



AWS Basics:

Elastic Block Store (EBS)

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Introduction

Amazon Elastic Block Store

Amazon Elastic Block Store (EBS) offers persistent storage for Amazon EC2 instances. Amazon EBS volumes are network-attached, and persist independently from the life of an instance. Amazon EBS volumes are highly available, highly reliable volumes that can be leveraged as an Amazon EC2 instance's boot partition or attached to a running Amazon EC2 instance as a standard block device.

When used as a boot partition, Amazon EC2 instances can be stopped and subsequently restarted, enabling you to only pay for the storage resources used while maintaining your instance's state. Amazon EBS volumes offer greatly improved durability over local Amazon EC2 instance stores, as Amazon EBS volumes are automatically replicated on the backend (in a single Availability Zone).

For those wanting even more durability, Amazon EBS provides the ability to create point-in-time consistent snapshots of your volumes that are then stored in Amazon S3, and automatically replicated across multiple Availability Zones. These snapshots can be used as the starting point for new Amazon EBS volumes, and can protect your data for long-term durability. You can also easily share these snapshots with co-workers and other AWS developers.

Amazon EBS provides two volume types: Standard volumes and Provisioned IOPS volumes. Standard volumes offer cost effective storage that is ideal for applications with moderate or "bursty" I/O requirements. Provisioned IOPS volumes are designed to deliver predictable, high performance for I/O intensive applications such as databases.

Technical Knowledge Prerequisites

To successfully complete this lab, you should be familiar with basic Amazon EC2 usage (as taught in the "Basics: Creating Amazon EC2 Resources" lab), Linux server administration and feel comfortable using the Linux command-line tools.

Basics: Elastic Block Store

If you are not familiar with basic Amazon EC2 usage the Self-Paced Lab "Creating Amazon EC2 Instances" takes you through the steps to get your first AWS Linux instance up and running. This lab focuses on Amazon Elastic Block Store – virtual "disks" that you can attach to Amazon EC2 instances.

In this lab session, you will cover the following steps:

- Create an EBS volume
- Attach the volume to an instance
- Configure the instance to use the virtual disk
- Create an EBS Snapshot
- Restore the snapshot

Elastic Block Store Overview and Essentials

EBS Volume Features

Amazon Elastic Block Store volumes deliver the following features:

- Persistent storage: Volume lifetime is independent of any particular Amazon EC2 instance.
- General purpose: EBS volumes are raw, unformatted block devices that can be used from any OS.
- High reliability: EBS volumes have built-in redundancy within an availability zone.
- The AFR (Annual Failure Rate) of EBS is between 0.1% and 1%.
- Volume sizes range from 1 GB to 1 TB.
- Easy to use: EBS volumes can be easily created, attached, backed up, restored, and deleted.

EBS Provisioned IOPS

For applications that need high, predictable performance, EBS volumes can be created with the EBS Provisioned IOPS feature:

- EBS Provisioned IOPS deliver predictable performance at 100-2000 16KB IOPS per volume.
- EBS Provisioned IOPS offer high throughput of up to 1750 Mbps (7 volume RAID 0 array).
- EBS Provisioned IOPS are easy to use, including all standard EBS.
- Amazon EC2 instances can be configured as EBS Optimized Instances for dedicated storage throughput (available for large, xlarge, high-mem 4XL instances). EBS Optimized instances provide up to 1 Gbps dedicated throughput between Amazon EC2 instance and EBS.

For the most up-to-date information regarding provisioned IOPS, please reference the EBS documentation:

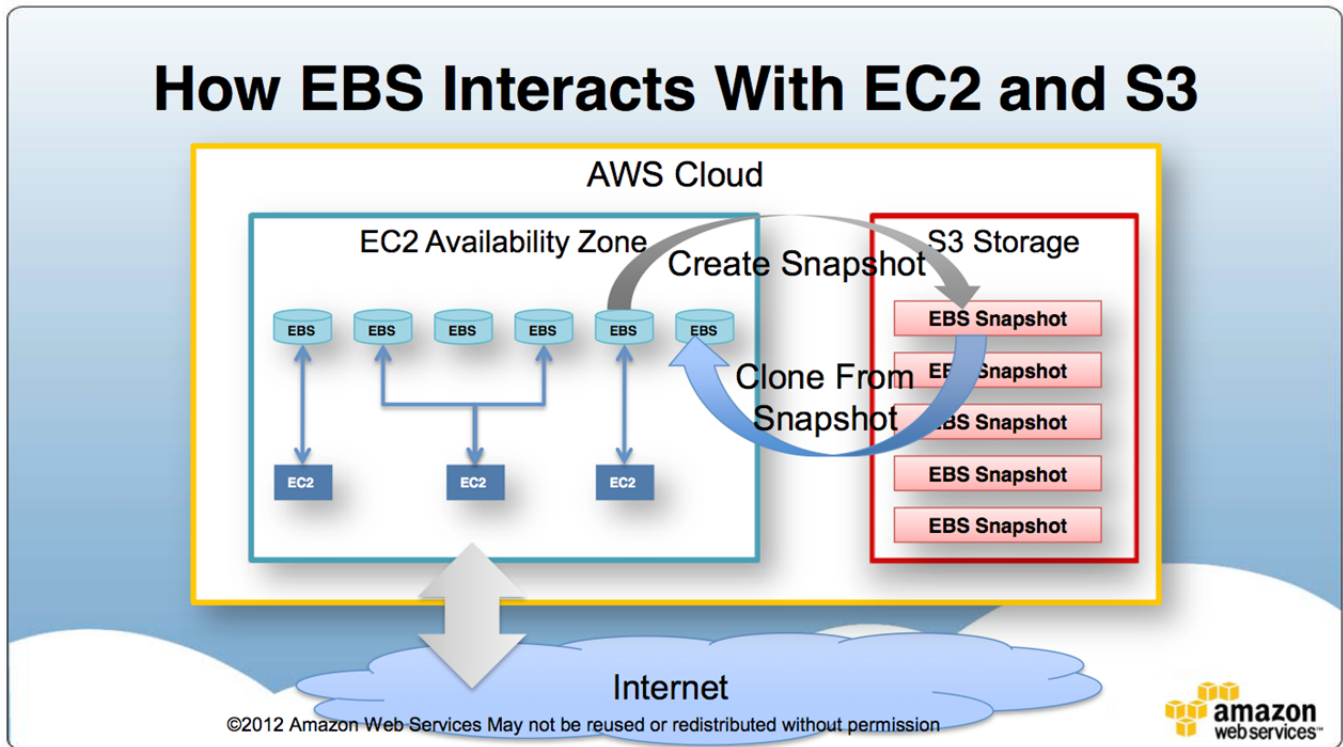
http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/AmazonEBS.html#EBSVolumeTypes_piops

EBS Snapshots

You can create any number of point-in-time, consistent snapshots from EBS volumes at any time. EBS Snapshots are stored in Amazon Simple Storage Service (S3) with high durability. New EBS volumes can be created out of snapshots for cloning or restoring backups. EBS snapshots can also be easily shared among AWS users or copied between AWS regions.

EBS, Amazon EC2 and Amazon S3 Interaction

The following diagram illustrates how EBS volumes, Amazon EC2 and Amazon S3 interact with each other:



The EBS Volume Lifecycle

Throughout its lifecycle, an EBS volume can be in one of the following states:

1. **Create:** New EBS volumes are created out of a vast amount of available space. They can have a size of 1 GB to 1 TB.
2. **Attach:** An EBS volume can be attached to an instance. After attachment, it becomes visible to the OS as a regular block device, just like a hard drive. Each EBS volume can only be attached to a single instance at a time.
3. **Attached & In Use:** The OS can now format, set up a file system on the EBS volume and use it as a regular storage device.
4. **Create Snapshot:** Snapshots can be created at any time, while the volume is in-use.
5. **Detach:** When the OS no longer uses the volume, it can be detached from the instance. Data remains stored on the EBS volume and the volume remains available for attachment to any other instance within the same availability zone.
6. **Delete:** When the volume and its contents are no longer needed, the EBS volume can be deleted.

EBS, AMIs, and Termination

It is possible to boot Amazon EC2 instances from EBS volumes. Such instances are created from AMIs that reference EBS snapshots containing the initial OS image to boot from. When creating such an instance, a new EBS volume for the root file system is created from a volume snapshot containing the OS image.

Upon termination of an instance, the default behavior for most Instances is to simply delete the EBS volume as it can be recreated at any time out of the underlying AMI.

If you wish to retain the EBS volume's contents after terminating an instance (for example to keep some customized configuration), you can specify the `DeleteOnTerminate=False` flag for the Instance. In this case, the EBS volume will only be detached from the instance upon instance termination.

Things You Should Know About EBS

EBS volumes are a resource over the network: Networks have variable performance and so figures into EBS performance can vary as well. To reduce network variability, you can use EBS optimized instances.

Striping can be used to combine performance and throughput of EBS volumes to a single logical volume. An observed sweet spot for standard volumes is around 4-8 EBS volumes at the moment. When using Provisioned IOPS EBS volumes, striping across 7 volumes could yield around 875 Mbps of throughput given (16 K per block * 2 K IOPS * 7 volumes * 8 Bits \approx 1792 Mbps in theory).

EBS is already a redundant resource. We do not recommend using RAID 1+ on top of EBS.

Lazy loads from snapshots: When you create a volume out of a snapshot, space is allocated immediately. Data from the snapshot is then written to disk on the first request for minimum restore wait time. For maximum IO performance when restoring EBS volumes from a snapshot, you might run `dd` or a similar utility to ensure blocks from the snapshot are all present on the EBS volume when you will first need them.

More Information

This lab guide can only give a brief overview of Amazon EBS concepts. For further information, please refer to the official Amazon Web Services Documentation for EC2 at: <https://aws.amazon.com/documentation/ec2/>

Start your *qwikLAB*™

1. Start your *qwikLAB*™

Use the 'Start Lab' button to start your lab.

(Hint: If you are prompted for a token, please use one you've been given or have purchased.)



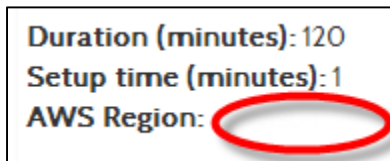
You will see the lab creation in progress.



2. Note a few properties of the lab.

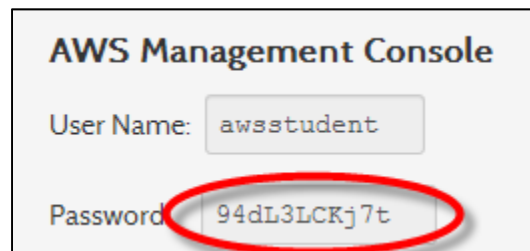
- a. **Duration** - The time the lab will run for before shutting itself down.
- b. **Setup Time** - The estimated lab creation time on starting the lab.
- c. **AWS Region** - The AWS Region the lab resources are being created in.

3. Note the AWS Region set for your lab in *qwikLAB*™

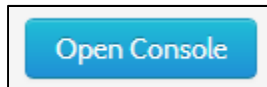


4. Copy the Password provided.

- a. Hint: selecting the value shown and using Ctrl+C works best



5. Click the 'Open Console' button.



6. Login to the AWS Management Console

Enter the User Name '**awsstudent**' and paste the password you copied from the lab details in *qwikLAB™* into the Password field.

Click on the 'Sign in using our secure server' button.

In this step you logged into the AWS Management Console using login credentials for a user provisioned via AWS Identity Access Management in an AWS account by *qwikLAB™*.

Amazon Web Services Sign In

Please enter the AWS Identity & Access Management (IAM) User name and password assigned by your system administrator to sign in.

AWS Account: 832809622232

User Name:

Password:

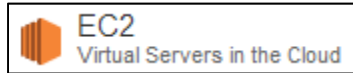
[Sign in using our secure server](#)

Please contact your system administrator if you have forgotten your user credentials.

[Sign in using AWS Account credentials](#)

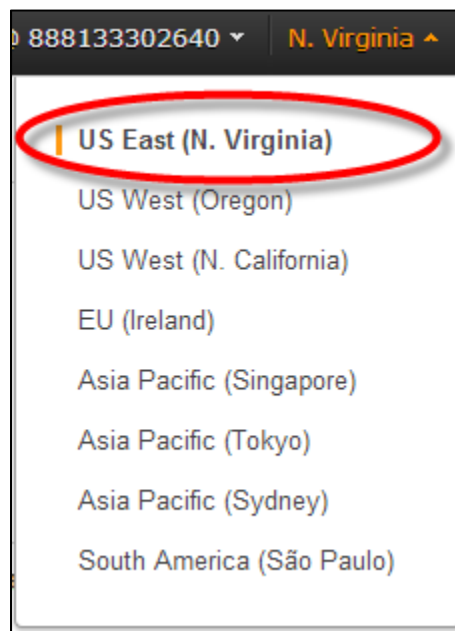
AWS Management Console

1. Once logged in, select "EC2" as from the Console Home.



Confirm your AWS Region

2. Select or confirm that the same AWS Region is already set in the AWS Management Console

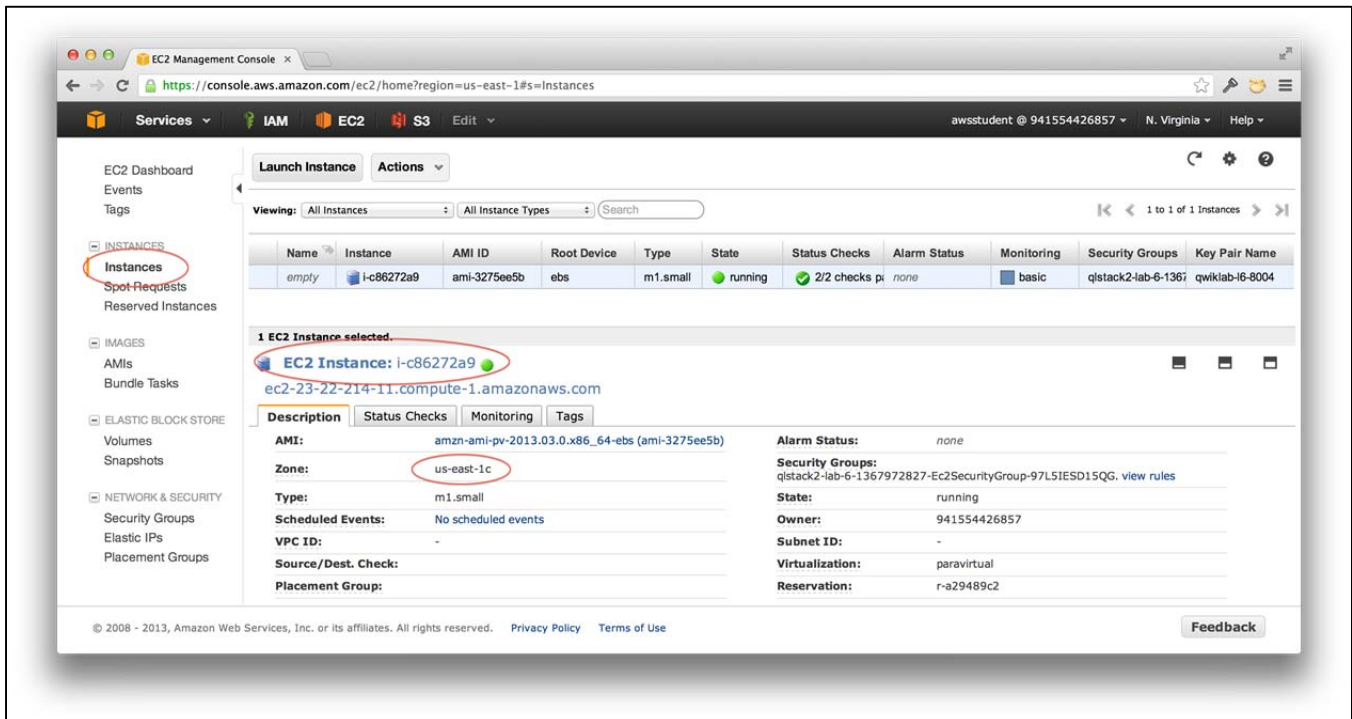


Hands-on: Elastic Block Store

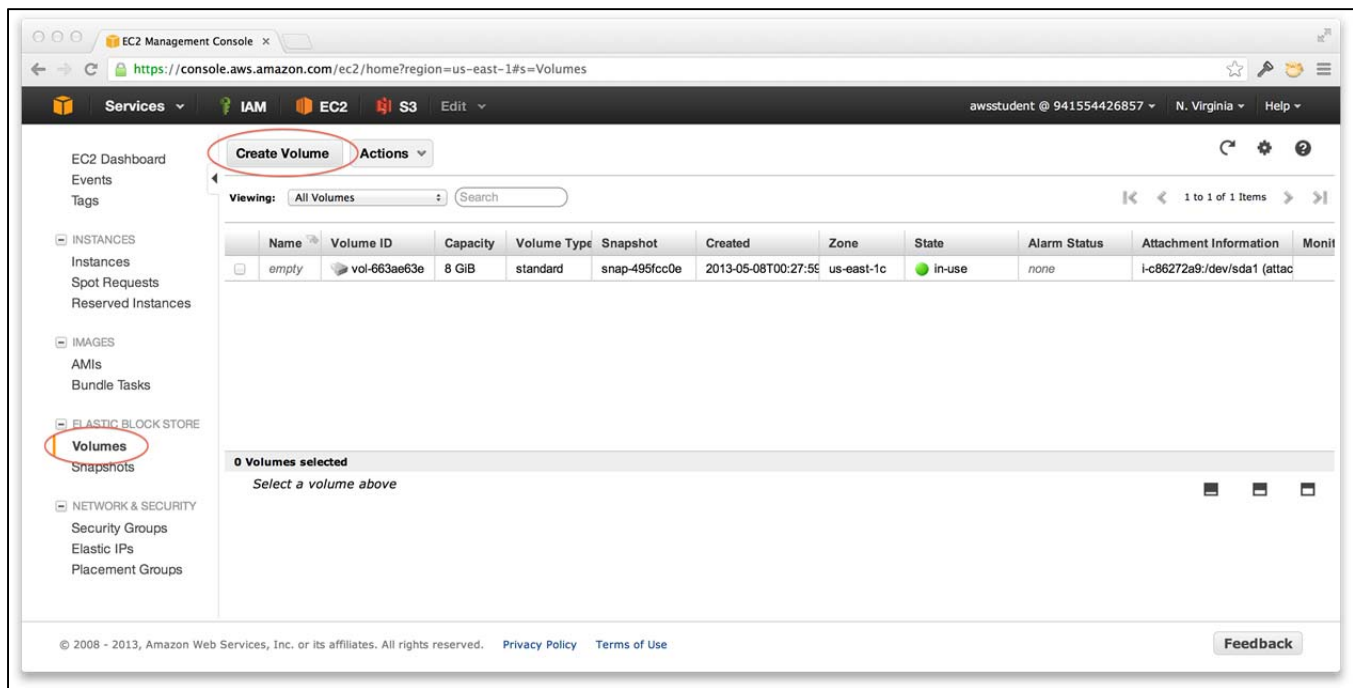
Create an EBS volume

EBS volumes are created in specific Availability Zones. Therefore it is important to first determine the location of the Amazon EC2 instance that will be receiving additional block storage.

1. Click on **Instances** under the *Instances* section in the menu on the left side of the screen
2. Select the instance and note the **instance ID** (i-c86272a9 in this example).
3. Select the **Zone** (The Zone is displayed in the Description tab of the lower part of your screen, it can also be added to the instance line by clicking on Show/Hide and adding a check to “Zone”).



- Click on **Volumes** under the Elastic Block Store section in the menu on the left side of the screen and on the **Create Volume** button:



- Enter the following properties for your new volume:
 - Volume Type: **Standard**
 - Size: **1 GiB**
 - Availability Zone: **Same as the EC2 instance you examined above**
 - Snapshot: **No Snapshot**
- Click **Yes, Create** to create a 1 GB volume:

Create Volume

Cancel

Volume Type:

Standard

Size:

1

GiB

(Min: 1 GiB, Max: 1TiB)

IOPS:

(Max: 2000 IOPS)

Availability Zone:

us-east-1d

Snapshot:

--- No Snapshot ---

Cancel

Yes, Create

- To help distinguish this volume from others, we will tag this volume with a name. Select the new volume, click on the **Tags** tab, and click on the **Add/Edit Tags** button:

Services

Edit

awsstudent @ 113525602255

Help

EC2 Dashboard

Events

Tags

INSTANCES

Instances

Spot Requests

Reserved Instances

IMAGES

AMIs

Bundle Tasks

ELASTIC BLOCK STORE

Volumes

Snapshots

NETWORK & SECURITY

Security Groups

Elastic IPs

Placement Groups

Create Volume

Actions

Viewing: All Volumes

Search

	Name	Volume ID	Capacity	Volume Type	Snapshot	Created	Zone	State	Alarm Status	Attachment I
<input checked="" type="checkbox"/>	empty	vol-2c7ad375	1 GiB	standard	--	2013-04-16T21:45:26	us-east-1d	available	none	
<input type="checkbox"/>	empty	vol-0337995a	8 GiB	standard	snap-0000000a	2013-04-16T20:37:32	us-east-1d	in-use	none	i-4cc25b29/d

Volume: vol-2c7ad375

Details

Status Checks

Monitoring

Tags

Add tags to your volume to simplify the administration of your EC2 infrastructure. A form of metadata, tags consist of a case-sensitive key/value pair, are stored in the cloud and are private to your account. You can create user-friendly names that help you organize, search, and browse your resources. For example, you could define a tag with key = Name and value = CRMwebroot. You can add up to 10 unique keys to each volume along with an optional value for each key. For more information, go to [Tagging Your Amazon EC2 Resources](#) in the *EC2 User Guide*.

Add/Edit Tags

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Privacy Policy

Terms of Use

Feedback

- Provide a name for the volume and click **Save Tags**

Tag EBS Volume
Cancel

Add tags to your volume to simplify the administration of your EC2 infrastructure. A form of metadata, tags consist of a case-sensitive key/value pair, are stored in the cloud and are private to your account. You can create user-friendly names that help you organize, search, and browse your resources. For example, you could define a tag with key = Name and value = CRMwebroot. You can add up to 10 unique keys to each volume along with an optional value for each key. For more information, go to [Tagging Your Amazon EC2 Resources](#) in the *EC2 User Guide*.

Key (127 characters maximum)	Value (255 characters maximum)	Remove
Name		✖
		✖

Add another Tag. (Maximum of 10)

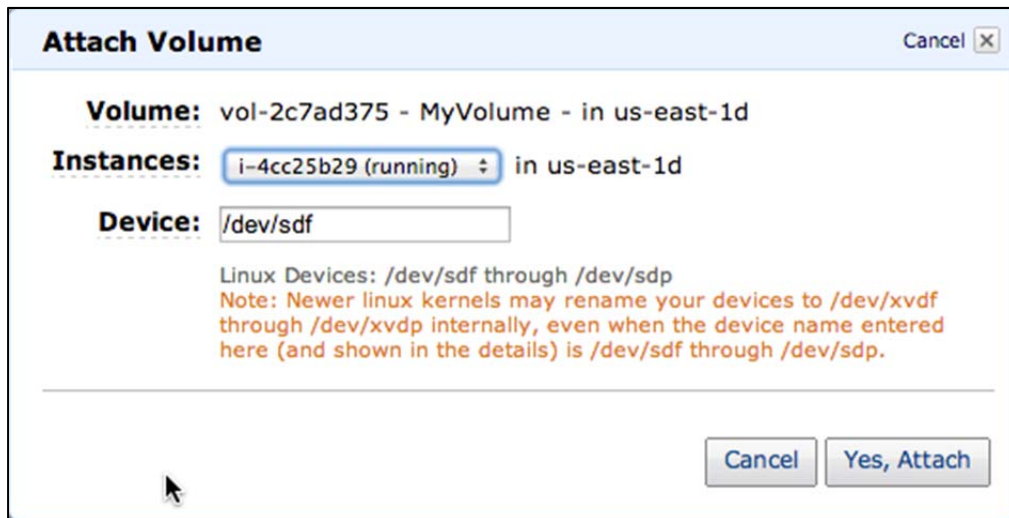
Cancel
Save Tags

Attach the volume to an instance

1. To attach this volume to your instance, right click on the new volume and select **Attach Volume**:

The screenshot shows the AWS Management Console interface. On the left, there's a sidebar with navigation options: EC2 Dashboard, INSTANCES, IMAGES, ELASTIC BLOCK STORE (highlighted), and NETWORK & SECURITY. The main area displays a table of EBS volumes. The volume 'MyVolume' (ID: vol-2c7ad375) is selected, and a context menu is open over it, showing options: Delete Volume, Attach Volume (highlighted), Create Snapshot, and Change Auto-Enable IO Setting. Below the table, there's a section for 'Volume: vol-2c7ad375' with tabs for Details, Status Checks, Monitoring, and Tags. The 'Tags' tab is active, showing a message about adding tags to the volume.

2. Select the EC2 instance from the drop down menu, assign a device mapping for the drive (`/dev/sdf` for this lab), and click **Yes, Attach**:



The volume status will now change to **in-use** for this volume.

Configure the instance to use the virtual disk

In order to complete this activity, you will need to log into your Amazon EC2 Linux instance with SSH.

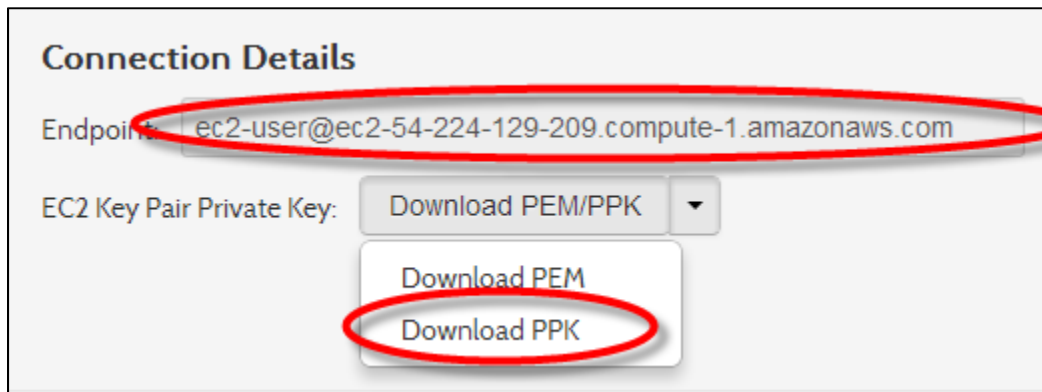
Option 1 (Windows): Connect to your EC2 Instance via SSH

Download PuTTY

1. Download PuTTY to a location of your choice unless you already have PuTTY.
<http://the.earth.li/~sgtatham/putty/latest/x86/putty.exe>

Download your EC2 Key Pair private key file

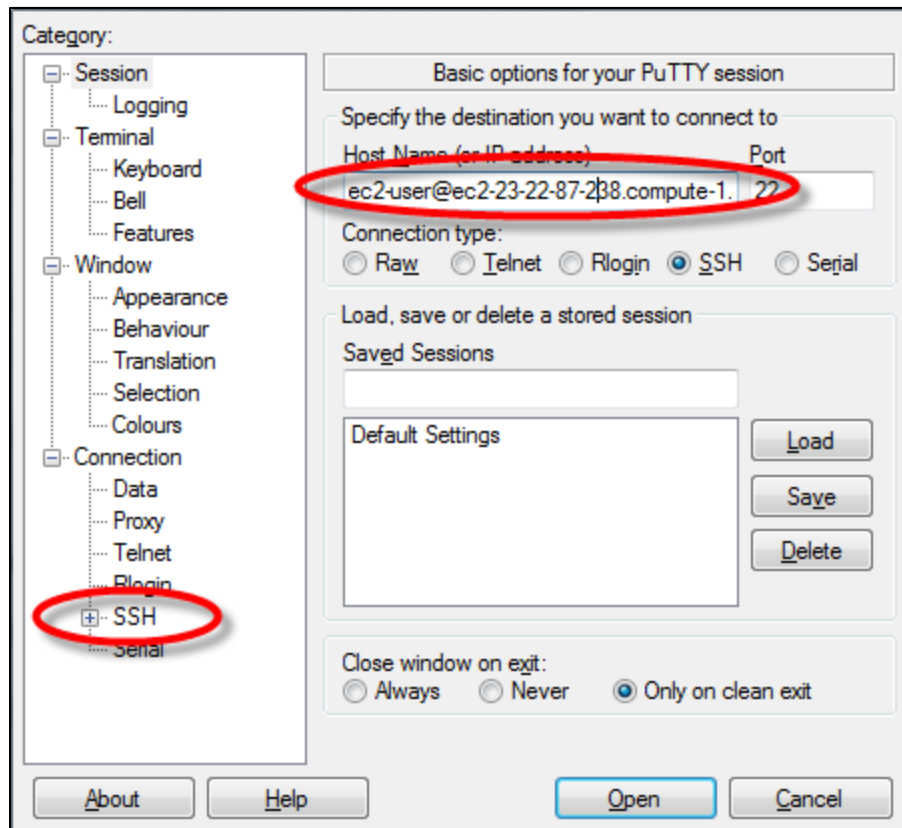
2. Go to your lab in *qwikLAB™*.
3. Download the *qwikLAB™* provided EC2 Key Pair private key file in the PuTTY compatible PPK format by clicking on the Download PPK option in the “Download PEM/PPK” drop-down.



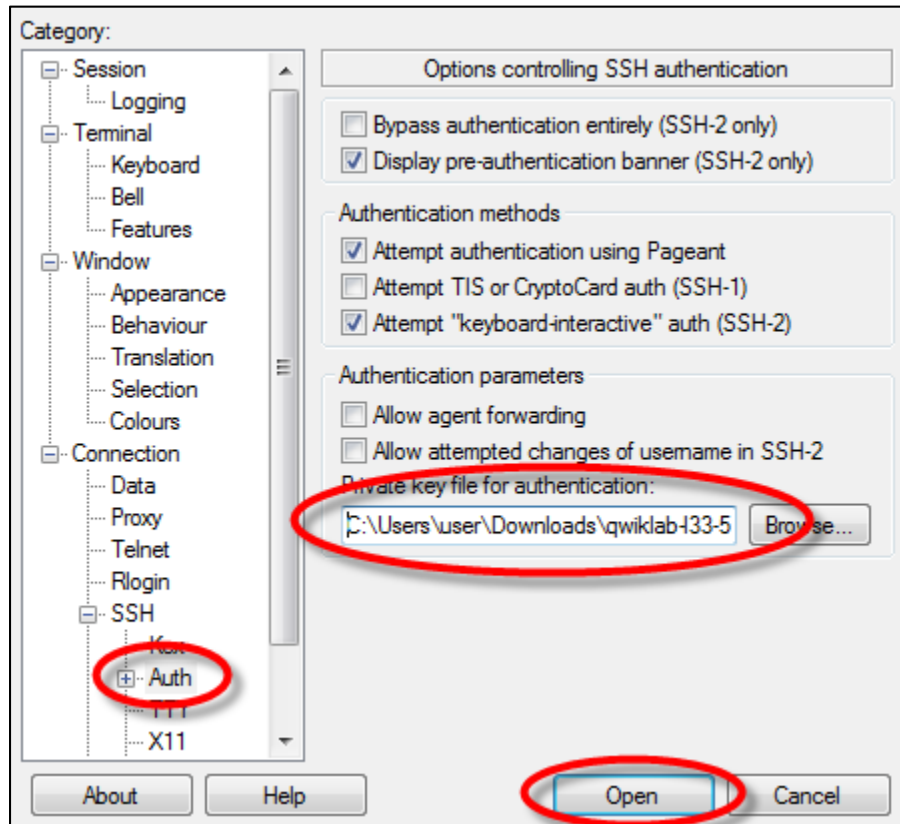
4. Save the file to your Downloads directory (or some other directory of your choice.)
5. Copy the entire content of Endpoint to your clipboard (select and then Ctrl+c)

Connect to the EC2 Instance using SSH and PuTTY.

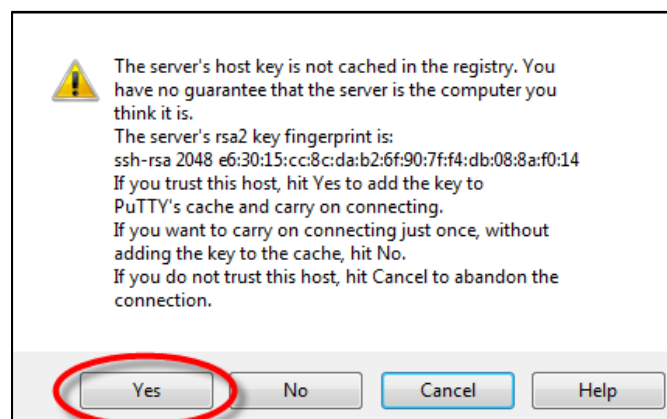
1. Open the putty.exe you downloaded or already had.
2. Paste the Endpoint string you copied to your clipboard into the Host Name input in Putty (Ctrl+v).
3. Expand the SSH category by clicking on it.



4. Select the Auth category by clicking on it (not the + symbol next to it).
5. Click Browse and locate the PPK file (ending in .ppk) in your Downloads directory or whatever other location you chose.
6. Click Open



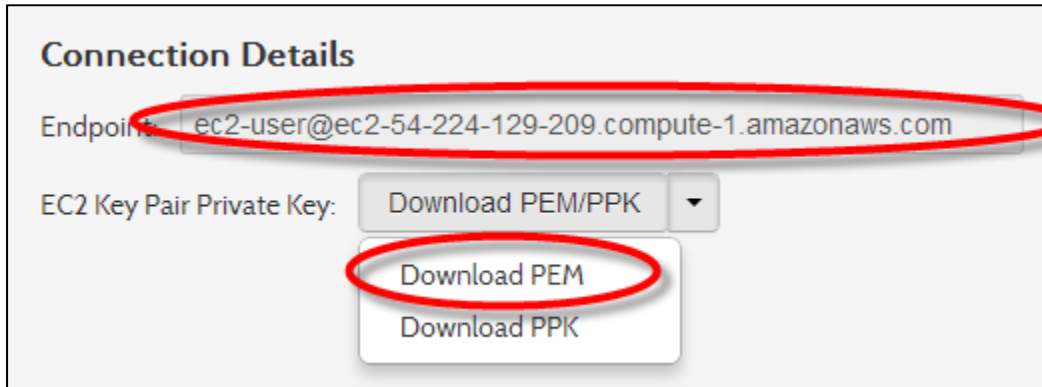
7. Click Yes when prompted to allow a first connection to this remote SSH server.



Option 2 (OS X and Linux): Connect to your EC2 Instance via SSH

Download your EC2 Key Pair private key file

1. Go back to your lab in *qwikLAB™*.
2. Download the *qwikLAB™* provided EC2 Key Pair private key file in the PEM format by clicking on the Download PEM option in the “Download PEM/PPK” drop-down.



3. Save the file to your Downloads directory (or some other directory of your choice.)
4. Copy the entire content of Endpoint to your clipboard (select and then Ctrl+c)

Connect to the EC2 Instance using the OpenSSH CLI client

1. Open the Terminal application.
2. Enter the below commands substituting the path/filename for the .pem file you downloaded from *qwikLAB™* and pasting the username@hostname you copied from Endpoint in *qwikLAB*.

```
chmod 600 ~/Downloads/qwiklab-l33-5018.pem  
ssh -i ~/Downloads/qwiklab-l33-5018.pem ec2-user@ec2-23-22-87-238.compute-1.amazonaws.com
```

Create a File System on Volume and Mount It

In this exercise, we will be adding an additional 1 GB of storage to a Linux instance as an ext3 file system under the `/mnt/data-store` mount point. Note that depending on the type of Linux distribution your volume may be shown under a slightly different device name, i.e. `/dev/xvdf` instead of `/dev/sdf`.

1. Issue the following command to create an ext3 file system on the new volume:

```
sudo mkfs -t ext3 /dev/sdf
```

2. Make the directory for mounting the new storage:

```
sudo mkdir /mnt/data-store
```

3. Mount the new volume:

```
sudo mount /dev/sdf /mnt/data-store
```

4. To configure the Linux instance to mount this volume on boot, open `/etc/fstab` in an editor by typing the following :

```
sudo nano /etc/fstab
```

5. Append the following line to `/etc/fstab`:

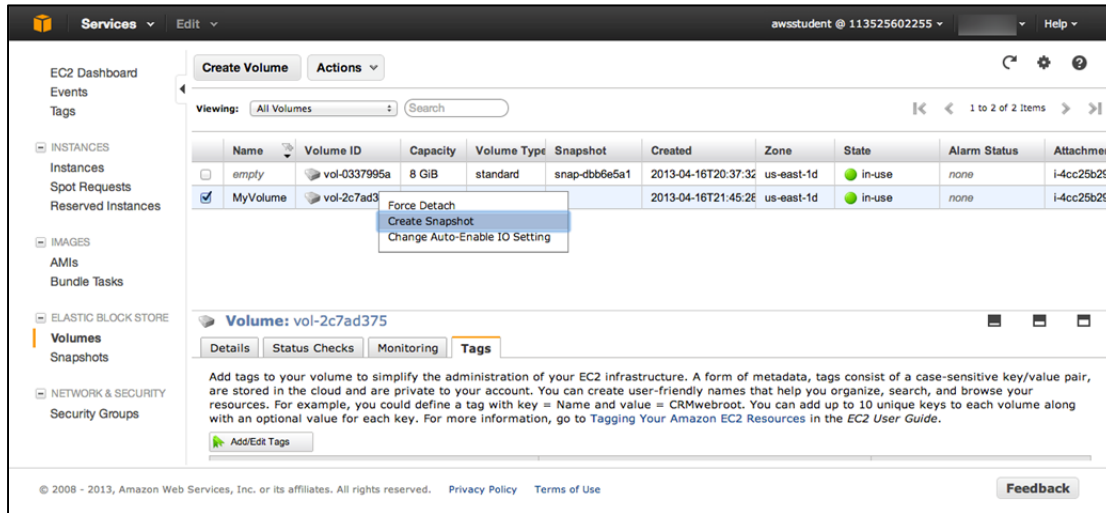
```
/mnt/data-store ext3 defaults,noatime 1 2
```

6. In the text editor, hit `Ctrl+O`, then `Ctrl+X` to save the file and exit the editor

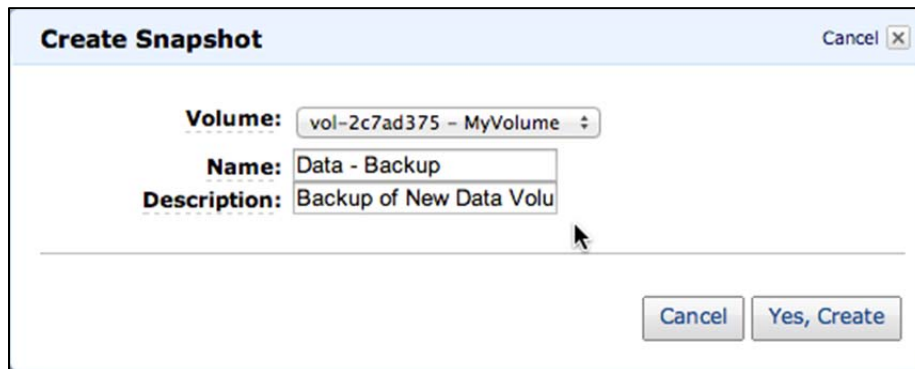
Create an EBS Snapshot

- Using the AWS Console EC2 section, right-click the volume to be backed up (e.g. "MyVolume") and select "Create Snapshot".

Although snapshots occur asynchronously, minimizing the amount of data changes during the snapshot is recommended to increase the snapshot speed and to more easily line up backup expectations with the point-in-time the snapshot is running. Snapshots of databases, for example, are often taken from a read-replica that temporarily suspends replication activities during the snapshot, and resumes after the snapshot has finished:

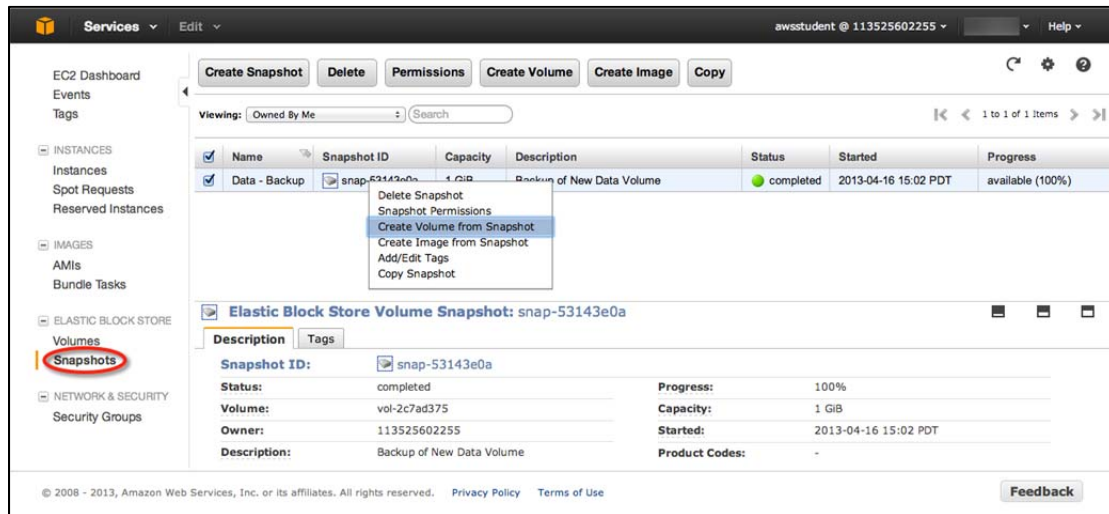


- Provide a snapshot name and description and click "Yes, Create":



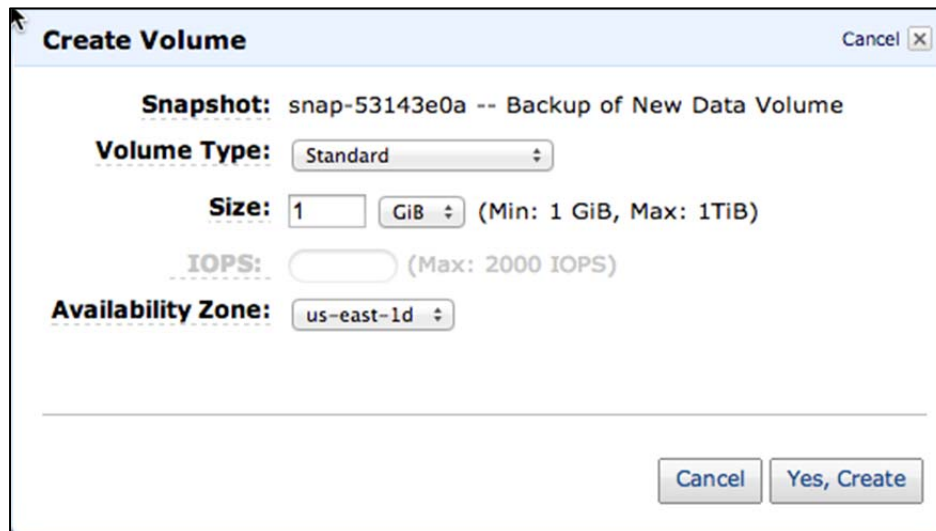
Restore the snapshot

1. To restore data from the snapshot, locate the desired snapshot from the “**Snapshots**” console link, right- click on the “**Create Volume from Snapshot**” link:



2. Then select the desired volume type, size, Availability Zone, and click “**Yes, Create**”:

After the data has been restored to a new volume, you can attach it to an instance and mount the storage as per the previous steps. Since the new volume has previous data, do not create a new file system (`mkfs` in Linux). Simply mount the volume (Linux) and start using the existing file system and data immediately.



Conclusion

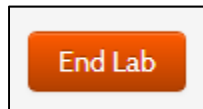
Congratulations! You now have successfully:

- Learned about the basic concepts of the Amazon Elastic Block Store (EBS) service,
- Created your own EBS volume and attached it to a running instance,
- Created a snapshot backup of your volume and
- Restored your snapshot into a new EBS volume.

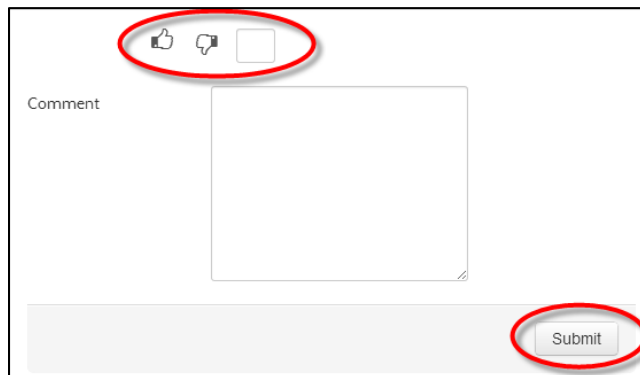
We hope you had fun while working through this tutorial and that you now have everything you need to know to start using EBS volumes to enhance your EC2 projects.

End Lab

1. Sign-out of the AWS Management Console.
2. Click the End Lab button in *qwikLAB™*.



3. Give the lab a thumbs-up/down, or enter a comment and click Submit

A feedback form interface. At the top, there are three icons: a thumbs-up, a thumbs-down, and a square box, all enclosed in a red oval. Below these is a text input field labeled "Comment". At the bottom right, there is a "Submit" button, also enclosed in a red oval.

Errors in this lab guide can be reported to aws-course-feedback@amazon.com.