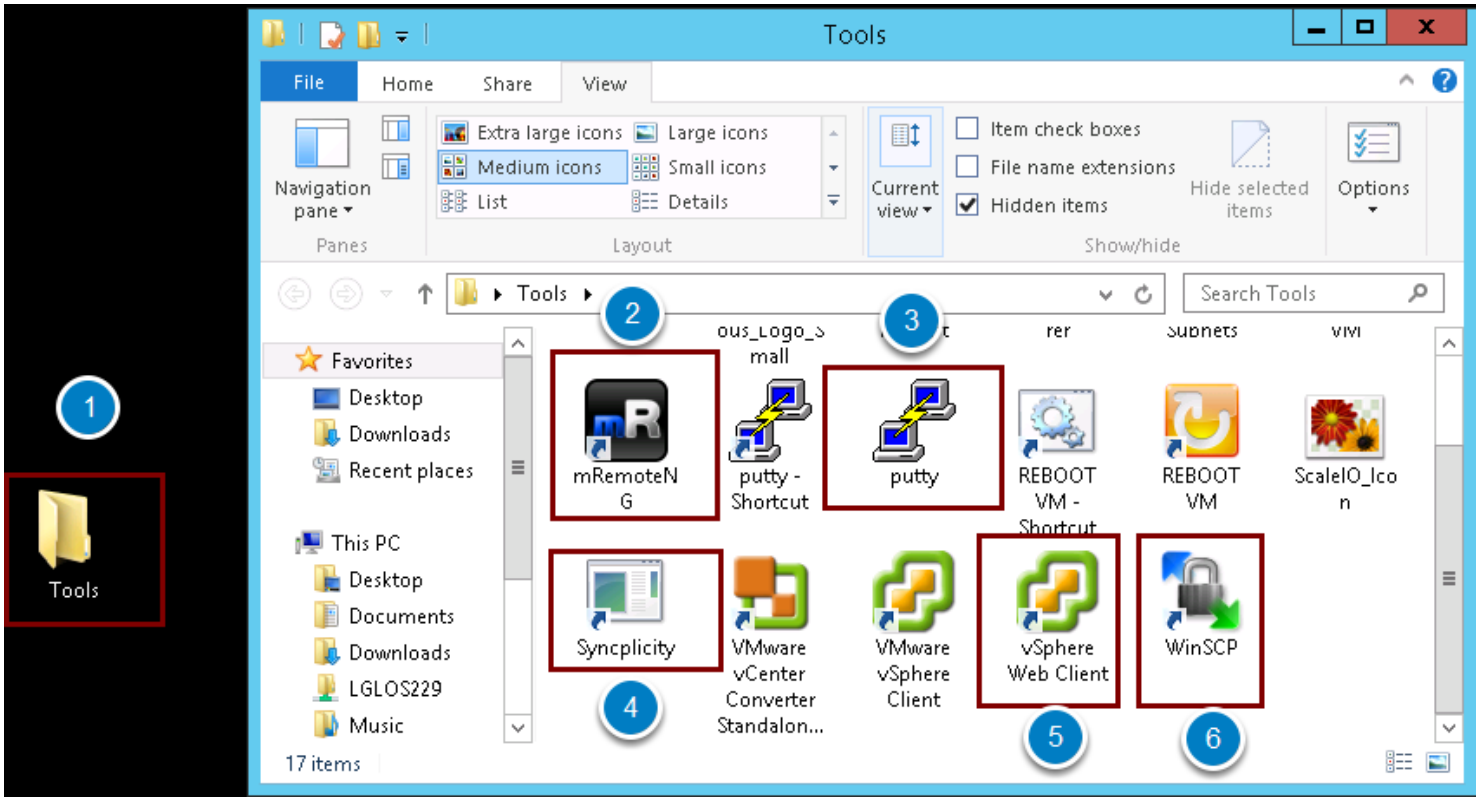
This section provides general suggestions and resolutions to potential issues that may arise in this lab.

This area is for general problems that may occur at any point during the lab.

1. Tools Folder

For your convenience, various tools have been provided that may be helpful in your troubleshooting.

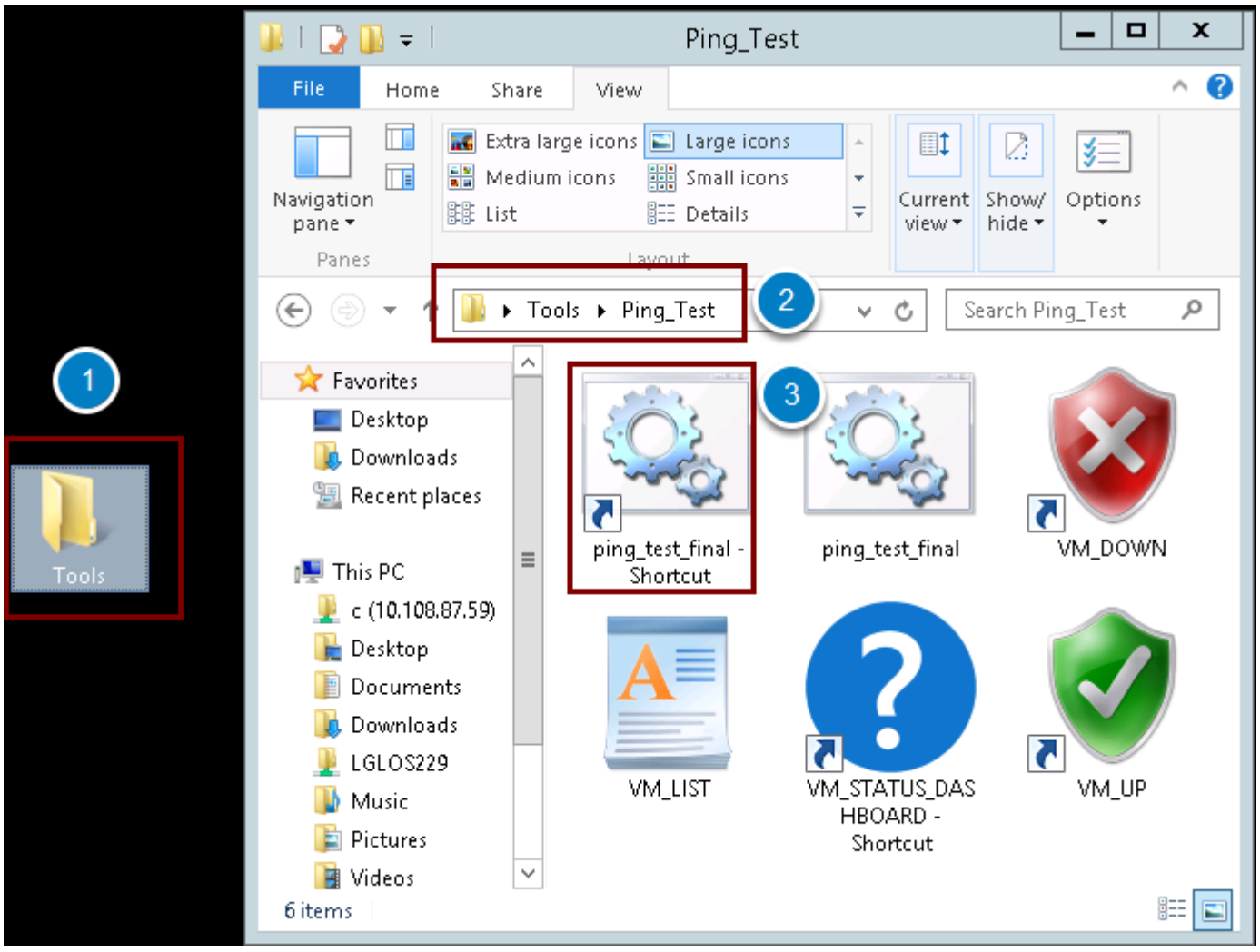
1. These tools are located in the **Tools** folder on the Launchpad Desktop
2. You can use mRemoteNG to access the Windows VM's in this lab
3. You can use Putty SSH terminal utility to access Linux VM's in this lab
4. You can use Syncplicity to upload custom content to and from this lab
5. You can use vSphere Web Client to check status and power on / off of the "nested" VM's
6. You can use WinSCP to copy the files to and from the Linux VM's in this lab



2. VM's Availability

This lab contains several Virtual Machines used at different points during this lab. You can initiate a script that verifies VM availability by executing ping command.

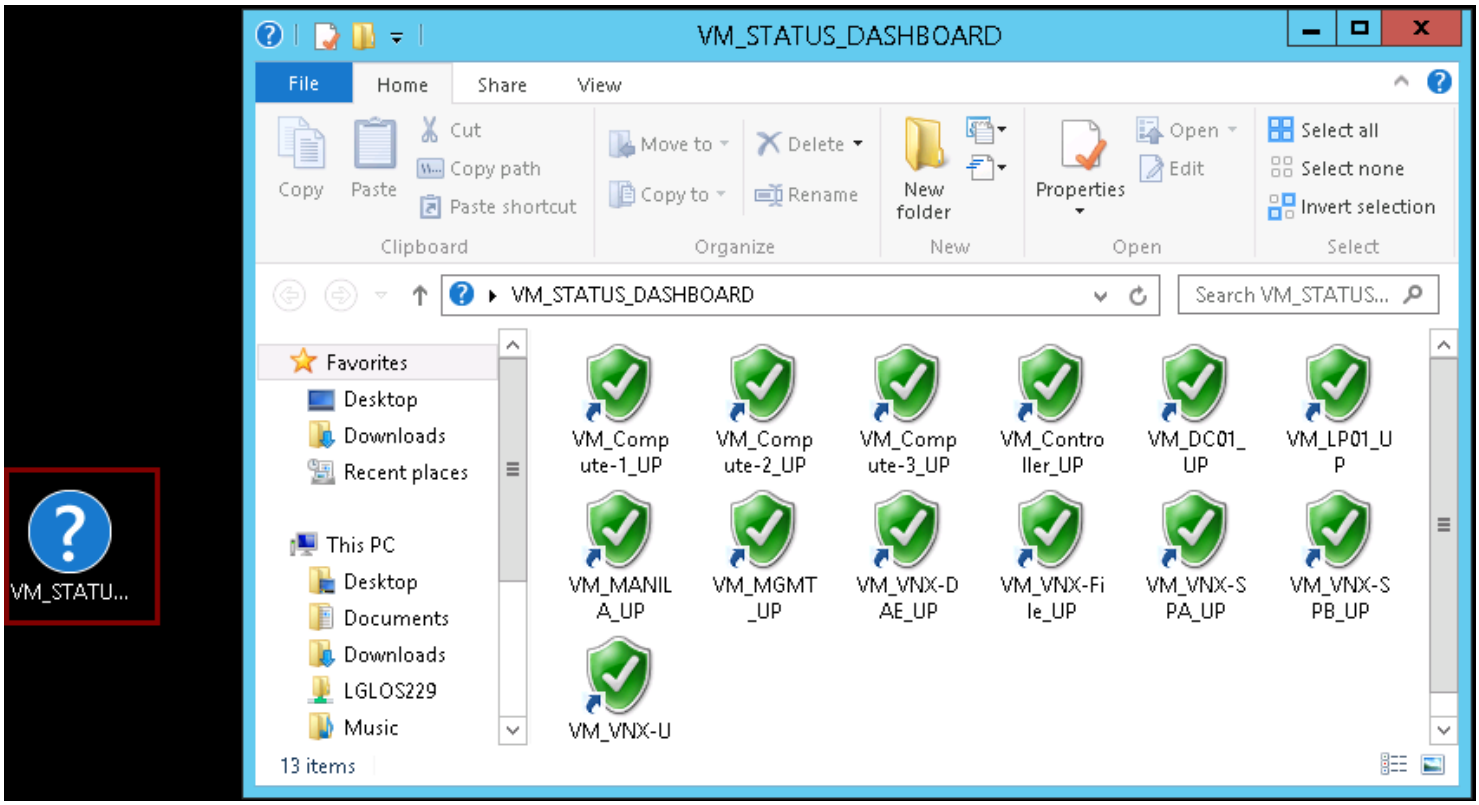
1. Open the **Tools** folder located on the Launchpad Desktop
2. Navigate to the **Ping_Test** folder
3. Launch the **ping_test_final script**



2.1 VM Status

You can verify the status of these VM's by checking the **"VM Status Dashboard"** Folder on the Launchpad Desktop.

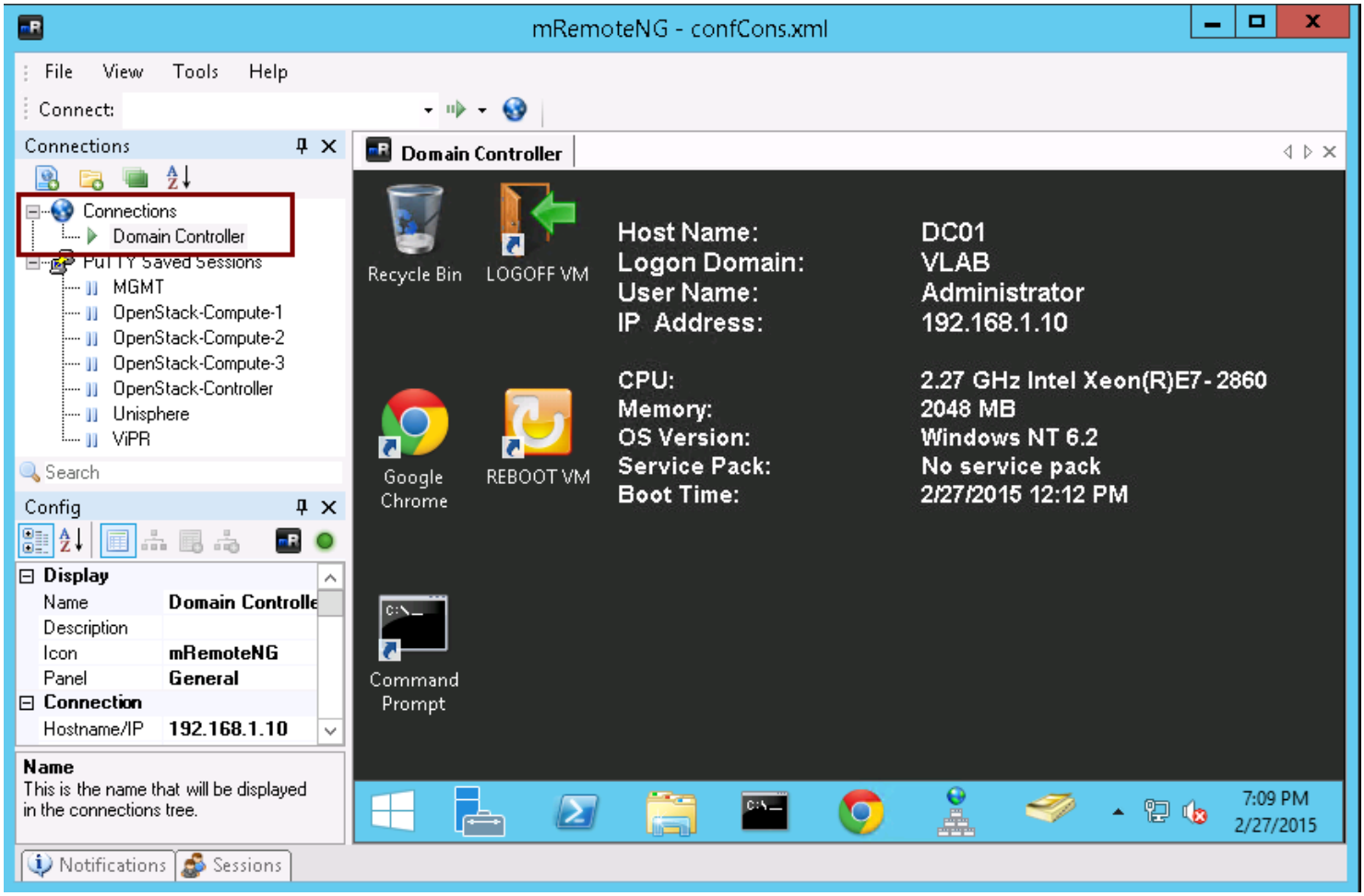
All shield icons should be green



3. Using mRemoteNG

You can use mRemoteNG to access the other Windows VM's in this lab.

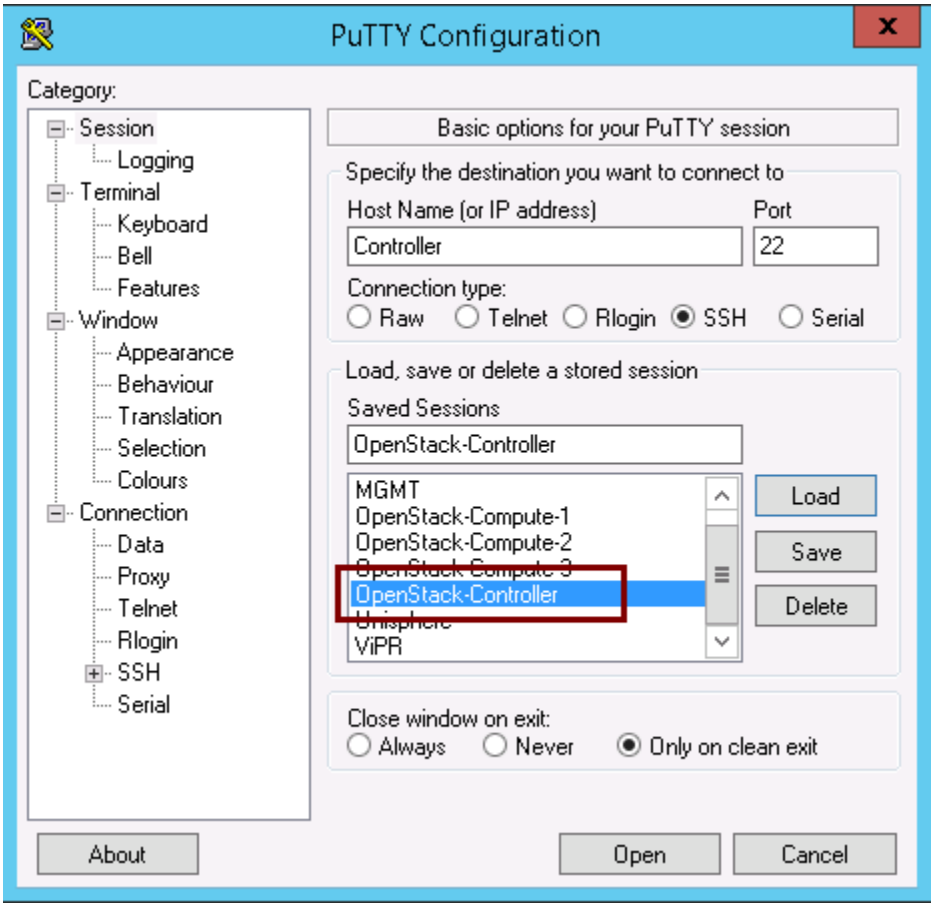
Pre-defined sessions have been created that allow you to access the Windows VM's without typing their IP address.



4. Using PuTTY SSH Terminal

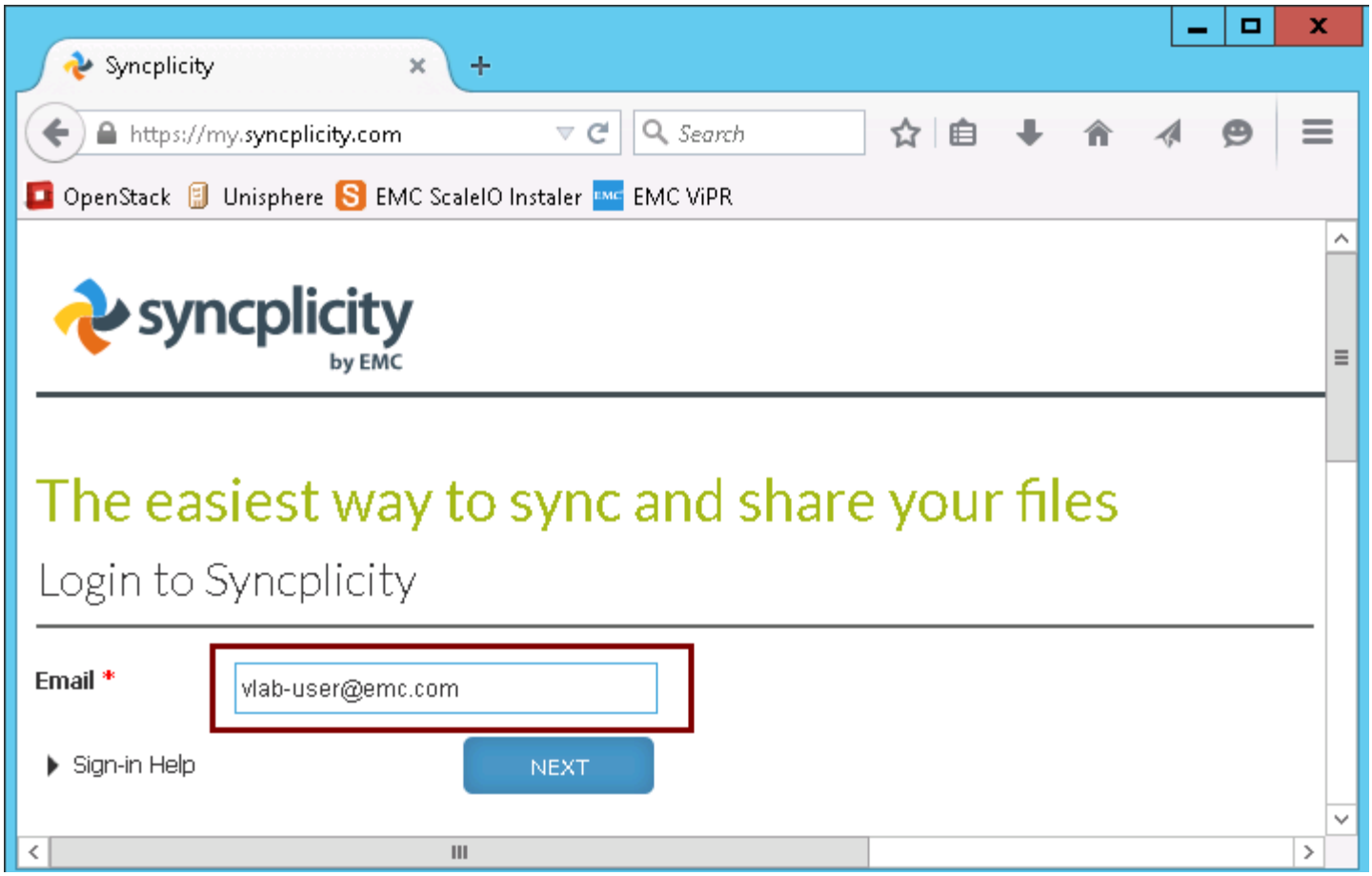
You can use PuTTY SSH Terminal utility to access other Linux VM's in this lab. Pre-defined sessions have been created that allow you access to the VM without typing it's IP address

All SSH credentials are the same: *root - Password123!*



5. Using Syncplicity

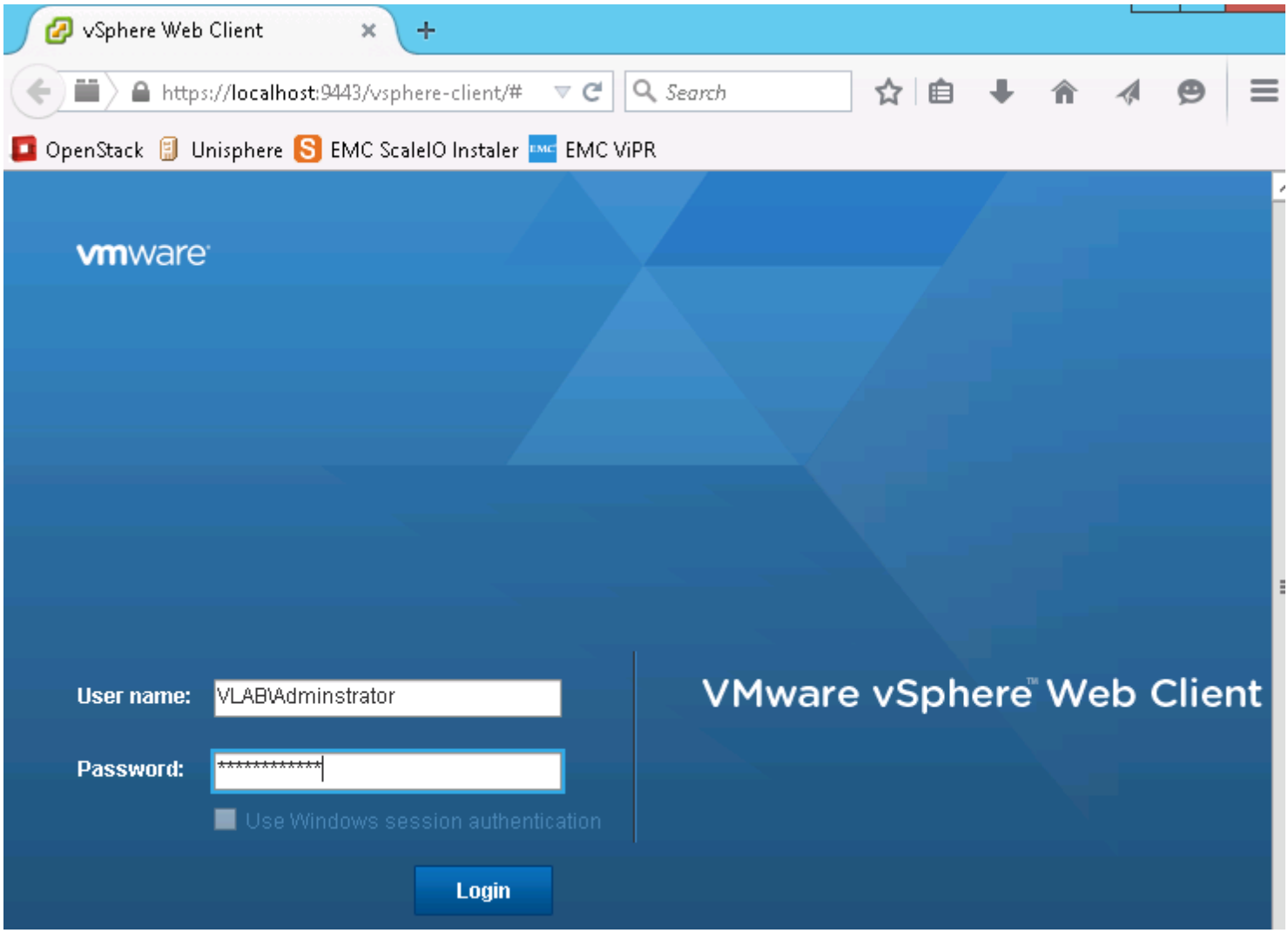
You can use Syncplicity to upload your custom content to and from this lab using your Syncplicity account:



6. Using vSphere Web Client

You can use vSphere Web Client to check status and power on / off of the "nested" VM's

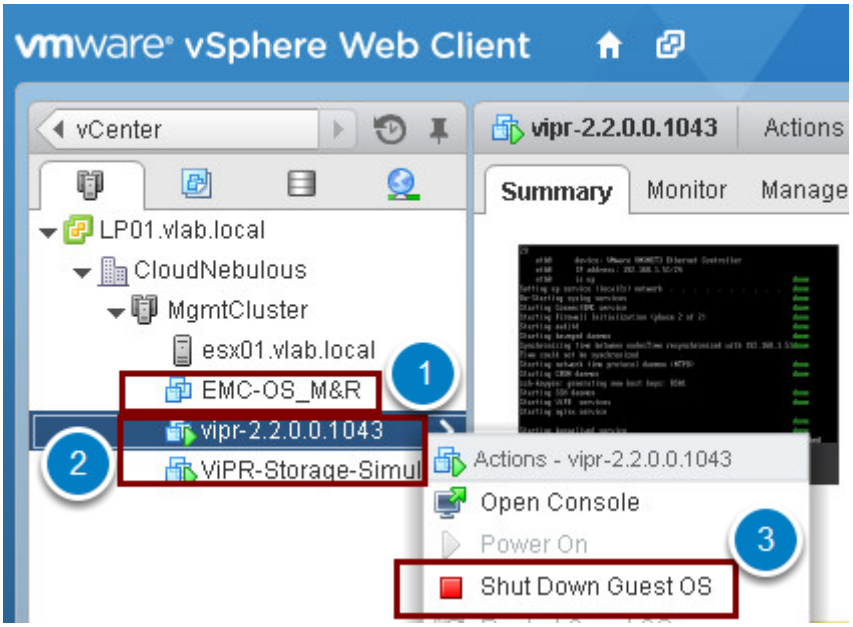
Login with credentials: *VLAB\Administrator - Password123!*



6.1 Nested VM's

While troubleshooting Lab 5: ViPR with Cinder, or Lab 6: OpenStack Monitoring & Reporting (M&R) labs, please make sure to check the status of the nested VM's. Having the unnecessary VM's powered on during other labs will lead to oversubscription of the ESX resources (CPU and RAM) and can cause timeouts in lab activities:

1. **EMC-OS_M&R** VM should be powered on only during **Lab 6: OpenStack Monitoring & Reporting (M&R)**
2. **ViPR-2.2.0.0.1043** and **ViPR-Storage-Simulator** VM's should be powered on only during **Lab 5: ViPR with Cinder**
3. You can power off unnecessary VM's using right-click menu **"Shut Down Guest OS"** command



Conclusion

Conclusion

Congratulations!

Bart, Stephan's manager has received fantastic feedback from Code Nebulous' Cloud Operations Team after partaking in Stephan's knowledge transfer session. The feedback highlighted the ease of bringing up an OpenStack cloud with support for building and managing multiple tenants in the heterogeneous cloud infrastructure throughout its entire lifecycle.

Additionally, Stephan had conducted a knowledge transfer session for Code Nebulous Tenants. The feedback highlighted the ease of use and quick and easy way to provisioning and manage Infrastructure services and all around good user experience.