INTRODUCTION TO CLOUD COMPUTING

What is Cloud Computing?
Cloud computing is the on-demand delivery of compute power, database storage, applications, and other IT resources through a cloud services platform via the internet with pay-as-you-go pricing.

Cloud Computing Basics
Whether you are running applications that share photos to millions of mobile users or you're supporting the critical operations of your business, a cloud services platform provides rapid access to flexible and low cost IT resources. With cloud computing, you don't need to make large upfront investments in hardware and spend a lot of time on the heavy lifting of managing that hardware. Instead, you can provision exactly the right type and size of computing resources you need to power your newest bright idea or operate your IT department. You can access as many resources as you need, almost instantly, and only pay for what you use.

Six Advantages and Benefits of Cloud Computing by Amazon:

Trade capital expense for variable expense
Instead of having to invest heavily in data centers and servers before you know how you're going to use them, you can only pay when you consume computing resources, and only pay for how much you consume.

Benefit from massive economies of scale
By using cloud computing, you can achieve a lower variable cost than you can get on your own. Because usage from hundreds of thousands of customers are aggregated in the cloud, providers such as Amazon Web Services can achieve higher economies of scale which translates into lower pay as you go prices.

Stop guessing capacity
Eliminate guessing on your infrastructure capacity needs. When you make a capacity decision prior to deploying an application, you often either end up sitting on expensive idle resources or dealing with limited capacity. With cloud computing, these problems go away. You can access as much or as little as you need, and scale up and down as required with only a few minutes notice.

Increase speed and agility
In a cloud computing environment, new IT resources are only ever a click away, which means you reduce the time it takes to make those resources available to your developers from weeks to just minutes. This results in a dramatic increase in agility for the organization, since the cost and time it takes to experiment and develop is significantly lower.

Stop spending money on running and maintaining data centers
Focus on projects that differentiate your business, not the infrastructure. Cloud computing lets you focus on your own customers, rather than on the heavy lifting of racking, stacking and powering servers.

Go global in minutes

Easily deploy your application in multiple regions around the world with just a few clicks. This means you can provide a lower latency and better experience for your customers simply and at minimal cost.

The NIST Definition of Cloud Computing

NIST is responsible for developing standards and guidelines, including minimum requirements, for providing adequate information security for all agency operations and assets.

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Essential Characteristics:

1. **On-demand self-service**
   A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

2. **Broad network access.**
   Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations)

3. **Resource pooling**
   The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

4. **Rapid elasticity**
   Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

5. **Measured service**
   Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Service Models:

1. **Software as a Service (SaaS)**

   The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user specific application configuration settings.

   SaaS providers host an application and make it available to users through the internet, usually a browser-based interface. As the most familiar category of cloud computing, users most commonly interact with SaaS applications such as Gmail, Dropbox, Salesforce, or Netflix.

2. **Platform as a Service (PaaS)**

   The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider.3 The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

   PaaS solutions appeal to developers who want to spend more time coding, testing, and deploying their applications instead of dealing with hardware-oriented tasks such as managing security patches and operating system updates.

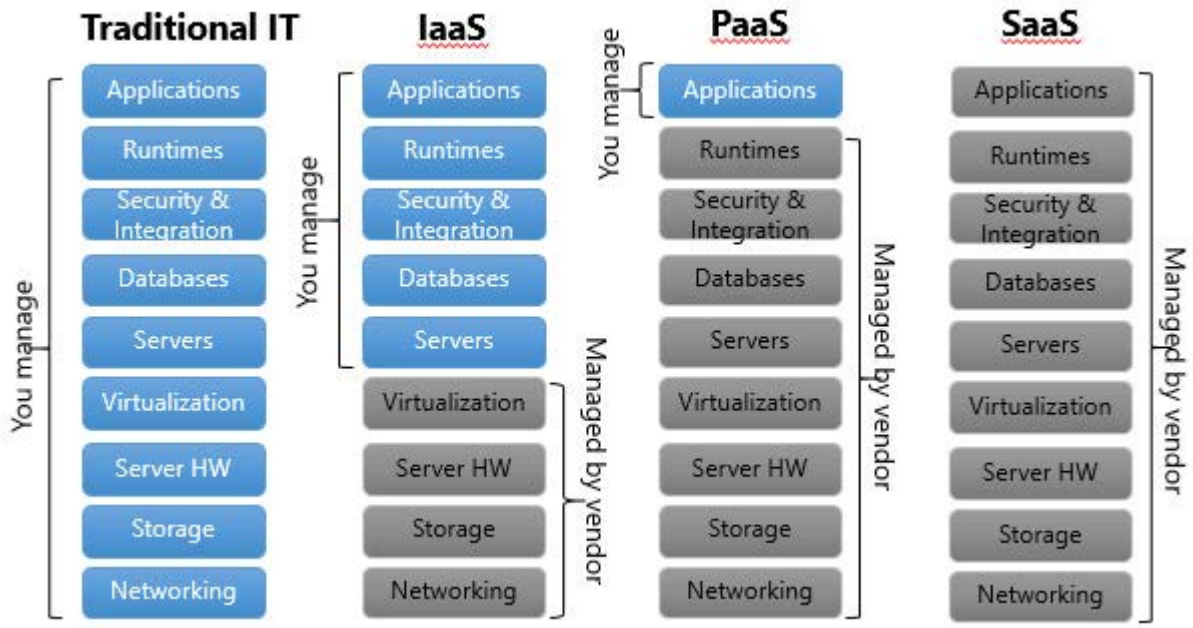
3. **Infrastructure as a Service (IaaS)**

   The capability provided to the consumer is to provision

   Processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components.

   IaaS providers deploy and manage pre-configured and virtualized hardware and enable users to spin up virtual machines or computing power without the labor-intensive server management or hardware investments.

   Amazon Web Services, for example, offers IaaS through the Elastic Compute Cloud, or EC2. Most IaaS packages cover the storage, networking, servers, and virtualization components, while IaaS customers are usually responsible for installing and maintaining the operating system, databases, security components, and applications.



Deployment Models:

1. **Private cloud**

   The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers. It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

   - A private cloud is dedicated to a single organization.
   - Private cloud offers hosted services to a limited number of people behind a firewall, so it minimizes the security concerns some organizations have around cloud. Private cloud also gives companies direct control over their data.

2. **Community Cloud**

   The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises

   - A community cloud is a multi-tenant infrastructure that is shared among several organizations from a specific group with common computing concerns.
   - The community cloud can be either on-premises or off-premises, and can be governed by the participating organizations or by a third-party managed service provider.

3. **Public Cloud**

   The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

   - Computing resources, such as virtual machines (VMs), applications or storage, available to the general public over the internet.

- It reduces the need for organizations to invest in and maintain their own on-premises IT resources.
- It enables scalability to meet workload and user demands.

4. **Hybrid Cloud**
   The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

   - Hybrid cloud is a combination of public and private cloud services, with orchestration between the two.

What is Amazon Web Services?

Amazon Web Services (AWS) is a secure cloud services platform, offering compute power, database storage, content delivery and other functionality to help businesses scale and grow. Explore how millions of customers are currently leveraging AWS cloud products and solutions to build sophisticated applications with increased flexibility, scalability and reliability.

Amazon Web Services (AWS) is a subsidiary of Amazon.com that provides on-demand cloud computing platforms to individuals, companies and governments, on a paid subscription basis with a free-tier option available for 12 months. Amazon Web Services was officially launched on March 14, 2006, combining the three initial service offerings of Amazon S3 cloud storage, SQS, and EC2. AWS has more than 70 services including computing, storage, networking, database, analytics, application services, deployment, management, mobile, developer tools, and tools for the Internet of Things. The most popular include Amazon Elastic Compute Cloud (EC2) and Amazon Simple Storage Service (S3).

AWS Global infrastructure

The AWS Cloud operates 80 Availability Zones within 25 geographic Regions around the world. (Till July, 2021).

Region: Region is a collection of availability zones that are geographically located close to one other. Each region is a separate geographic area. There is no technical definition for AWS Region. Each region has multiple, isolated locations known as Availability Zones and

Availability Zone: These are essentially the physical data centers of AWS. This is the place where actual compute, storage, network, and database resources are hosted. A single availability zone is equal to a single data center. Each region will contains minimum of two Availability Zones.

Edge Locations: Edge locations are CDN endpoints. Edge locations are located in most of the major cities around the world and are specifically used by CloudFront (CDN) to distribute content to end user to reduce latency.

Amazon CloudFront is a web service that gives businesses and web application developers an easy and cost effective way to distribute content with low latency and high data transfer speeds.

Regions and Codes:

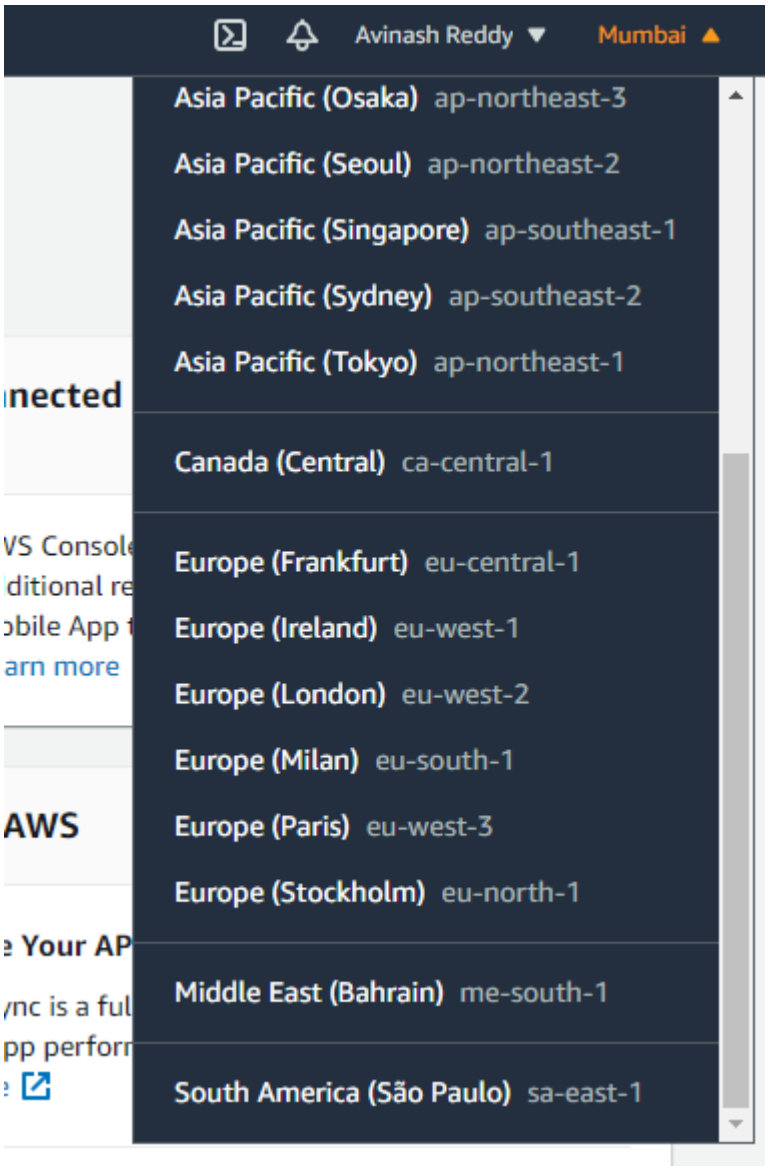
Region Name	Region Code
US East (N. Virginia)	us-east-1
US East (Ohio)	us-east-2
US West (N. California)	us-west-1
US West (Oregon)	us-west-2
Africa (Cape Town)	af-south-1
Asia Pacific (Hong Kong)	ap-east-1
Asia Pacific (Mumbai)	ap-south-1
Asia Pacific (Osaka)	ap-northeast-3
Asia Pacific (Seoul)	ap-northeast-2
Asia Pacific (Singapore)	ap-southeast-1
Asia Pacific (Sydney)	ap-southeast-2
Asia Pacific (Tokyo)	ap-northeast-1
Canada (Central)	ca-central-1
Europe (Frankfurt)	eu-central-1
Europe (Ireland)	eu-west-1
Europe (London)	eu-west-2
Europe (Milan)	eu-south-1
Europe (Paris)	eu-west-3
Europe (Stockholm)	eu-north-1
Middle East (Bahrain)	me-south-1
South America (São Paulo)	sa-east-1
China (Beijing)	cn-north-1
China (Ningxia)	cn-northwest-1
AWS GovCloud (US-West)	us-gov-west-1
AWS GovCloud (US-East)	us-gov-east-1

- AWS GovCloud (US) account provides access to the AWS GovCloud (US) region only.
- AWS (China) account provides access to the China (Beijing & Ninxia) region only.


Regions
Coming Soon

How to find regions and Availability Zones using the console

1. Open the Amazon EC2 console
2. From the navigation bar, view the options in the region selector.

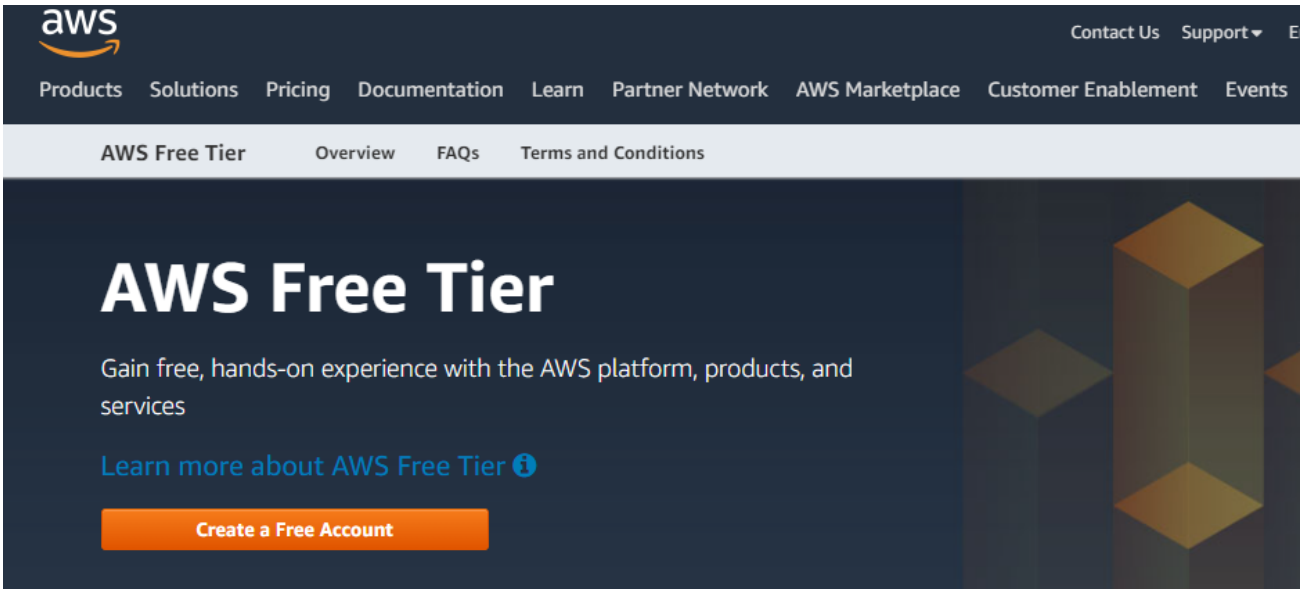


3. You can switch between the regions and some services are region specific and some are global.

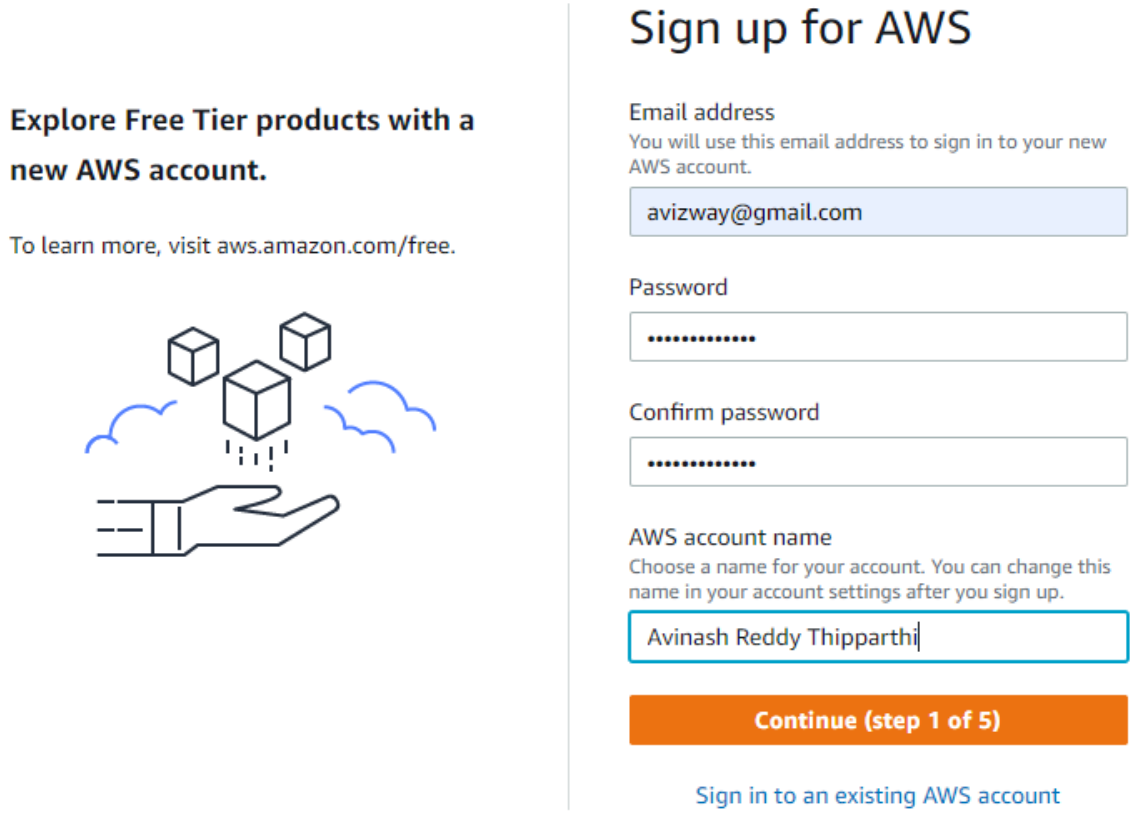
AWS ACCOUNT CREATION

AWS Account Creation

1. Open **https://aws.amazon.com/free**, and verify the free tier limitations then choose "Create a Free Account".

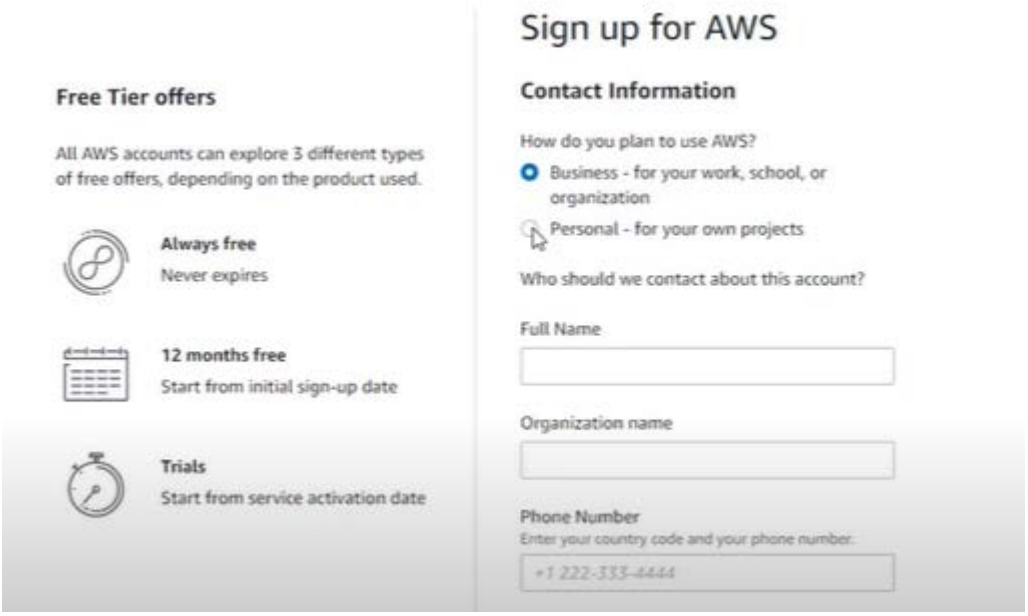


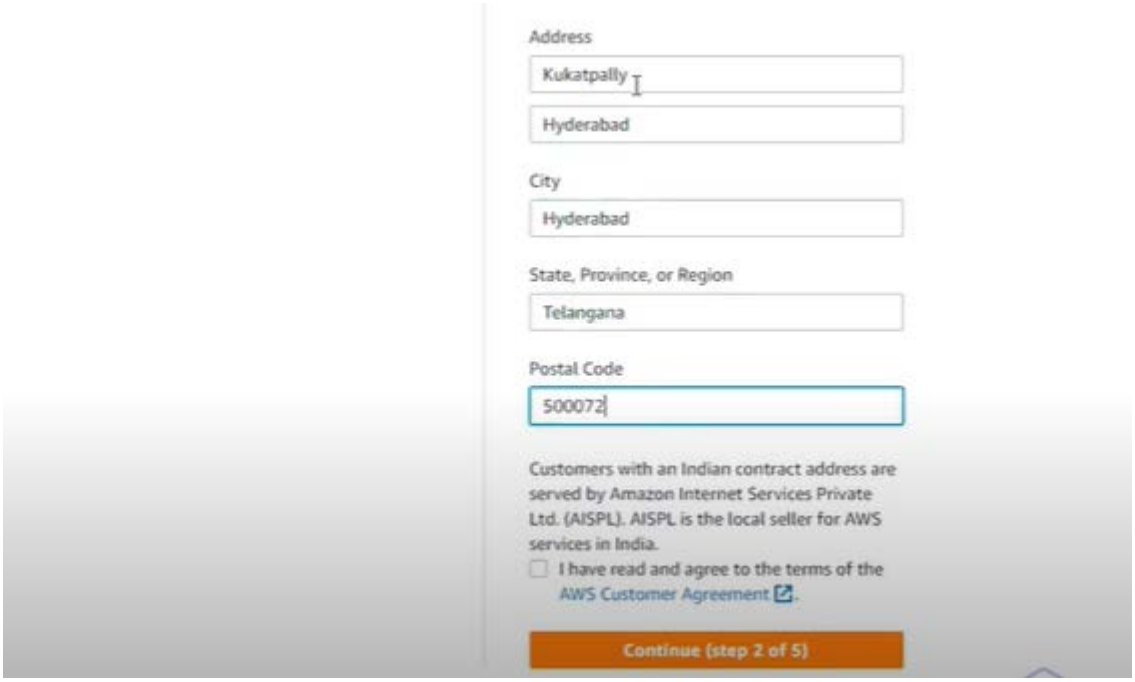
2. And Select "Create a new AWS account" option if you want to create a new account, or enter your Email ID if you are an existing user.
3. Enter the required details; AWS Account Name (You can give your name), Email Address and Choose a Password. Whatever the email ID you are using here is called as "**Root"** user and this user will have highest privileges on your AWS account.



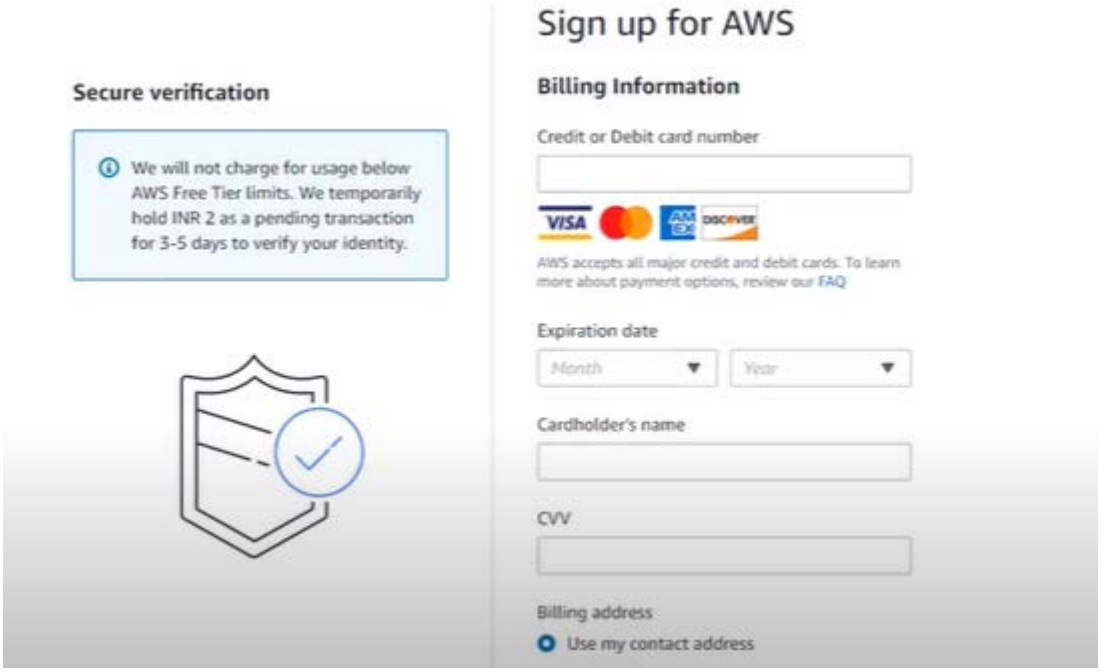
4. In this step we have to select “Account type” and need to provide the “Contact information”.
   - **a.** You can select “Personal Account” as your AWS account type, if you are an individual user.
   - **b.** You can select “Business Account” if you are creating this account for your organization.
   - **c.** You have to provide the required contact Information (i.e; Full Name, Country, Address, City, State, Postal code and Phone Number)
   - **d.** Click on checkbox for Agree the terms and conditions defined by Amazon.

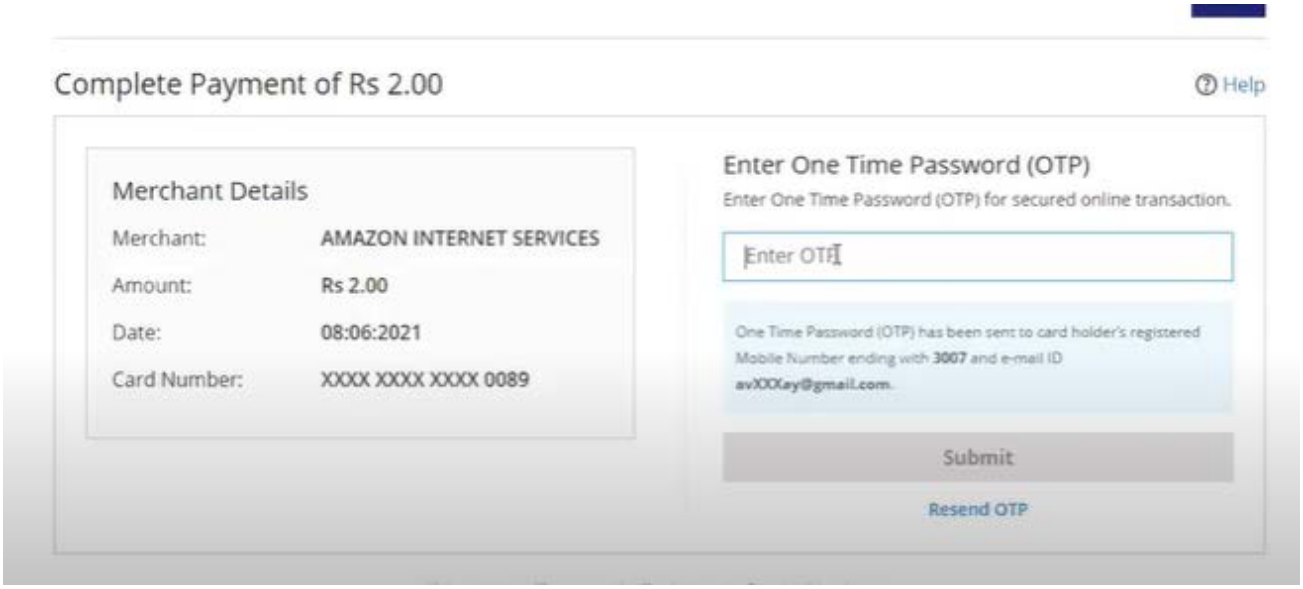
   Then select **“Create account and continue”** button.



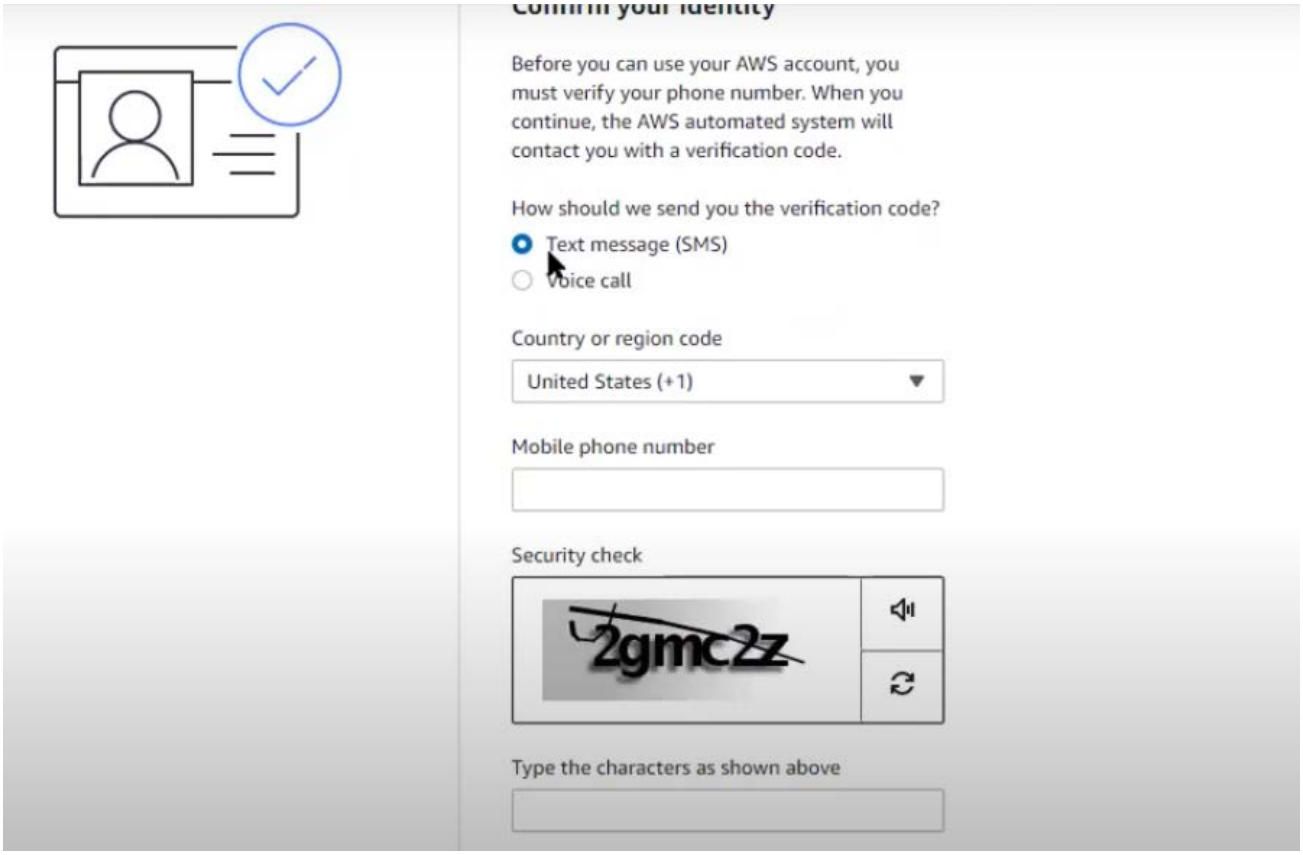


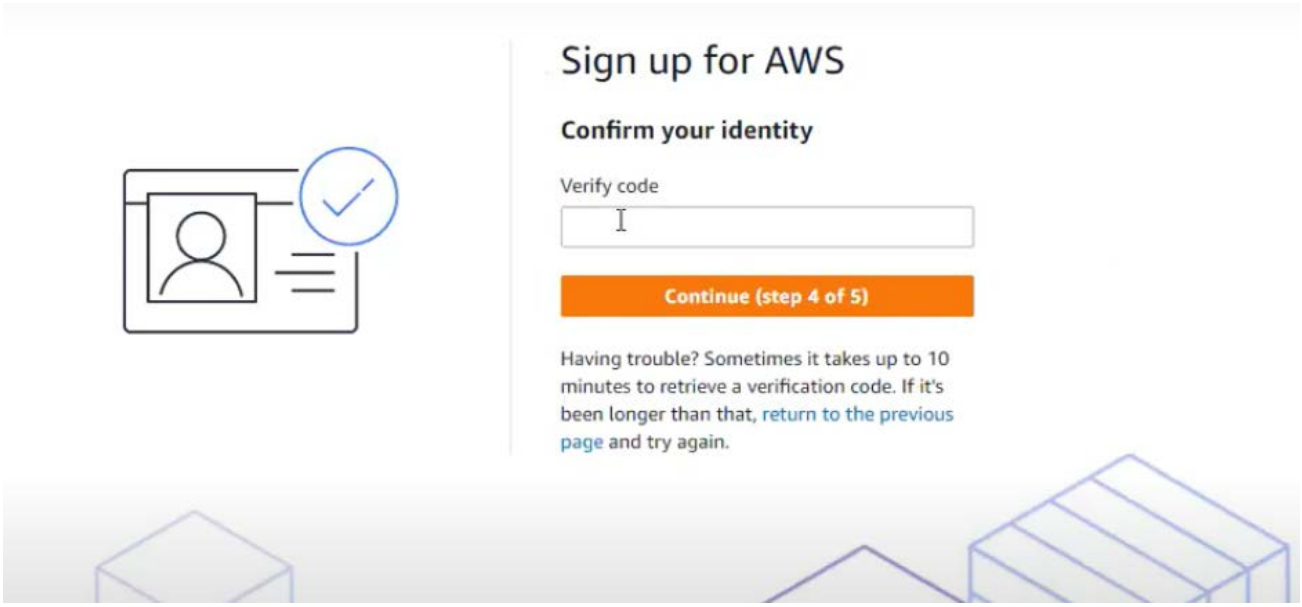
5. You have to enter your payment information. AWS will accept Credit/Debit Card (Visa /Mastercard /Americal express).
   As part of payment details verification process amazon will deduct INR 2 from your account. However this amount will refunded once your card has been validated.





6. In Step 6, we have to perform “Identity verification” and to complete this step you need to have a valid Phone number with you.
    a. Enter the valid phone number, captcha and press “Call me now” button.
    b. When you click on call me now option, you will get a 4 digit PIN on your phone and simultaneously you will get a phone call from AWS to the mentioned phone number.
    c. You have to enter the 4 digit pin number on the IVR call, then your Identity verification is going to complete.
7. Or we can confirm the identity by Receiving a OTP from AWS, Choose the **“Text message (SMS)”** option, choose Country code, Enter a Valid phone number and displayed captcha.



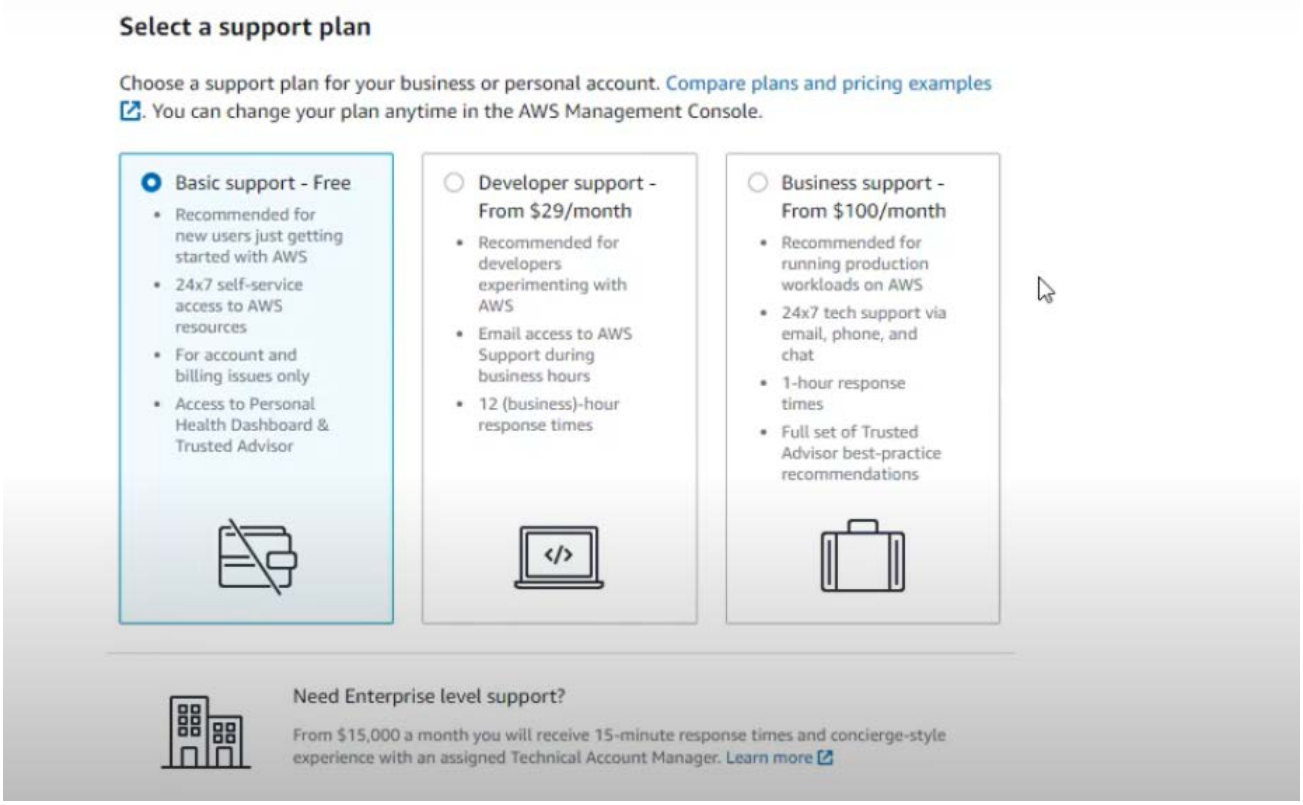


8. After completing the Identity verification, we have to select the “Support Plan” and click on “Continue”.
   Amazon have 4 support plans, those are

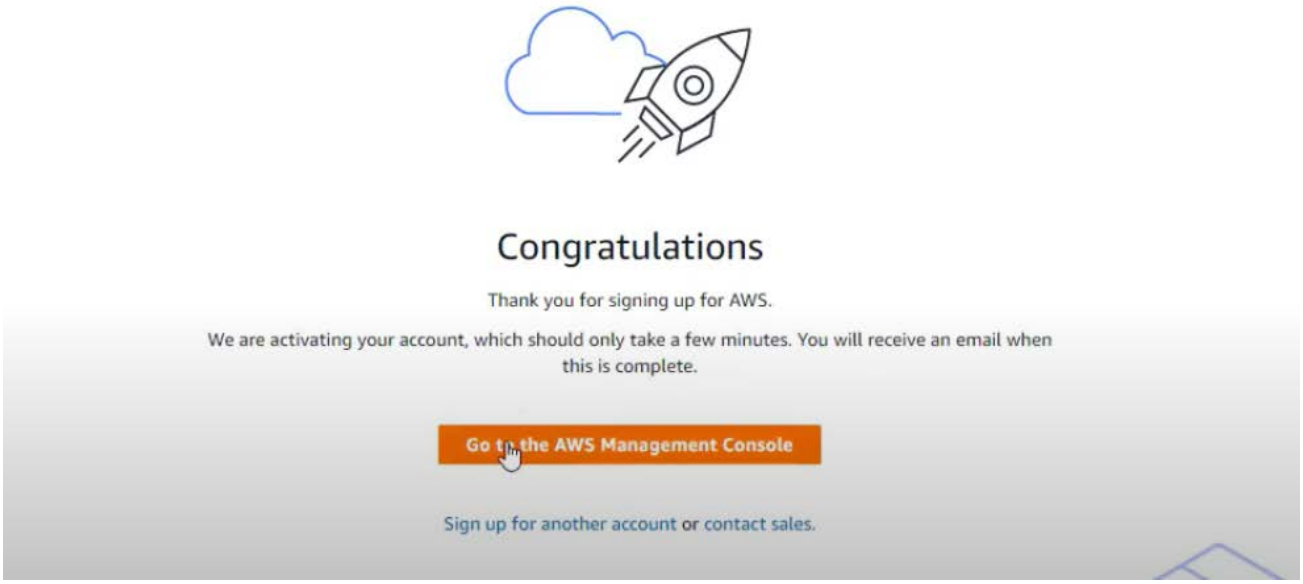
   a. **Basic:** No Monthly Pricing for Basic support plan and no option to get technical support from Amazon if you are facing any.
   b. **Developer:** Starting at $29/month and **one primary contact** may ask technical questions through support center and your issue will address within 12-24 hours during local business hours.

c. **Business:** Starting at $100/month and 24x7 access to Cloud Support Engineers via email, chat, and phone. 1 hour response to urgent support cases.
d. **Enterprise:** Starting at $15,000/month and you will get thee business support plan benefits along with Operational reviews, recommendations, and reporting, Designated Technical Account Manager, Access to online self-paced labs and Assigned Support Concierge.

Note: You can change this support plan at any time by logging in with Root account. You can "Support Center" under "support" navigation pane. Then click on change button and select the required support plan. We can use "Basic Support Plan" to explore the AWS features.



9. We have completed the AWS Account creation process select the **"Launch Management Console"**and Select **"Sign in to the console"**



10. Now you can enter the Email id and Password to login to your AWS account.

AWS basically offers usage of certain of its products at no charge for a period of 12months from the date of the actual signup.

AWS Product	What's free?
Amazon EC2	750 hours per month of Linux micro instance usage 750 hours per month of Windows micro instance usage
Amazon S3	5 GB of standard storage 20,000 get requests 2,000 put requests
Amazon RDS	750 Hours of Amazon RDS Single-AZ micro instance usage 20 GB of DB Storage: any combination of general purpose (SSD) or magnetic 20 GB for backups 10,000,000 I/Os
Amazon ELB	750 hours per month 15 GB of data processing

For complete list of free tier eligibility products, please refer https://aws.amazon.com/free/

IAM

(IDENTITY AND ACCESS MANAGEMENT)

Root User

When you first create an Amazon Web Services (AWS) account, you begin with a single sign-in identity that has complete access to all AWS services and resources in the account. This identity is called the AWS account root user and is accessed by signing in with the email address and password that you used to create the account.

- The "root account" is simply the account created when first setup your AWS account. It has complete Admin access on your account.

AWS strongly recommend that you do not use the root user for your everyday tasks, even the administrative ones. Instead of using the root user we can create IAM user and allocates the appropriate permissions for the IAM user.

IAM:

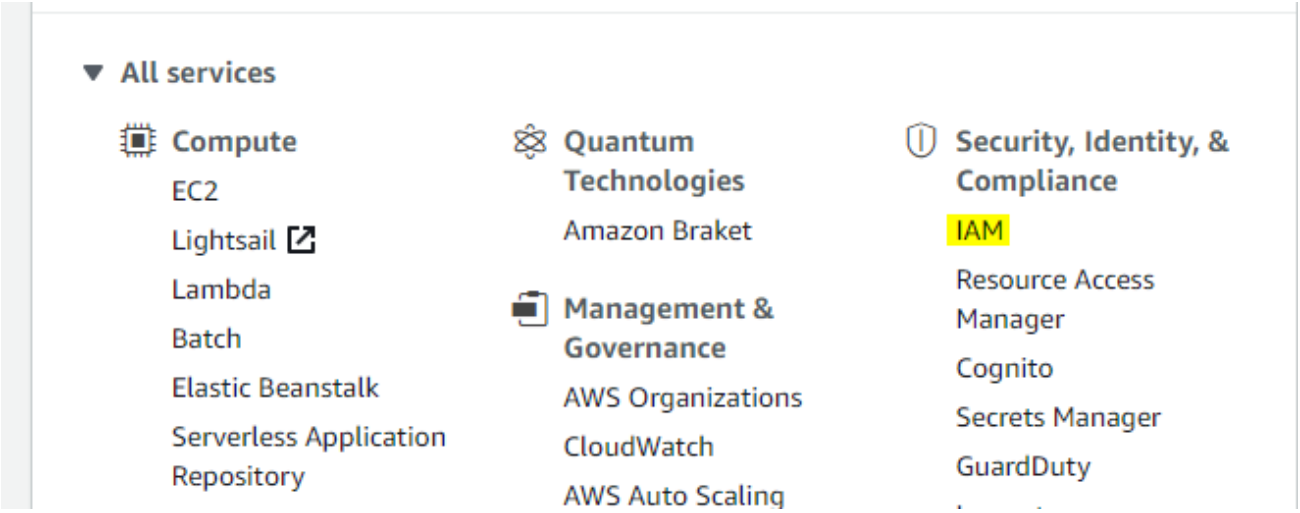
IAM stands for Identity and Access Management (IAM). IAM is a web service that helps you securely control access to AWS resources for your users. We can use IAM to control who can use our AWS resources and how they can use resources.

IAM Features:

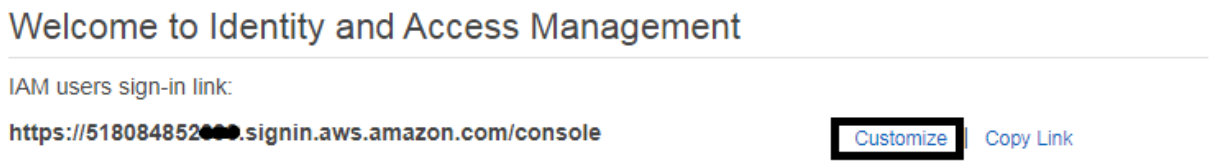
- You can provide Shared Access to your AWS account
- You can grant different permissions to different people for different resources.
- IAM allows you to manage users and their level of access to AWS console.
- IAM is universal. It does not apply to regions.
- You can enable Multi-factor authentication (MFA) for your AWS account
- IAM allows you to set up your own password rotation policy
- Integrates with many different AWS services

Steps to Create an IAM user:

1. Login with the root Account credentials and find the **"IAM"** under **"Security, Identity & Compliance"**

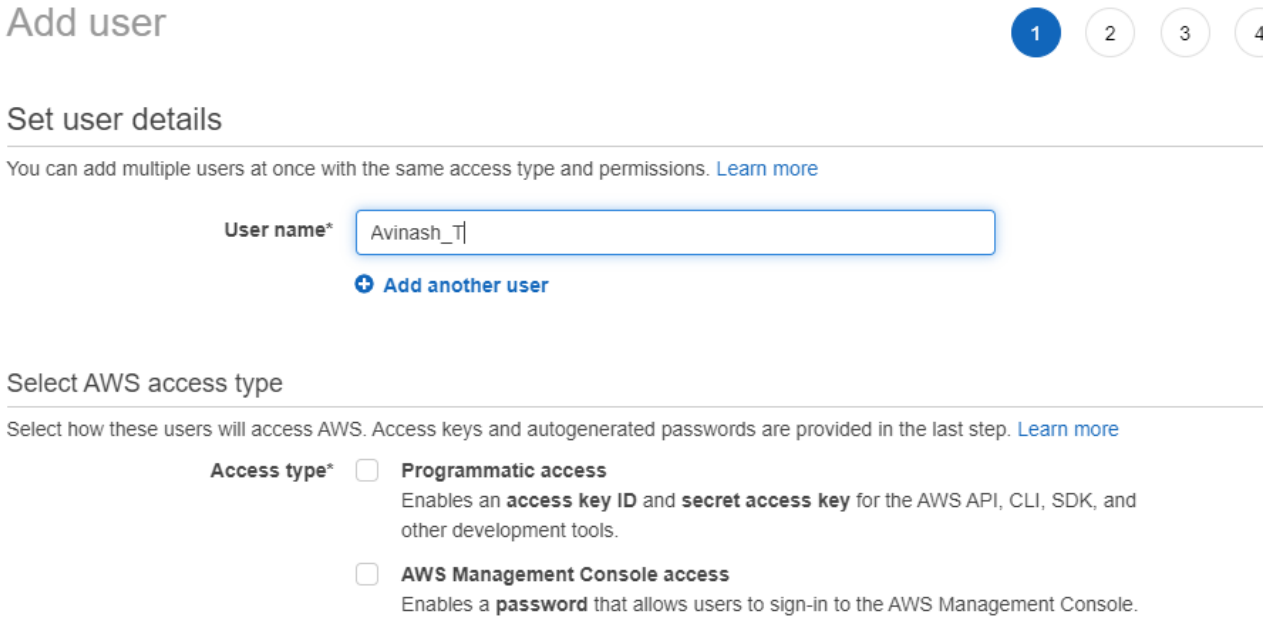


2. IAM users have to sign-in using a dedicated Sign-In link. Every AWS account user will get a 12 Digit account number, that 12 digit number will be displayed on the Sign-In link, if you don't want to expose the account Number you can give an Alias name. For that select the **"customize"** option in IAM dashboard.



- Alias name must be unique over the globe.

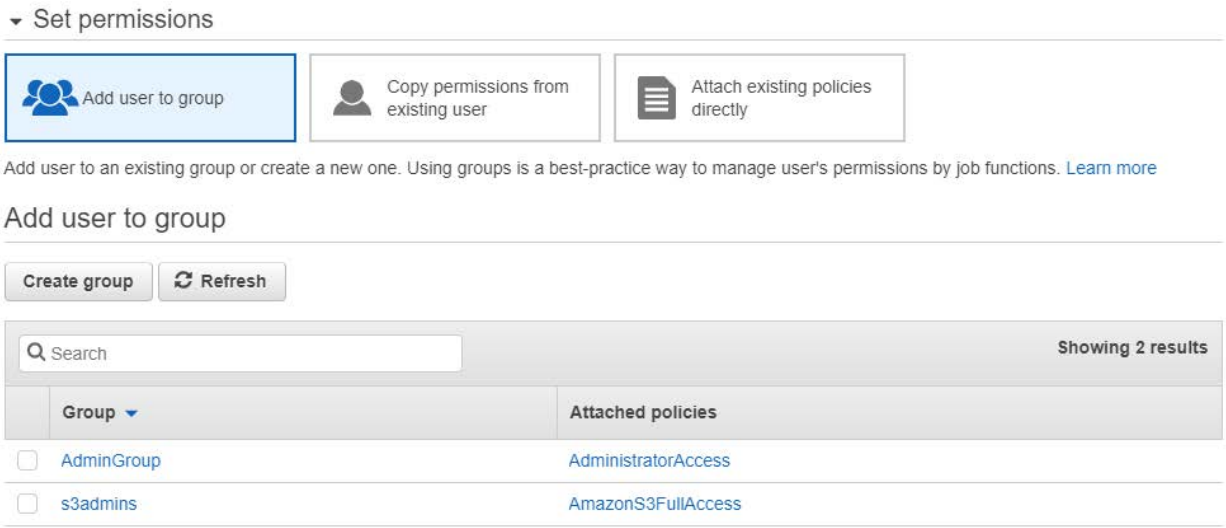
3. To create a new IAM user, Please select **"Users"** option under IAM Resources and Select **"Add User"** option.



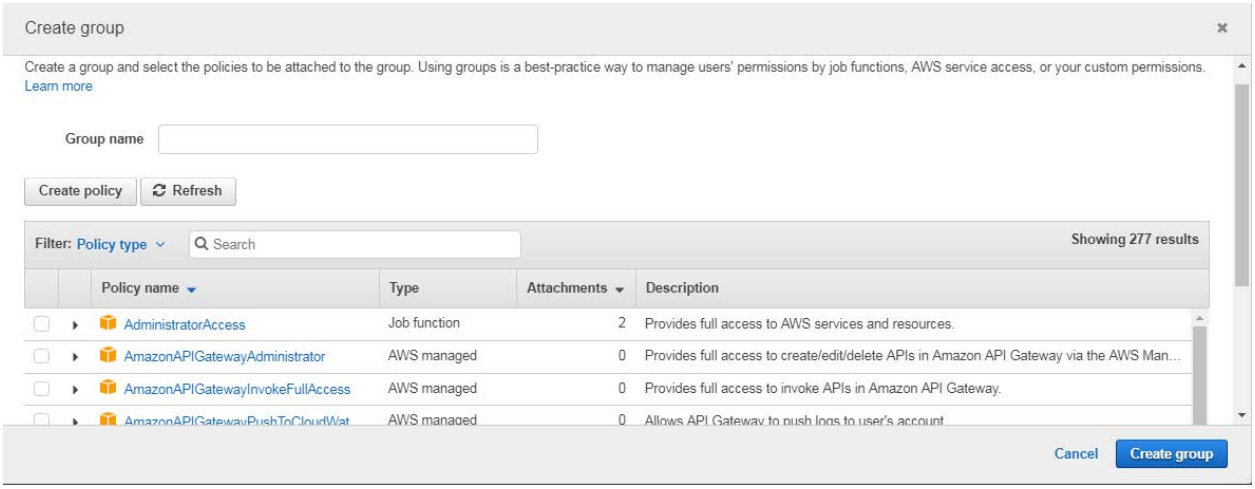
- We need to provide a "user name" for the newly creating IAM user. This username must be unique with-in your AWS account.
- Then you have to select AWS access type. We have two types of the access types
  - **Programmatic access:** This Enables the access to your AWS account by AWS API, CLI, SDK, and other development tools. You will get an access key ID and secret access key if you select this access type.
  - **AWS Management Console access:** This enables users to sign-in to the AWS Management Console i.e; Web Browser. You will get a username and password to login.
- If you select "**AWS Management Console access"** you have to get a password by **"Auto generated password"** or **"Custom password"** option.
- You can select the **"Require password reset option"** tick box if you want IAM user to create a new password at next sign-in.

4. By default IAM users will create with **NO Permissions**. If you want to allocate certain level of permission on any of the AWS resource, you have to attach/apply policy to the user.
    - You can directly Attach one or more existing policies directly to the users or create a new policy
    - If you have any existing user with policies you can select the user, same permissions will apply for the newly created user also.
    - Or, you can create a group allocate the policy on top of the group, then you can add this IAM user to that group. Creating group will eases the administration.
5. To create a group, select the **"Create a Group"** option and you will get a pop-up to select the policy. You can filter the policies based on your requirement and select.
   Here is some key policies, you have to remember

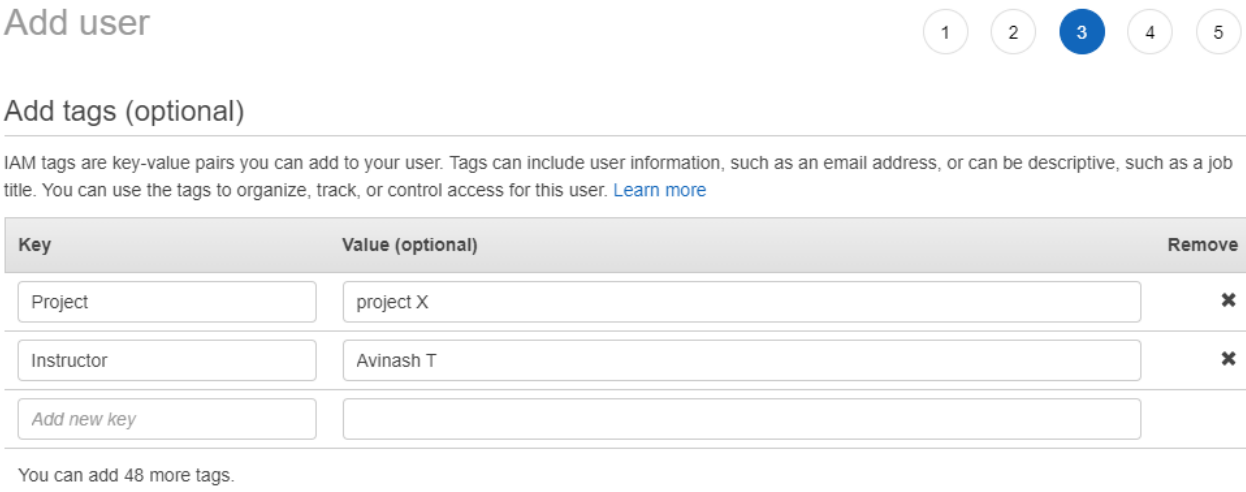
    - **AdministratorAccess:** Provides full access to AWS services and resources Except Billing and Account management. He can create/delete an IAM user or Groups.
    - **PowerUserAccess:** Provides full access to AWS services and resources, but does not allow management of Users and groups. He can launch any resource but doesn't have any permission to create a new user, group or deleting an existing user.
    - **ReadonlyAccess:** Provides Read Only access on all AWS services and resources.



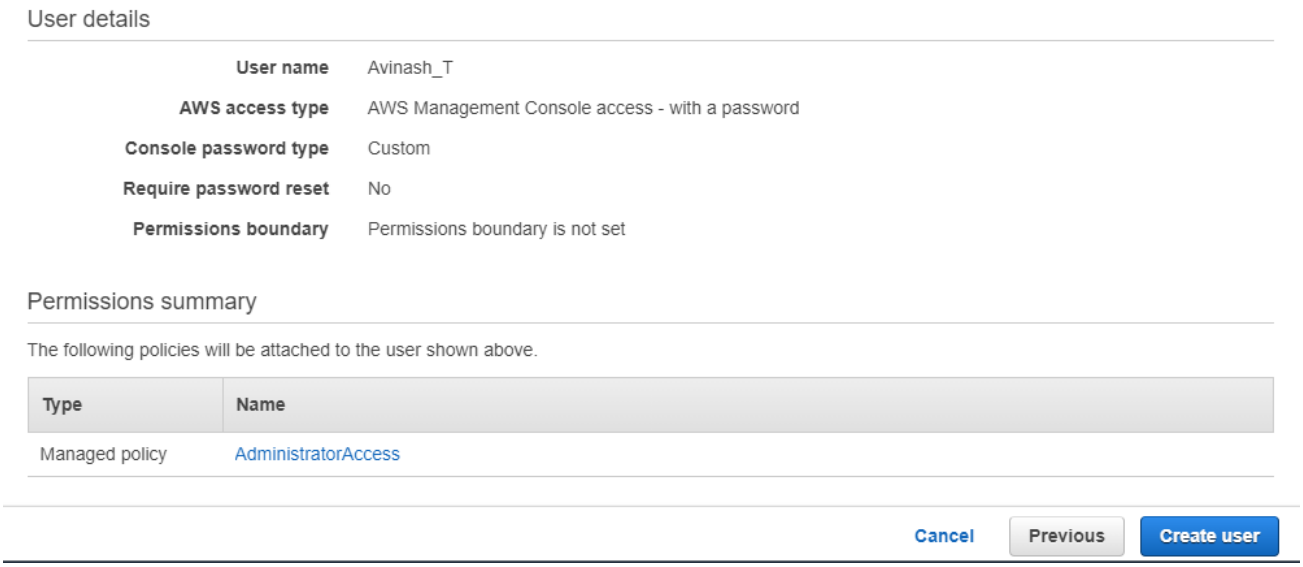
To Create group, use the **"Create Group"** option and choose the required policy. Permissions managed at group level, not at user level.



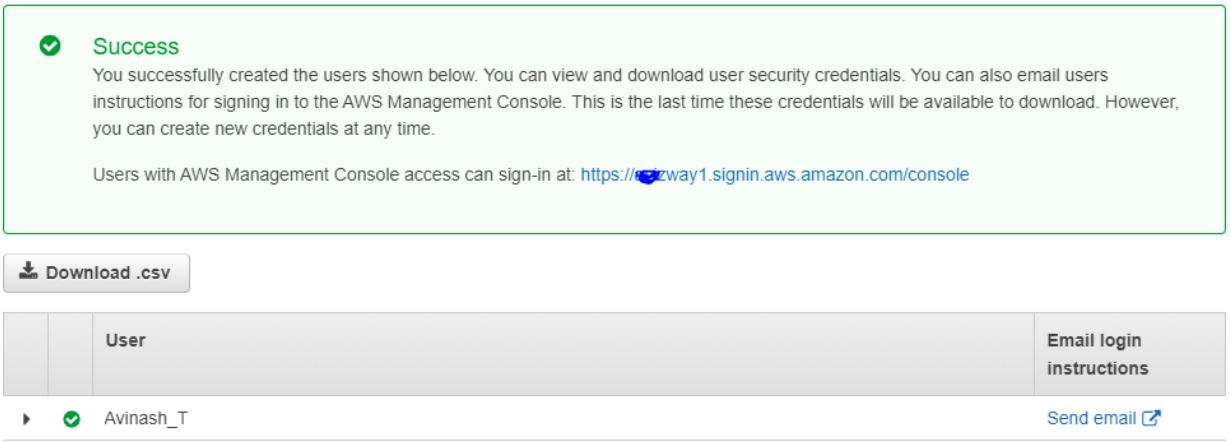
6. Add required tags. Tag allow us to add metadata to the AWS resources.



7. Review the screen and click on **"Create User"** option. New IAM user will create and you can send the credentials directly to the user by using "Send Email" option.



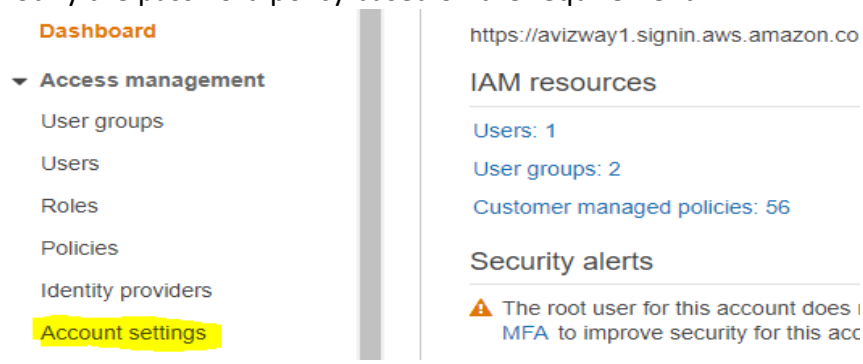
8. You can download the Credentials.csv file and keep it in a secured location.

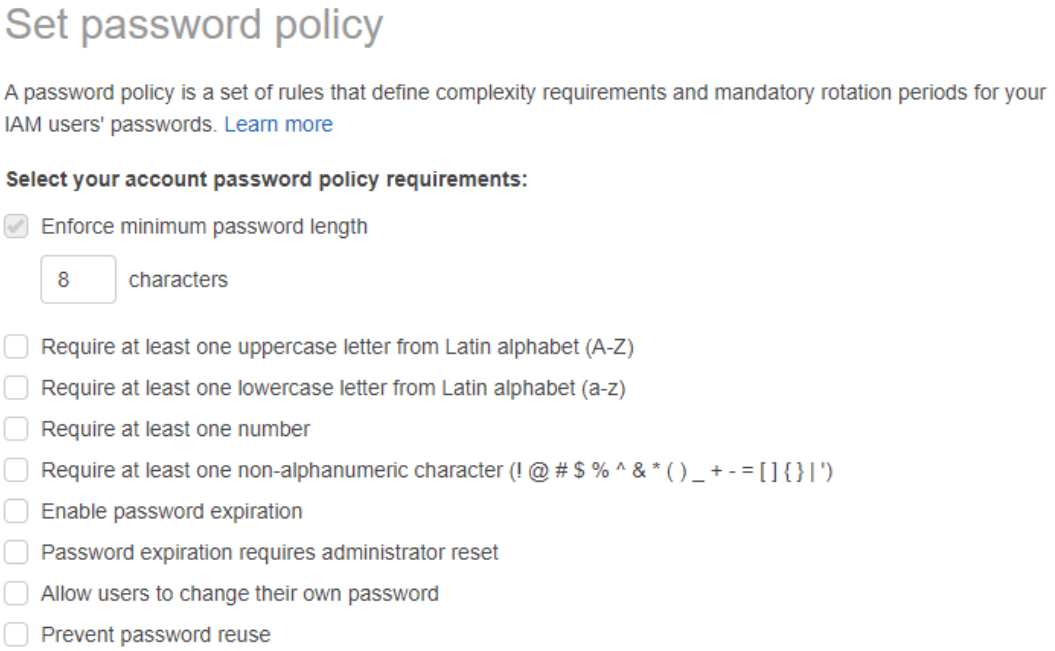


9. By using the mentioned IAM sig-in URL, this newly created IAM user can login to AWS console.

Setup own password policy:

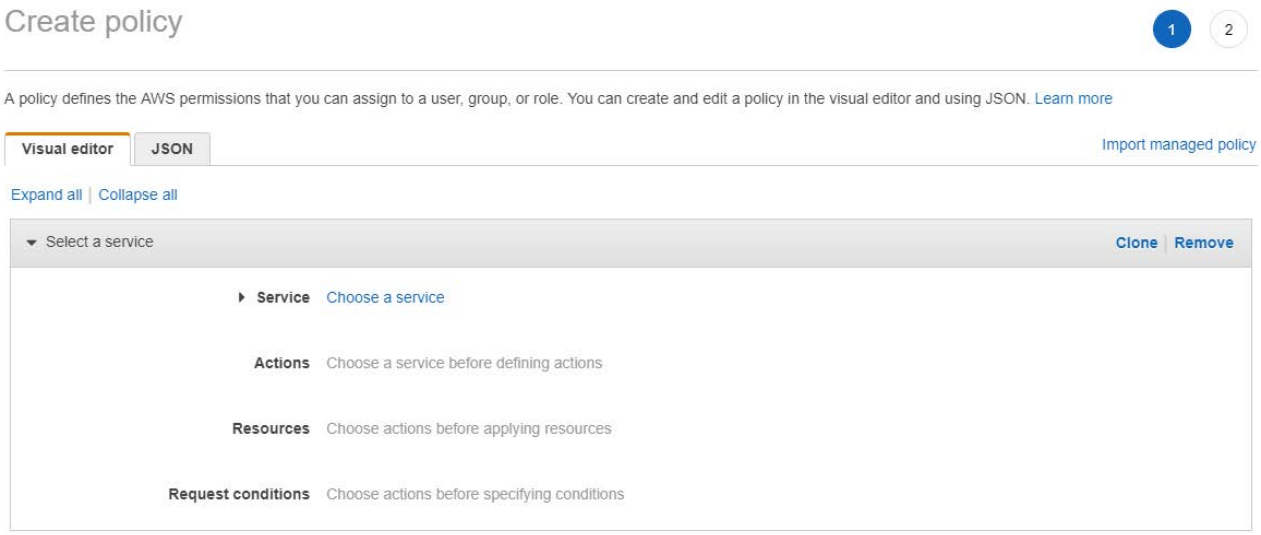
A password policy is a set of rules that define the type of password an IAM user can set. You can set the password complexity to secure your AWS account from easily guessable passwords. You can modify the password policy based on the requirement.





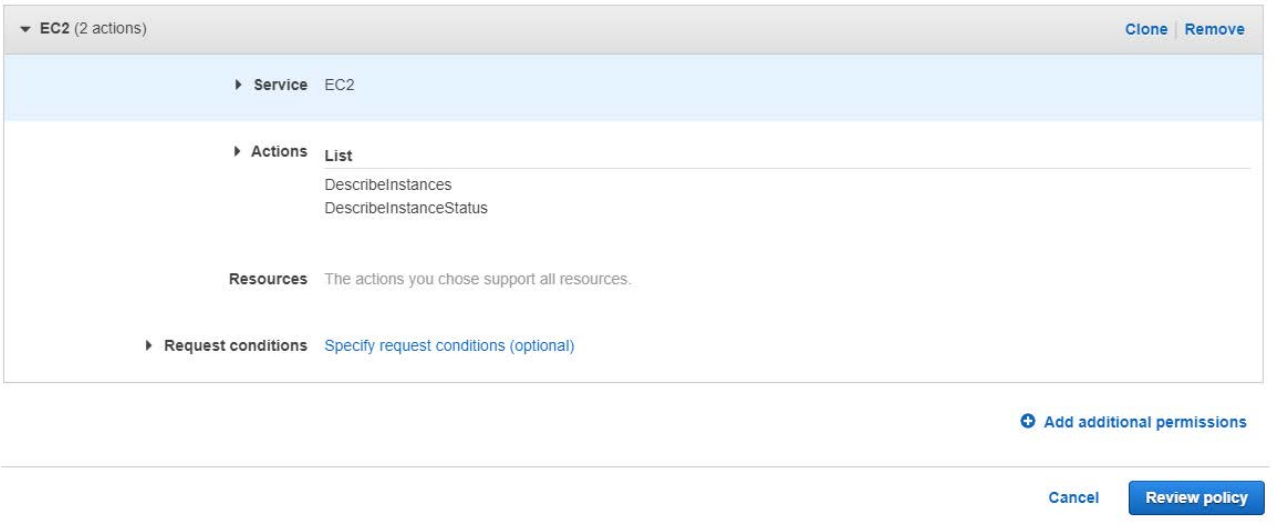
Create a custom policy for allocating custom permissions for an IAM user.

1. Navigate to Policy option on IAM, and **"Create Policy"** Then choose visual editor option for easy policy creation. We can even create in JSON format.

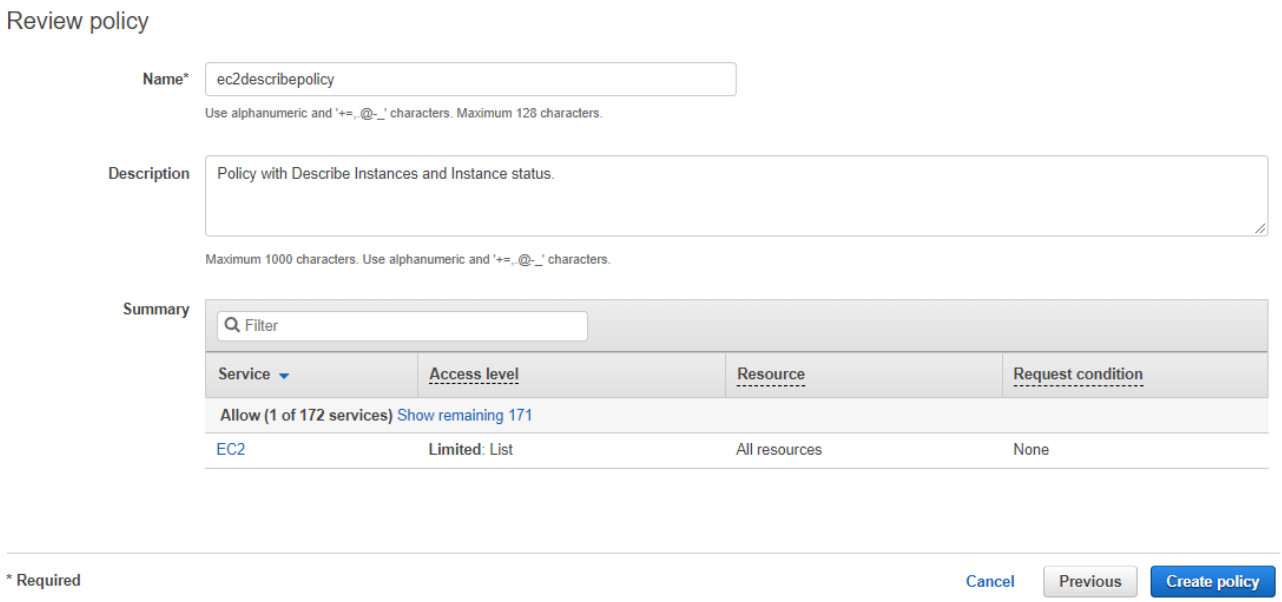


2. Now choose the Service, Actions on the required Resources.

3. In this example, am allocating "Describe Instances" and "DescribeInstanceStatus" actions. IAM user who allocated with this policy just can Get information about the Instances, but he cannot perform any operation on ec2 insatnces.



4. Review the Policy and Create with valid name and Description.



EXERCISE 1

Create an IAM Group

Create a group for all IAM administrator users and assign the proper permissions to the new group. This will allow you to avoid assigning policies directly to a user later in these exercises.

1. Log in as the root user.
2. Create an IAM group called Administrators.
3. Attach the managed policy, IAM Full Access, to the Administrators group.

EXERCISE 2

Create a Customized Sign-In Link and Password Policy

In this exercise, you will set up your account with some basic IAM safeguards. The password policy is a recommended security practice, and the sign-in link makes it easier for your users to log in to the AWS Management Console.

1. Customize a sign-in link, and write down the new link name in full.
2. Create a password policy for your account.

EXERCISE 3

Create an IAM User

In this exercise, you will create an IAM user who can perform all administrative IAM functions. Then you will log in as that user so that you no longer need to use the root user login. Using the root user login only when explicitly required is a recommended security practice (along with adding MFA to your root user).

1. While logged in as the root user, create a new IAM user called Administrator.
2. Add your new user to the Administrators group.
3. On the Details page for the administrator user, create a password.
4. Log out as the root user.
5. Use the customized sign-in link to sign in as Administrator.

EXERCISE 4

Set Up MFA

In this exercise, you will add MFA to your IAM administrator. You will use a virtual MFA application for your phone. MFA is a security recommendation on powerful accounts such as IAM administrators.

1. Download the AWS Virtual MFA app to your phone.
2. Select the administrator user, and manage the MFA device.
3. Go through the steps to activate a Virtual MFA device.
4. Log off as administrator.
5. Log in as administrator, and enter the MFA value to complete the authentication process.

EXERCISE 5

Create a custom policy and associate with an IAM user.

In this exercise, you will create an IAM policy and associate with an IAM user to verify the custom permissions.

1. Create an IAM User.
2. Associate “ec2describe policy” to newly created IAM user.
3. Login as an IAM user and Navigate to ec2 dashboard and check the permissions.

S3 (SIMPLE STORAGE SERVICE)

Introduction to S3

Amazon S3 is one of first services introduced by AWS. Amazon S3 provides developers and IT teams with secure, durable, and highly-scalable cloud storage. Amazon S3 is easy-to-use object storage with a simple web service interface that you can use to store and retrieve any amount of data from anywhere on the web. Amazon S3 also allows you to pay only for the storage you actually use, which eliminates the capacity planning and capacity constraints associated with traditional storage.

Block storage operates at a lower level, the raw storage device level and manages data as a set of numbered, fixed-size blocks. Object storage or File storage operates at a higher level, the operating system level, and manages data as a named hierarchy of files and folders.

- S3 is Object based i.e. allows you to upload, Download, Share files.
- All our Objects reside in containers called **buckets.**
- S3 is a universal namespace that means **name of your bucket must be unique globally**.
- Amazon S3 is cloud object storage. Instead of being closely associated with a server, Amazon S3 storage is independent of a server and is accessed over the Internet.
- You can create and use multiple buckets; you can have up to **100 per account by default,** this is a soft limit, you can increase this at any time by creating a service limit increase ticket with AWS.
- File Size can be from 0/1 Byte to 5TB
- Single bucket can store an unlimited number of files.
- You can create buckets in your nearby region which is located close to a particular set of end users or customers in order to minimize latency.
- Or, Create bucket and store data far away from your primary facilities in order to satisfy disaster recovery and compliance needs
- Amazon S3 objects are automatically replicated on multiple devices in multiple facilities within a region
- Every Amazon S3 object can be addressed by a unique URL i.e;
  https://s3-region.amazonaws.com/uniquebucketName/objectname
- You can access using this URL also, We call it as Virtual Path (It won't work if we have . in bucket name)
  http://mybucket.s3.amazonaws.com/document.doc
  http://bucket.s3-awsregion.amazonaws.com
- Bucket names must be at least 3 and no more than 63 characters long
- Bucket names must not be formatted as an IP address (e.g., 192.168.32.1).

Invalid Bucket Name	Comment
.myawsbucket	Bucket name cannot start with a period (.).
myawsbucket.	Bucket name cannot end with a period (.).
my..examplebucket	There can be only one period between labels

S3 Storage classes:

S3-Standard – Amazon S3 Standard offers high durability, high availability, low latency, and high performance object storage for general purpose use. 99.99% availability, 99.999999999% durability, stored redundantly across multiple devices in multiple facilities and is designed to sustain the loss of 2 facilities concurrently.

Amazon S3 Intelligent-Tiering (S3 Intelligent-Tiering) - The S3 Intelligent-Tiering storage class is designed to optimize costs by automatically moving data to the most cost-effective access tier, without performance impact or operational overhead. It works by storing objects in two access tiers: one tier that is optimized for frequent access and another lower-cost tier that is optimized for infrequent access.

- Designed for durability of 99.999999999% of objects across multiple Availability Zones
- Designed for 99.9% availability over a given year
- Automatically moves objects between two access tiers based on changing access patterns
- Small monthly monitoring and auto-tiering fee

S3 - IA (Infrequently Accessed) For data that is accessed less frequently, but requires rapid access when needed. Lower fee than S3, but you are charged a retrieval fee. Min Obj Size is 128Kb.

- Designed for durability of 99.999999999% of objects across multiple Availability Zones
- Designed for 99.9% availability over a given year
- Lower Price than S3 Standard
- Designed for storing less frequently accessed data.
- Minimum duration 30 days
- Retrieval charges applicable

S3 One Zone-Infrequent Access - S3 One Zone-Infrequent Access (S3 One Zone-IA; Z-IA) is a new storage class designed for customers who want a lower-cost option for infrequently accessed data, but do not require the multiple Availability Zone data resilience model of the S3 Standard and S3 Standard-Infrequent Access (S3 Standard-IA; S-IA) storage classes. S3 One Zone-IA is intended for use cases with infrequently accessed data that is re-creatable, such as storing secondary backup copies of on-premises data or for storage that is already replicated in another AWS Region for compliance or disaster recovery purposes. With S3 One Zone-IA, customers can now store infrequently accessed data within a single Availability Zone at 20% lower cost than S3 Standard-IA.

- Same low latency and high throughput performance of S3 Standard and S3 Standard-IA.
- Designed for durability of 99.999999999% of objects in a single Availability Zone, but data will be lost in the event of Availability Zone destruction.
- Designed for 99.5% availability over a given year.

Reduced Redundancy Storage - Designed to provide 99.99% durability and 99.99% availability of objects over a given year. It is most appropriate for derived data that can be easily reproduced, such as image thumbnails.

Glacier - Amazon Glacier is an extremely low-cost storage service that provides durable, secure, and flexible storage for data archiving and online backup. Storage class offers secure, durable, and extremely low-cost cloud storage for data that does not require real-time access, such as archives and long-term backups.

- **Archives:** In Amazon Glacier, data is stored in archives. An archive can contain up to **40TB** of data, andyou can have an unlimited number of archives.
- **Vaults:**Vaults are containers for archives. Each AWS account can have up to 1,000 vaults.
- After requesting for data three to five hours later, the Amazon Glacier object is copied to Amazon S3 RRS.
- Amazon Glacier allows you to retrieve up to 5% of the Amazon S3 data stored in Amazon Glacier for free each month.

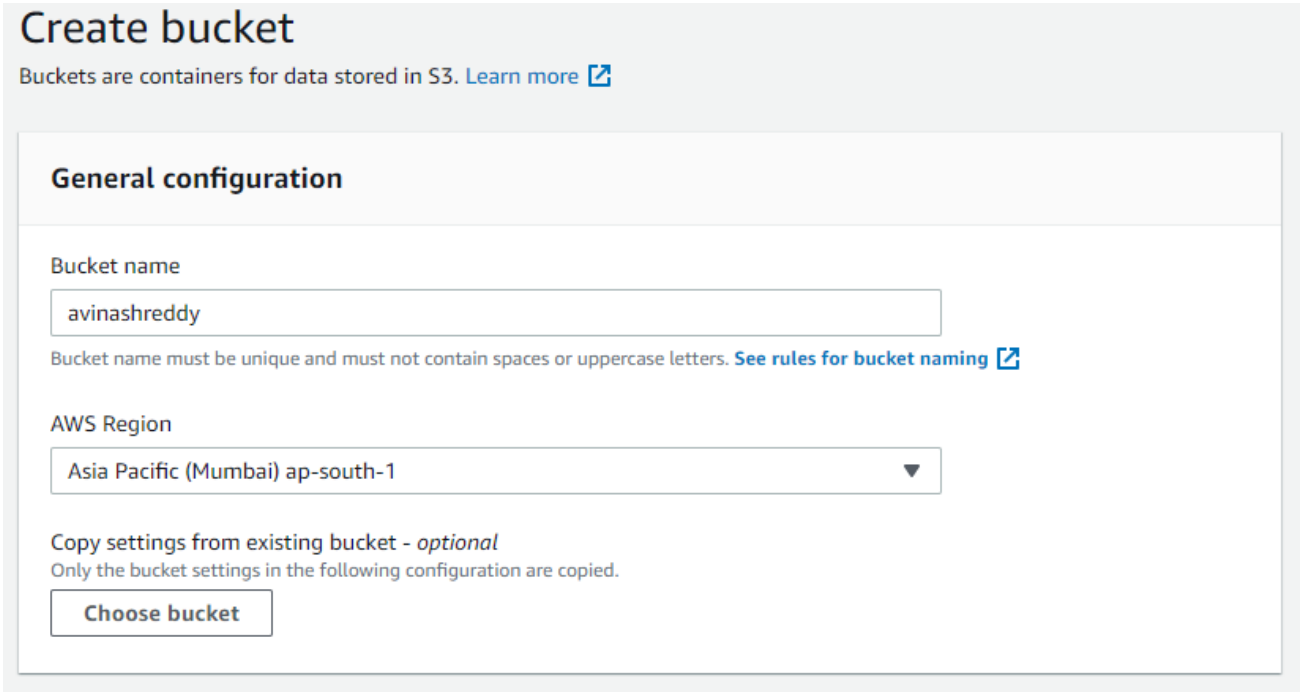
Glacier Deep Archieve : The new Glacier Deep Archive storage class is designed to provide durable and secure long-term storage for large amounts of data at a price that is competitive with off-premises tape archival services. Data is stored across 3 or more AWS Availability Zones and can be retrieved in 12 hours or less.

	Storage class	Designed for	Availability Zones	Min storage duration
◉	Standard	Frequently accessed data	≥ 3	-
○	Intelligent-Tiering	Long-lived data with changing or unknown access patterns	≥ 3	30 days
○	Standard-IA	Long-lived, infrequently accessed data	≥ 3	30 days
○	One Zone-IA	Long-lived, infrequently accessed, non-critical data	1	30 days
○	Glacier	Long-term data archiving with retrieval times ranging from minutes to hours	≥ 3	90 days
○	Glacier Deep Archive	Long-term data archiving with retrieval times within 12 hours	≥ 3	180 days
○	Reduced redundancy	Frequently accessed, non-critical data	≥ 3	-

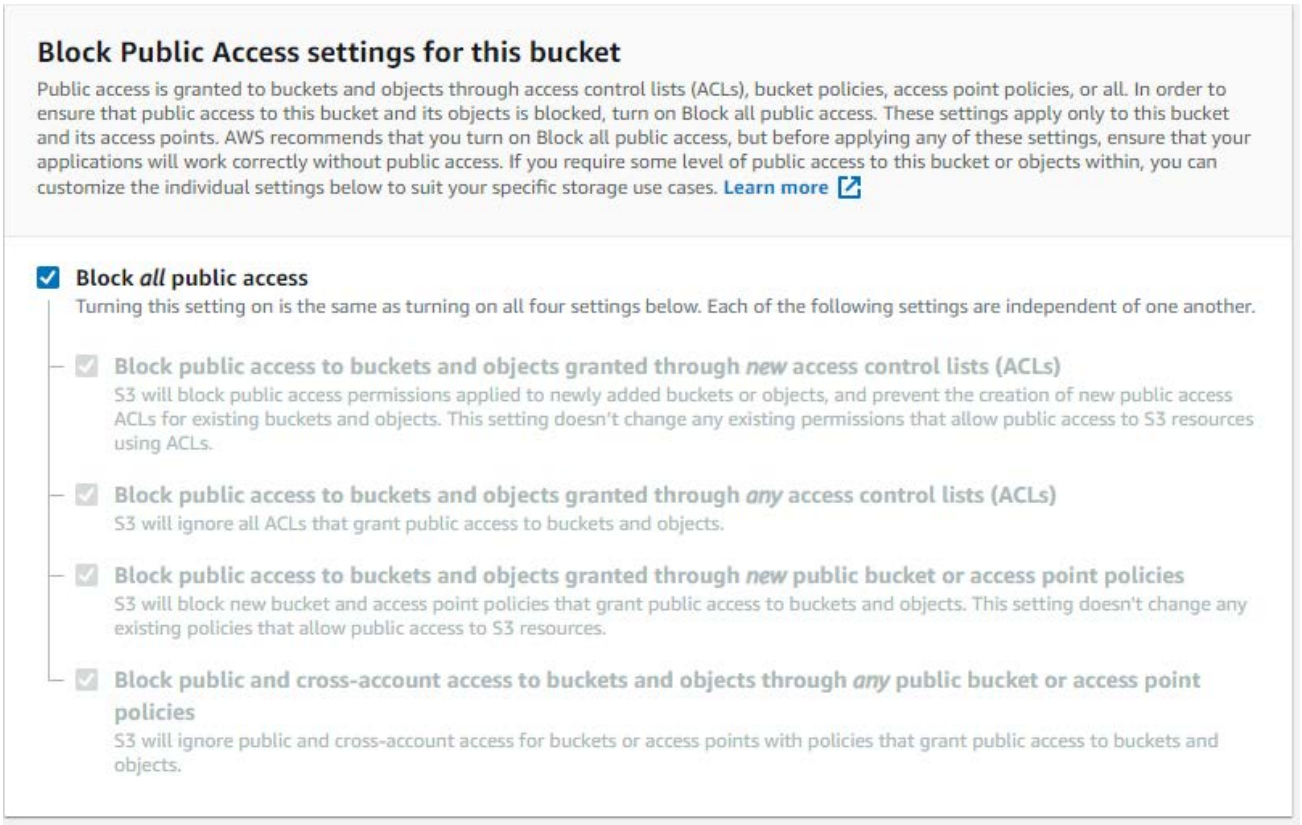
Availability and Durability chart

	S3 Standard	S3 Intelligent-Tiering*	S3 Standard-IA	S3 One Zone-IA†	S3 Glacier	S3 Glacier Deep Archive**
Designed for durability	99.999999999% (11 9's)	99.999999999% (11 9's)	99.999999999% (11 9's)	99.999999999% (11 9's)	99.999999999% (11 9's)	99.999999999% (11 9's)
Designed for availability	99.99%	99.9%	99.9%	99.5%	N/A	N/A
Availability SLA	99.9%	99%	99%	99%	N/A	N/A
Availability Zones	≥3	≥3	≥3	1	≥3	≥3
Minimum capacity charge per object	N/A	N/A	128KB	128KB	40KB	40KB
Minimum storage duration charge	N/A	30 days	30 days	30 days	90 days	180 days
Retrieval fee	N/A	N/A	per GB retrieved	per GB retrieved	per GB retrieved	per GB retrieved
First byte latency	milliseconds	millseconds	milliseconds	milliseconds	select minutes or hours	select hours
Storage type	Object	Object	Object	Object	Object	Object
Lifecycle transitions	Yes	Yes	Yes	Yes	Yes	Yes

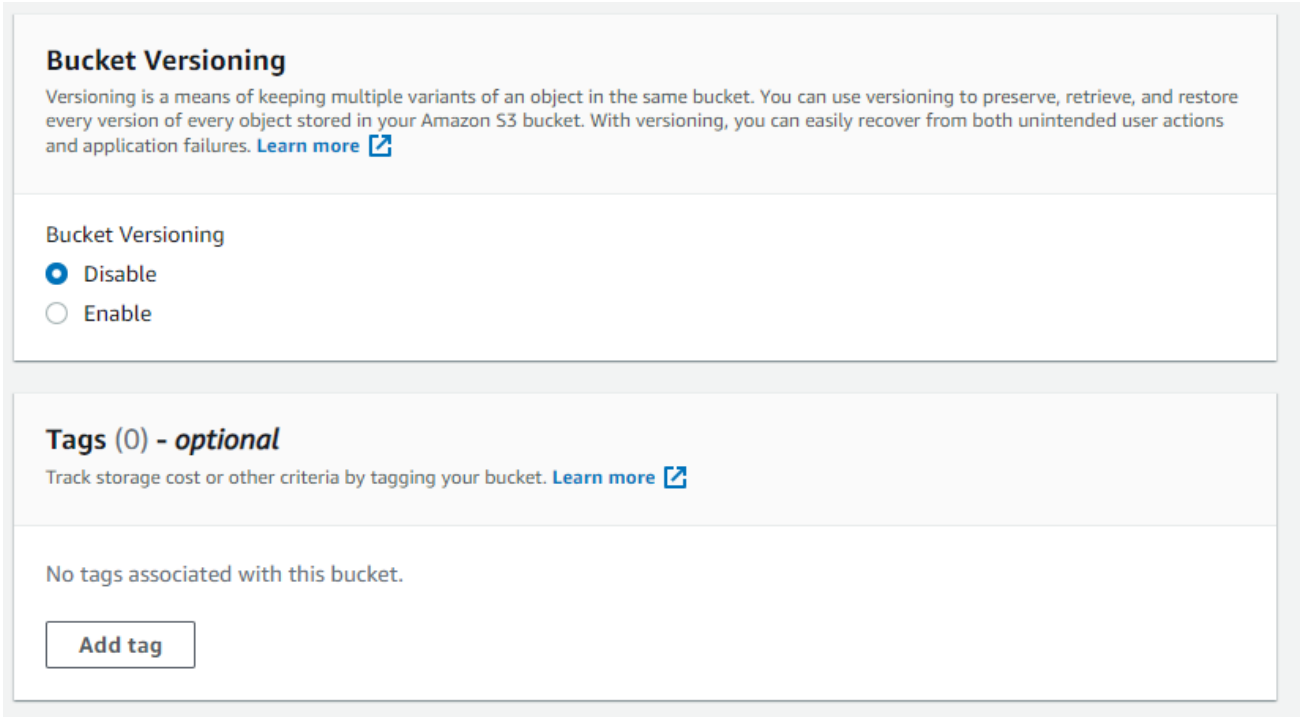
S3 Bucket Creation:



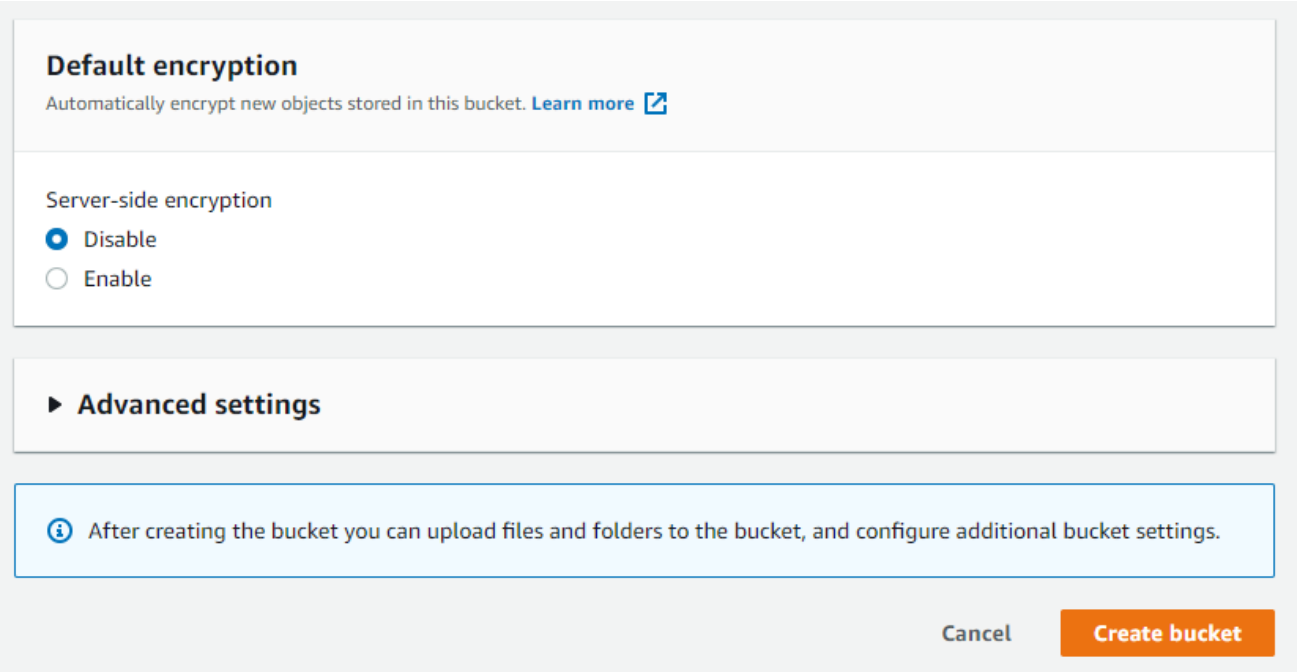
- Choose a Valud bucket name by following the bucket naming limitations.
- Bucket data physically resides in the selected region.



- If you want to make any data “publicly accesable” we need to disable the above option. If this option is enabled we cannot make any data public.



- Add prropriate tags (based on project/organization standards)



- After selection of files, we can give access to other users who requiredpermissions.
- We can Manage Public Permissions or give permissions for other AWS account users.
- Here we can select the object Properties, We can select the Object storage class of the object, Encryption methods, Metadata and tags for the object.
- Then we can review and click on upload option to upload the object into S3 bucket.

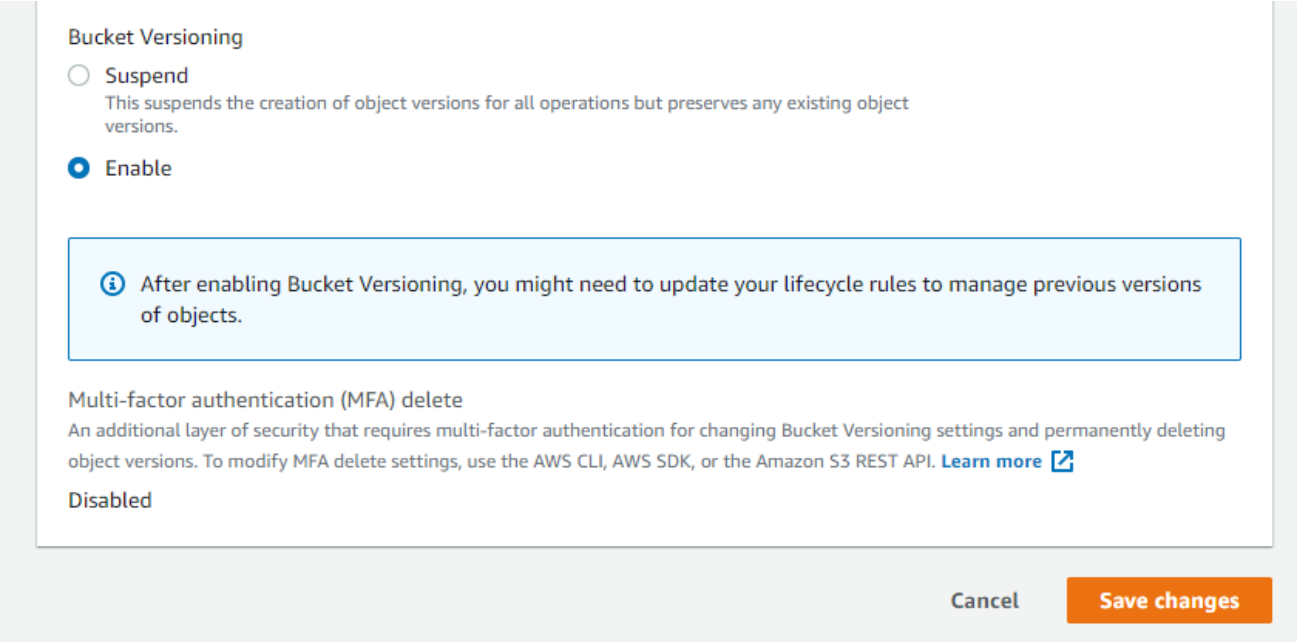
Versioning

We can use the S3 Versioning feature to preserve, retrieve, and restore every version of every object stored in our buckets. With versioning we can recover more easily from both unintended user actions and application failures. After versioning is enabled for a bucket, if Amazon S3 receives multiple write requests for the same object simultaneously, it stores all of those objects.

- Versioning is turned on at the bucket level.
- Once enabled, versioning cannot be removed from a bucket; it can only be suspended.
- If you enable versioning you will get Current version files and previous version files in your bucket.
- If you delete current version file, if will overwrite with a Delete Marker, if you want to get that object back to you S3 bucket, you can delete the delete marker.

If you delete an object, Amazon S3 inserts a delete marker instead of removing the object permanently. The delete marker becomes the current object version. If you overwrite an object, it results in a new object version in the bucket. You can always restore the previous version.

To enable versioning on bucket, navigate to properties of the respective bucket and select versioning, click on edit and select “Enable versioning” option.



Lifecycle Management

By using Life cycle management we can automate the storage tiers in s3 buckets.

We can move objects from one storage class/tier to another storage class/tier based on our business requirements.

Here is the possible scenarios:

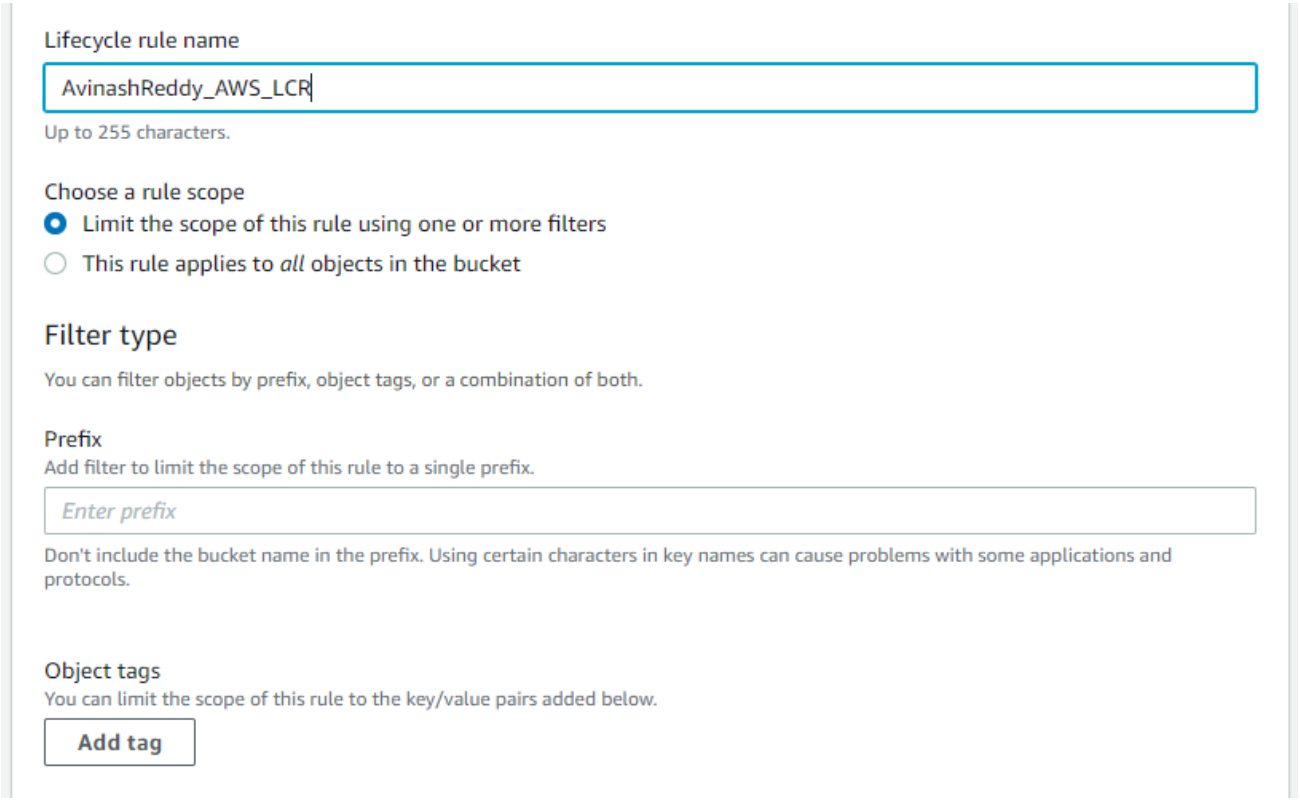
S3-Standard → S3-IA/OneZone-IA/Intelligent tier → Glacier / Glacier Deep Archieve → Delete

S3-Standard → Glacier/Glacier Deep archieve → Delete

S3-Standard → Delete

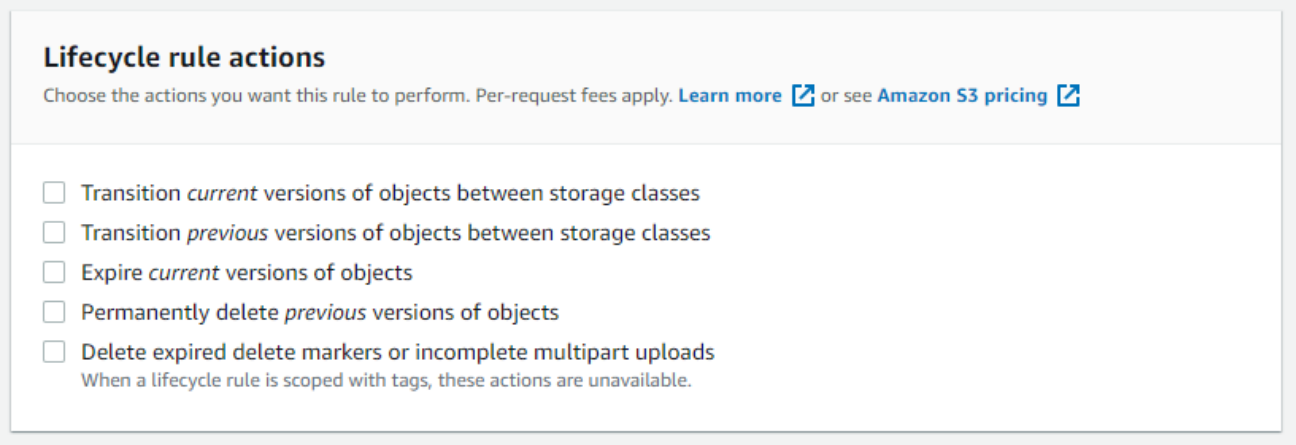
Steps to enable lifecycle management rules:

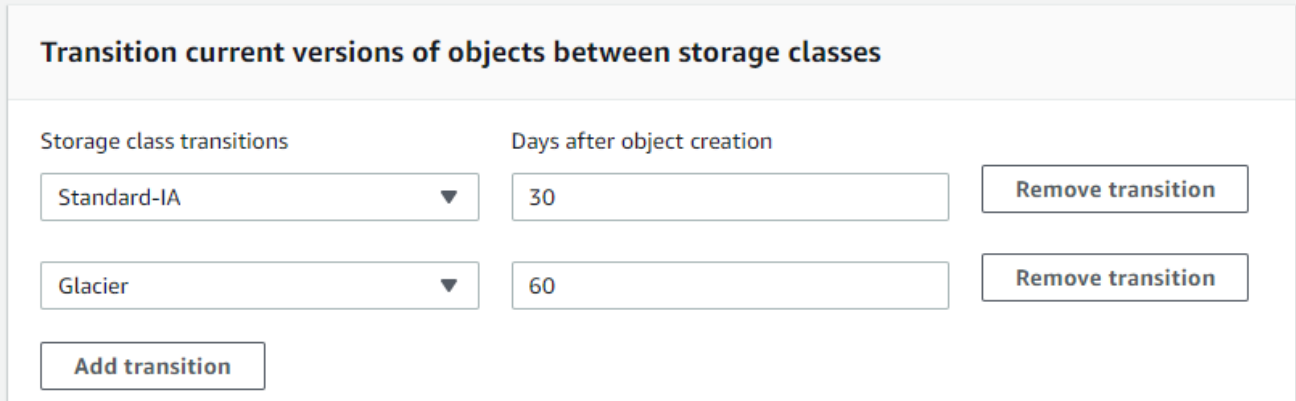
- Select the S3 bucket which we want to add lifecycle rule.
- Go to management option of the bucket and click on “create lifecycle rule”.
- Select Add Lifecycle rule and then give a valid name for the life cycle rule. We can limit the transition to a specific prefix or specific tagged objects. We can even apply to the entire buckets objects.

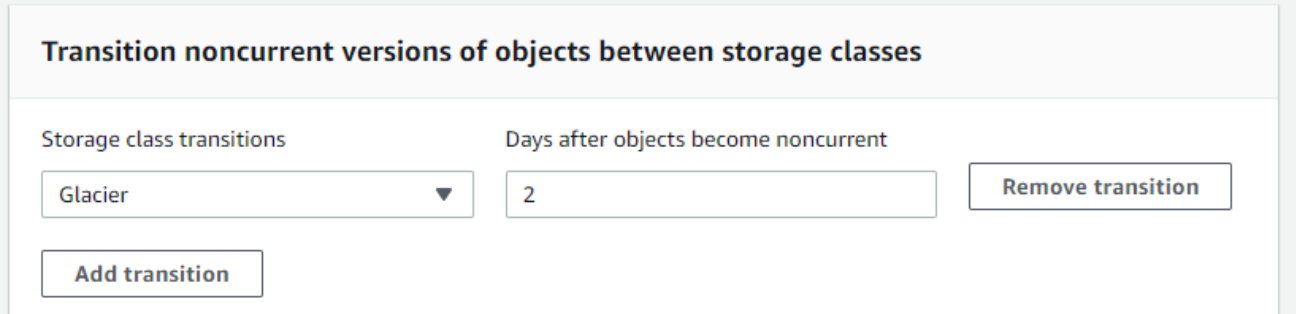


- After entering "name and scope" we need to configure the transitions. We can configure transitions for current version and previous versions. Navigate to Lifecycle rule actions and add the required transitions.

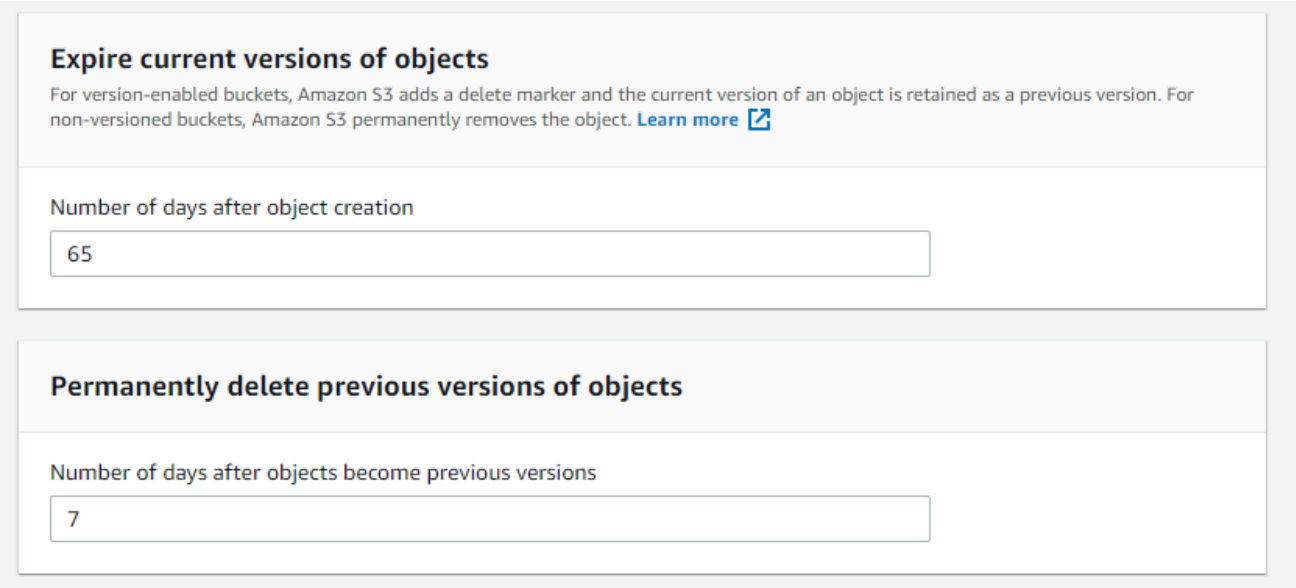
- For S3-IA We need to store the object for minimum of 30 days and for Glacier 60 days from object creation date.



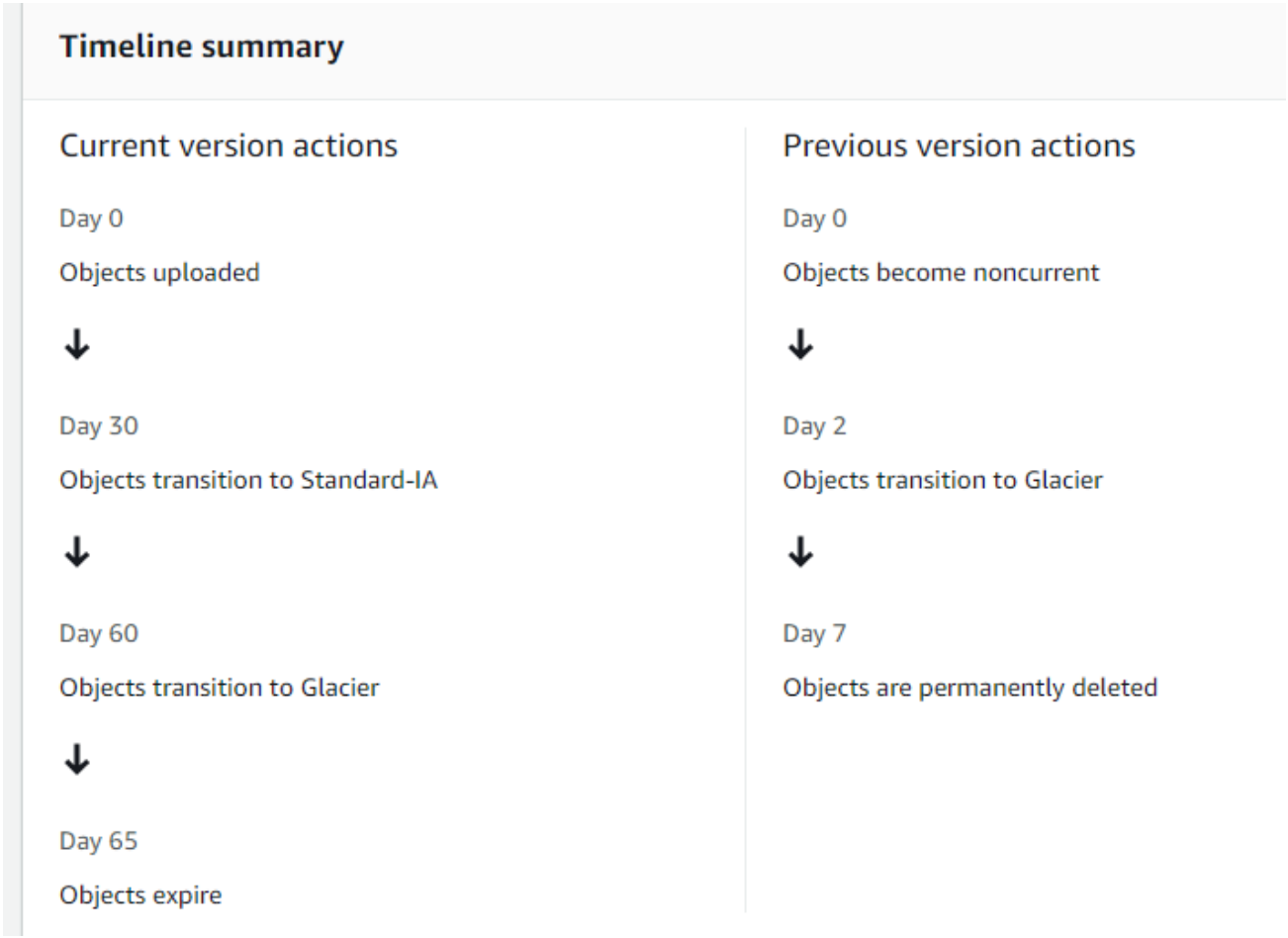




- In Next step we can configure object expirations.
    - For current version Expiration creates a Delete Marker if Versioning is enabled on this bucket.
    - For Previous version object will delete permanently.



- This is the review status for the lifecycle rule that we have created. Review the Lifecycle rule and click on “Save”, Created lifecycle rule will apply on bucket.



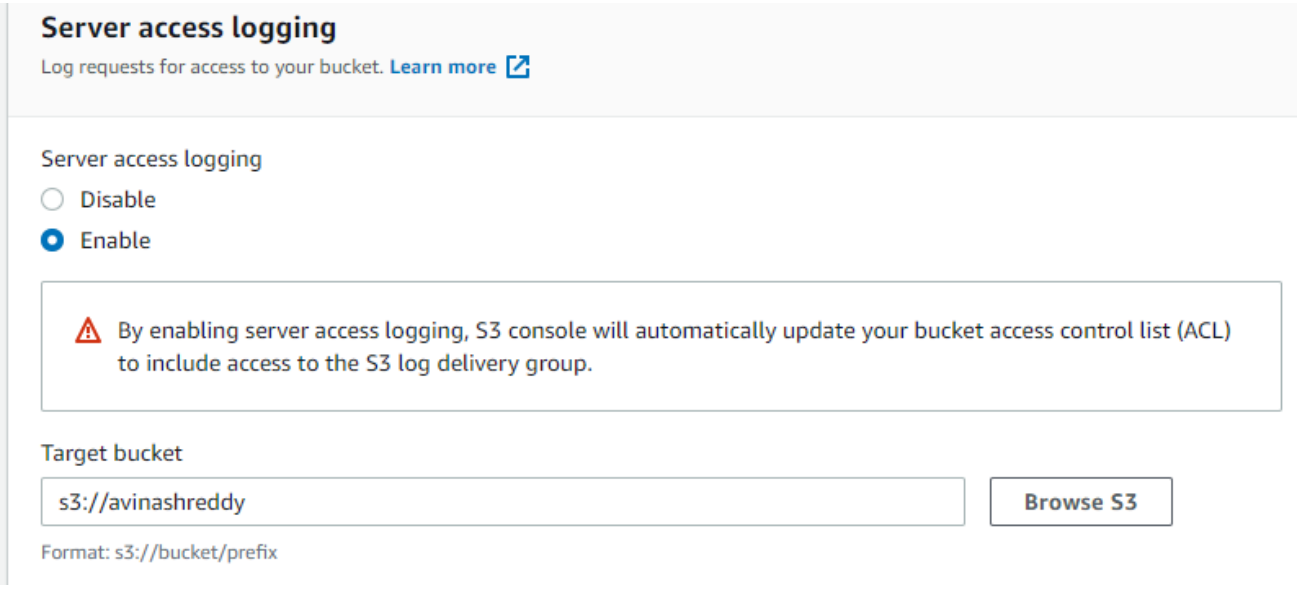
- In the above example, current versioned objects configured to to move to “Standard-IA” on Day 30, Glacier on “Day 60” and Expire on “Day 65”.
- For previous versioned objects, Moving to Glacier on “Day 2” and Permanently Deletes on “Day 7”.

Logging

By enabling logs we can track requests on our Amazon S3 bucket. Logging is off by default. You can enable it from bucket properties.

Every log will contains the below information

- Requestor account and IP address
- Bucket name
- Request time
- Action (GET, PUT, LIST, and so forth)
- Response status or error code



Cross-Region Replication / Same region Replication:

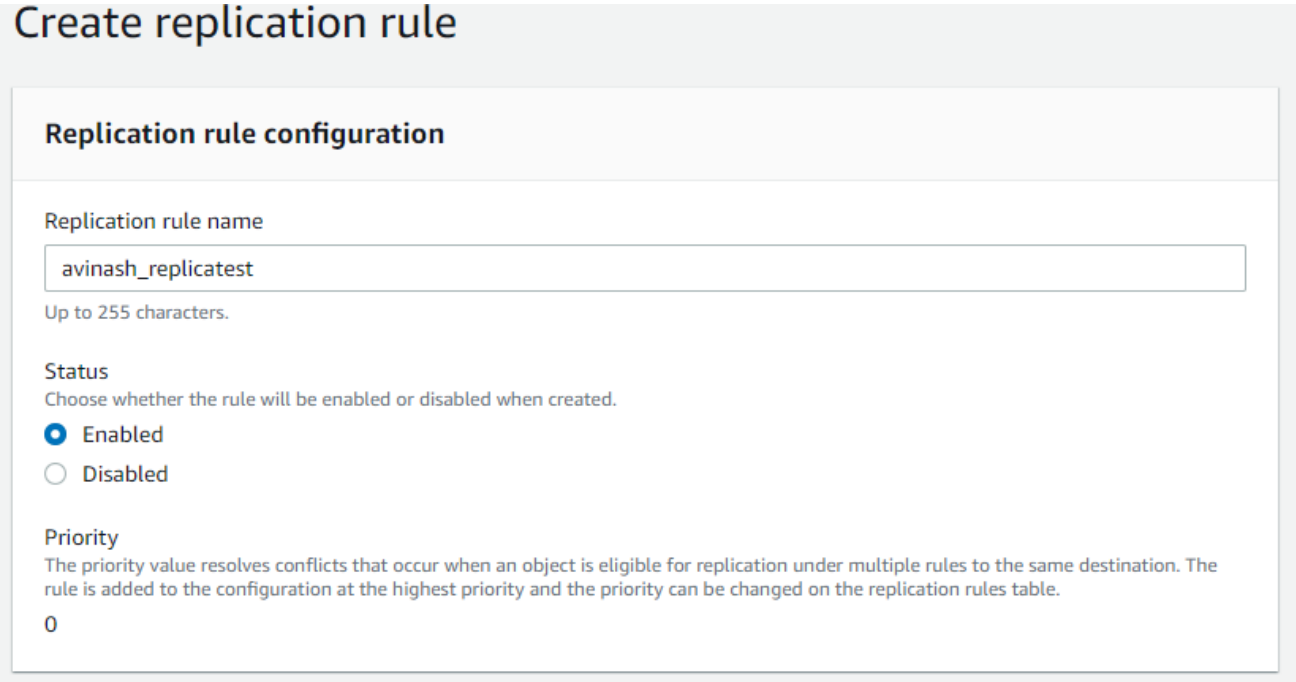
With Cross-region replication Amazon S3 allows you to asynchronously replicate all new objects in the source bucket in one AWS region to a target bucket in another region.

If Source bucket and Destination bucket is in same region we call it as "Same Region Replication".

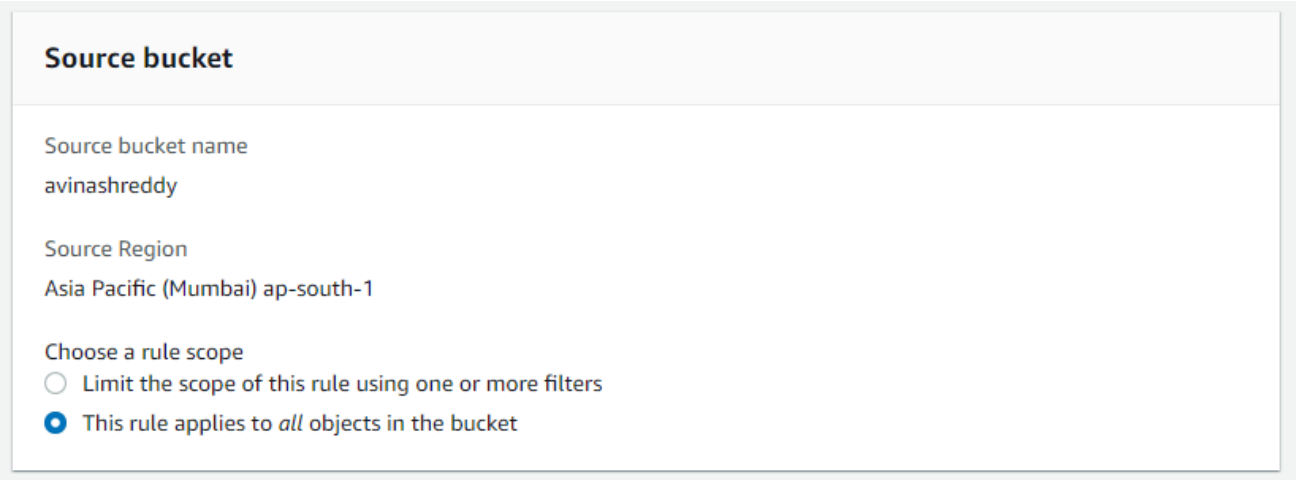
- Versioning must be enabled on both the source and destination buckets.
- Files in an existing bucket are not replicated automatically. All subsequent/future updated files will be replicated automatically.
- **We can have multiple destination buckets from single source bucket.**
- Deleting individual versions or delete markers will not be replicated.
- Cross-region replication is used to reduce the latency required to access objects in Amazon S3 by placing objects closer to a set of users or to meet requirements to store backup data at a certain distance from the original source data.
- Amazon S3 must have permission to replicate objects from that source bucket to the destination bucket on your behalf.
    - You can grant these permissions by creating an IAM role that Amazon S3 can assume.

Steps to enable cross region replication:

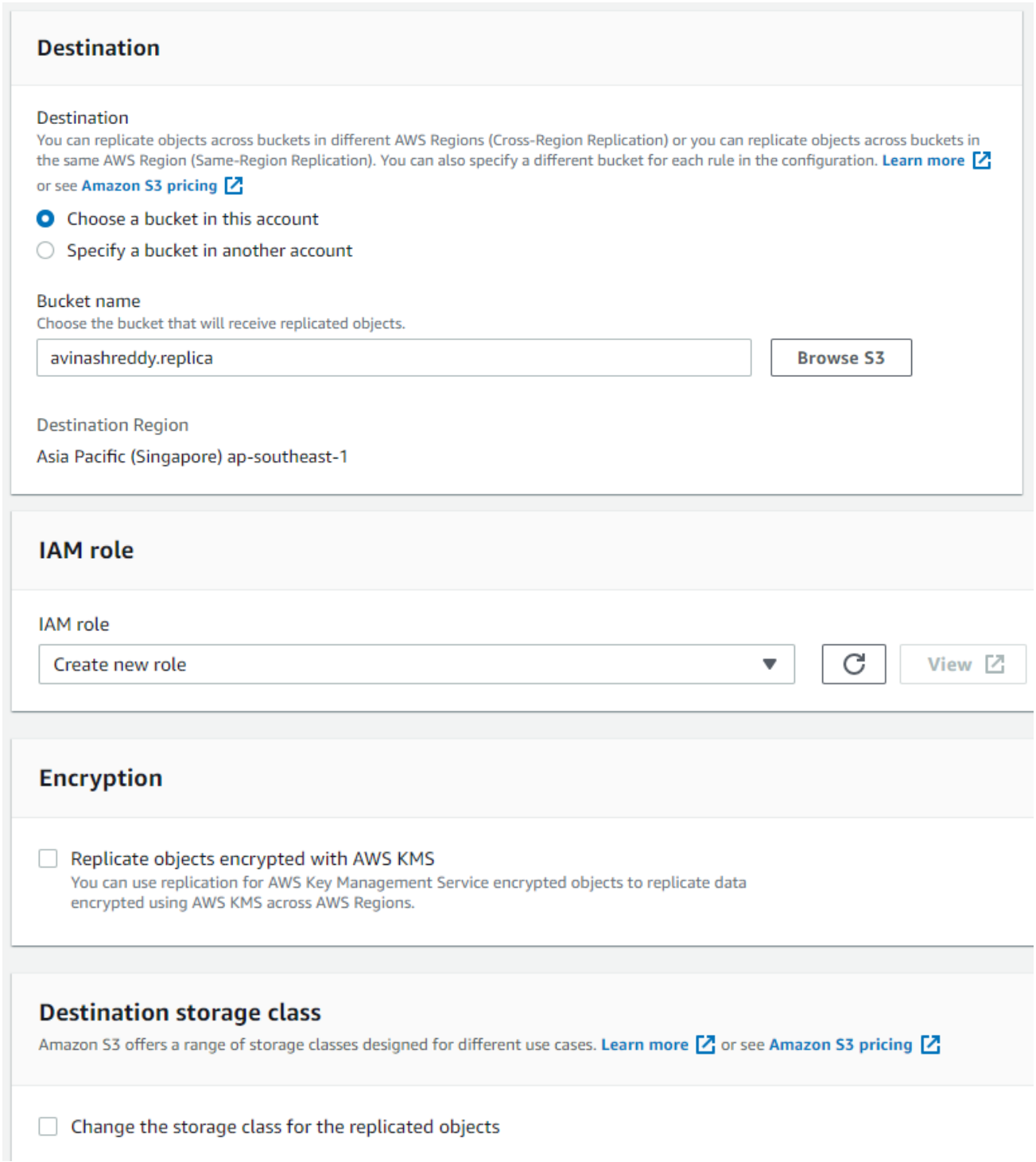
- Select S3 bucket that you want to replicate, Select Replication option under Management.



- We can replicate the entire bucket or we can use particular prefixes (i.e; all objects that have names that begin with the string pictures)

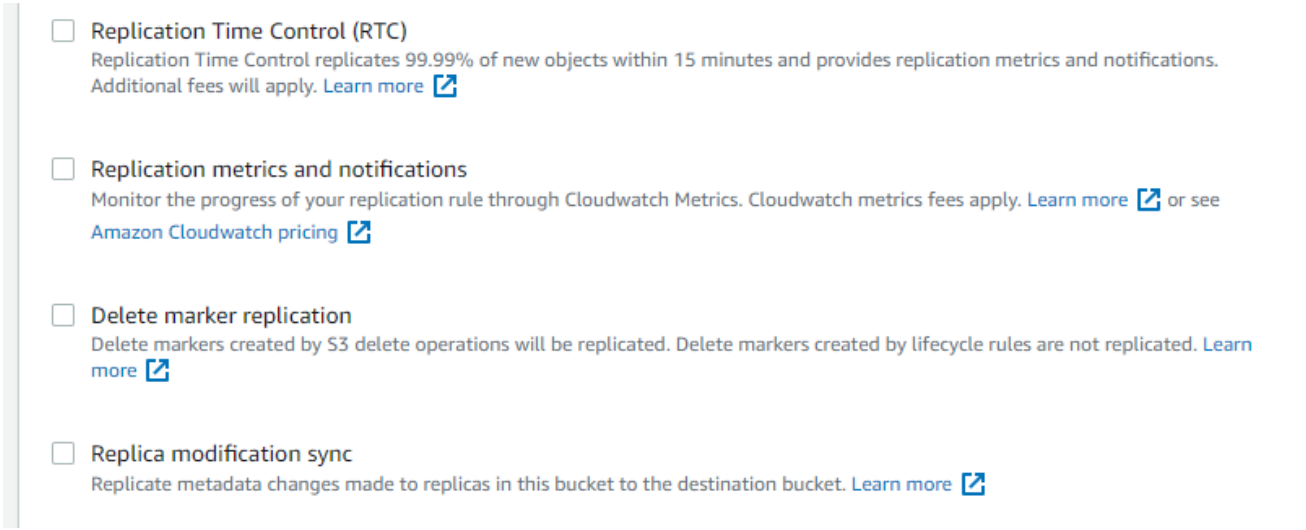


- On the **Destination** tab, under **Destination bucket**, select destination bucket for the replication. You can choose a destination bucket from same account or we can choose to create new bucket, or else we can replicate the data to a destination bucket from a different AWS account.
- Give a valid name for the replication rule

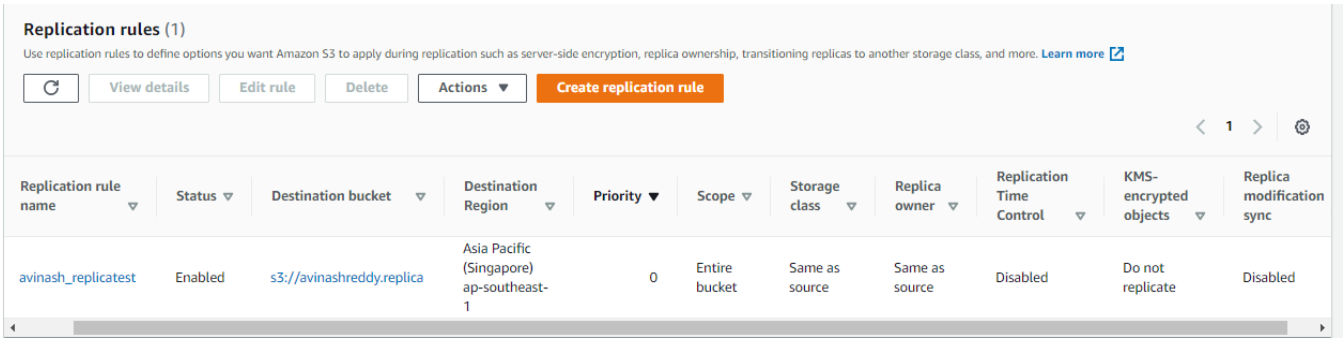


- We have to create an IAM role for replication. Click on IAM role and choose “Create new role” option.
- We can enforce the encryption for the destination buckets replicating data.
- We can change the object storage class for the destination bucket, if required.

Replication Time Control / RTC : Replication Time Control replicates 99.99% of new objects within 15 minutes and provides replication metrics and notifications. If we want to replicate the data much faster to the destination bucket this feature will helps us. Additional charges applicable.



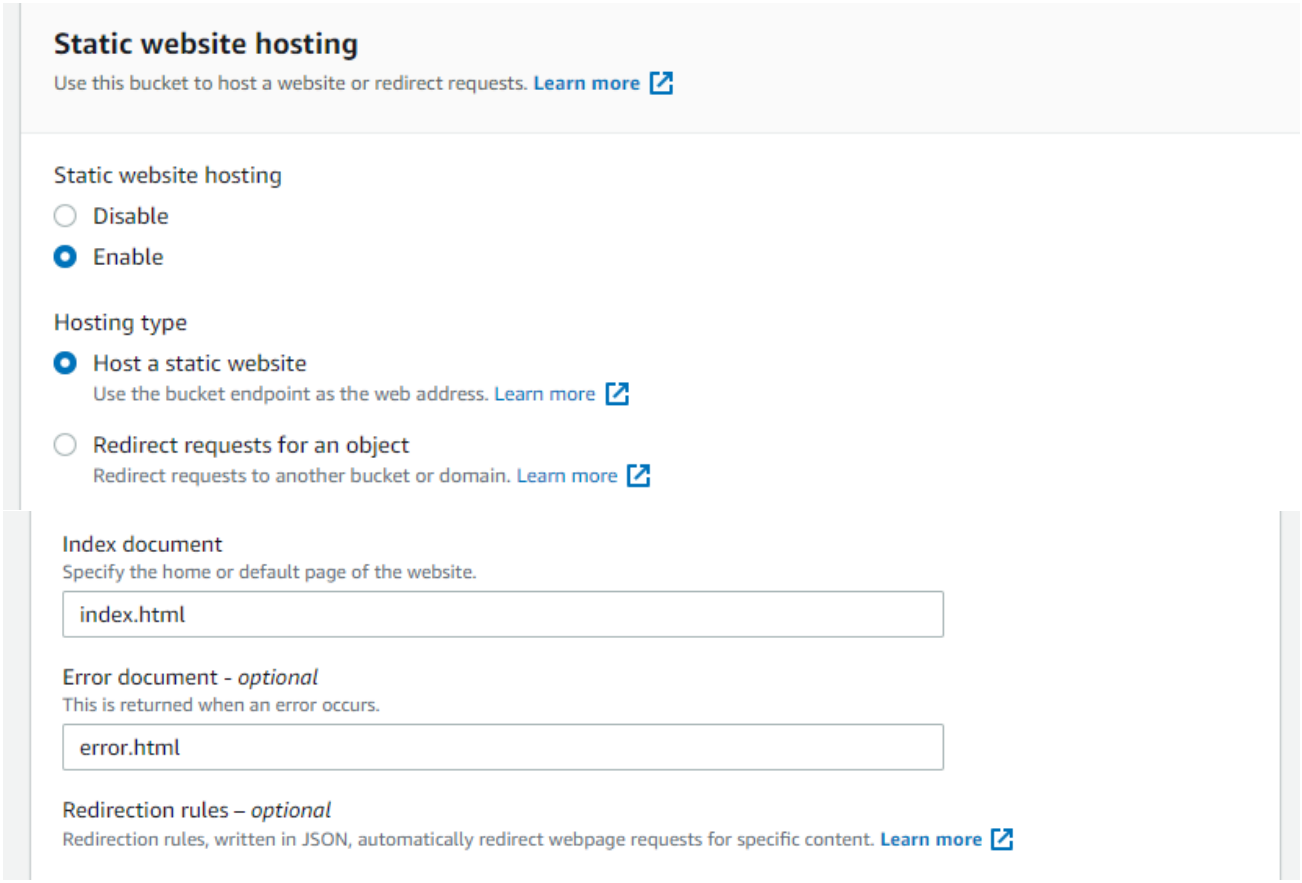
- Review and click on save to activate the cross region replication on the bucket.
- After you save your rule, you can edit, enable, disable, or delete your rule on the **Replication** page.



Static Website Hosting:

We can host a static website on Amazon Simple Storage Service.

- We need to create a bucket with the same name as the desired website hostname.
- Upload the static files to the bucket (Index.html and error.html).
- Make all the files public, then only website will be readable for all the world.
- Go to Properties of the bucket and Enable static website hosting for the bucket. And mention the specifying an Index.html and an Error.html.
- The website will now be available at the S3 website URL: **<bucket-name>.s3-website-<AWS-region>.amazonaws.com**.
- We have to create a DNS record in Route53 with purchased Domain name, then all the requests to the domain name will point to S3 bucket.
- If required, we can redirect the requests to another bucket also.



Object Lock:

S3 Object Lock, you can prevent an object from being deleted or overwritten for a fixed amount of time or indefinitely. S3 Object Lock enables you to meet regulatory requirements that require WORM (Write Once and Read Many) storage or simply to add an additional layer of protection against object changes and deletion.

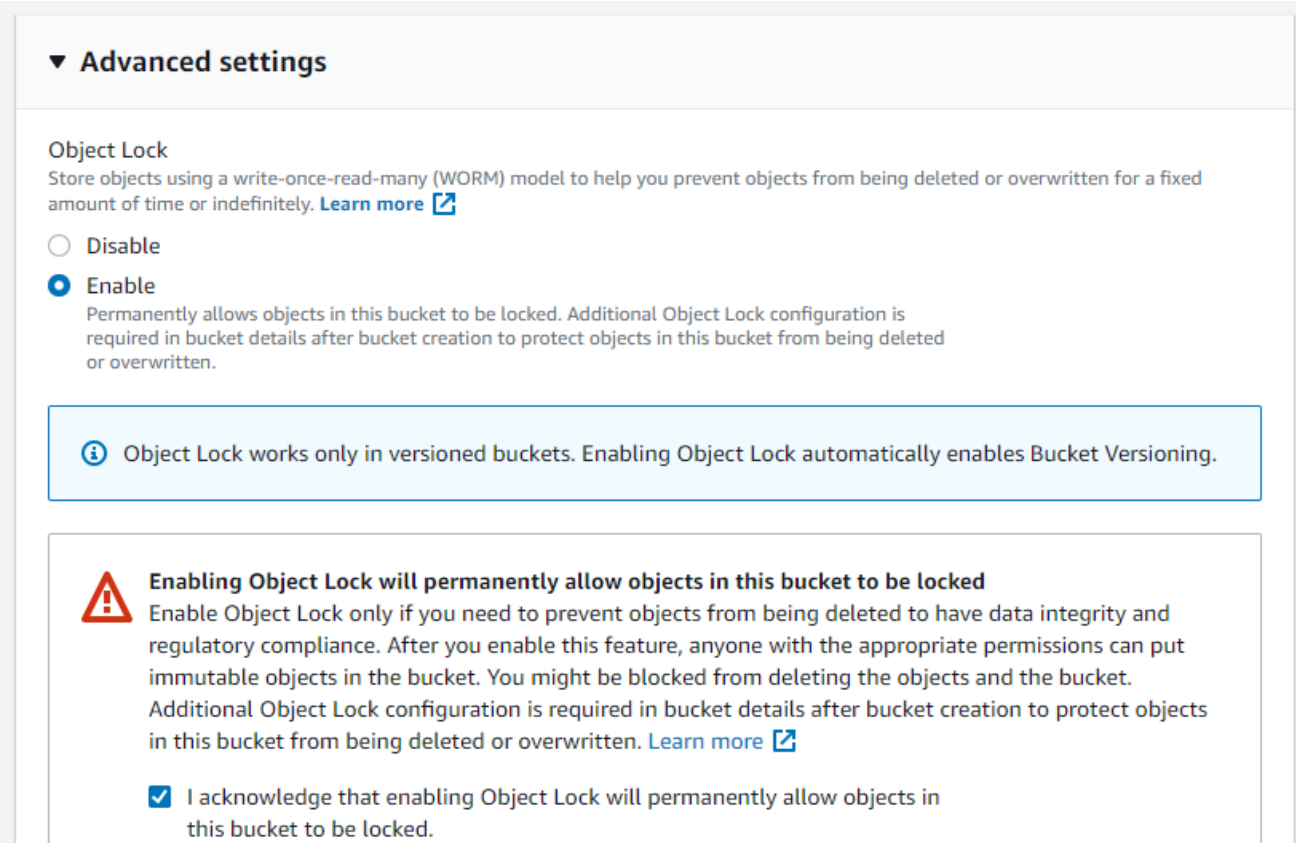
After bucket creation, upload an object and navigate to object properties to lock a specific object.

S3 Object Lock provides two ways to manage object retention: retention periods and legal holds. A retention period specifies a fixed period of time during which an object remains locked. During this period, your object will be WORM-protected and can't be overwritten or deleted.

To use Amazon S3 Object Lock, you take the following steps:

1. Create a new bucket with S3 Object Lock enabled.
2. Place the objects that you want to lock in the bucket.
3. Apply a retention period, a legal hold, or both, to the objects that you want to protect.
4. We cannot enable Object lock option to en existing bucket. Need to enable while bucket creation.
5. Versioning must be enabled if we want to use Object lock option.

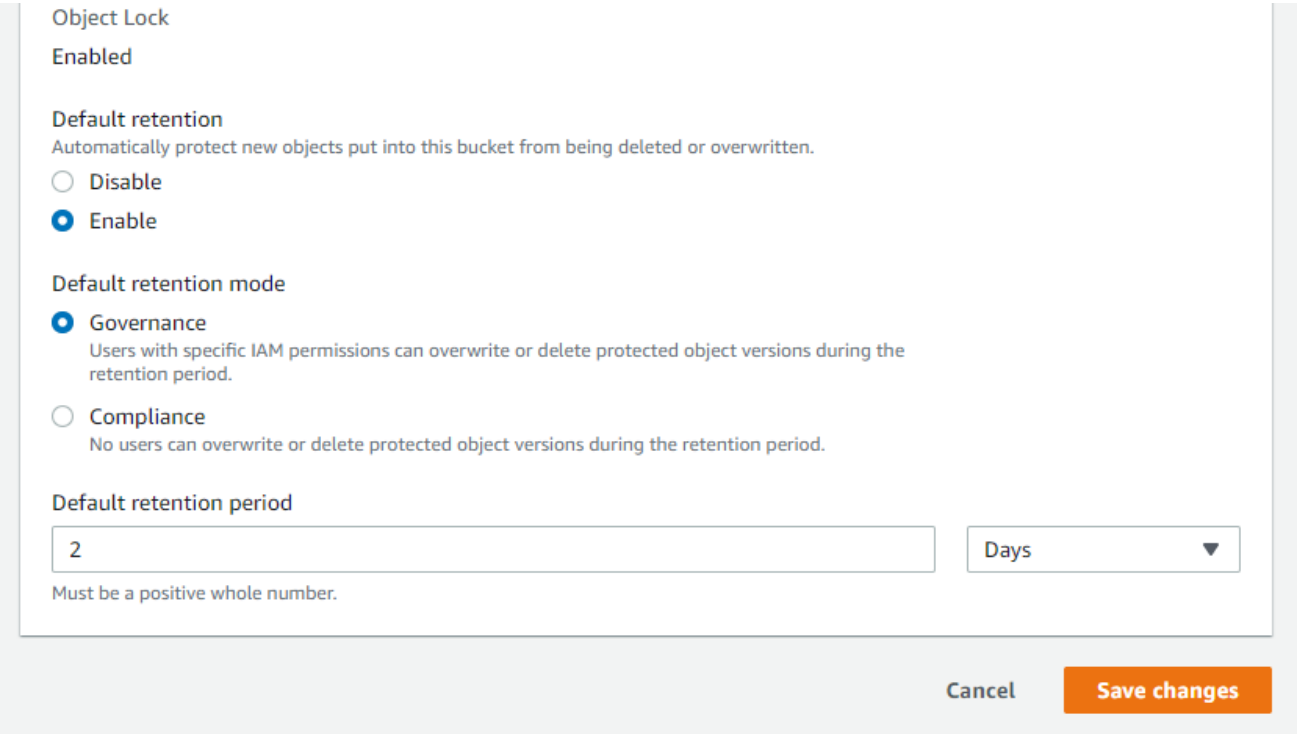
Expand the “Advanced Options” while creating bucket and enable the Object lock as shown in below image.



A legal hold provides the same protection as a retention period, but has no expiration date. Instead, a legal hold remains in place until you explicitly remove it. Legal holds are independent from retention periods: an object version can have both a retention period and a legal hold, one but not the other, or neither.

Governance mode: Governance mode can be disabled by AWS accounts that have specific IAM permissions.

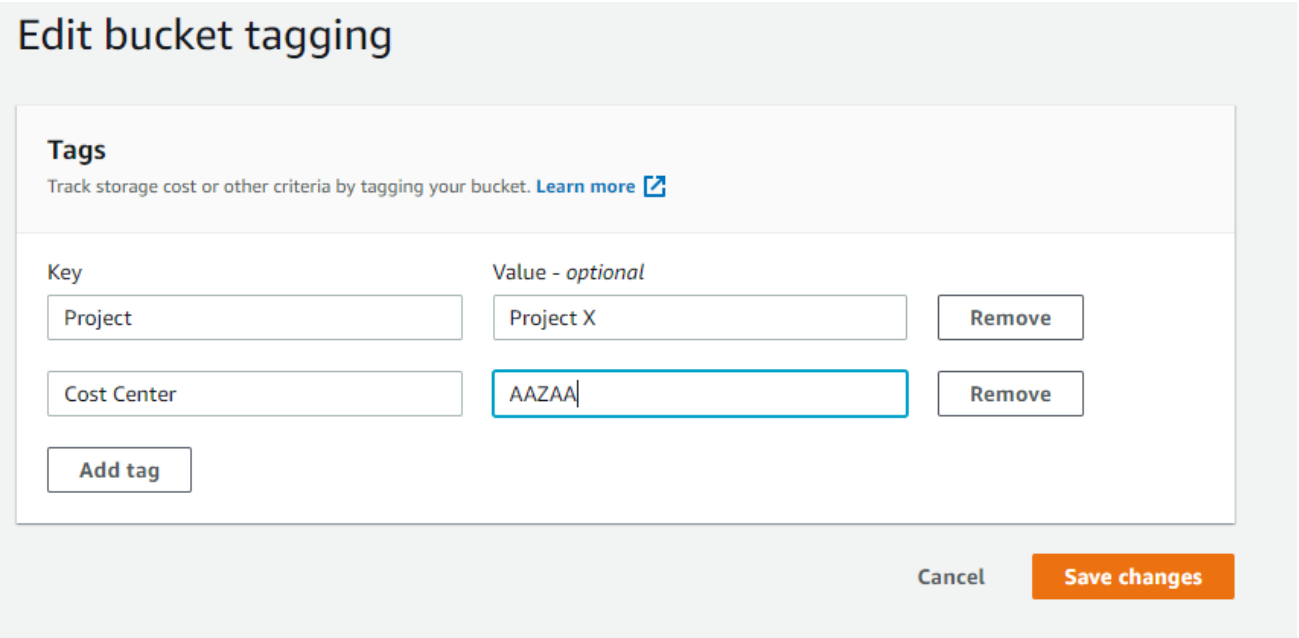
Compliance mode: Compliance mode cannot be disabled by any user, including the root account.



Tags:

Tags are combination of keys & values. Each tag is a simple label consisting of a customer-defined key and an optional value that can make it easier to manage, search for, and filter resources.

We can add tags under S3 bucket properties tab.

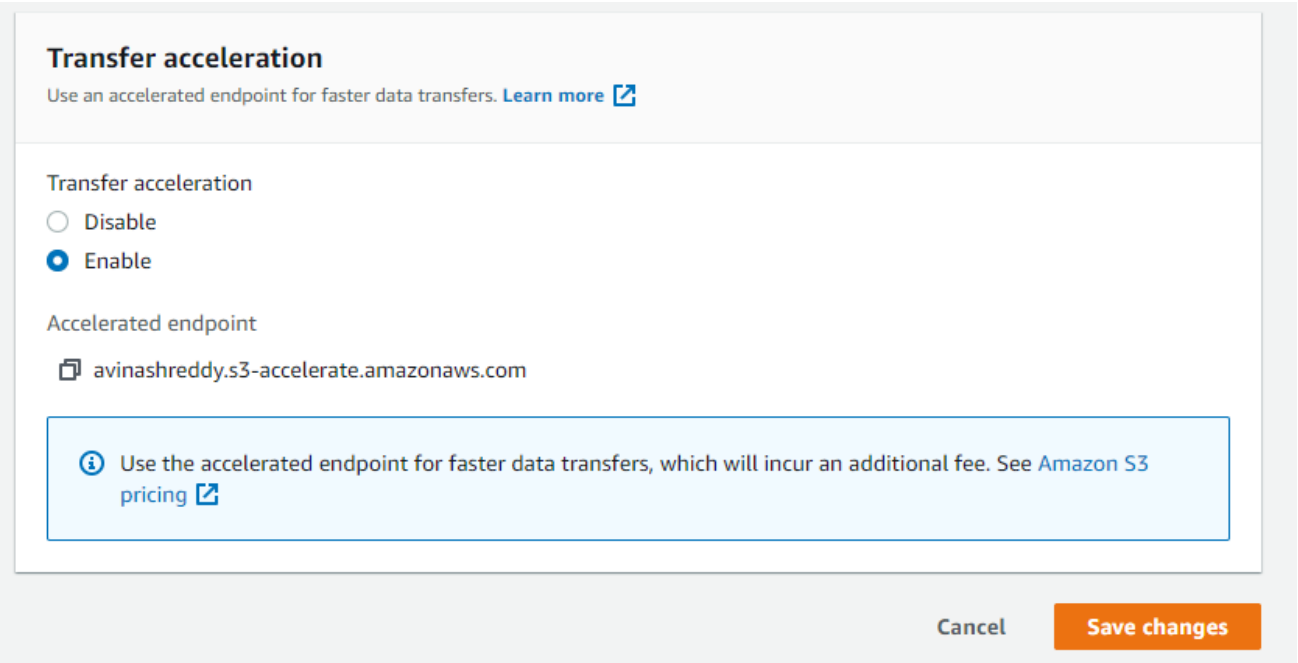


Amazon S3 Transfer Acceleration:

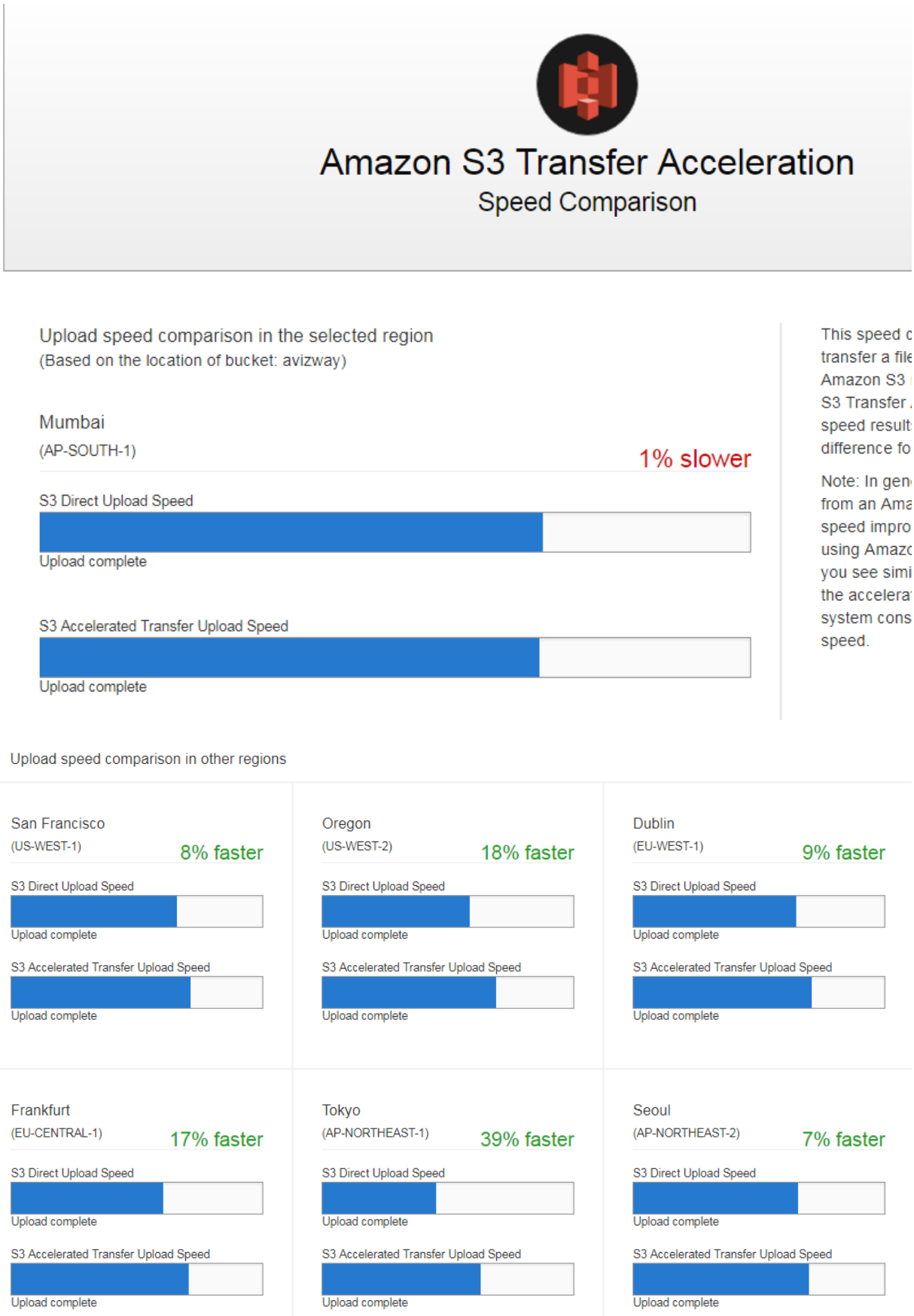
Amazon S3 Transfer Acceleration enables fast, easy, and secure transfers of files over long distances between your client and an S3 bucket. Transfer Acceleration takes advantage of Amazon CloudFront's globally distributed edge locations. As the data arrives at an edge location, data is routed to Amazon S3 over an optimized network path. Additional data transfer charges will apply for this tool.

- By Using the Amazon S3 Transfer Acceleration Speed Comparison Tool we can compare the accelerated and non-accelerated upload speeds across Amazon S3 regions.
- The Speed Comparison tool uses multipart uploads to transfer a file from your browser to various Amazon S3 regions with and without using Transfer Acceleration.

You can enable the Transfer acceleration option under S3 Bucket Properties.



Here is a sample result for Transfer acceleration result.



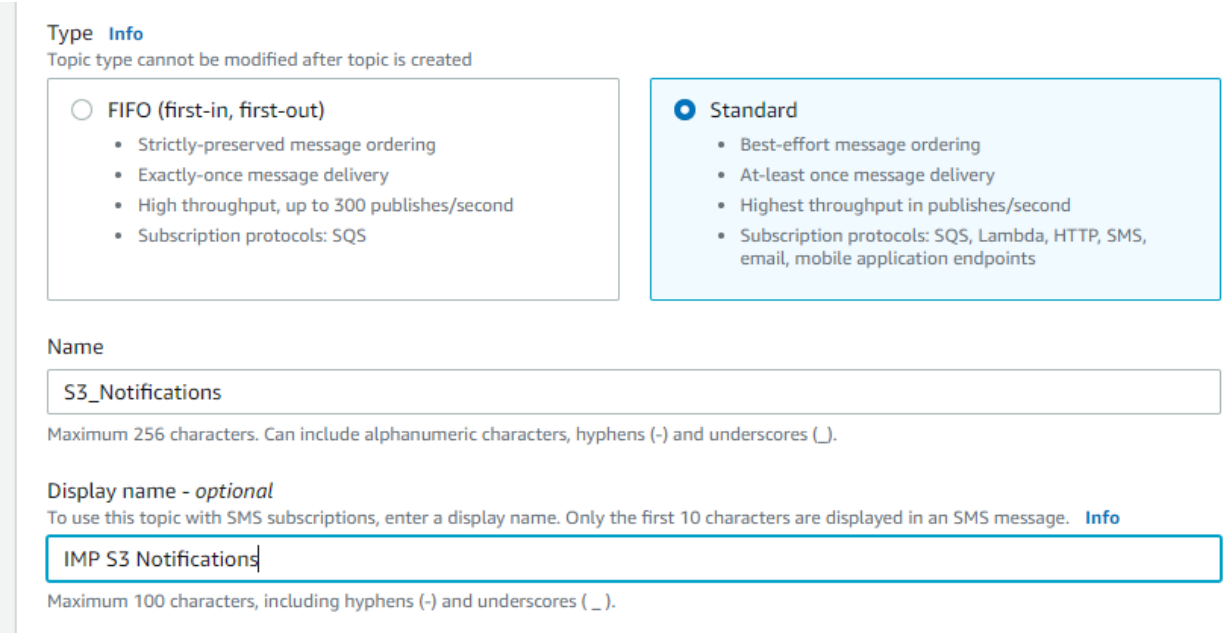
Events

Amazon S3 event notifications can be sent in response to actions taken on objects uploaded or stored in Amazon S3. The Amazon S3 notification feature enables you to receive notifications when certain events happen in your bucket.

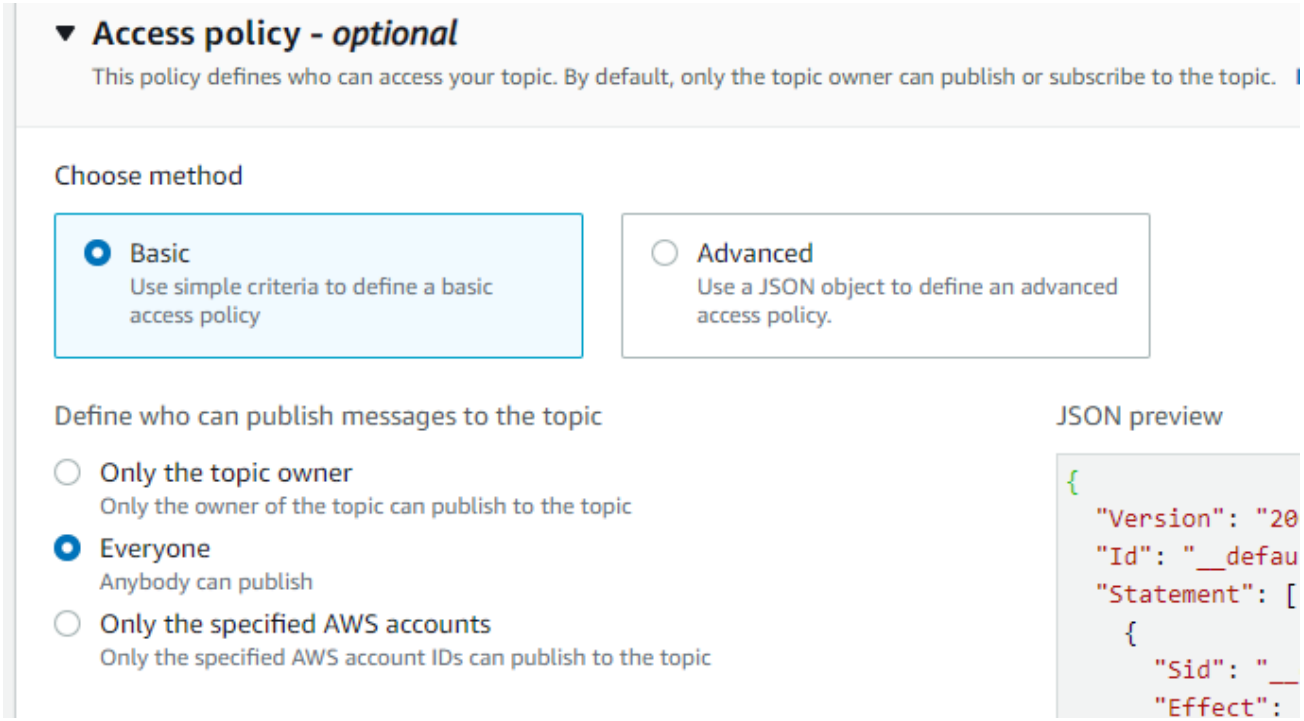
- Notification messages can be sent through either Amazon Simple Notification Service or Amazon Simple Queue Service or delivered directly to AWS Lambda to invoke AWS Lambda functions.

Here is an example to enable Notifications through SNS

- To set event notifications via SNS, Go to services and Search for Simple Notifications Service. In SNS dashboard, we have to create topic in SNS service and edit the Topic Policy to publish through S3.
- Click on **"Create Topic"** and choose "Standard", Provide a Valid name and Display name.

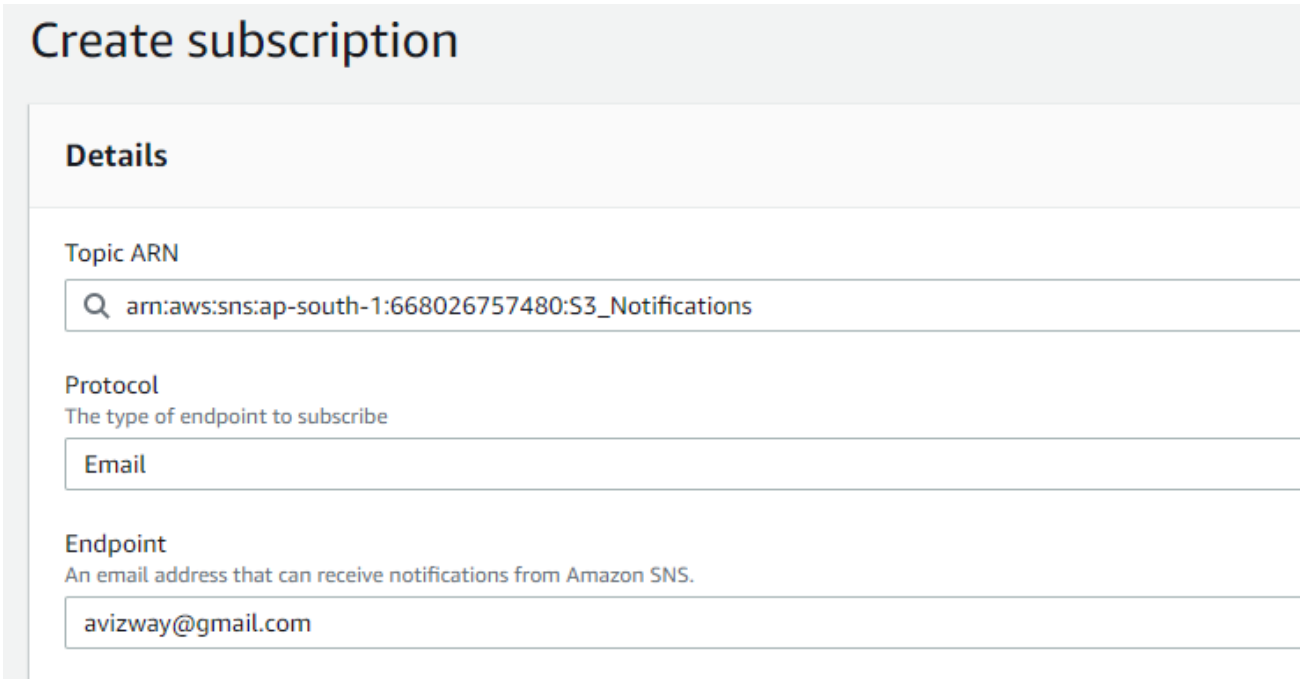


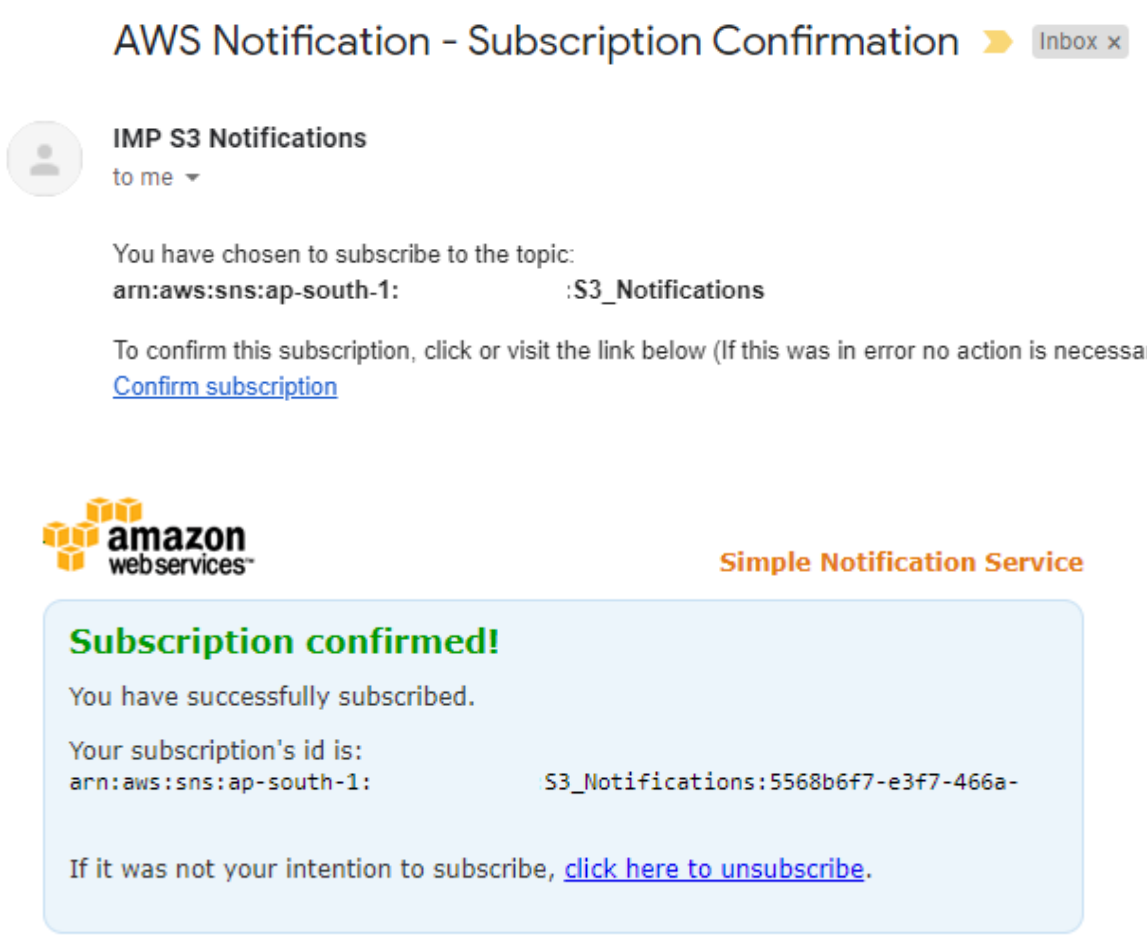
Make sure you expand the **"Access Policy"** and Chosse **Everyone** under **"Who can publish message"** to the topic. If you don't perform this s3 cannot use the SNS to send notifications.



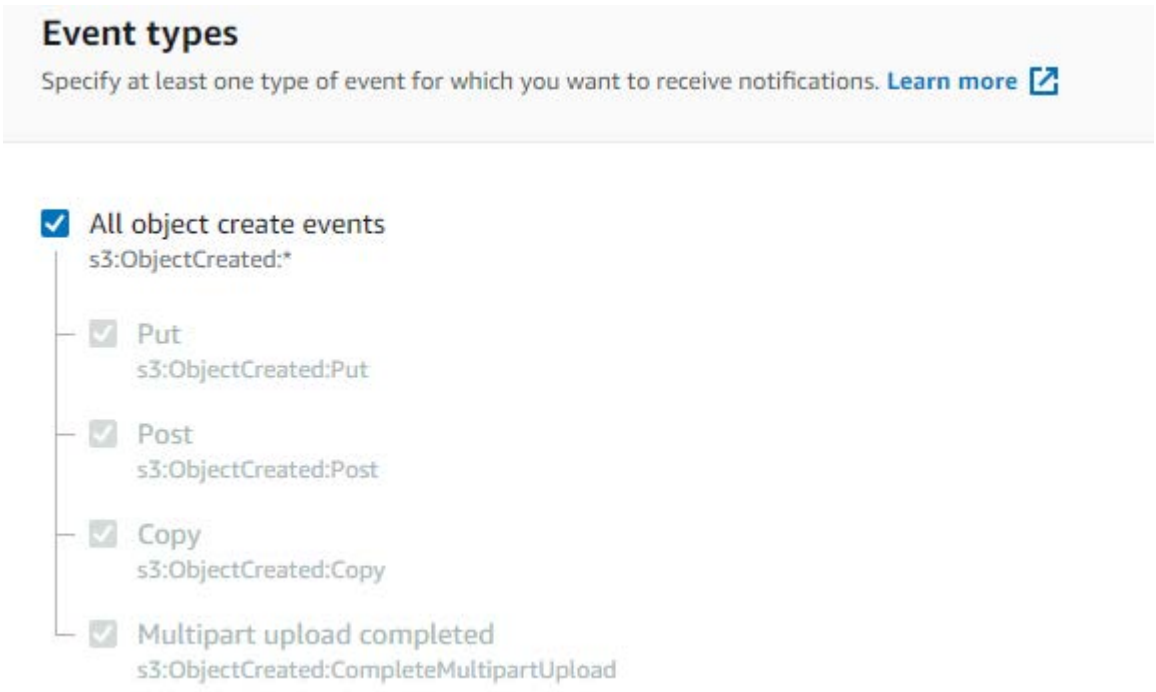
After creating topic, Add the email id for subscription of notifications. Once we select confirm option from email id then that email got subscribed for event notifications.
Navigate to the **"Subscriptions"** option in SNS topic, and click on **"Create Subscription",** and ente
Choose **"protocol as Email"** and provide Valid Email ID under Endpoint.

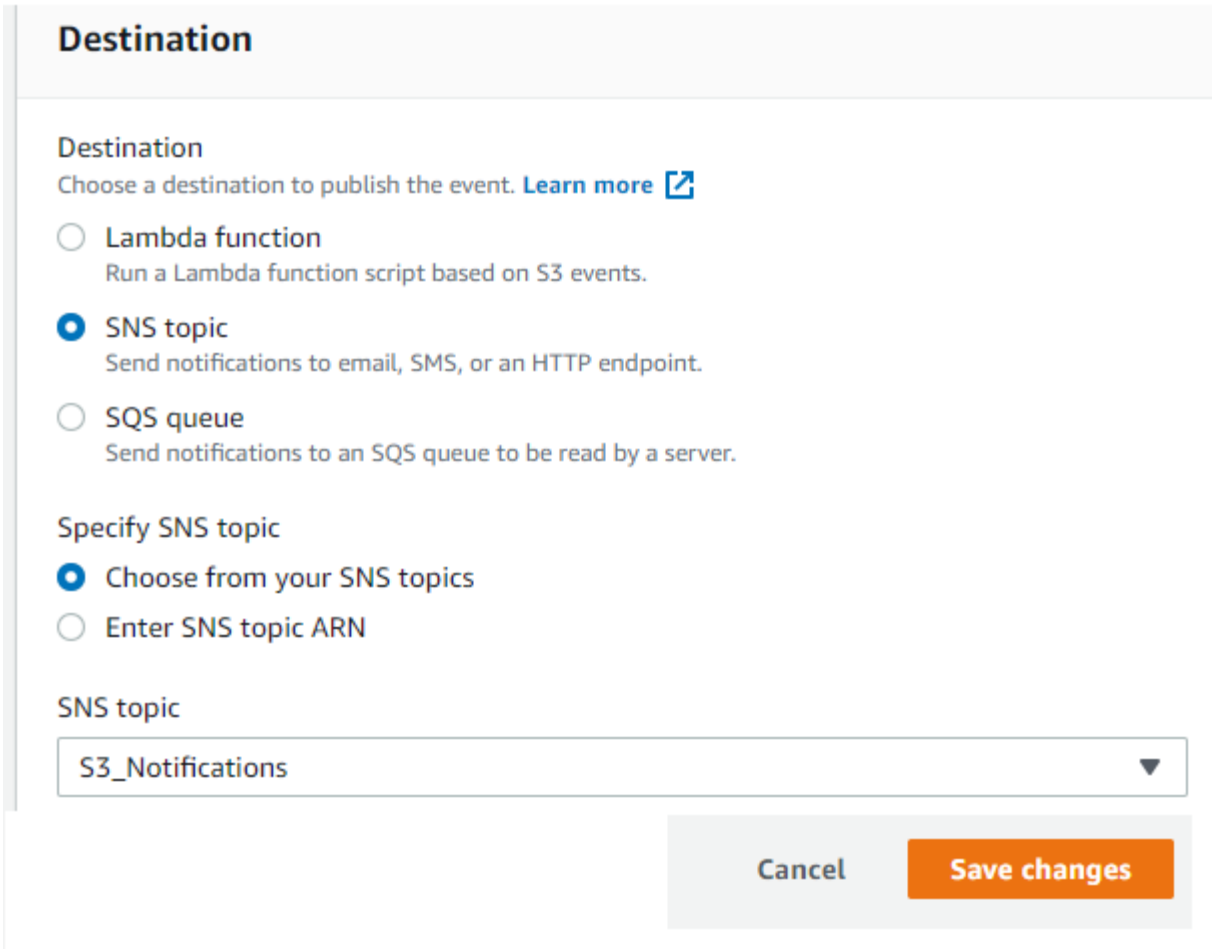
Once you create subscription you need to login to the given email ID, and click on the **subscription confirmation email**.





- Now Go to Properties of S3 bucket and select **Events** →Add notification→give event name→select Events→select SNS topic and select save option.
- We can select the Event type to get notified through the Email.





- When the selected action performed on S3 bucket, Subscribed users to that topic will get a notification.

Inventory:
Amazon S3 inventory is one of the tools Amazon S3 provides to help manage your storage. Amazon S3 inventory provides a comma-separated values (CSV) flat-file output of your objects and their corresponding metadata on a daily or weekly basis for an S3 bucket or a shared prefix.

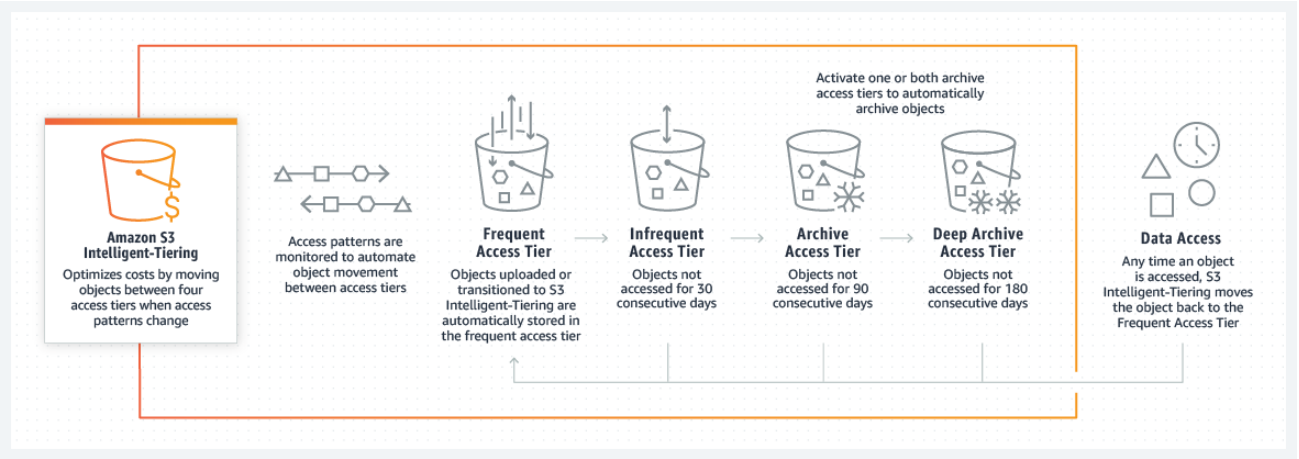
Requester pays
Generally, bucket owners pay for all Amazon S3 storage and data transfer costs associated with their bucket. If you enable Requester pays on the bucket, instead of bucket owner requested user will pay.

- Anonymous access to that bucket is not allowed, if we want to enable the requester pays on bucket.

Intelligent-Tiering Archive configurations: S3 Intelligent-Tiering is a storage class that is designed to optimize storage costs by automatically moving data to the most cost-effective access tier without performance impact or operational overhead.

- **Archive Access tier :** When enabled, Intelligent-Tiering will automatically move objects that haven't been accessed for a minimum of 90 days to the Archive Access tier.

- **Deep Archive Access tier :** When enabled, Intelligent-Tiering will automatically move objects that haven't been accessed for a minimum of 180 days to the Deep Archive Access tier.



S3 Performance optimization :
In S3 platform, we can achieve at least 3,500 PUT/COPY/POST/DELETE or 5,500 GET/HEAD requests per second per prefix in a bucket.
For example, if you create 10 prefixes in an Amazon S3 bucket to parallelize reads, you could scale your read performance to 55,000 read requests per second. Similarly, you can scale write operations by writing to multiple prefixes.

S3 Consistency Models :
S3 provides **Read-after-Write consistency for PUTS** of new objects.
S3 provides **Eventual Consistency for overwrite PUTS and DELETES.**

Encryption:
We have three types of encryptions available in S3

1. Server-Side Encryption: All SSE performed by Amazon S3 and AWS Key Management Service (Amazon KMS) uses the 256-bit Advanced Encryption Standard (AES).
    - SSE-S3 (AWS-Managed Keys) :
    - SSE-KMS (AWS KMS Keys)
    - SSE-C (Customer-Provided Keys)
2. Client-Side Encryption: We can encrypt the data on the client before sending it to Amazon S3. We have to take care about the encryption and Decryption process.
3. In-Transit Encryption
    - We can use SSL API endpoints, this ensures that all data sent to and from Amazon S3 is encrypted while in transit using the HTTPS protocol.

Bucket policies : We can create and configure bucket policies to grant permission to Amazon S3 resources. Bucket policies use JSON-based access policy language.

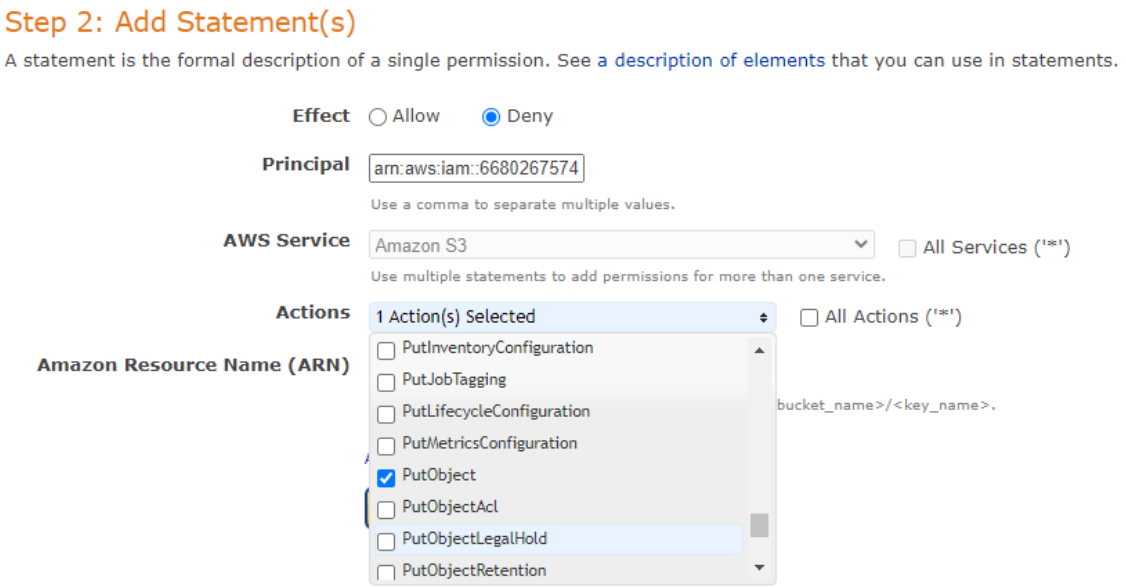
You can use the AWS Policy Generator to create a bucket policy for your Amazon S3 bucket. While generating policy we need to provide the required resource, effect, action and user information.

Effect : Allow / Deny

Principal : IAM user/Group ARN

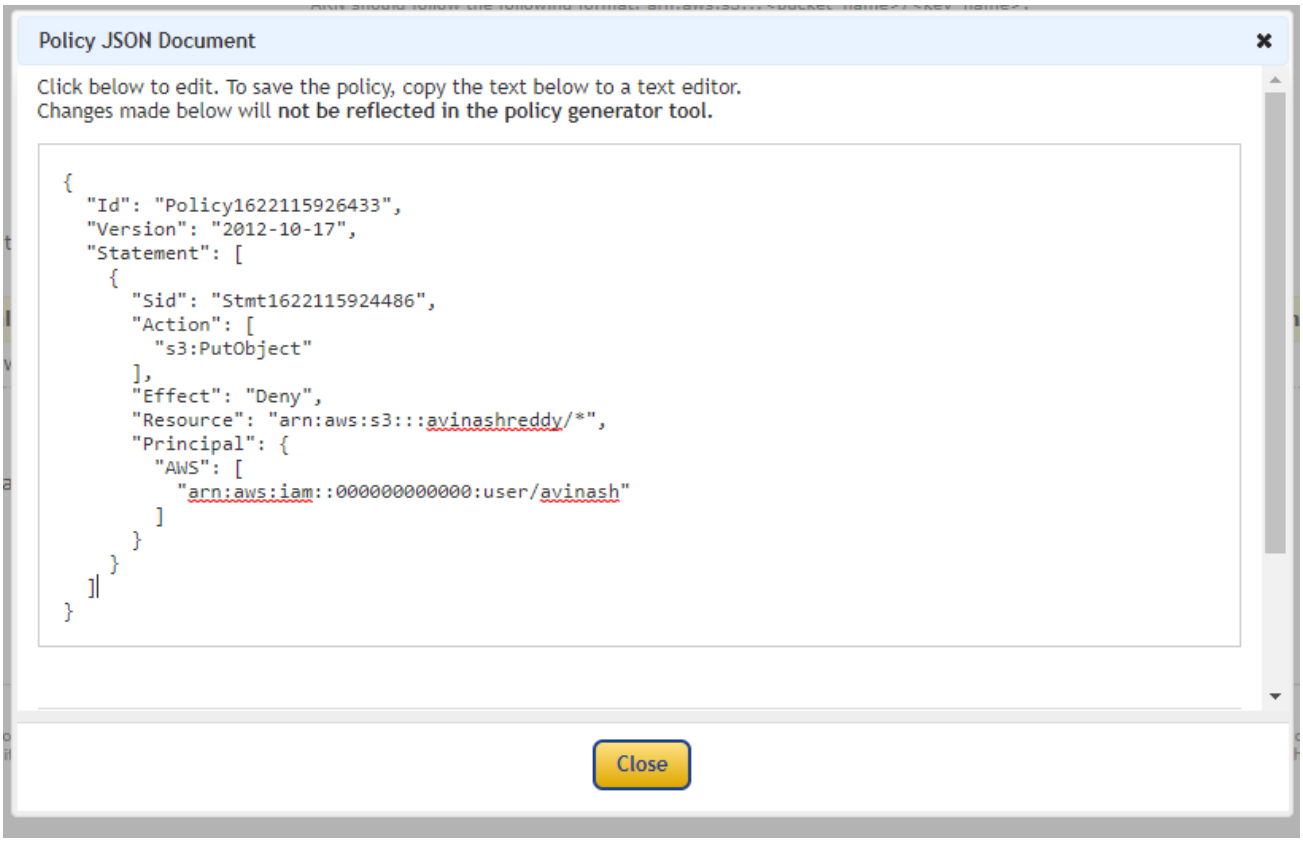
Action : What operations you want to Allow / Deny.

ARN : ARN of S3 Bucket you want to apply this policy.



Choose “Add Statement’ and click on “generate Policy”.

Below sample policy can deny “PUT” operation for an IAM user “avinash” on “avinashreddy” bucket.



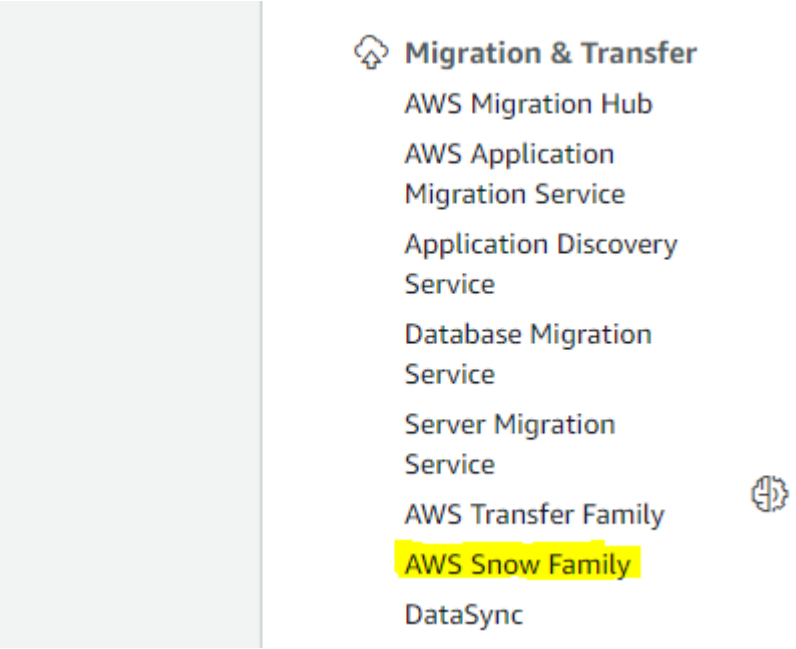
AWS SNOWBALL

Snowball is a petabyte-scale data transport solution that uses secure appliances to transfer large amounts of data into and out of the AWS cloud.

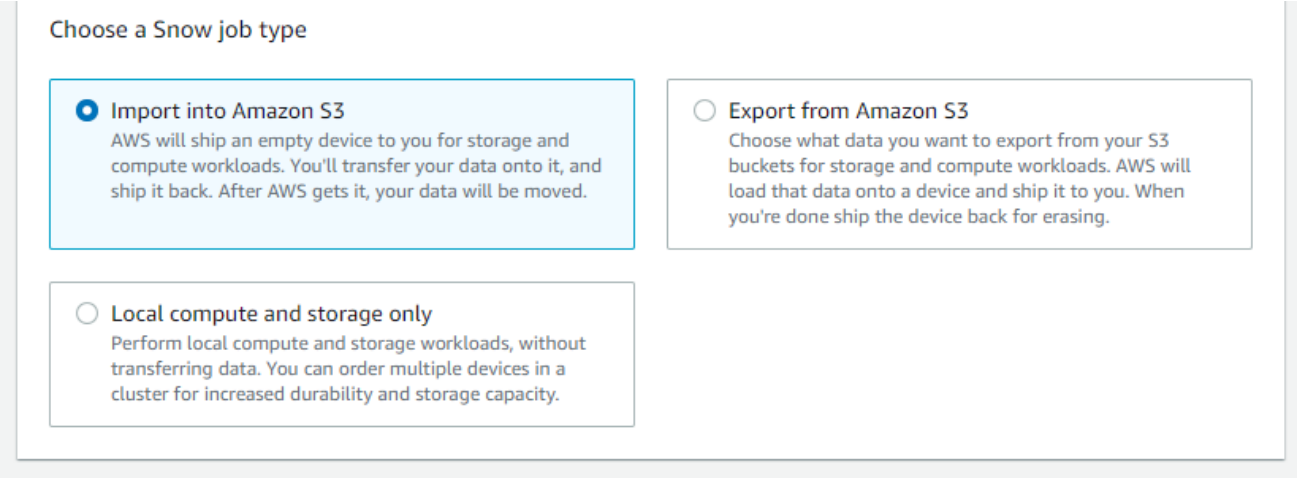
We don't need to write any code or purchase any hardware to transfer your data. Simply create a job in the AWS Management Console and a Snowball appliance will be automatically shipped to you.

Once it arrives, attach the appliance to your local network, download and run the Snowball client to establish a connection, and then use the client to select the file directories that you want to transfer to the appliance. The client will then encrypt and transfer the files to the appliance at high speed. Once the transfer is complete and the appliance is ready to be returned, the shipping label will automatically update and you can track the job status via Amazon Simple Notification Service (SNS), text messages, or directly in the Console.

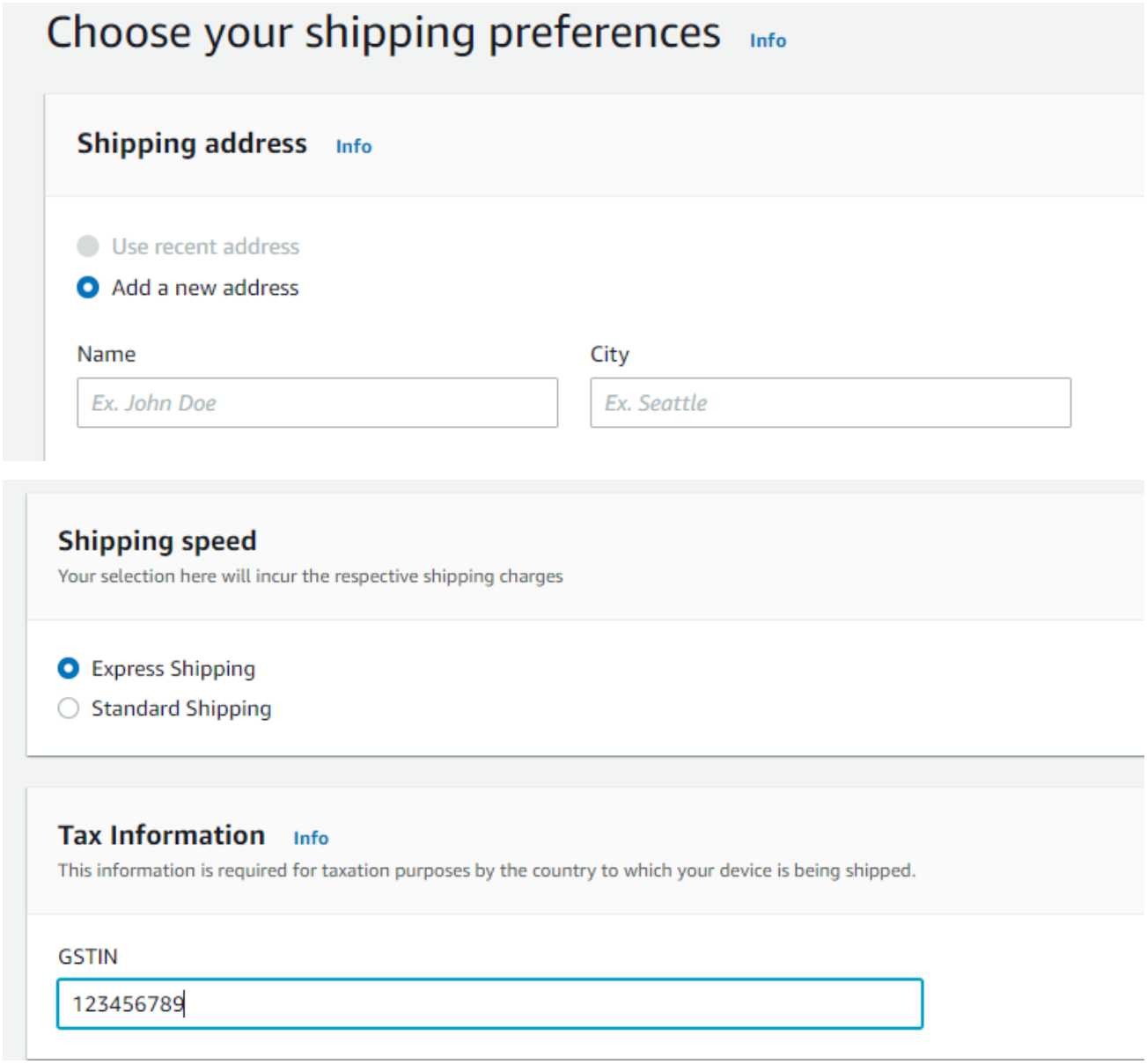
You can find the AWS Snowball under Migration category:

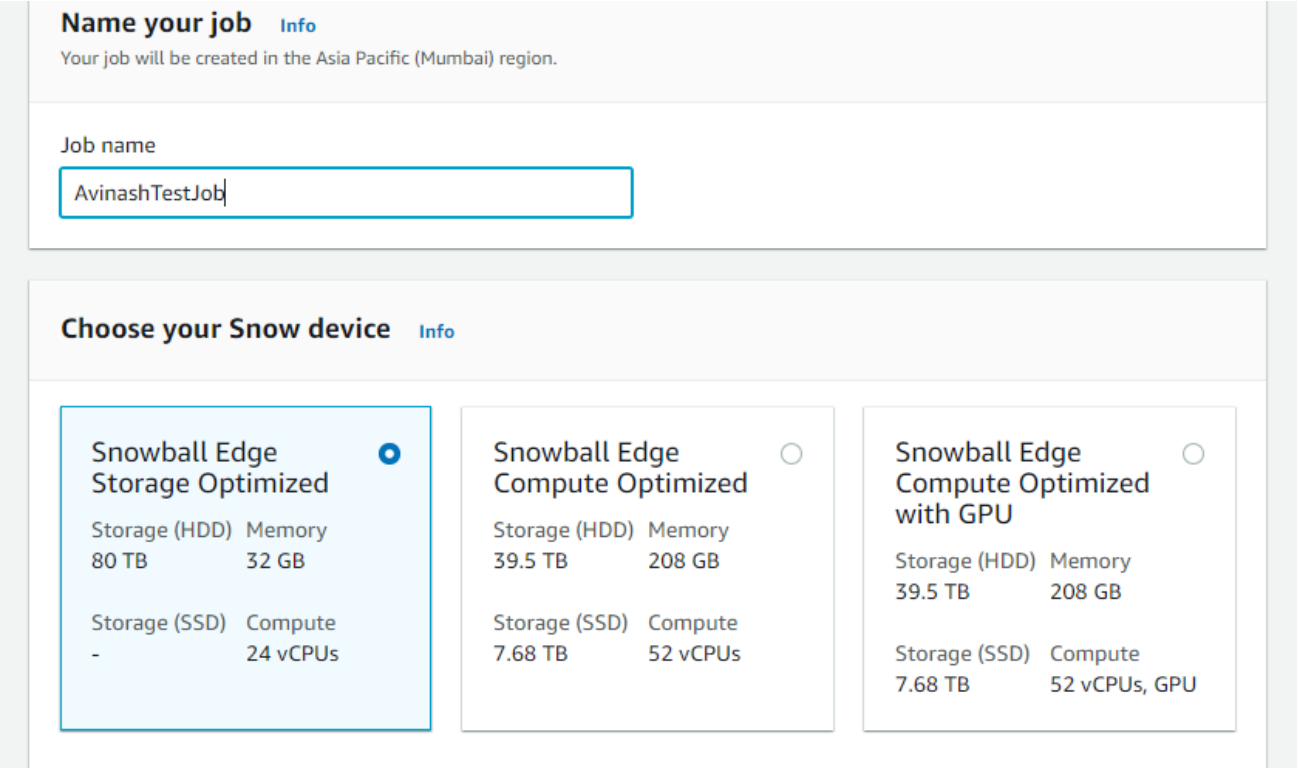


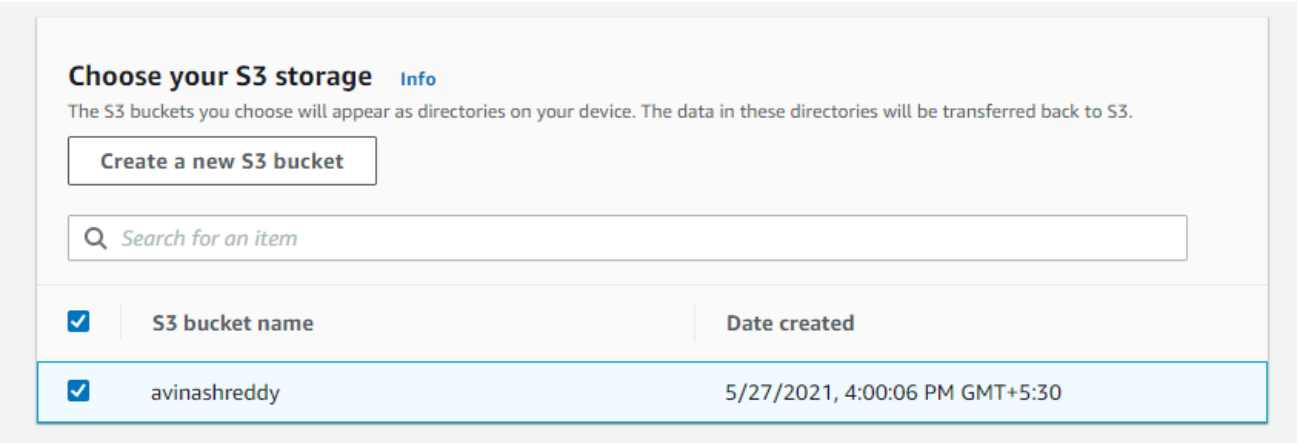
Select the Job type (Import into S3 / Export from S3)



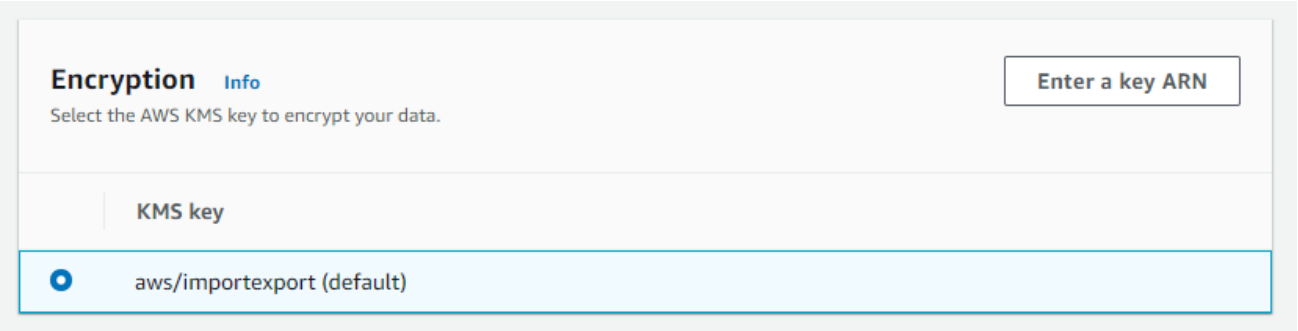
Give the address to ship the snowball device and give a name for the Job and select the S3 bucket to Import/Export the data.







By default all the data will be encrypted by KMS service. And need to create a IAM role to perform the copy operation to our S3 bucket.



We can configure the SNS topics to get notifications about the Snowball device status.

In next step, Review the screen and create the Job. Amazon will send you the snowball device on given address.

Here is the pricing details for snowball device: Service Fee per Job is based on the appliance capacity. We have 50 TB device and 80 TB device. First 10 days of onsite usage are free* and each extra onsite day is $15

Snowball 50 TB: $200

Snowball 80 TB: $250

Snowball Edge:AWS Snowball Edge is a 100TB data transfer device with on-board storage and compute capabilities. It also have compute capability that is approximately the equivalent of an EC2 m4.4xlarge instance. 16 vCPU & 64 GB RAM

AWS Snowmobile:Snowmobile is a Exabyte-Scale Data transfer service used to move extremely large amount of data to AWS.Capacity : 100 PB

With Snowmobile, we can move 100 petabytes of data in as little as a few weeks, plus transport time. If you transfer same with 1Gbps connection, it may take more than 20 years.

We need to request the amazon with the given url to get the snowmobile https://aws.amazon.com/contact-us/aws-sales/

AWS Direct Connect

AWS Direct Connect makes it easy to establish a dedicated network connection from your premises to AWS. Using AWS Direct Connect, you can establish private connectivity between AWS and your datacenter, office, or colocation environment, which in many cases can reduce your network costs, increase bandwidth throughput, and provide a more consistent network experience than Internet-based connections.

AWS Direct Connect lets you establish a dedicated network connection between your network and one of the AWS Direct Connect locations. Using industry standard 802.1q VLANs, this dedicated connection can be partitioned into multiple virtual interfaces. This allows you to use the same connection to access public resources such as objects stored in Amazon S3 using public IP address space, and private resources such as Amazon EC2 instances running within an Amazon Virtual Private Cloud (VPC) using private IP space, while maintaining network separation between the public and private environments. Virtual interfaces can be reconfigured at any time to meet your changing needs.

Service Advantages:

1. Reduces Your Bandwidth Costs
2. Consistent Network Performance
3. Compatible with all AWS Services
4. Private Connectivity to your Amazon VPC
5. Elastic

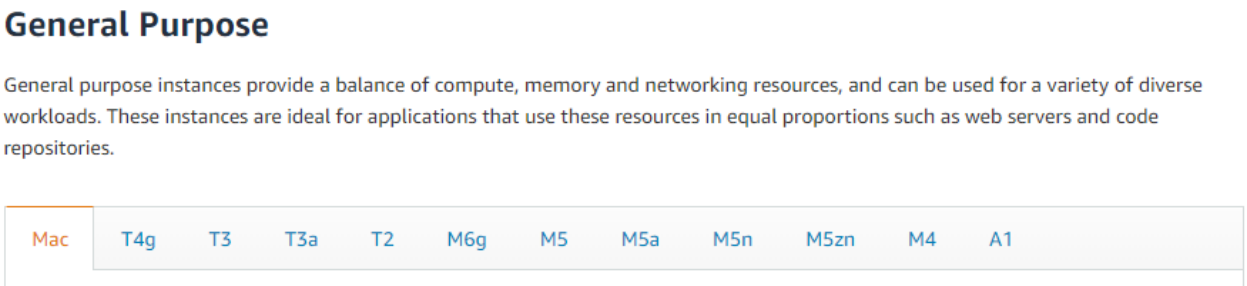
EC2 (ELASCTIC COMPUTE CLOUD)

Amazon Elastic Compute Cloud (Amazon EC2)
Amazon EC2 is AWS primary web service that provides resizable compute capacity in the cloud. Amazon EC2 allows you to acquire compute through the launching of virtual servers called **instances.** Instance is nothing but a Virtual Server.

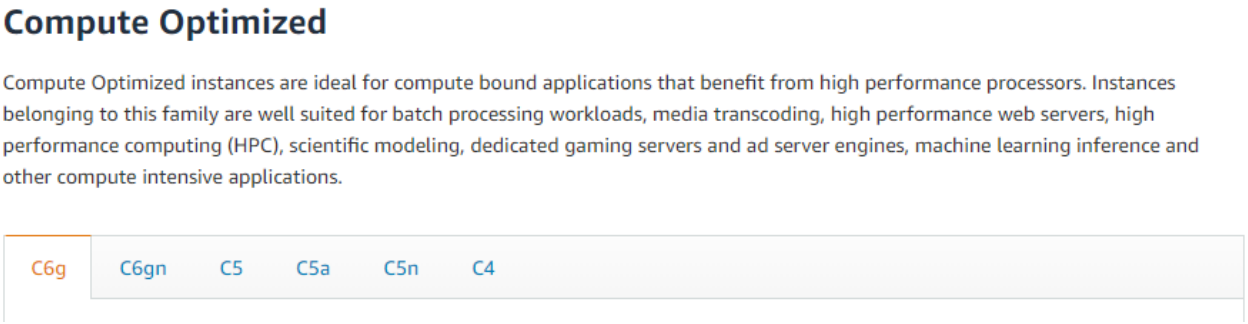
Instance Types:
The instance type defines the virtual hardware supporting an Amazon EC2 instance. There are many instance types available, based on the following dimensions:

- General purpose
- Compute Optimized (vCPUs)
- GPU Compute
- Memory Optimized
- Storage Optimized
- FPGA Instances
- GPU Graphics
- GPU Instances

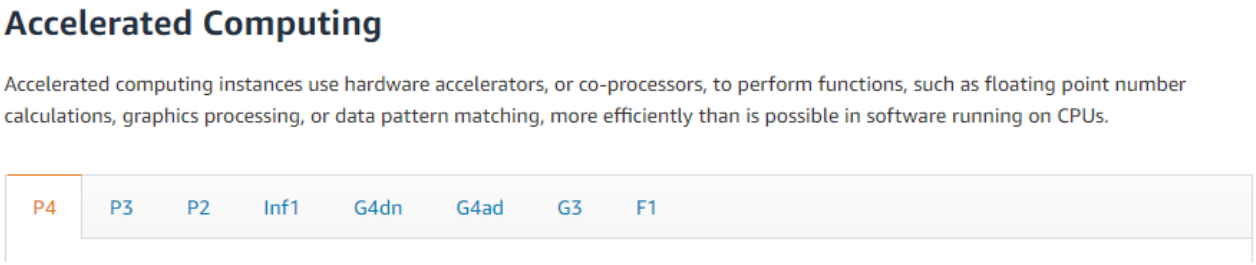
General Purpose: General purpose instance family provides a balance of compute, memory, and network resources, and it is a good choice for many applications.



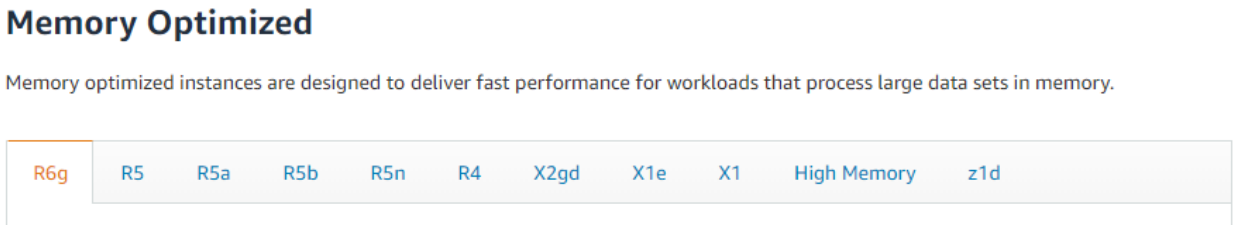
Compute Optimized (vCPUs): Compute Optimized instances are optimized for compute-intensive workloads and delivers high performance computing, batch processing.



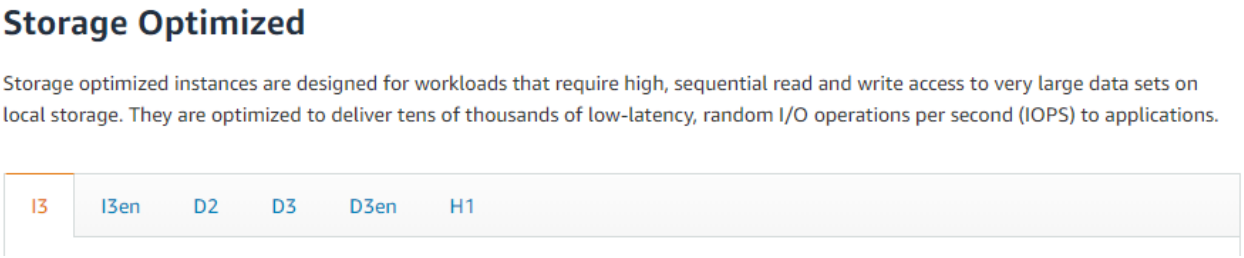
GPU Compute: GPU Compute instances are next generation of general purpose GPU computing instances. We can use GPU instances for 3D visualizations, graphics-intensive remote workstation, 3D rendering, application streaming, video encoding, Machine/Deep learning, high performance computing and other server-side graphics workloads.



Memory Optimized: Memory Optimized category instances are most suitable for high performance databases, distributed memory caches, in-memory analytics, large-scale, enterprise-class, and In-memory applications.



Storage Optimized:
Optimized category instances are most suitable for low latency, very high random I/O performance, high sequential read throughput and provide high IOPS and NoSQL databases like Cassandra, MongoDB, Redis and In-memory databases.



Instance launch pricing Options:

- On-Demand Instances
- Reserved Instances
- Spot Instances

On-Demand Instances:
The price **per hour/ per Second (with min of 60 sec)** for each instance type published on the AWS website represents the price for On-Demand Instances.

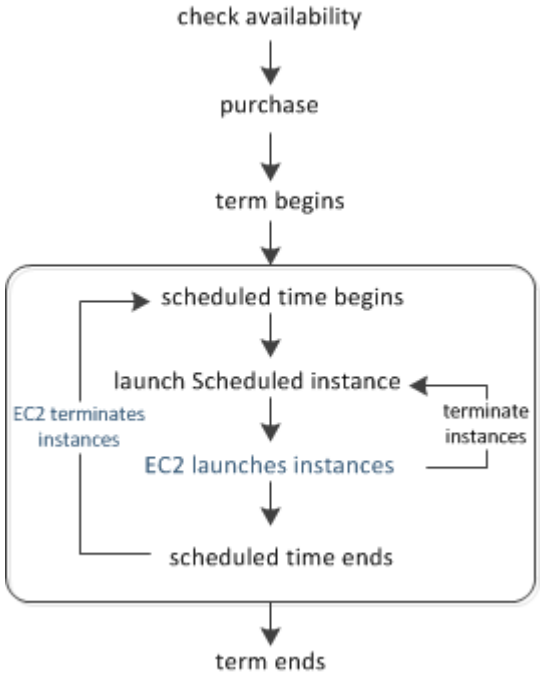
- On-Demand is most flexible pricing option, as it doesn't requires up-front commitment.
- We will have control over when the instance is launched and when it is terminated.
- Suitable for unpredictable workloads.

Reserved Instances:
When purchasing a reserved instance we have to specify the instance type and Availability Zone for that Reserved Instance and achieves a lower effective hourly price for that instance for the duration of the reservation. You can select duration from 1 Yr to 3 yrs. We have three offering classes in RI: Convertible, Standard and Scheduled.

Standard reserved Instances: These provide the most significant discount (up to 75% off On-Demand) and are best suited for steady-state usage.

Convertible reserved Instances: These provide a discount (up to 54% off On-Demand) and the capability to change the attributes of the RI as long as the exchange results in the creation of Reserved Instances of equal or greater value. Like Standard RIs, Convertible RIs are best suited for steady-state usage.

Scheduled Reserved Instances: These are available to launch within the time windows you reserve. This option allows you to match your capacity reservation to a predictable recurring schedule that only requires a fraction of a day, a week, or a month.



We have three payment options for Reserved Instances.

- **All Upfront**—Pay for the entire reservation up front. There is no monthly charge for the customer during the term.
- **Partial Upfront**—Pay a portion of the reservation charge up front and the rest in monthly installments for the duration of the term.

- **No Upfront—**Pay the entire reservation charge in monthly installments for the duration of the term.

Spot Instances:

For workloads that are not time critical and are tolerant of interruption, Spot Instances offer the greatest discount.

- We can specify the price they are willing to pay for a certain instance type.
- When the bid price is above the current Spot price, we'll get the requested instance.
- These instances will operate like all other Amazon EC2 instances, and the customer will only pay the Spot price for the hours that instance(s) run.

The instances will run until:

- Till we terminate them manually.
- The Spot price goes above our bid price.
- There is not enough unused capacity to meet the demand for Spot Instances.
- If Amazon EC2 needs to terminate a Spot Instance, the instance will receive a termination notice providing a **two-minute warning prior to termination**.
- If we terminate Instance manually we have to pay for Partial hours, if amazon terminates we will not get charged for partial hours.

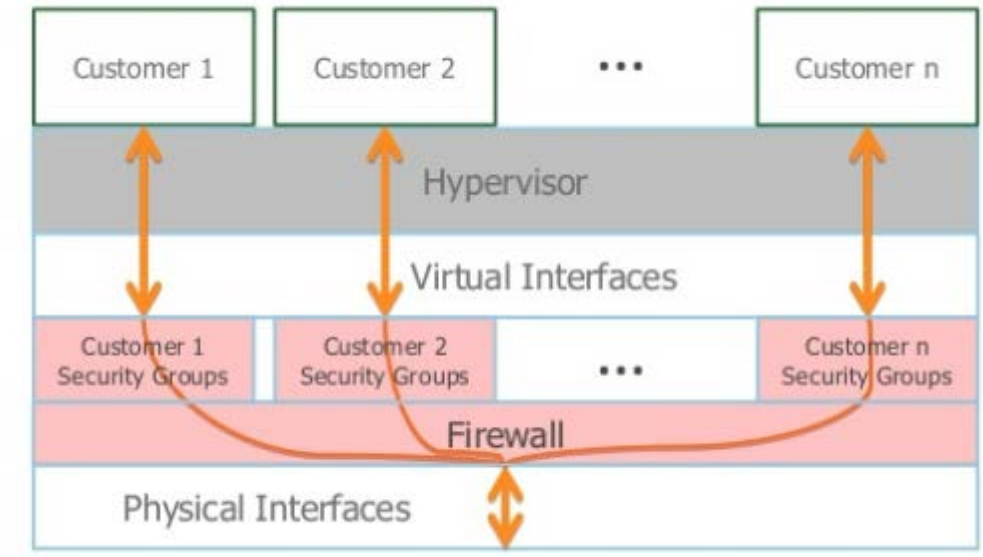
Tenancy Options:

Shared Tenancy: Shared tenancy is the default tenancy model for all Amazon EC2 instances. A single host machine may house instances from different customers. (One host may share with multiple customers).

Dedicated Instances: Dedicated Instances run on hardware that's dedicated to a single customer. As a customer runs more Dedicated Instances, more underlying hardware may be dedicated to their account.

Dedicated Host: An Amazon EC2 Dedicated Host is a physical server with Amazon EC2 instance capacity fully dedicated to a single customer's use. We will get complete control over which specific host runs an instance at launch.

EC2 Instance Isolation Diagram:



Amazon Machine Images (AMIs)

The Amazon Machine Image (AMI) defines the initial software that will be on an instance when it is launched.

- The Operating System (OS) and its configuration
- The initial state of any patches
- Application or system software

All AMIs are based on x86 OSs, either Linux or Windows.
We can launch instances from four options

1. Published by AWS
2. AWS Marketplace
3. Generated from existing Instance (Custom AMIs)
4. Uploaded Virtual Servers

Accessing an Instance: We can access our Instances by Using Public DNS, Public IP address and Elastic IP addresses.

Public DNS: When we launch instance, we will get one Public DNS associated for that instance.

- Public DNS will generate automatically. We can't specify
- We can found this information in Instance description
- We cannot transfer this Public DNS to another instance.
- We will get public DNS when the instance is in running state.

Public IP:

- When we launch instance, we will get one Public IP address also.
- AWS will allocate this address, no option to select specific IP.
- This is unique on the Internet.

Elastic IP

- An Elastic IP address is a static IPv4 address designed for dynamic cloud computing. An Elastic IP address is associated with your AWS account.
- To use an EIP address, we have to generate one to our AWS account, and then associate it with your instance or a network interface.
- We can disassociate an EIP address from a resource, and reassociate it with a different resource.
- A disassociated EIP address remains allocated to your account until you manually release it.
- By Default, we are limited to 5 Elastic IP addresses per region.

Steps to get EIP Address:

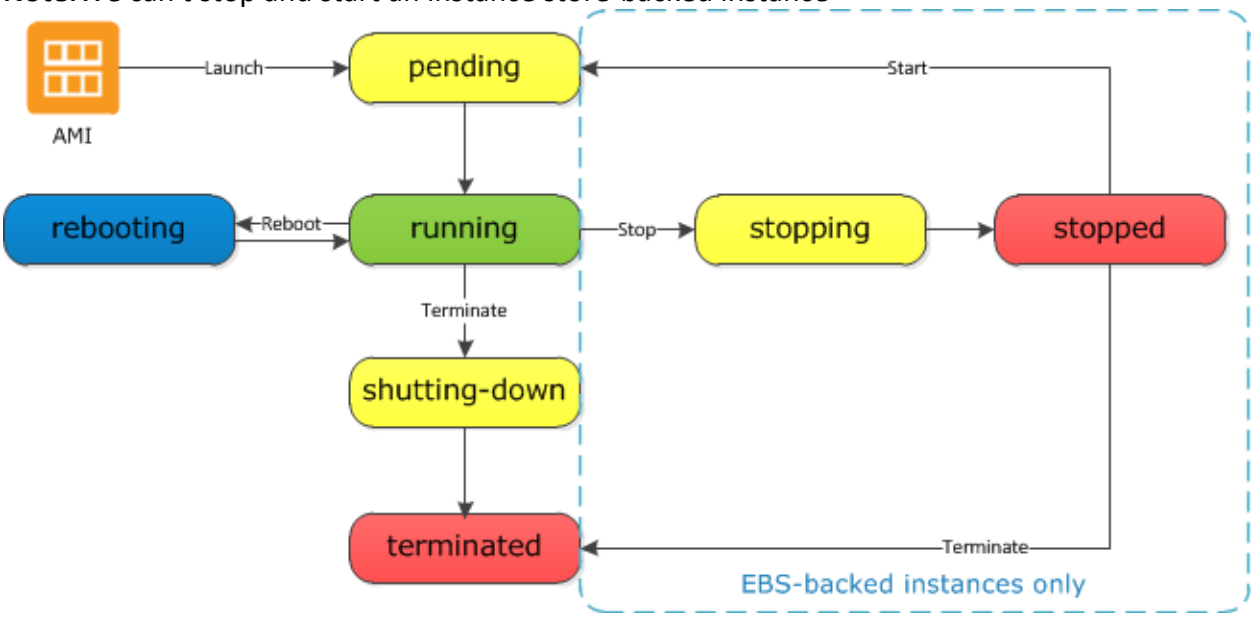
1. Login to AWS account and navigate to Amazon EC2 console.
2. In the navigation pane, choose **Elastic IPs**.
3. Choose Allocate new address.
4. Select Allocate. Close the confirmation screen.

Enhanced networking: reduces the impact of virtualization on network performance by enabling a capability called Single Root I/O Virtualization (SR-IOV). This results in more Packets per Second, lower latency, and less jitter.

Instance Lifecycle

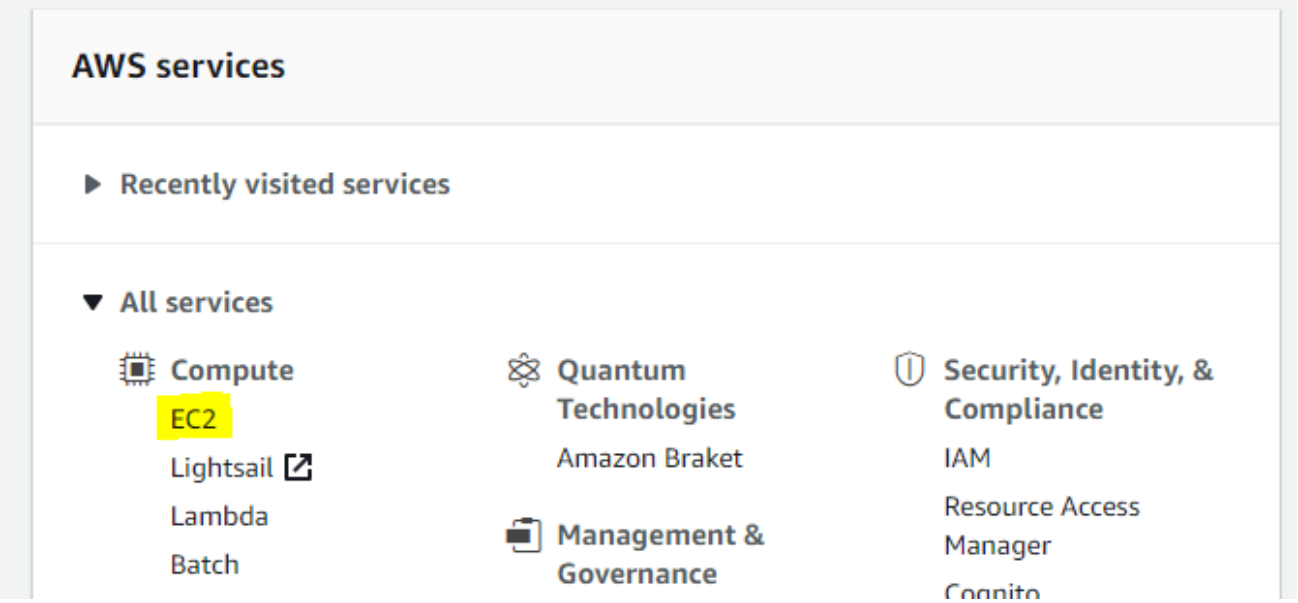
Here is a diagram that represents the transitions between instance states.

Note: We can't stop and start an instance store-backed instance

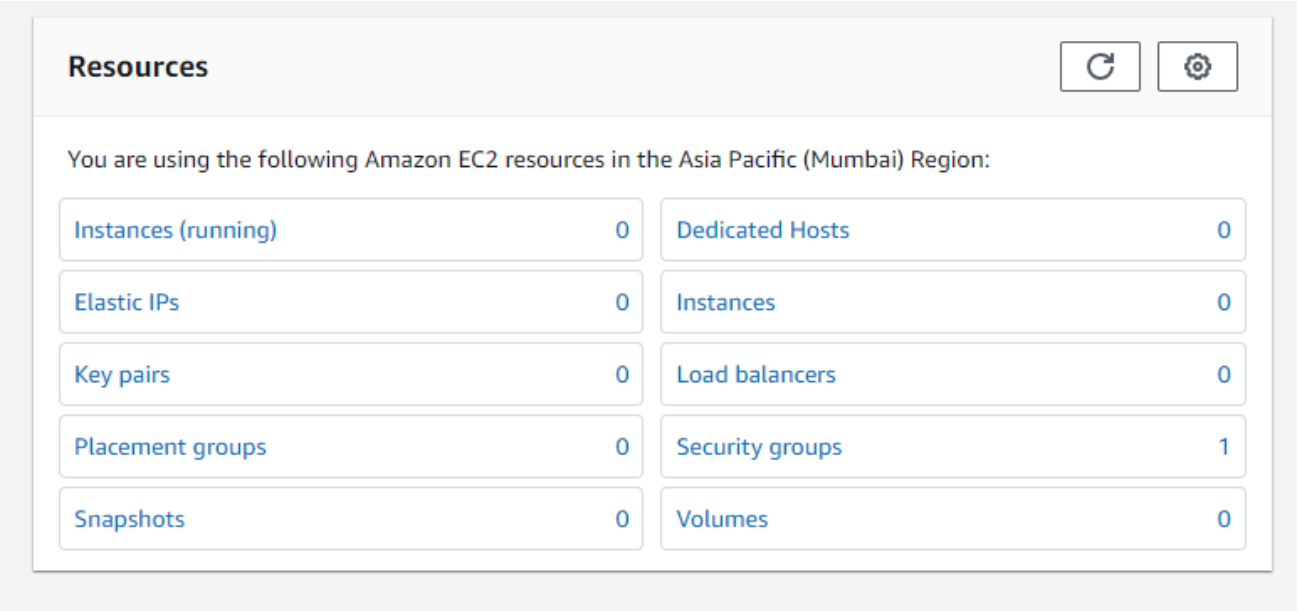


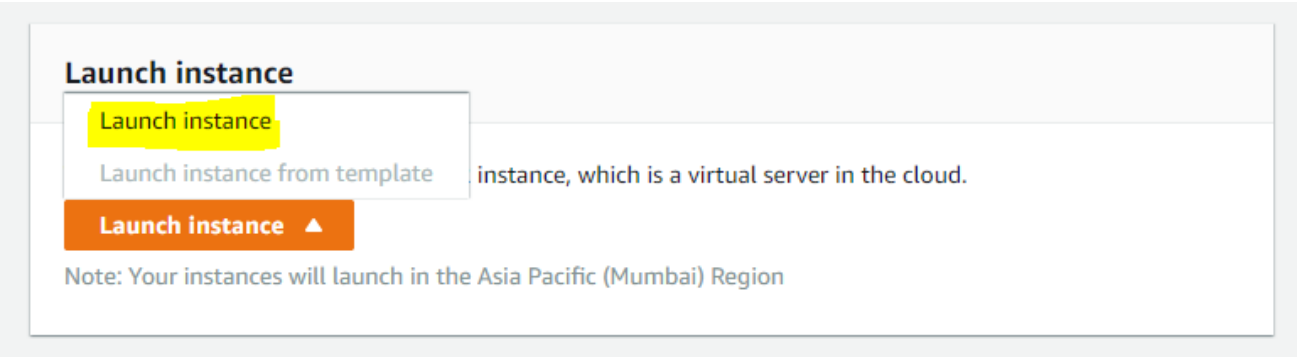
Instance launch process:

Login to Your AWS Account, Select and switch to the required Region and find **EC2 under Compute Section**.



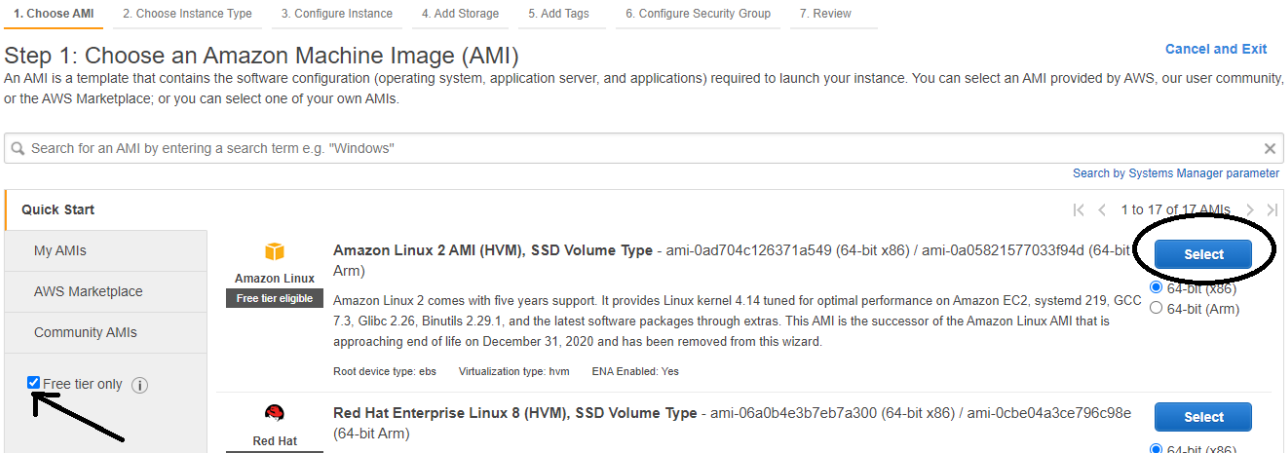
Select the Launch instance option and it will launch an instance launch wizard.





Step 1 : Choose an Amazon Machine Image (AMI)

I want to launch an Amazon Linux 2 AMI, so selecting Amazon Linux AMI from the Quick Start menu.

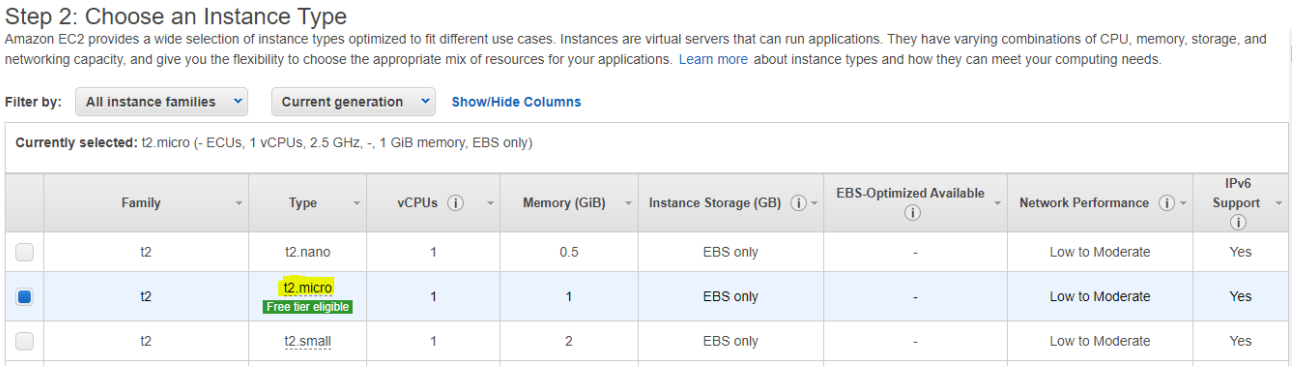


- We have Windows and Linux operating systems available here in Quick start option
- Along with the Quick Start option, you can also spin up your instances using the AWS Marketplace and the Community AMIs section. Both these options contains list of customized AMIs that have been created by either third-party companies or by developers and can be used for a variety of purposes.

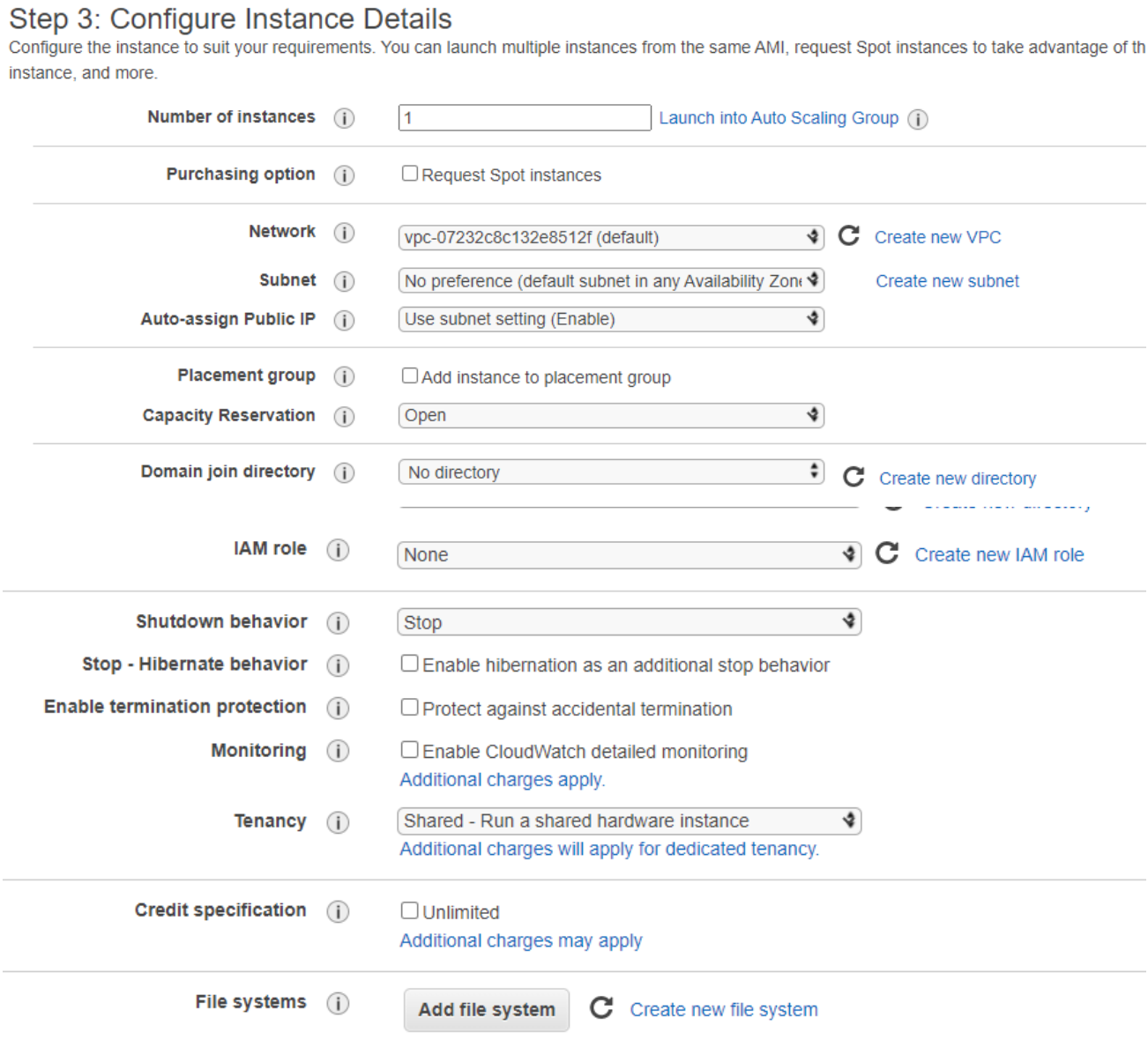
Step 2 : Choose an instance type

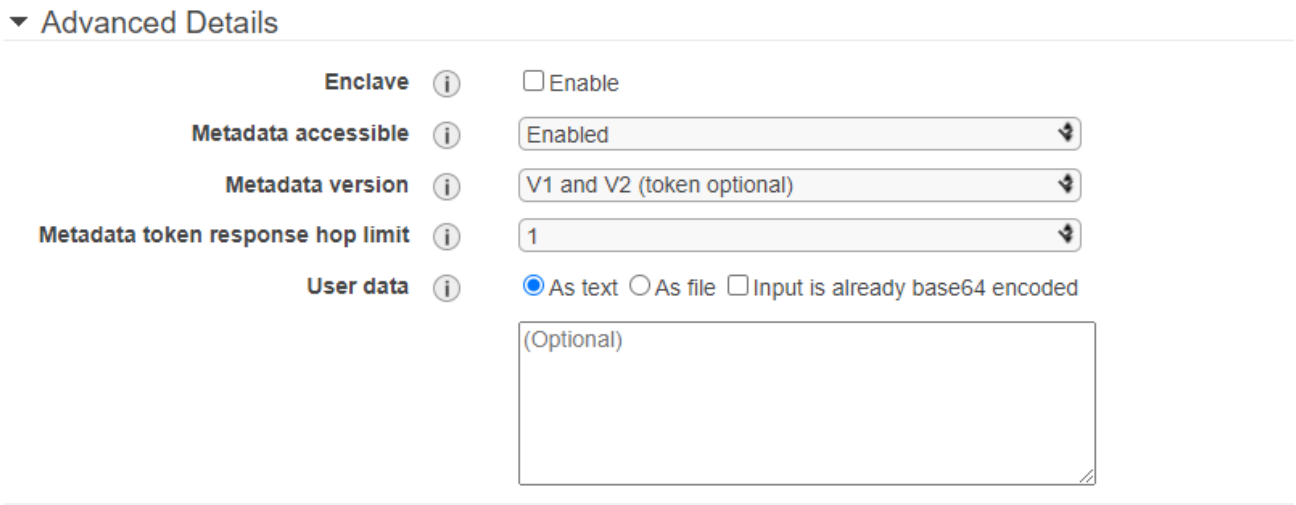
In the next step, we have to select the instance type as per our requirements. You can filter instances according to their families.

We can use the general purpose t2.micro instance type, which is comes under the free tier eligibility and configuration is 1 vCPU and 1 GB of RAM.



Step 3 : Configure instance details





Here is Step 3, we have multiple options,

Number of instances: You can specify how many instances the wizard should launch using this field. By default, the value is always set to one single instance.

Purchasing option: We can this instance under spot instances request. For now let's leave this option. We can launch this under Spot category.

Network: Select the default **Virtual Private Cloud** (**VPC**) network that is displayed in the dropdown list. We can even go ahead and create a new VPC network for this instance, but we will leave and will see VPC in later chapters.

Subnet: select the **Subnet** in which you wish to deploy your new instance.
You can either choose to have AWS select and deploy your instance in a particular subnet from an available list or you can select a particular choice of subnet on your own.

Auto-assign Public IP: Each instance that you launch will be assigned a Public IP. We are going to use this public IP to connect to our Instance over Internet.

Placement Groups: A placement group is a logical grouping of instances within a single Availability Zone. We have three types of Placement groups.

1. Cluster Placement groups
2. Partition Placemnt groups
3. Spread Placement groups

- Recommended for applications that benefit from low network latency, high network throughput, or both.
- The name you specify for a placement group must be unique within your AWS account.
- AWS recommend homogenous instances within placement groups.
- You can't merge placement groups.
- You can't move an existing instance into a placement group.

Capacity Reservations enable you to reserve compute capacity for your Amazon EC2 instances in a specific Availability Zone for any duration**.** By creating Capacity Reservations, we can ensure that we always have access to EC2 capacity when we need it, for as long as we need it.

Domain join directory : We can join launching ec2 instance into a Directory (if we have any).

IAM role: You can additionally select a particular IAM role to be associated with your instance. An IAM role automatically deploys AWS credentials to resources that assume it. We can access aws services from instance without configuring IAM Credentials.

Shutdown behavior: This option allows us to select whether the instance should stop or be terminated when issued a shutdown request. In this case, we have opted for the instance to stop when it is issued a shutdown command.

Stop - Hibernate behavior: Hibernation stops our instance and saves the contents of the instance's RAM to the root volume. We cannot enable hibernation after launch.

Enable termination protection: Select this option in case you wish to protect your instance against accidental deletions. It adds additional step for instance termination. If, we enable this option, we need to manually Disable to terminate the instance.

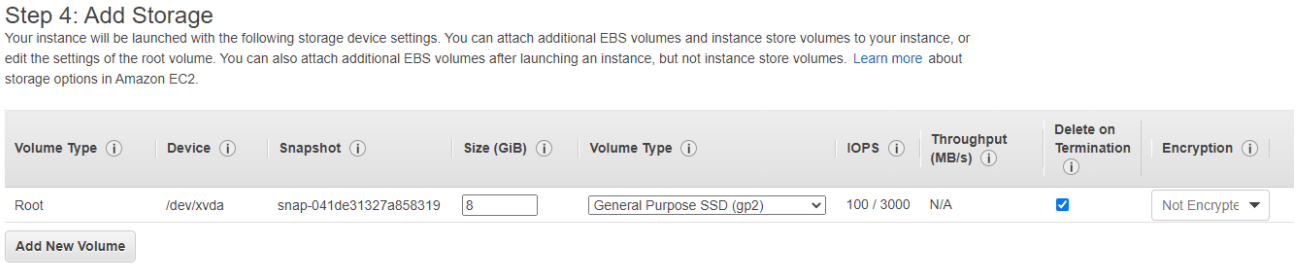
Monitoring: By default, AWS will monitor few basic parameters about your instance for free, but if you wish to have an in-depth insight into your instance's performance, then select the **Enable CloudWatch detailed monitoring** option**. But you'll get charged for detailed monitoring.**

Tenancy: We can choose to run our instances on physical servers fully dedicated for your use. The use of host tenancy will request to launch instances onto dedicated hosts.

File systems: While launching ec2 instance we can mount an EFS file system, ignore now.
Metadata accessible : We can turn on/off access to our instance metadata. Metadata is nothing but data about the data.

Bootstrapping We can configure instances and install applications programmatically when an instance is launched. The process of providing code to be run on an instance at launch is called bootstrapping.
On Linux instances this can be shell script, and on Windows instances this can be a batch style script or a PowerShell script.

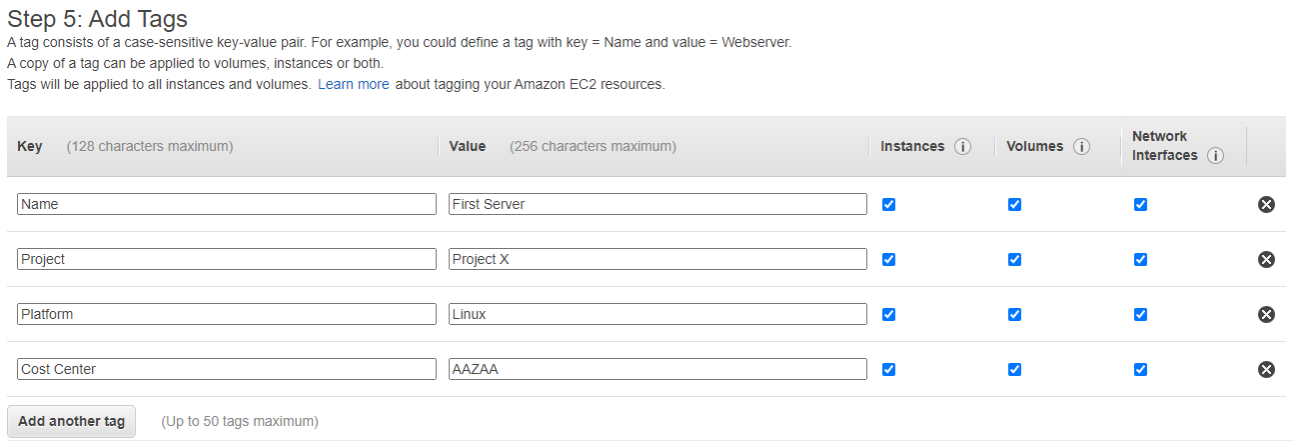
Step 4: Add Storage
We can add EBS volumes to your instances. To add new volumes, simply click on the Add New Volume button. This will provide you with options to provide the size of the new volume along with its mount points. There is an 8 GB volume already attached to our instance. This is the t2.micro instance's root volume.



- Try to keep the volume size under 30 GB, It'll comes under free tier eligibility.
- We can create volumes and attach to instance even after instance launch also.

Step 5: Add Tags

Tags are normal key-value pairs. We can manage our AWS resources with Tags options. We can create maximum of 50 tags per Instance.

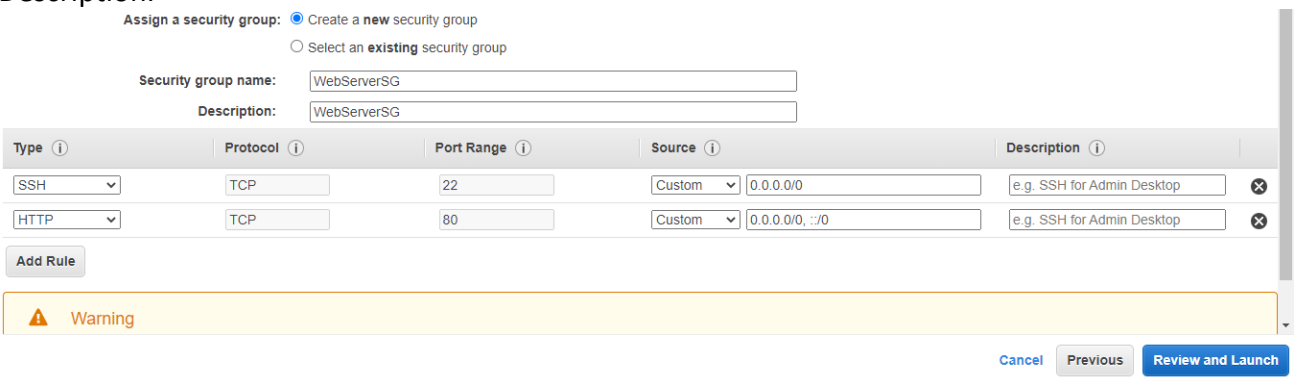


Step 6: Configure Security Group

A security group is a set of firewall rules that control the traffic for our instance. We can add rules to allow specific traffic to reach our instance. A security group acts as a virtual firewall for your EC2 instances to control incoming and outgoing traffic. Inbound rules control the incoming traffic to your instance, and outbound rules control the outgoing traffic from your instance.

For example, if you want to set up a web server and allow Internet traffic to reach our instance, add rules that allow unrestricted access to the HTTP and HTTPS ports. We can create a new security group or select from an existing one.

Select the **Create a new security group** option and enter the suitable Security group name and Description.



- You need to open SSH to Connect Linux machines, RDP for Windows machines. HTTP and HTTPS if webservers.
- We can give 0.0.0.0/0 to connect this instance from any network and subnet.
- We can select custom option and give the particular Network's public IP, then the service will be available for that particular network only.

Some Important points about Security Groups:

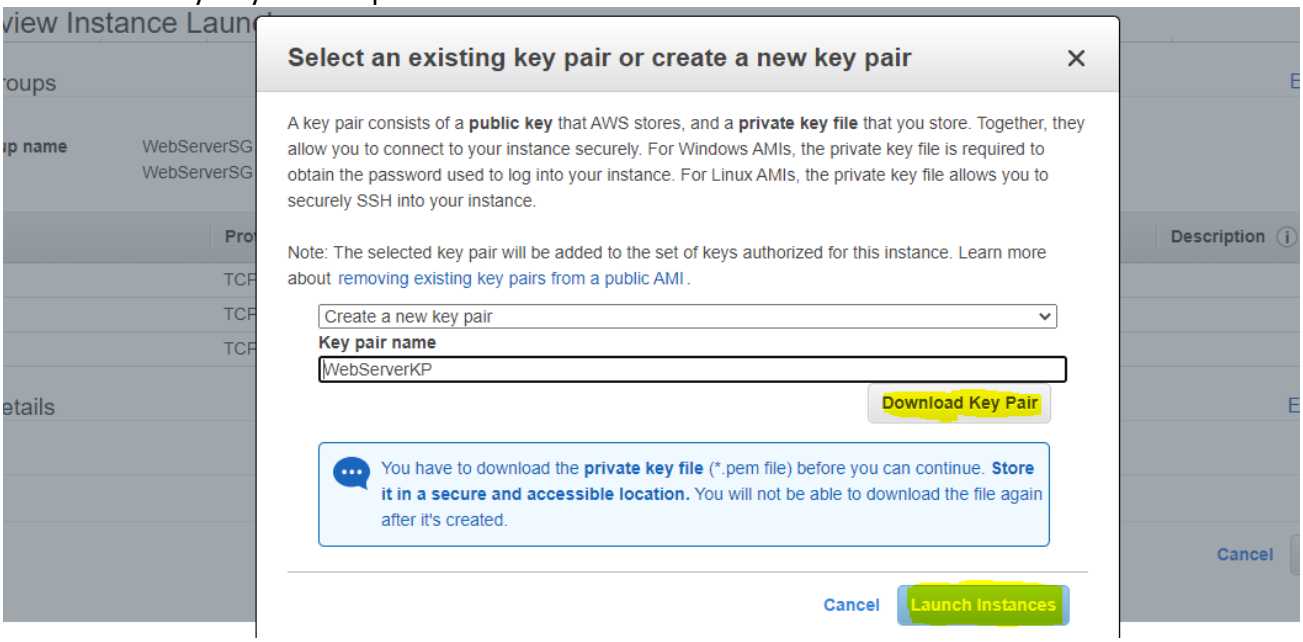
- Security group rules are always permissive; you can't create rules that deny access.
- You can add up to 50 inbound and 50 outbound rules to each security group. If you need to apply more than 100 rules to an instance, you can associate up to five security groups with each network interface.
- You can specify allow rules, but not deny rules. This is an important difference between security groups and ACLs.
- By default, no inbound traffic is allowed until you add inbound rules to the security group.
- By default, new security groups have an outbound rule that allows all outbound traffic.
- Security groups are **stateful**. This means that responses to allowed inbound traffic are allowed to flow outbound regardless of outbound rules and vice versa.
- You can change the security groups with which an instance is associated after launch, and the changes will take effect immediately

Step 7: Review Instance Launch

Here in step 7, we will get review screen. We will get complete summary of our instance's configuration details, including the AMI details, instance type selected, instance details, and so on. If all the details are correct, then simply go and click on the Launch option.

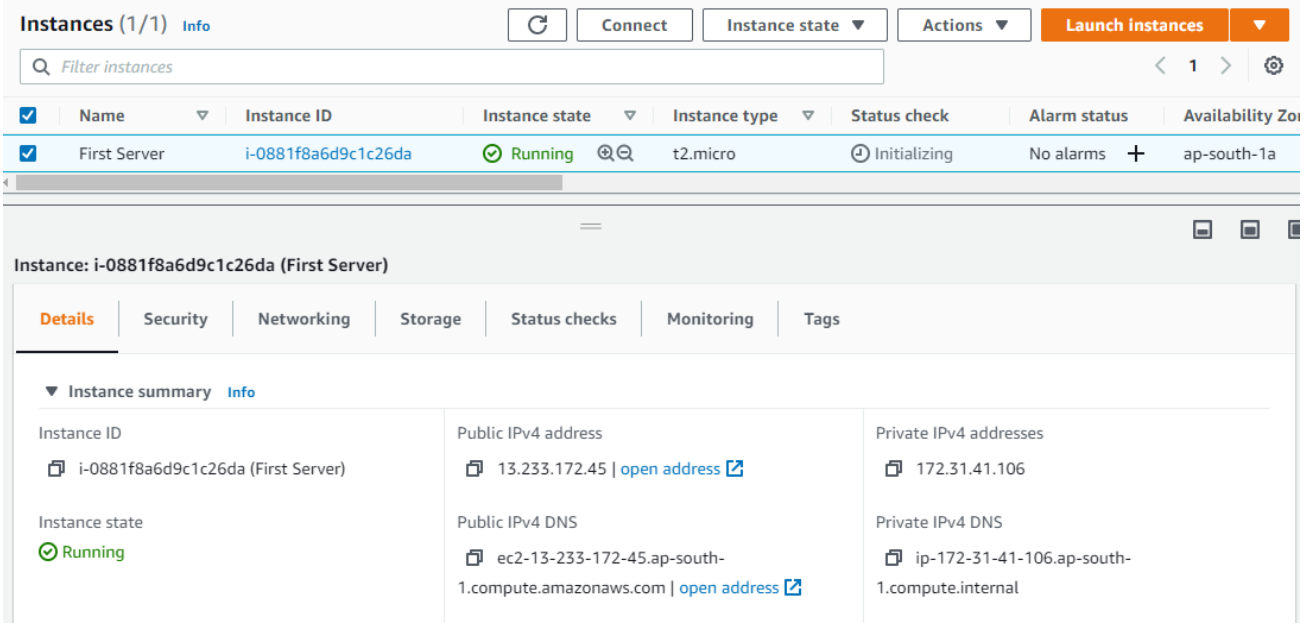
Then we have to associate a key pair to our instance.

A key pair is basically a combination of a public and a private key, which is used to encrypt and decrypt your instance's login info. AWS generates the key pair for you which you need to download and save locally to your computer.



Once a key pair is created and associated with an instance, we need to use that key pair itself to access the instance. We will not be able to download this key pair again so, save it in a secure location.

Select the **Create a new key pair** option from the dropdown list and provide a suitable name for your key pair as well. Click on the **Download Key Pair** option to download the **.PEM file**. Once completed, select the **Launch Instance** option.

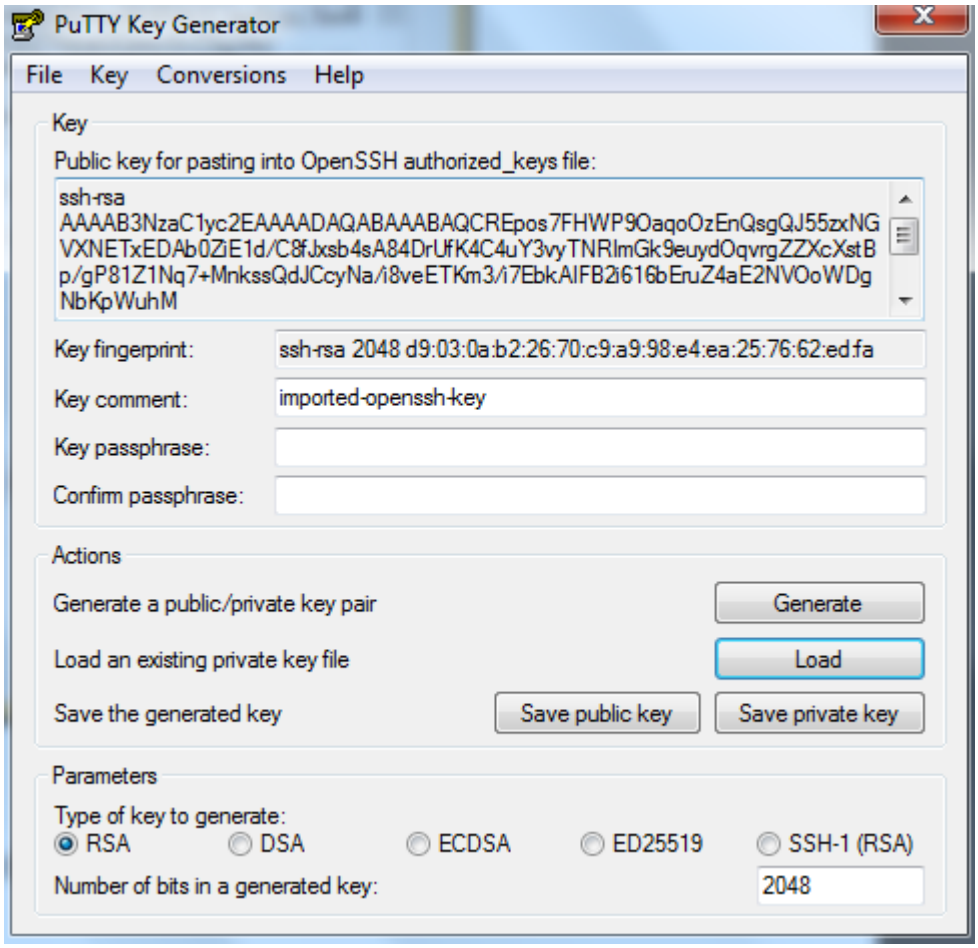


- The dashboard provides all of the information about our instance. We can view instance's ID, instance type, IP information, AZ, Security Group, and a whole lot more info.
- We can also obtain instance's health information using the Status Checks tab and the Monitoring tab.
- We can perform power operations on your instance such as start, stop, reboot, and terminate using the Actions tab located in the preceding instance table.

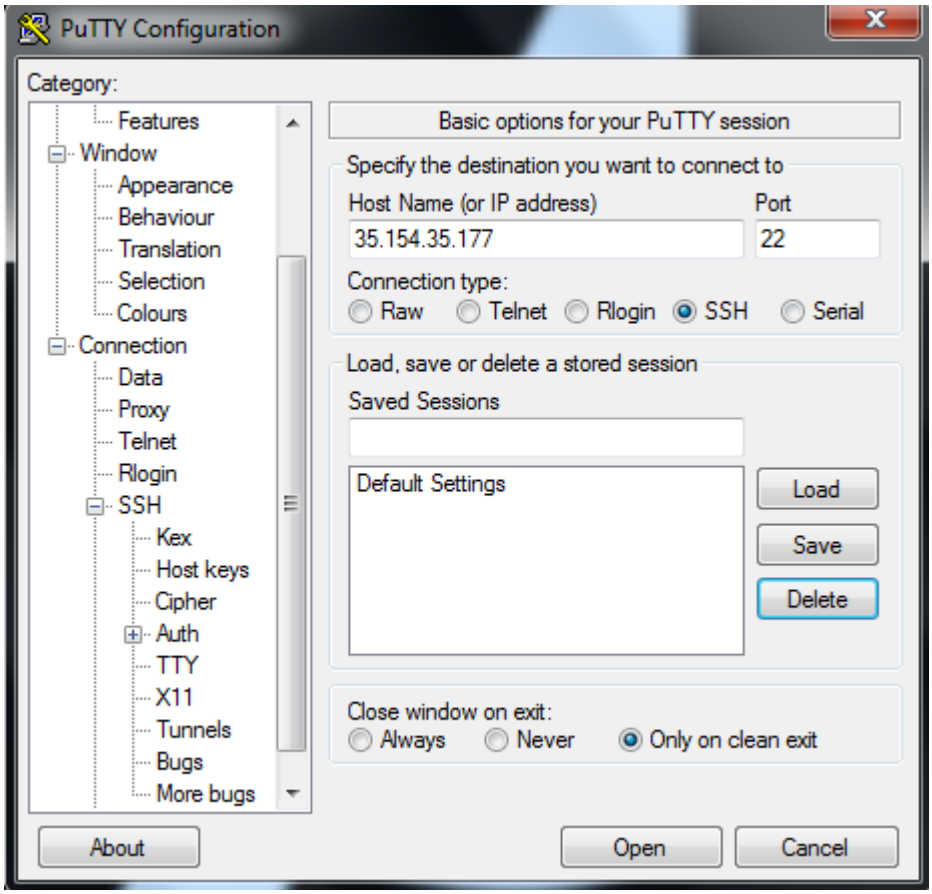
Connecting to Instance:

Once the instance is launched we have multiple options to connect to the instance. Mostly we can use **PuTTY** to connect Linux machines and **Remote Desktop** Feature for Windows Machine.
As we launched Linux machine, here we are going to see PuTTY option now.
PuTTY is basically an SSH and telnet client that can be used to connect to remote Linux instances. But before you get working on Putty, we need a tool called **PuttyGen** to convert the PEM file to PPK (Putty Private Key).
We can download the Putty.exe and PuttyGen.exe from the below URL:
https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html

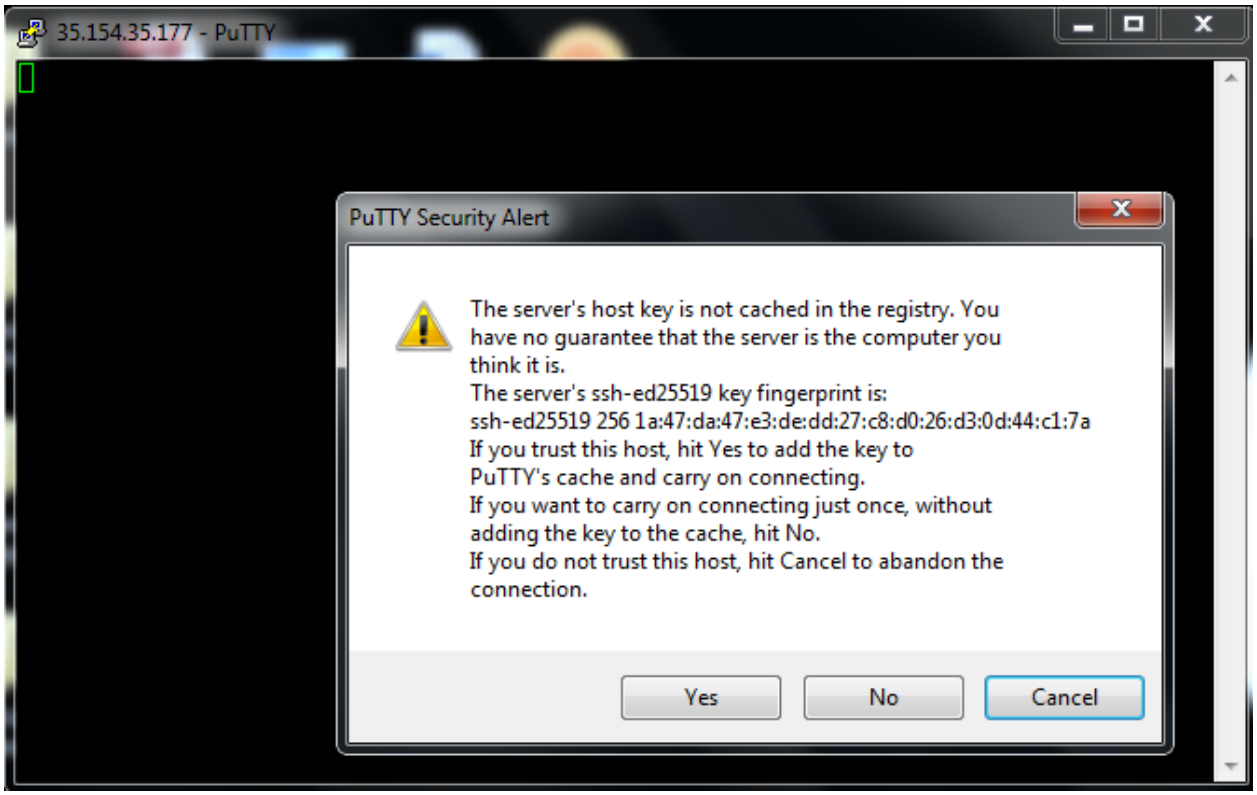
1. Download and install the latest copy of Putty and PuttyGen on local computer.
2. Launch PuttyGen and select the Load button and browse the downloaded Pem file (Which is created at the time of Instance launch).



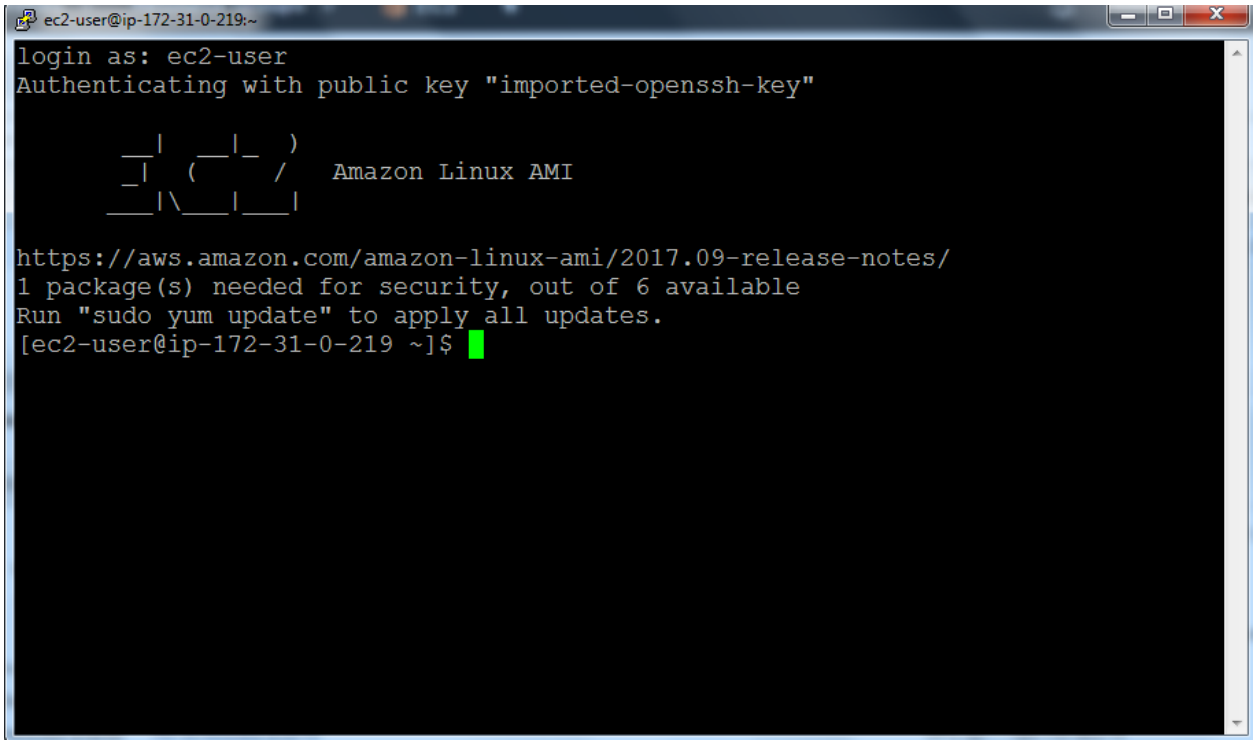
3. Once pem file is loaded, Select **"Save private key"** option.
    a. PuttyGen will prompt you with a warning message that you are saving this key without a passphrase and would you like to continue, Select **YES.**
4. Provide a name and save the new file (*.PPK) at a secure location. You can use this PPK file to connect to your instance using Putty
5. Please note down the **public IP address/ public DNS** of your instance.
6. Now open the **Putty** and enter the public IP in Host Name field and make sure to enter Port **22**



7. In Putty, under **Category pane**, expand the **SSH** option and then select **Auth**, then browse and upload the recently saved PPK file in the **Private key file for authentication** field. Once uploaded, click on Open to establish a connection to instance.
8. Give yes for on the Putty Security Alert.

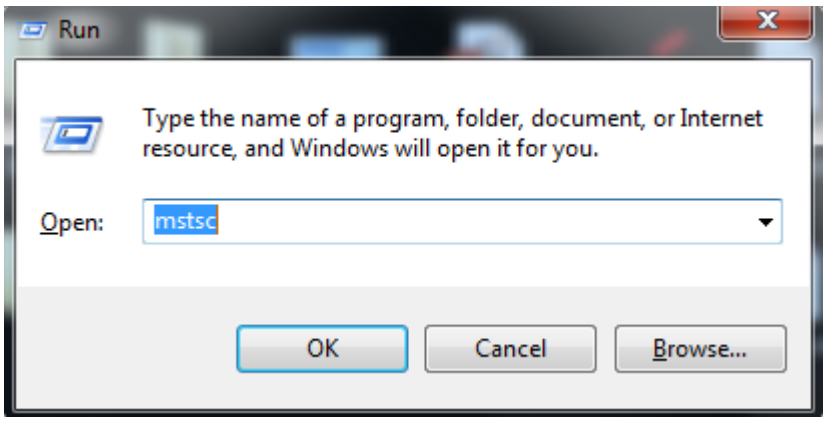


9. In the Putty terminal window, provide the user name for your Amazon Linux instance (ec2-user) and hit the *Enter* key. Now we have connected to our first instance and it is ready for use
10. Each Linux instance type launches with a default Linux system user account. For Amazon Linux, the user name is ec2-user. For RHEL, the user name is **ec2-user** or **root**. For Ubuntu, the user name is **ubuntu** or **root**. For Centos, the user name is **centos**. For Fedora, the user name is **ec2-user**. For SUSE, the user name is **ec2-user** or **root**. Otherwise, if **ec2-user** and **root** don't work, check with your AMI provider.
11

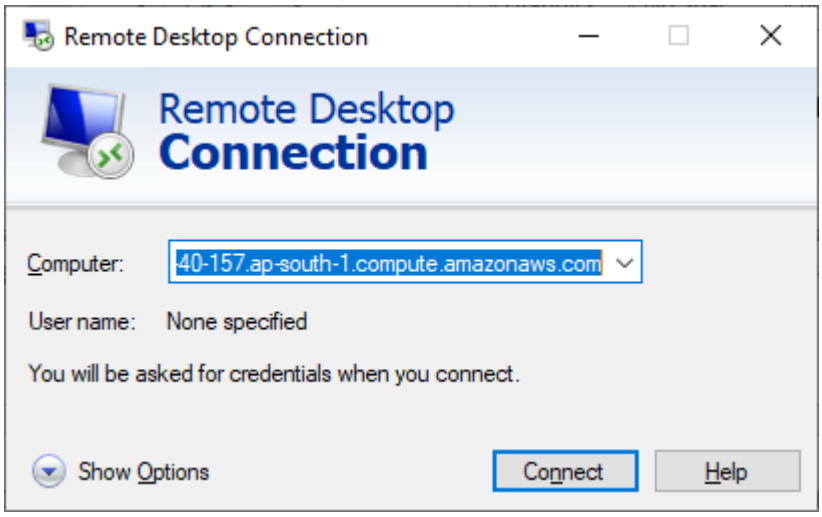


For RHEL-based AMIs (Redhat), the user name is either **root or the ec2-user**, and for Ubuntu-based AMIs, the user name is generally **Ubuntu** itself.

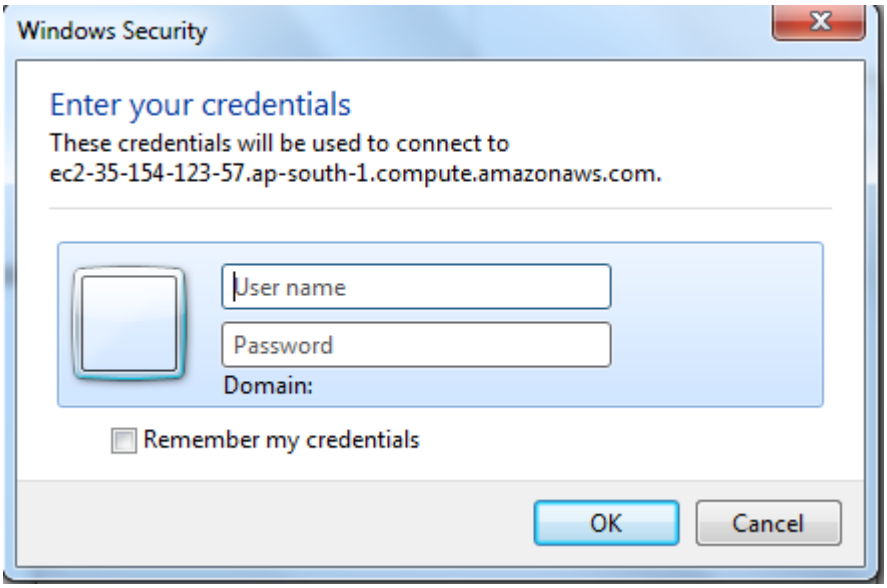
12. **To connect to Windows Instanc**e we have to use Remote Desktop Connection application.
13. Open Run and enter **mstsc**and press enter



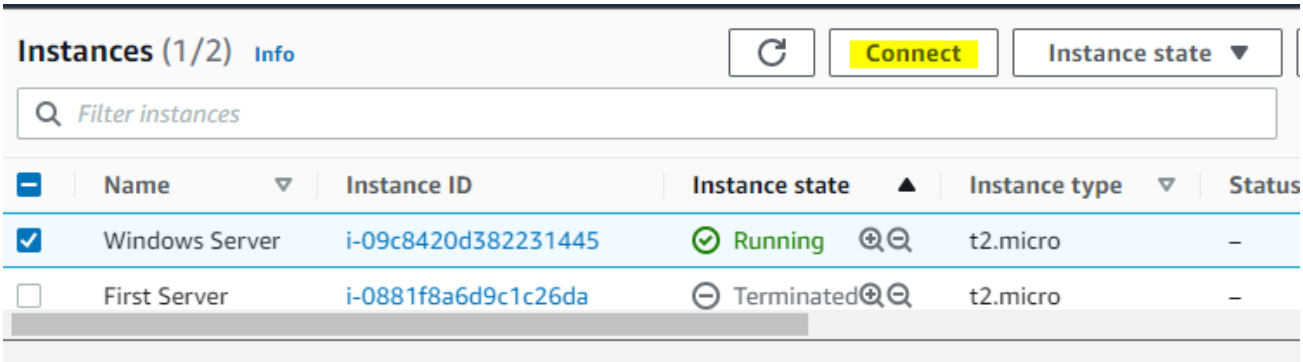
14. Note the public DNS/IP of the windows instance and enter it computer field and click on Connect.



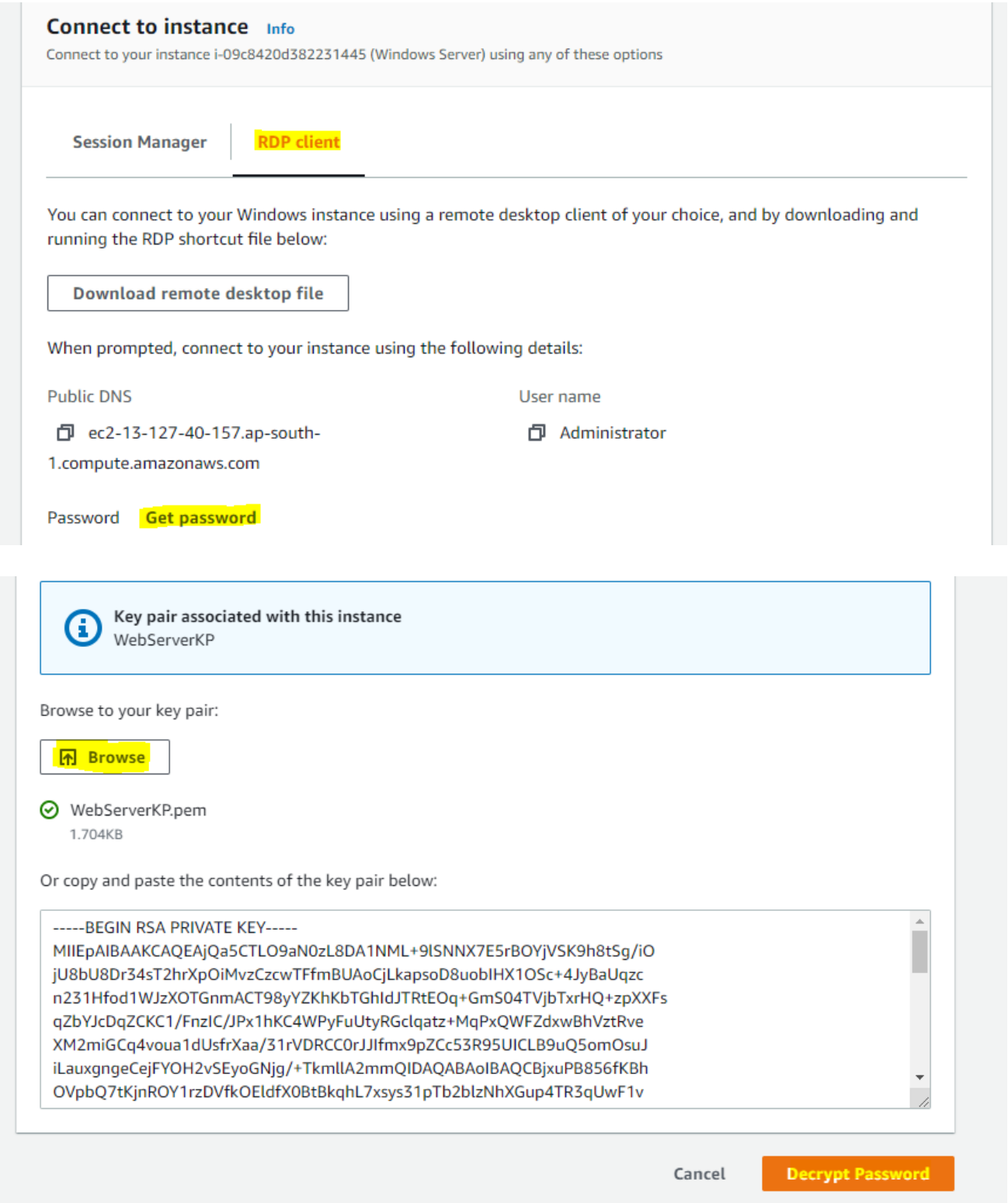
15 Now, It will ask you to enter the username and password to login to the instance.



16 To get the Username and password to login to the instance we have get it from EC2 console.



17 Select the instance which you want to get the UN & PWD. Click on **"Connect"**, then choose **"RDP CLient"** click on **"Get Password"** browse the PEM file and select "Decrypt Password" button.


Connect to instance Info
Connect to your instance i-09c8420d382231445 (Windows Server) using any of these options
Session Manager
RDP client
You can connect to your Windows instance using a remote desktop client of your choice, and by downloading and running the RDP shortcut file below:
Download remote desktop file
When prompted, connect to your instance using the following details:
Public DNS
ec2-13-127-40-157.ap-south-1.compute.amazonaws.com
User name
Administrator
Password
Get password
Key pair associated with this instance
WebServerKP
Browse to your key pair:
Browse
WebServerKP.pem
1.704KB
Or copy and paste the contents of the key pair below:
-----BEGIN RSA PRIVATE KEY-----
MIIEpAIBAAKCAQEAjQa5CTLO9aN0zL8DA1NML+9lSNNX7E5rBOYjVSK9h8tSg/iO
jU8bU8Dr34sT2hrXpOiMvzCzcwTFfmBUAoCjLkapsoD8uobIHX1OSc+4JyBaUqzc
n231Hfod1WJzXOTGnmACT98yYZKhKbTGhIdJTRtEOq+GmS04TVjbTxrHQ+zpXXFs
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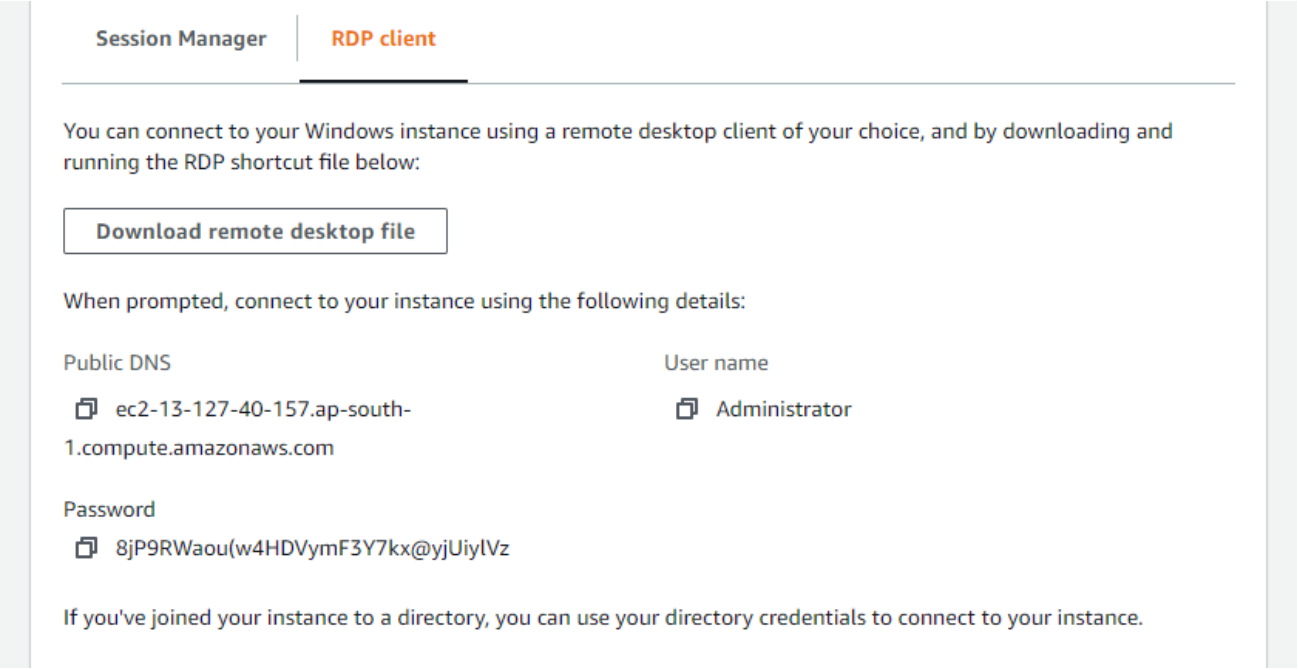
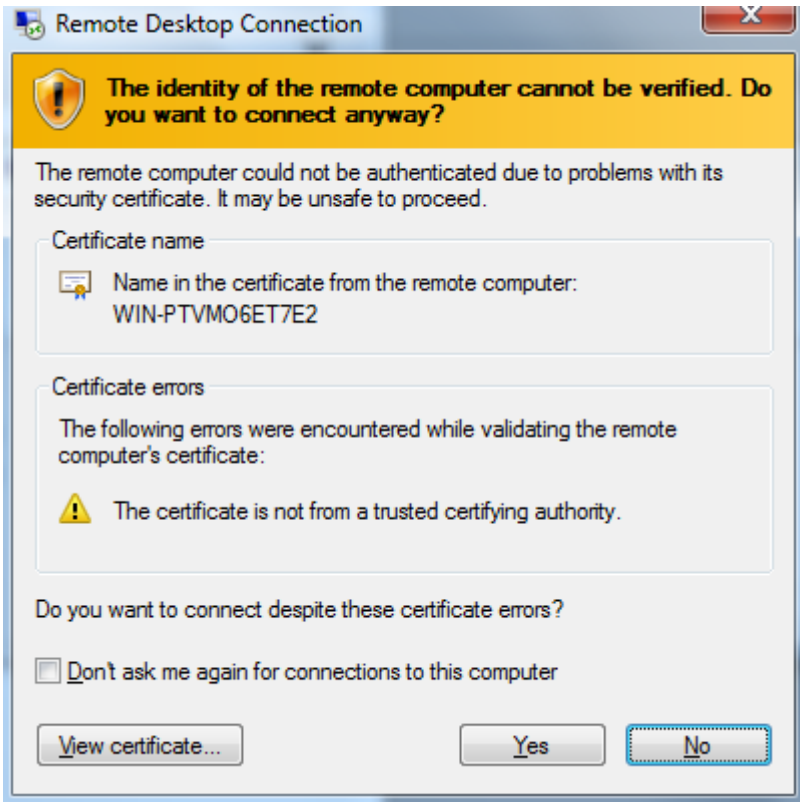
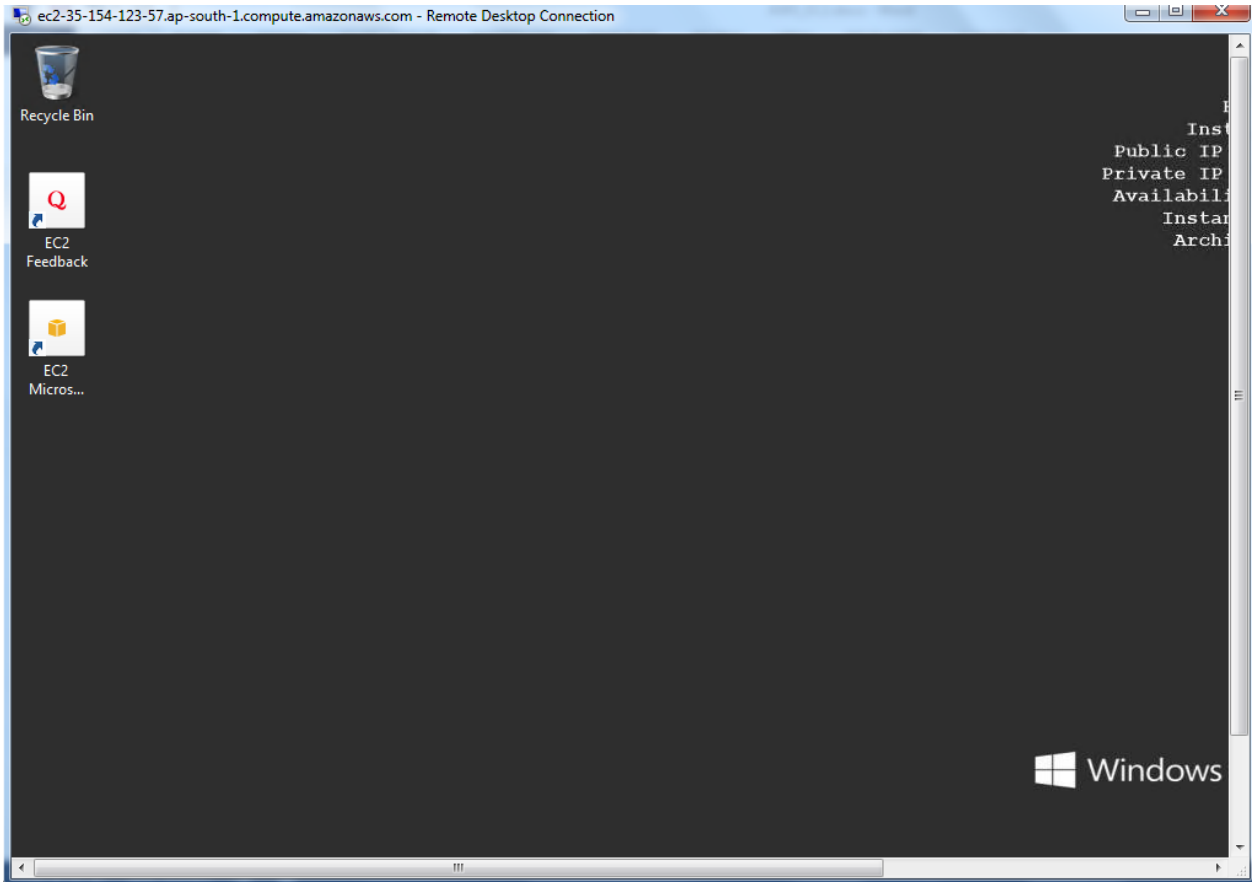
XM2miGCq4voua1dUsfrXaa/31rVDRCC0rJJIfmx9pZCc53R95UICLB9uQ5omOsuJ
iLauxgngeCejFYOH2vSEyoGNjg/+TkmllA2mmQIDAQABAoIBAQCBjxuPB856fKBh
OVpbQ7tKjnROY1rzDVfkOEldfX0BtBkqhL7xsys31pTb2blzNhXGup4TR3qUwF1v
Cancel
Decrypt Password



18 Then you'll get the UN and Password, you can enter this UN &Pwd and click on connect, You'll asked for Certificate error prompt, simply click on **Yes** to connect to this machine.



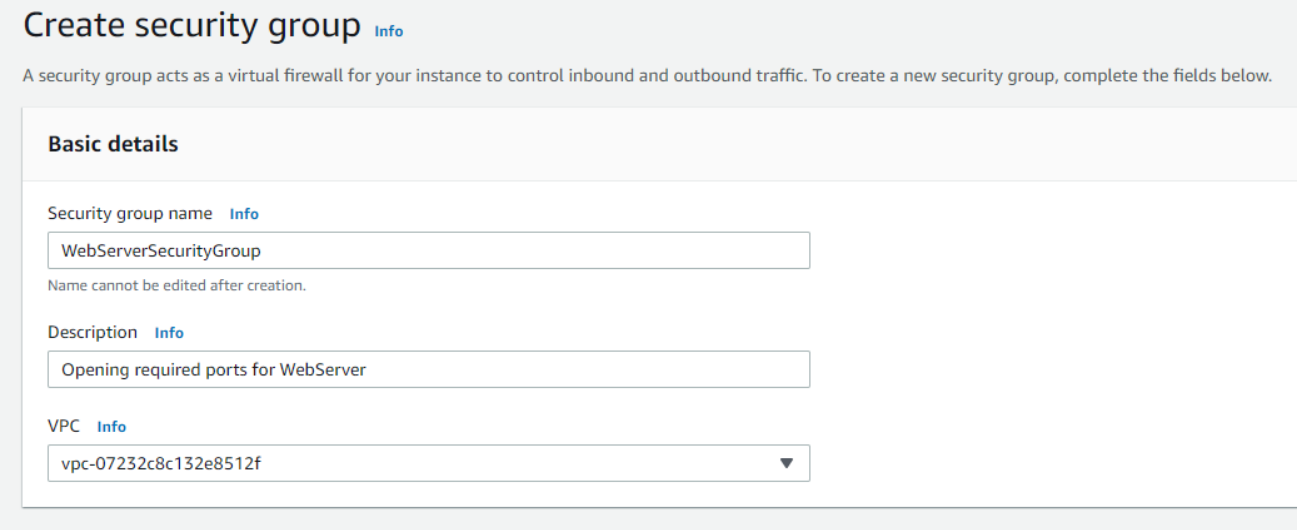
19 Now we have successfully connected to Windows Instance

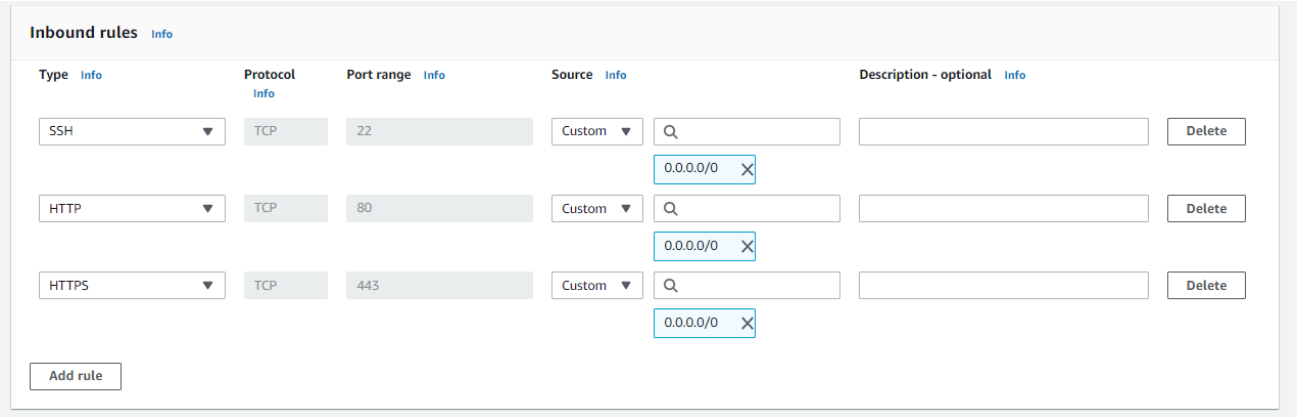

ec2-35-154-123-57.ap-south-1.compute.amazonaws.com - Remote Desktop Connection
Recycle Bin
EC2 Feedback
EC2 Micros...
Public IP
Private IP
Windows

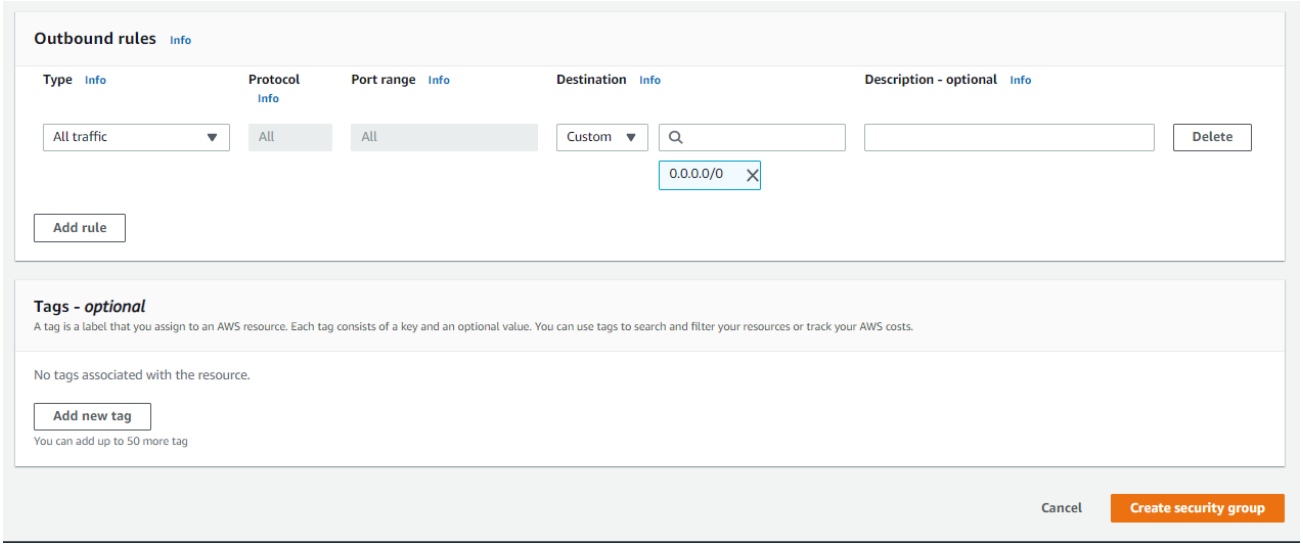
Security Groups

Security groups allow you to control traffic based on port, protocol, and source/destination.
You can use Security Groups to restrict and filter out both the inbound and outbound traffic of an instance using a set of firewall rules. Each rule can allow traffic based on a particular protocol—TCP or UDP, based on a particular port—such as 22 for SSH, or even based on individual source and destination IP addresses. This provides lot of control and flexibility in terms of designing a secure environment for instances to run from.

- Security groups are associated with instances when they are launched. Every instance must have at least one security group but can have more.
- A security group is **default deny**; that is, it does not allow any traffic that is not explicitly allowed by a security group rule.
- A security group is a **stateful firewall,** If you open some port in inbound, it'll automatically allowed for outbound also.
- Security groups are applied at the instance level.
- **Changes to Security Groups take effect immediately**
- We cannot block specific IP address using security groups.
- We can specify allow rules, but not deny rules.
- We can modify the firewall rules of Security Groups any time, even when your instance is running.







You can select the Protocol Type inn Type field, automatically it'll show the protocol type and Port Range, and then we have to select the source.
Source field where you can basically specify any of these three options:
Anywhere: Using this option as the source, particular application port will be accessible from any and all networks out there (0.0.0.0/0). This is not a recommended configuration by AWS.
My IP: AWS will autofill the IP address of your local computer/Network here. If you select My IP option then the service works only in that particular network only.
Custom IP: This is the most preferable option, the Custom IP option allows you to specify your own custom source IP address or IP range as per our requirements. Ex: allow the particular application to access only via traffic coming from the network 202.153.31.0/24 CIDR.

VOLUMES AND SNAPSHOTS

An Amazon EBS volume is a durable, block-level storage device that you can attach to an EC2 instance.
Amazon EBS provides persistent block-level storage volumes for use with Amazon EC2 instances. Each Amazon EBS volume is automatically replicated within its Availability Zone to protect you from component failure, offering high availability and durability. Multiple Amazon EBS volumes can be attached to a single Amazon EC2 instance. AWS have SSD-based volumes and HDD-based volumes.

Types of Amazon EBS Volumes

Amazon EBS provides the following volume types:

- General Purpose SSD (gp2)
- General Purpose SSD (gp3)
- Provisioned IOPS SSD (io1)
- Provisioned IOPS SSD (io2)
- Provisioned IOPS SSD (io2 Block Express) (in preview- July'21)
- Throughput Optimized HDD (st1)
- Cold HDD (sc1) and
- Magnetic (standard, a previous-generation type).

SSD-backed volumes optimized for transactional workloads involving frequent read/write operations with small I/O size, where the dominant performance attribute is IOPS
HDD-backed volumes optimized for large streaming workloads where throughput (measured in MiB/s) is a better performance measure than IOPS.

General Purpose SSD (gp2):
General Purpose SSD (gp2) volumes offer cost-effective storage that is ideal for a broad range of workloads. These volumes deliver single-digit millisecond latencies and the ability to burst to 3,000 IOPS for extended periods of time. Between a minimum of 100 IOPS (at 33.33 GiB and below) and a maximum of 10,000 IOPS (at 3,334 GiB and above), baseline performance scales linearly at 3 IOPS per GiB of volume size. AWS designs gp2 volumes to deliver the provisioned performance 99% of the time.
A gp2 volume can range in size from 1 GiB to 16 TiB.

General Purpose SSD (gp3): Amazon gp3 volumes are the latest generation of gp2 that enable customers to provision performance independent of storage capacity, while providing up to 20% lower pricing per GB than existing gp2 volumes.
A gp3 volume can range in size from 1 GiB to 16 TiB.

Provisioned IOPS SSD (io1):
Provisioned IOPS SSD (io1) volumes are designed to meet the needs of I/O-intensive workloads, particularly database workloads, that are sensitive to storage performance and consistency.

- An io1 volume can range in size from 4 GiB to 16 TiB and you can provision up to 32,000 IOPS per volume.

Provisioned IOPS SSD (io2): io2 is the latest generation of the Provisioned IOPS SSD volumes that is designed to provide 100X durability of 99.999% as well as a 10X higher IOPS to storage ratio of 500 IOPS for every provisioned GB –at the same price as the previous generation (io1). io2 is a high performance EBS storage option designed for business-critical, I/O intensive database applications, such as SAP HANA, Oracle, Microsoft SQL Server, and IBM DB2 that have high durability requirements.
To achieve the limit of 64,000 IOPS and 1,000 MB/s throughput, the volume must be attached to an EC2 instance built on the AWS Nitro System.

Throughput Optimized HDD (st1):
Throughput Optimized HDD (st1) volumes provide low-cost magnetic storage that defines performance in terms of throughput rather than IOPS. This volume type is a good fit for large, sequential workloads such as Amazon EMR, ETL, data warehouses, and log processing.

- Not supported to use with root volume (Not Bootable)
- volume sizes ranging from 125 GiB to 16 TiB
- We will get Throughputs and Baseline is 40 MB/s per TiB

Cold HDD (sc1) Volumes

Cold HDD (sc1) volumes provide low-cost magnetic storage that defines performance in terms of throughput rather than IOPS. With a lower throughput limit than st1, sc1 is a good fit ideal for large, sequential cold-data workloads. If you require infrequent access to your data and are looking to save costs, sc1 provides inexpensive block storage.

- Not supported to use with root volume (Not Bootable)
- volume sizes ranging from 125 GiB to 16 TiB
- We will get Throughputs and Baseline is 12 MB/s per TiB

Magnetic volumes:

Magnetic volumes are backed by magnetic drives and are suited for workloads where data is accessed infrequently, and scenarios where low-cost storage for small volume sizes is important. These volumes deliver approximately 100 IOPS on average, with burst capability of up to hundreds of IOPS.

- Volume sizes ranging from 1 GiB to 1 TiB.

AWS Recently introduced Multi Attach volume feature.

Amazon EBS Multi-Attach enables you to attach a single Provisioned IOPS SSD (io1 or io2) volume to multiple instances that are in the same Availability Zone.

- Multi-Attach enabled volumes can be attached to up to 16 Linux instances built on the Nitro System that are in the same Availability Zone.
- Multi-Attach is supported exclusively on Provisioned IOPS SSD volumes.
- Multi-Attach for io2 volumes is available in all Regions that support io2 volumes. Multi-Attach for io1 volumes is available in the following Regions only: us-east-1, us-west-2, eu-west-1, and ap-northeast-2.
- Multi-Attach enabled volumes can't be created as boot volumes.
- Multi-Attach enabled volumes can be attached to one block device mapping per instance.
- Multi-Attach can't be enabled during instance launch using either the Amazon EC2 console or RunInstances API.
- The following table shows volume modification support for Multi-Attach enabled io1 and io2 volumes after creation. (* We can't enable or disable Multi-Attach while the volume is attached to an instance.)

	io2 volumes	io1 volumes
Modify volume type	✗	✗
Modify volume size	✓	✗
Modify provisioned IOPS	✓	✗
Enable Multi-Attach	✓ *	✗
Disable Multi-Attach	✓ *	✗

Solid State Drives (SSD)

Volume Type	EBS Provisioned IOPS SSD (io2 Block Express)	EBS Provisioned IOPS SSD (io2)	EBS Provisioned IOPS SSD (io1)	EBS General Purpose SSD (gp3)	EBS General Purpose SSD (gp2)*
Short Description	Highest performance SSD volume designed for business-critical latency-sensitive transactional workloads	Highest performance and highest durability SSD volume designed for latency-sensitive transactional workloads	Highest performance SSD volume designed for latency-sensitive transactional workloads	Lowest cost SSD volume that balances price performance for a wide variety of transactional workloads	General Purpose SSD volume that balances price performance for a wide variety of transactional workloads
Durability	99.999%	99.999%	99.8% - 99.9% durability	99.8% - 99.9% durability	99.8% - 99.9% durability
Use Cases	Largest, most I/O intensive, mission critical deployments of NoSQL and relational databases such as Oracle, SAP HANA, Microsoft SQL Server, and SAS Analytics	I/O-intensive NoSQL and relational databases	I/O-intensive NoSQL and relational databases	Virtual desktops, medium sized single instance databases such as Microsoft SQL Server and Oracle, latency sensitive interactive applications, boot volumes, and dev/test environments	Virtual desktops, medium sized single instance databases such as Microsoft SQL Server and Oracle, latency sensitive interactive applications, boot volumes, and dev/test environments
API Name	io2	io2	io1	gp3	gp2
Volume Size	4 GB – 64 TB	4 GB – 16 TB	4 GB - 16 TB	1 GB - 16 TB	1 GB - 16 TB
Max IOPS**/Volume	256,000	64,000	64,000	16,000	16,000

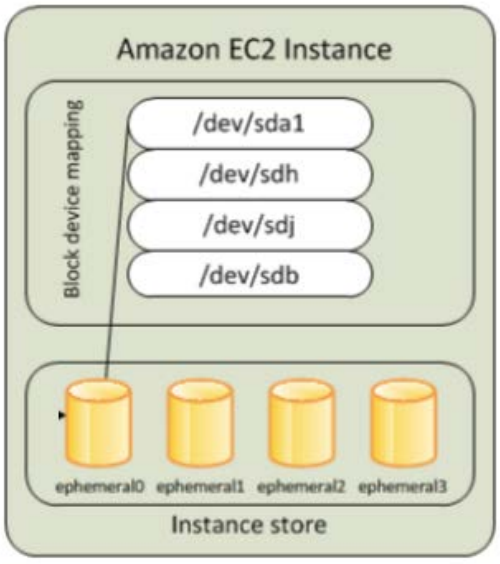
	Hard Disk Drives (HDD)	
	Throughput Optimized HDD (st1)	Cold HDD (sc1)
Short Description	Low cost HDD volume designed for frequently accessed, throughput intensive workloads	Lowest cost HDD volume designed for less frequently accessed workloads
Durability	99.8% - 99.9% durability	99.8% - 99.9% durability
Use Cases	Big data, data warehouses, log processing	Colder data requiring fewer scans per day
API Name	st1	sc1
Volume Size	125 GB - 16 TB	125 GB - 16 TB
Max IOPS**/Volume	500	250
Max Throughput***/Volume	500 MB/s	250 MB/s

Throughput is the maximum rate of production or the maximum rate at which something can be processed.

Network throughput is the rate of successful message delivery over a communication channel.

Instance Store Volume

An instance store provides temporary block-level storage for your instance. This storage is located on disks that are physically attached to the host computer. Instance store is ideal for temporary storage of information that changes frequently, such as buffers, caches, scratch data, and other temporary content



Instance Store Lifetime

- The underlying disk drive fails
- The instance stops
- The instance terminates

Instance Store Volumes are also called as Ephemeral Storage.

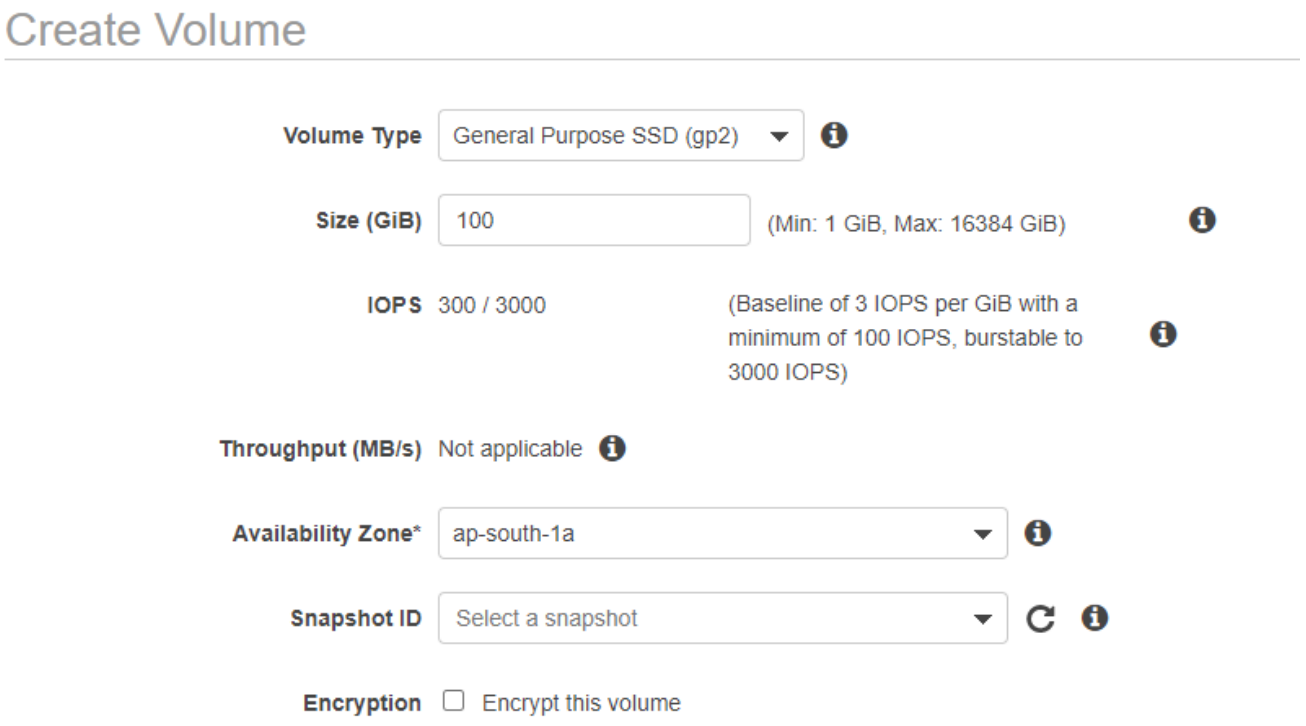
Instance store volumes cannot be stopped. If the underlying host fails, you will lose your data.

EBS backed instances can be stopped. You will not lose the data on this instance if it is stopped.

By default, both ROOT volumes will be deleted on termination, however with EBS volumes, you can keep the root device volume by Unchecking the "Delete on Termination" option.

Create a Volume:

From the Volume Management dashboard, select the Create Volume option.



Type: From the Type drop-down list, select either General Purpose (SSD), Provisioned IOPS (SSD), or Magnetic as per the requirements.

Size (GiB): Provide the size of your volume in GB.

IOPS: This field will only be editable if you have selected Provisioned IOPS (SSD) as the volume's type. Enter the max IOPS value as per your requirements.

Availability Zone: Select the appropriate availability zone in which you wish to create the volume.

Snapshot ID: This is an optional field. We can choose to populate your EBS volume based on a third party's snapshot ID.

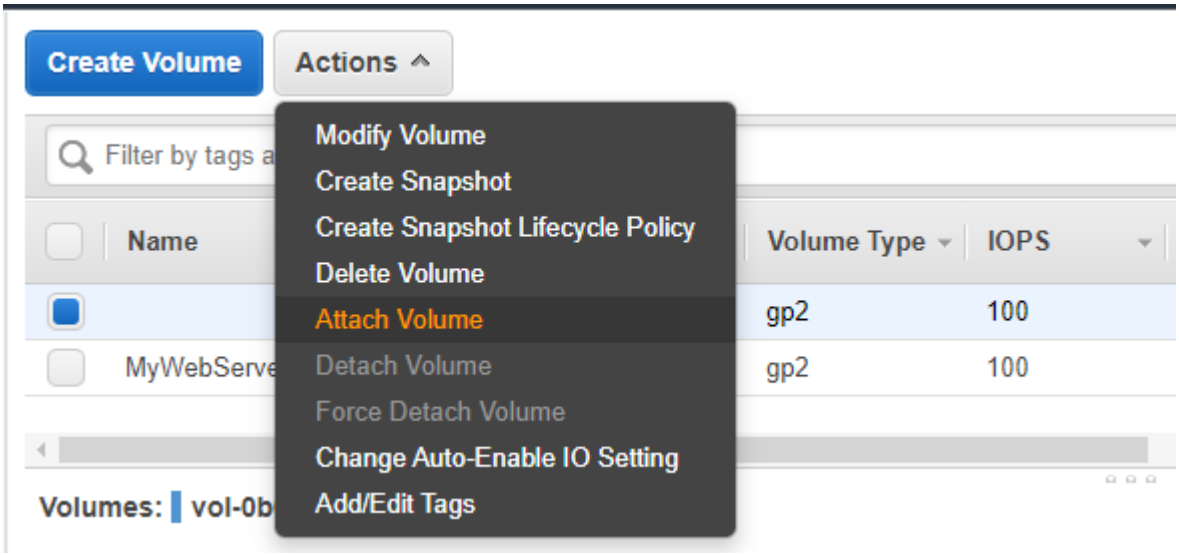
Encryption: We can choose whether or not to encrypt EBS Volume. Select Encrypt this volume checkbox if you wish to do so.

Master Key: On selecting the Encryption option, AWS will automatically create a default key pair for the AWS's KMS.

Once configuration settings are filled in, select Create to complete the volume's creation process. The new volume will take a few minutes to be available for use. Once the volume is created, we can now attach this volume to running instance.

Attaching EBS Volumes: Once the EBS volume is created, make sure it is in the available state before you go ahead and attach it to an instance. You can attach multiple volumes to a single instance at a time.

To attach a volume, select the **volume** from the Volume Management dashboard. Then select the **Actions** tab and click on the **Attach Volume** option.



When you select instance field, automatically you'll get thee running instances list from that particular availability zone. Select the Instance you want to attach this volume. Then click on **Attach**. Now the Volume state will change to **in-use** from Available.

We have to mount this volume from operating system level. For windows, you have to perform it though Disk Management option.

In Linux:

1. Elevate your privileges to root.
2. Type **df –h** command to check the current disk partitioning of instance.
3. Give **fdisk –l** command to verify the newly added disk.

```
[root@ip-172-31-7-51 ~]# fdisk -l
WARNING: fdisk GPT support is currently new, and therefore in an experimental phase.
 Use at your own discretion.

Disk /dev/xvda: 8589 MB, 8589934592 bytes, 16777216 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: gpt


#         Start          End    Size  Type            Name
 1         4096     16777182      8G  Linux filesyste Linux
128         2048         4095      1M  BIOS boot parti BIOS Boot Partition

Disk /dev/xvdf: 1073 MB, 1073741824 bytes, 2097152 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
```

4. We have to choose the file system type. Here am using ext4 file system. Then run the following command.

   If you wish to use ext4 file system : mkfs –t ext4 /dev/xvdf

   If you wish to use xfs file system : mkfs -t xfs /dev/xvdf

```
[root@ip-172-31-7-51 ~]# mkfs -t ext4 /dev/xvdf
mke2fs 1.42.12 (29-Aug-2014)
Creating filesystem with 262144 4k blocks and 65536 inodes
Filesystem UUID: 380ed17c-022a-440e-a696-ccd0caa3bd78
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376

Allocating group tables: done
Writing inode tables: done
Creating journal (8192 blocks): done
Writing superblocks and filesystem accounting information: done
```

5. Now volume is formatted, we can create a new directory on Linux instance and mount the volume to it using standard Linux commands:

   mkdir /newvolume

   mount /dev/xvdf /newvolume

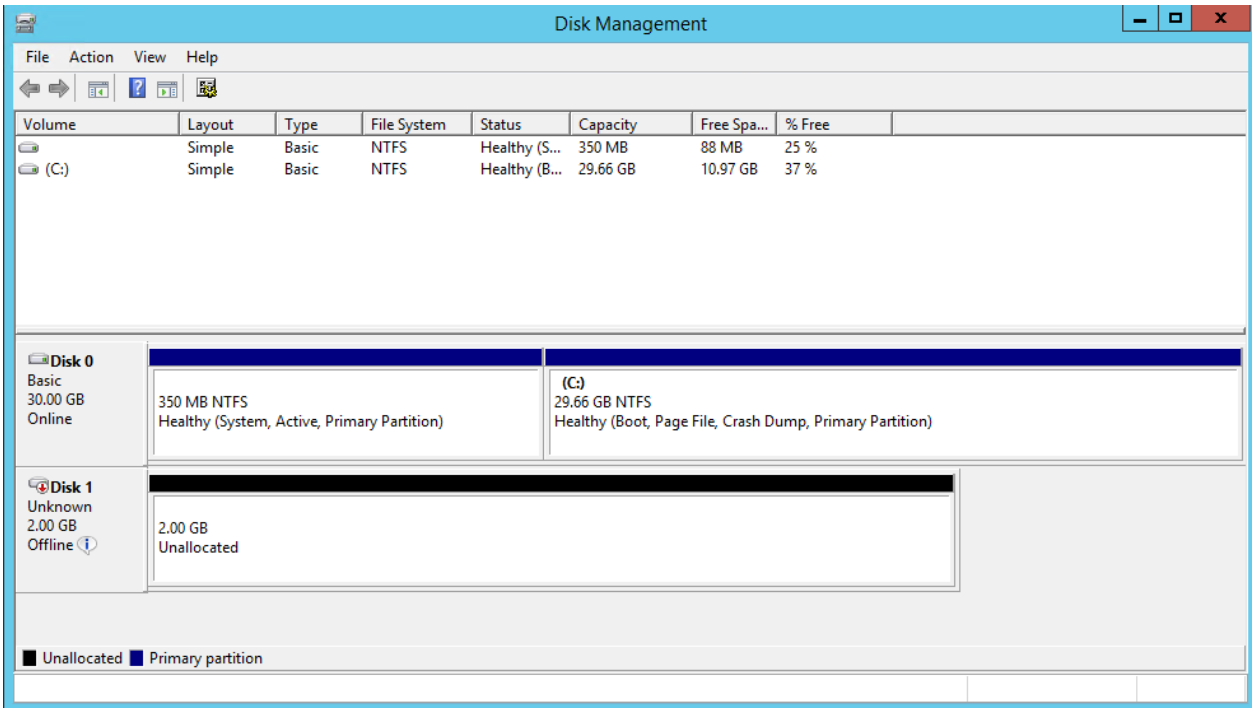
```
[root@ip-172-31-7-51 ~]# mkdir /newvolume
[root@ip-172-31-7-51 ~]# mount /dev/xvdf /newvolume
[root@ip-172-31-7-51 ~]#
```

6. Now the volume is available for the use.

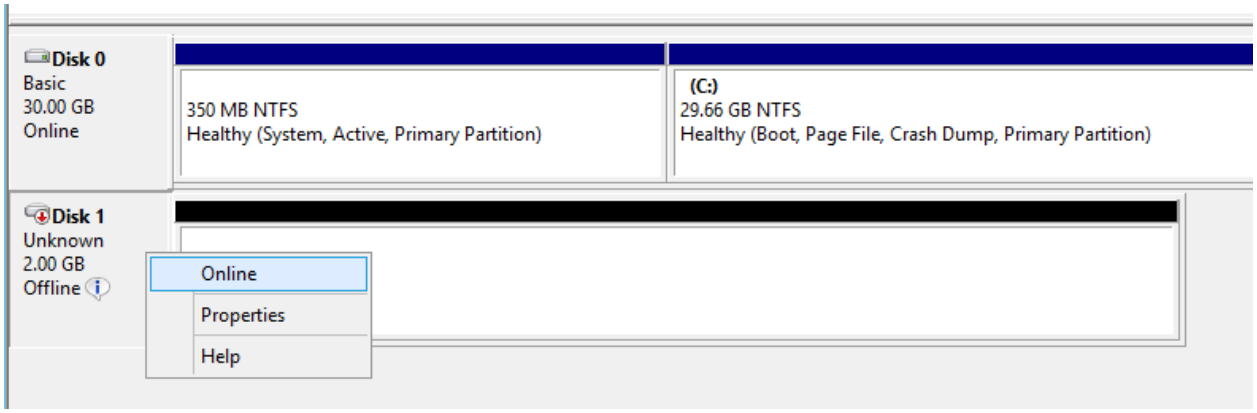
7. This is a temporary mount, for permanent mount, make sure you enter the volume information in "**/etc/fstab"** document.

For Windows Instances:

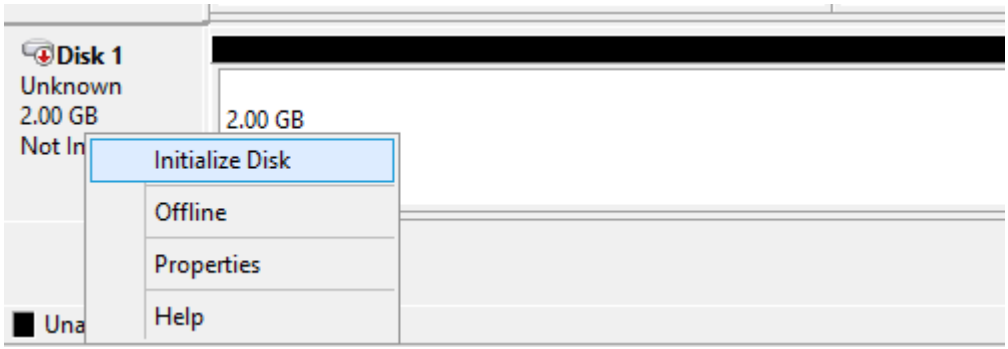
1. Attach the volume to the windows instance same as previous step.
2. Login to the windows instance and open Disk management console.
3. Open Run and give **diskmgmt.msc**command to open the Disk Management.

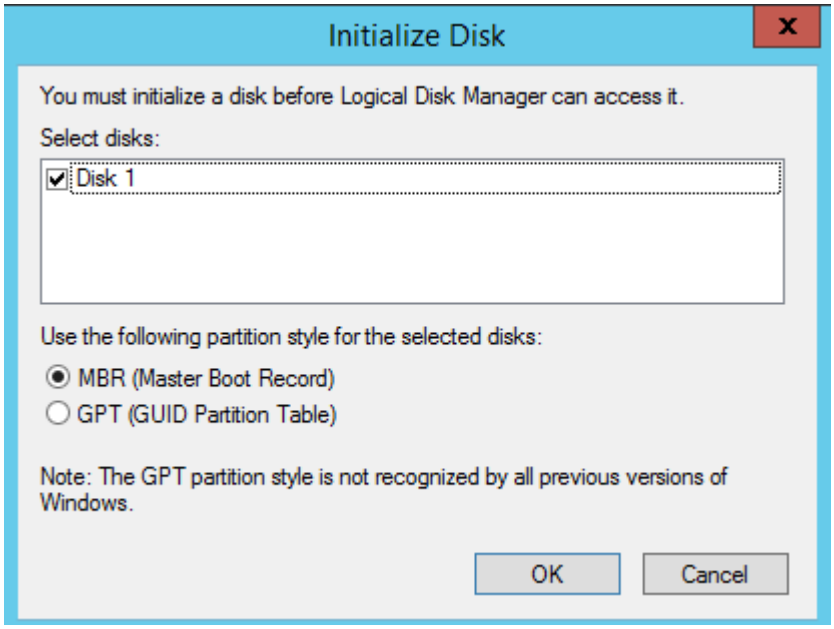


4. The newly created 2GB volume is attached to the Windows instance and by default the status of this drive will set to offline, Select the Disk 1, then choose **Online** option to make the volume online.

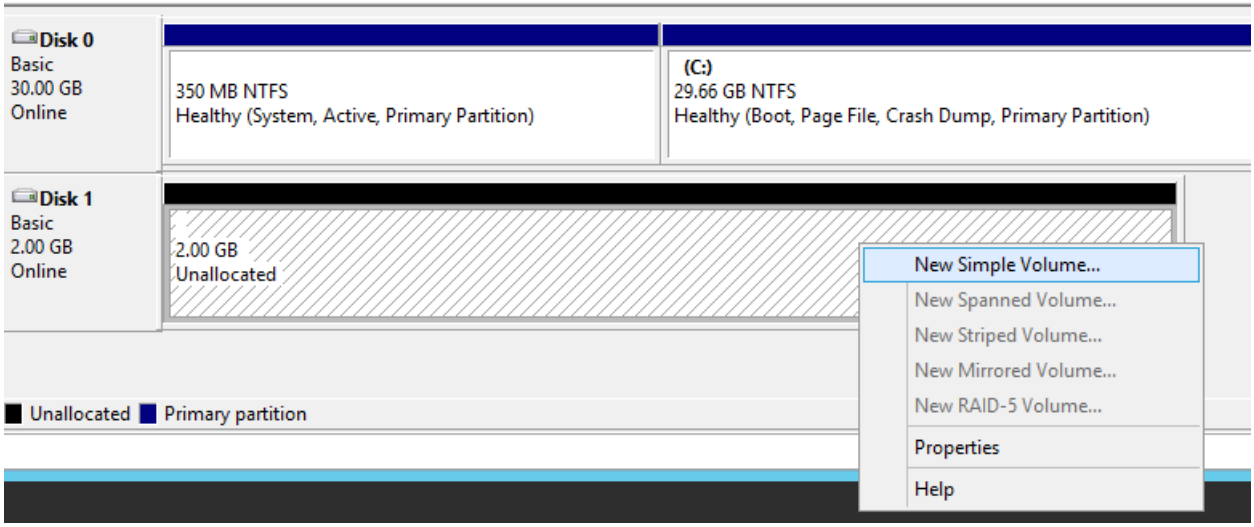


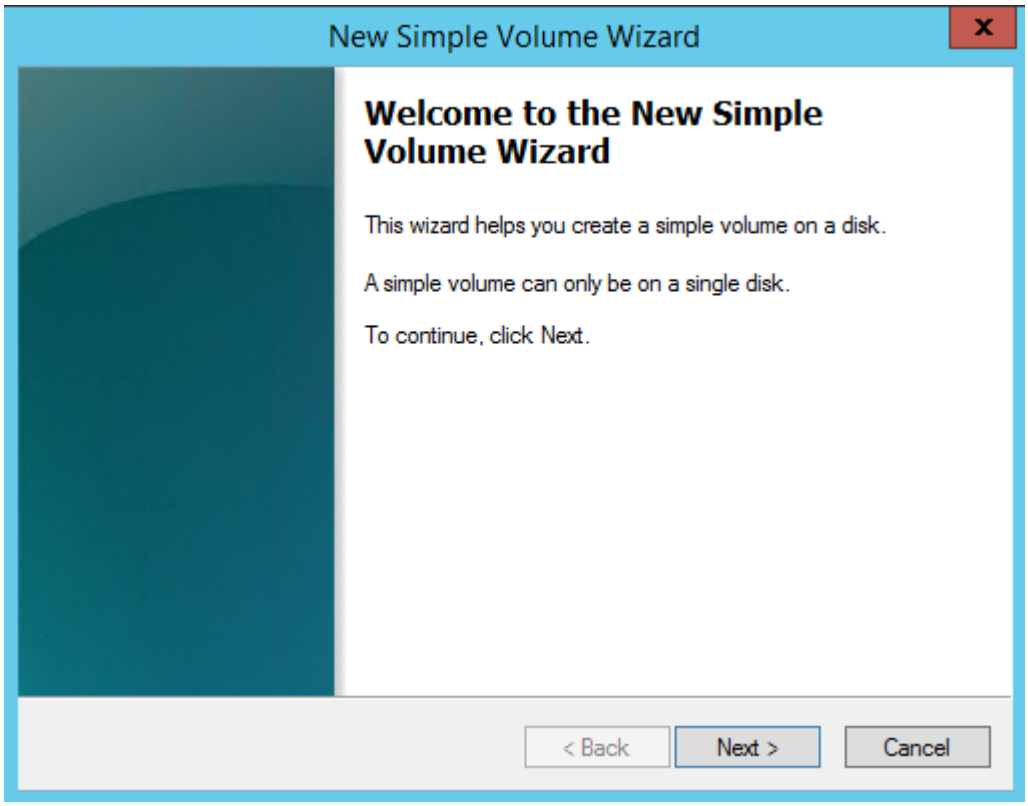
5. Here we have to initialize the Disk, Give right click on Disk then select the **initialize disk** option and click on **OK**

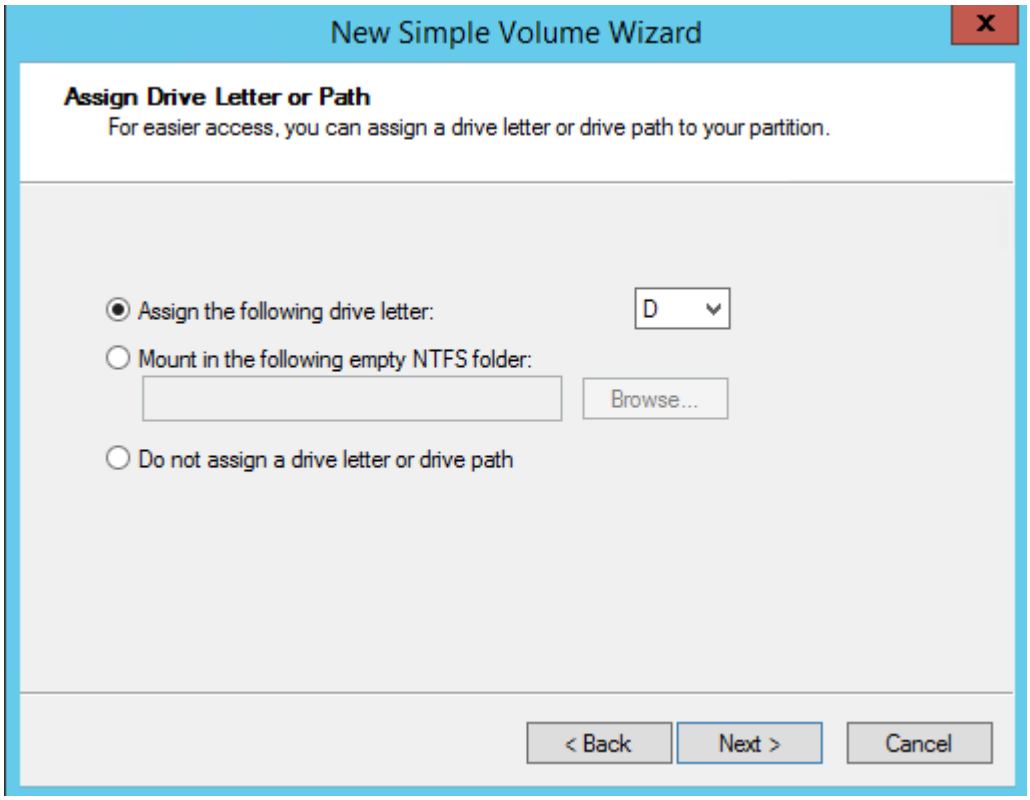


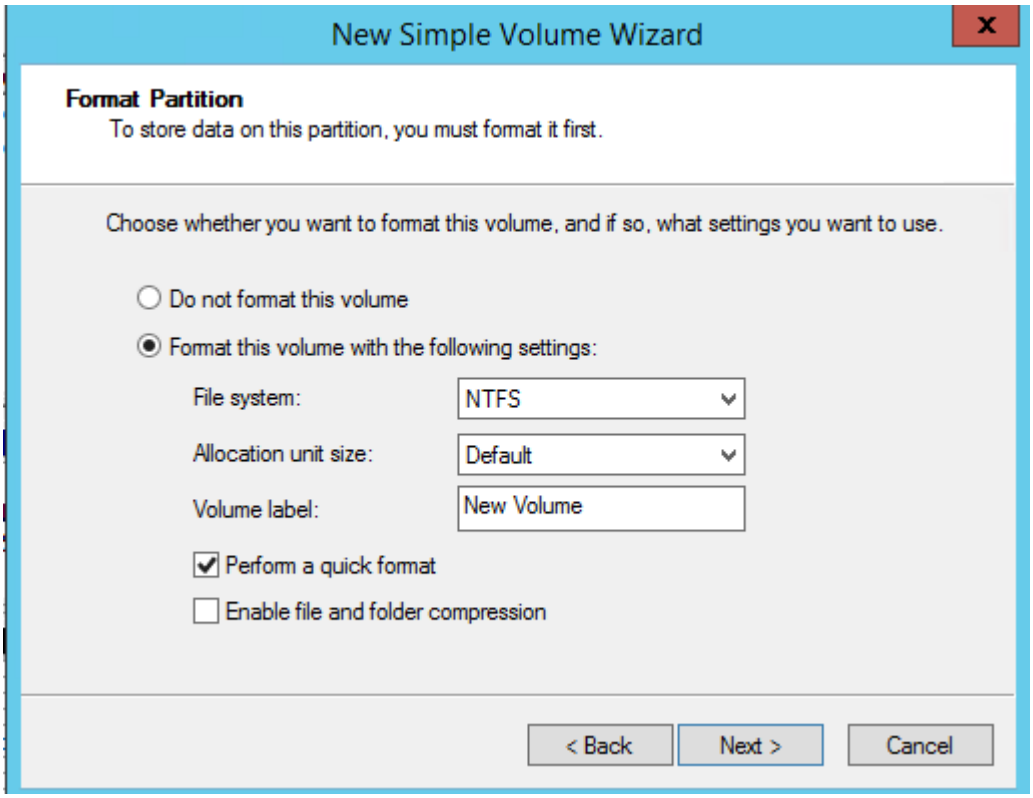


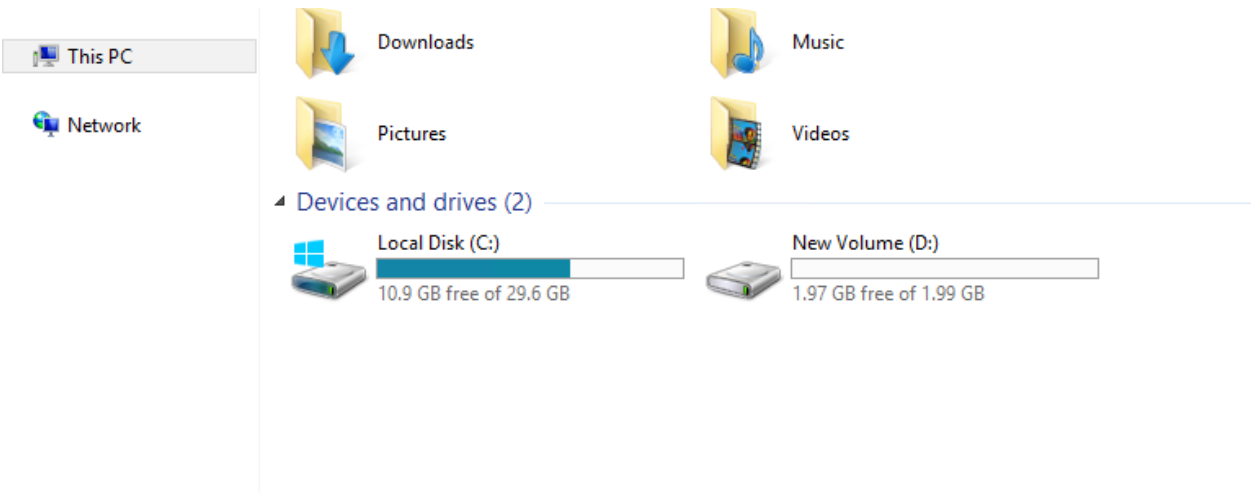
6. Now we have to create a volume, Give right click on dive select the “New Simple Volume” option, It will open up a Volume creation wizard, follow the wizard as below images




New Simple Volume Wizard
Welcome to the New Simple Volume Wizard
This wizard helps you create a simple volume on a disk.
A simple volume can only be on a single disk.
To continue, click Next.
< Back
Next >
Cancel


New Simple Volume Wizard
Assign Drive Letter or Path
For easier access, you can assign a drive letter or drive path to your partition.
Assign the following drive letter:
D
Mount in the following empty NTFS folder:
Browse...
Do not assign a drive letter or drive path
< Back
Next >
Cancel





7. Now we can see the newly created volume along with other volumes. You can use the Disk Management console to Shrink, extend or to delete the volumes.

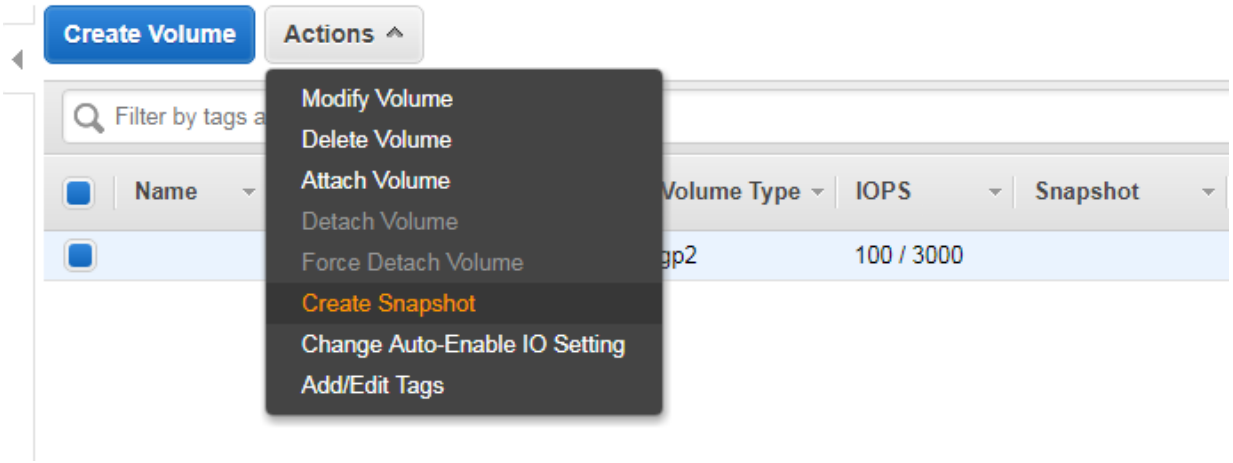
Backup of EBS volumes

We can back up the data on our Amazon EBS volumes, regardless of volume type, by taking point-in-time snapshots.

- Snapshots are incremental backups, which means that only the blocks on the device that have changed since your most recent snapshot are saved.
- Data for the snapshot is stored using Amazon S3 technology.
- While snapshots are stored using Amazon S3 technology, they are stored in AWS-controlled storage and not in your account's Amazon S3 buckets.
- Snapshots are constrained to the region in which they are created, meaning you can use them to create new volumes only in the same region.

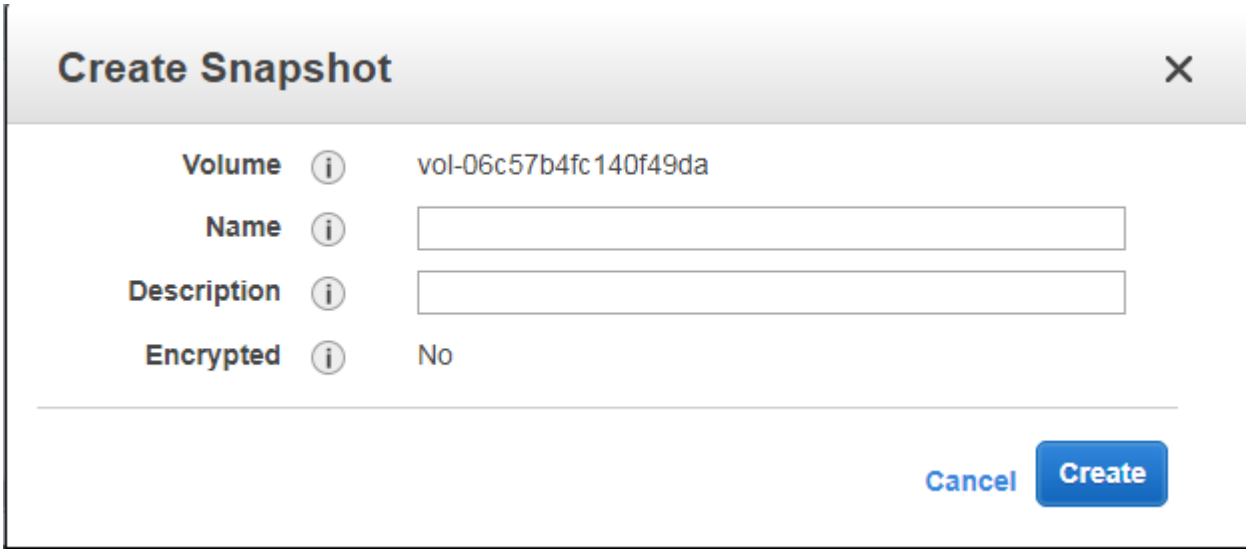
- If you need to restore a snapshot in a different region, you can copy a snapshot to another region.
- Snapshots can also be used to increase the size of an Amazon EBS volume.
    - To increase the size of an Amazon EBS volume, take a snapshot of the volume, then create a new volume of the desired size from the snapshot. Replace the original volume with the new volume.

To create a snapshot of volumes, select the particular volume from the Volume Management dashboard. Click on the **Actions** tab and select the **Create Snapshot** option.

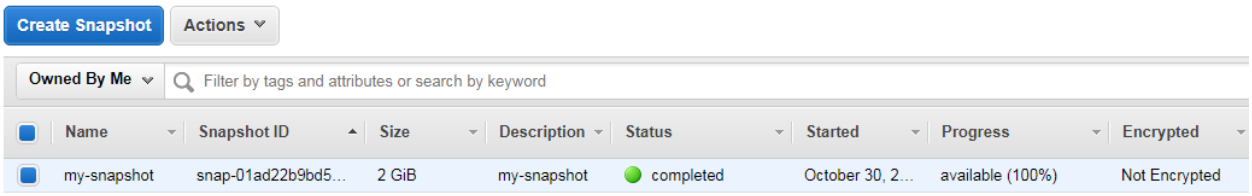


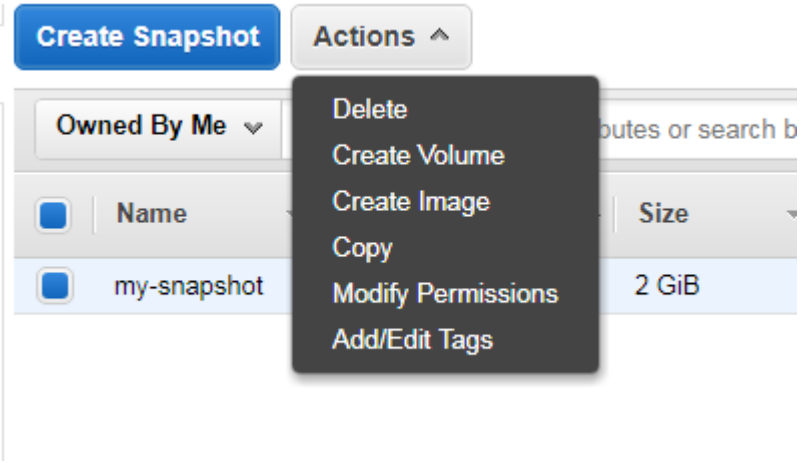
Give a Name and Description for the Snapshot.

- Snapshot of an Encrypted root volume is going to be an encrypted one.
- Volume creating from the encrypted snapshot also going to be an encrypted one.
- We can share the snapshots, but the snapshot must be an **unencrypted.**



We can go to Snapshot dashboard to verify the snapshot creation.





The above are the options available for snapshot.

Delete: we can delete the selected snapshot with this option.

Create Volume: We can create a new volume from this snapshot, while creating the new snapshot, we can change the volume type or increase the size if we want.

Create Image: We can create an AMI from this snapshot.

Copy: We can copy the snapshot from one region to another region.

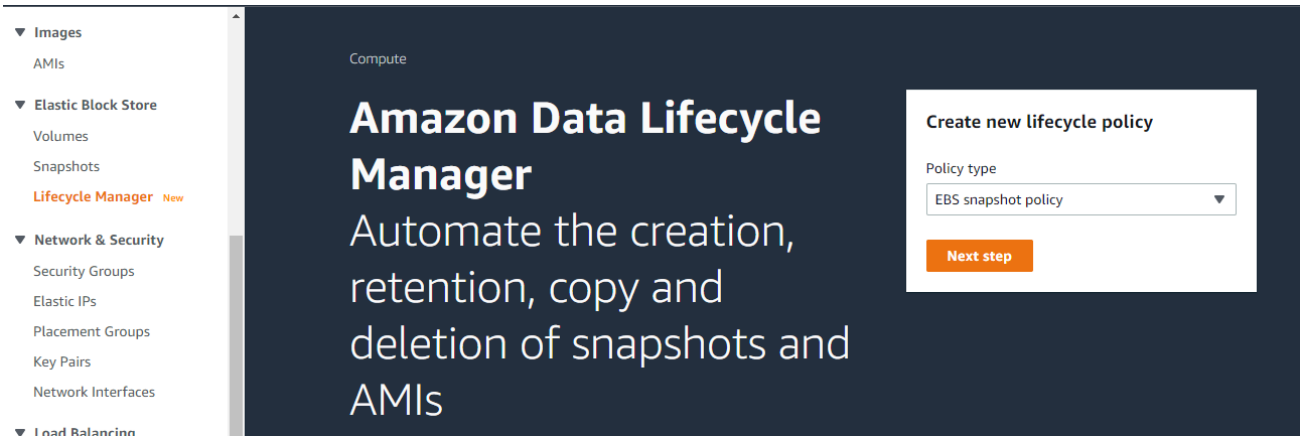
Modify Permissions: We can share the snapshots with specific AWS account user or made available to public, but this option will not enable if our snapshot is an encrypted.

Amazon Data Lifecycle Manager : Amazon Data Lifecycle Manager provides a simple, automated way to back up data stored on Amazon EBS volumes. We can use Amazon Data Life Cycle Manager (Amazon DLM) lifecycle policies to automate the creation, retention, and deletion of Amazon EBS snapshots.

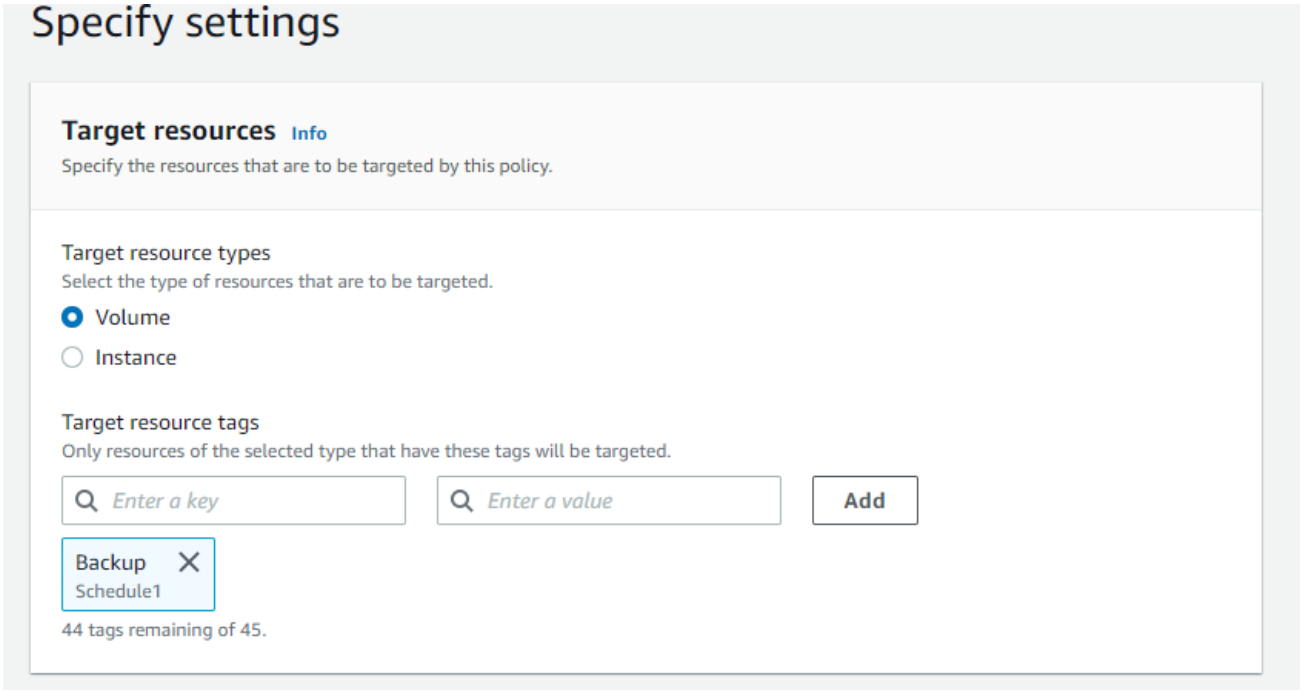
Choose policy type as **"EBS Snapshot Policy"** as shown image and click **"Next Step"**

We can Create Snapshot Lifecycle Policy that applies to the resources within the selected account for the selected AWS Region.

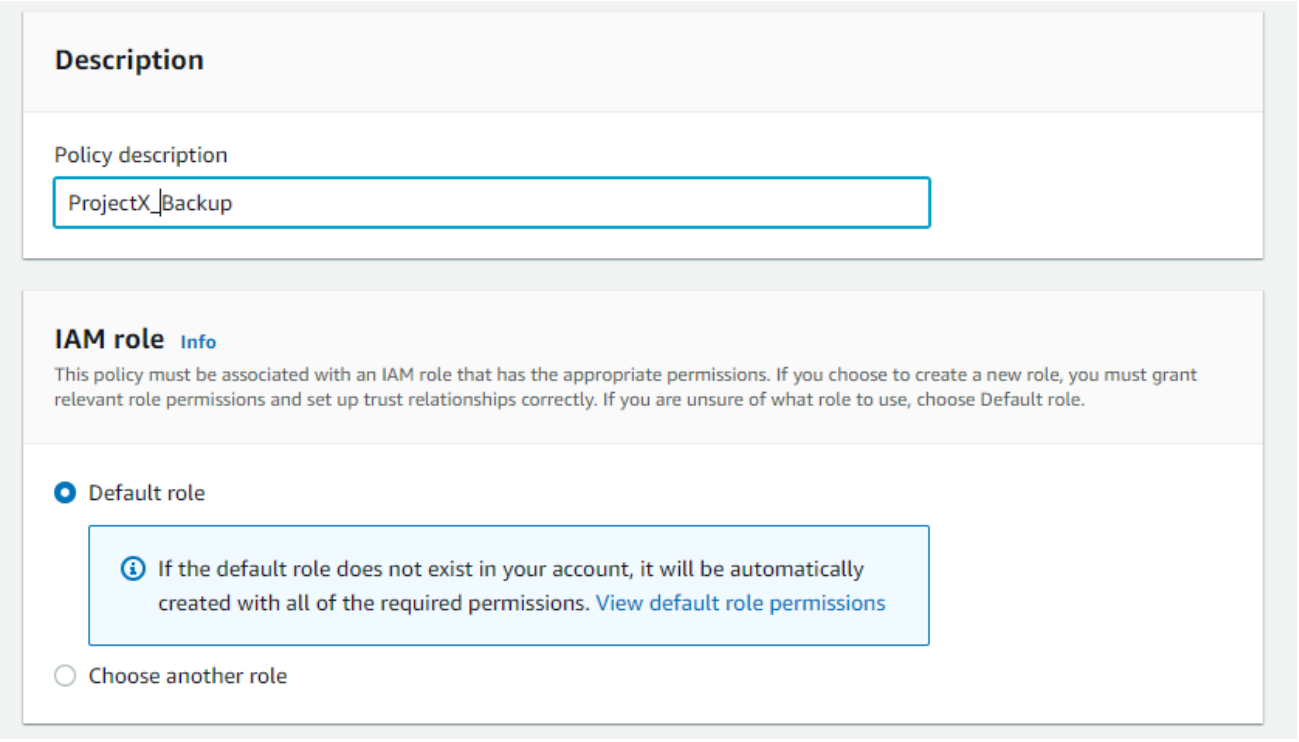
DLM Uses the Tags to choose/find the resources. (Tag is combination of Key and value), so adding valis tags to the resources is very important in real environments.



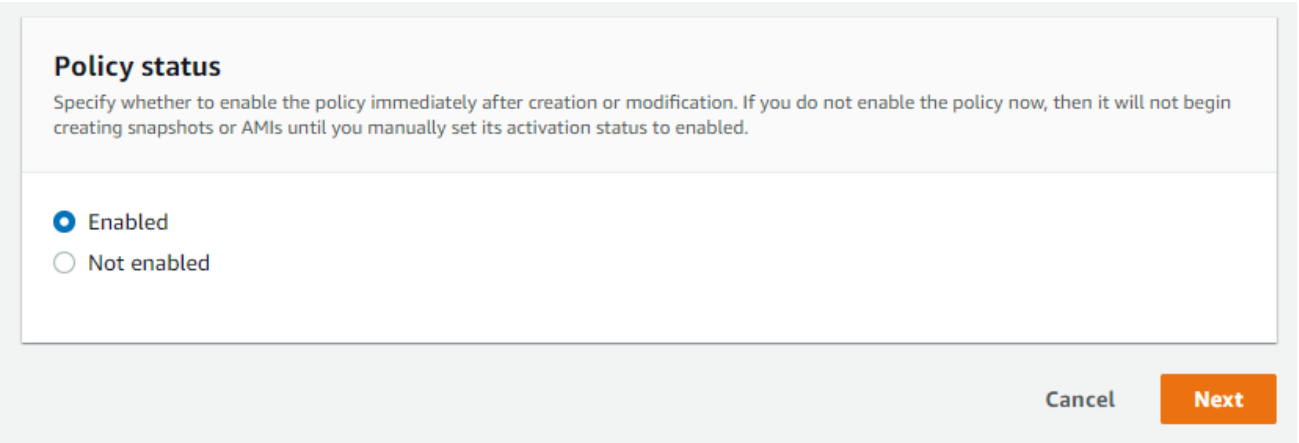
In Below image I have selected Target resource type as **"Volume"** and all the volumes having tags **(Key = Backup, value = Schedule 1)** will comes under this backup job.



Provide a meaningful description for this DLM policy and associate a valid role (Choose Default role)

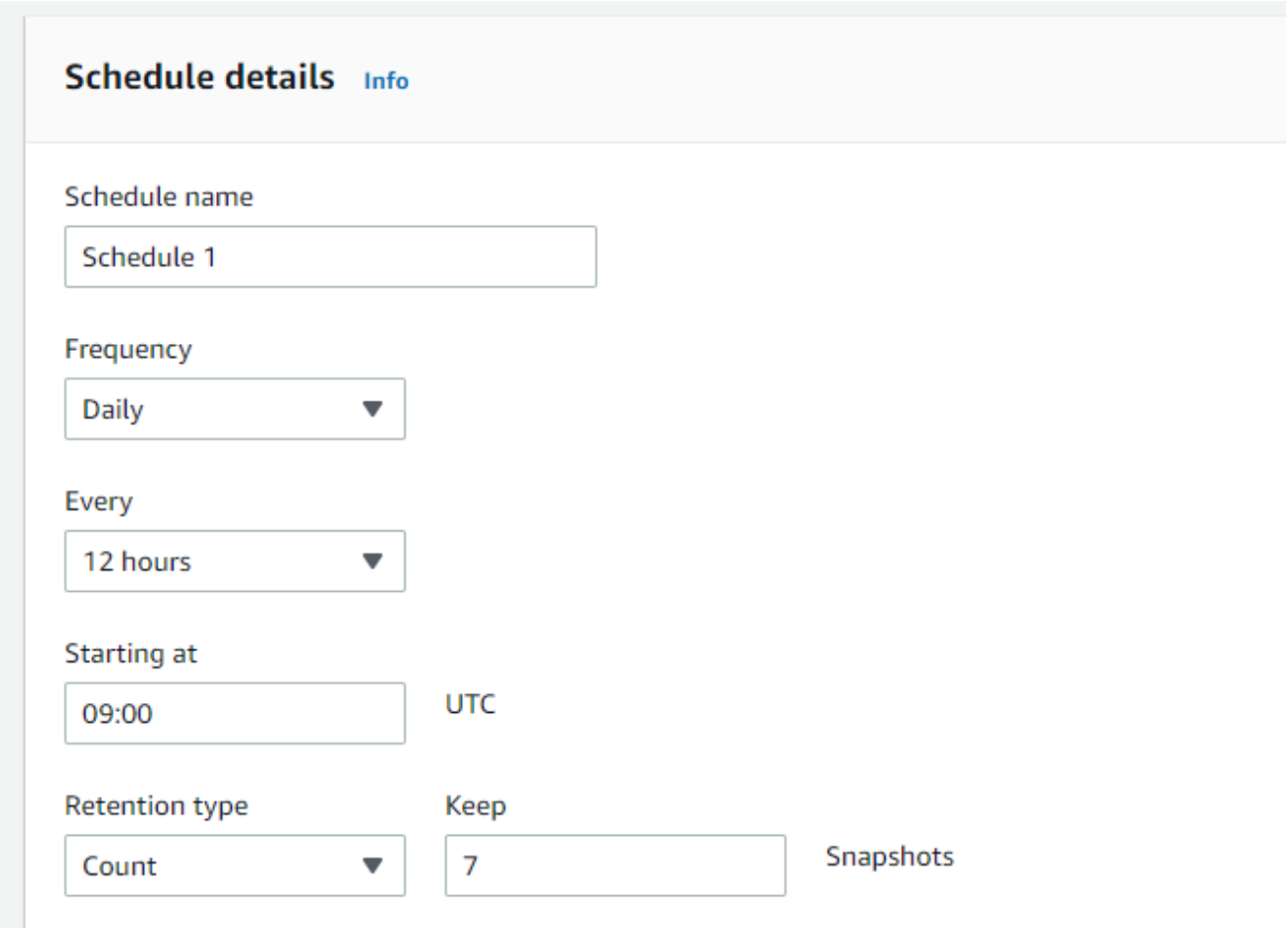


Set policy status as “Enabled” to take this policy effect immediate after the creation.



In next setp, we need to Configure schedule. Schedules define how often the policy runs and the specific actions that are to be performed. Evenry policy must have at least one schedule, and we can add maximum of 3 schedules.

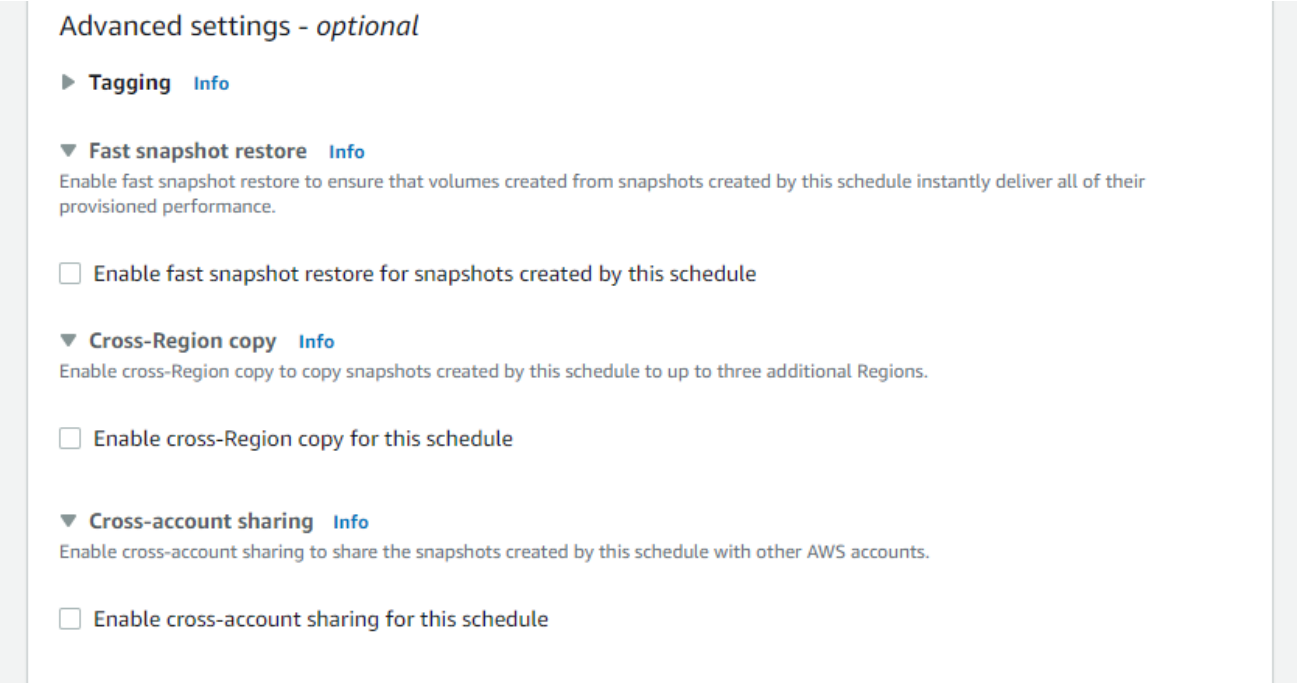
As per the below image, Starting from 09:00 UTC DLM will create a backup copy for every 12 hrs and it will retain the most recently created 7 snapshots. We can define snapshots in age wise also.



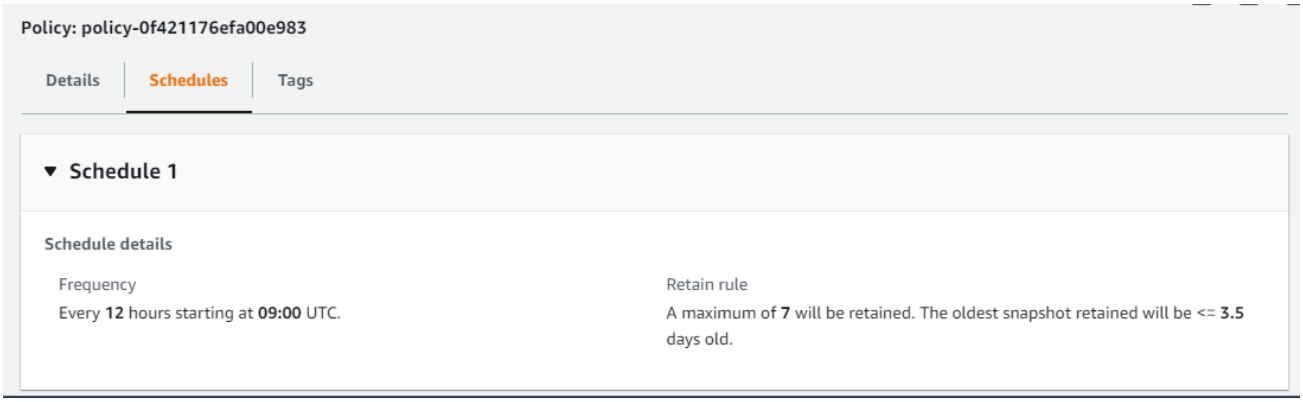
Fast snapshot restore : Fast snapshot restore enables you to restore a volume from a snapshot that is fully initialized at creation and that instantly delivers all of its provisioned performance.

Cross-region copy : Cross region copy feature allow us to copy the snapshots to desired/selected region. We can choose retention period for the copies snapshot also.

Cross-account sharing : Cross-account sharing allows us to share snapshots created by this schedule with up to 50 AWS accounts. To share snapshots, specify the AWS account IDs of the accounts.



Review all the settings and Create Policy. Once policy is choose the Schedules option and it will show the Schedule details as below image.

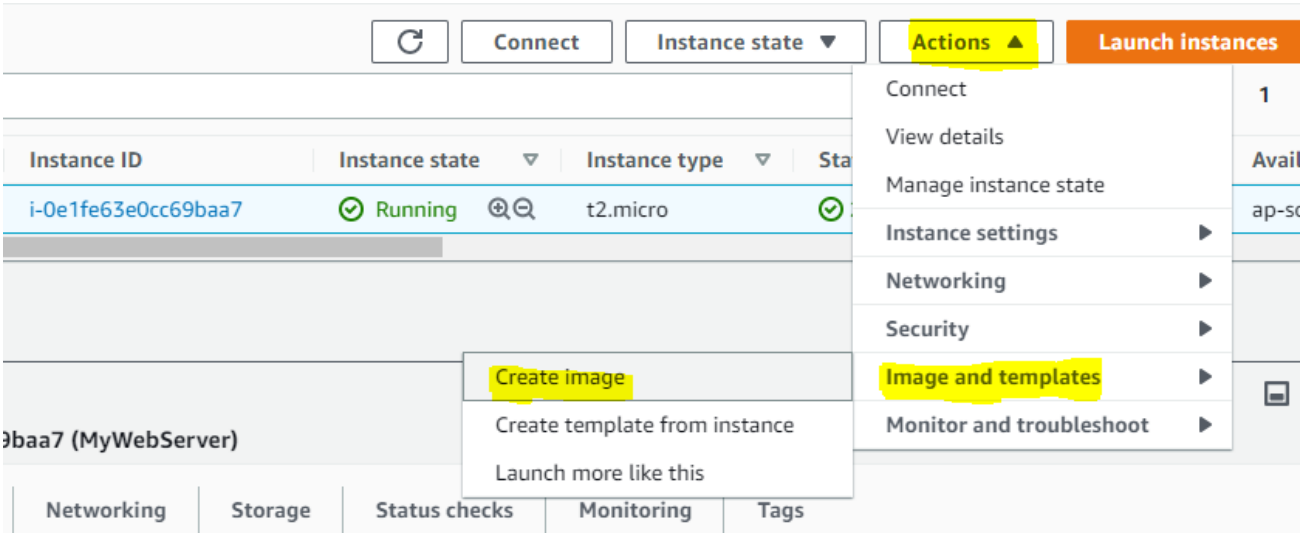


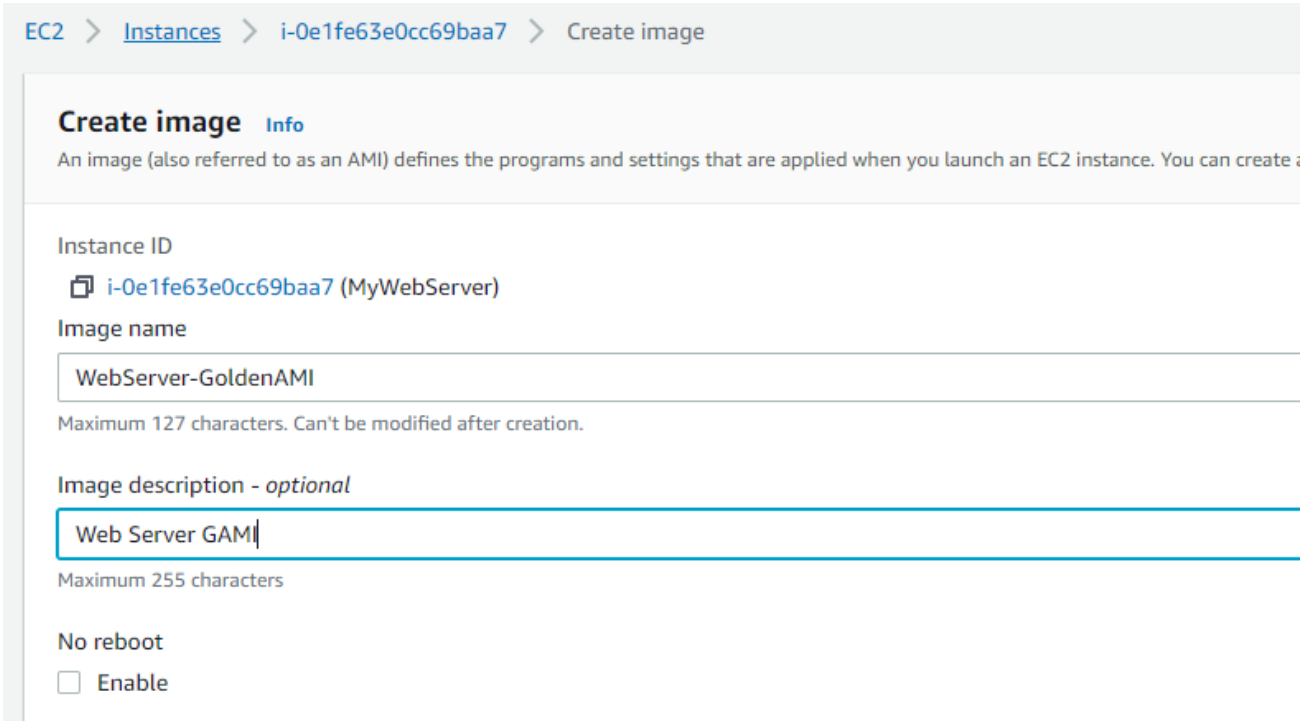
Creating an AMI

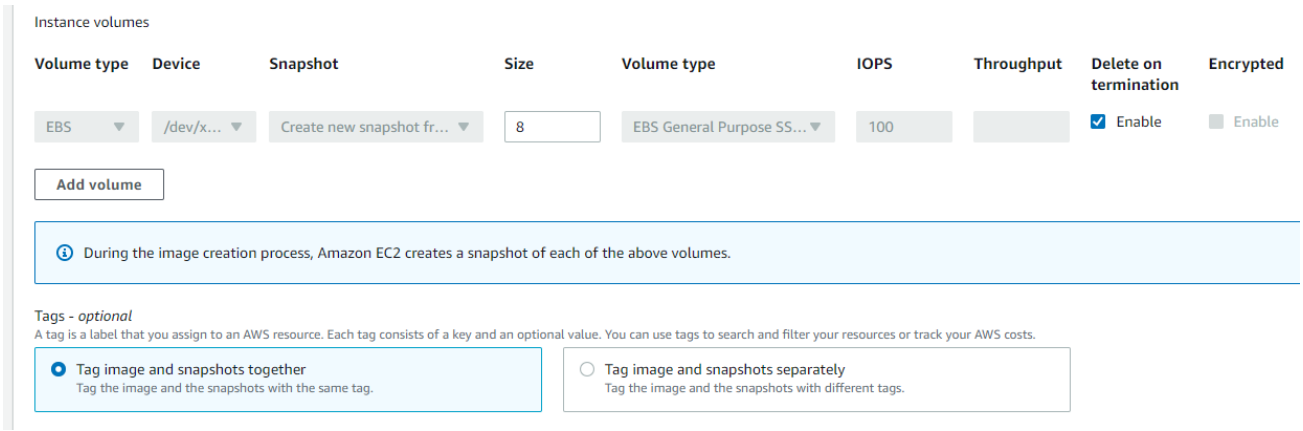
An Amazon Machine Image (AMI) provides the information required to launch a virtual server in the cloud. You specify an AMI when you launch an instance, and you can launch as many instances from the AMI as you need. You can also launch instances from as many different AMIs as you need.

- A template for the root volume for the instance.
- Launch permissions that control which AWS accounts can use the AMI to launch instances.

To create an AMI, Select the EC2 instance, Actions, **"Images and templates"** then select **Create Image** option.


Connect
Instance state
Actions
Launch instances
Connect
View details
Manage instance state
Instance settings
Networking
Security
Image and templates
Monitor and troubleshoot
Create image
Create template from instance
Launch more like this
Instance ID
Instance state
Instance type
i-0e1fe63e0cc69baa7
Running
t2.micro
Networking
Storage
Status checks
Monitoring
Tags


EC2 > Instances > i-0e1fe63e0cc69baa7 > Create image
Create image Info
An image (also referred to as an AMI) defines the programs and settings that are applied when you launch an EC2 instance. You can create
Instance ID
i-0e1fe63e0cc69baa7 (MyWebServer)
Image name
WebServer-GoldenAMI
Maximum 127 characters. Can't be modified after creation.
Image description - optional
Web Server GAMI
Maximum 255 characters
No reboot
Enable


Instance volumes
Volume type
Device
Snapshot
Size
Volume type
IOPS
Throughput
Delete on termination
Encrypted
EBS
/dev/x...
Create new snapshot fr...
8
EBS General Purpose SS...
100
Enable
Enable
Add volume
During the image creation process, Amazon EC2 creates a snapshot of each of the above volumes.
Tags - optional
A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.
Tag image and snapshots together
Tag the image and the snapshots with the same tag.
Tag image and snapshots separately
Tag the image and the snapshots with different tags.

Name: Provide a suitable and meaningful name for your AMI.

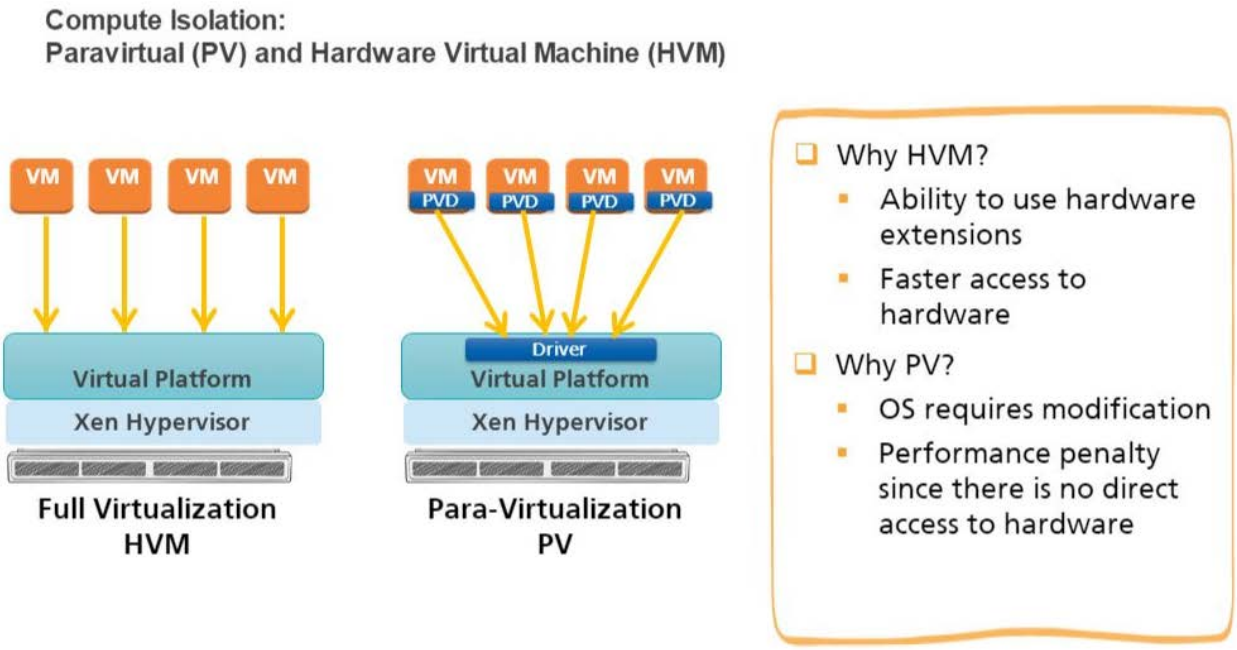
Description: Provide a suitable description for your new AMI.

No reboot: Amazon EC2 shuts down the instance, takes snapshots of any attached volumes, creates and registers the AMI, and then reboots the instance. Select No reboot to avoid having your instance shut down.

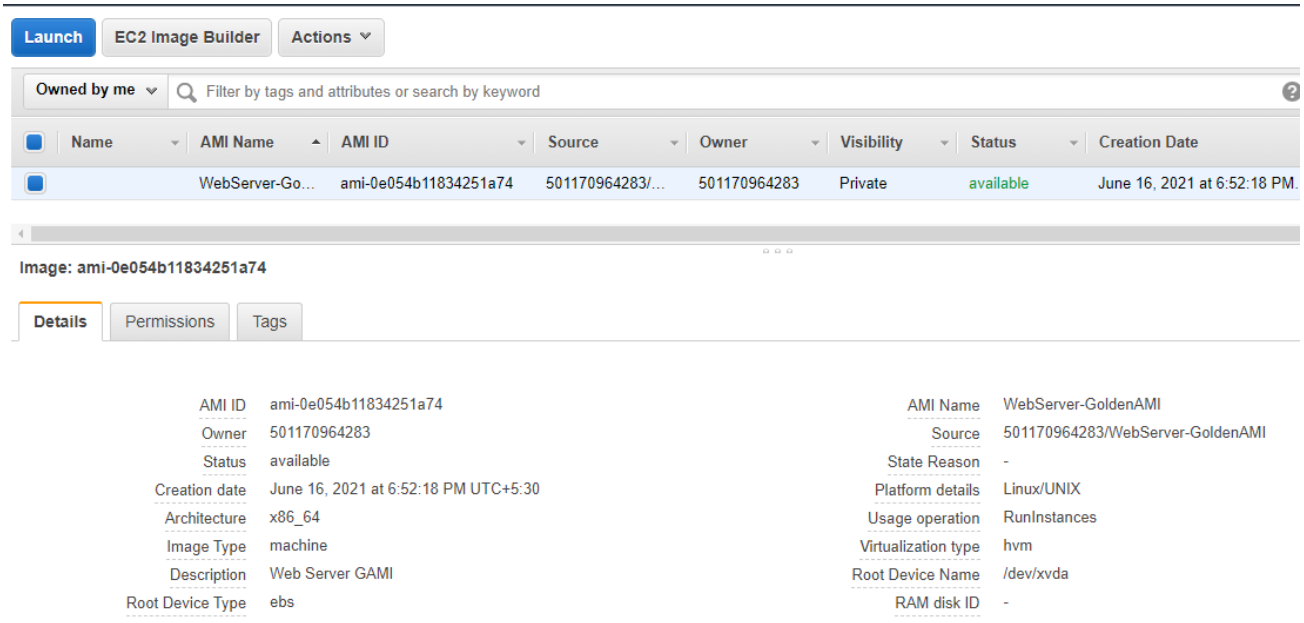
Tags: We can tag the AMI and the snapshots with the same tags, or we can tag them with different tags.

Virtualization type: We can choose whether the instances launched from this particular AMI will support Paravirtualization (PV) or Hardware Virtual Machine (HVM) virtualization.

- **Xen** is an hypervisor that runs on metal (the pc / server) and then hosts virtual machines called domains.
- **PV** domain is a paravirtualizeddomain, that means the operating system has been modified to run under Xen, and there's no need to actually emulate hardware. This should be the most efficient way to go, performance wise.
- **HVM** domain is hardware emulated domain, that means the operating system (could be Linux, Windows, whatever) has not been modified in any way and hardware gets emulated.



Click on **Create** to complete the AMI creation process. The new AMI will take a few minutes to spin up.



We can select the AMI and choose **Launch** option to launch a new instance. We will get the instance launch wizard.

- AMI are regional, if required we can copy AMI to another region with Copy option.
- We can share the AMI to any other AWS account users or we can make it public.
- Every AMI will associate with a Snapshot.
- AMI are registered with the AWS accounts, if you no longer required any AMI, you can select Deregister option under **Actions**.
- Delete the backend snapshots used for this AMI.

Elastic Load Balancing

The Elastic Load Balancing service allows you to distribute traffic across a group of Amazon EC2 instancesenabling you to achieve high availability in your applications.

Elastic Load Balancing supports routing and load balancing of Hypertext Transfer Protocol (HTTP), Hypertext Transfer Protocol Secure (HTTPS), Transmission Control Protocol (TCP), and Secure Sockets Layer (SSL) traffic to Amazon EC2 instances.

Elastic Load Balancing supports health checks for Amazon EC2 instances to ensure traffic is not routed to unhealthy or failing instances.

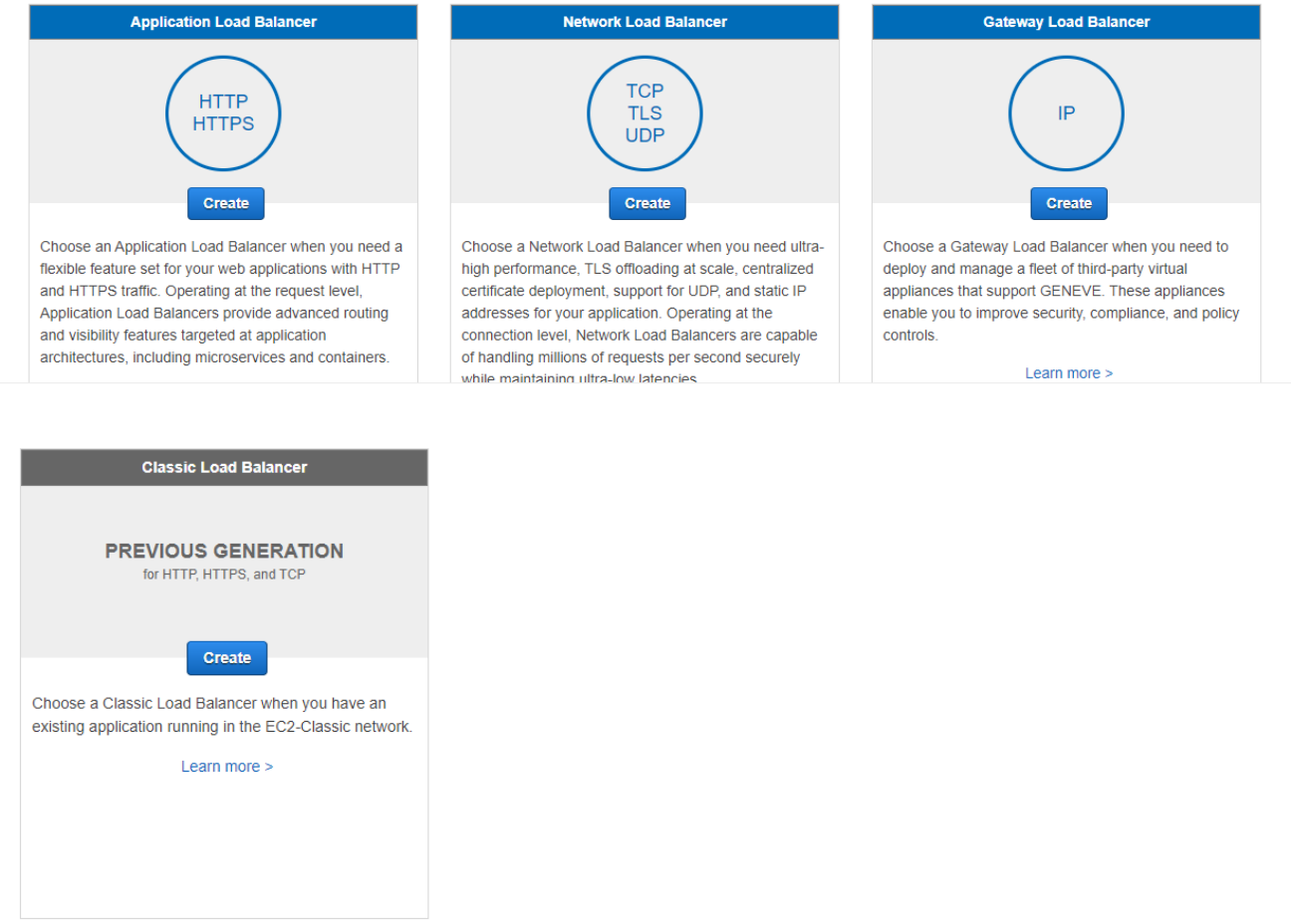
We will not get any public IP address for ELBs, We will get a DNS record for every LB.

Advantages of ELB

- Elastic Load Balancing is a managed service, it scales in and out automatically to meet the demands of increased application traffic and is highly available within a region itself as a service.
- ELB helps you achieve high availability for your applications by distributing traffic across healthy instances in multiple Availability Zones.
- ELB seamlessly integrates with the Auto Scaling service to automatically scale the Amazon EC2 instances behind the load balancer.

- ELB is secure, working with Amazon Virtual Private Cloud (Amazon VPC) to route traffic internally between application tiers, allowing you to expose only Internet-facing public IP addresses.
- ELB also supports integrated certificate management and SSL termination.

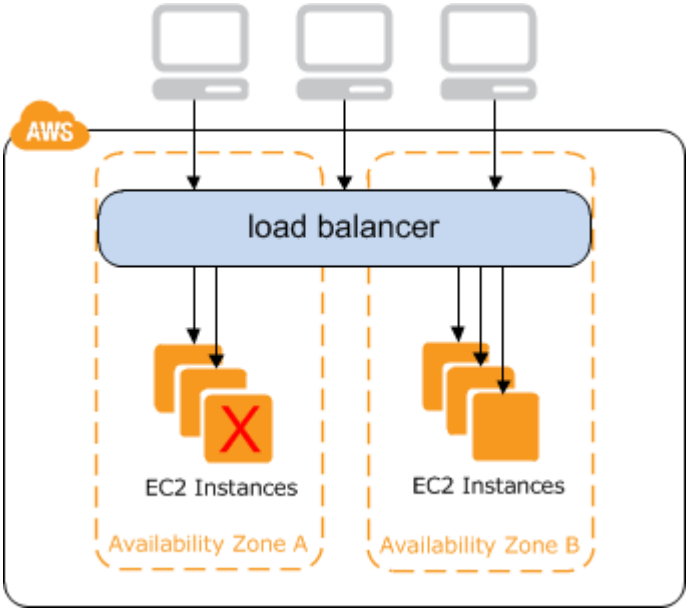
We have four types of load balancers available with AWS.



1. Classic Lead balancer
2. Application load Balancer
3. Network Load Balancer
4. Gateway Load Balancer

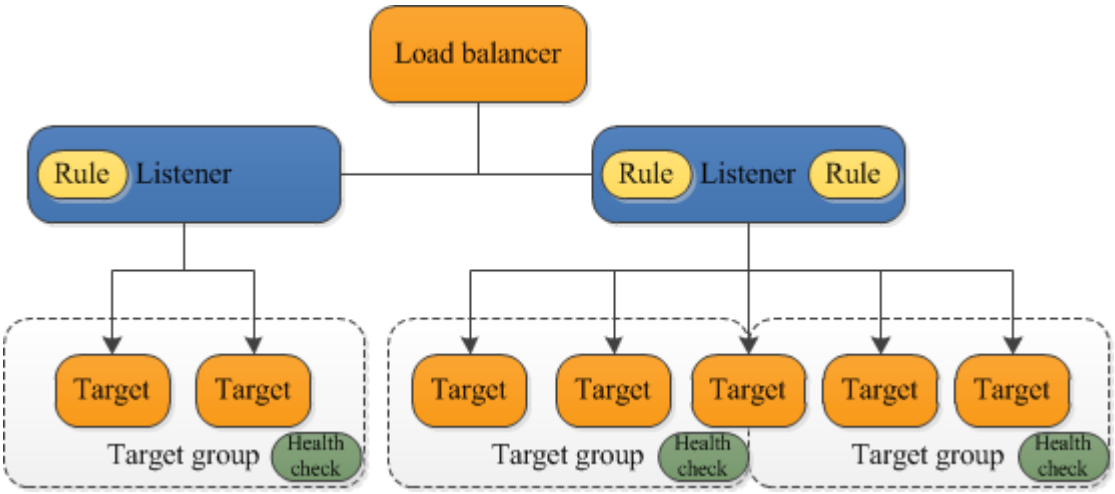
Classic Load Balancer:

A Classic load balancer work with listener checks for connection requests from clients, using the protocol and port that we configure, and forwards requests to one or more registered instances using the protocol and port number that you configure. We can add one or more listeners to our load balancer.



Application Load Balancer:

An Application Load Balancer functions at the application layer, the seventh layer of the Open Systems Interconnection (OSI) model. After the load balancer receives a request, it evaluates the listener rules in priority order to determine which rule to apply, and then selects a target from the target group for the rule action using the round robin routing algorithm. Note that you can configure listener rules to route requests to different target groups based on the content of the application traffic. Routing is performed independently for each target group, even when a target is registered with multiple target groups.



We can add and remove targets from load balancer as our needs change, without disrupting the overall flow of requests to our application.

Network Load Balancer:

A Network Load Balancer functions at the fourth layer of the Open Systems Interconnection (OSI) model. It can handle millions of requests per second. After the load balancer receives a connection request, it selects a target from the target group for the default rule. It attempts to open a TCP connection to the selected target on the port specified in the listener configuration.

Gateway Load Balancer : Gateway Load Balancer makes it easy to deploy, scale, and manage third-party virtual appliances. It gives one gateway for distributing traffic across multiple virtual appliances, while scaling them up, or down, based on demand.

Internet-Facing Load Balancers: An Internet-facing load balancer is a load balancer that takes requests from clients over the Internet and distributes them to Amazon EC2 instances that are registered with the load balancer.

Internal load balancers: Internal Load Balancers that connect and route traffic to private subnets. We can use internal load balancers to route traffic to your Amazon EC2 instances in VPCs with private subnets.

Listeners: Every load balancer must have one or more listeners configured. A listener is a process that checks for connection requests.

Health Checks

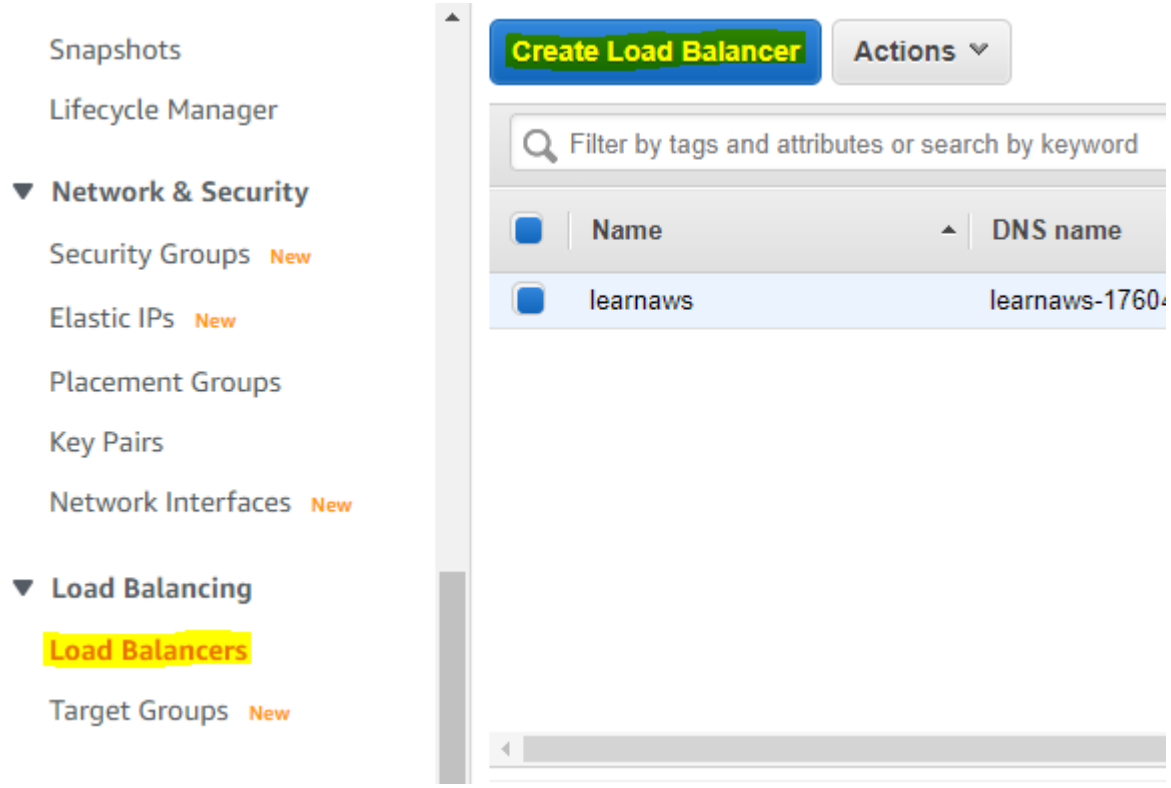
Elastic Load Balancing supports health checks to test the status of the Amazon EC2 instances behind an Elastic Load Balancing load balancer.

- The status of the instances that are healthy at the time of the health check is **InService**. The status of any instances that are unhealthy at the time of the health check is **OutOfService**.
- The load balancer performs health checks on all registered instances to determine whether the instance is in a healthy state or an unhealthy state.
- A health check is a ping, a connection attempt, or a page that is checked periodically. You can set the time interval between health checks and also the amount of time to wait to respond in case the health check page includes a computational aspect.
- We can set a Threshold for the number of consecutive health check failures before an instance is marked as unhealthy.

Load Balancer Comparison chart

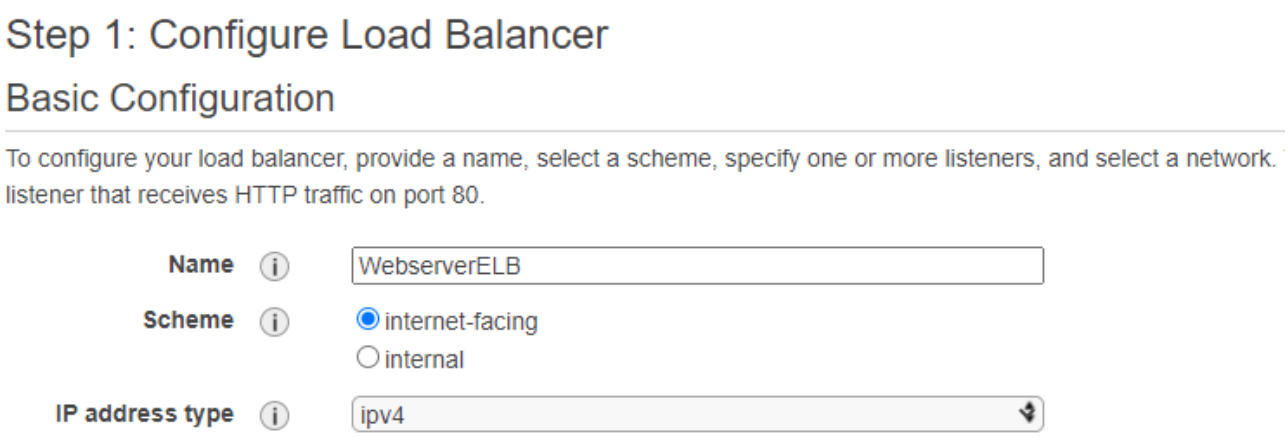
Feature	Application Load Balancer	Network Load Balancer	Gateway Load Balancer	Classic Load Balancer
Load Balancer type	Layer 7	Layer 4	Layer 3 Gateway + Layer 4 Load Balancing	Layer 4/7
Target type	IP, Instance, Lambda	IP, Instance	IP, Instance	
Terminates flow/proxy behavior	Yes	Yes	No	Yes
Protocol listeners	HTTP, HTTPS, gRPC	TCP, UDP, TLS	IP	TCP, SSL/TLS, HTTP, HTTPS

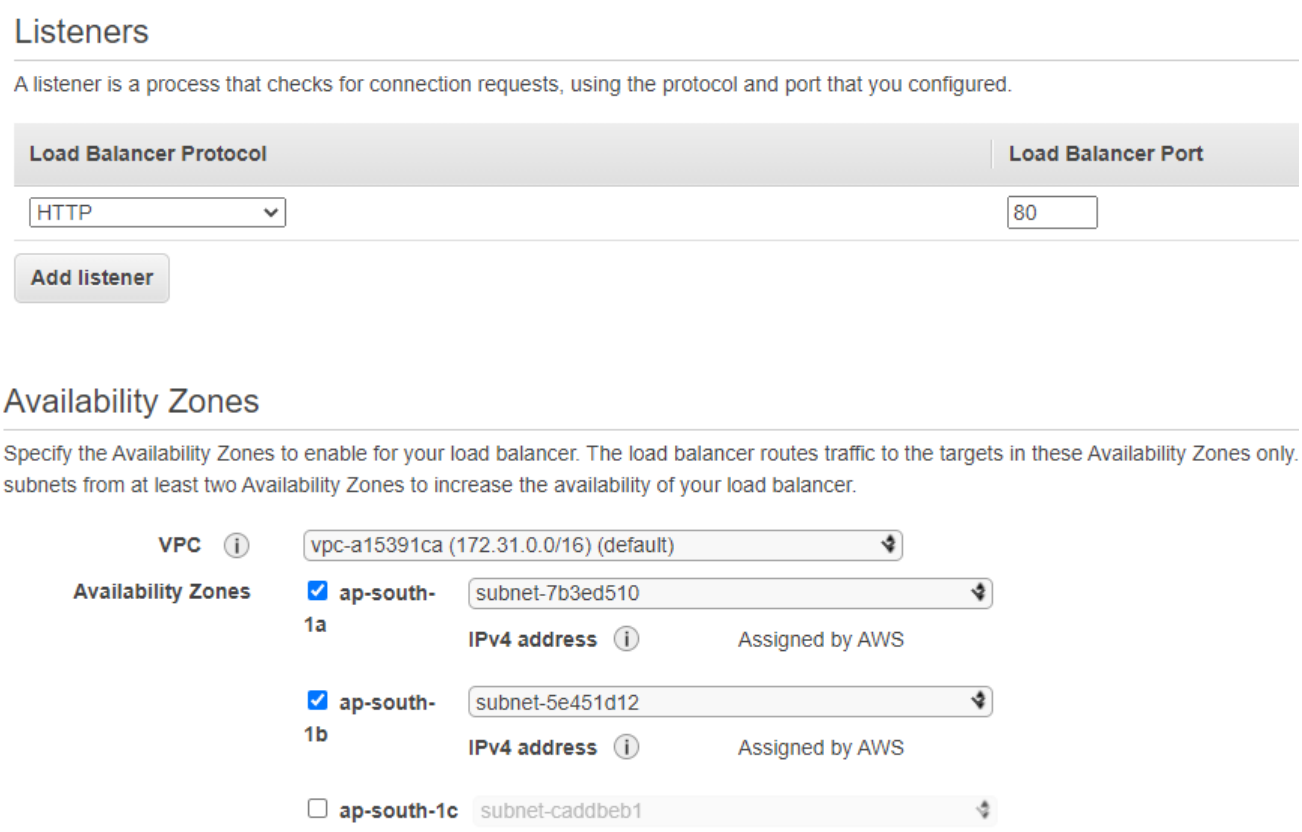
To create ELB navigate to EC2ManagementConsole. Next, from the navigation pane, select the **Load Balancers** option, this will bring up the ELB Dashboard as well, using which you can create and associate ELBs.



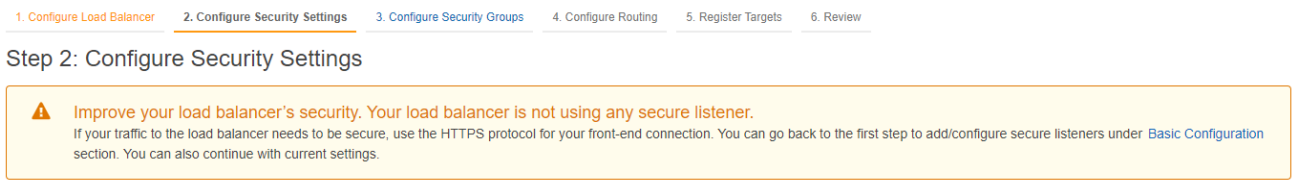
Step 1 – Defining the Load Balancer

1. Select **Create Load Balancer** option and provide a suitable name for ELB in the Load Balancer name field. Next select the VPC option in which you wish to deploy ELB.
2. Make sure you have selected 2 subnets for high availability.
3. Choose Internet-facing as we want to get/test the output from outside worls.
4. In the Listener Configuration section, select HTTP from the Load Balancer Protocol drop-down list and provide the port number 80 in the Load Balancer Port field, as shown in the following screenshot.

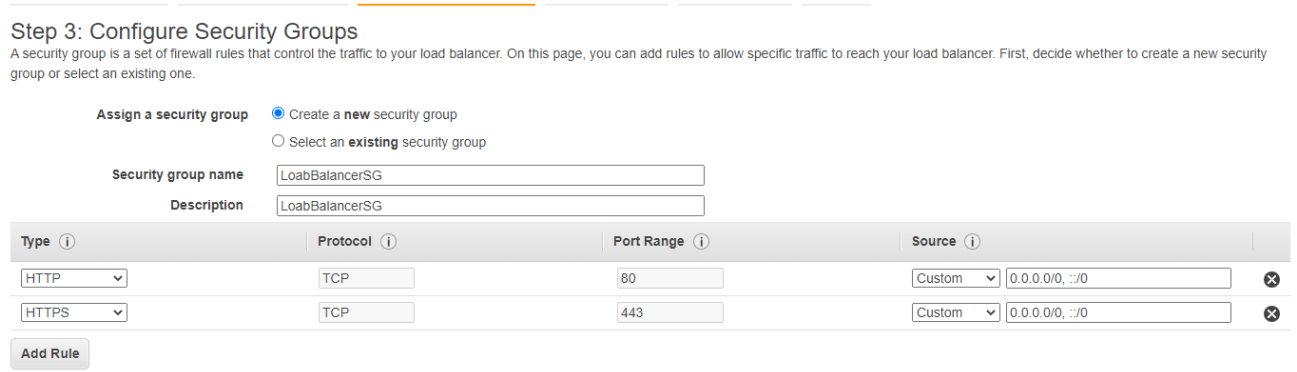




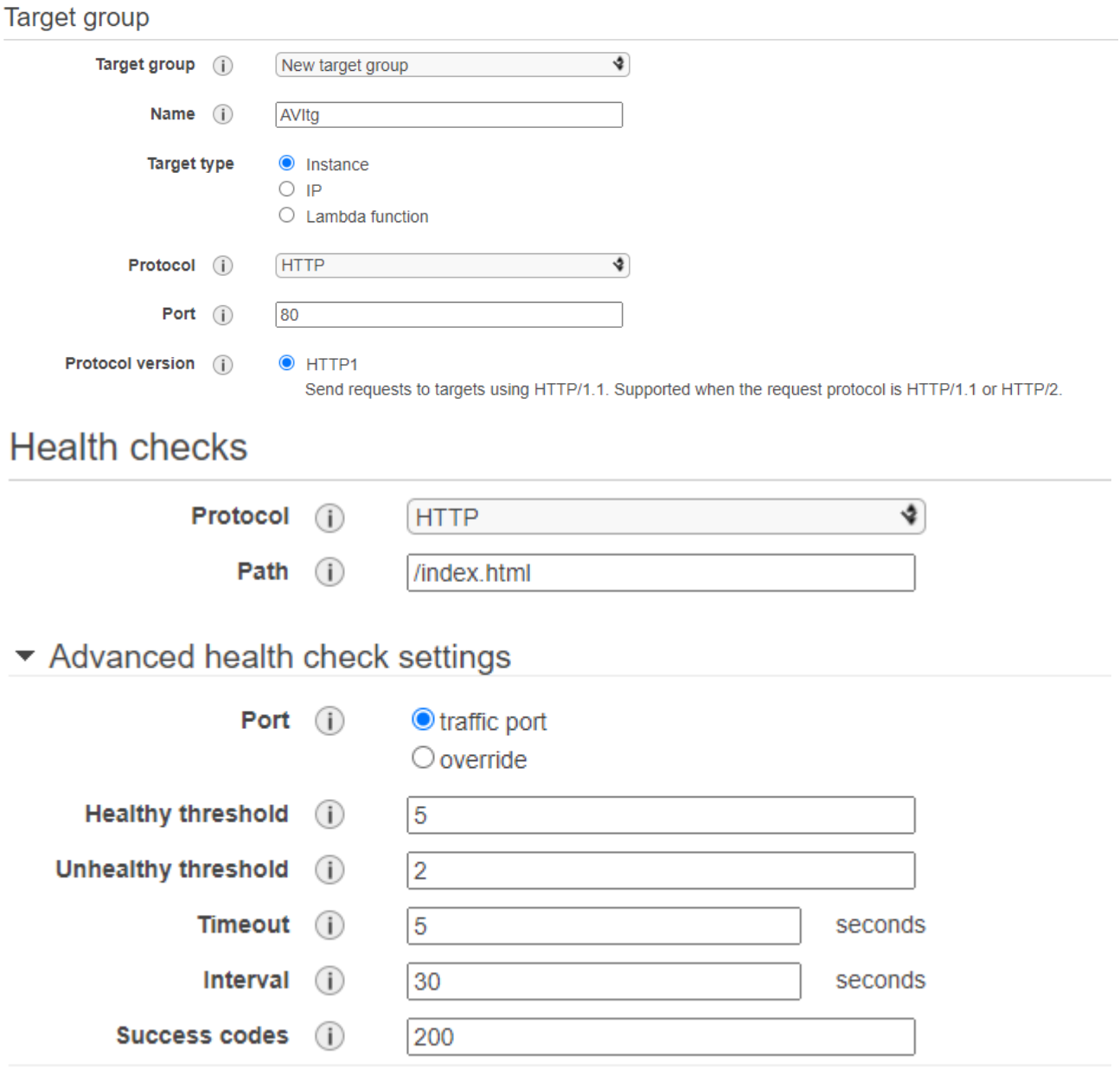
5. In Step 2, This is an optional page that basically allows you to secure your ELB by using either the HTTPS or the SSL protocol for your frontend connection. But since we have opted for a simple HTTP-based ELB, we can ignore this page.



6. We have to select the Security group for ELB, Make sure your ELB is opened with port 80 for everyone.



7. In Step 4 we have to configurerouting, Give a Target Group name and choose target type as "Instance / IP" and go with http and port 80.



Ping protocol: This field indicates which protocol the ELB should use to connect to EC2 instances. We can use the TCP, HTTP, HTTPS, or the SSL options.

Ping path: This value is used for the HTTP and HTTPS protocols. Can also use a /index.html here.

Healthy Threshold: This field indicates the number of consecutive successful health checks an ELB must wait before declaring an instance healthy. The default value is 2 with a maximum threshold value of 10.

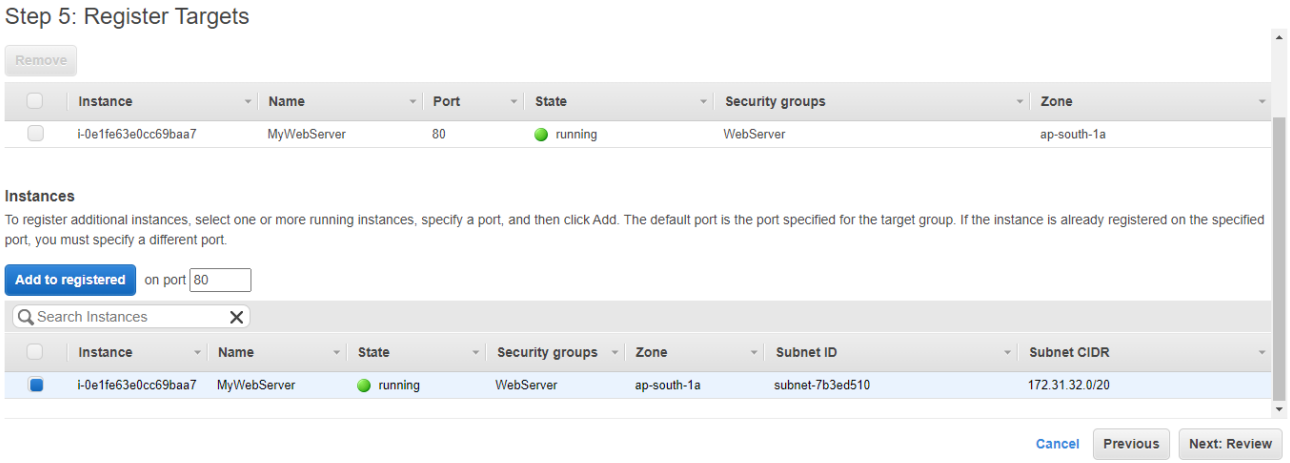
Unhealthy Threshold: This field indicates the number of consecutive failed health checks an ELB must wait before declaring an instance unhealthy. The default value is 2 with a maximum threshold value of 10.

Timeout: The Response Time is the time the ELB has to wait in order to receive a response. The default value is 5 seconds with a maximum value up to 60 seconds.

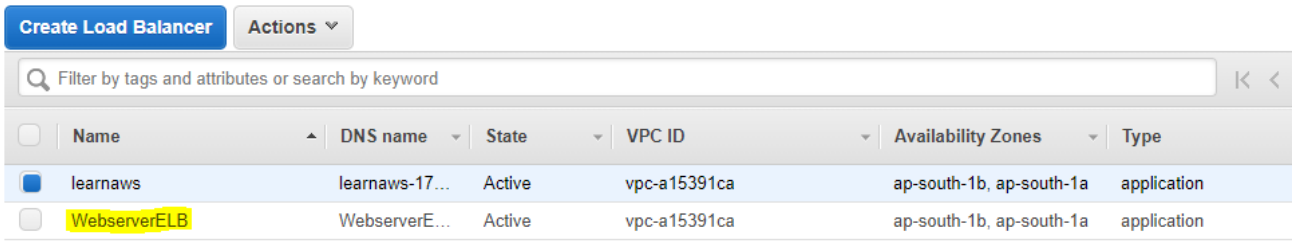
Interval: This field indicates the amount of time (in seconds) the ELB waits between health checks of an individual EC2 instance. The default value is 30. Maximum value is 300 seconds.

Success Codes : We can define http success codes from 200-299

8. Step 5 – Add EC2 instances to the target group we created in previous step. Choose all the instance we want to run top of the Load Balancer and make sure you select **"Add to Registered"** then choose review option and create load balancer**.**



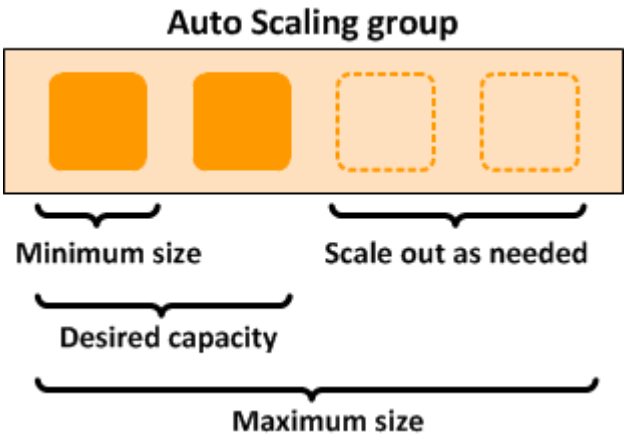
9. I have a installed sample wordpress website in ec2 instance then started the httpd service and am able to get the webpage using the Instance's public IP.
10. And Here is the details for created ELB, As we know we'll get a DNS name for our created ELB, We can access the same webpage by using the ELB's DNS name also.



11. We are able to get the same page by using the DNS name of ELB. This means our ELB configured successfully.

Auto Scaling Group (ASG)

Auto Scaling is a service that allows us to scale our Amazon EC2 capacity automatically by scaling out and scaling in according to criteria that we define. With Auto Scaling, we can ensure that the number of running Amazon EC2 instances increases during demand spikes or peak demand periods to maintain application performance and decreases automatically during demand lulls or troughs to minimize costs.



Launch Configuration

A launch configuration is the template that Auto Scaling uses to create new instances, and it is composed of the configuration name, Amazon Machine Image (AMI), Amazon EC2 instance type, security group, and instance key pair. Each Auto Scaling group can have only one launch configuration at a time.

Launch Template

A launch template is similar to a launch configuration, in that it specifies instance configuration information. Included are the ID of the Amazon Machine Image (AMI), the instance type, a key pair, security groups, and the other parameters that you use to launch EC2 instances.

Auto Scaling Group

An Auto Scaling group is a collection of Amazon EC2 instances managed by the Auto Scaling service. Each Auto Scaling group contains configuration options that control when Auto Scaling should launch new instances and terminate existing instances. An Auto Scaling group must contain a name and a minimum and maximum number of instances that can be in the group. You can optionally specify desired capacity, which is the number of instances that the group must have at all times. If you don't specify a desired capacity, the default desired capacity is the minimum number of instances that you specify.

Scaling Options :

With your Launch Configuration created, the final step left is to create one or more scaling plans. Scaling Plans describe how the Auto Scaling Group should actually scale.

- **Maintain current instance levels at all times :** You can configure your Auto Scaling group to maintain a specified number of running instances at all times. To maintain the current instance levels, Amazon EC2 Auto Scaling performs a periodic health check on running instances within an Auto Scaling group. When Amazon EC2 Auto Scaling finds an unhealthy instance, it terminates that instance and launches a new one.

- **Scheduled scaling / Scale based on a schedule:** We can scale resources based on a particular time and date. This is useful when you know exactly when to increase or decrease the number of instances in your group, simply because the need arises on a predictable schedule.

- **Scale based on demand / Dynamic scaling:** A more advanced way to scale your resources, using dynamic scaling, lets you define a scaling policy that dynamically resizes your Auto Scaling group to meet changes in demand. For example, let's say that you have a web application that currently runs on two instances and you want the CPU utilization of the Auto Scaling group to stay at around 50 percent when the load on the application changes. This method is useful for scaling in response to changing conditions, when you don't know when those conditions will change. We have 3 types of scaling policies.
    - **Target tracking scaling** : Increase or decrease the current capacity of the group based on a target value for a specific metric. This is similar to the way that your thermostat maintains the temperature of your home, you select a temperature and the thermostat does the rest. Example, We can Configure a target tracking scaling policy to keep the average aggregate CPU utilization of your Auto Scaling group at 40 percent.
    - **Step scaling :** Increase or decrease the current capacity of the group based on a set of scaling adjustments, known as step adjustments, that vary based on the size of the alarm breach.
    - **Simple scaling** : Increase or decrease the current capacity of the group based on a single scaling adjustment.

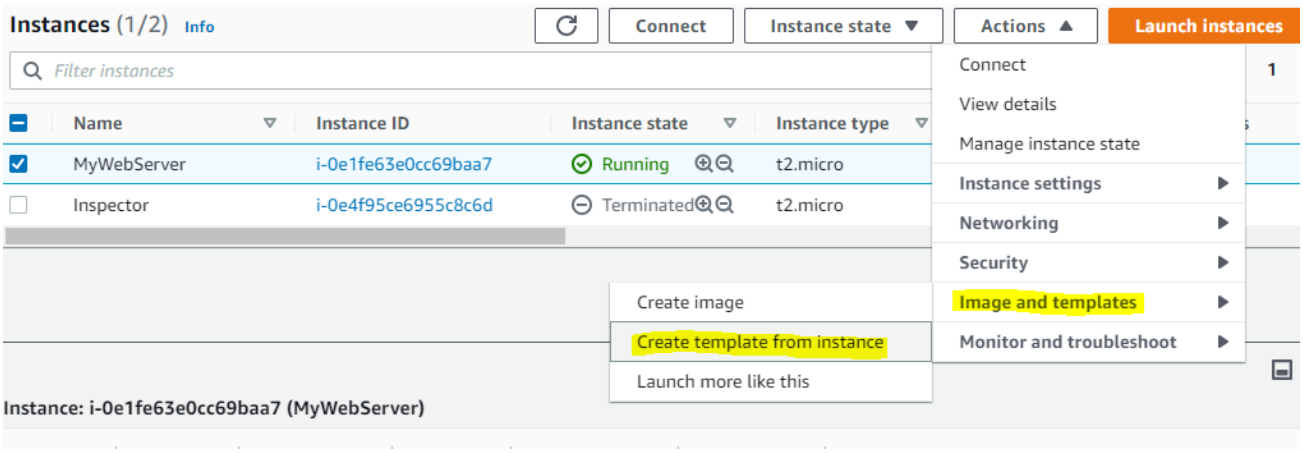
Auto scaling group creation involves with two steps. First one is Creating a Launch Configuration and second is Creating Auto Scaling group.

Amazon recently introduced "launch template" feature.

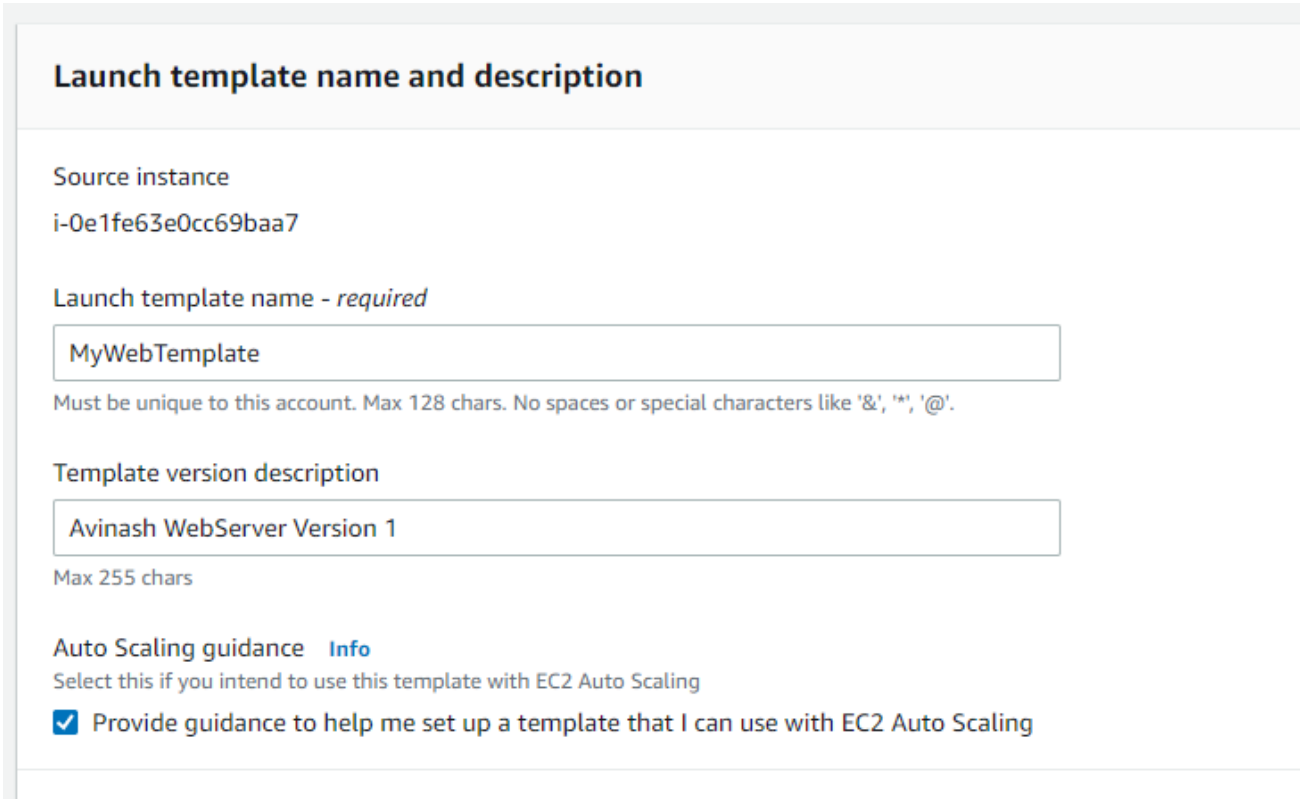
**** Create an CustomAMI/GoldenAMI to use Launch template / Launch configuration feature.**

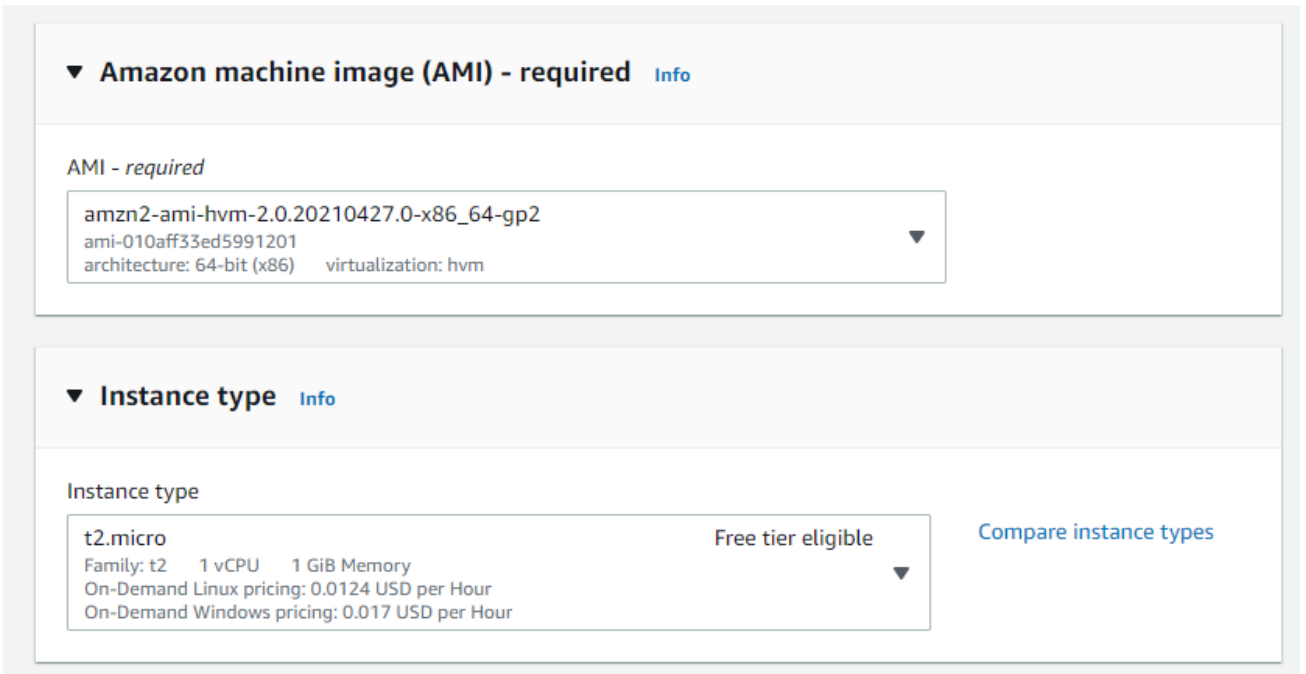
Create Launch template,

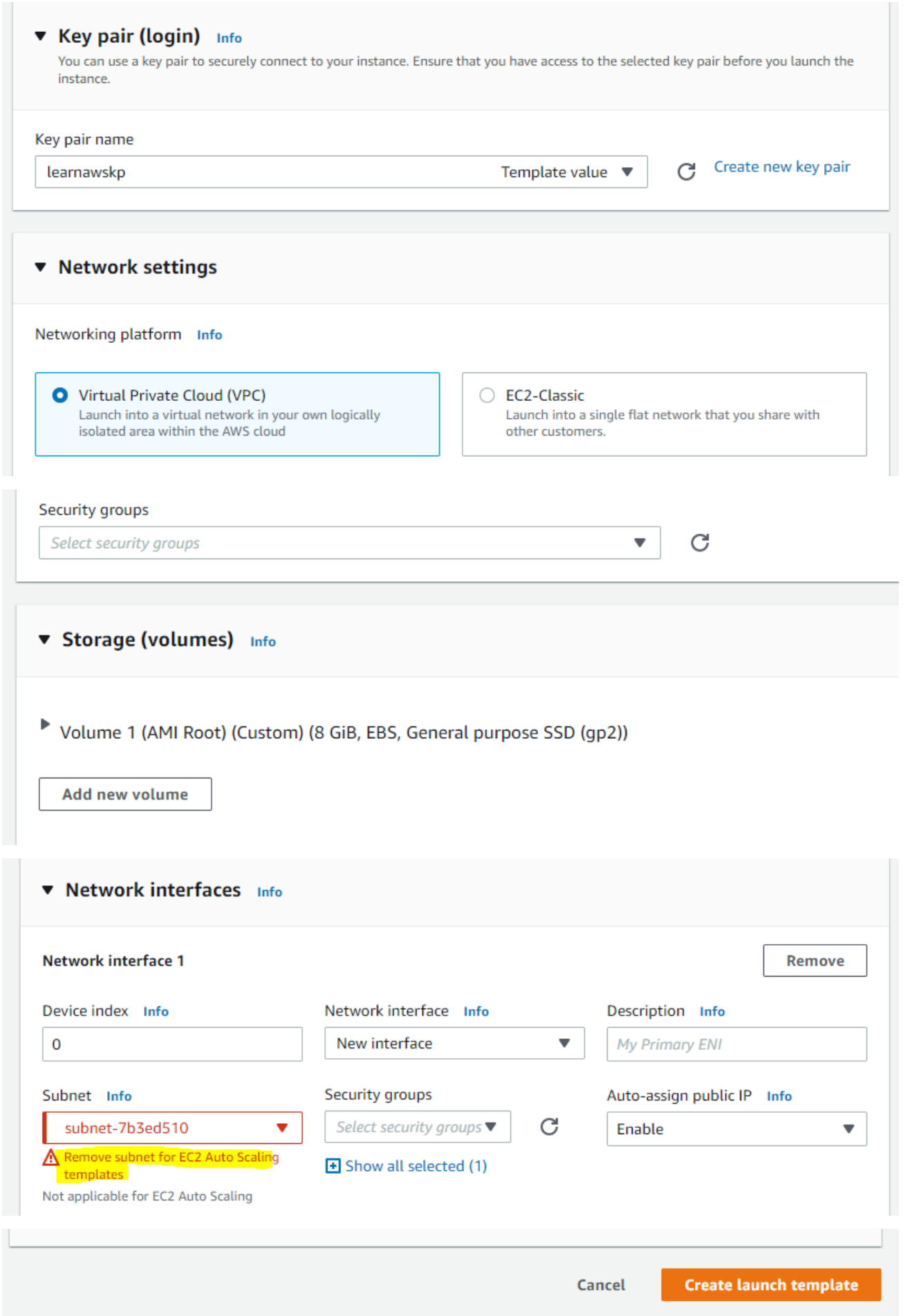
Navigate to ec2 console and Choose the Instance you want to use for creating a template.



Then Launch template will pick all settings from the instance we selected.


Launch template name and description
Source instance
i-0e1fe63e0cc69baa7
Launch template name - required
MyWebTemplate
Must be unique to this account. Max 128 chars. No spaces or special characters like '&', '*', '@'.
Template version description
Avinash WebServer Version 1
Max 255 chars
Auto Scaling guidance Info
Select this if you intend to use this template with EC2 Auto Scaling
Provide guidance to help me set up a template that I can use with EC2 Auto Scaling

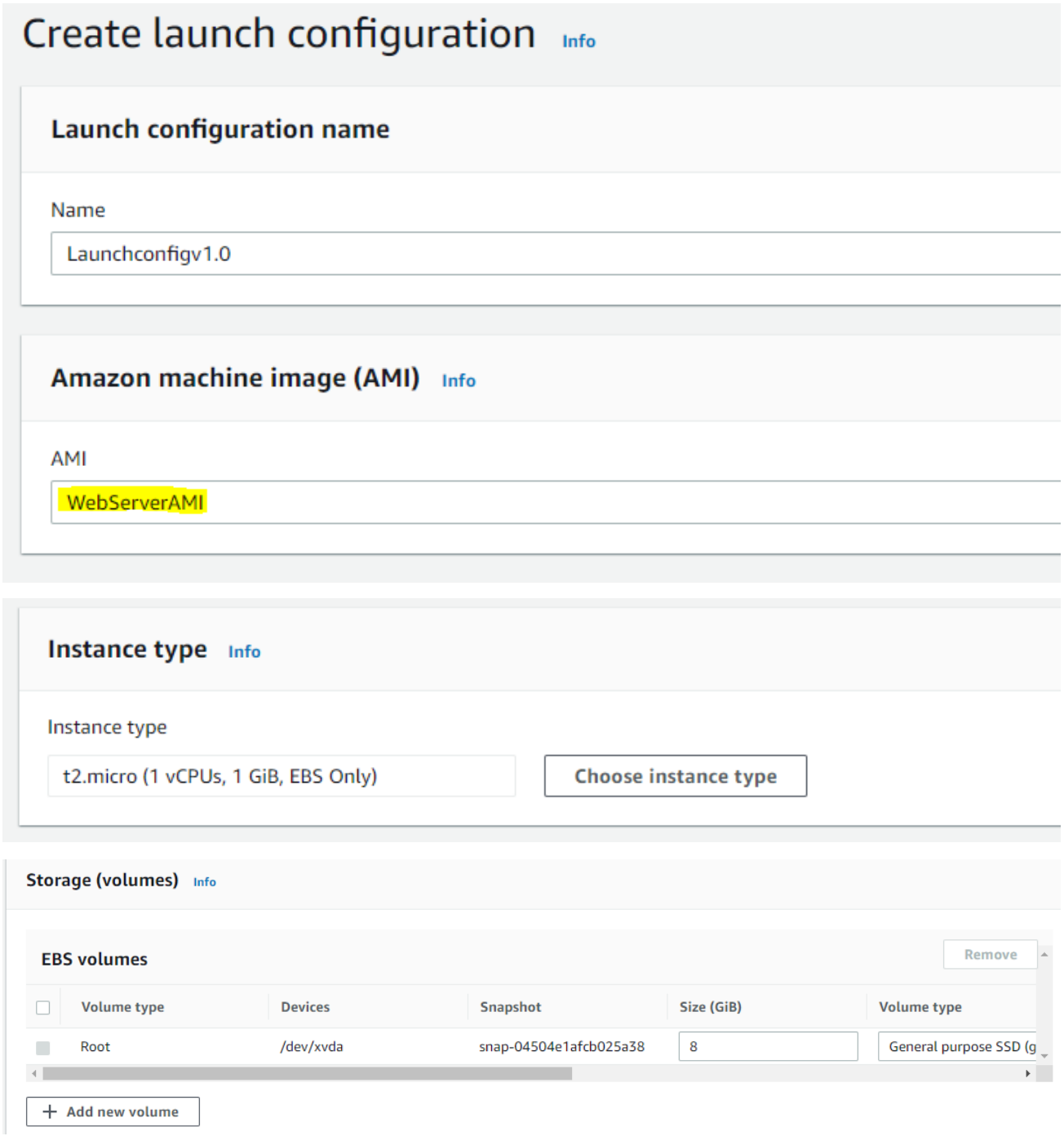

Amazon machine image (AMI) - required Info
AMI - required
amzn2-ami-hvm-2.0.20210427.0-x86_64-gp2
ami-010aff33ed5991201
architecture: 64-bit (x86) virtualization: hvm
Instance type Info
Instance type
t2.micro
Free tier eligible
Family: t2 1 vCPU 1 GiB Memory
On-Demand Linux pricing: 0.0124 USD per Hour
On-Demand Windows pricing: 0.017 USD per Hour
Compare instance types

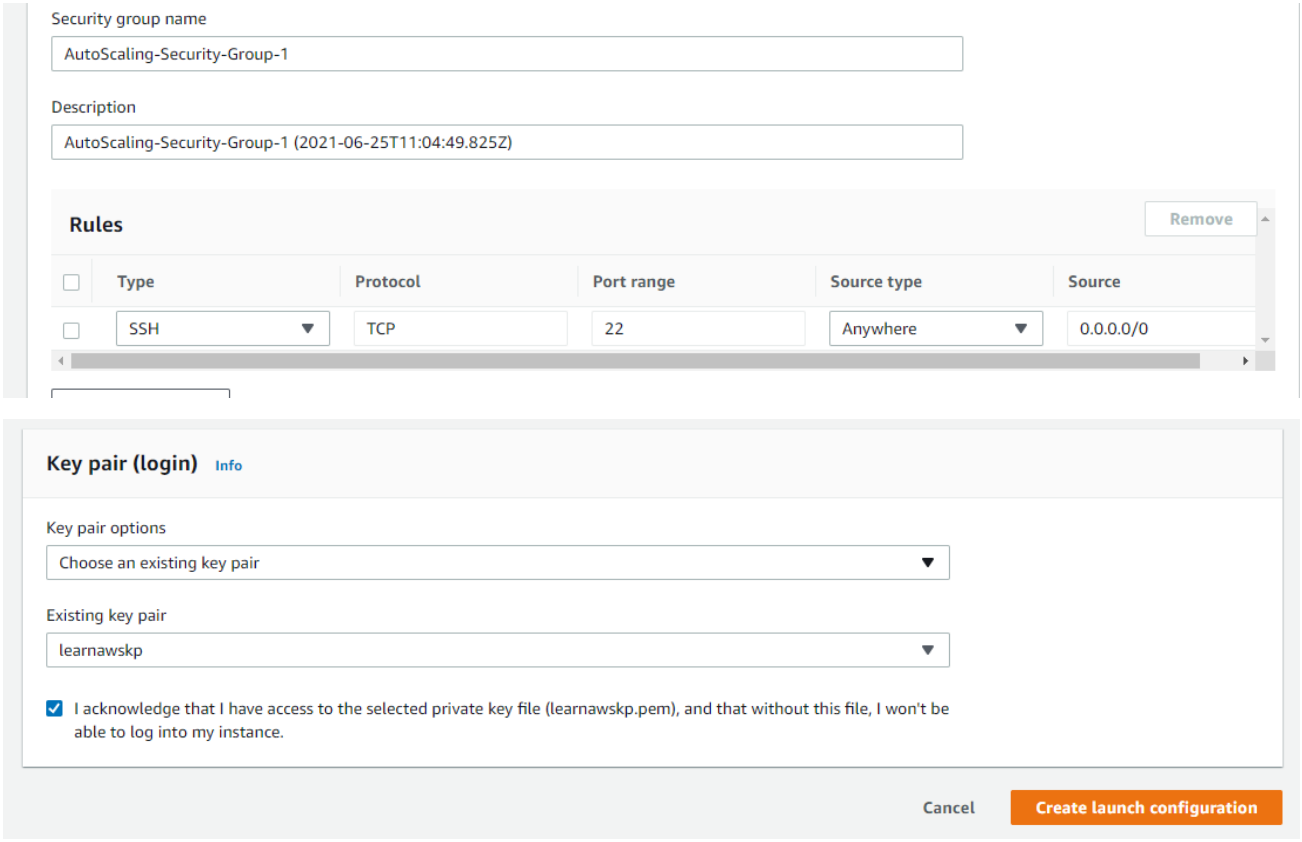

Key pair (login) Info
You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.
Key pair name
learnawskp
Template value
Create new key pair
Network settings
Networking platform Info
Virtual Private Cloud (VPC)
Launch into a virtual network in your own logically isolated area within the AWS cloud
EC2-Classic
Launch into a single flat network that you share with other customers.
Security groups
Select security groups
Storage (volumes) Info
Volume 1 (AMI Root) (Custom) (8 GiB, EBS, General purpose SSD (gp2))
Add new volume
Network interfaces Info
Network interface 1
Remove
Device index Info
0
Network interface Info
New interface
Description Info
My Primary ENI
Subnet Info
subnet-7b3ed510
Remove subnet for EC2 Auto Scaling templates
Not applicable for EC2 Auto Scaling
Security groups
Select security groups
Show all selected (1)
Auto-assign public IP Info
Enable
Cancel
Create launch template

Make sure you remove the subnet selecyion for ASG and Click on "**Create launch template**"

Creating the Launch Configuration steps

1. Go to **EC2 Management Dashboard** option, select the **AutoScaling Groups** option from the navigation pane. This will bring up the Auto Scaling Groups dashboard. Next, select the **Create Auto Scaling group** option to bring up the Auto Scaling setup wizard.



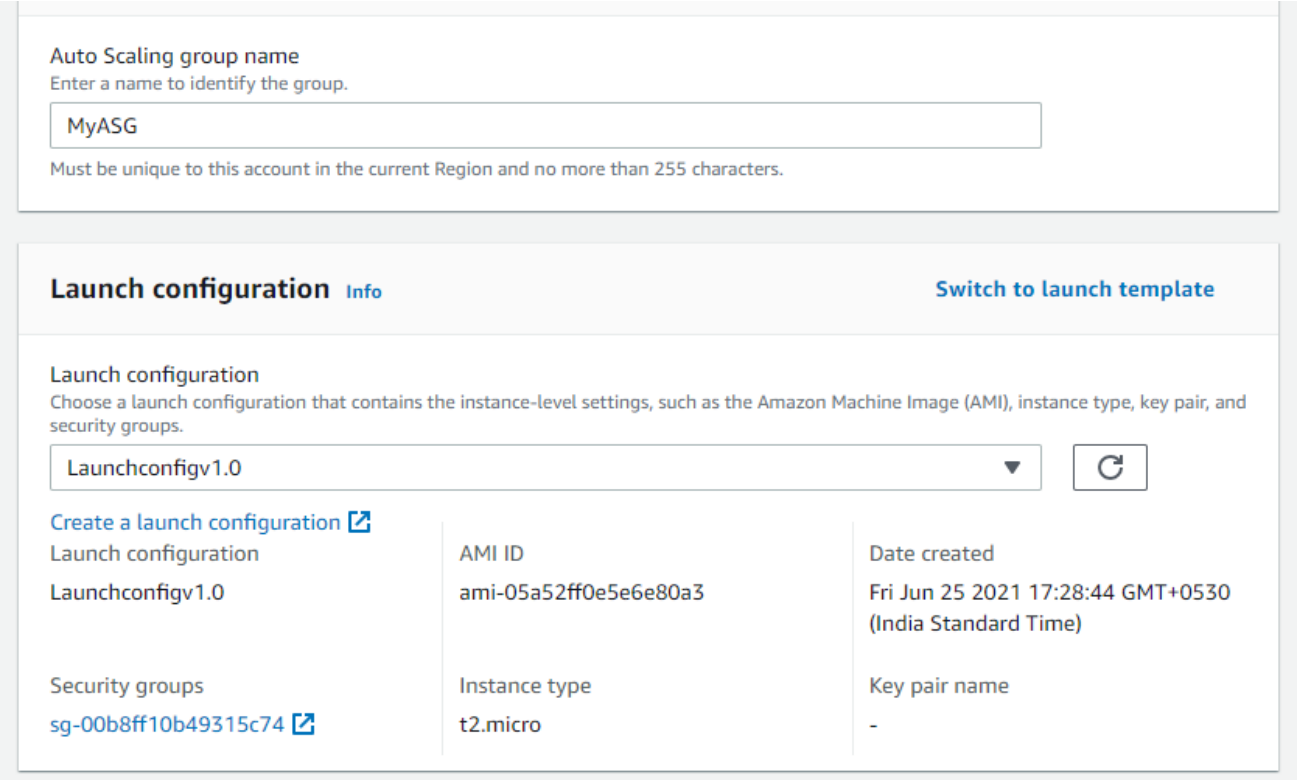


2. Select Create launch configuration is similar to the instance launch wizard. If you have any custom AMIs you can select here.
3. Give a valid name for the Launch configuration. Choose Instance configuration, Storage options, security groups, tags and key pairs and select Create Launch Configuration to complete the process

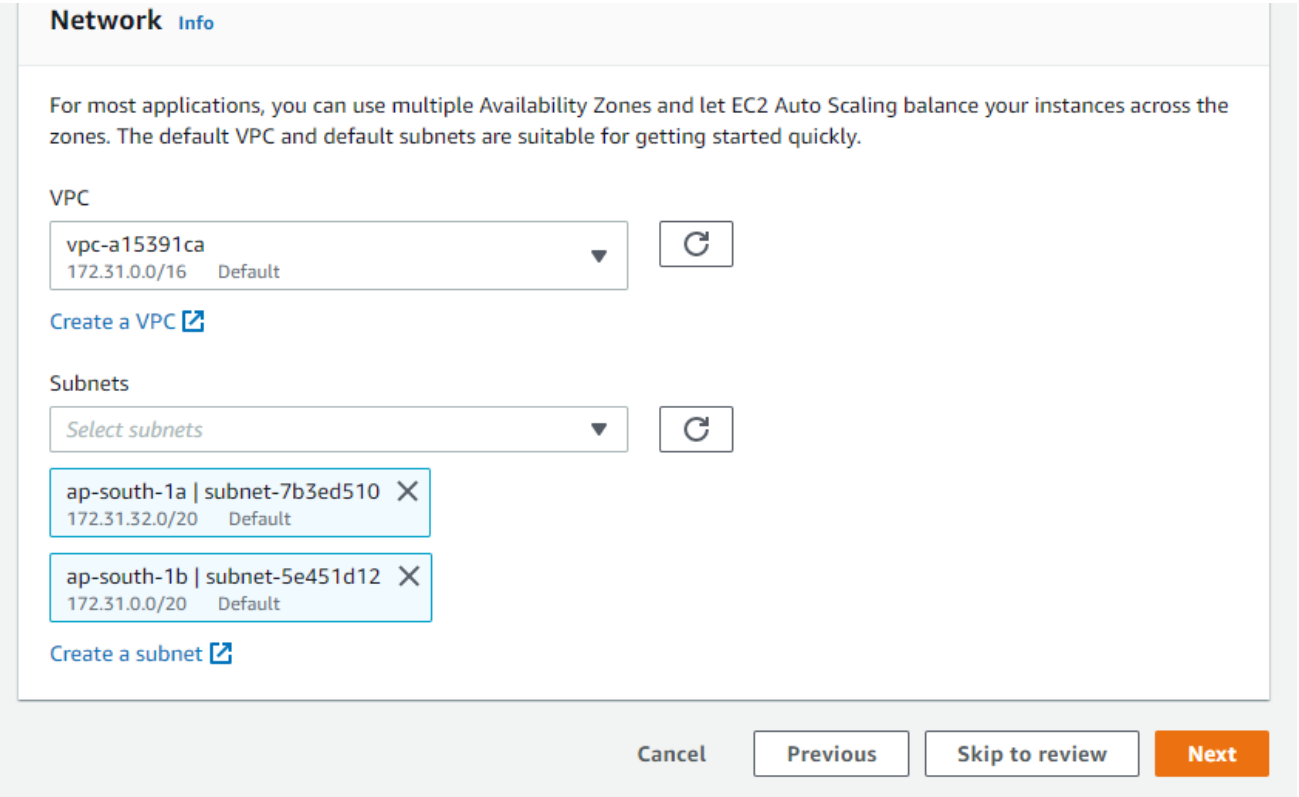
Step 2: Creating the Auto Scaling Group

An Auto Scaling Group is nothing more than a logical grouping of instances that share some common scaling characteristics between them. Each group has its own set of criteria specified which includes the minimum and maximum number of instances that the group should have along with the desired number of instances which the group must have at all times.

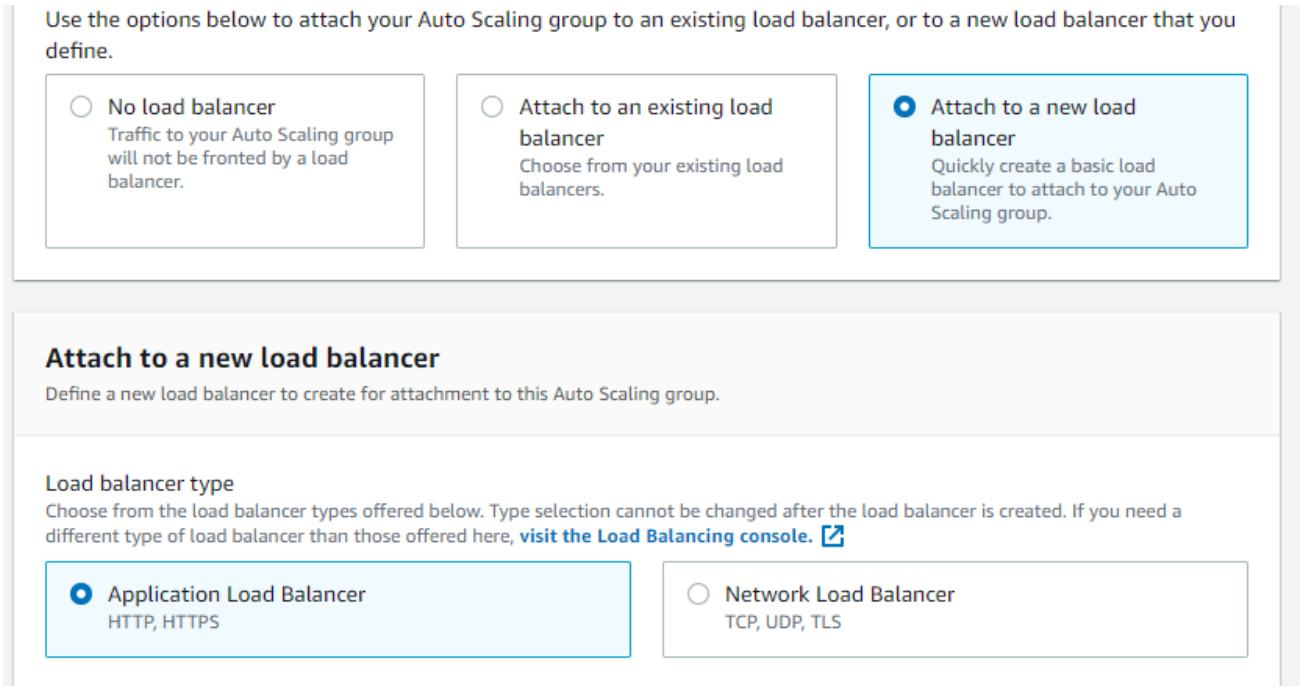
4. When we completes with creating launch configuration, it will take us to Step 2, Here we have to give a name for the Group, We can select the Group size and VPC.



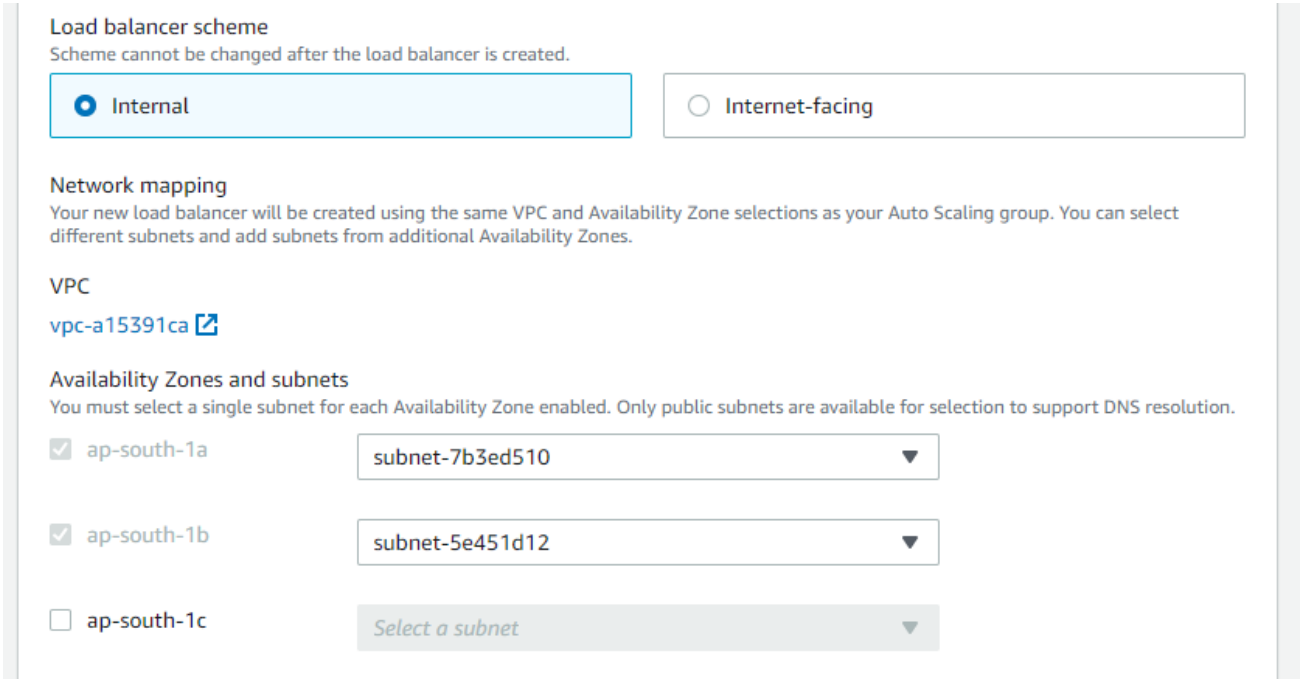
On the Choose launch template or configuration page, for Auto Scaling group name, **enter a name for your Auto Scaling group**.

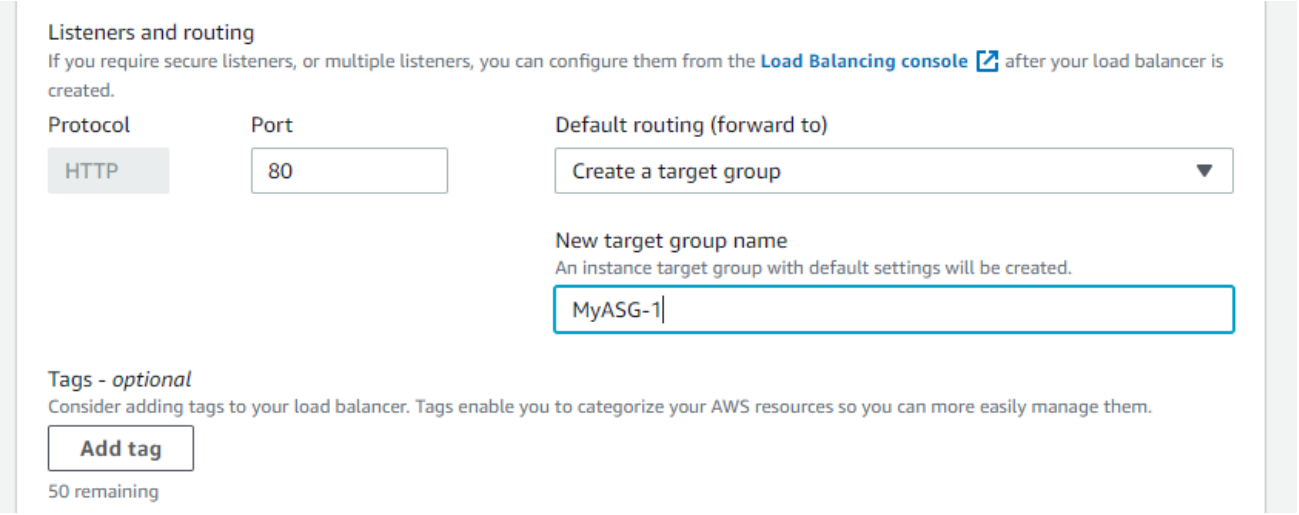


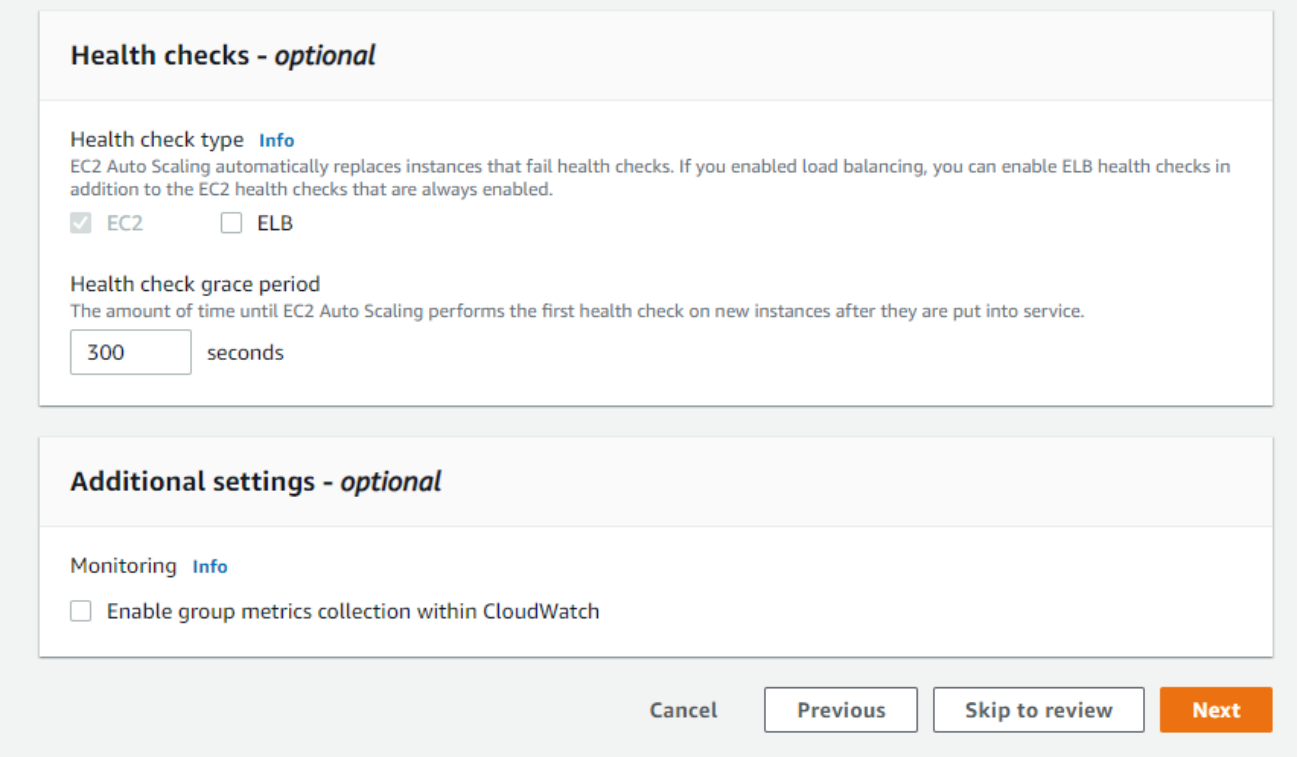
For **Network**, choose the VPC that you used for your load balancer. I have selected Default vpc with 2 subnets, Always choose 2 subnets for High availability purpose.



Choose an Existing ELB (Create an ELB and keep it ready) or create a new ELB by following below images.



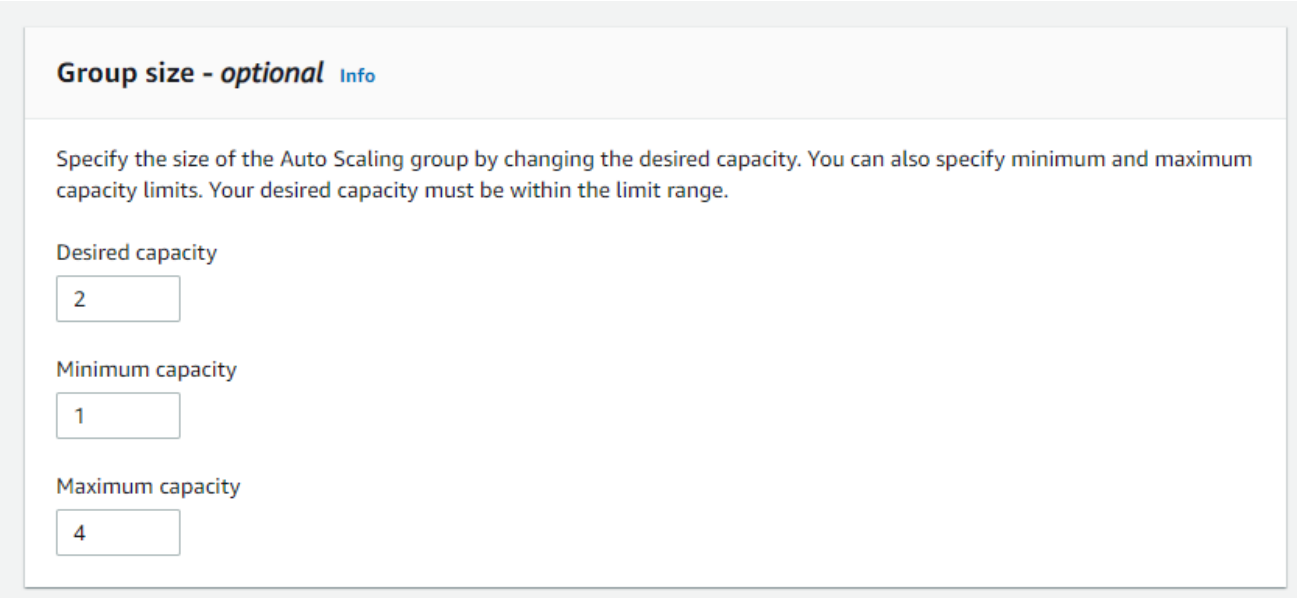




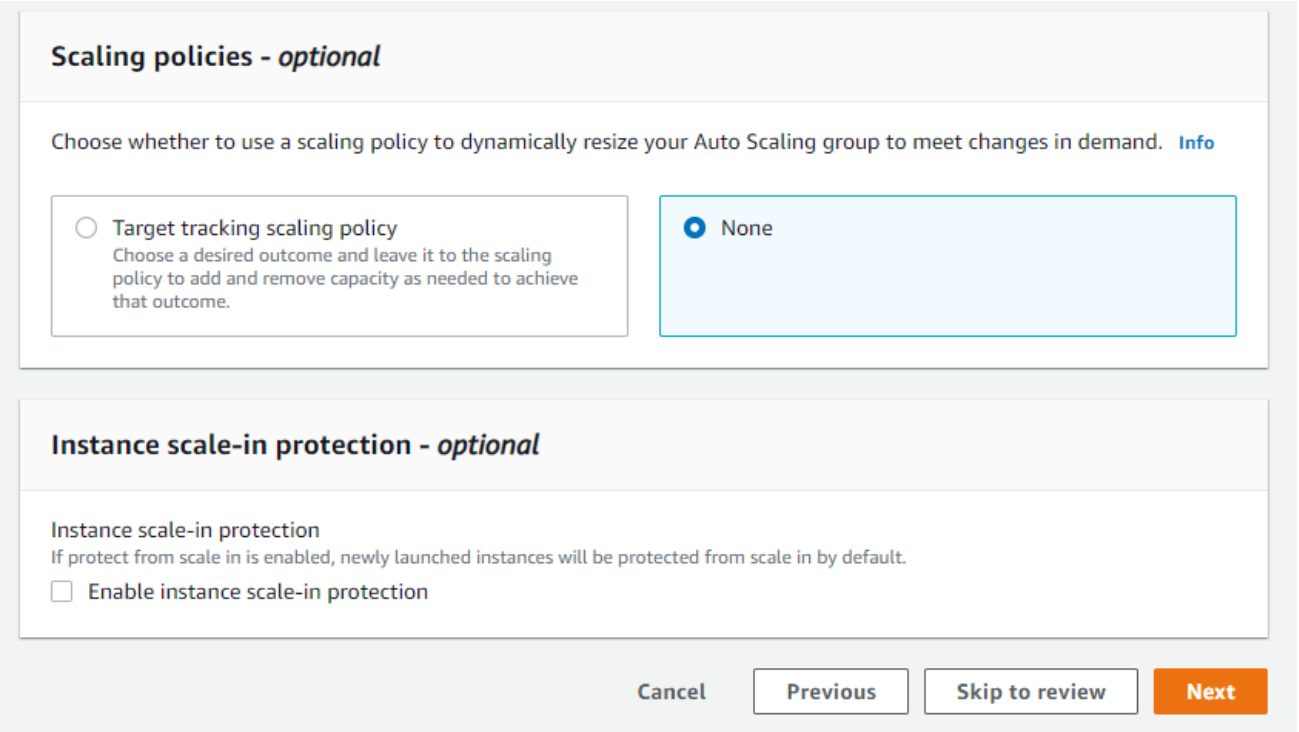
Health Check Type: You can use either your EC2 instances or even your ELB as a health check mechanism to make sure that your instances are in a healthy state and performing optimally. By default, Auto Scaling will check your EC2 instances periodically for their health status. If an unhealthy instance is found, Auto Scaling will immediately replace that with a healthy one.

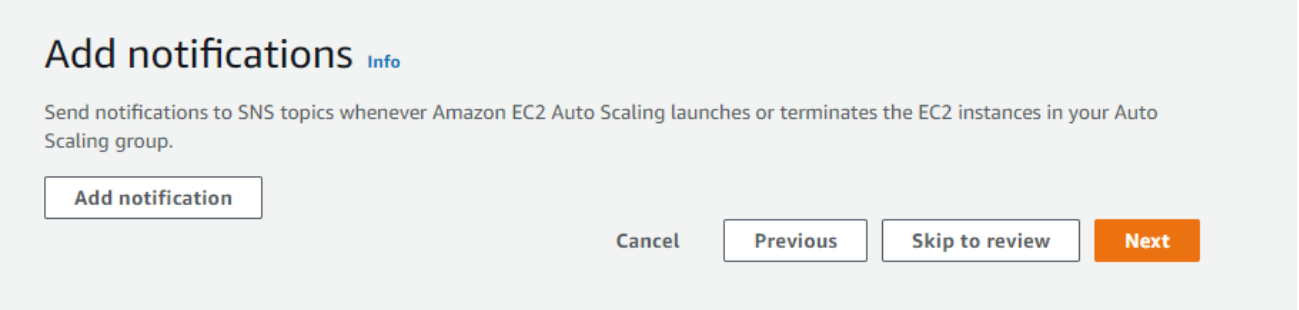
Health Check Grace Period: Enter the health check's grace period in seconds. By default, this value is set to 300 seconds.

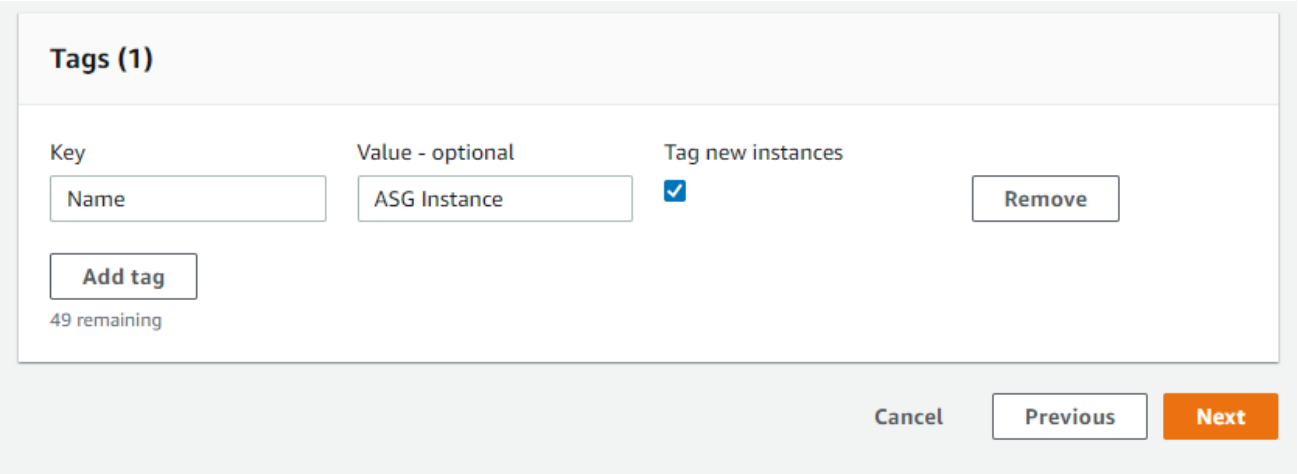
Enable group metrics if we are looking to get group metrics for all the instances running in ASG.

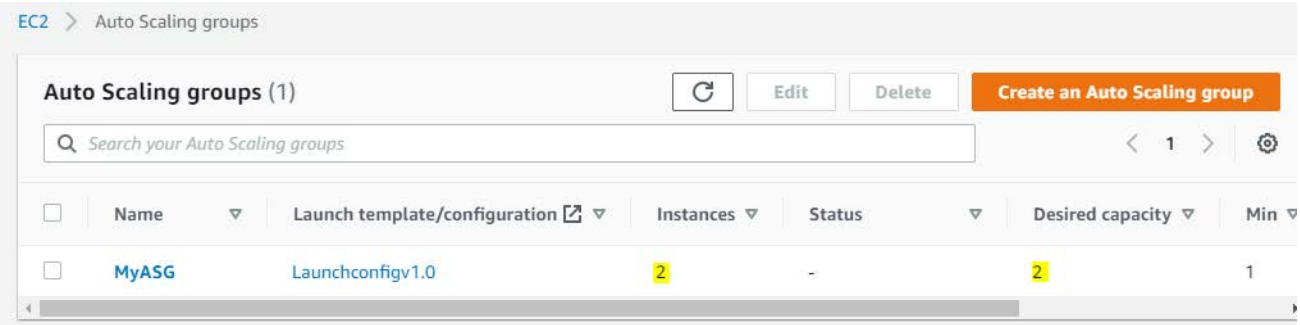


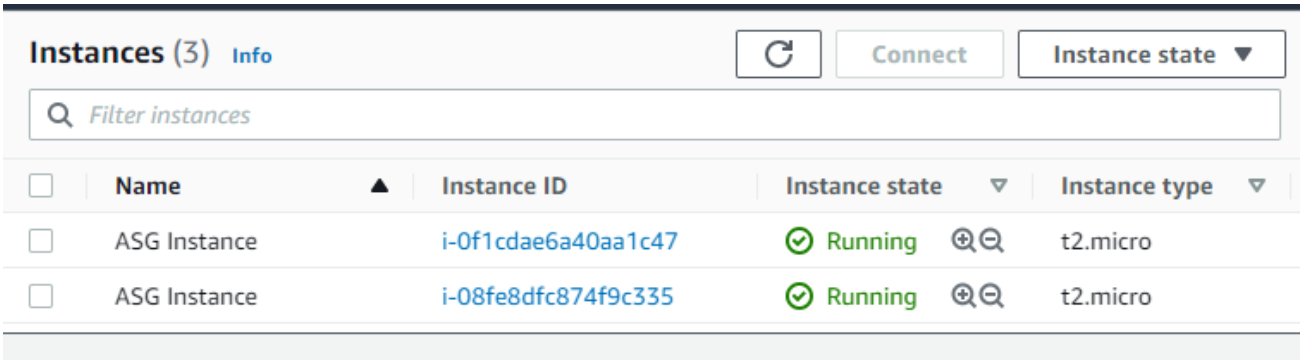
In above example, I have setup “Desired Capacity” as 2, so application runs with 2 instances always, if any one of the instance is down ASG creates a new instance automatically.











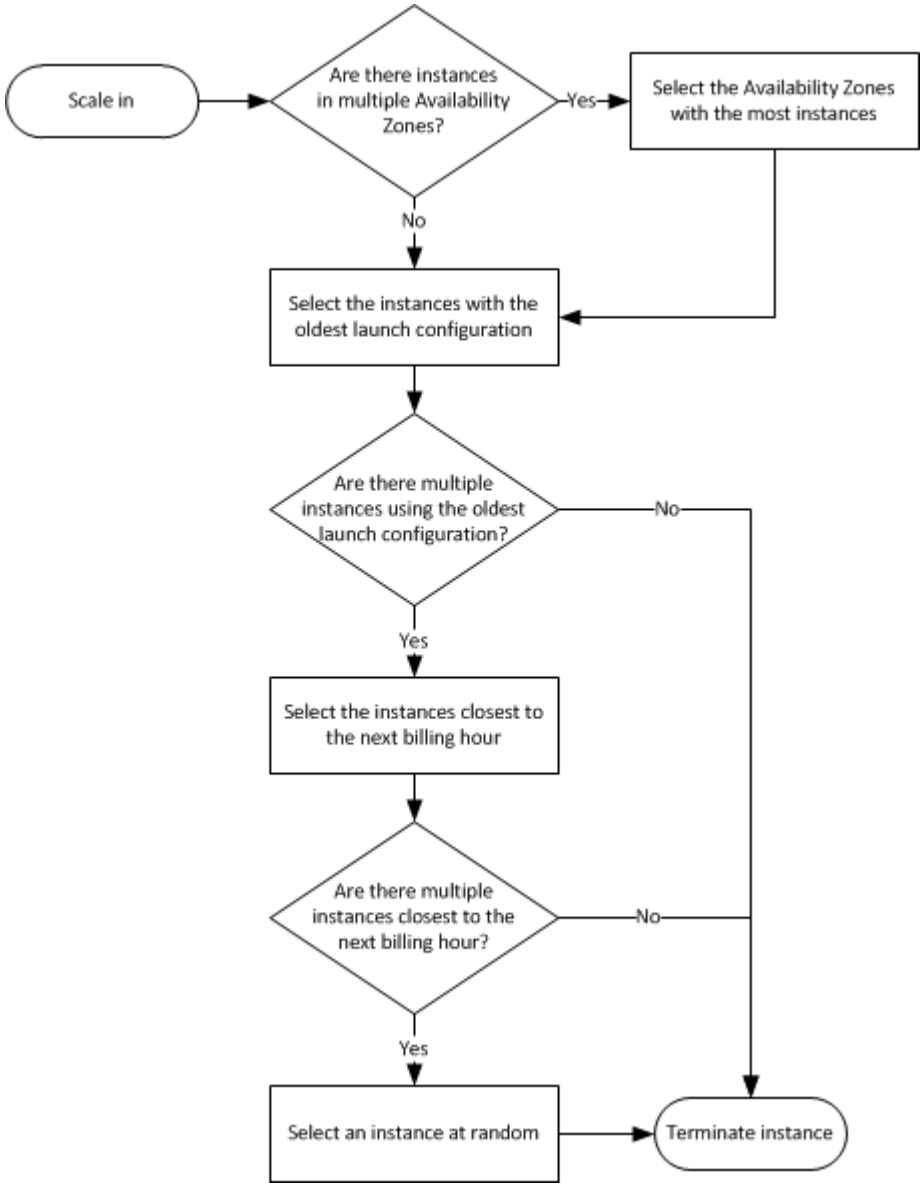
To configure Dynamic Scaling, “Create an Alarm” and define the required count.

Default Termination Policy for Auto Scaling Group:

1. If there are instances in multiple Availability Zones, select the Availability Zone with the most instances and at least one instance that is not protected from scale in. If there is more than one Availability Zone with this number of instances, select the Availability Zone with the instances that use the oldest launch configuration.
2. Determine which unprotected instances in the selected Availability Zone use the oldest launch configuration. If there is one such instance, terminate it.

3. If there are multiple instances that use the oldest launch configuration, determine which unprotected instances are closest to the next billing hour. If there is one such instance, terminate it.
4. If there is more than one unprotected instance closest to the next billing hour, select one of these instances at random.

Here is a diagram that shows how the default termination policy works for ASG.



USER DATA:

When you launch an instance in Amazon EC2, you have the option of passing user data to the instance that can be used to perform common automated configuration tasks and even run scripts after the instance starts.

If you want to know, what userdata given to an ec2 instance, run the below URL in browser or perminal, it desplays the oputput with given userdata.

Curl http://169.254.169.254/latest/user-data/

You can pass two types of user data to Amazon EC2: shell scripts and cloud-init directives. You can also pass this data into the launch wizard as plain text, as a file (this is useful for launching instances using the command line tools), or as base64-encoded text.

Here is a simple User Data script to use with **Linux EC2 instances** to make as a simple webserver with a simple index.html page.

#!/bin/bash
Yum install httpd -y
echo "Hi This is a Bootstrap script generated webpage" > /var/www/html/index.html
service httpd start
chkconfig httpd on

"yum update" for updating the Operating system with latest security patches.

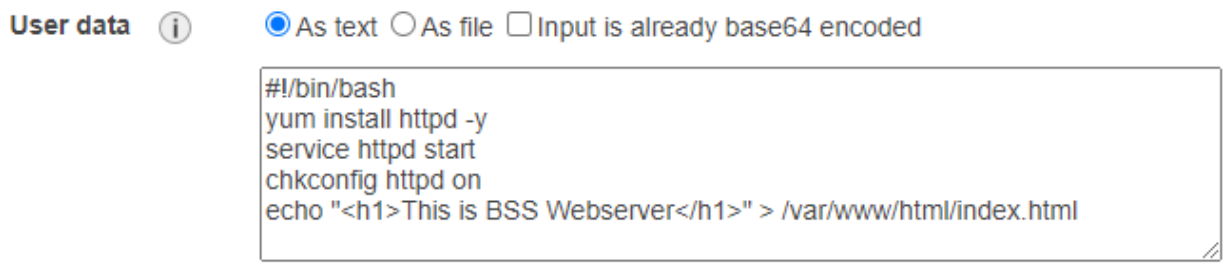
"Yum install httpd" for installing Apache to make this instance as a webserver

By Using echo command generating a string and copying the generated string to a file named "index.html" and saving the file under "/var/www/html" directory.

"Service httpd start" to start the apache service

"Chkconfighttpd on" starting and turning the service on / startup service.

1. While launching instance I've entered the bootstrap scripting



2. Then launching the instance and entering the public IP in the web browser without connecting to my instance. (Make sure port 80 open in the Security groups)

3. We got the output without login to the instance.

For Windows:

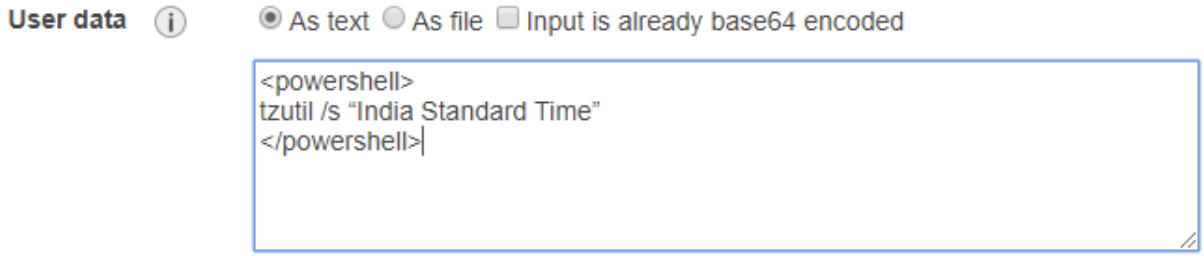
For EC2Config or EC2Launch to execute user data scripts, you must enclose the lines of the specified script within one of the following special tags:

<script></script>

<powershell></powershell>

Example: <powershell> tzutil /s “India Standard Time” </powershell>

Tzutil is a tool to set the time zone in windows operating systems. Without loggin into the ec2 instance, we can setup the timezone.



1. Here we have run very simple script to change the timezone to “India standard time” inside an ec2 instance.
2. Login to instance and verify the oputput.

AWS CLI (Command Line Interface):

The AWS Command Line Interface (CLI) is a unified tool to manage AWS services. With just one tool to download and configure, you can control multiple AWS services from the command line and automate them through scripts.

- We can download the AWS tolls by using this URL: https://aws.amazon.com/cli/
- You can select the setup file based on your system architecture, if you are a windows user.
- Amazon Linux will get the CLI tools pre-installed.

Windows
Download and run the 64-bit Windows installer.

MacOS
Download and run the MacOS PKG installer.

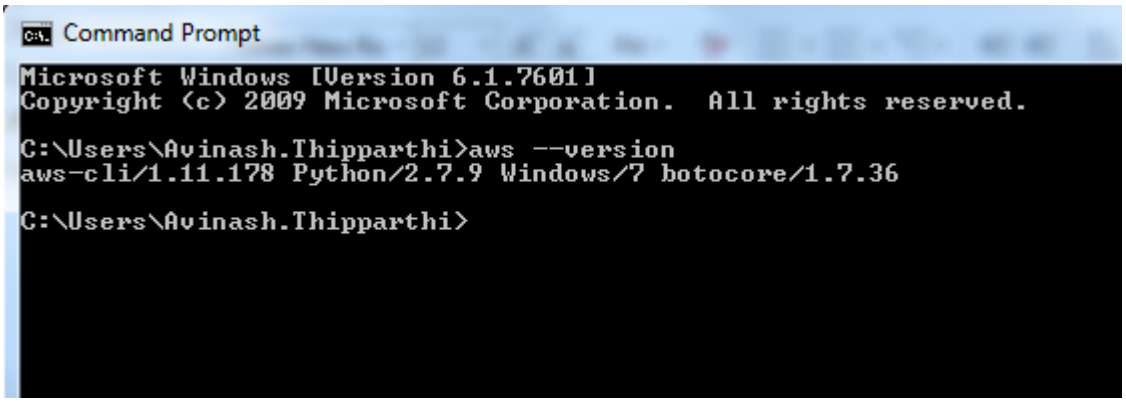
Linux
Download, unzip, and then run the Linux installer

Amazon Linux
The AWS CLI comes pre-installed on Amazon Linux AMI.

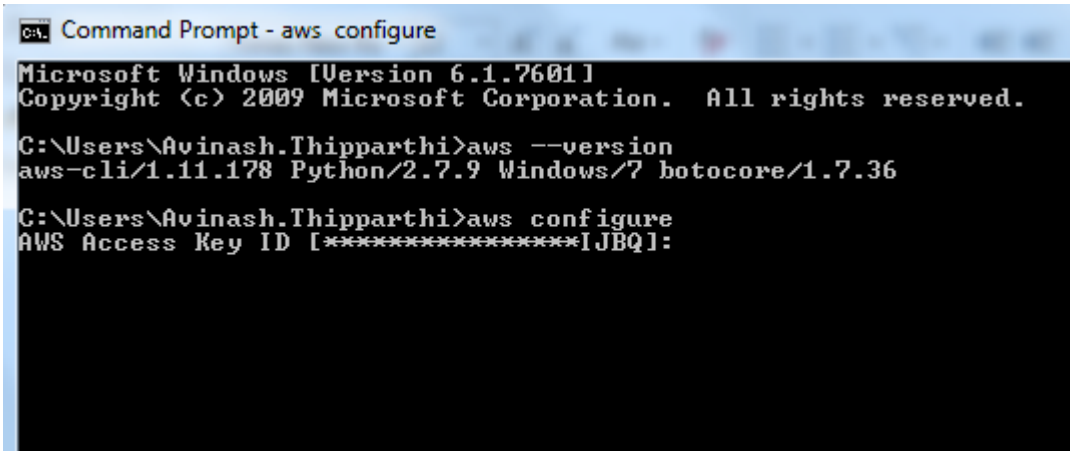
- Here is the url to get all the commands for each and every AWS service: http://docs.aws.amazon.com/cli/latest/reference/

Steps to configure CLI tools on windows Operating systems:

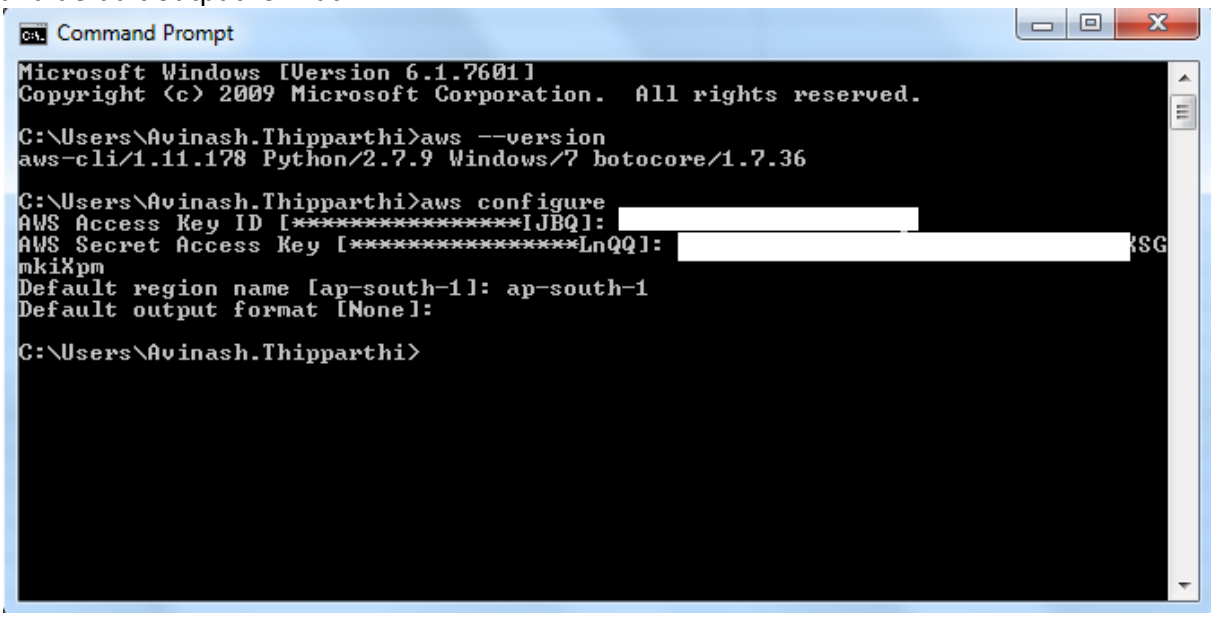
1. First we have to download the setup file from the above mentioned webpage, then follow the simple installation wizard.
2. After installing these tools, we can use the windows command prompt to connect to AWS resources/services.
3. To verify CLI tools installation, open command prompt and enter **"AWS –version",** it should return with installed version information as the below image.



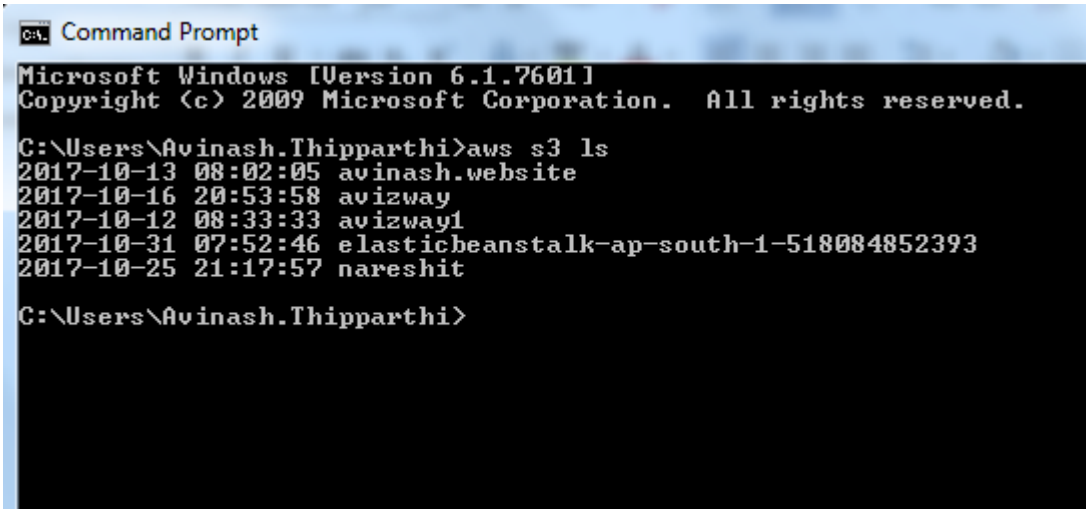
4. But we cannot configure CLI tools using IAM Management console access users, we need to have Programmatic Access IAM user.
5. When we create a Programmatic Access IAM user we will get **Access key ID** and **Secret Access Key**. Please create a user and allocate appropriate permissions.
6. To configure IAM user in local windows machine, we have to "**AWS configure**" command.



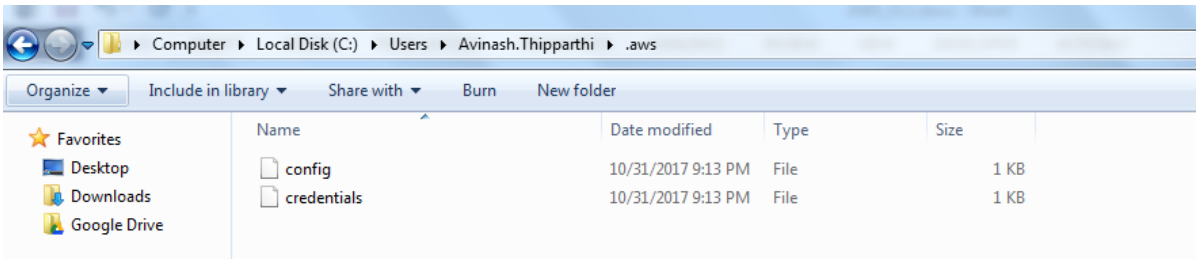
7. Enter the AWS Access Key ID and then enter the Secret Access key, choose the default region and default output format.



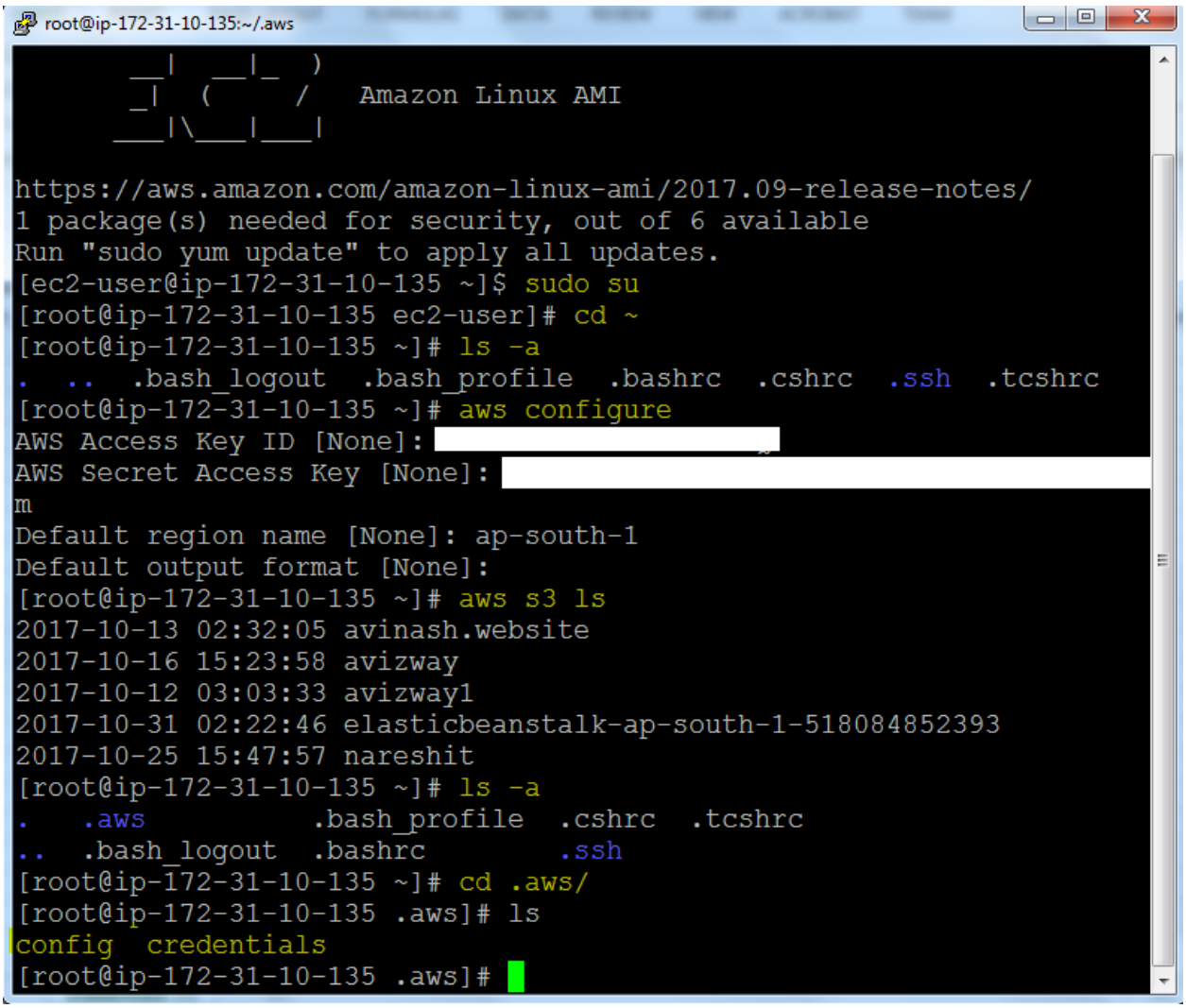
8. We have successfully configured the CLI tools and now try to access any of the AWS resource from the CLI configured device. Here am trying to list my S3 buckets for that am using **aws s3 ls** command.



9. We are able to get the details that means we are connecting to AWS account resources by using the Programmatic access IAM user credentials.
10. But, the IAM user credentials will store in a directory called .aws , In windows the path is **C:\Users\WindowsUserName\.aws** , if you open credentials file, we will get the Configured IAM user's Aceess Key ID and Secret Access Key.



11. In Linux, The .aws directory will store under / (root) and It is a hidden directory, we can give **ls –a** command to get it, and inside the .aws directory we will have config and credentials files.



12. In the above image, I've logged into the linux instance and switched to root, looked for .aws directory, but it is not existed. Then Configured the IAM user with Access Key IA and Secret Access Key and accessed the AWS resources and we get the required resource information.

13. After installing CLI IAM user, we got .aws directory under **/** (give **ls –a** to verify), inside that .aws directory we have config and credentials files, Credential file will contains the Access Key id and secret access key.
14. So this is not a secure method, anybody can view these credentials and configure CLI tools on their own machines and they may access, So amazon will **recommend to use the ROLES** instead of storing the credentials in local machines.

Policy: A policy is a JSON document that fully defines a set of permissions to access and Manipulate AWS resources. Policy documents contain one or more permissions.

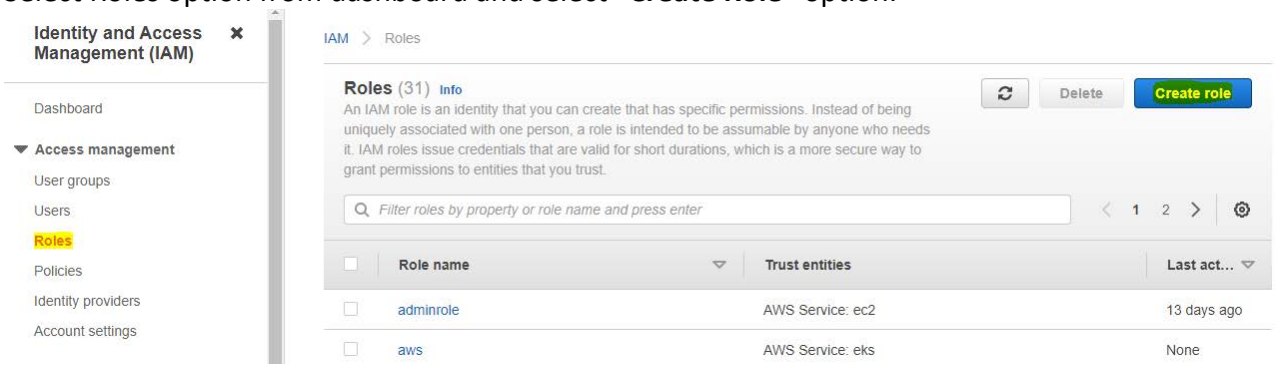
IAM ROLES:

Roles are used to allow AWS services to perform actions on your behalf. Roles are used to grant specific privileges to specific actors.

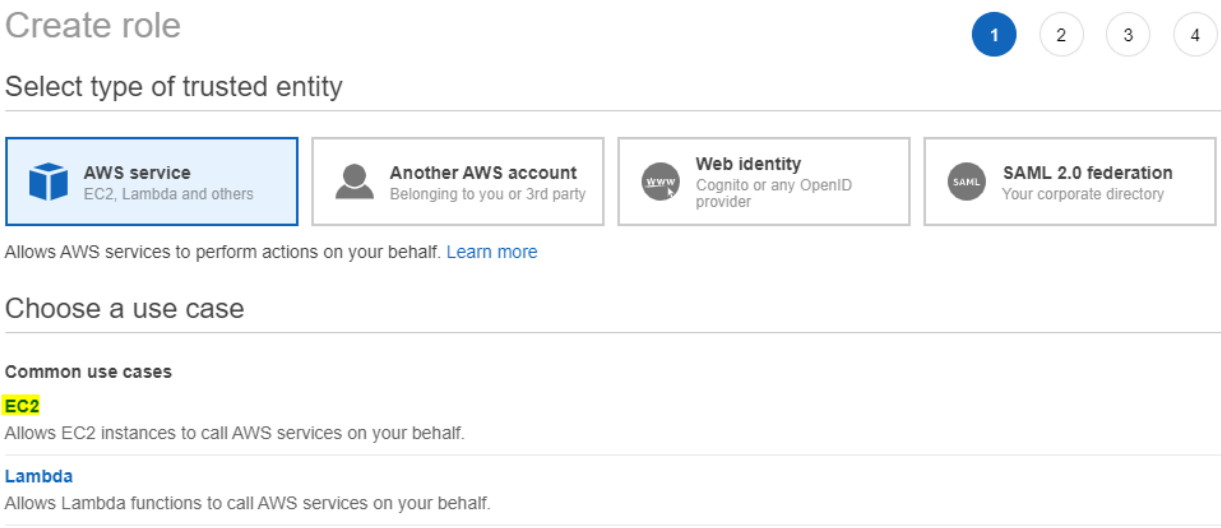
- Roles are more secure than storing your access key and secret access key on individual EC2 instances.
- Roles are easier to manage
- We can attach or Remove role to a running instance now. Previously this option is not available.
- Roles are universal, you can use them in any region.

Steps to create a role and attaching to EC2 instance.

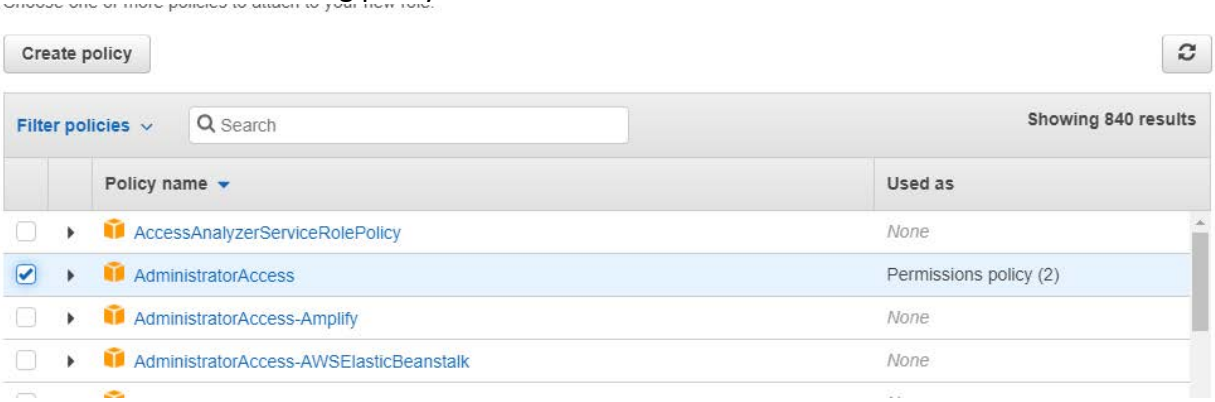
1. Navigate to IAM dashboard to create an IAM role.
2. Select Roles option from dashboard and select **"Create Role"** option.



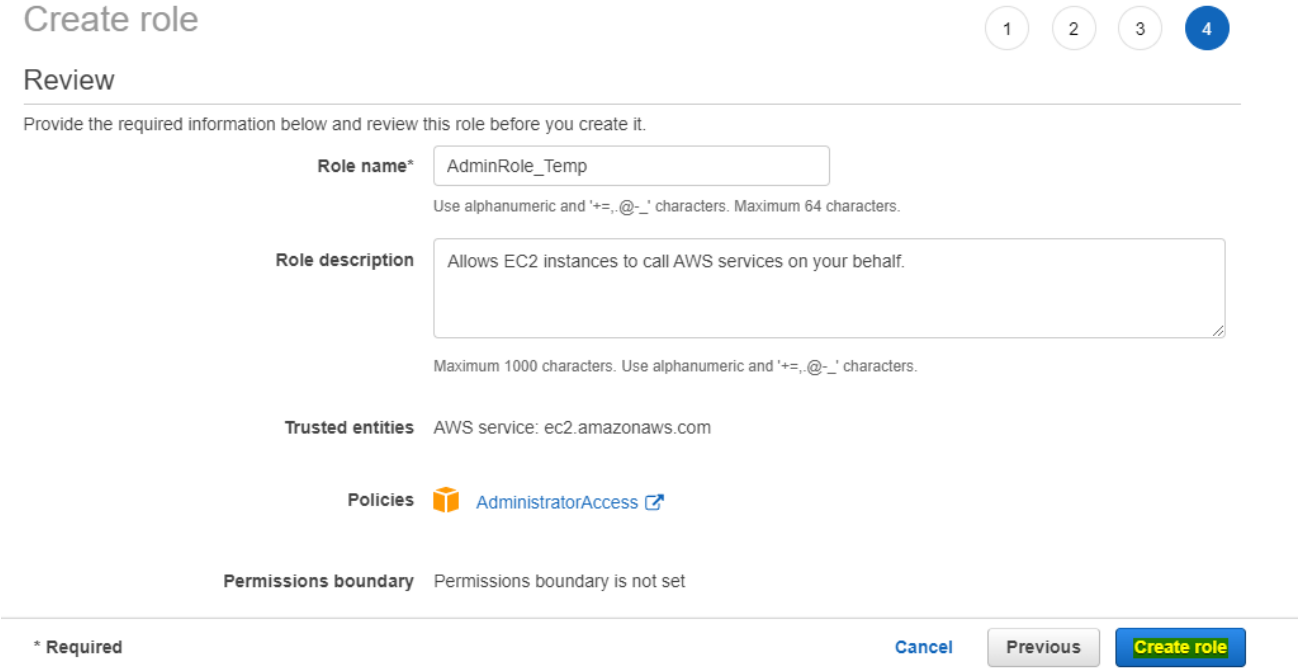
3. We have four option in the roles, We are going to create this role under "AWS Services", and select the **EC2.**
4. After selecting EC2, we have to select the appropriate Use Case. We would like to call some AWS services on our behalf to the EC2 instance. Select EC2 and click on **Next: Permissions** button.



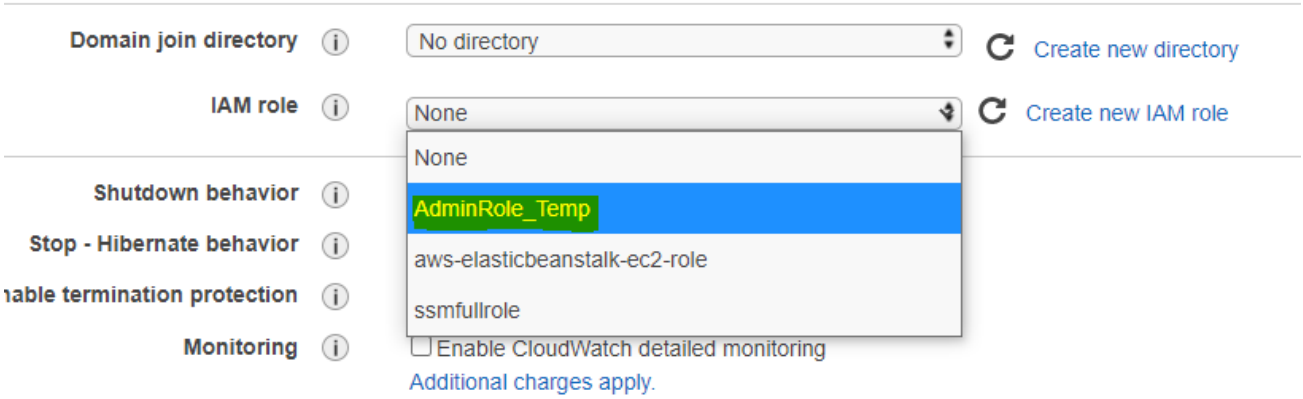
5. In this step, we have to select the policy, you can generate a new policy based on your requirement or choose existing policy.



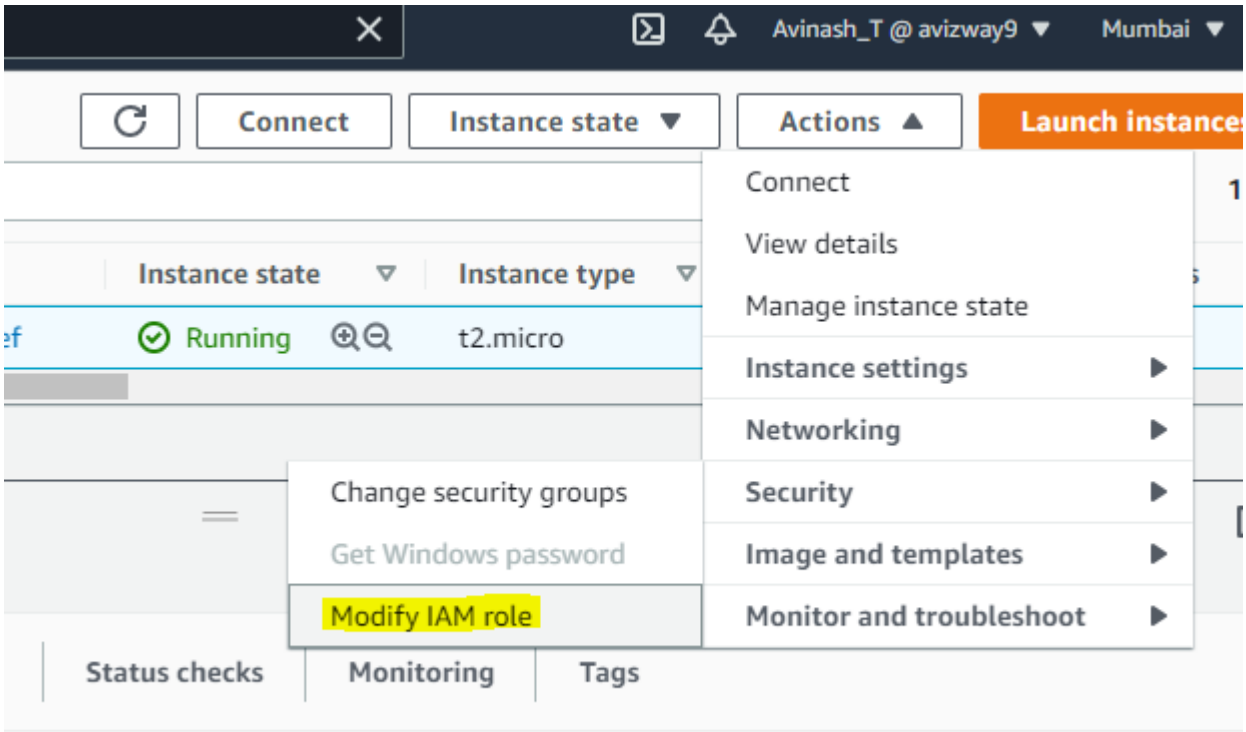
6. Select appropriate role, based on your requirement, am selecting AdministratorAccess role here. Add tags if required, Then Select **Review.**
7. In review page, Give a name for the role and a valid description and select **Create Role** option.



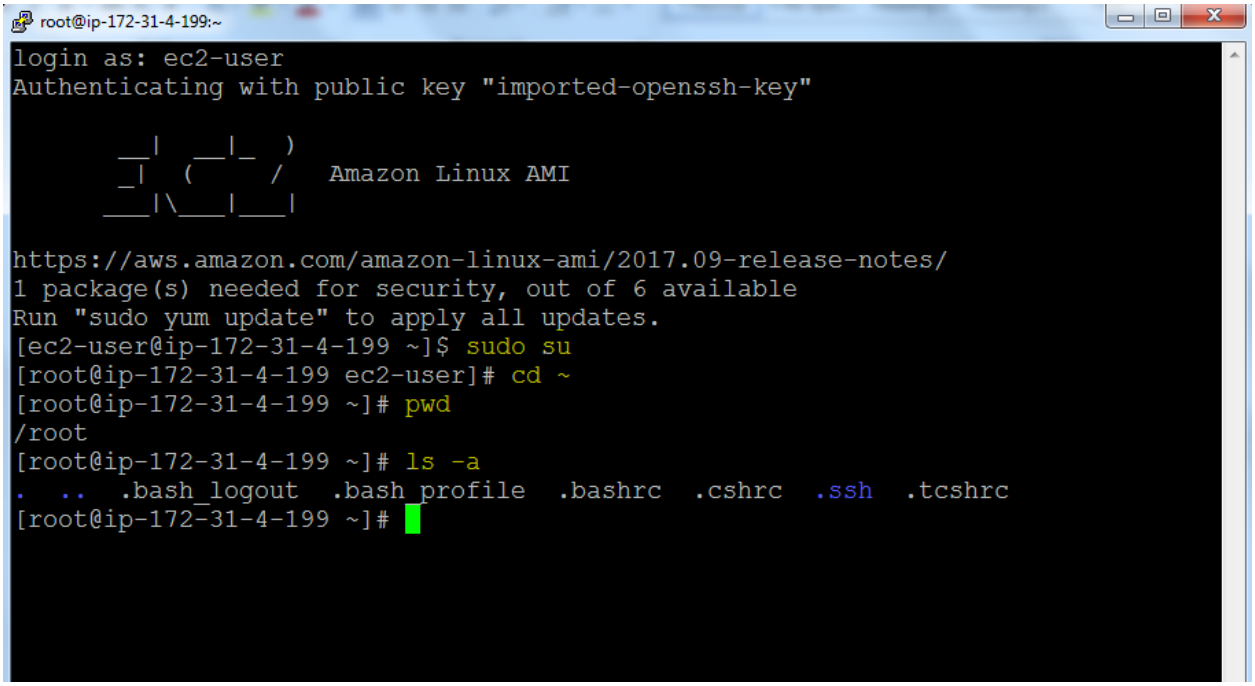
8. Now launch an EC2 instance and try to access/call any AWS service to verify the role.



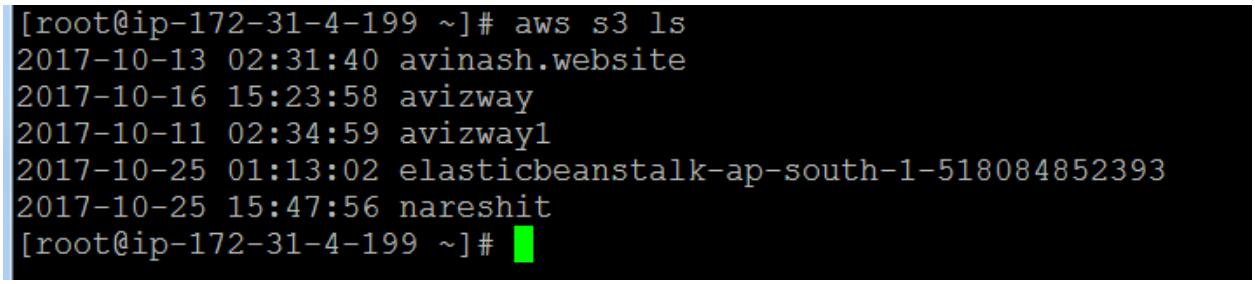
9. We can even associate a role after instance launch. To associate a role to existing instance, “Actions”, “Security” and **“modify IAM Role”**



10. Logged into EC2 instance and elevated privileges to root and trying to find the .aws directory under / , but we cannot find, That means we don’t have any credentials on instance.



11. Try to access any AWS service, here am trying to list the S3 buckets by **AWS s3 ls** command.



12. We are able to access the resources and nowhere storing the Access key ID and Secret Access key.

Instance Metadata:

Instance metadata is data about your instance that you can use to configure or manage the running instance. This is unique in that it is a mechanism to obtain AWS properties of the instance from within the OS. By using below URL we can query the local instance metadata.

- Curl http://169.254.169.254/latest/meta-data/
- When you enter this URL, it'll return with all the available information to get. We can give the required option after meta-data/ you'll get the information.

Steps to get the instance Metadata:

1. I've logged into my EC2 instance
2. Enter the metadata url

```
[root@ip-172-31-23-113 ec2-user]# curl http://169.254.169.254/latest/meta-data/
ami-id
ami-launch-index
ami-manifest-path
block-device-mapping/
hostname
instance-action
instance-id
instance-type
local-hostname
local-ipv4
mac
metrics/
network/
placement/
profile
public-hostname
public-ipv4
public-keys/
reservation-id
security-groups
services/[root@ip-172-31-23-113 ec2-user]#
```

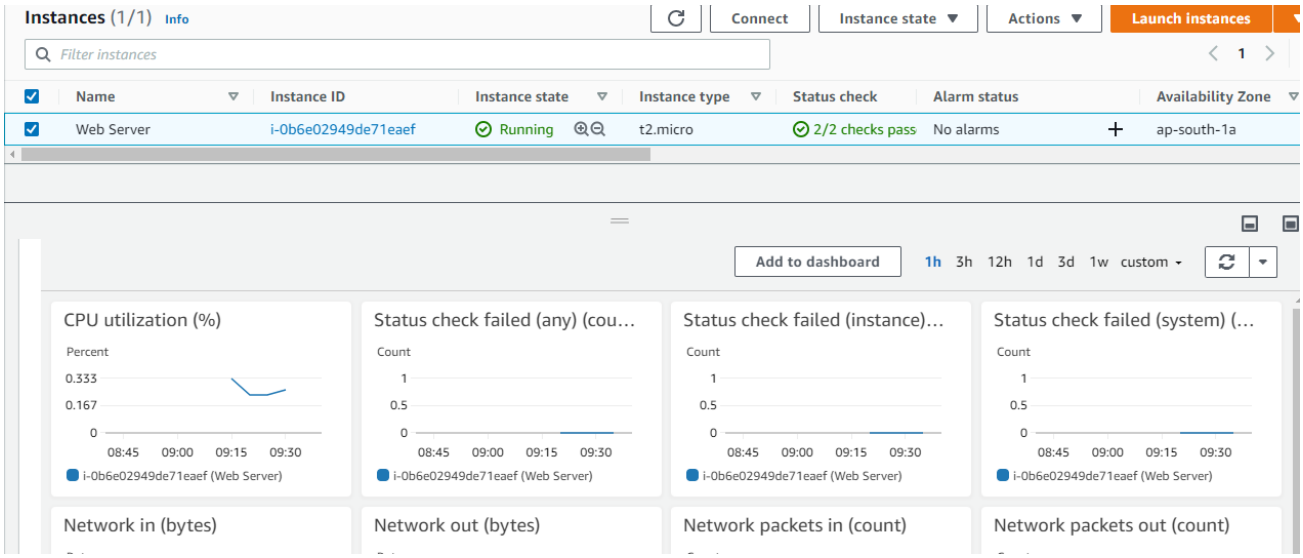
3. It is returned with all the available option, now whatever the information you want to get, give it along with the URL.
   Ex: if you want to know hostname, give as Curl http://169.254.169.254/latest/meta-data/hostname

```
[root@ip-172-31-23-113 ec2-user]# curl http://169.254.169.254/latest/meta-data/hostname
ip-172-31-23-113.ap-south-1.compute.internal[root@ip-172-31-23-113 ec2-user]#
```

AWS CLOUDWATCH

Amazon CloudWatch is a service that you can use to monitor your AWS resources and your applications in real time. With Amazon CloudWatch, you can collect and track metrics, create alarms that send notifications, and make changes to the resources being monitored based on rules you define.

- You can specify parameters for a metric over a time period and configure alarms and automated actions when a threshold is reached.
- Amazon CloudWatch offers either basic or detailed monitoring for supported AWS products.
- Basic monitoring sends data points to Amazon CloudWatch every five minutes for a limited number of preselected metrics at no charge.
- Detailed monitoring sends data points to Amazon CloudWatch every minute and allows data aggregation for an additional charge. If you want to use detailed monitoring, you must enable it—basic is the default.
- AWS provides a rich set of metrics included with each service, but you can also define custom metrics to monitor resources and events.
- Amazon CloudWatch Logs can be used to monitor, store, and access log files from Amazon EC2 instances.
- Amazon CloudWatch Logs can also be used to store your logs in Amazon S3 or Amazon Glacier.
- Each AWS account is limited to 5,000 alarms per AWS account, and metrics data is retained for two weeks by default.



Sample image for EC2 instance cloudwatch monitorings.

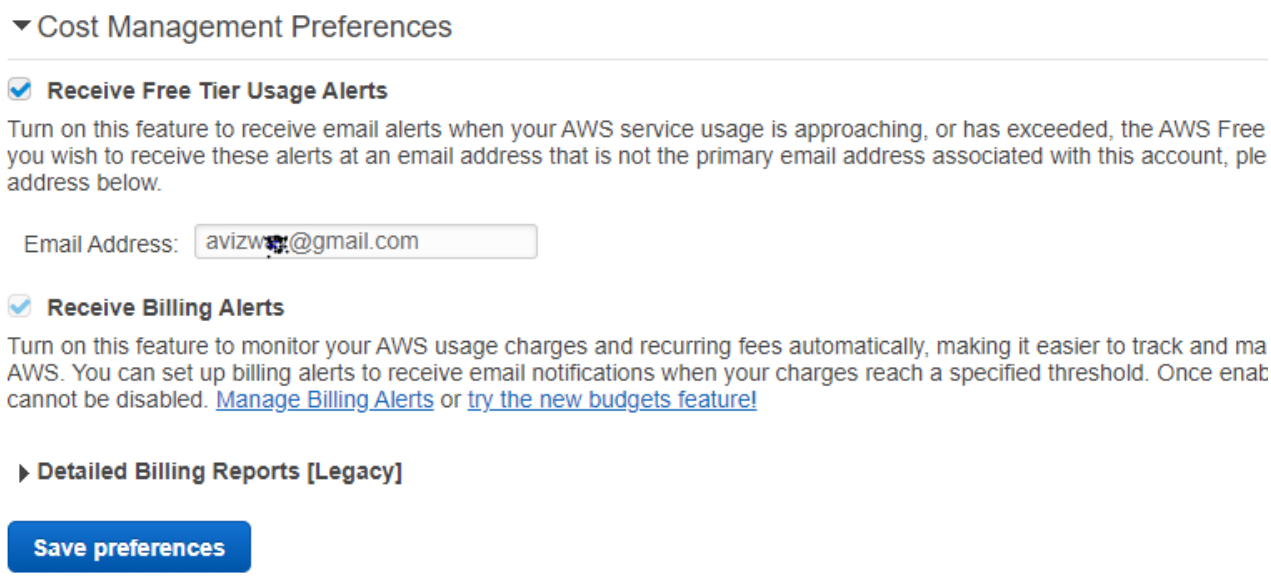
Metrics: Metrics form the core of Amazon CloudWatch's functionality. Essentially, these are nothing more than certain values to be monitored. Each metric has some data points associated with it which tend to change as time progresses.

Alarms: An alarm basically watches over a particular metric for a stipulated period of time and performs some actions based on its trigger. These actions can be anything from sending a notification to the concerned user using the Simple Notification Service (SNS).

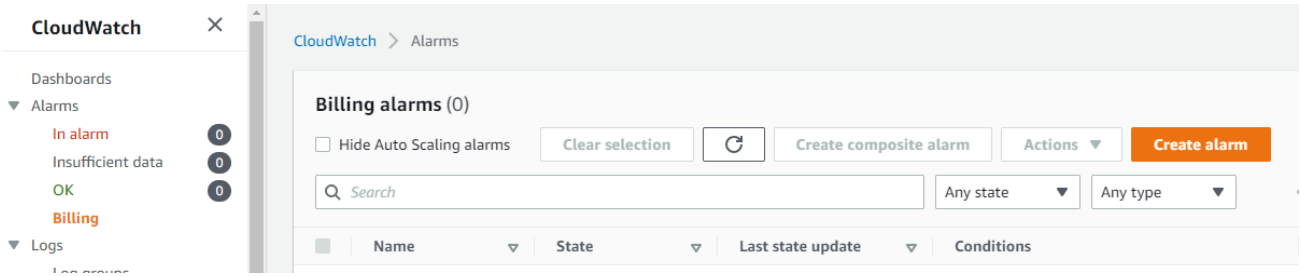
Monitoring your account's estimate charges using CloudWatch

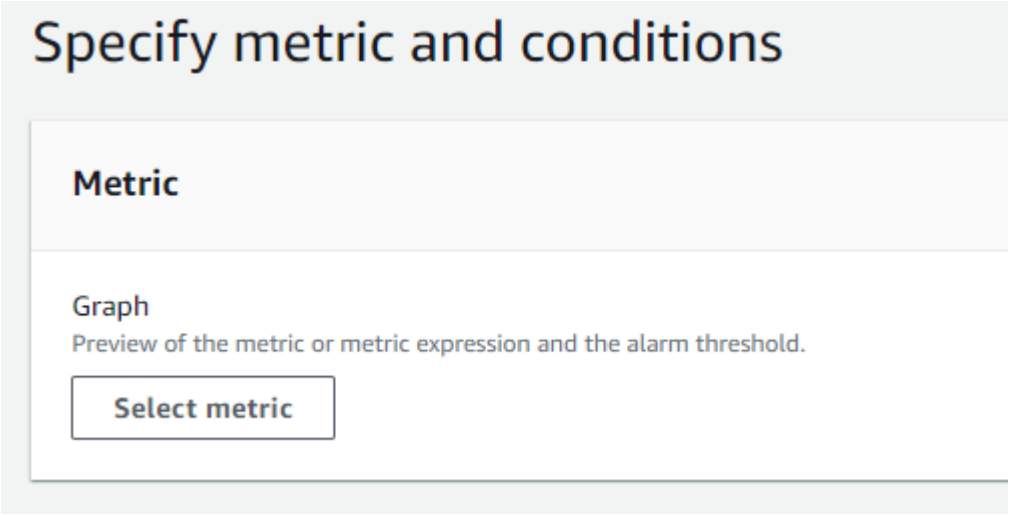
You can configure the alerts on your AWS usage by using the Cloudwatchh alarms. Here is the steps to create an alarm on estimated charges.

1. Login with root account credentials.
2. Select My Account option and navigate to "**Preferences**"
3. Go to Select Receive Billing Alerts checkbox and select **"ManageBilling Alerts**" option. (Cloudwatch alarms will create in North Virginia region).

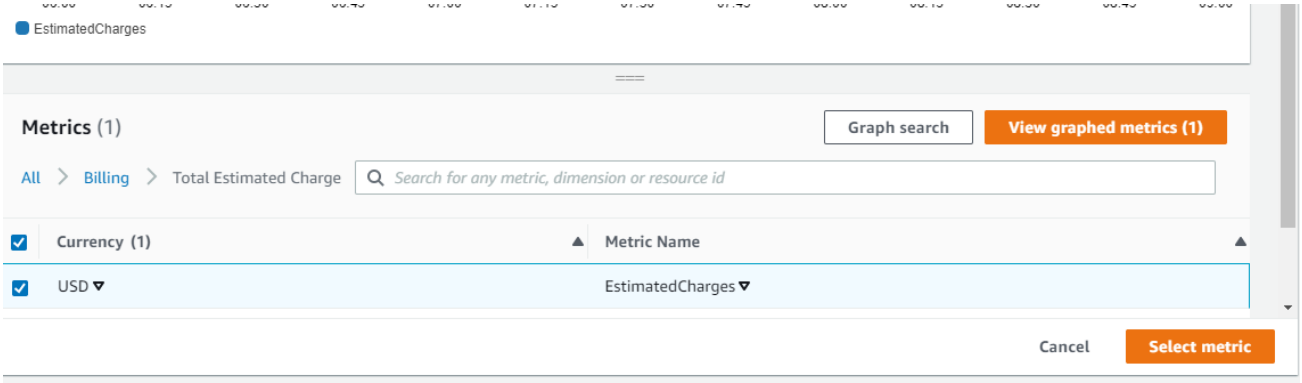


4. When you click on **"ManageBilling Alerts**" option, you'll redirect to Cloudwatch dashboard, there select **"Billing"** option from Left Pane, then click on **"Create Alarm"**.





Click on "**Select metric**", then Choose **"billing" then "Total estimated charges".**



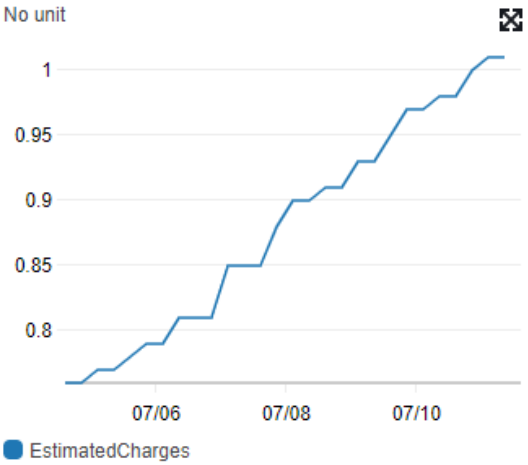
5. In this windows, enter the USD value, when you want to receive the notifications and enter your email id which you want to get the notifications, Click on **"Create Alarm"** When your monthly usage reaches to 5$ you'll get notified by the cloudwatch service through the mentioned email.

Metric

Edit

Graph

This alarm will trigger when the blue line goes above the red line for 1 datapoints within 6 hours.



Namespace
AWS/Billing

Metric name
EstimatedCharges

Currency
USD

Statistic
Maximum

Period
6 hours

Conditions

Threshold type

- Static — Use a value as a threshold
- Anomaly detection — Use a band as a threshold

Whenever EstimatedCharges is...

Define the alarm condition.

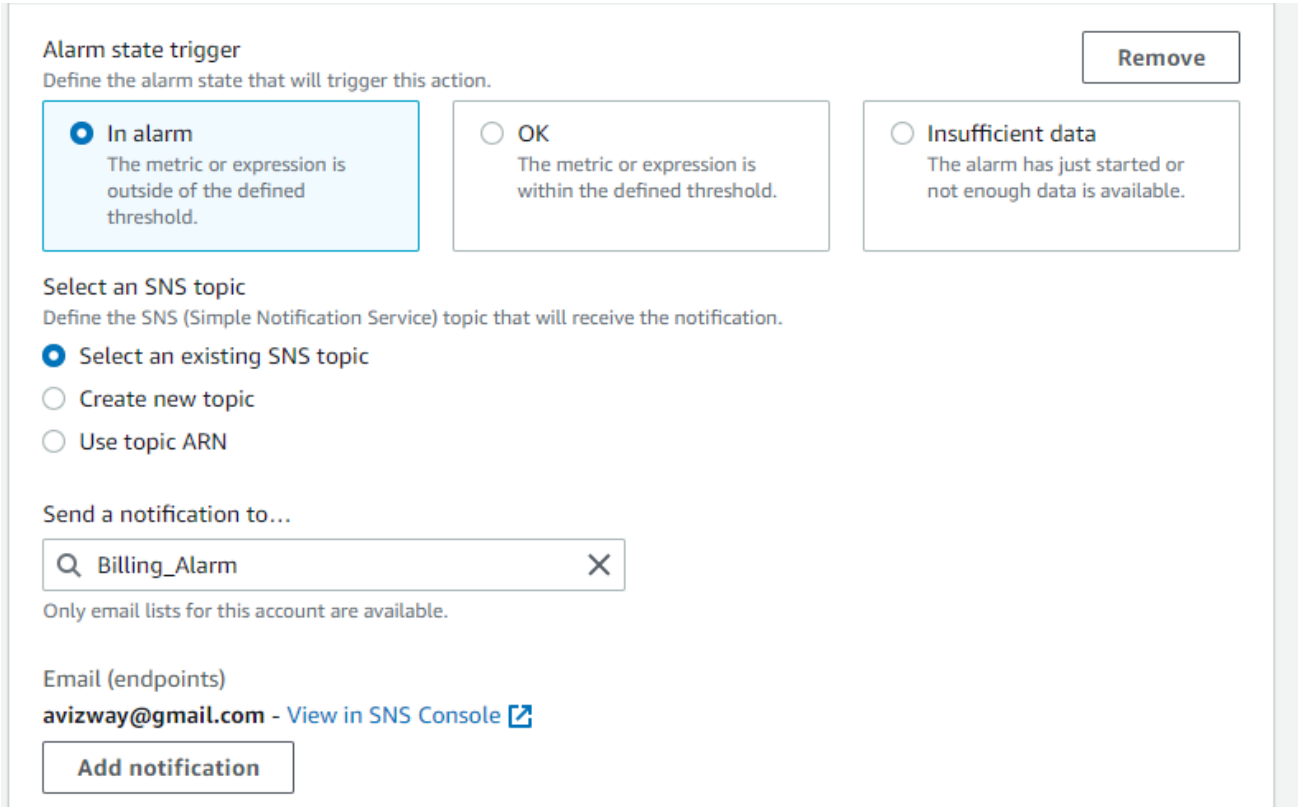
- Greater — > threshold
- Greater/Equal — >= threshold
- Lower/Equal — <= threshold
- Lower — < threshold

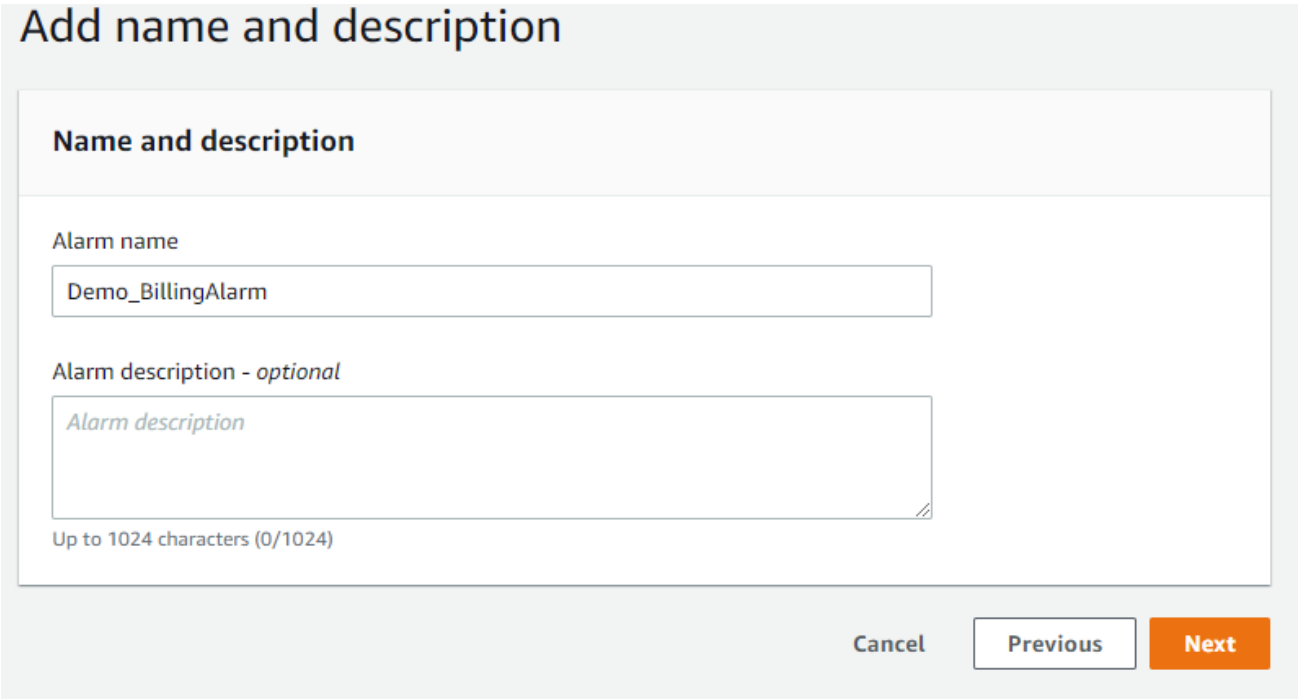
than...

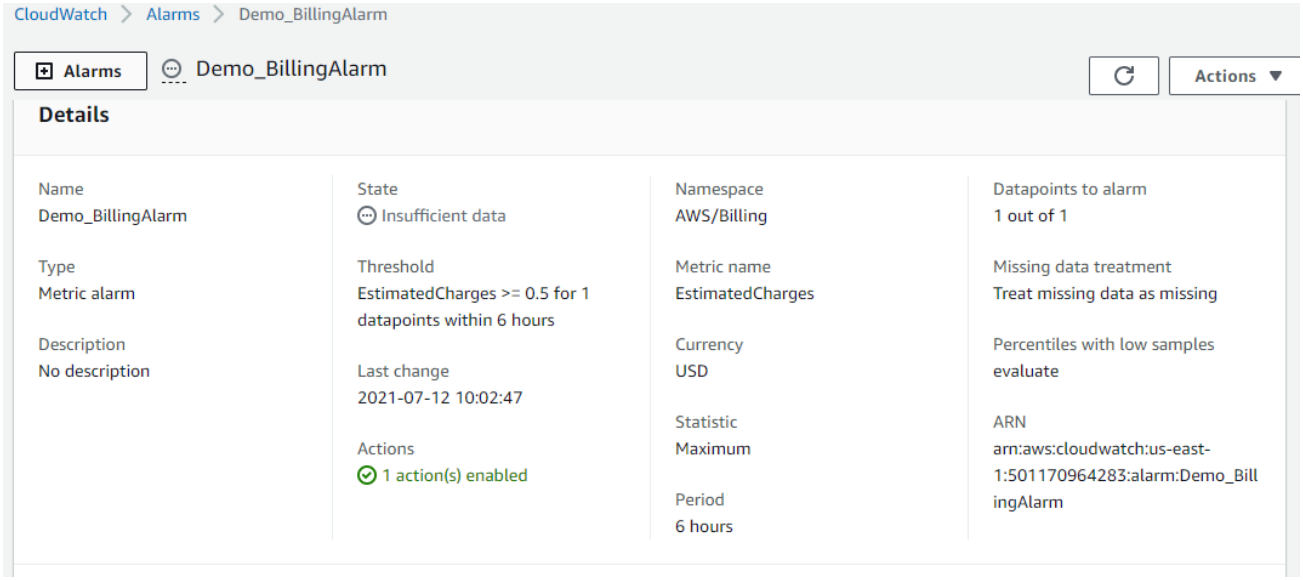
Define the threshold value.

0.5 USD

Must be a number


Alarm state trigger
Define the alarm state that will trigger this action.
Remove
In alarm
The metric or expression is outside of the defined threshold.
OK
The metric or expression is within the defined threshold.
Insufficient data
The alarm has just started or not enough data is available.
Select an SNS topic
Define the SNS (Simple Notification Service) topic that will receive the notification.
Select an existing SNS topic
Create new topic
Use topic ARN
Send a notification to...
Billing_Alarm
Only email lists for this account are available.
Email (endpoints)
avizway@gmail.com - View in SNS Console
Add notification


Add name and description
Name and description
Alarm name
Demo_BillingAlarm
Alarm description - optional
Alarm description
Up to 1024 characters (0/1024)
Cancel
Previous
Next



ALARM Threshold details:

With the Alarm's threshold set, the final thing that you need to do is define what action the alarm must take when it is triggered. From the Notification section, fill out the required details, as mentioned in the following:

Whenever this alarm: This option will allow you to determine when the alarm will actually perform an action. There are three states of an alarm out of which you can select any one at a single time:

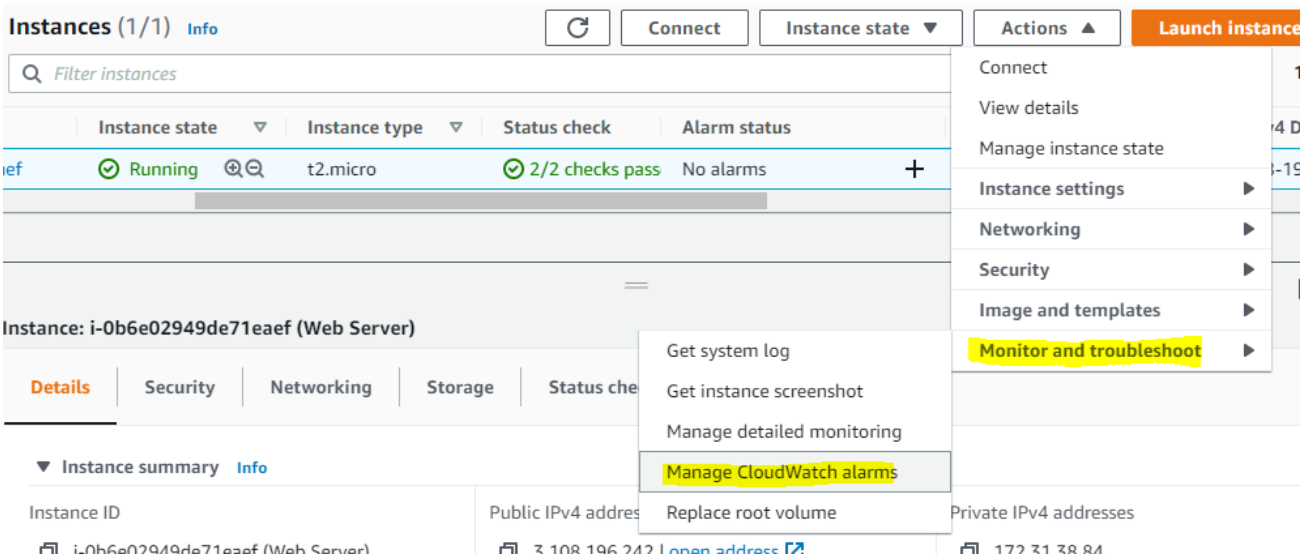
State is ALARM: Triggered when the metric data breaches the threshold value set by you
State is OK: Triggered when the metric data is well within the supplied threshold value
State is INSUFFICIENT: Triggered when the alarm generally doesn't have enough data with itself to accurately determine the alarm's state.

Monitoring your instance's CPU Utilization using CloudWatch

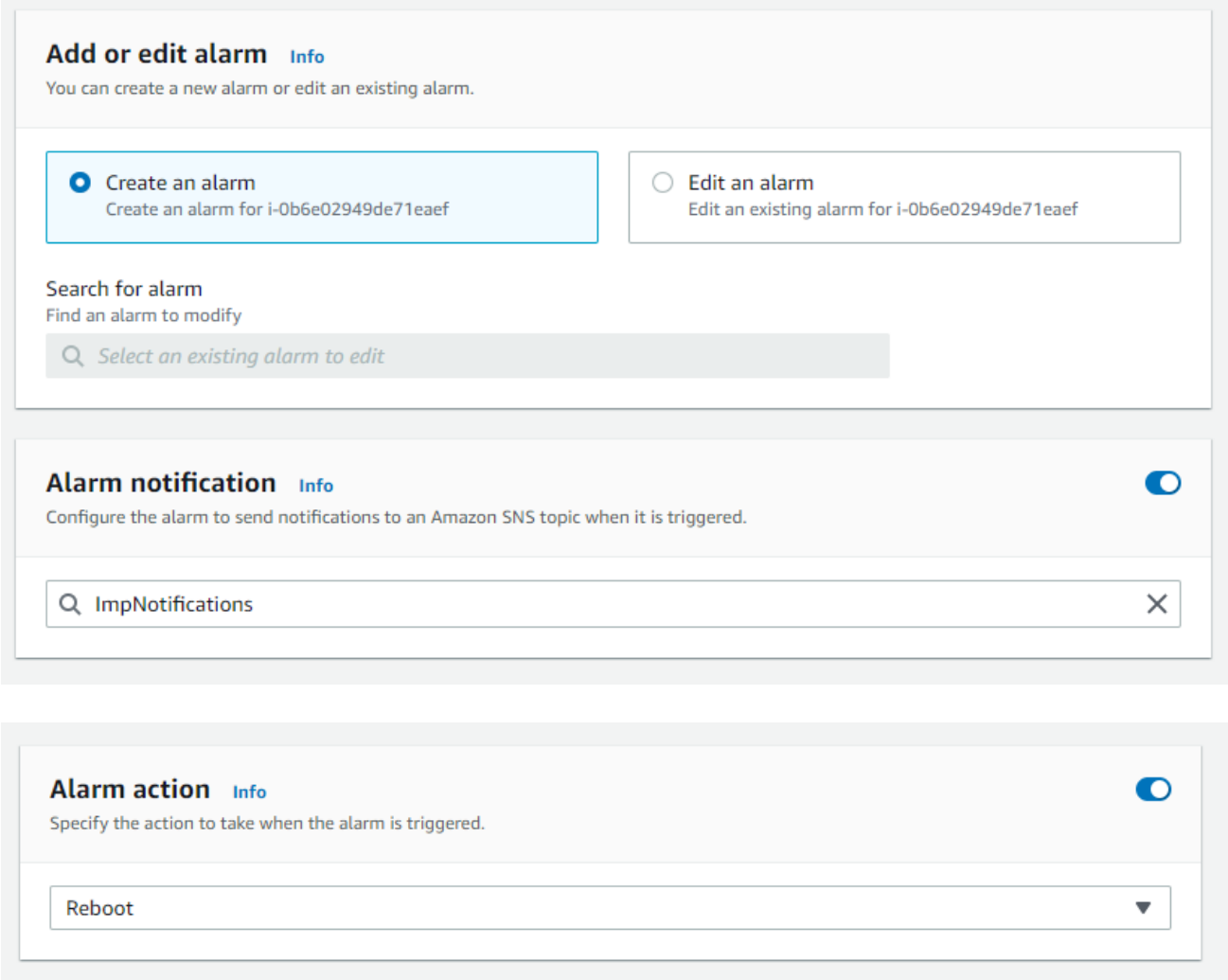
We are going to creating a simple alarm to monitor an instance's CPU utilization. If the CPU utilization breaches a certain threshold, say 75 percent, then the alarm will trigger an email notification as well as perform an additional task such as stop/restart the instance.

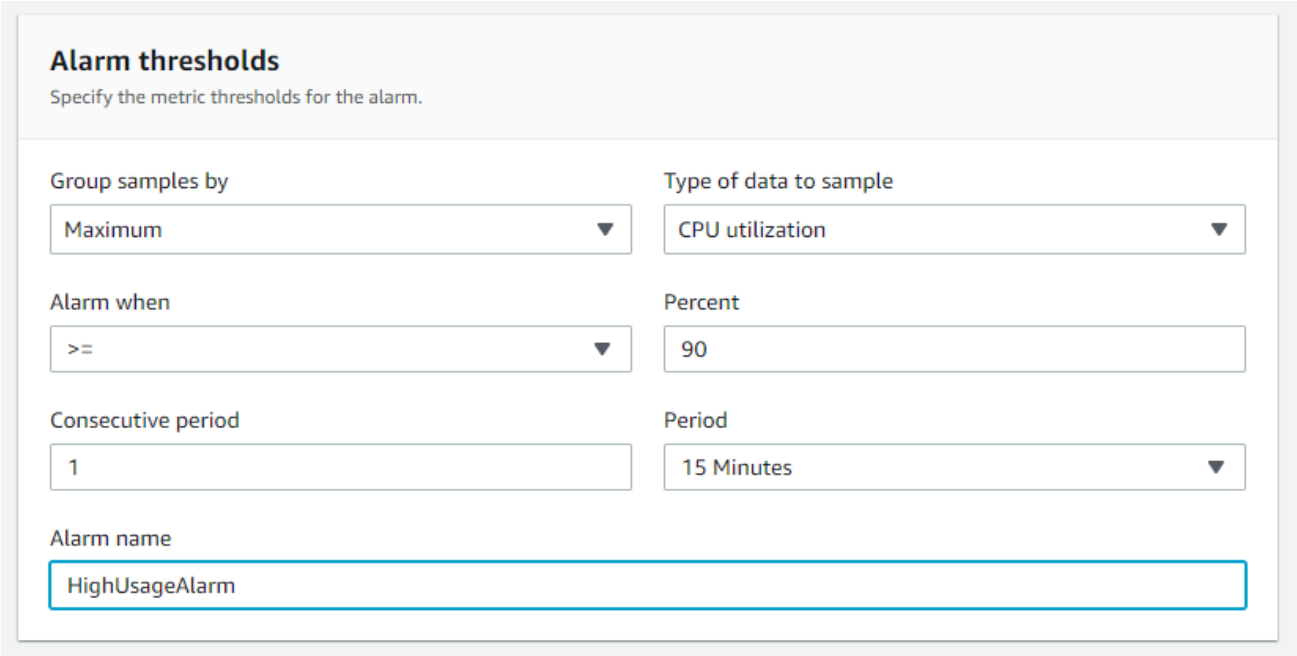
Each instance is monitored on a five-minute interval by default. We can modify this behavior and set the time interval as low as one minute by selecting the Enable Detailed Monitoring option.

To create an Alarm, Choose the instance and Navigate to "Monitoring and troubleshooting" and click on **"Manage Cloudwatch Alarm".**



Choose "**Create an Alarm**" and choose the "Alarm Notification" and threshoulds when to trigger alarm and what happens when an alarm triggered.





Dashboard: Dashboard is a centralized place to monitor all your resources. Free Tier

- New and existing customers also receive 3 dashboards of up to 50 metrics each per month at no additional charge. ($3.00 per dashboard per month after that)
- Basic Monitoring metrics (at five-minute frequency) for Amazon EC2 instances are free of charge, as are all metrics for Amazon EBS volumes, Elastic Load Balancers, and Amazon RDS DB instances.
- New and existing customers also receive 10 metrics, 10 alarms and 1 million API requests each month at no additional charge.

Cloudwatch Events: Amazon CloudWatch Events delivers a near real-time stream of system events that describe changes in Amazon Web Services (AWS) resources.
You can configure the following AWS services as targets for CloudWatch Events:

- Amazon EC2 instances
- AWS Lambda functions
- Streams in Amazon Kinesis Data Streams
- Delivery streams in Amazon Kinesis Data Firehose
- Amazon ECS tasks
- Systems Manager Run Command
- Systems Manager Automation
- AWS Batch jobs
- Step Functions state machines
- Pipelines in AWS CodePipeline
- AWS CodeBuild projects
- Amazon Inspector assessment templates
- Amazon SNS topics
- Amazon SQS queues

- Built-in targets—EC2 CreateSnapshot API call, EC2 RebootInstances API call, EC2 StopInstances API call, and EC2 TerminateInstances API call.
- The default event bus of another AWS account.

Cloudwatch Logs: You can use Amazon CloudWatch Logs to monitor, store, and access your log files from Amazon Elastic Compute Cloud (Amazon EC2) instances, AWS CloudTrail, Route 53, and other sources.

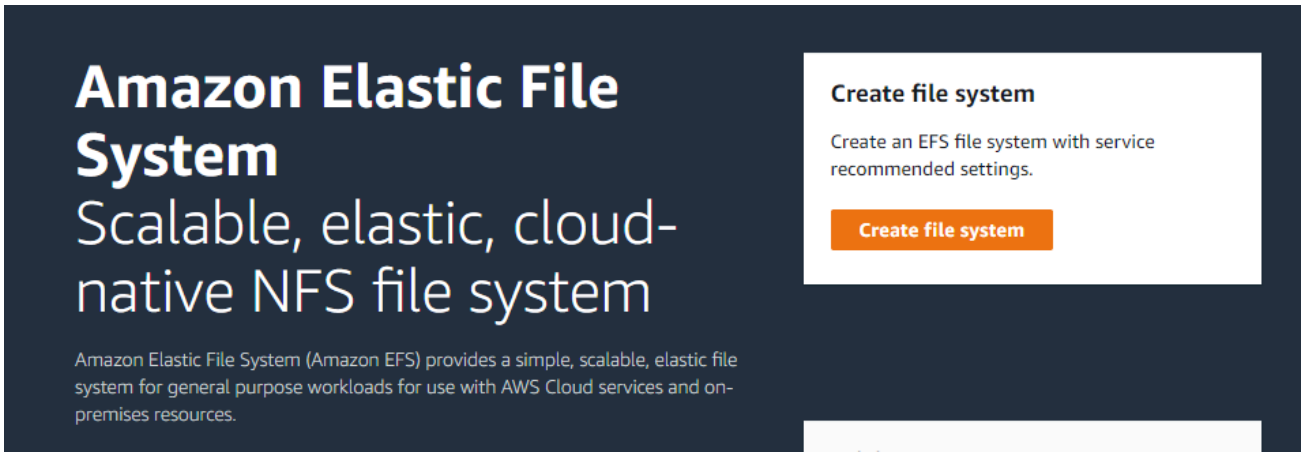
- Monitor Logs from Amazon EC2 Instances in Real-time
- Monitor AWS CloudTrail Logged Events
- Log Retention
- Archive Log Data
- Log Route 53 DNS Queries

ELASTIC FILE SYSTEM (EFS)

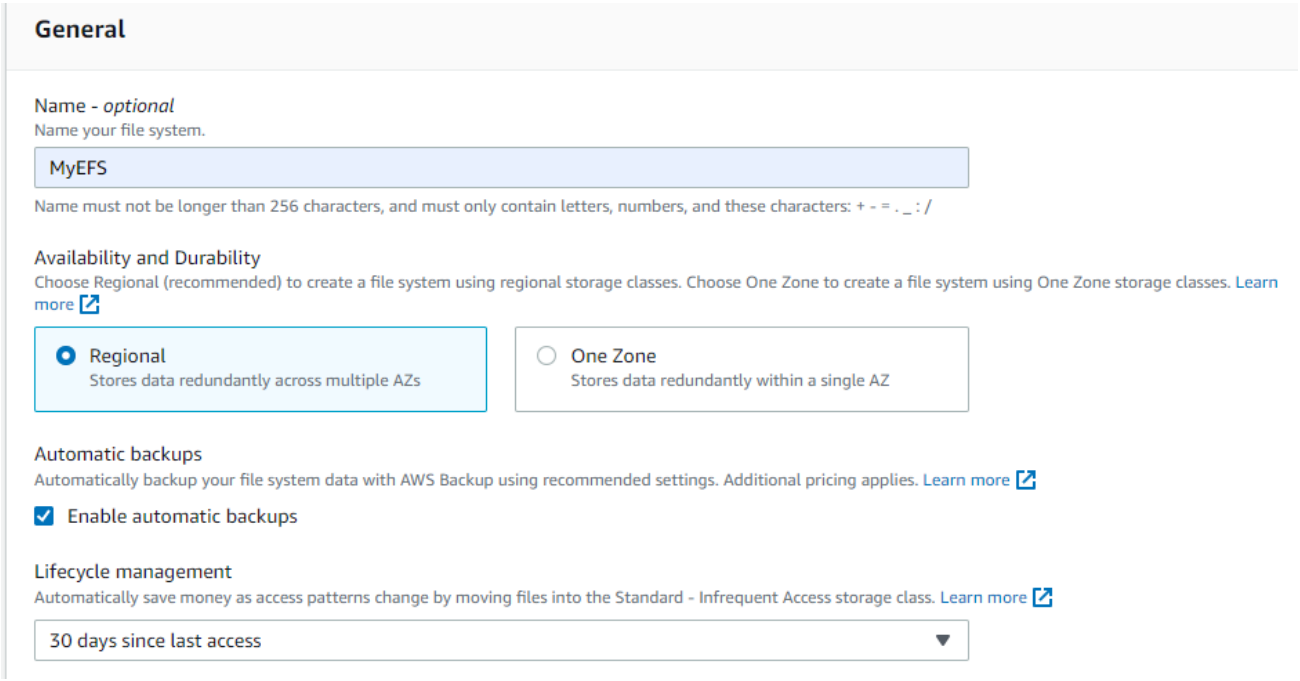
- Amazon EFS is easy to use and offers a simple interface that allows you to create and configure file systems quickly and easily. With Amazon EFS, storage capacity is elastic, growing and shrinking automatically as you add and remove files.
- Supports the Network File System version 4 (NFSv4.1) protocol.
- Multiple Amazon EC2 instances can access an Amazon EFS file system, so applications that scale beyond a single instance can access a file system.
- Amazon EC2 instances running in multiple Availability Zones (AZs) within the same region can access the file system, so that many users can access and share a common data source.
- It is also based on the pay-per-use model, which means that you only have to pay for the storage used by your filesystem
- Using Amazon EFS with Microsoft Windows Amazon EC2 instances is not supported.
- Multiple Amazon EC2 instances can access an Amazon EFS file system at the same time, allowing Amazon EFS to provide a common data source for workloads and applications running on more than one Amazon EC2 instance.
- You can mount your Amazon EFS file systems on your on-premises datacenter servers when connected to your Amazon VPC with AWS Direct Connect.

Steps to Create EFS:

1. We can find the EFS under storage category. Click on **"Create file system"** and then choose **"customize".**



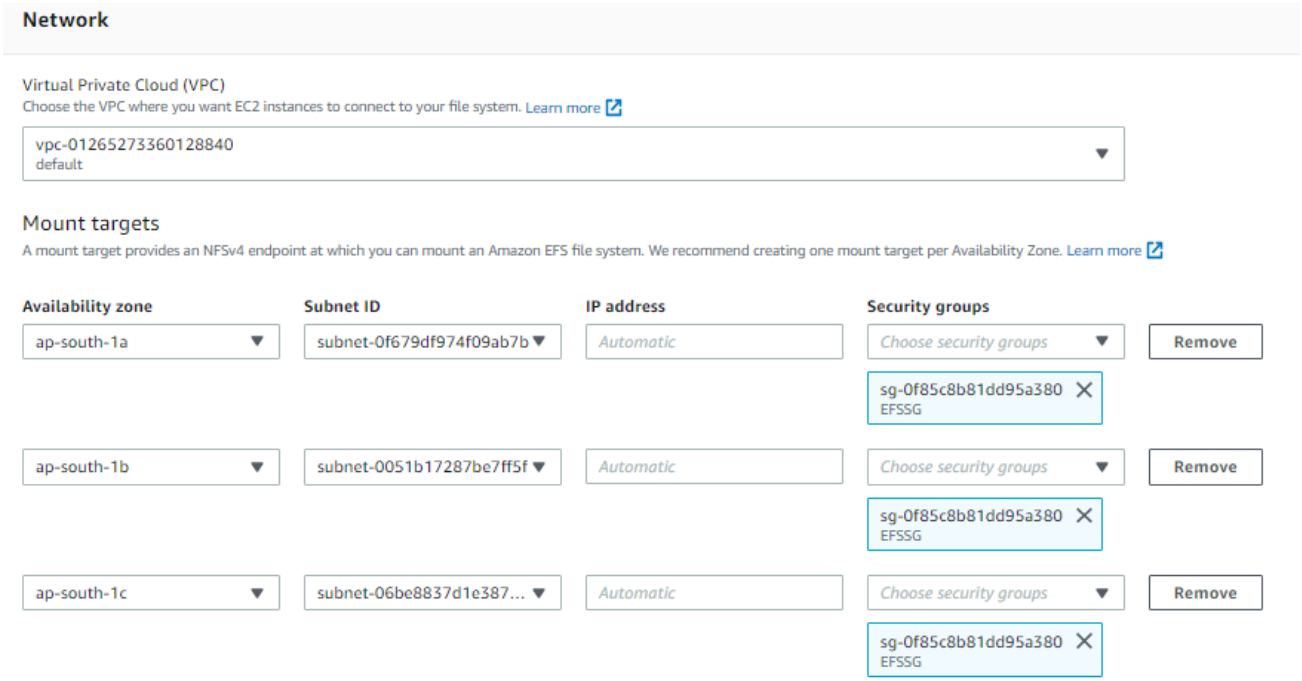
2. Select your VPC and Subnets, if you don't want to make this file system available to any specific subnet, Just untick that here. Then select **Next.**



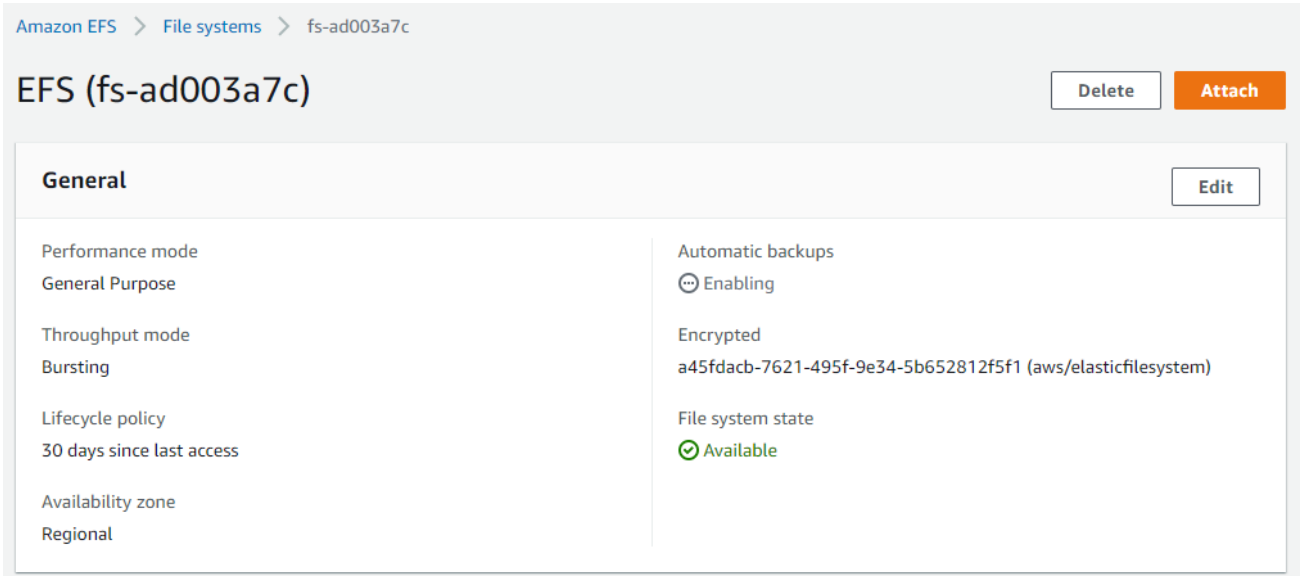
- **Regional** to create a file system that uses Standard storage classes. Standard storage classes store file system data and metadata redundantly across all Availability Zones within an AWS Region. Regional offers the highest levels of availability and durability.
- **One Zone** to create a file system that uses One Zone storage classes. One Zone storage classes store file sytem data and metadata redundantly within a single Availability Zone which makes it less expensive than Standard storage classes.
- **Automatic backups** are turned on by default. You can turn off automatic backups by clearing the check box.
- Choose a Lifecycle management policy. The default policy is 30 days after last access. If you don't want to use lifecycle management, choose None. We can use this feature to reduse the cost.

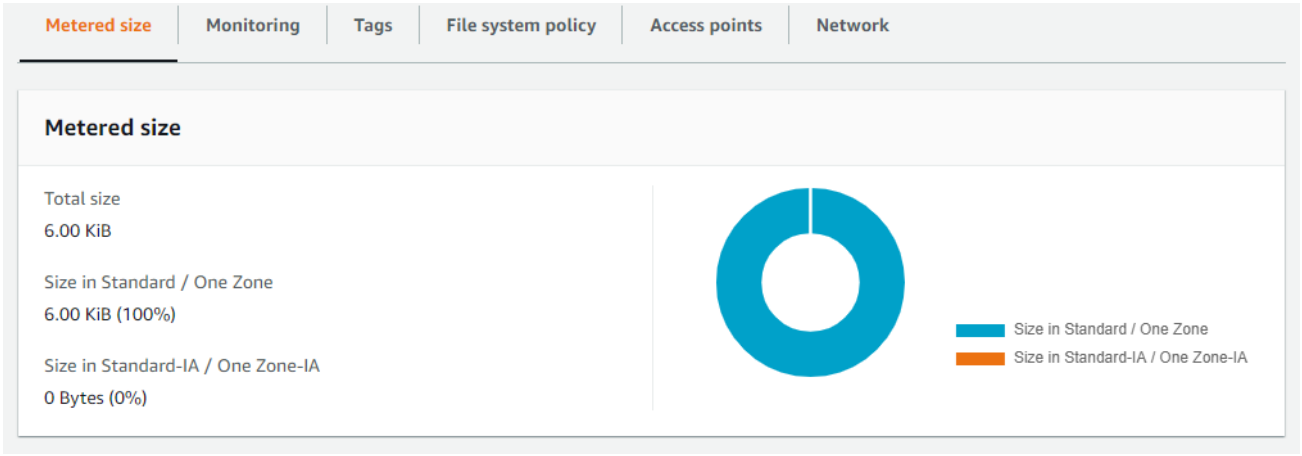
- **General Purpose** is ideal for latency-sensitive use cases, like web serving environments, content management systems, home directories, and general file serving.
- **Max I/O mode** can scale to higher levels of aggregate throughput and operations per second.
- **Bursting Throughput mode:** throughput on Amazon EFS scales as the size of your file system in the EFS Standard or One Zone storage class grows.
- **Provisioned Throughput mode:** you can instantly provision the throughput of your file system (in MiB/s) independent of the amount of data stored.

3. Configure the Network options in Next screen. Am making EFS available in all the 3 AZs. I have a Security with "NFS Protocol" opened.

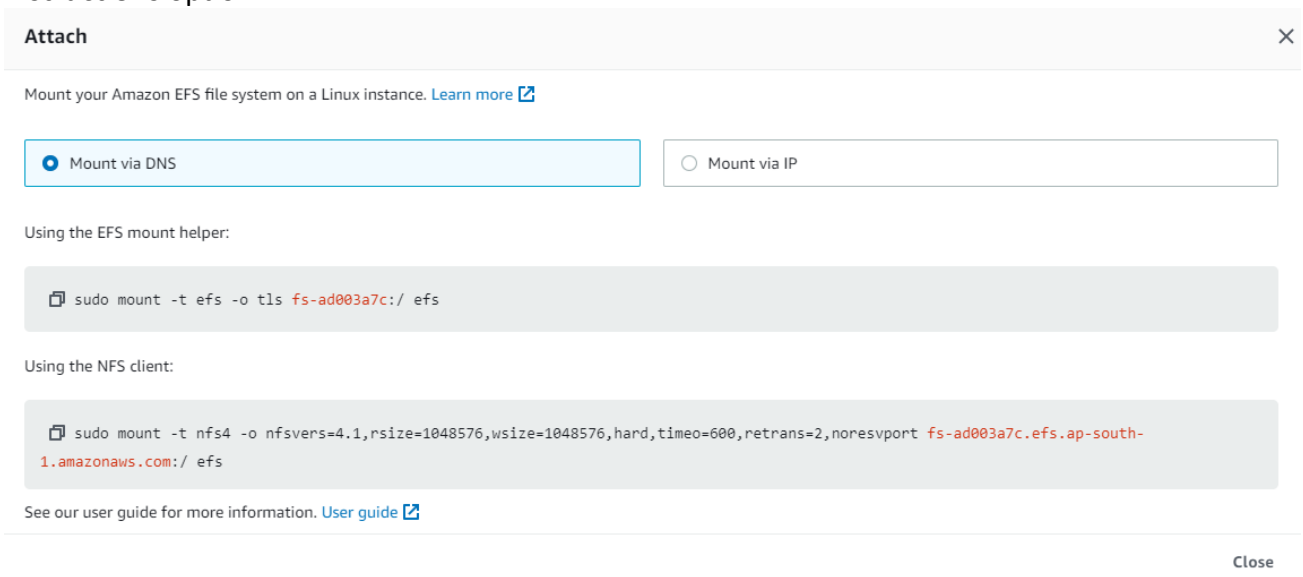


4. Review all the options and select Create File System option, file system will be created now and available for usage.

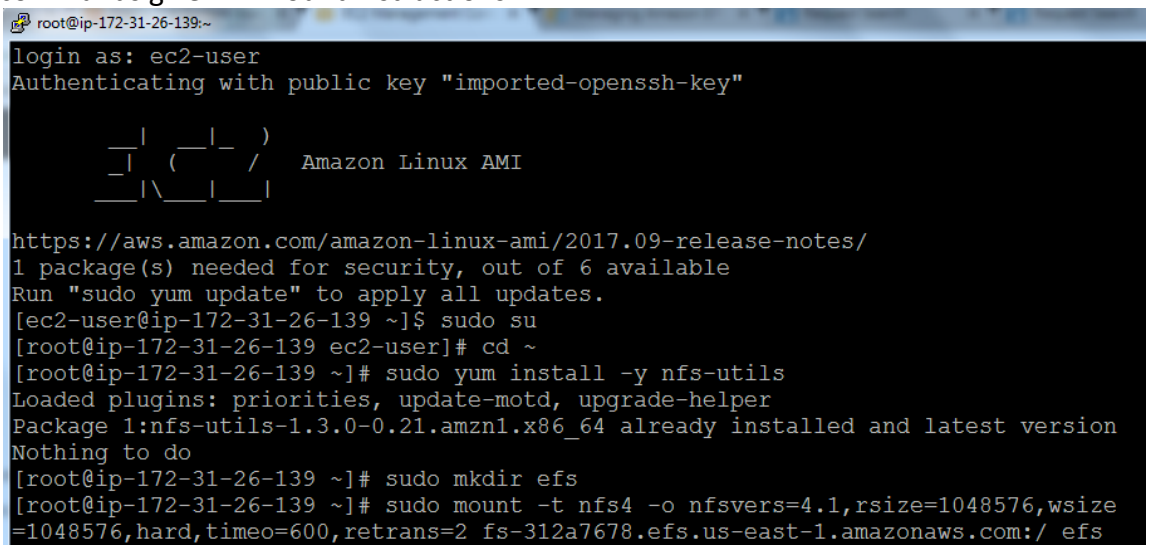




5. Now we have to mount it to EC2 instances, for mounting we need to login to Instance and need to follow mounting instructions. To get the Instructions select the **Amazon EC2 mount instructions** option.

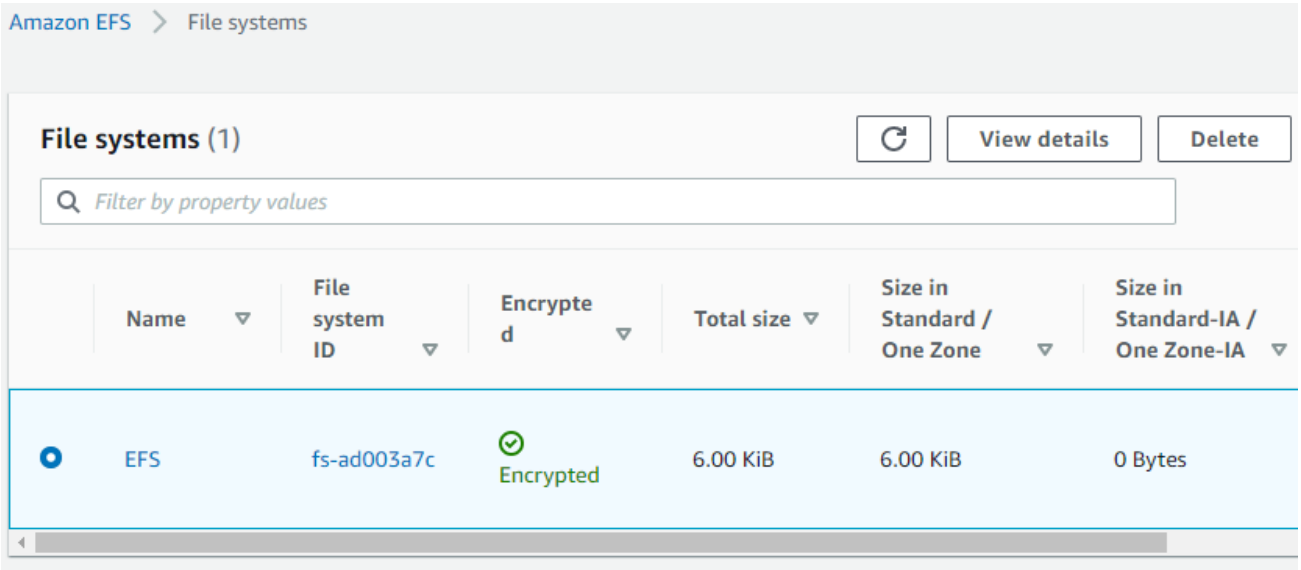


6. You can run the following commands on your EC2 instance.
7. **Your instance must be member of the Default Security group for successful EFS mounting.**
8. Here am launching Linux EC2 instance, as windows not supportable and executing the commands given in Mount Instructions.

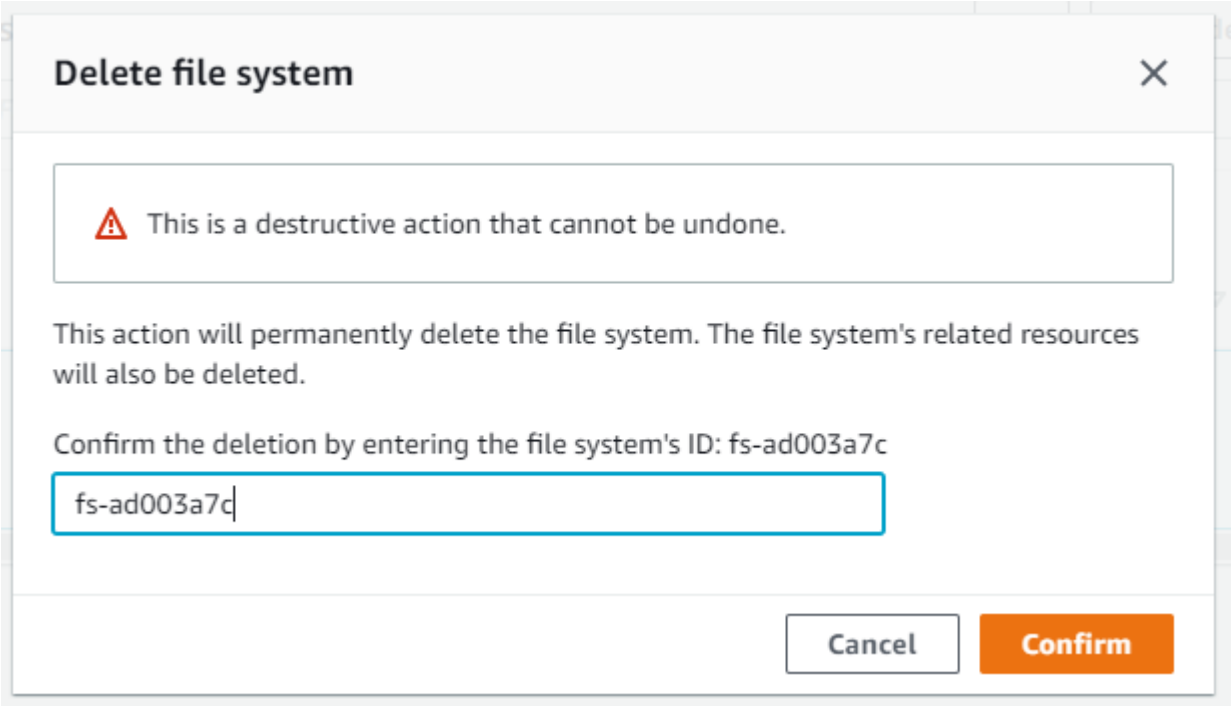


9. In above image, I've elevated my privileges to root and tried to install the required **nfs-utils,** but It'll installed by default in Amazon Linux Instances.
   - Created a directory named efs with "**sudo mkdir efs**" command.
   - And executed the mounting command to the created directory, now whatever the files I created under "efs" is going to available for all EC2 instances.
   - If you want to test this, perform the same steps in another EC2 instance and test it.

10. If you want to delete the EFS, Select the EFS and go to "**Actions"** and **"Delete File System".**



11. Enter the file system's ID in the box and select the "Delete File System" button, File system will delete now.



Amzon FSx : Amazon FSx provides you with the native compatibility of third-party file systems with feature sets for workloads such as Windows-based storage, high-performance computing (HPC), machine learning, and electronic design automation (EDA).

We need to have Microsoft Active Directory ID to use Amazon FSx Service, Please refer to this video to create a Simple AD in AWS and continue creating the Amazon FSx.

AWS Directory Service Creation : https://www.youtube.com/watch?v=RDlBoAHVmZs

FSx: https://www.youtube.com/watch?v=s15ljWSTWY4

AWS Server Migration Service : https://www.youtube.com/watch?v=Vx9lRRY-shg

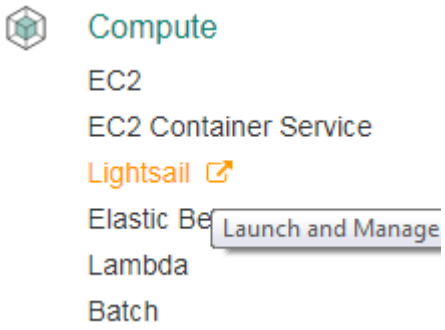
LIGHTSAIL :

With Amazon Lightsail with a couple of clicks we can choose a configuration from a menu and launch a virtual machine preconfigured with SSD-based storage, DNS management, and a static IP address.

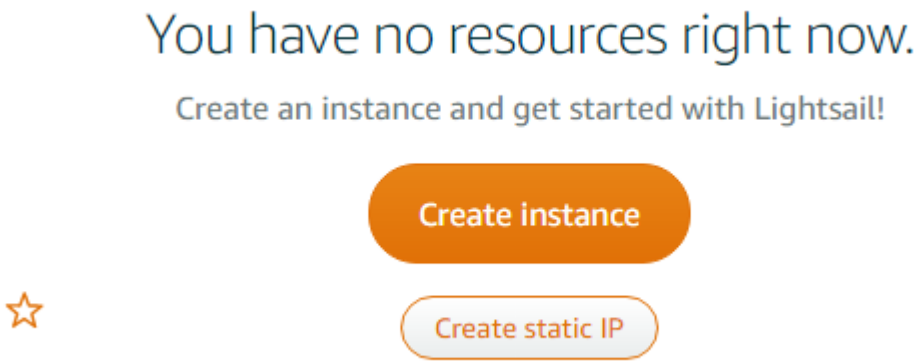
We can launch it on Amazon Linux AMI or Ubuntu operating system, developer stack (LAMP, LEMP, MEAN, or Node.js), or application (Drupal, Joomla, Redmine, GitLab, and many others), with flat-rate pricing plans that start at $5 per month including a generous allowance for data transfer.

Steps to launch Lightsail Instance

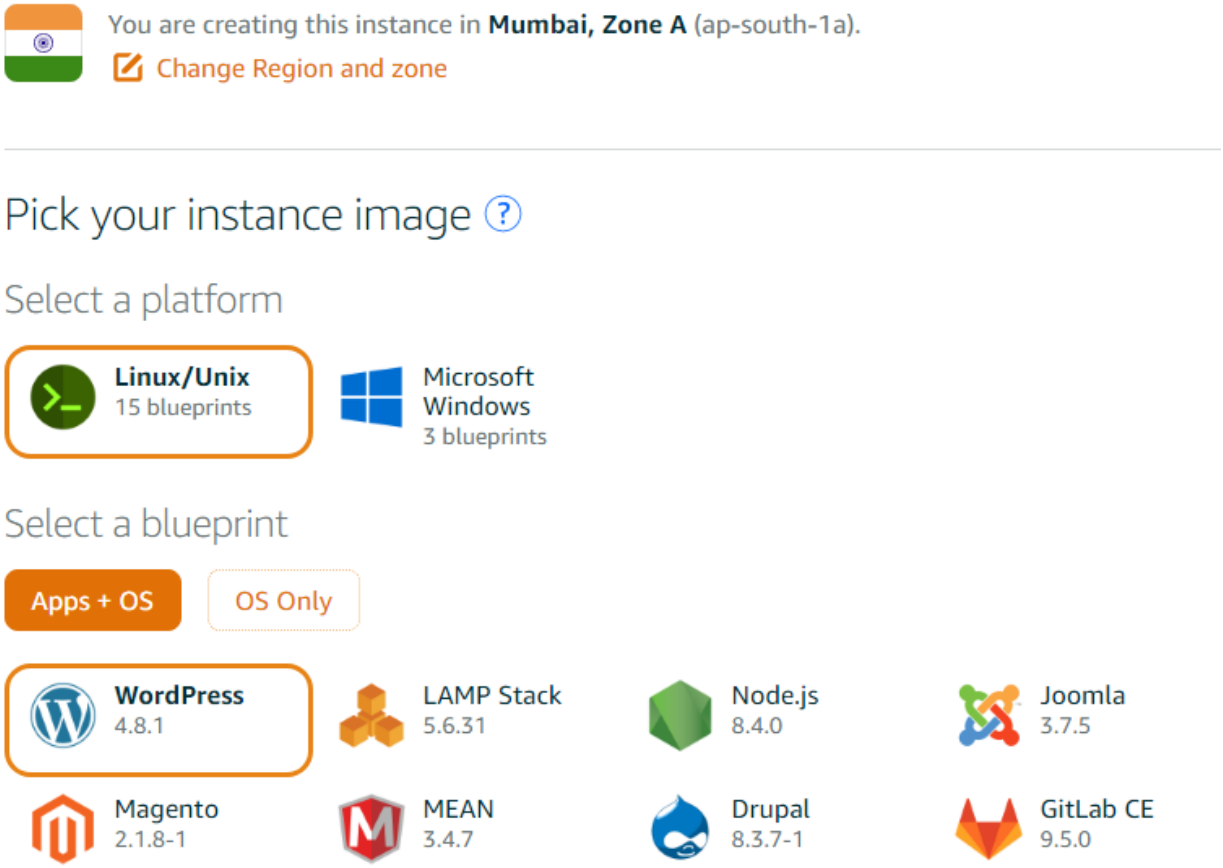
1. Select the **Lightsail** from Compute Service.



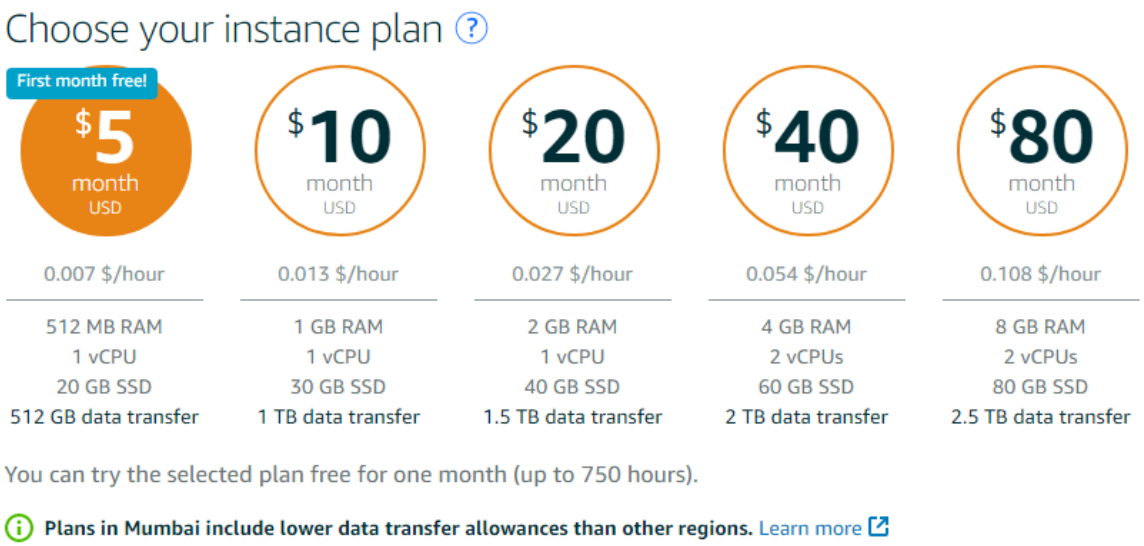
2. Select the **Create instance** option.



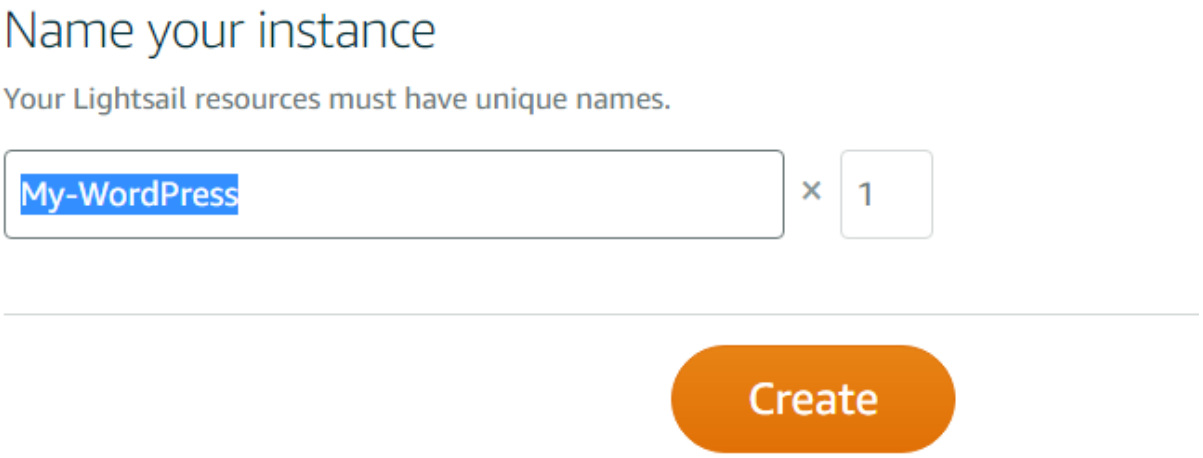
3. Select the Region and Zone, then select the Platform, and a blueprint what instance what application we required. Now am going to launch **Wordpress** website.



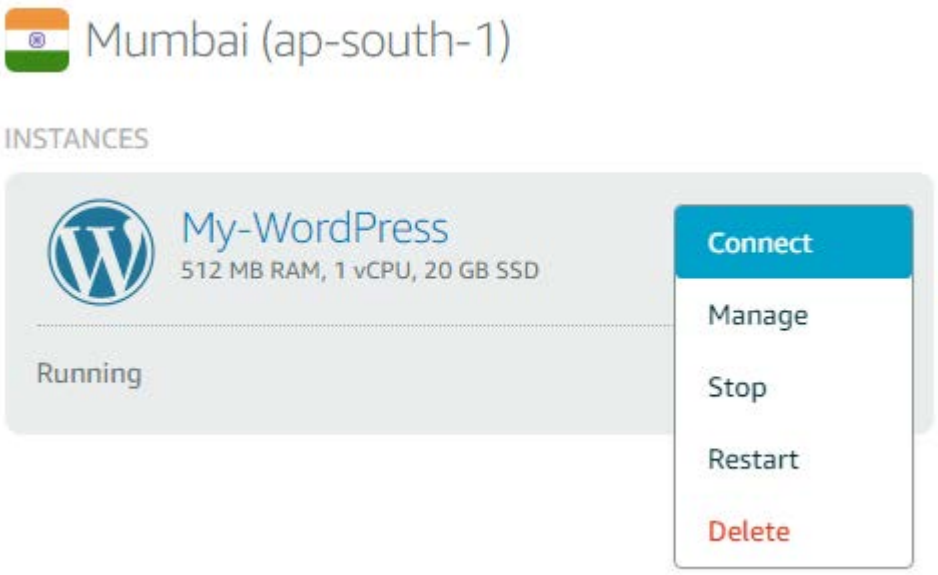
1. Then choose instance plan, am selecting $5/Month.



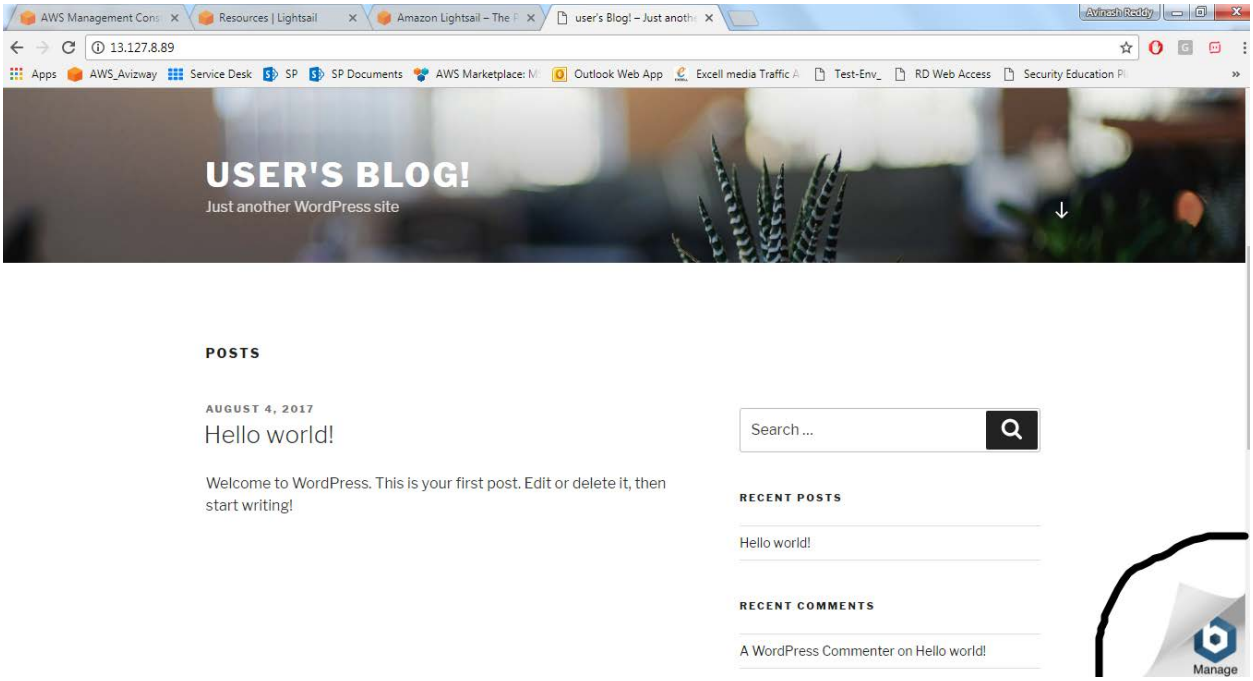
2. And give a name for your instance and select **Create** option.



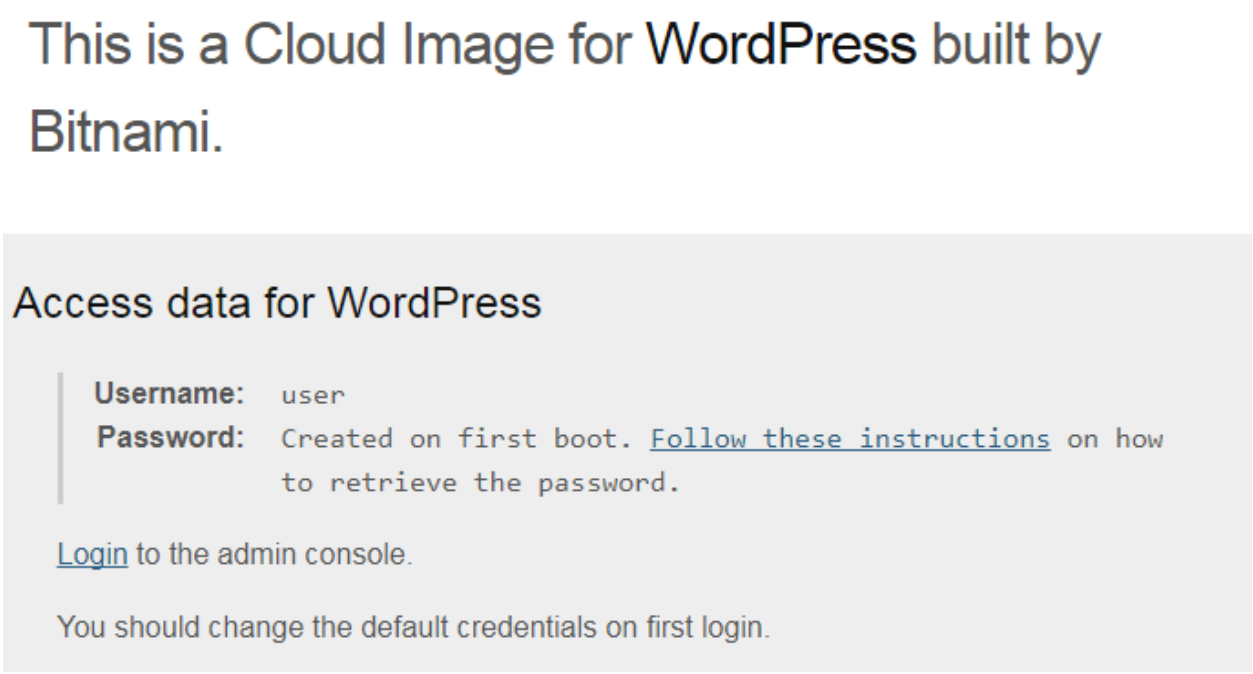
3. When the instance is ready select the connect option and you'll get a console.



4. We'll get a public IP address by using that Public IP, we can access the WP website.
5. We will get a default template, if you want to customize that we have to login to the Admin panel. Here I've entered public IP the browser. In bottom corner, We will get Manage button, select that to login.



6. Default username is **user** and to get the password am connecting to the instance and entering command as below image. Select on **Login** option.

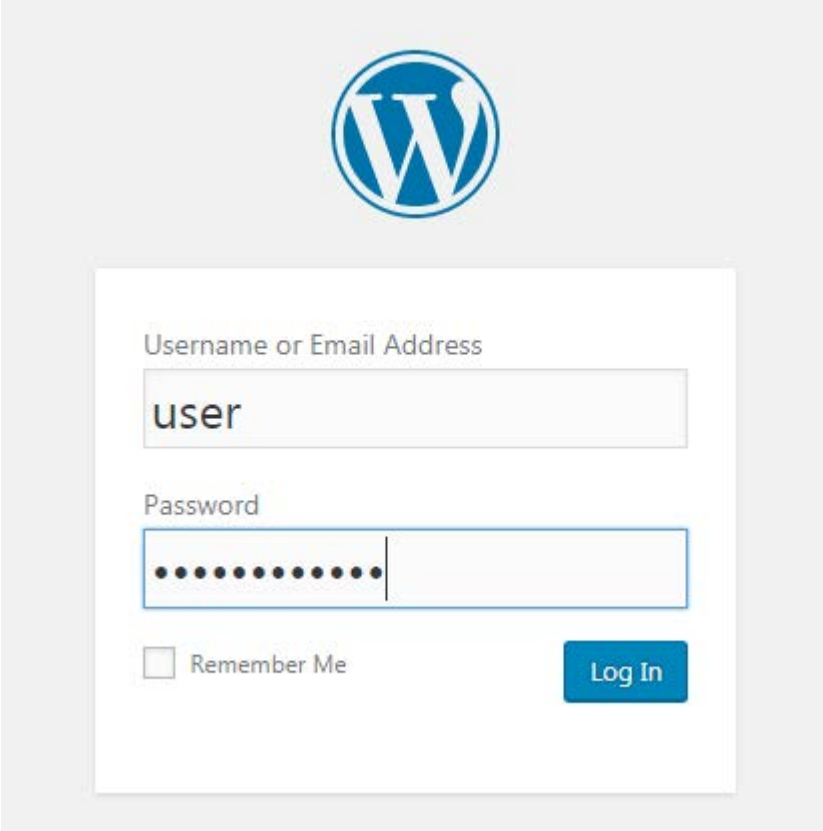


7. After connecting the instance give ls command you'll find bitname_application_password file, open it with cat command you'll get password to login, note it and enter in the login page.

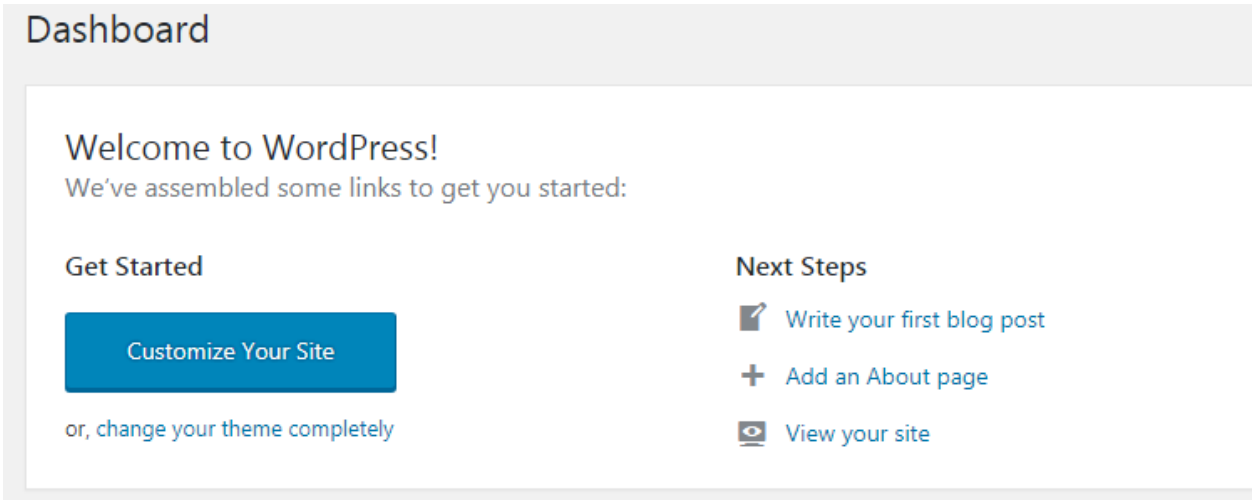
```
Welcome to Ubuntu 14.04.5 LTS (GNU/Linux 3.13.0-125-generic x86_64)
      ___ _ _                                _
     | _ |_) |_ _ _  __ _ _ _ __ (_)
     | _ \ |  _| ' \/ _` | '  \| |
     |___/_|\__|_|_|\__,_|_|_|_|_|

  *** Welcome to the Bitnami WordPress 4.8.1-0 ***
  *** Documentation:  https://docs.bitnami.com/aws/apps/wordpress/ ***
  ***                 https://docs.bitnami.com/aws/ ***
  *** Bitnami Forums: https://community.bitnami.com/ ***
bitnami@ip-172-26-10-72:~$ ls
apps  bitnami_application_password  htdocs  stack
bitnami@ip-172-26-10-72:~$ cat bitnami_application_password
X9U6ur9pKU5v
bitnami@ip-172-26-10-72:~$
```

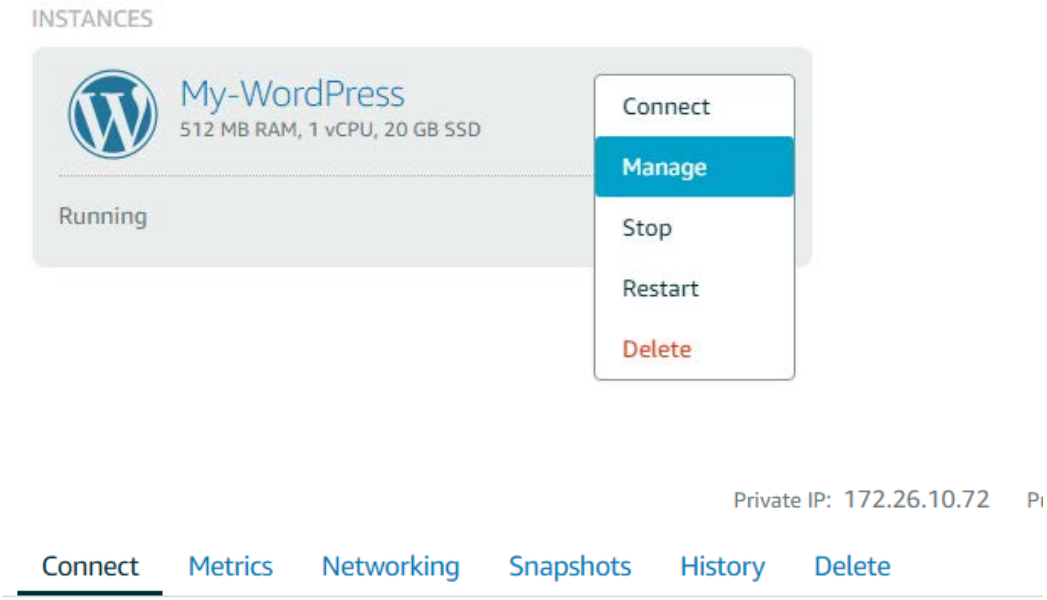
8. Give the username and password in the listed fields.



9. After authenticating, we'll login to the WP website and we can start customizing the website and select the Publish then the changes will update immediately.



10. If you want to manage your instance you can select the Manage option and you'll get the options to view the Metrics, Networking, Snapshots for backup, History and Delete options.



11. You can delete it anytime, by Delete option.

Elastic Beanstalk

With Elastic Beanstalk, we can deploy, monitor, and scale an application quickly and easily.

AWS Elastic Beanstalk is an orchestration service offered from Amazon Web Services for deploying infrastructure which orchestrates various AWS services, including EC2, S3, Simple Notification Service (SNS), CloudWatch, autoscaling, and Elastic Load Balancers.

AWS Elastic Beanstalk supports the following languages and development stacks:

- Apache Tomcat for Java applications
- Apache HTTP Server for PHP applications
- Apache HTTP Server for Python applications
- Nginx or Apache HTTP Server for Node.js applications
- Passenger or Puma for Ruby applications
- Microsoft IIS 7.5, 8.0, and 8.5 for .NET applications
- Java SE
- Docker
- Go

Application Deployment requires a number of components to be defined as follows

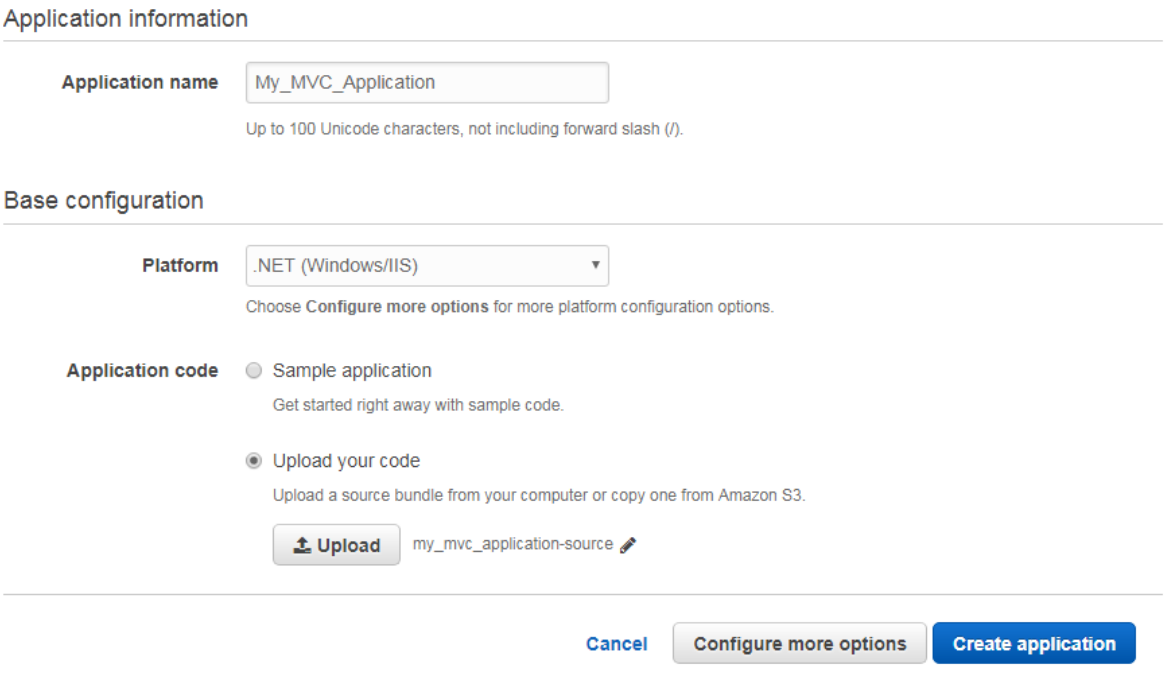
Application: as a logical container for the project.

Version: which is a deployable build of the application executable.

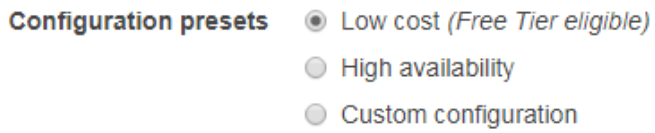
Configuration template: This contains configuration information for both the Beanstalk environment and for the product.

Environment: combines a 'version' with a 'configuration' and deploys them.

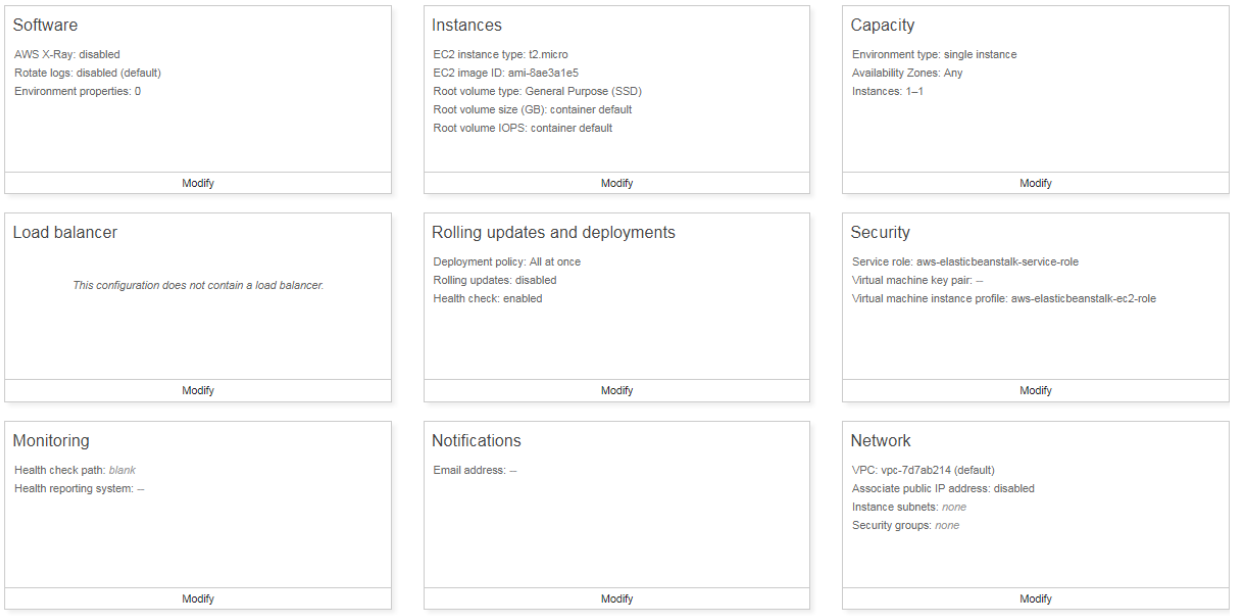
1. Create a Web Application. It involves with multiple options. By creating an environment, we allow AWS Elastic Beanstalk to manage AWS resources and permissions on behalf of us.



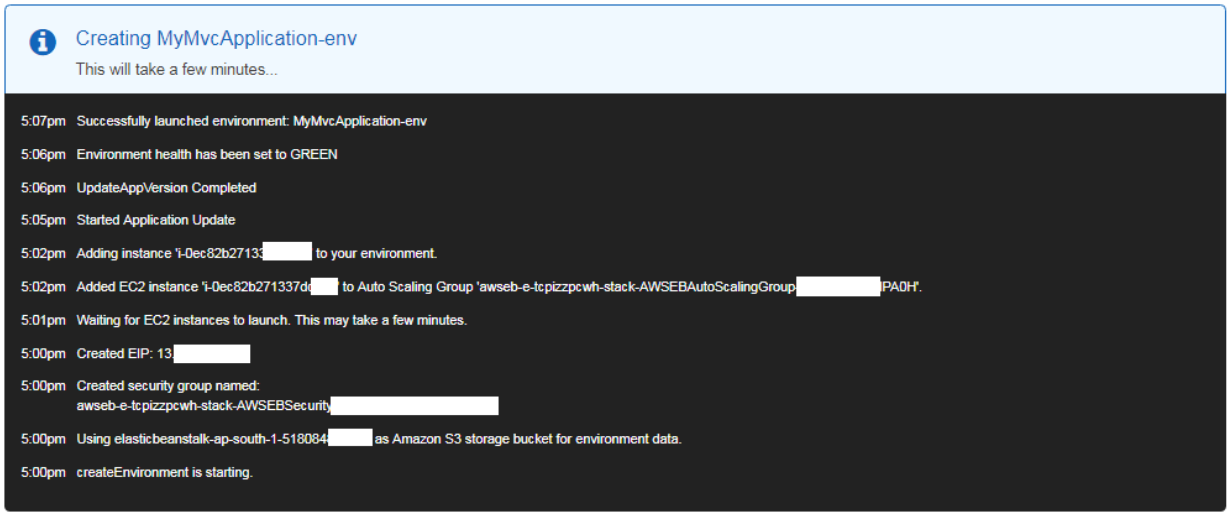
2. You can simply select the Create application option to perform the deployment and selecting the appropriate configuration for our instances.
3. If you want to customize each and every step, as you required, Select **Configure more options** option.
    - Then we'll get three options for **Configuration presets**
        i. **Low Cost (Free Tier eligible)**
        ii. **High Availability**
        iii. **Custom Configuration**



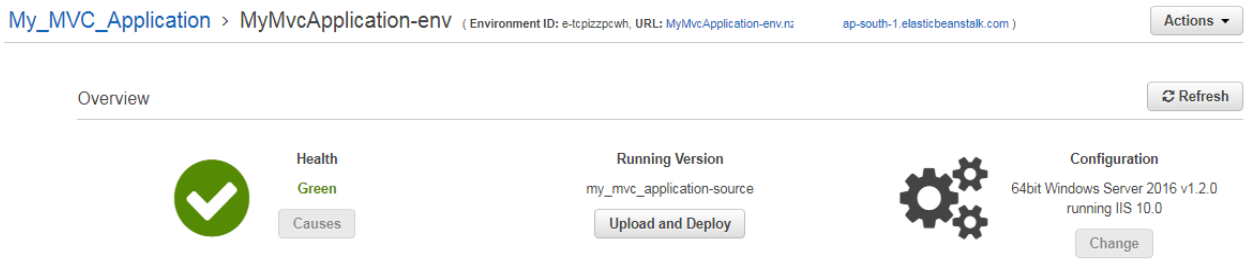
4. If we want to change the Platform of Windows server or IIS, we can select change platform configuration option otherwise go with the default option.
5. Select the appropriate option, here am selecting the Low Cost, Free Tier eligible.
6. Here is the available options to customize



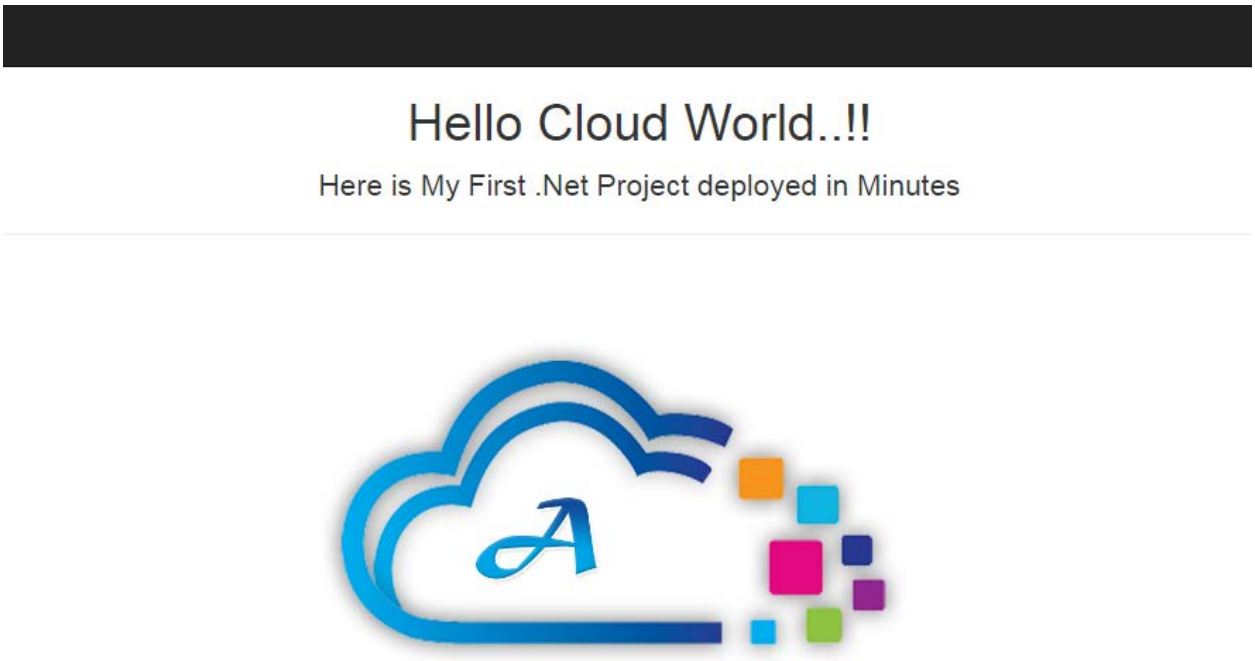
7. Status of Instance creation, and all the required resources are provisioning by Elastic BS i.e; Security group, EIP, EC2, S3, Simple Notification Service (SNS), CloudWatch, autoscaling, and Elastic Load Balancers.



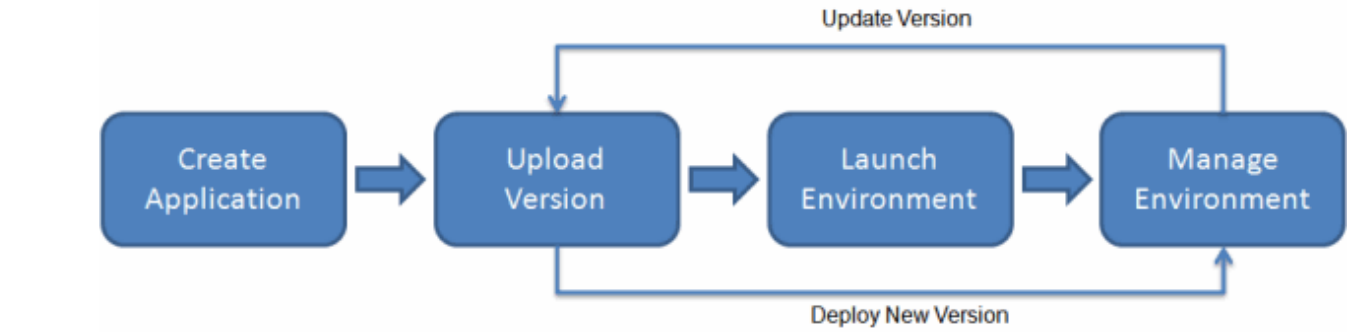
8. Here is the status we'll get when the application is deployed.



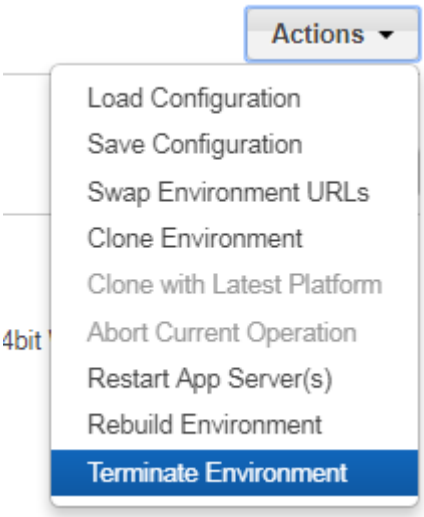
9. We'll get Environment ID to access the application.
10. Here is the output for my uploaded code.



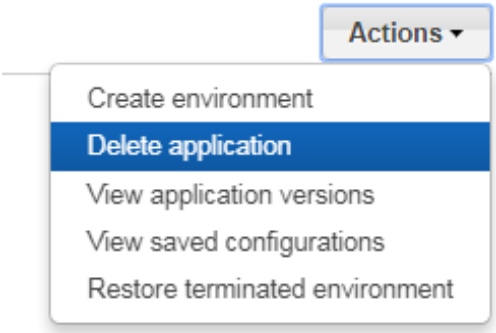
11. If you made any changes to your existing code, you can zip it and upload it.
12. Here is the illustration diagram of workflow



13. If you want to terminate the environment, select the **Actions** option in Top right corner, then choose Terminate Environment.



14. Or go back to the applications page and delete the application.



Amazon Route 53 (DNS Service)

- Domain Name Servers (DNS) are the Internet's equivalent of a phone book. They maintain a directory of domain names and translate them to Internet Protocol (IP) addresses.
- This is necessary because, although domain names are easy for people to remember, computers or machines, access websites based on IP addresses.
- When you type in a web address, e.g., Avinash.website, your Internet Service Provider views the DNS associated with the domain name, translates it into a machine friendly IP address (202.153.xx.xx) and directs your Internet connection to the correct website.
- Amazon Route 53 is an authoritative DNS system. An authoritative DNS system provides an update mechanism that developers use to manage their public DNS names.
- It answers DNS queries, translating domain names into IP addresses so that computers can communicate with each other.

Top-Level Domains (TLDs)

A Top-Level Domain (TLD) is the most general part of the domain. The TLD is the farthestportion to the right (as separated by a dot). Common TLDs are .com, .net, .org, .gov, .edu,and .io.

- The last word in a domain name represents the "top level domain".
- The second word in a domain name is known as a second level domain name.
- These top level domain names are controlled by the Internet Assigned Numbers Authority (IANA) in a root zone database which is essentially a database of all available top level domains.
- You can view this database by visiting http://www.iana.org/domains/root/db
- Each domain name becomes registered in a central database, known as the WhoIS database.

Domain Names

A domain name is the human-friendly name that we are used to associating with an Internet resource.

The URL aws.amazon.com is associated with the servers owned by AWS. The DNS allows usersto reach the AWS servers when they type aws.amazon.com into their browsers.IP Addresses an IP address is a network addressable location. Each IP address must be unique within itsnetwork. For public websites, this network is the entire Internet.

- IPv4 addresses, the most common form of addresses, consist of four sets of numbers separated by a dot, with each set having up to three digits.
  For example, 111.222.111.222 could be a valid IPv4 IP address.

- With DNS, we map a name to that address so that you do not have to remember a complicated set of numbers for each place you want to visit on a network.
- Due to the tremendous growth of the Internet and the number of devices connected to it, the IPv4 address range has quickly been depleted.
- Today, most devices and networks still communicate using IPv4, but migration to IPv6 is proceeding gradually over time.

Domain Name Registrars

All of the names in a given domain must be unique, there needs to be a way toorganize them so that domain names aren't duplicated. This is where domain name registrars come in.

A domain name registrar is an organization or commercial entity thatmanages the reservation of Internet domain names.

- A registrar is an authority that can assign domain names directly under one or more top-level domains.
- These domains are registered with ICANN (The Internet Corporation for Assigned Names and Numbers), which enforces uniqueness of domain names across the Internet.
- Each domain name becomes registered in a central database known as the WHOIS database.
- Domain registrars : GoDaddy.com, BigRock , Amazon etc

Domain Registration

If you want to create a website, you first need to register the domain name.

- If you already registered a domain name with another registrar, you have the option to transfer the domain registration to Amazon Route 53.
- It isn't required to use Amazon Route 53 as your DNS service or to configure health checking for your resources.
- Amazon Route 53 supports domain registration for a wide variety of generic TLDs (for example, .com and .org) and geographic TLDs (for example, .be and .us).

Name Servers

NS stands for Name Server records and are used by Top Level Domain servers to direct traffic to the Content DNS server which contains the authoritative DNS records.

A name server is a computer designated to translate domain names into IP addresses. Theseservers do most of the work in the DNS. Because the total number of domain translations istoo much for any one server, each server may redirect requests to other name servers ordelegate responsibility for the subset of subdomains for which they are responsible.

Name servers can be authoritative, meaning that they give answers to queries about domainsunder their control. Otherwise, they may point to other servers or serve cached copies ofother name servers' data.

Zone Files

A zone file is a simple text file that contains the mappings between domain names and IPaddresses. This is how a DNS server finally identifies which IP address should be contactedwhen a user requests a certain domain name.

Record Types:

Each zone file contains records. In its simplest form, a record is a single mapping between aresource and a name. These can map a domain name to an IP address or define resources forthe domain, such as name servers or mail servers. This section describes each record type indetail.

Start of Authority (SOA) Record

A Start of Authority (SOA) record is mandatory in all zone files, and it identifies the baseDNS information about the domain. Each zone contains a single SOA record.

The SOA record stores information about the following:

- The name of the DNS server for that zone
- The administrator of the zone
- The current version of the data file
- The number of seconds that a secondary name server should wait before checking for updates

- The number of seconds that a secondary name server should wait before retrying a failed zone transfer
- The maximum number of seconds that a secondary name server can use data before it must either be refreshed or expire
- The default TTL value (in seconds) for resource records in the zone

A and AAAA
Both types of address records map a host to an IP address. The A record is used to map a hostto an IPv4 IP address, while AAAA records are used to map a host to an IPv6 address.

Canonical Name (CNAME)
A Canonical Name (CNAME) record is a type of resource record in the DNS that defines analias for the CNAME for your server (the domain name defined in an A or AAAA record).

Mail Exchange (MX)
Mail Exchange (MX) records are used to define the mail servers used for a domain andensure that email messages are routed correctly. The MX record should point to a hostdefined by an A or AAAA record and not one defined by a CNAME.

Name Server (NS)
Name Server (NS) records are used by TLD servers to direct traffic to the DNS server that contains the authoritative DNS records.

Pointer (PTR)
A Pointer (PTR) record is essentially the reverse of an A record. PTR records map an IPaddress to a DNS name, and they are mainly used to check if the server name is associatedwith the IP address from where the connection was initiated.

Text (TXT)
Text (TXT) records are used to hold text information. This record provides the ability toassociate some arbitrary and unformatted text with a host or other name, such as humanreadable information about a server, network, data center, and other accounting information.

Service (SRV)
A Service (SRV) record is a specification of data in the DNS defining the location (the hostname and port number) of servers for specified services. The idea behind SRV is that, given a domain name (for example, example.com) and a service name (for example, web [HTTP],which runs on a protocol [TCP]), a DNS query may be issued to find the host name thatprovides such a service for the domain, which may or may not be within the domain.

Hosted Zones
A hosted zone is a collection of resource record sets hosted by Amazon Route 53. Like atraditional DNS zone file, a hosted zone represents resource record sets that are managedtogether under a single domain name. Each hosted zone has its own metadata andconfiguration information.

There are two types of hosted zones: private and public. A private hosted zone is a containerthat holds information about how you want to route traffic for a domain and its subdomainswithin one or more Amazon Virtual Private Clouds (Amazon VPCs). A public hosted zone is acontainer that holds

information about how you want to route traffic on the Internet for adomain (for example, example.com) and its subdomains (for example, apex.example.com andacme.example.com).

- Use an alias record, not a CNAME, for your hosted zone. CNAMEs are not allowedfor hosted zones in Amazon Route 53.

Routing Policies:

SimpleRouting Policy

This is the default routing policy when you create a new resource. Use a simple routing policywhen you have a single resource that performs a given function for your domain (forexample, one web server that serves content for the example.com website). In this case,Amazon Route 53 responds to DNS queries based only on the values in the resource recordset (for example, the IP address in an A record).

WeightedRouting Policy

With weighted DNS, you can associate multiple resources (such as Amazon Elastic ComputeCloud [Amazon EC2] instances or Elastic Load Balancing load balancers) with a single DNSname.

Use the weighted routing policy when you have multiple resources that perform the samefunction (such as web servers that serve the same website), and you want Amazon Route 53to route traffic to those resources in proportions that you specify. For example, you may usethis for load balancing between different AWS regions or to test new versions of your website(you can send 10 percent of traffic to the test environment and 90 percent of traffic to theolder version of your website).

To create a group of weighted resource record sets, you need to create two or more resourcerecord sets that have the same DNS name and type. You then assign each resource record seta unique identifier and a relative weight.

Latency-BasedRouting Policy

Latency-based routing allows you to route your traffic based on the lowest network latencyfor your end user (for example, using the AWS region that will give them the fastest responsetime).

Use the latency routing policy when you have resources that perform the same function inmultiple AWS Availability Zones or regions and you want Amazon Route 53 to respond toDNS queries using the resources that provide the best latency.

FailoverRouting Policy

Use a failover routing policy to configure active-passive failover, in which one resource takesall the traffic when it's available and the other resource takes all the traffic when the firstresource isn't available. Note that you can't create failover resource record sets for privatehosted zones.

For example, you might want your primary resource record set to be in U.S. West (N.California) and your secondary, Disaster Recovery (DR), resource(s) to be in U.S. East (N.Virginia). Amazon Route 53 will monitor the health of your primary resource endpoints usinga health check.

A health check tells Amazon Route 53 how to send requests to the endpoint whose health youwant to check: which protocol to use (HTTP, HTTPS, or TCP), which IP address and port touse, and, for HTTP/HTTPS health checks, a domain name and path.

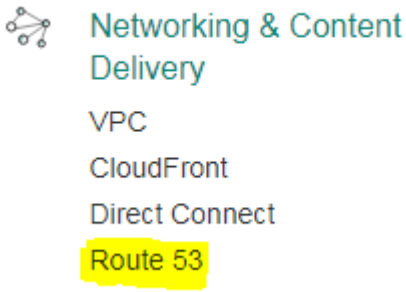
After you have configured a health check, Amazon will monitor the health of your selectedDNS endpoint. If your health check fails, then failover routing policies will be applied andyour DNS will fail over to your DR site.

Geolocation

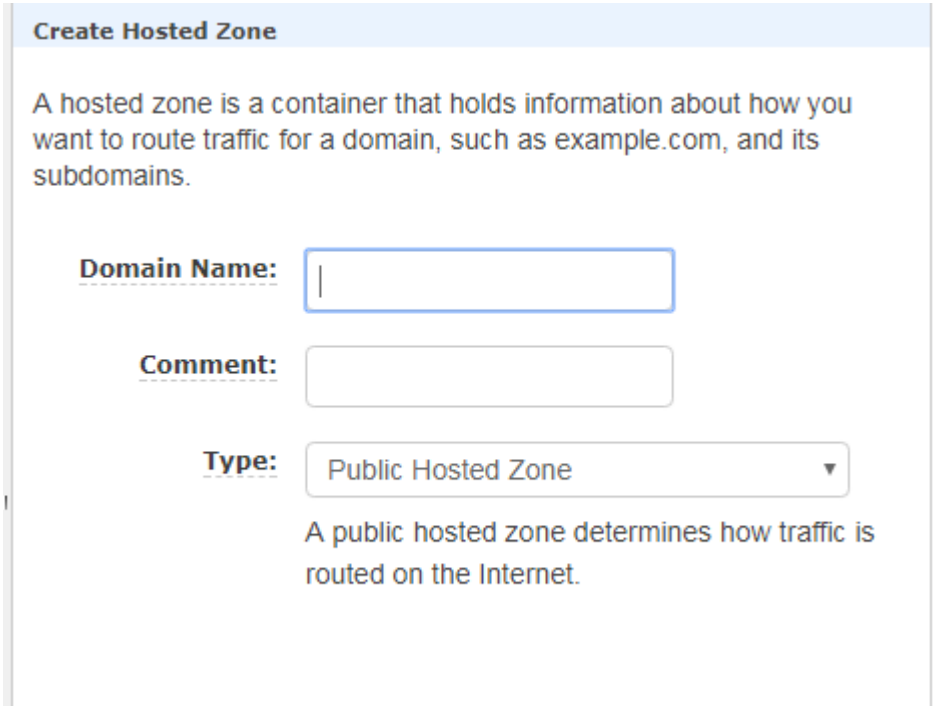
Geolocation routing lets you choose where Amazon Route 53 will send your traffic based onthe geographic location of your users (the location from which DNS queries originate). Forexample, you might want all queries from Europe to be routed to a fleet of Amazon EC2instances that are specifically configured for your European customers, with local languagesand pricing in Euros.
You can also use geolocation routing to restrict distribution of content to only the locations inwhich you have distribution rights. Another possible use is for balancing load acrossendpoints in a predictable, easy-to-manage way so that each user location is consistentlyrouted to the same endpoint.
You can specify geographic locations by continent, by country, or even by state in the UnitedStates. You can also create separate resource record sets for overlapping geographic regions,and priority goes to the smallest geographic region. For example, you might have oneresource record set for Europe and one for the United Kingdom. This allows you to routesome queries for selected countries (in this example, the United Kingdom) to one resourceand to route queries for the rest of the continent (in this example, Europe) to a differentresource.

Steps to Create a Hosted Zone.

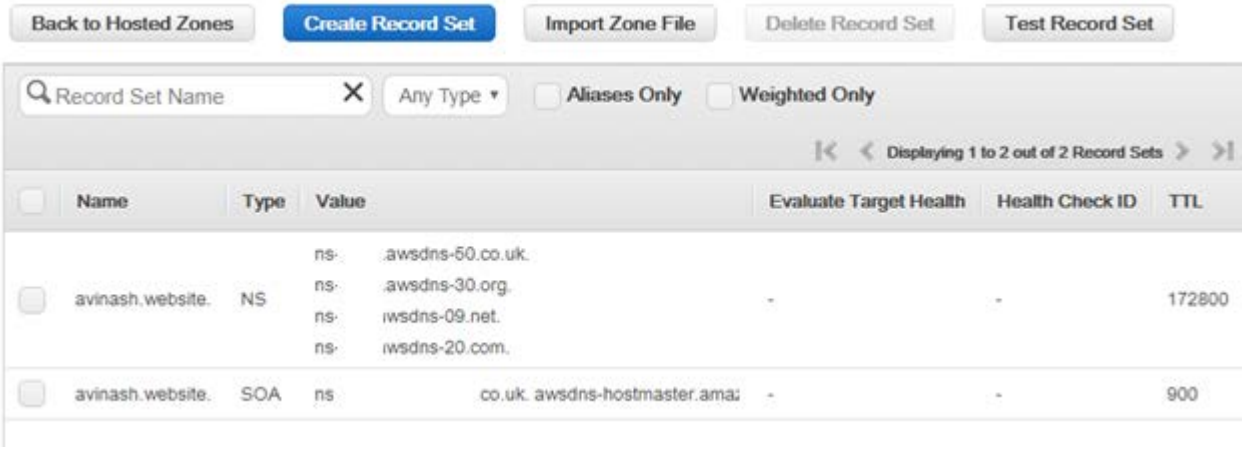
1. Log in to the AWS Management Console, Navigate to Amazon “Route 53” under “Network & Content Delivery”.



2. Create a Hosted Zone by selecting Create Hosted Zone” and Give the Purchased Domain Name, enter thee comments and choose the Type. We have two types of Hosted Zone, Selecting the **Public Hosted Zone** now.
    1. **Public Hosted Zone:**A public hosted zone is acontainer that holds information about how you want to route traffic on the Internet for adomain and its subdomains.
    2. **Private Hosted Zone:**A private hosted zone is a containerthat holds information about how you want to route traffic for a domain and its subdomains within one or more VPC.



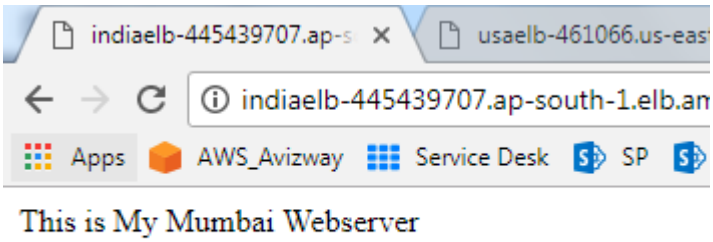
3. When you created a Hosted Zone, you'll get two record sets. Those are NS record and SOA record.



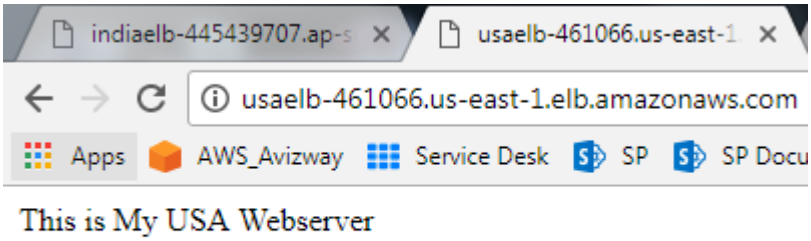
4. Now the Hosted Zone is created. If you purchase the Domain name from any other domain registrar i.e; Godaddy, bigrock we have to configure these NameServers in that account, or we can transfer the domain to AWS.

Now, we are going to create two Web Servers in two different regions and going to configure different routing policies. I've choose Mumbai and N. Virginia.

5. Create an EC2 Instance in Mumbai region and connect to the instance
6. Install **httpd** package and create **index.html under /var/www/html and start the httpd service**and verify the access using public IP address.
7. Create an **Elastic Load Balancer** and add this EC2 instance to ELB and verify the access using the ELB name.



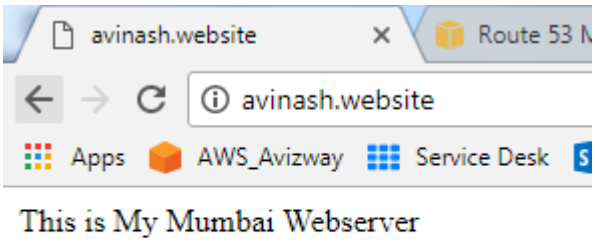
8. Choose another region (N. Virginia) and perform the same in N. Virginia region also. (Instance launch and ELB creation).

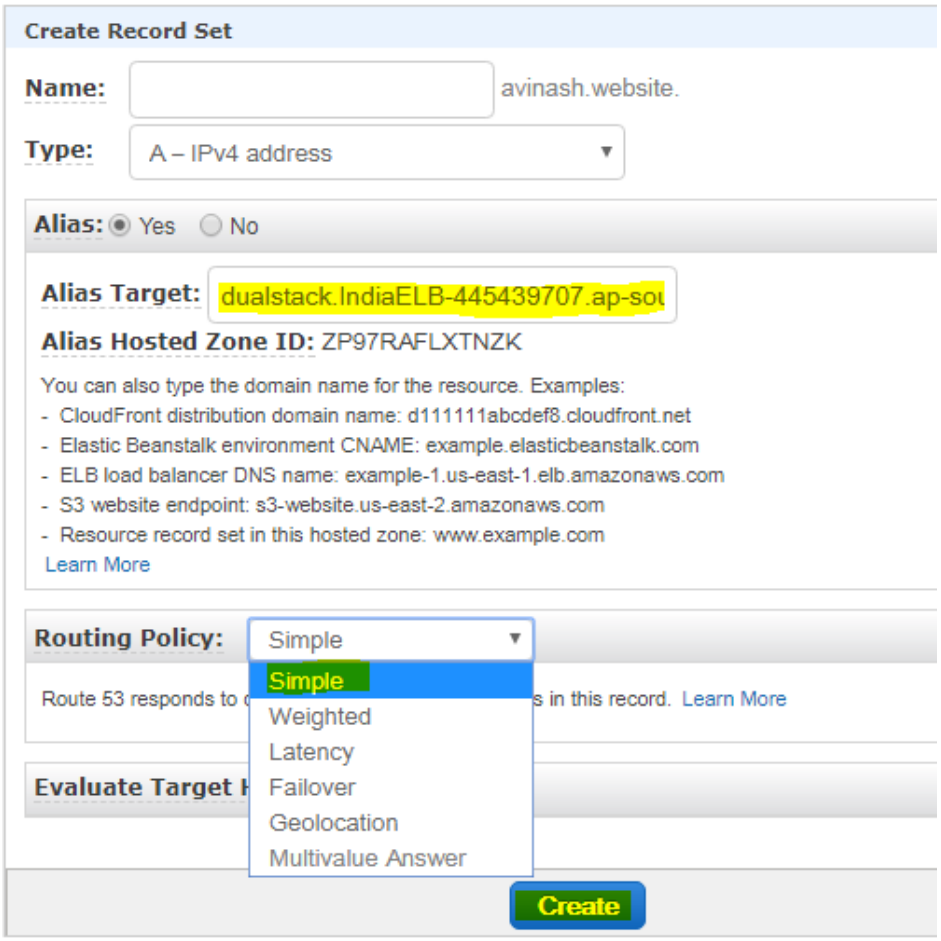


9. Now, we have two web servers in two different regions and we are going to configure routing policies between these two region resources.

Simple Routing Policy: This is the default routing policy when you create a new record set. This is most commonly used when you have a single resource that performs a given function for your domain

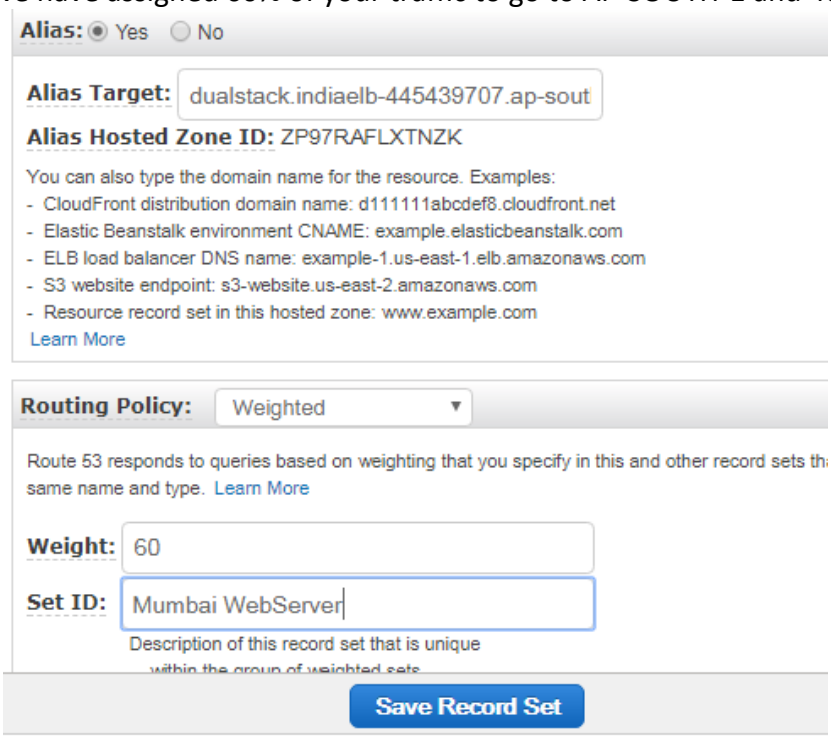
10. Select the Create Record Set option, you'll get an option like below.
    a. Give a name for your record ser
    b. Choose Type as **A – IPV4 address**
    c. Select **Alias**record and click on Alias Target option, you'll get all the available resources under AWS to map your domain with record set. Am selecting **Mumbai ELB**and selected simple **Routing Policy.**

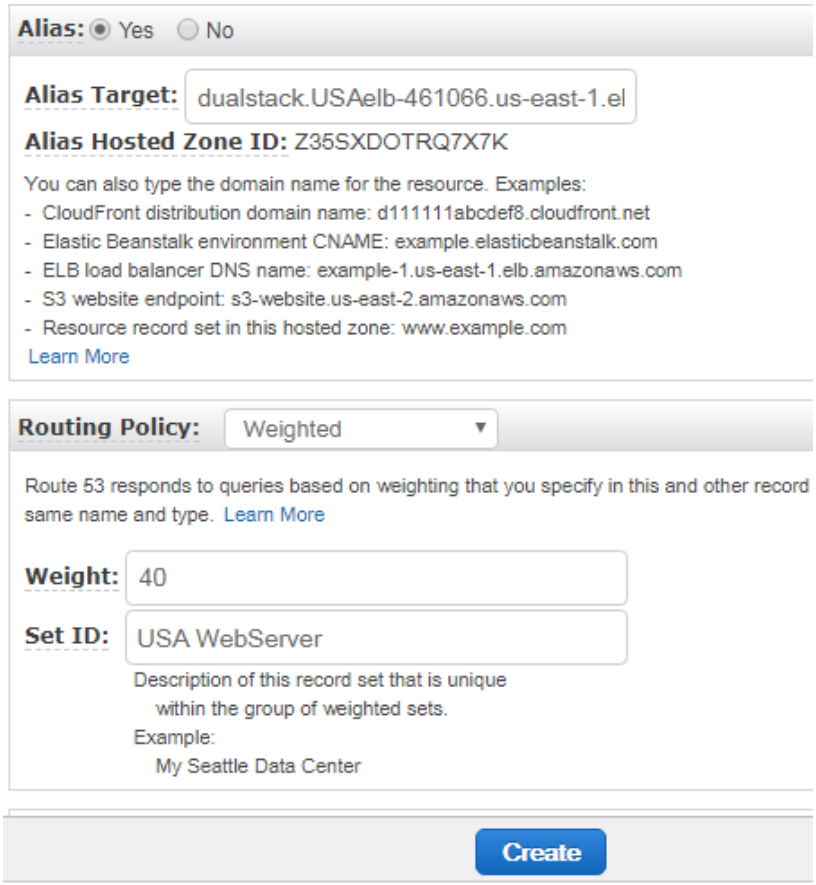




11. Now all my domain requests should route to Mumbai ELB as this is a simple routing policy and we'll have single resource for this routing type.

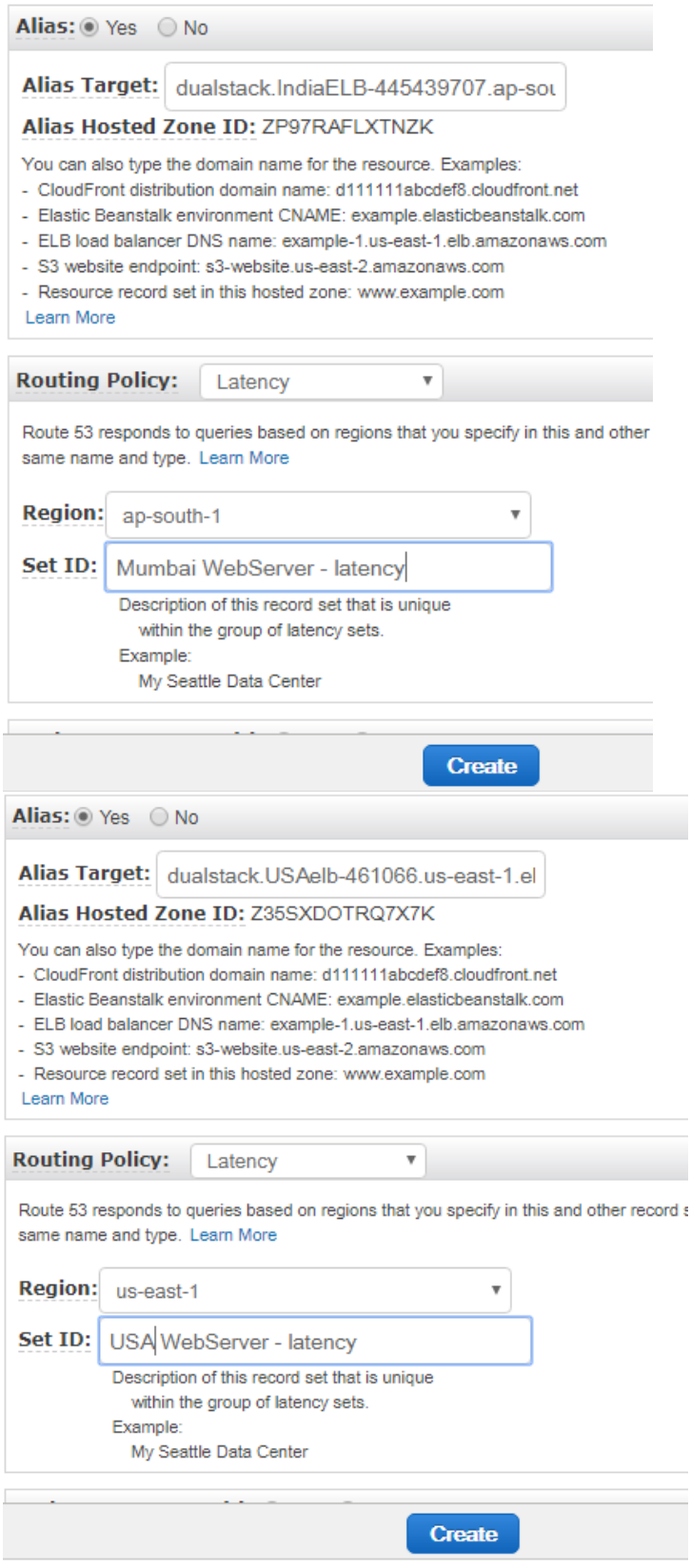
Weighted: Weighted Routing Policies let you split your traffic based on different weights assigned. Below we have assigned 60% of your traffic to go to AP-SOUTH-1 and 40% to go to US-EAST-1.





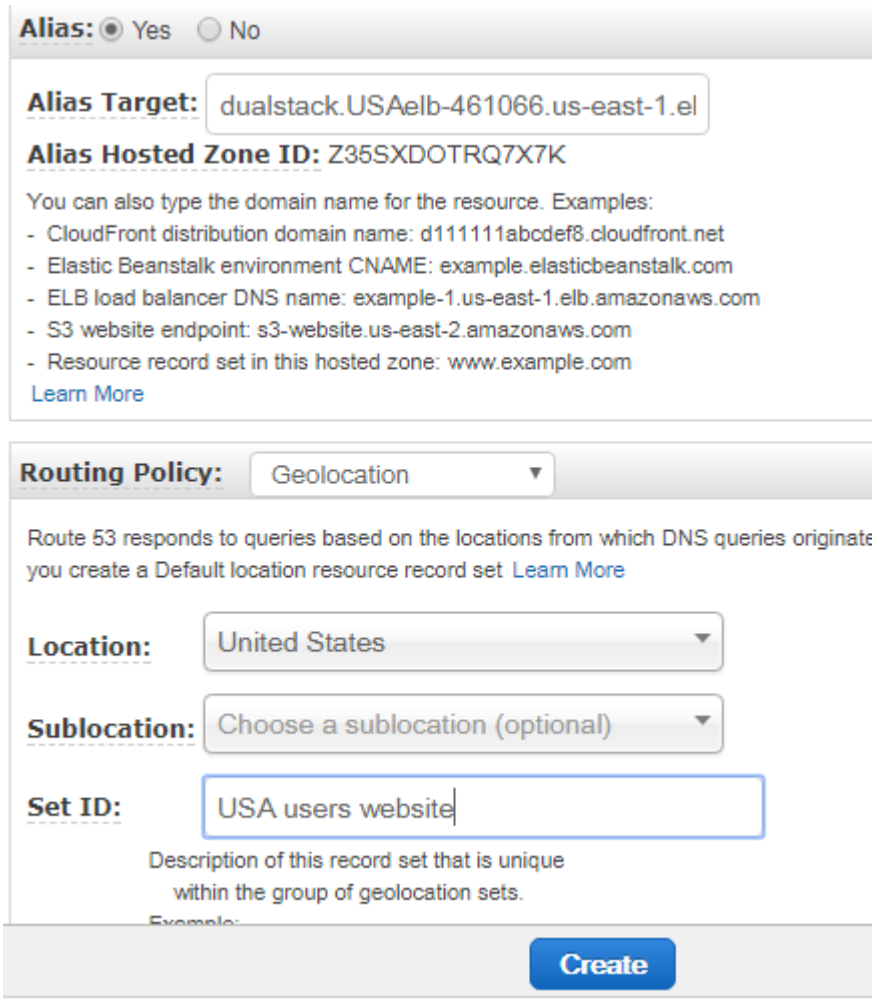
Latency: Latency based routing allows you to route your traffic based on the lowest network latency for your end user (ie which region will give them the fastest response time).

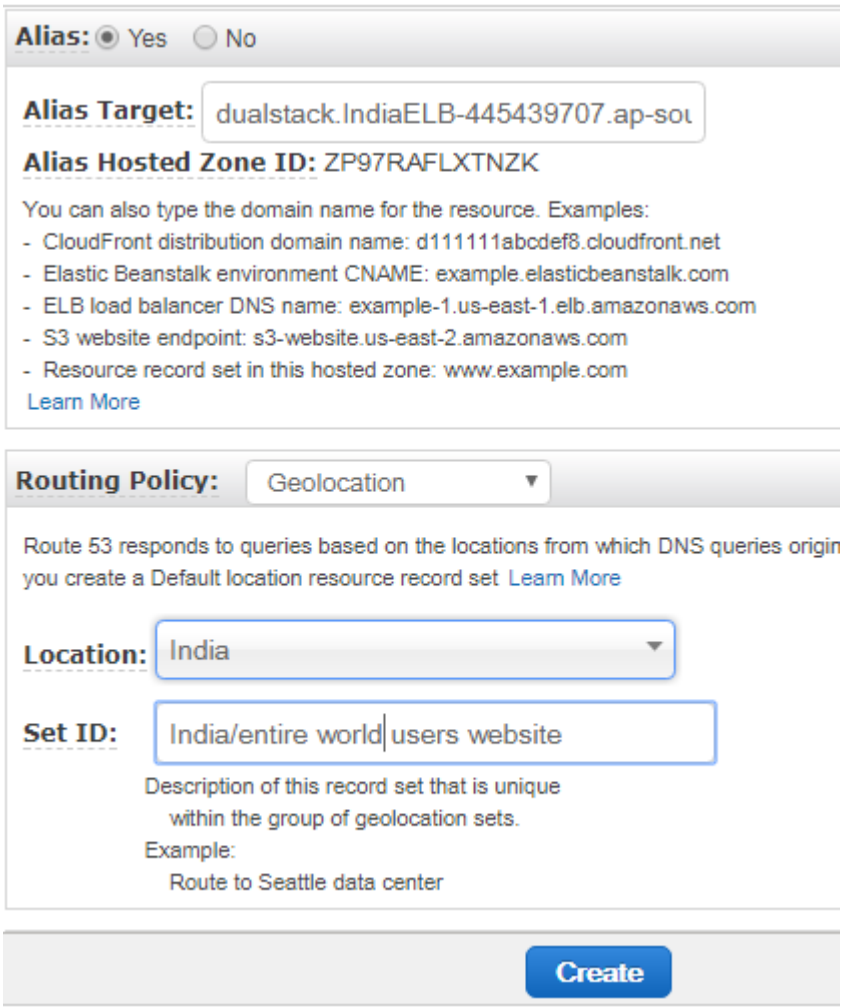
To use latency-based routing you create a latency resource record set for the Amazon EC2 (or ELB) resource in each region that hosts your website. When Amazon Route 53 receives a query for your site, it selects the latency resource record set for the region that gives the user the lowest latency. Route 53 then responds with the value associated with that resource record set.



Geolocation: Geolocation routing lets you choose where your traffic will be sent based on the geographic location of your users (ie the location from which DNS queries originate).

For example, you might want all queries from Europe to be routed to a fleet of EC2 instances that are specifically configured for your European customers. These servers may have the local language of your European customers and all prices are displayed in Euros.


Alias: Yes No
Alias Target: dualstack.USAelb-461066.us-east-1.el
Alias Hosted Zone ID: Z35SXDOTRQ7X7K
You can also type the domain name for the resource. Examples:
- CloudFront distribution domain name: d111111abcdef8.cloudfront.net
- Elastic Beanstalk environment CNAME: example.elasticbeanstalk.com
- ELB load balancer DNS name: example-1.us-east-1.elb.amazonaws.com
- S3 website endpoint: s3-website.us-east-2.amazonaws.com
- Resource record set in this hosted zone: www.example.com
Learn More
Routing Policy: Geolocation
Route 53 responds to queries based on the locations from which DNS queries originate
you create a Default location resource record set Learn More
Location: United States
Sublocation: Choose a sublocation (optional)
Set ID: USA users website
Description of this record set that is unique
within the group of geolocation sets.
Create



Failover : Failover routing policies are used when you want to create an active/passive set up. For example you may want your primary site to be in US-East-1 and your secondary DR Site in AP-South-1.

Route53 will monitor the health of your primary site using a health check.

A health check monitors the health of your end points.

Configure health check

Route 53 health checks let you track the health status of your resources, such as web servers or mail servers

Name IND WS Healthcheck

What to monitor Endpoint

Monitor an endpoint

Multiple Route 53 health checkers will try to establish a TCP connection with the following resource to determi

Specify endpoint by IP address

Protocol HTTP

IP address

Host name www.example.com

Port * 80

Path / images

Alias: Yes No

Alias Target: dualstack.IndiaELB-445439707.ap-sou

Alias Hosted Zone ID: ZP97RAFLXTNZK

You can also type the domain name for the resource. Examples:
- CloudFront distribution domain name: d111111abcdef8.cloudfront.net
- Elastic Beanstalk environment CNAME: example.elasticbeanstalk.com
- ELB load balancer DNS name: example-1.us-east-1.elb.amazonaws.com
- S3 website endpoint: s3-website.us-east-2.amazonaws.com
- Resource record set in this hosted zone: www.example.com

Learn More

Routing Policy: Failover

Route 53 responds to queries using primary record sets if any are healthy, or using s otherwise. Learn More

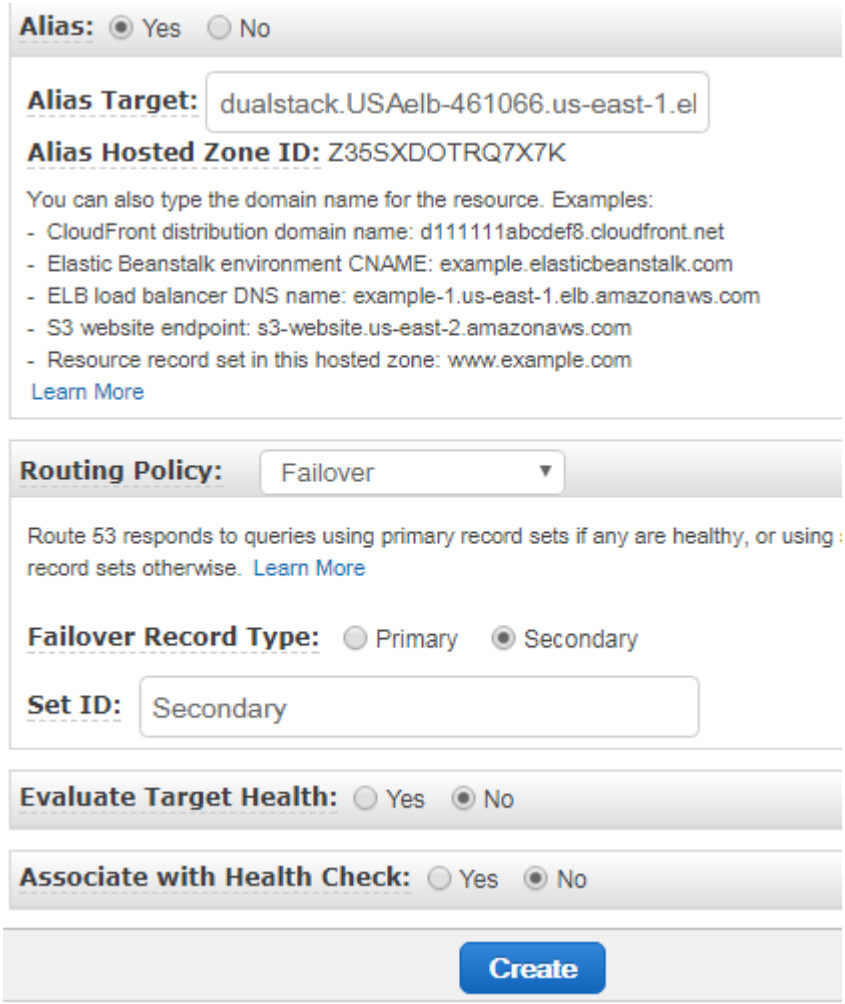
Failover Record Type: Primary Secondary

Set ID: Primary

Evaluate Target Health: Yes No

Associate with Health Check: Yes No

Create



Multivalue answer routing policy – Use when you want Amazon Route 53 to respond to DNS queries with up to eight healthy records selected at random.

Virtual Private Cloud (Amazon VPC)

The Amazon Virtual Private Cloud (Amazon VPC) is a custom-defined virtual networkwithin the AWS Cloud. You can provision your own logically isolated section of AWS, similarto designing and implementing a separate independent network that would operate in an onpremisesdata center. Amazon VPC is the networking layer for Amazon Elastic Compute Cloud (Amazon EC2), andit allows you to build your own virtual network within AWS.

You will have complete control over your virtual networking environment, including selection of your own IP address range, creation of subnets, and configuration of route tables and network gateways.

You can easily customize the network configuration for your Amazon Virtual Private Cloud.
For example, you can create a public-facing subnet for your webservers that has access to the Internet, and place your backend systems such as databases or application servers in a private-facing subnet with no Internet access.
VPCs also have a few limits set on them by default. For example, **you can have a maximum of five VPCs per region.** Each VPC can have a max of one Internetgateway as well as one virtual private gateway. Also, **each VPC has a limit of hosting a maximum of up to 200 subnets per VPC**. You can increase these limit by simplyrequesting AWS to do so.

An Amazon VPC consists of the following components:

- Subnets
- Route tables
- Dynamic Host Configuration Protocol (DHCP) option sets
- Security groups
- Network Access Control Lists (ACLs)

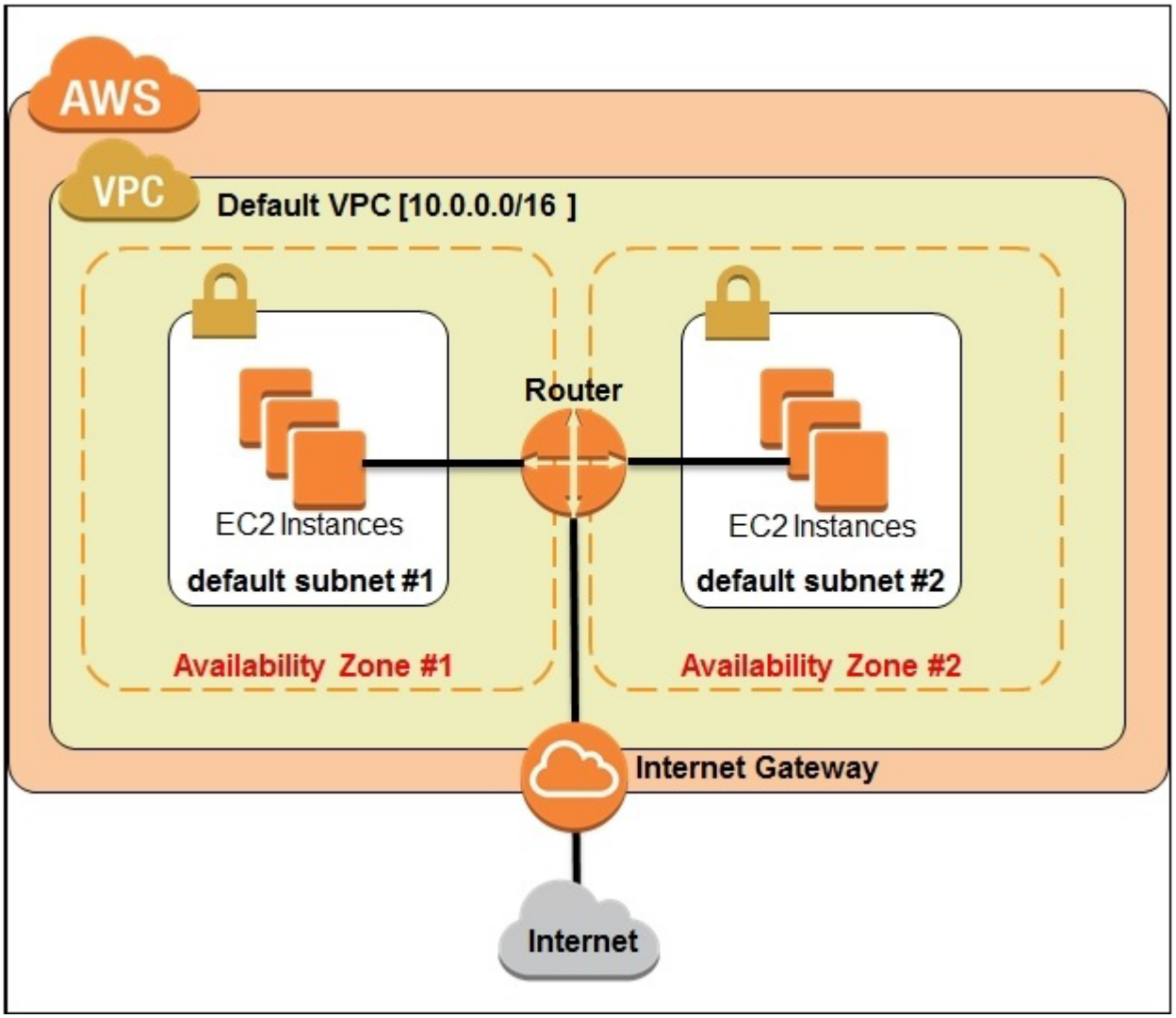
An Amazon VPC has the following optional components:

- Internet Gateways (IGWs)
- Elastic IP (EIP) addresses
- Elastic Network Interfaces (ENIs)
- Endpoints
- Peering
- Network Address Translation (NATs) instances and NAT gateways
- Virtual Private Gateway (VPG), Customer Gateways (CGWs), and Virtual PrivateNetworks (VPNs)

By default, AWS will create a VPCfor you in your particular region the first time you sign up for the service. This is called asthe default VPC. The default VPC comes preconfigured with the following set ofconfigurations:

The default VPC is always created with a CIDR block of /16, which means itsupports 65,536 IP addresses in it. A default subnet is created in each AZ of your selected region. Instances launched in these default subnets have both a public and a private IP address by default as well. An Internet Gateway is provided to the default VPC for instances to have Internetconnectivity. A few necessary

route tables, security groups, and ACLs are also created by default. That enable the instance traffic to pass through to the Internet. Refer to the following figure:



Classless Inter-Domain Routing (CIDR): When you create an Amazon VPC, you must specify the IPv4 address range by choosing aClassless Inter-Domain Routing (CIDR) block, such as 10.0.0.0/16. The address range of theAmazon VPC cannot be changed after the Amazon VPC is created. An Amazon VPC addressrange may be as large as /16 (65,536 available addresses) or as small as /28 (16 availableaddresses) and should not overlap any other network with which they are to be connected.

Subnets: A subnet is a segment of an Amazon VPC's IP address range where you can launch AmazonEC2 instances, Amazon Relational Database Service (Amazon RDS) databases, and otherAWS resources.
After creating an Amazon VPC, you can add one or more subnets in each Availability Zone.Subnets reside within one Availability Zone and cannot span zones.

- Remember that one subnet equals one Availability Zone. You can, however, have multiple subnets in one Availability Zone.

Subnets can be classified as public, private, or VPN-only
A **public subnet** is one in which the associated route table directs the subnet's traffic to the Amazon VPC's IGW.

A **private subnet** is one in which the associated route table does not direct the subnet's traffic to the Amazon VPC's IGW.

A **VPN-only subnet** is one in which theassociated route table directs the subnet's traffic to the Amazon VPC's VPGand does not have a route to the IGW.

Route Tables:

A route table is a logical construct within an Amazon VPC that contains a set of rules (called routes) that are applied to the subnet and used to determine where network traffic isdirected.

- You can modify route tables and add your own custom routes.
- You can also use route tables to specify which subnets are public (by directing Internet traffic to the IGW) and which subnets are private (by not having a route that directs traffic to the IGW).
- Each route table contains a default route called the local route, which enablescommunication within the Amazon VPC, and this route cannot be modified or removed.
- Additional routes can be added to direct traffic to exit the Amazon VPC via the IGW, the VPG, or the NAT instance.

You should remember the following points about route tables:

- Your VPC has an implicit router.
- Your VPC automatically comes with a main route table that you can modify.
- You can create additional custom route tables for your VPC.
- Each subnet must be associated with a route table, which controls the routing for the subnet. If you don't explicitly associate a subnet with a particular route table, the subnetuses the main route table.
- You can replace the main route table with a custom table that you've created so that eachnew subnet is automatically associated with it.

Internet Gateways:

An Internet Gateway (IGW) is a horizontally scaled, redundant, and highly available AmazonVPC component that allows communication between instances in your Amazon VPC and theInternet.

Amazon EC2 instances within an Amazon VPC are only aware of their private IP addresses.When traffic is sent from the instance to the Internet, the IGW translates the reply address tothe instance's public IP address (or EIP address, covered later) and maintains the one-to-onemap of the instance private IP address and public IP address.

When an instance receivestraffic from the Internet, the IGW translates the destination address (public IP address) tothe instance's private IP address and forwards the traffic to the Amazon VPC.

You must do the following to create a public subnet with Internet access:

- Attach an IGW to your Amazon VPC.
- Create a subnet route table rule to send all non-local traffic (0.0.0.0/0) to the IGW.
- Configure your network ACLs and security group rules to allow relevant traffic to flow to and from your instance.

Elastic IP Addresses (EIP): An Elastic IP Addresses (EIP) is a static,public IP address in the pool for the region that you can allocate to your account (pull fromthe pool) and release (return to the pool).

AWS maintains a pool of public IP addresses in each region and makes them available for youto associate to resources within your Amazon VPCs.

- EIPs are specific to a region (that is, an EIP in one region cannot be assigned to an instance within an Amazon VPC in a different region).

- There is a one-to-one relationship between network interfaces and EIPs.
- You can move EIPs from one instance to another, either in the same Amazon VPC or a different Amazon VPC within the same region.
- EIPs remain associated with your AWS account until you explicitly release them.
- There are charges for EIPs allocated to your account, even when they are not associated with a resource.

Peering:

An Amazon VPC peering connection is a networking connection between two Amazon VPCsthat enables instances in either Amazon VPC to communicate with each other as if they arewithin the same network. You can create an Amazon VPC peering connection between yourown Amazon VPCs or with an Amazon VPC in another AWS account within a single region.

An Amazon VPC may have multiple peering connections, and peering is a one-to-onerelationship between Amazon VPCs, meaning two Amazon VPCs cannot have two peeringagreements between them.

Peering connections are created through a request/accept protocol. The owner of therequesting Amazon VPC sends a request to peer to the owner of the peer Amazon VPC. If thepeer Amazon VPC is within the same account, it is identified by its VPC ID. If the peer VPC iswithin a different account, it is identified by Account ID and VPC ID. The owner of the peerAmazon VPC has one week to accept or reject the request to peer with the requesting AmazonVPC before the peering request expires.

- You cannot create a peering connection between Amazon VPCs that have matching or overlapping CIDR blocks.
- You cannot create a peering connection between Amazon VPCs in different regions.
- Amazon VPC peering connections do not support transitive routing.
- You cannot have more than one peering connection between the same two Amazon VPCs at the same time.

Network Access Control Lists (ACLs):

A network access control list (ACL) is another layer of security that acts as a stateless firewall on a subnet level.

A network ACL is a numbered list of rules that AWS evaluates in order, starting with the lowest numbered rule, to determine whether traffic is allowed in or out ofany subnet associated with the network ACL. Here is a small example of how ACL looks like.

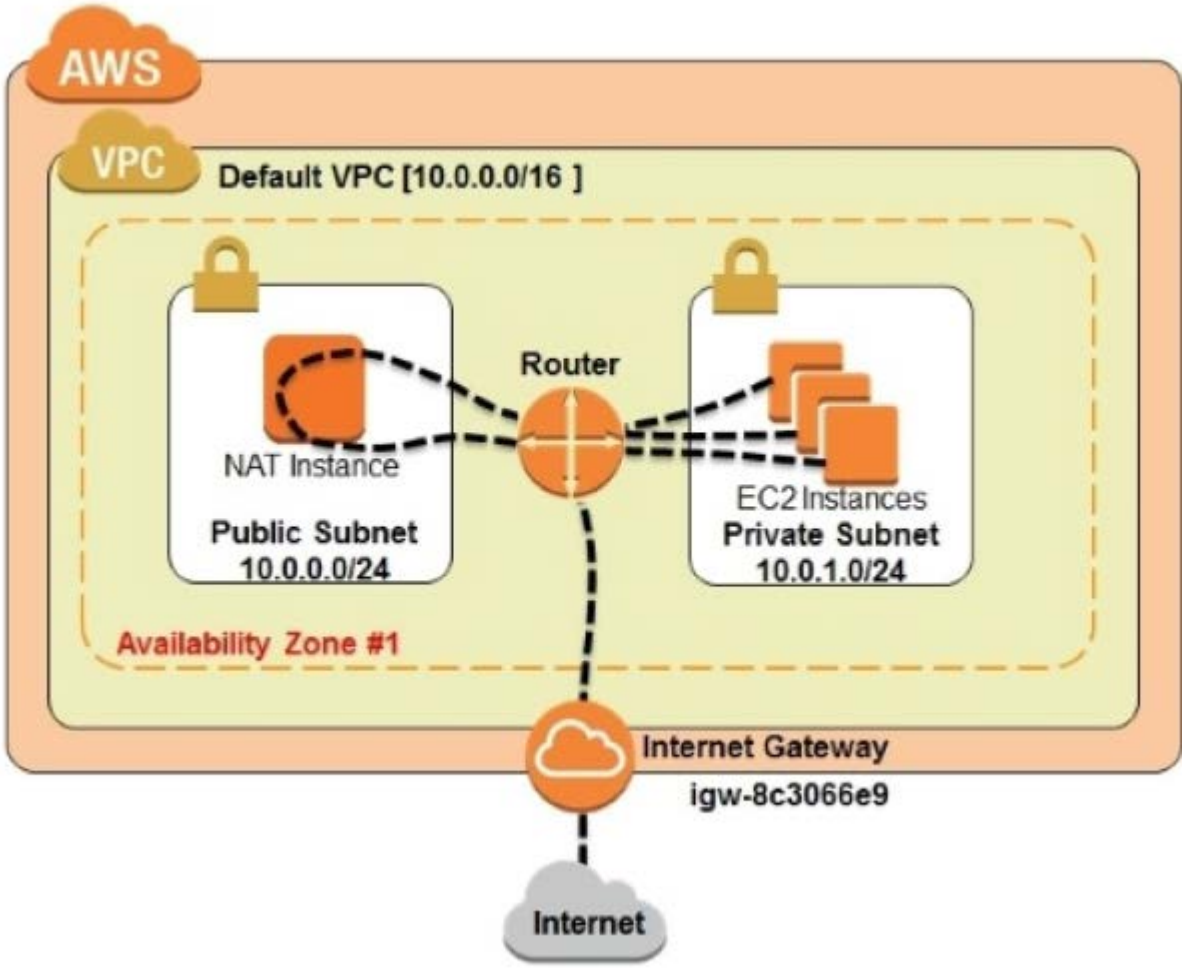
Inbound ACL rules				
Rule No.	**Source IP**	**Protocol**	**Port**	**Allow/Deny**
100	0.0.0.0/0	All	All	ALLOW
*	0.0.0.0/0	All	All	DENY
Outbound ACL rules				
Rule No.	**Dest IP**	**Protocol**	**Port**	**Allow/Deny**
100	0.0.0.0/0	all	all	ALLOW
*	0.0.0.0/0	all	all	DENY

When you create a custom network ACL, its initial configuration will deny all inboundand outbound traffic until you create rules that allow otherwise.

Security Group	**Network ACL**
Operates at the instance level (first layer of defense)	Operates at the subnet level (second layer of defense)
Supports allow rules only	Supports allow rules and deny rules
Stateful: Return traffic is automatically allowed, regardless of any rules	**Stateless:** Return traffic must be explicitly allowed by rules.
AWS evaluates all rules before deciding whether to allow traffic	AWS processes rules in number order when deciding whether toallow traffic.
Applied selectively to individual instances	Automatically applied to all instances in the associated subnets; this is a backup layer of defense, so you don't have to rely onsomeone specifying the security group.

Network Address Translation (NAT) Instances and NAT Gateways

By default, any instance that you launch into a private subnet in an Amazon VPC is not ableto communicate with the Internet through the IGW.AWS provides NATinstances and NAT gateways to allow instances deployed in private subnets to gain Internetaccess.



NAT Instance: A network address translation (NAT) instance is an Amazon Linux Amazon Machine Image(AMI) that is designed to accept traffic from instances within a private subnet, translate thesource IP address to the public IP address of the NAT instance, and forward the traffic to theIGW. NAT Instances allows in private subnets to send outbound Internetcommunication, but it prevents the instances from receiving inbound traffic initiated bysomeone on the Internet.

- Create a security group for the NAT with outbound rules that specify the needed Internet resources by port, protocol, and IP address.
- Launch an Amazon Linux NAT AMI as an instance in a public subnet and associate it with the NAT security group.
- Disable the Source/Destination Check attribute of the NAT.
- Configure the route table associated with a private subnet to direct Internet-bound traffic to the NAT instance (for example, i-1a2b3c4d).

NAT Gateway: A NAT gateway is an Amazon managed resource that is designed to operate just like a NAT instance, but it is simpler to manage and highly available within an Availability Zone.

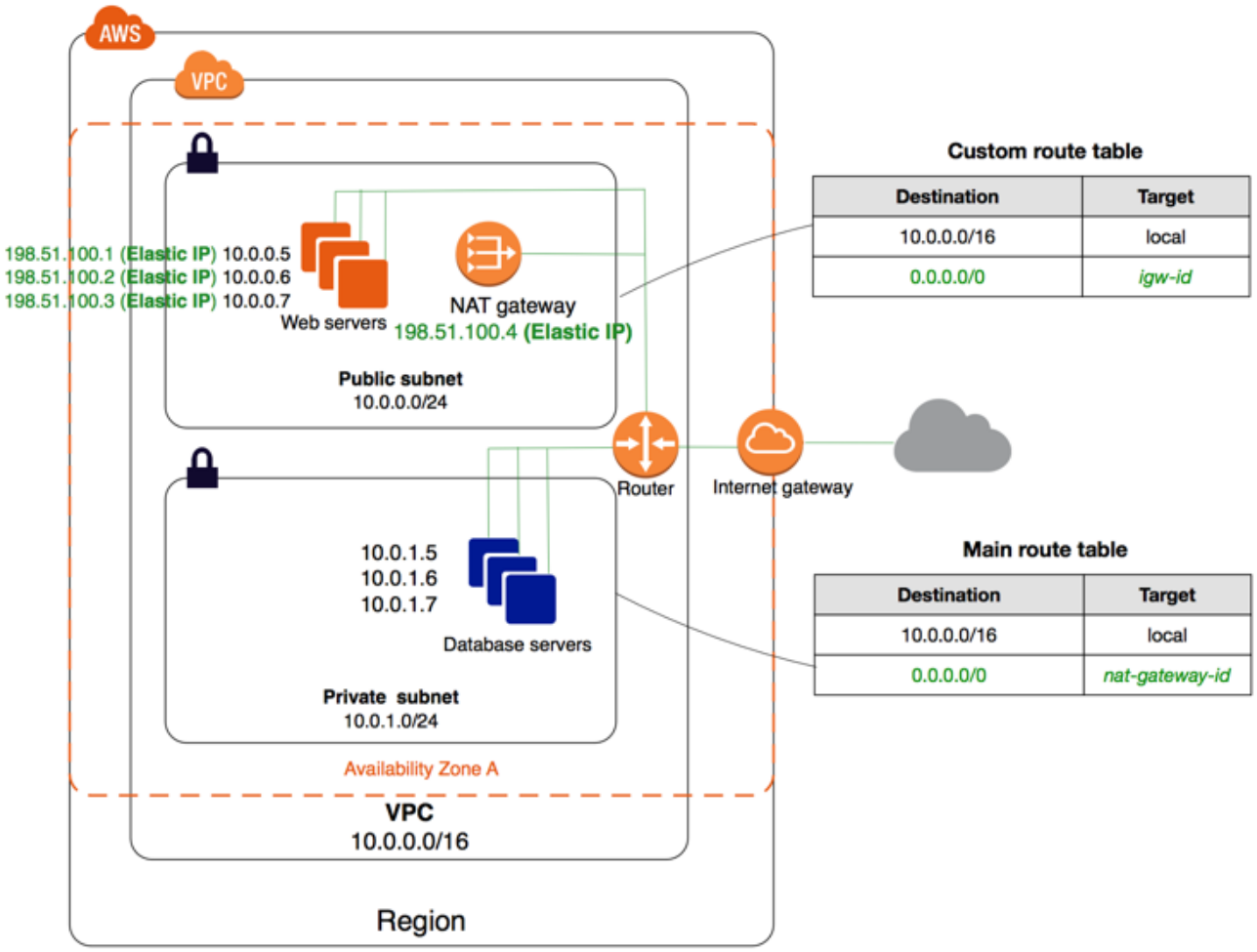
- Allocate an EIP and associate it with the NAT gateway.
- Configure the route table associated with the private subnet to direct Internet-boundtraffic to the NAT gateway.

You can connect an existing data center to Amazon VPC using either hardware or softwareVPN connections, which will make Amazon VPC an extension of the data center. Amazon VPCoffers two ways to connect a corporate network to a VPC: VPG and CGW.

A virtual private gateway:VPG is the virtual private network (VPN) concentrator on theAWS side of the VPN connection between the two networks.

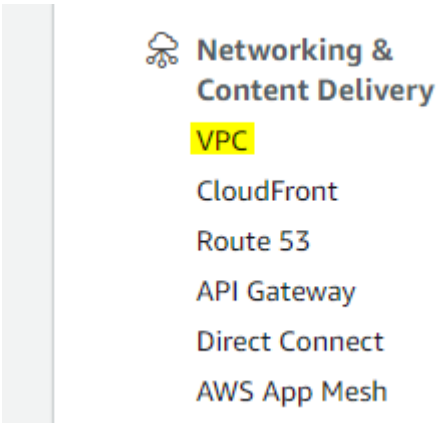
A customer gateway (CGW)represents a physical device or a software application on the customer's side of the VPNconnection.

Here is the VPC diagram we are about to deploy with Public and private Subnets including NAT:

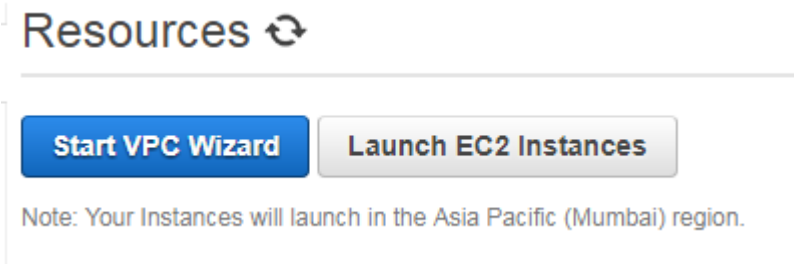


VPC deployment options:

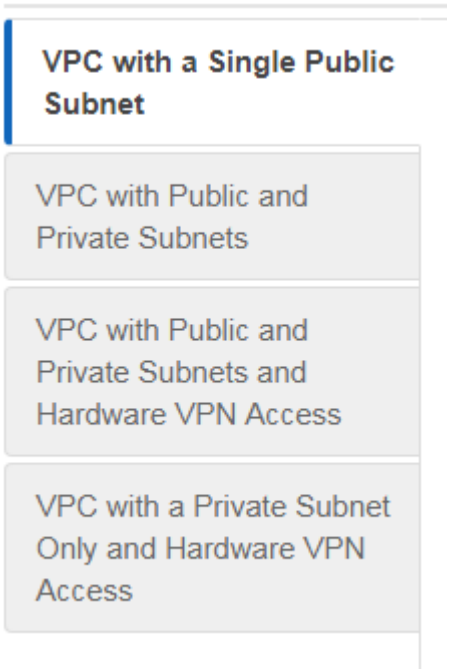
1. You can find VPC under Network & Content Delivery category in AWS console. Select VPC.



2. You can select the **Start VPC Wizard**option to get all the the VPC deployment methods.



3. We have 4 deployment models available currently with AWS VPC. Detailed description given below.



VPC with a single public subnet: This is by far the simplest of the four deploymentscenarios. Using this scenario, we will get a**VPC will provision a single public subnet with a default Internet**

Gateway attached to it. The subnet will also have a few simple andbasic route tables, security groups, and network ACLs created. This type ofdeployment is ideal for small-scaled web applications or simple websites that don'trequire any separate application or subnet tiers.

VPC with public and private subnets (NAT): This is the most commonly useddeployment scenario, this option will provide you with **a public subnet and a private subnet** as well. The public subnet will be connected to an Internet gateway and allowinstances launched within it to have Internet connectivity, whereas the private subnetwill not have any access to the outside world. This scenario will also provision asingle NAT instance inside the public subnet using which your private subnetinstances can connect with the outside world but not vice versa. Besides this, thewizard will also create and assign a route table to both the public and private subnets,each with the necessary routing information prefilled in them. This type ofdeployment is ideal for large-scale web applications and websites that leverage a mixof public facing (web servers) and non-public facing (database servers).

VPC with public and private subnets and hardware VPN access: This deploymentscenario is very much similar to the VPC with public and private subnets, however, withone component added additionally, which is the Virtual Private Gateway. This VirtualPrivate Gateway connects to your on premise network's gateway using a standard VPNconnection. This type of deployment is well suited for organizations that wish to extendtheir on premise datacenters and networks in to the public clouds while allowing theirinstances to communicate with the Internet.

VPC with a private subnet only and hardware VPN access: Unlike the previousdeployment scenario, this scenario only provides you with a private subnet that canconnect to your on premise datacenters using standard VPN connections. There is noInternet Gateway provided and thus your instances remain isolated from the Internet.This deployment scenario is ideal for cases where you wish to extend your onpremise datacenters into the public cloud but do not wish your instances to have anycommunication with the outside world.

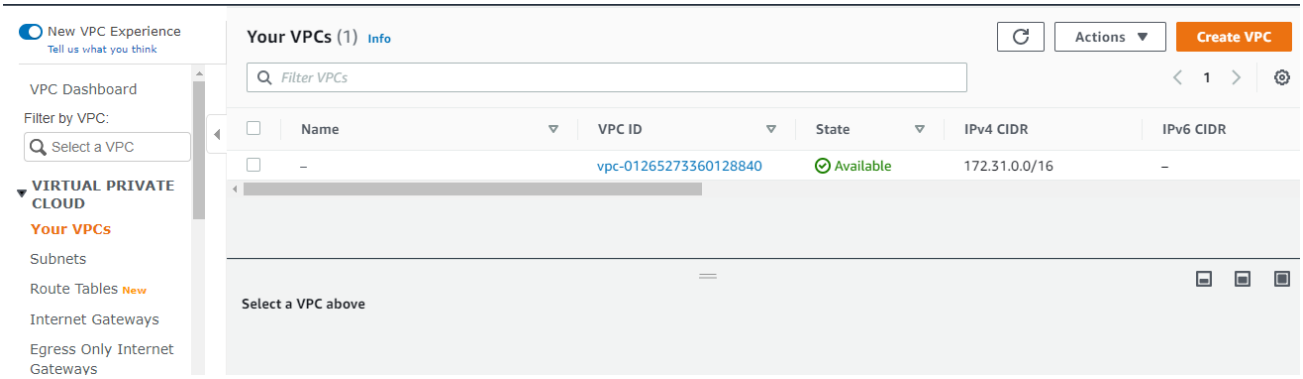
Here is a simple use case for creating Custom VPC

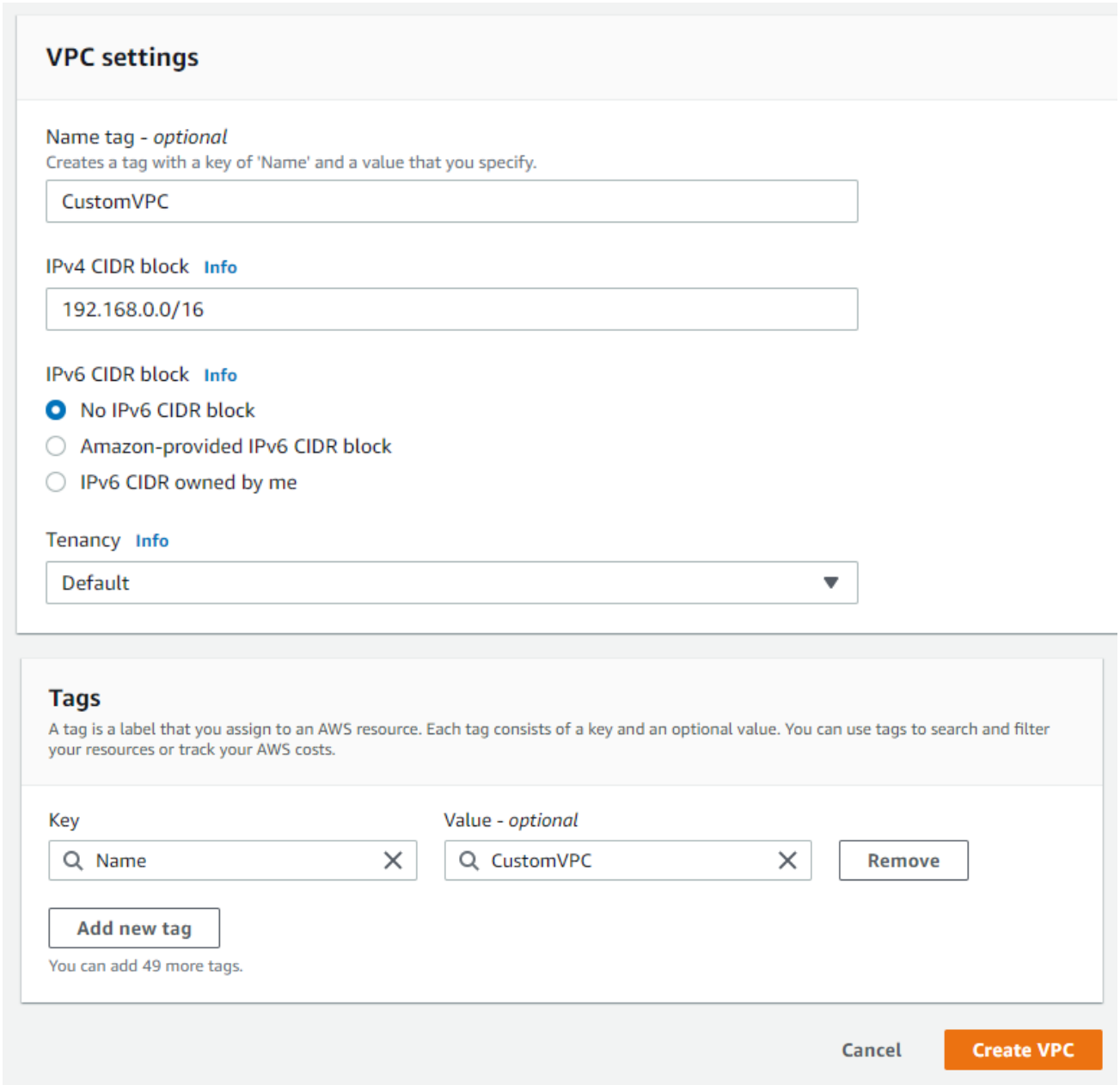
- Create a VPC (AP-SOUTH-PROD-1 - 192.168.0.0/16) with separate secure environments for hosting the web servers and database servers.
- Only the web server environment (AP-SOUTH-PROD-WEB - 192.168.1.0/24) should have direct Internet access.
- The database server environment (AP-SOUTH-PROD-DB - 192.168.2.0/24) should be isolated from any direct access from the outside world.
- The database servers can have restricted Internet access only through a jump server (NAT Instance). The jump server needs to be a part of the web server environment.

You can follow the simple wizard, but to understand the flow clearly am going to create and configure each and every option manually. Here is the steps am going to perform.

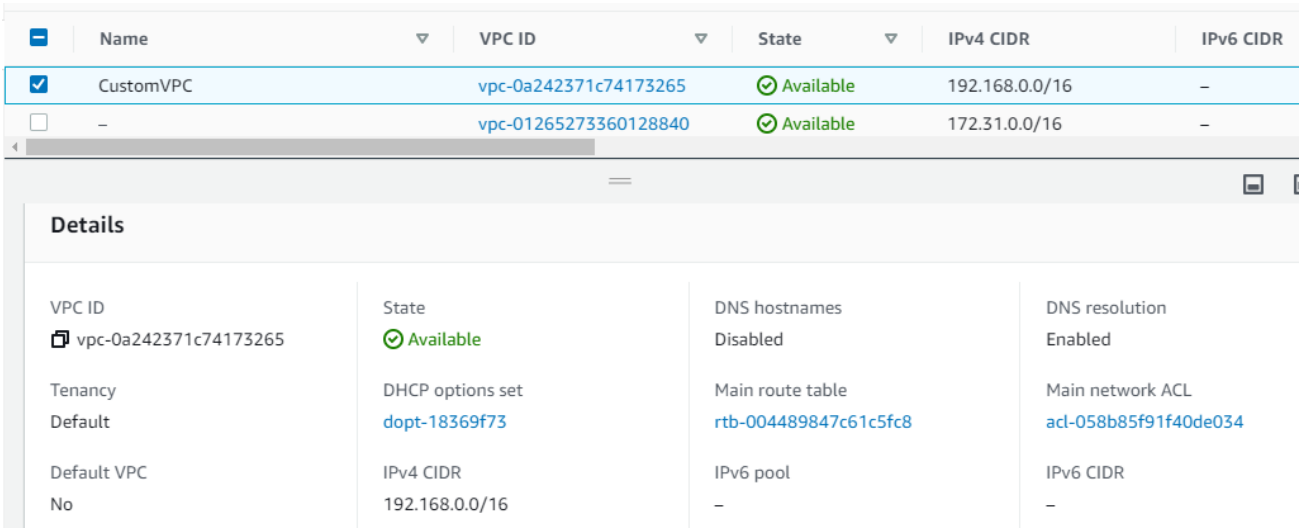
- Creating a Custom VPC
- Creating Subnets under Custom VPC
- Creating IGW and associating with VPC
- Creating a Route table and performing subnet association
- Launching instance in Public subnet and private subnet

STEP 1: To create a custom VPC Navigate to **"Your VPCs"** from left pane, and Click on **"Create VPC".**



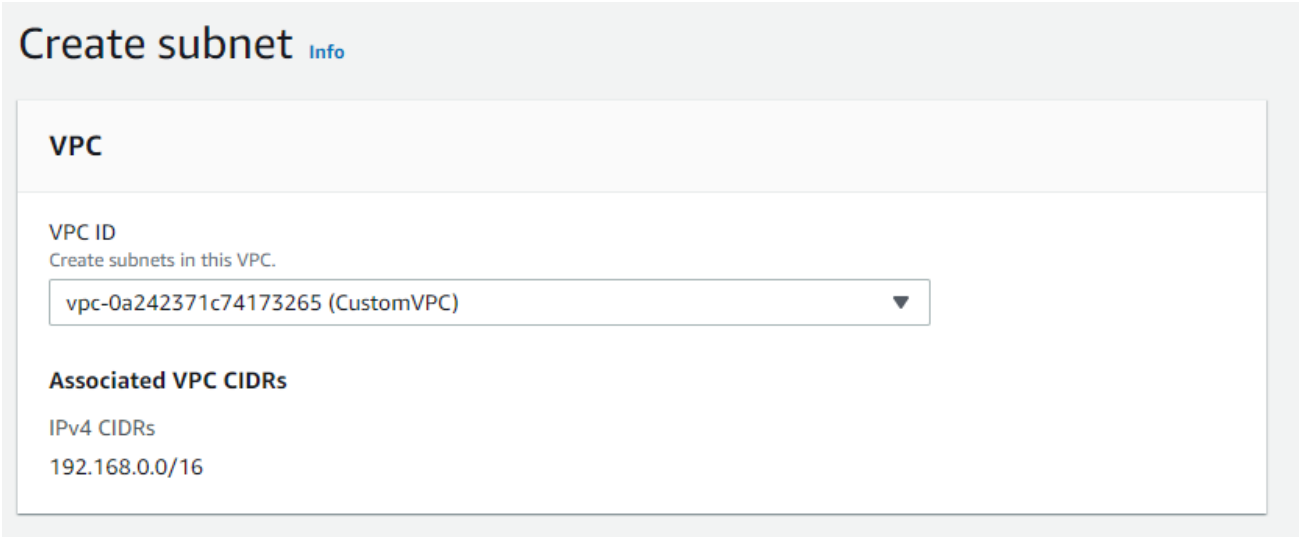


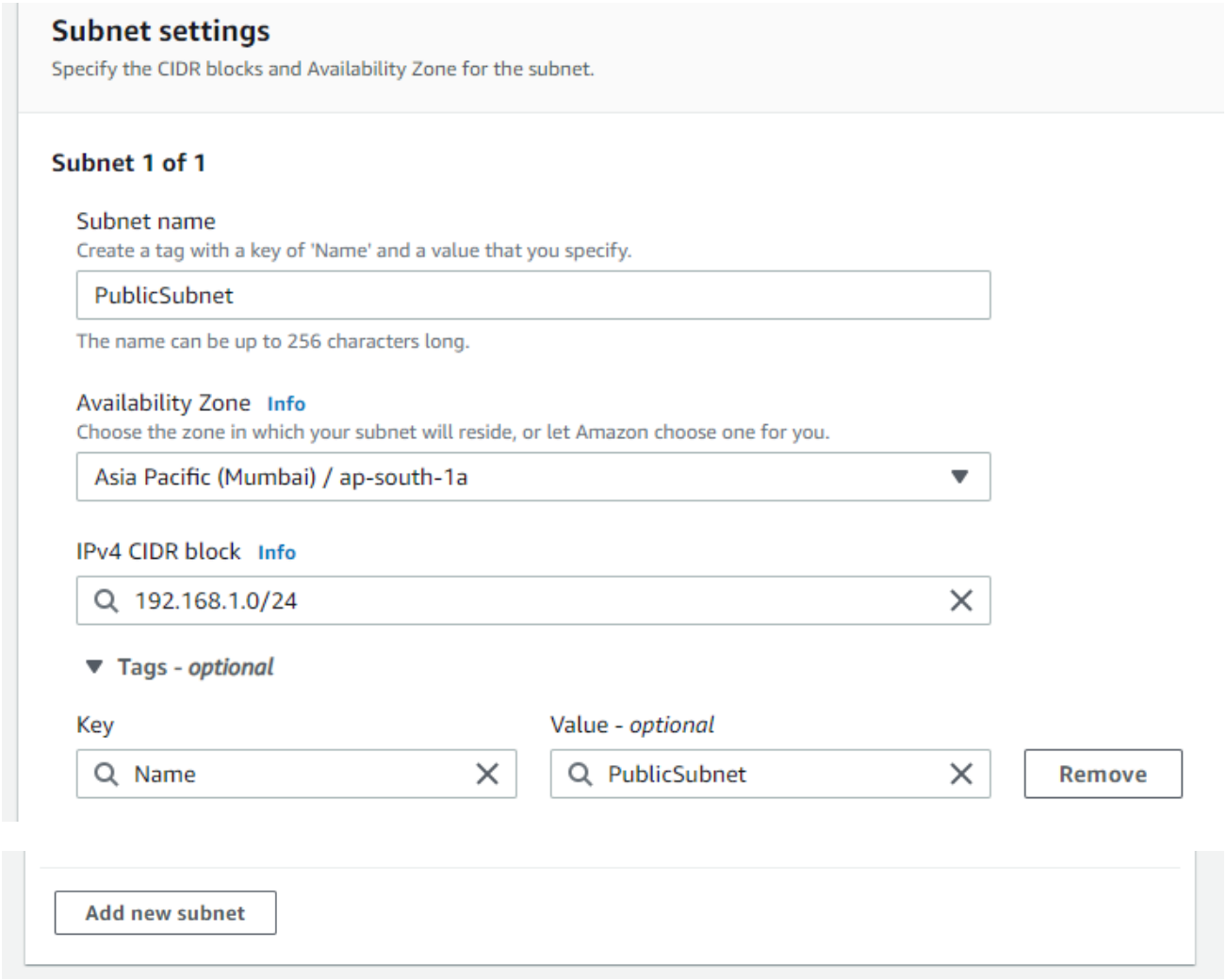
- As mentioned in above image, am creating a VPC with **CustomVPC** name and selecting CIDR block in Class C IP address range **192.168.0.0/16** (provide a /16 subnet will provide us 65,531 IP addresses to use) and selecting tenancy as **Default.**



STEP 2: Creating a subnets under custom VPC (One public and one private subnets in this example).

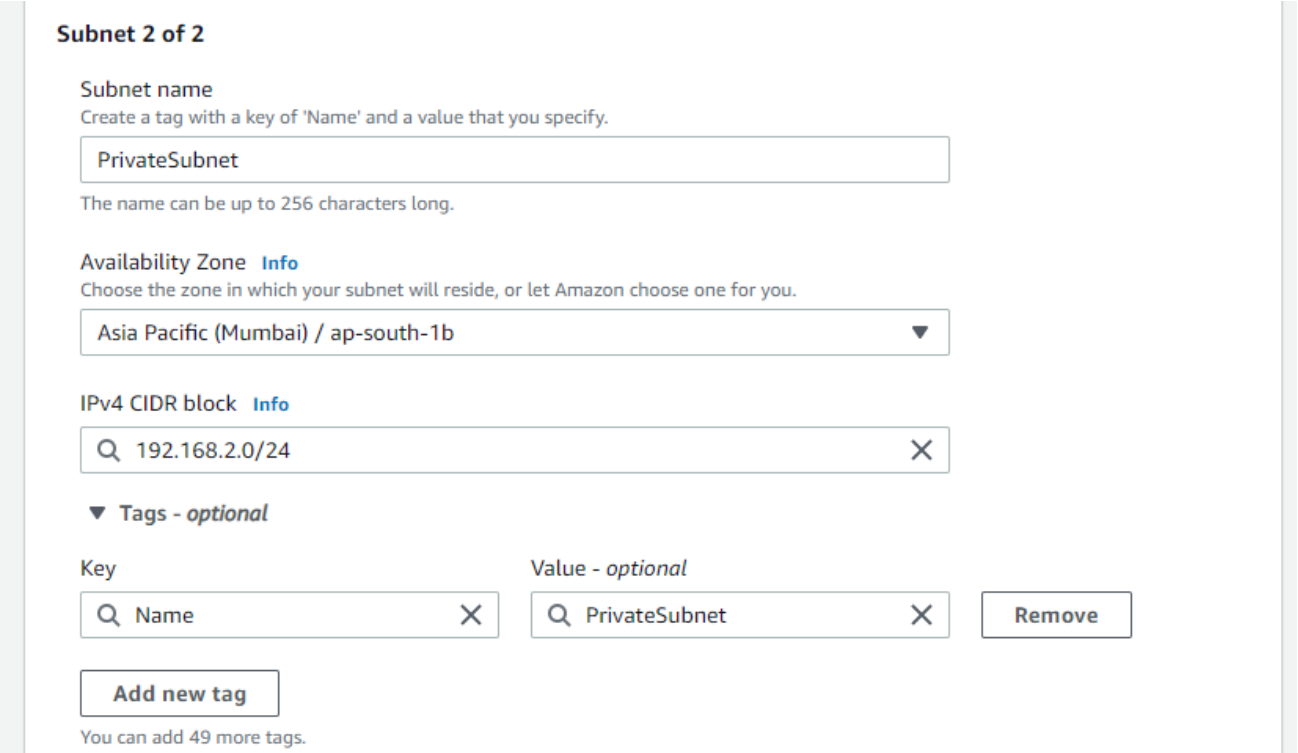
- Navigating to Subnets option and selecting **"Creating Subnet"**and giving name as **"Public Subnet"** where I want to deploy my Internet Facing instances.
- Creating this Subnet under Custom VPC, Select that option and select the **ap-south-1a** Availability Zone , Given a CIDR block as 192.168.1.0/24 (all instances launched under ap-south-1a will get the same range Private IP addresses and we'll get 251 usable IP addresses) and click on Create. Remember again, one subnet is equal to one AZ.



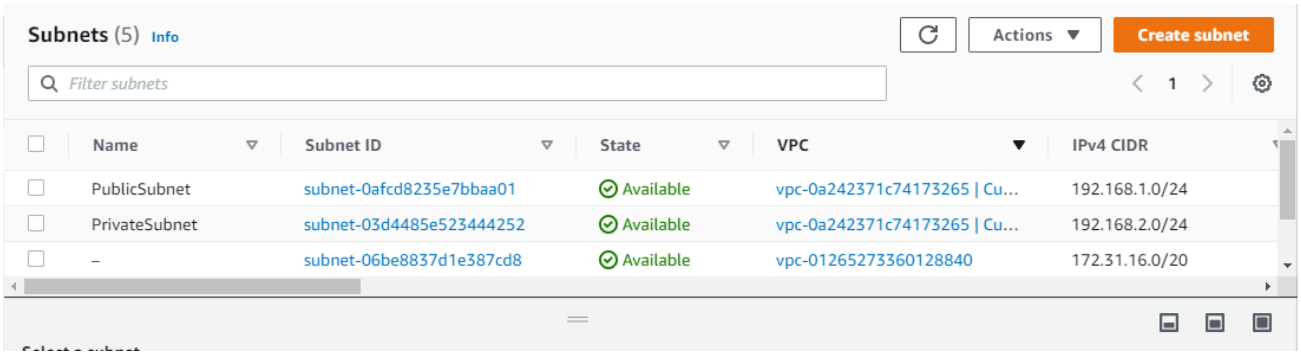


- Now creating another subnet by clicking **"Add new subnet"** and naming it as **"Private Subnet"** and want to deploy the instance which doesn't required internet faced.

- Creating this subnet under Custom VPC, and named as "Private Subnet" then provided CIDR as 192.168.2.0/24 and selecting Avaiablility Zone as **ap-south-1b**and click on Create option.

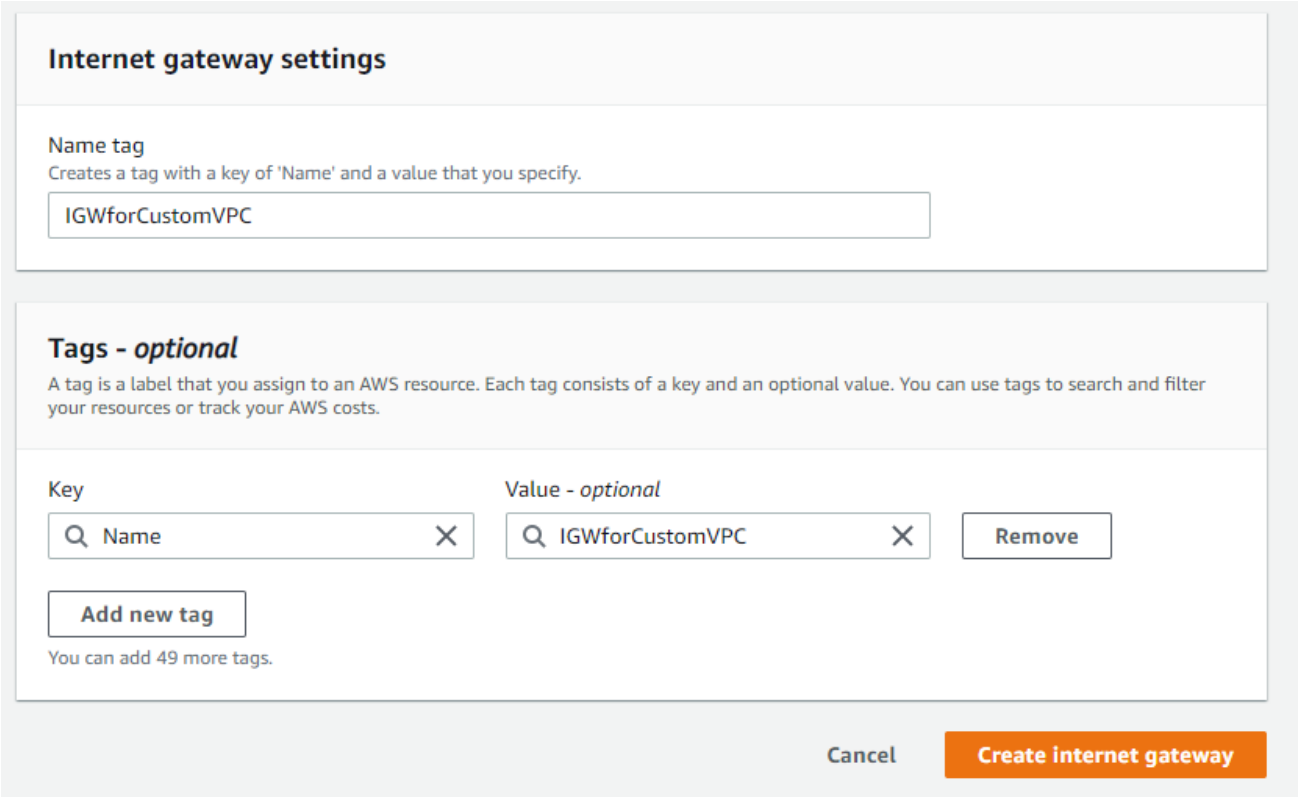


- This is how exactly subnet dashboard looks like now.

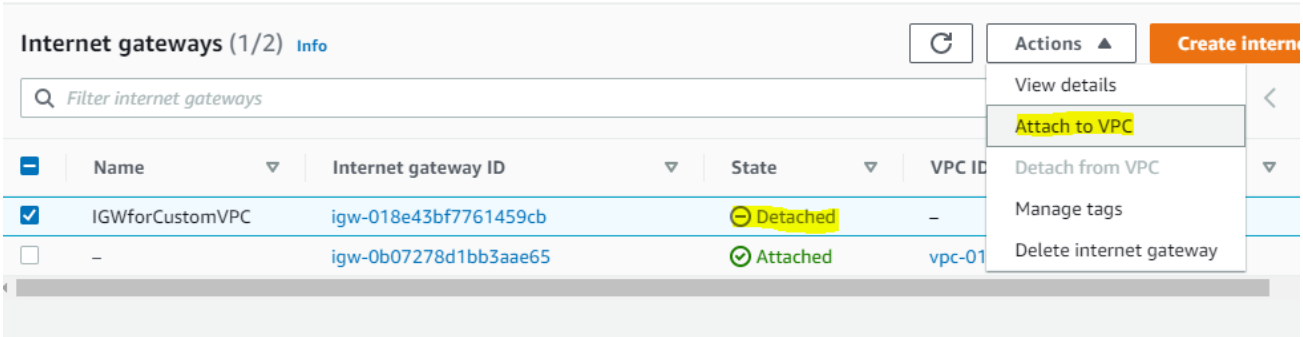


STEP 3: Creating an Internet gateway and Associating with Custom VPC.

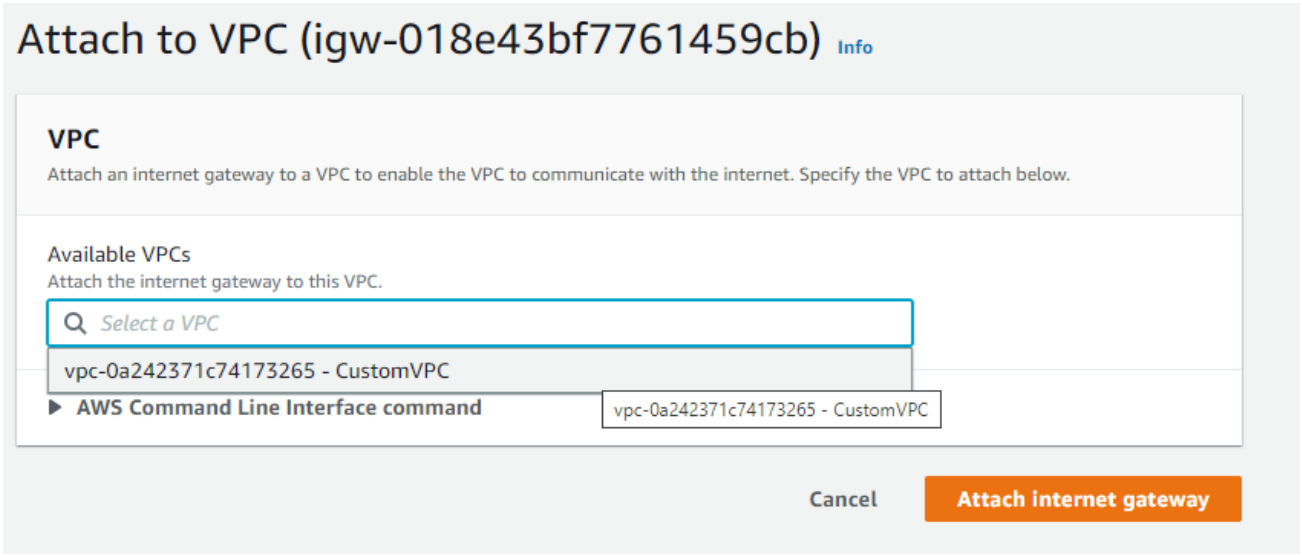
- Navigate to internet Gateways from Navigation pane and Select **"Create Internet gateway"** option and provide a name for Internet Gateway.

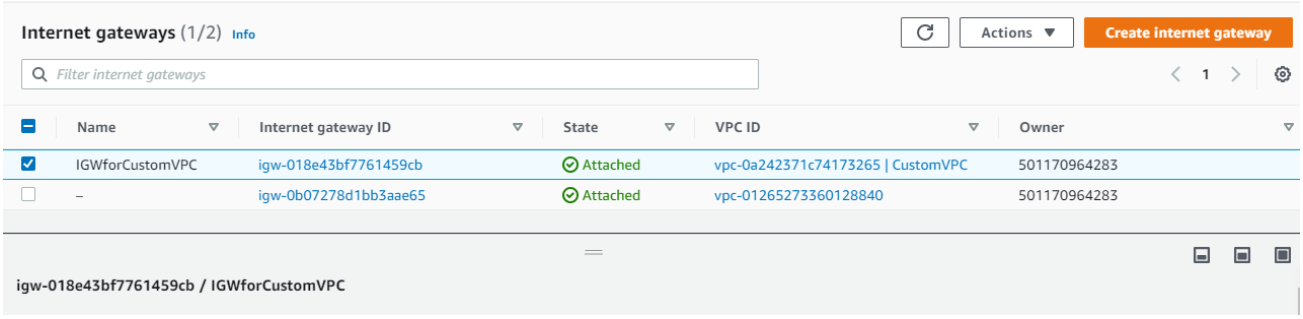


- Internet Gateway is now in **"Detached"** mode, Select the VPC and navigate to **"Actions"** and click on "**Attach to VPC**" option and select the Custom VPC and click on **"Yes, Attach"** option.



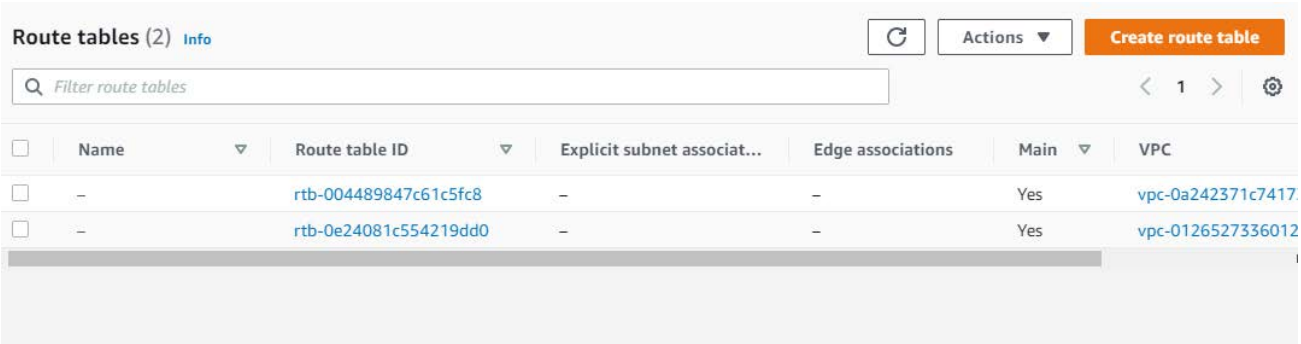
- This is how the IGW dashboard looks like after attaching it to custom VPC. Remember: One Internet gateway can be attached with only one VPC.

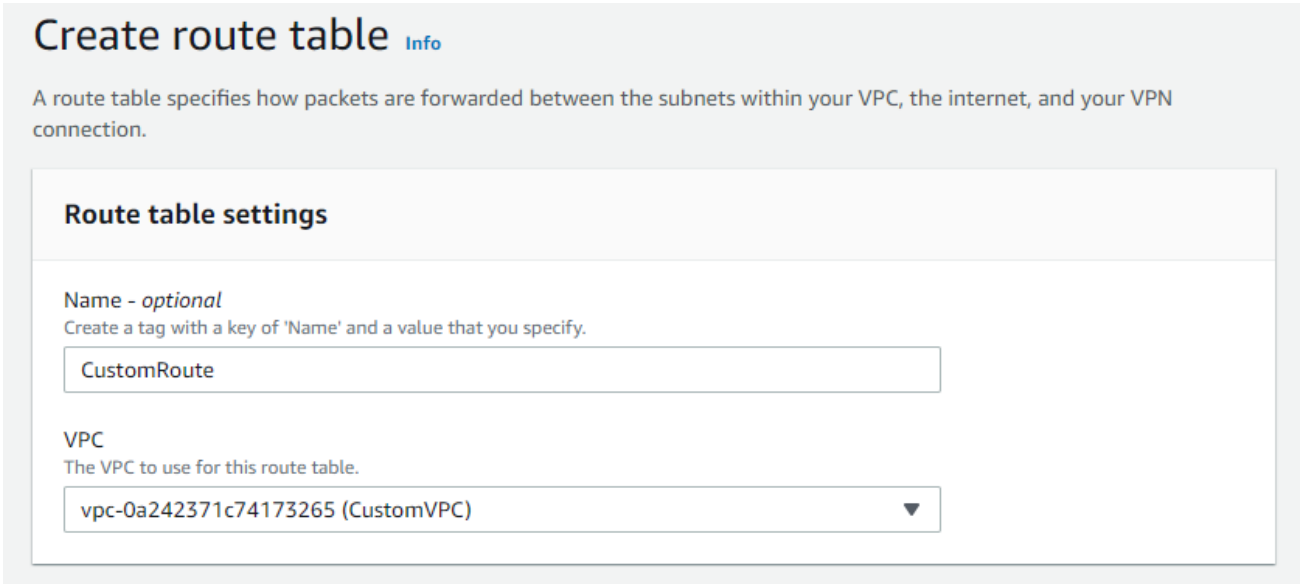




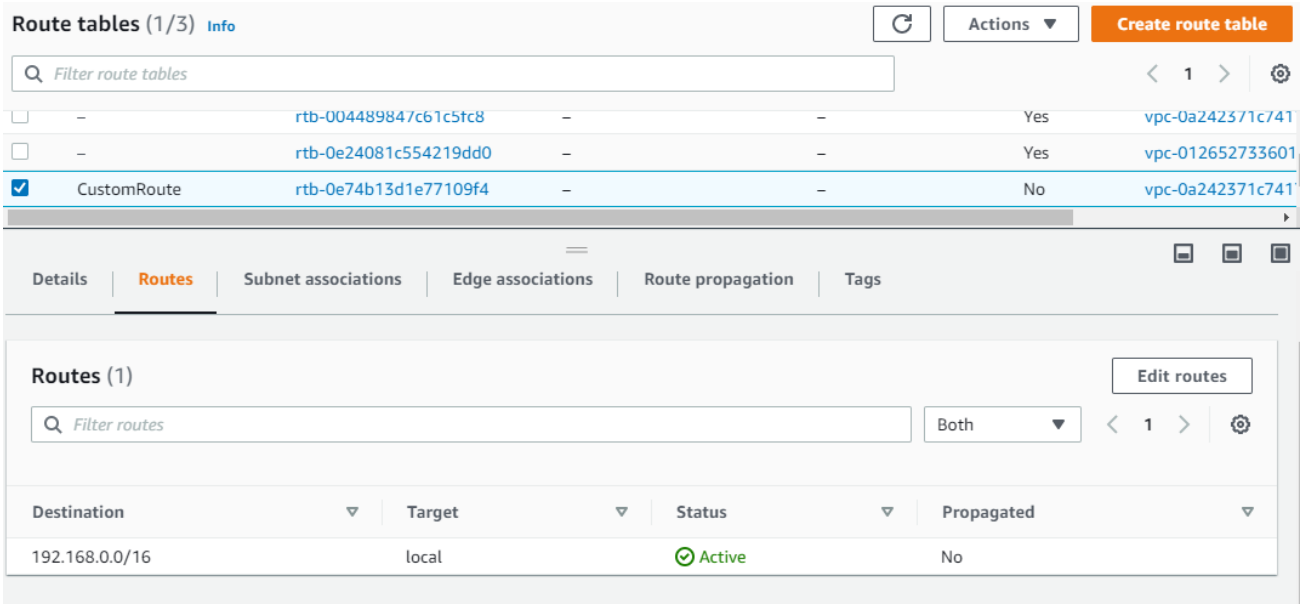
STEP 4: Creating Route Table and Performing Subnet association.

- Till now we have created a Custom VPC, Private and Public subnets, Created internet gateway and associated that to our custom VPC. Now we need to allow the traffic to our newly created subnets through the internet gateway, for that we are going to create a Route Table.
- Select **"Create Route Table"** option and give a name tag and select the Custom VPC and click on **"Yes, Create"** option.

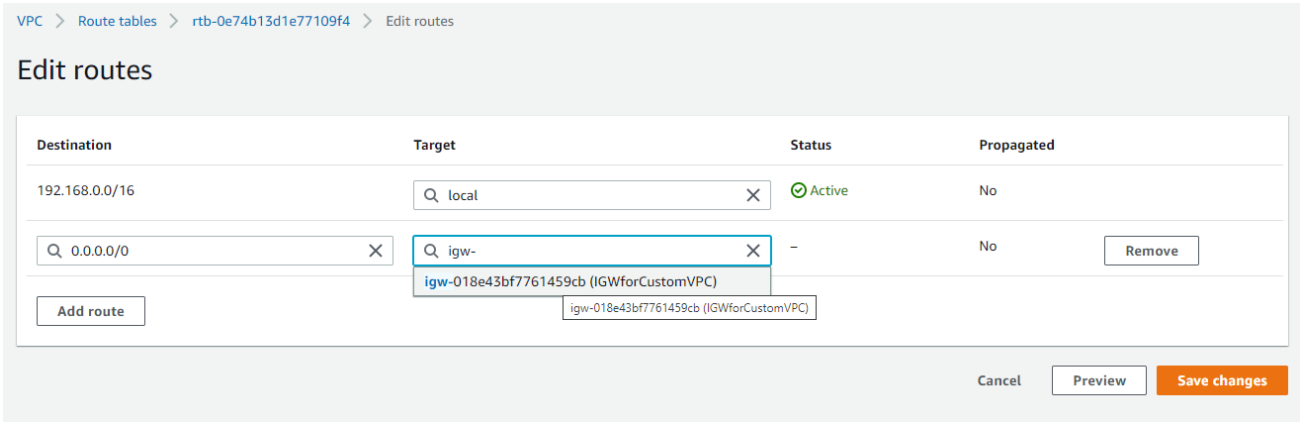




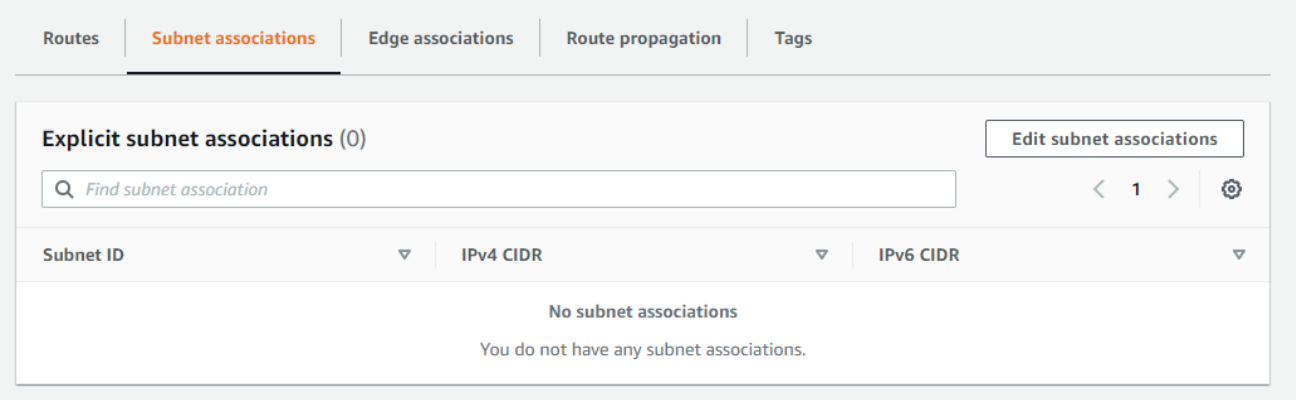
- Newly created route is not enabled with any of the public routes through IGW, Select the newly created route table to choose Route option to verify this.

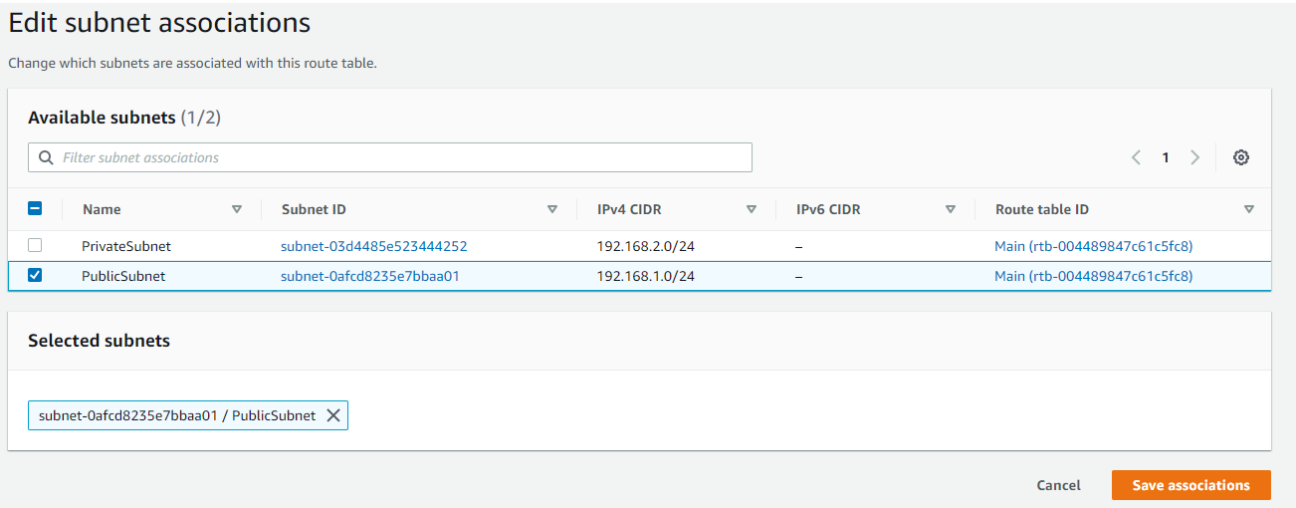


- Now we have to add a route by selecting edit option and select "**Add Route"** option and enter **0.0.0.0/0** and when you click on Target automatically internet gateway will populate, choose **the populated IGW** and click on **save changes**.



- Then select the **"Subnet Association"**ad click on **"Edit"** option and select the **"Public Subnet"** and click on save.

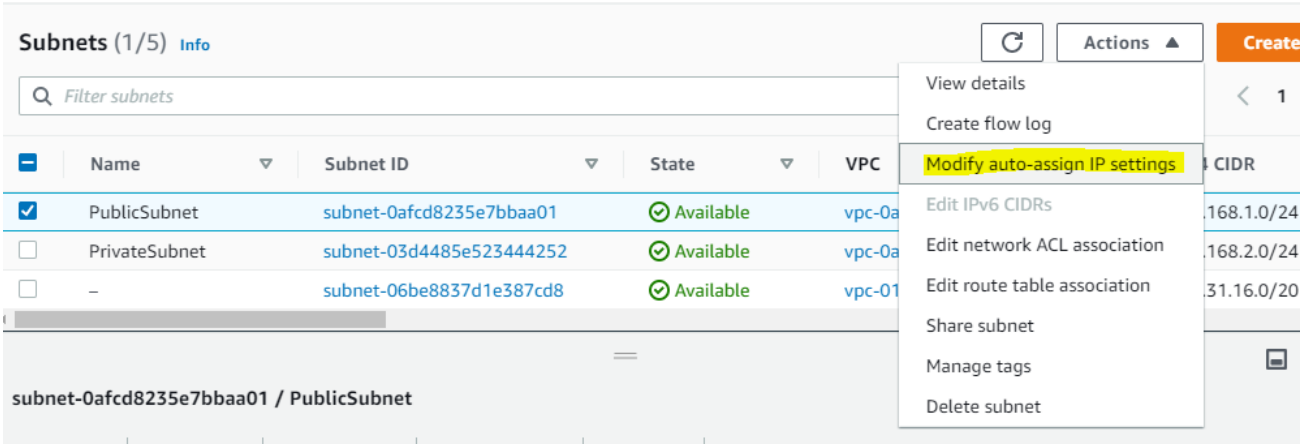


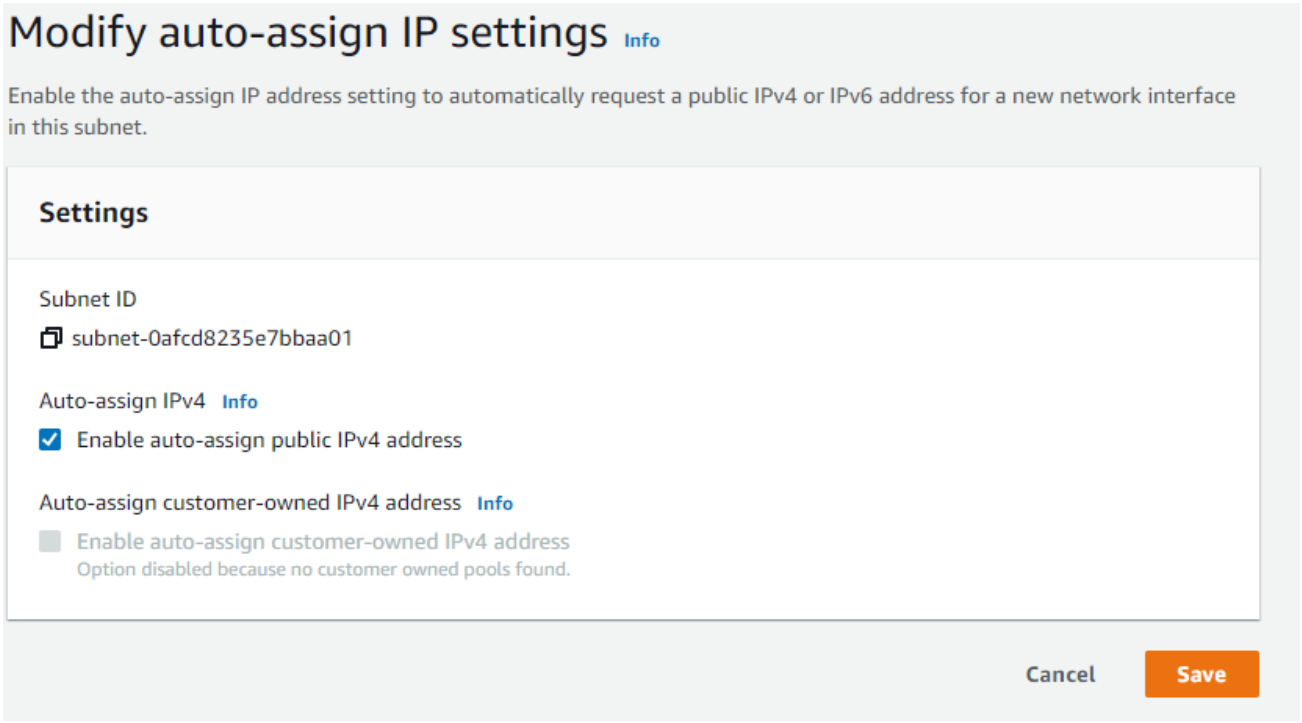


That's it our custom VPC is ready to deploy the resources. But we have one additional option.

STEP 5: Enabling Auto-assign IP Settings for Public Subnet (Optional Step).

You can enable auto assign public IP address option for Public Subnet instances, by editing the subnet settings. Navigate to Subnets dashboard and select the **"Public Subnet"** and choose the **"Actions"** and choose "**Modify auto-assign IP settings"**, select the checkbox and click on save.

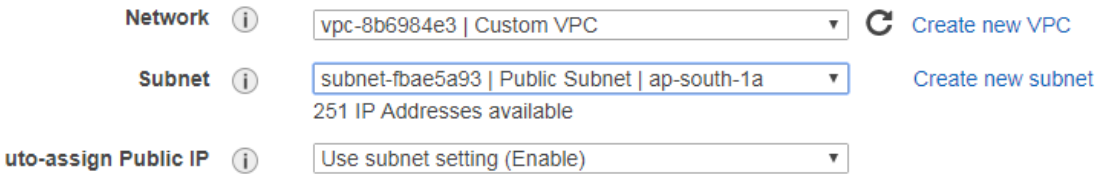




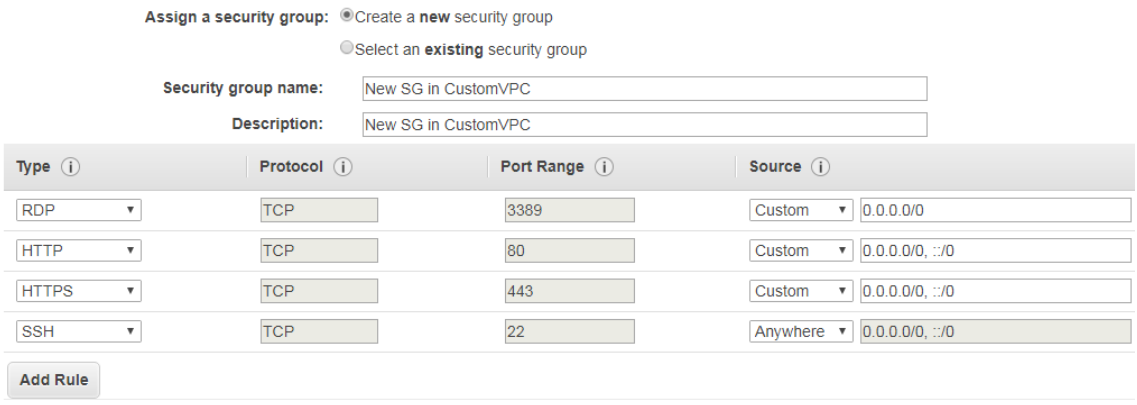
- Now we will get public IP address for every instance when we are launching it under public subnet, we no need to select the option in instance launch wizard.

Now Launch Instances in newly created custom VPC and verify.

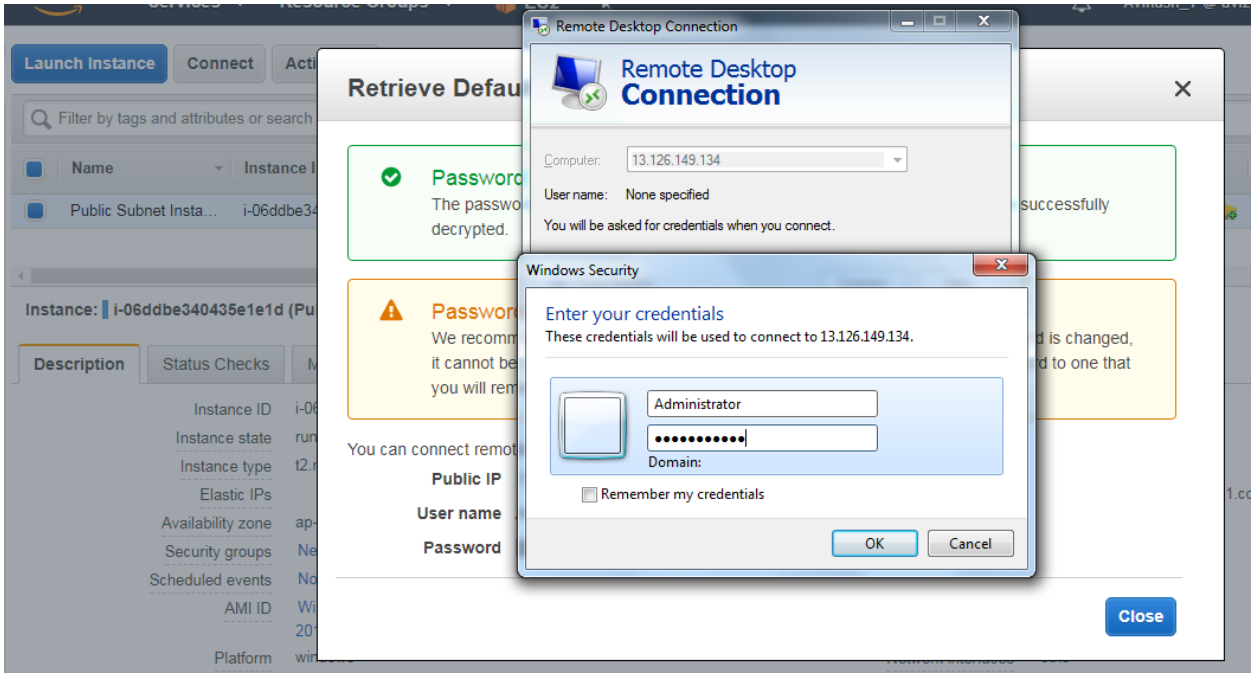
1. Launching an Instance in Custom VPC and selected to launch under "Public Subnet".



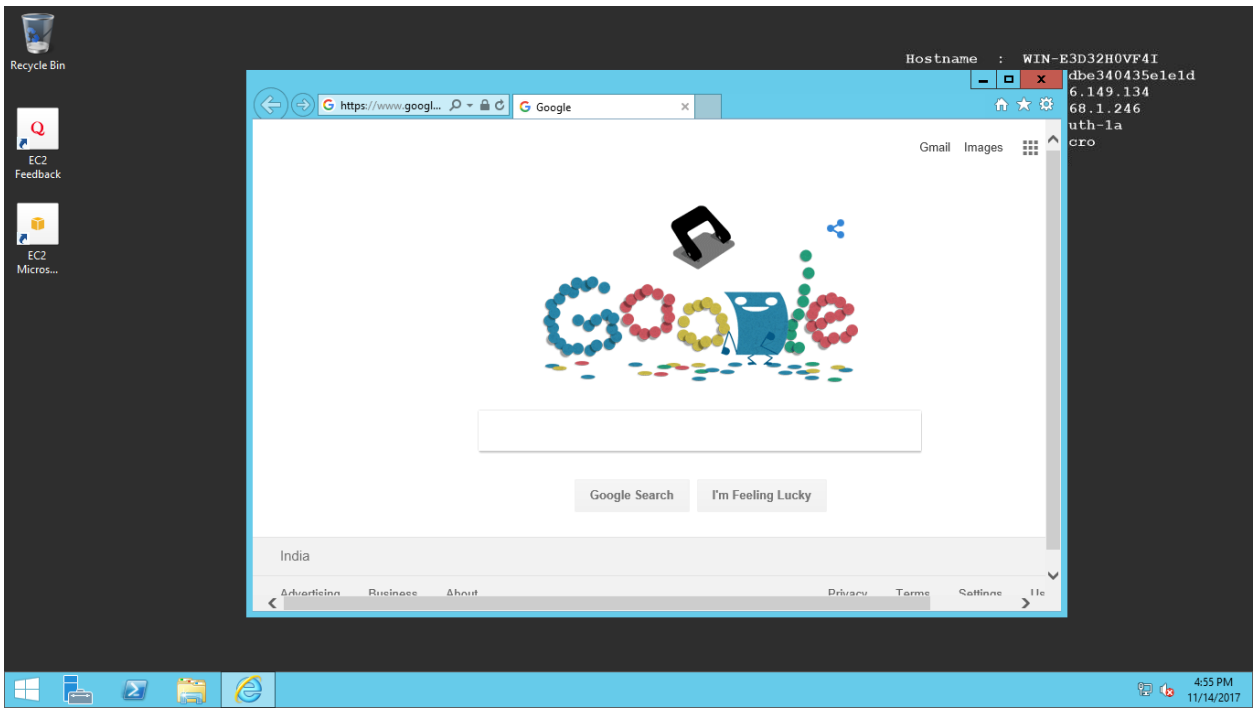
2. As this is a first instance launching under Custom VPC, we have to create new security group and need to open required ports and protocols.



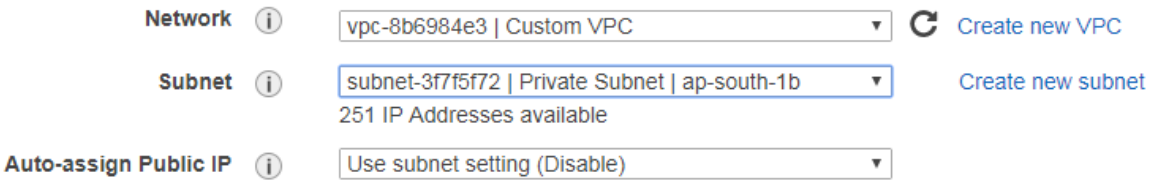
3. Now try to connect to the instance over the internet and verify the status as this is launched in Public Subnet, you can connect without any issues and you can browse the internet also in Instance.



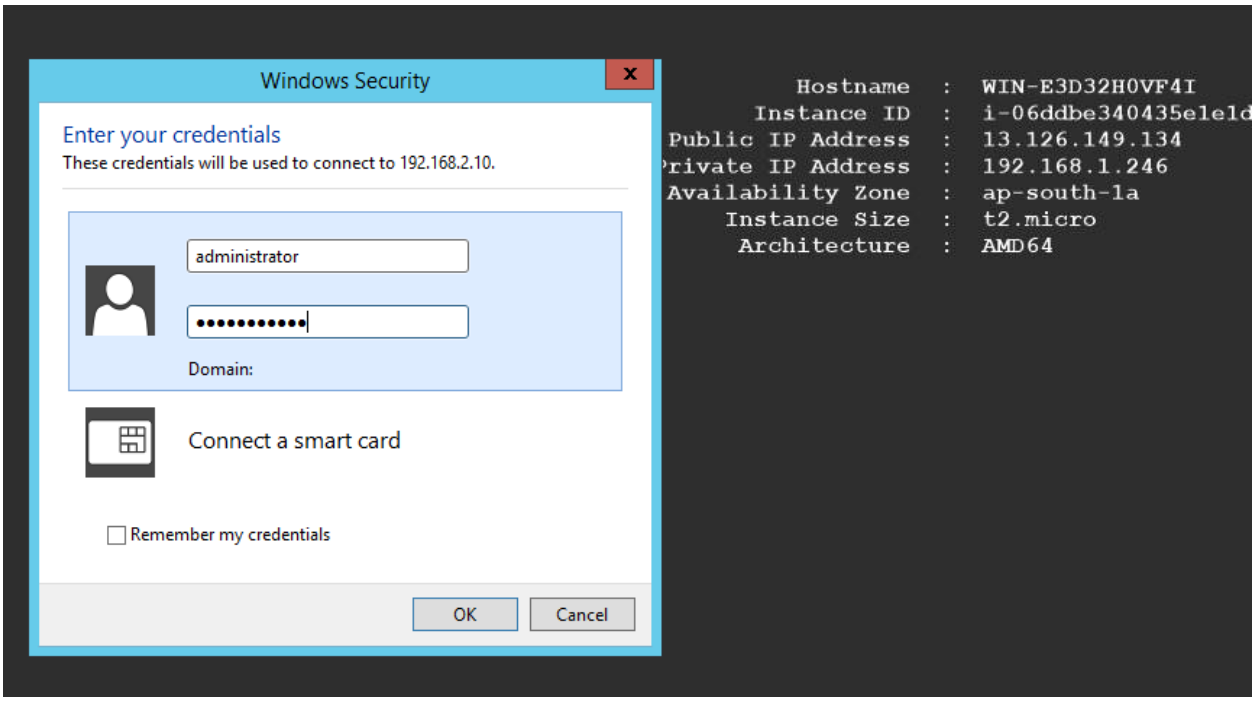
And we have successfully connected to the Instance, That means this instance is internet-faced and we can access anywhere from the world.

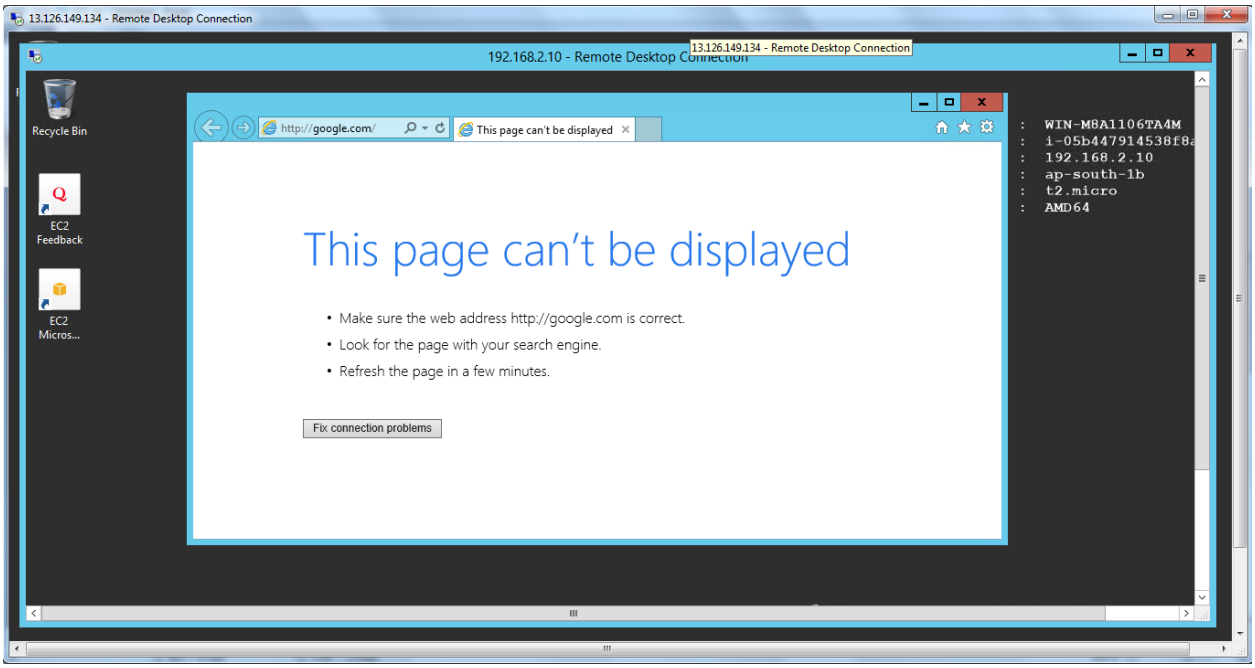


4. Now Launching another Instance in **"Custom VPC"** and selected to launch under **"Private Subnet"**.



5. And try to connect to the Private Subnet launched instance. When you browse for Username and password for instance connectivity, you'll get a Private IP address and we cannot use this to connect to the Launched instance.
    a. But we can connect to the same instance from the Public Subnets launched Instance.
    b. Remember as this is a private subnet instance, we will not get Internet in the Private Subnet instances.

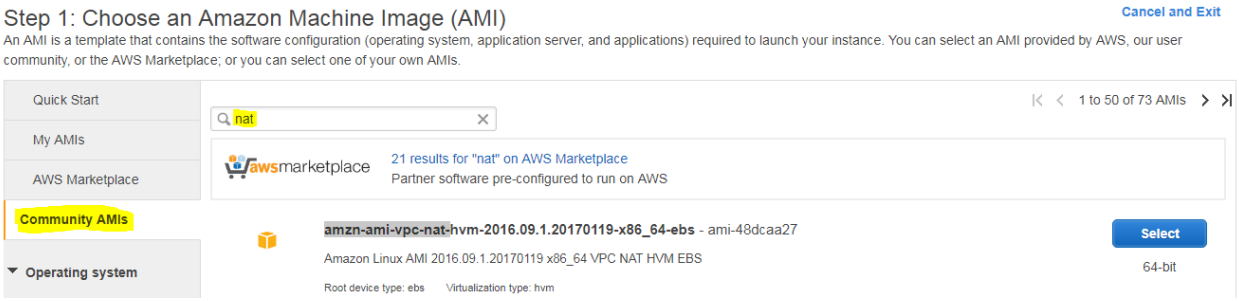




We have successfully connected to the Private Subnet instance from public Subnet instance, But We are not able to get internet connectivity in private subnet instance. TO get Internet in private Hosted instances we need to **launch a NAT Instance or NAT gateway.**

Launching NAT Instance:

- To launch NAT instance go to EC2 Dashboard and initiate an instance launch and Select **"Community AMI"** and Search for **"NAT"**as shown in below image and choose any of the instance.



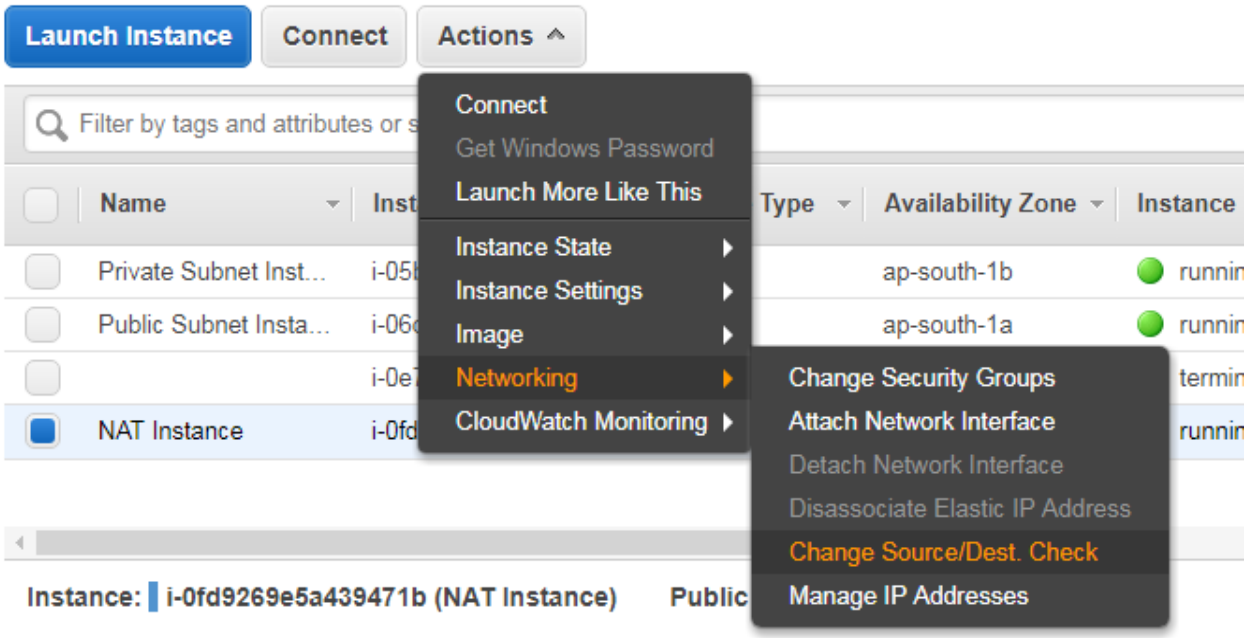
- Select one of the instances from the listed instances, and choose NAT instance with t2.micro and follow the instance launch wizard same as a regular instance.
  Note: The amount of traffic that NAT instances supports, depends on the instance size. If you are bottlenecking, increase the instance configuration.

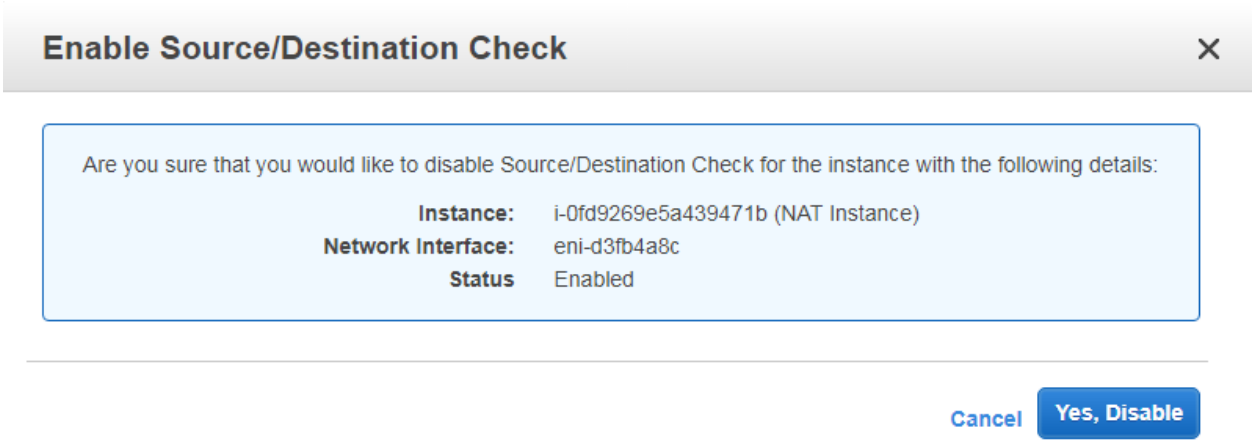
  Note: Make sure your NAT instance security group is opened with Http and Https.

  Note: NAT Instance must be launched in **Custom VPC's Public Subnet.**

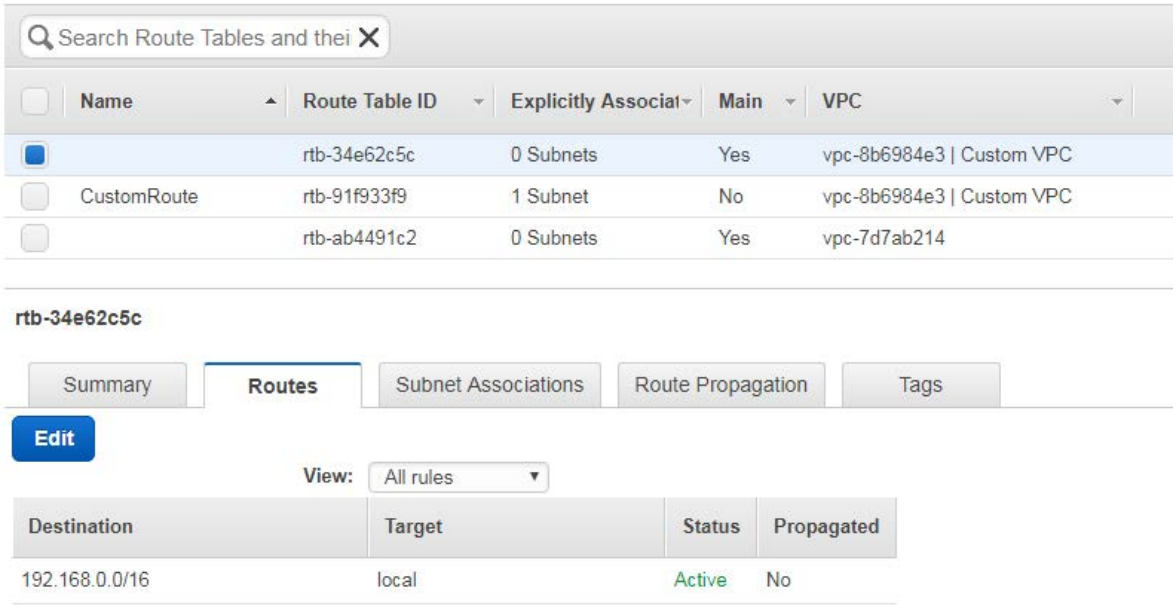
- We need to disable Source/Destination check for NAT instance.
  Each EC2 instance performs source/destination checks by default. This means that the instance must be the source or destination of any traffic it sends or receives. However, a NAT instance must be able to send and receive traffic when the source or destination is not itself. Therefore, you must disable source/destination checks on the NAT instance.

- To disable source/destination check, Select the NAT Instance, Goto Actions, Networking and choose **"Change Source/Destination Check"**and select **"Yes, Disable".**

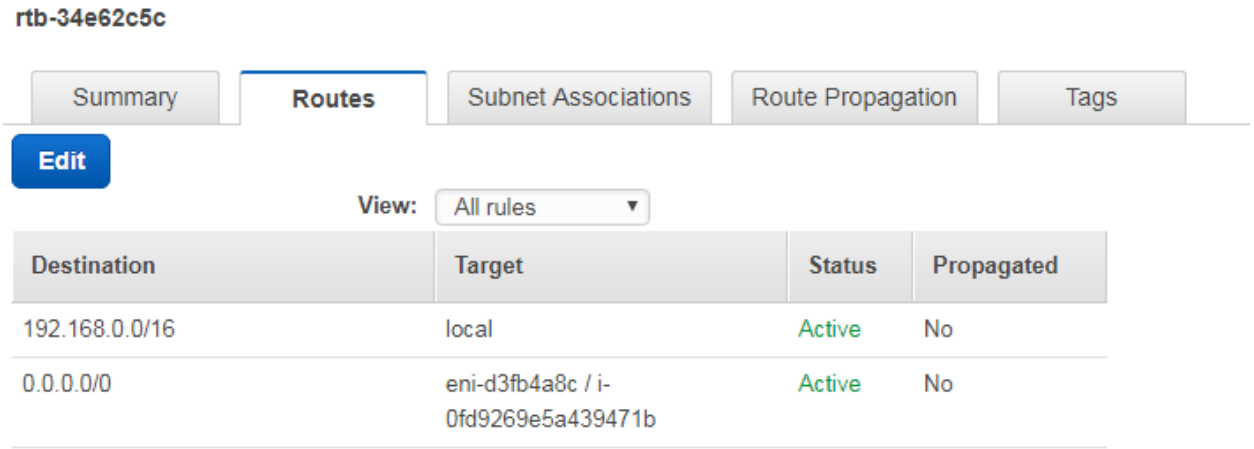




- Now we have to edit **"Custom VPCs Main Route table"** and need to add a route through the NAT Instance, then the private subnet instances will get the internet connectivity.



- Select the Edit option and enter the Destination as **0.0.0.0/0**and select the target as **NAT Instance**.



- Now we will get the internet for our Private subnet instances through the NAT instances. And here is the output.

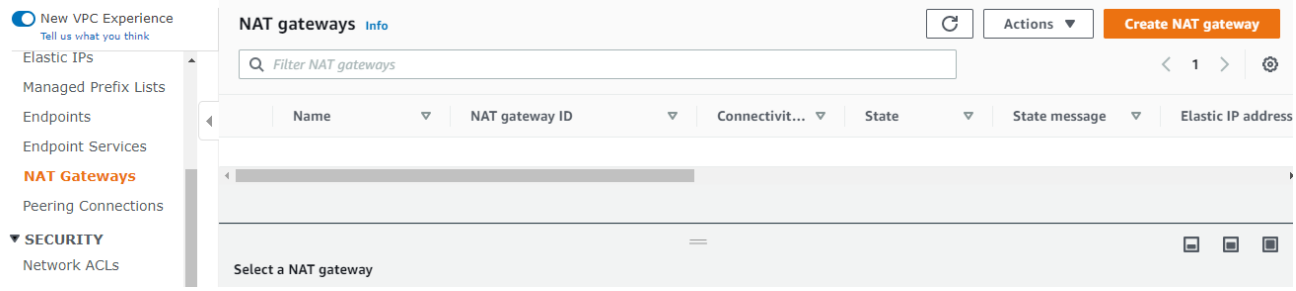
NAT GATEWAYS: Instead of NAT Instances, we can use NAT Gateways. We have lot of advantages with NAT gateways compare to NAT instances. Make sure you terminate the NAT Instance before performing the NAT Gateways, we don't required two resources to provide internet to Private subnet.

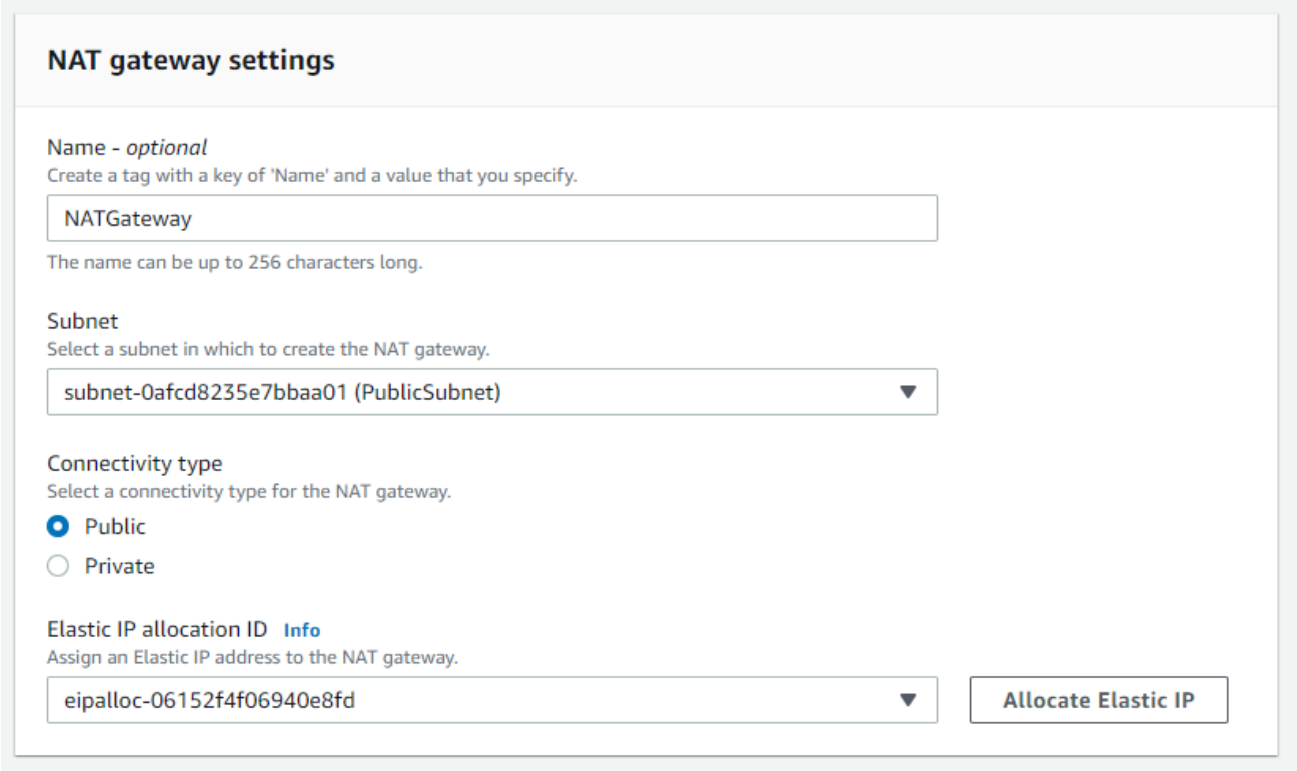
Here is some advantages listed:

- Preferred for the enterprise/Production level
- Scale automatically up to 10 Gbps
- Not associated with security groups
- Automatically assigned a public ip address (EIP)
- You have to update route tables to take effect.
- No O.S so No need to patch
- No Instance so No need to disable Source/Destination Checks

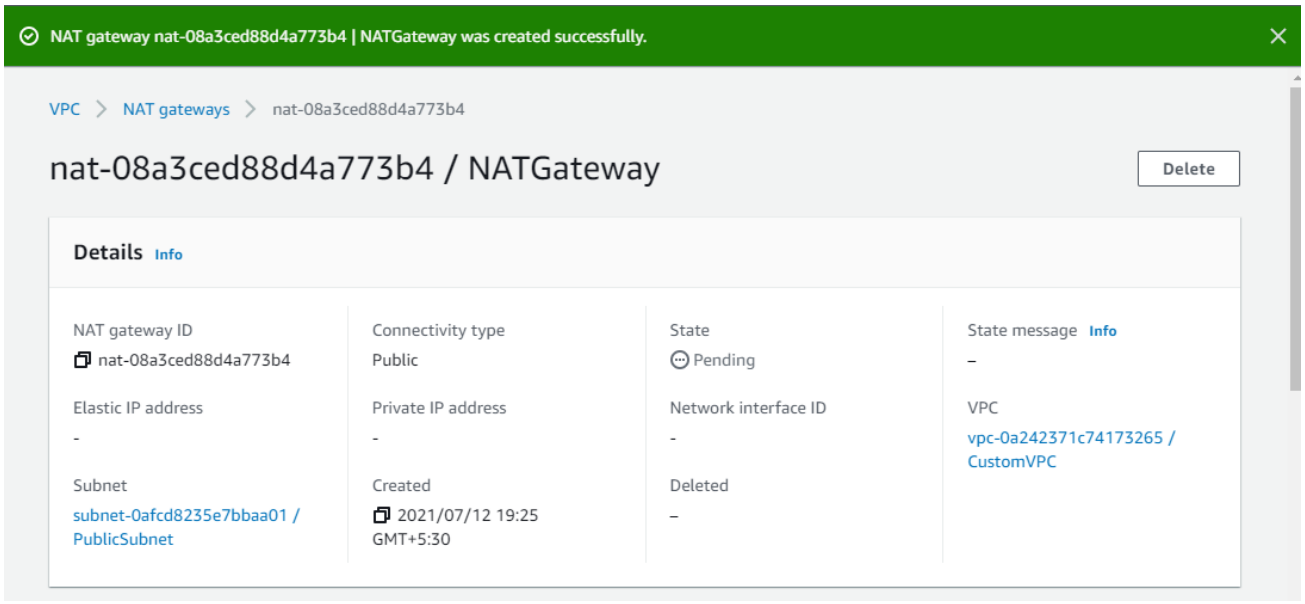
Steps to create NAT gateways:

- Select NAT Gateways option from VPC Navigation Pane. And click on **"Create NAT Gateway"** option.
- As same as NAT instance, we have to create the NAT Gateway also in **Public Subnet of CustomVPC**.
- If you have any Elastic IP without associating to any of the resource, we can use the same here, if you don't have select the **Create New EIP** option and click on **Create a NAT Gateway**.

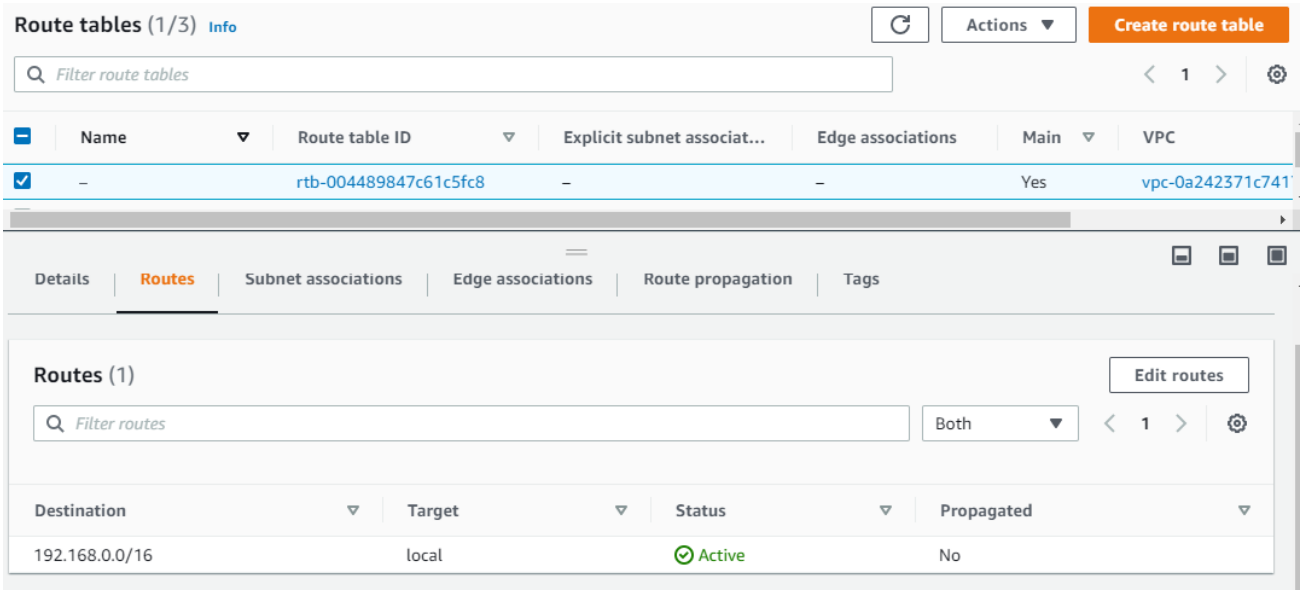


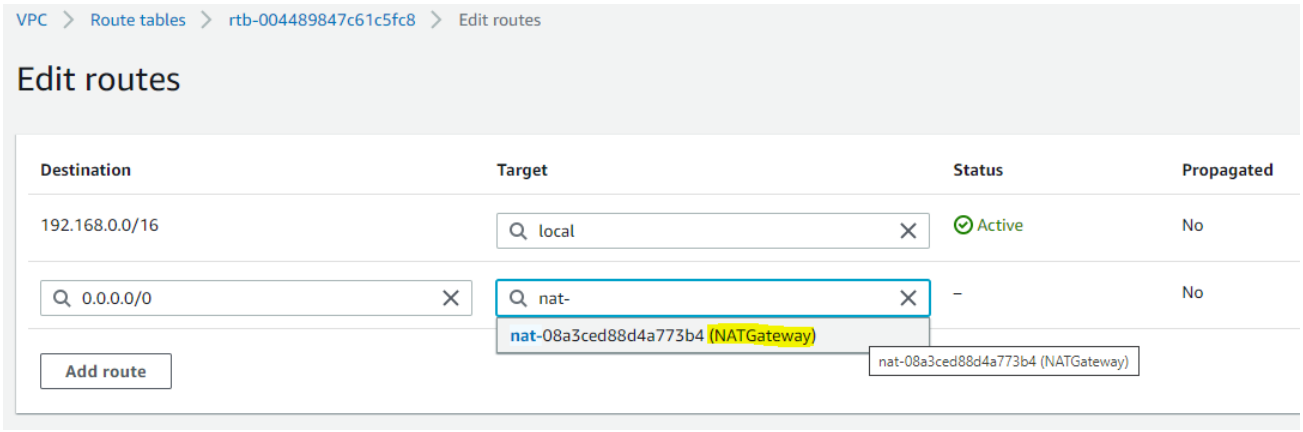


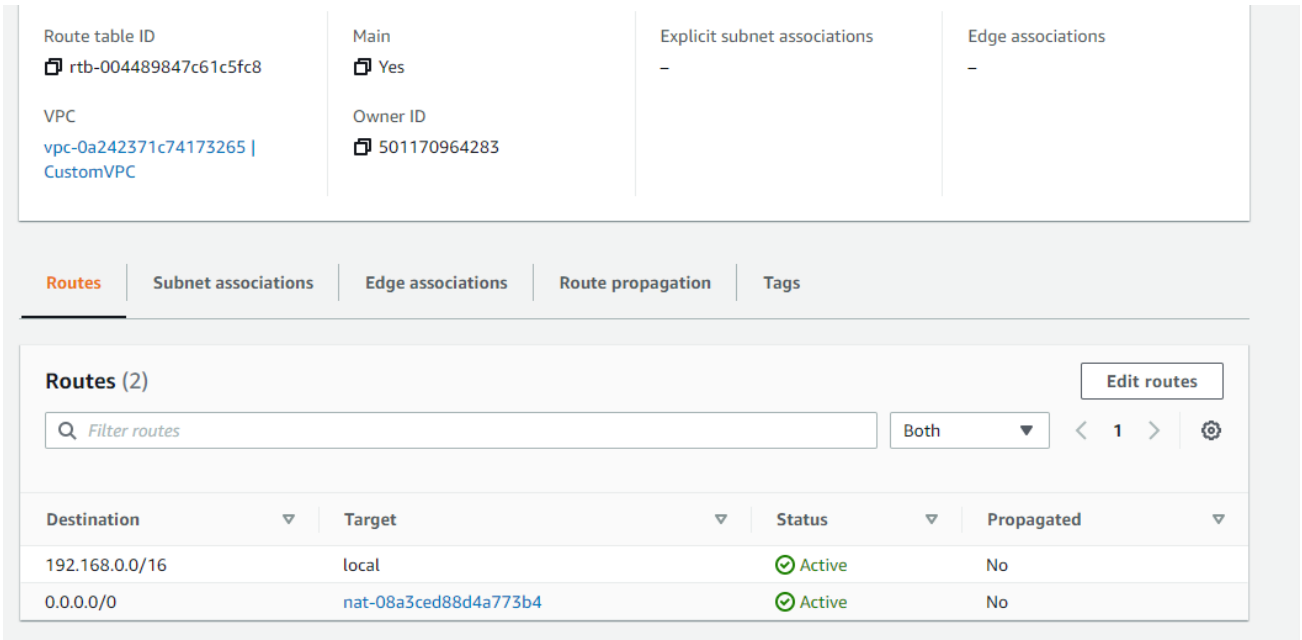
- Here is the NAT Gateway information after creation.



- And we have to edit the Route table as same as NAT instance process. Select the Custom VPCs Main Route table and open the Destination **0.0.0.0/0** and target as **NAT Gateway.**







- Now go to private subnet instance and verify the internet connectivity. You will able to browse the internet and try to look for the public Ip information from the private subnet

instance you'll get the NAT gateway's IP Address, That means we are getting internet through NAT Gateway to the Private subnet instance.

Network Access Control Lists (ACLs)

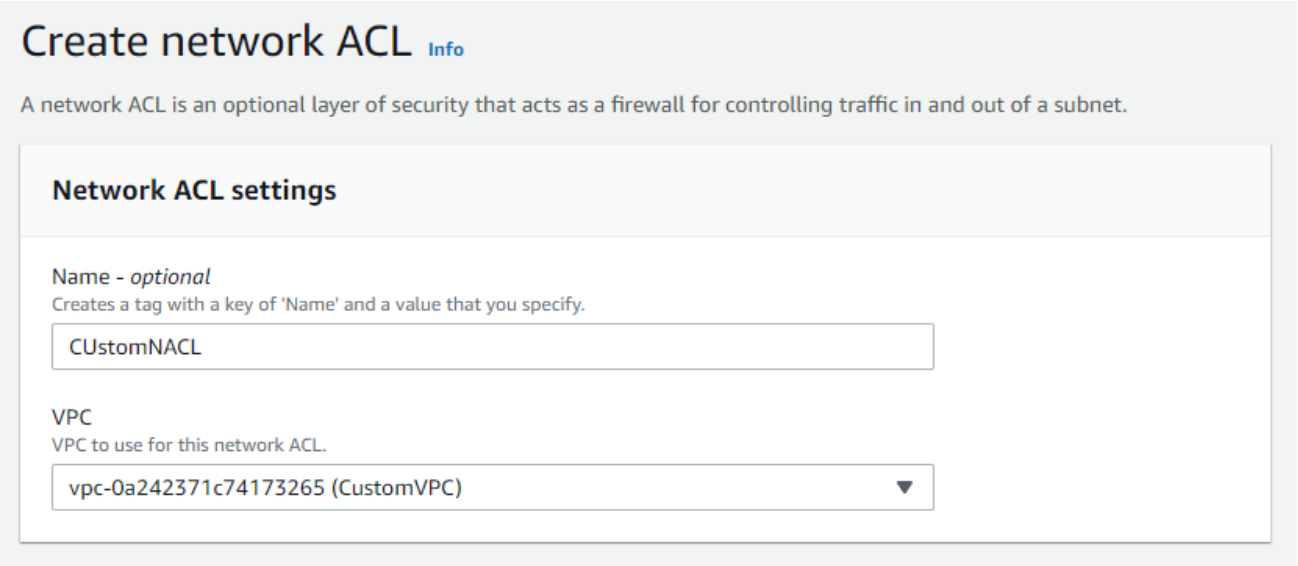
A network access control list (ACL) is another layer of security that acts as a stateless firewallon a subnet level. A network ACL is a numbered list of rules that AWS evaluates in order,starting with the lowest numbered rule, to determine whether traffic is allowed in or out ofany subnet associated with the network ACL.

Every subnet must be associated with a networkACL.

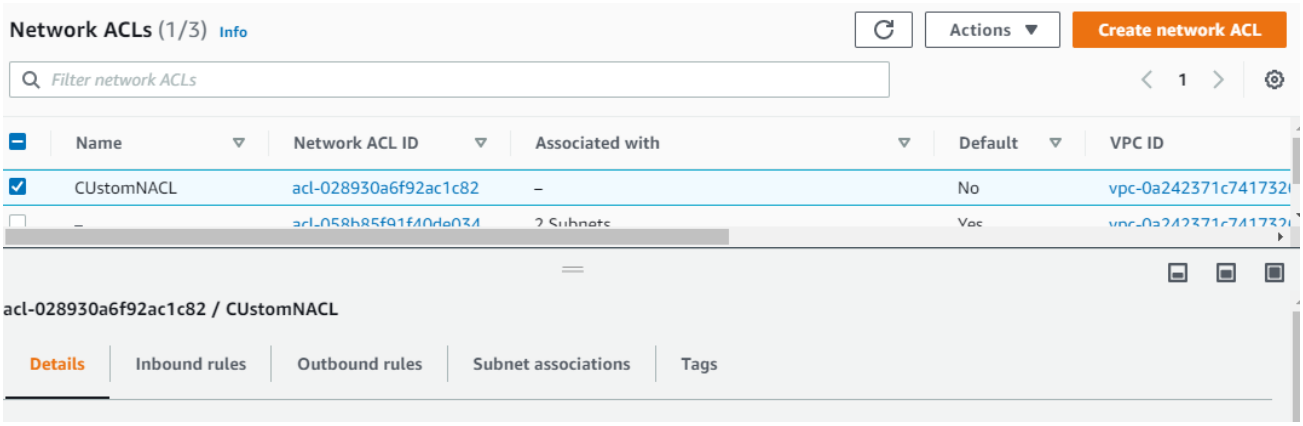
Security Groups Vs Network ACLs

Security Group	Network ACL
Operates at the instance level (first layer of defense)	Operates at the subnet level (second layer of defense)
Supports allow rules only	Supports allow rules and deny rules
Stateful: Return traffic is automatically allowed, regardless of any rules	Stateless: Return traffic must be explicitly allowed by rules.
AWS evaluates all rules before deciding whether to allow traffic	AWS processes rules in number order when deciding whether to allow traffic.
Applied selectively to individual instances	Automatically applied to all instances in the associated subnets; this is a backup layer of defense, so you don't have to rely on someone specifying the security group.

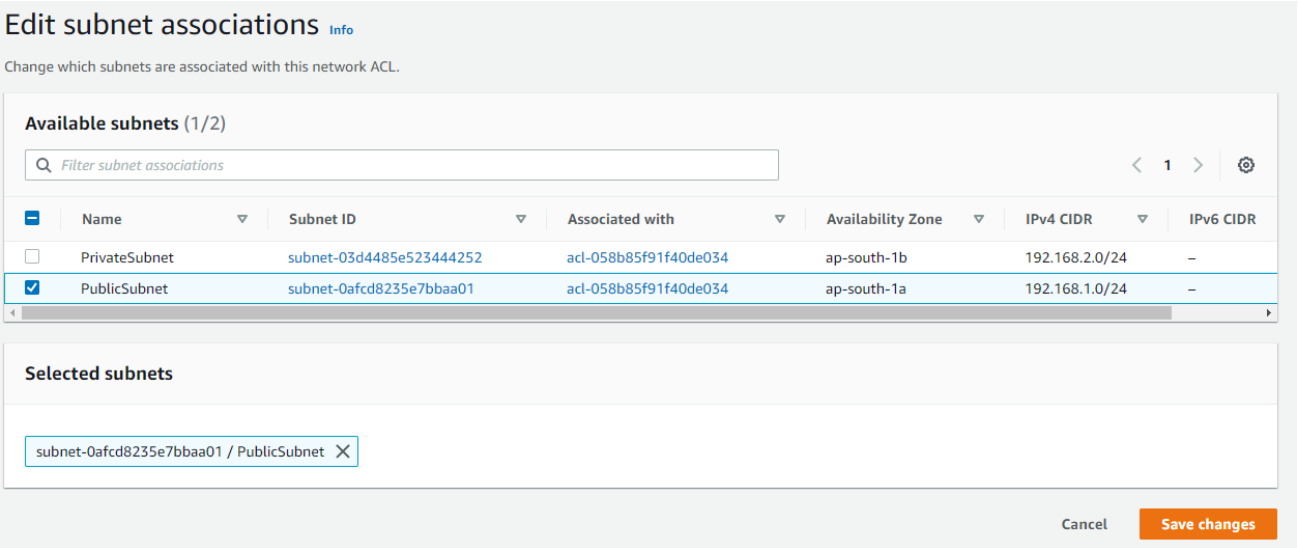
- Navigate to the "Network ACLs" under "Security" option and choose "Create Network ACL" option.
- Give a name for the newly creating Network ACL and Create this under Custom VPC.



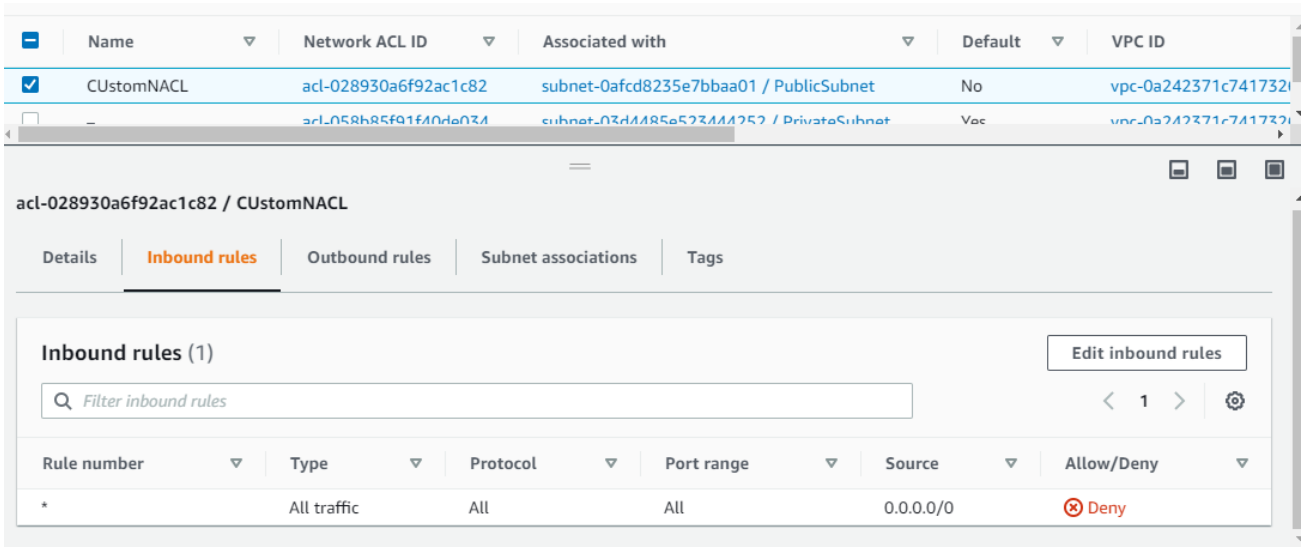
- Newly Created NACL will not have any Subnets Associated with it.



- To Associate a subnet Select the “Subnet Association” and choose the subnet you want to associate under the “Custom Network ACL”.



- By Default, all the Inbound and outbound traffic will be set to Deny mode.



- Here we have to Edit and add the required Protocol and Port Range and Source same as Security groups.

The following are the parts of a network ACL rule:

Rule number: Rules are evaluated starting with the lowest numbered rule. As soon as a rule matches traffic, it's applied regardless of any higher-numbered rule that may contradict it.

Protocol: You can specify any protocol that has a standard protocol number. For more information, see Protocol Numbers. If you specify ICMP as the protocol, you can specify any or all of the ICMP types and codes.

[Inbound rules only] The source of the traffic (CIDR range) and the destination (listening) port or port range.

[Outbound rules only] The destination for the traffic (CIDR range) and the destination port or port range.

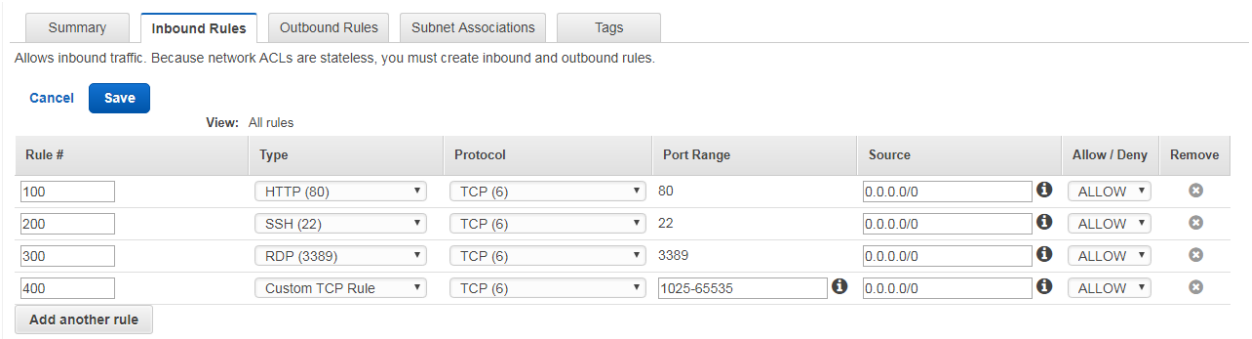
Choice of **ALLOW or DENY** for the specified traffic.

- And AWS will suggest to create the rules increments of 100.
- If you want to use this Network ACL with Elastic Load balancers, open the Ephemeral ports in inbound and outbound.
  Ephemerals port range varies depending on the client's operating system. Many Linux kernels use ports 32768-61000.

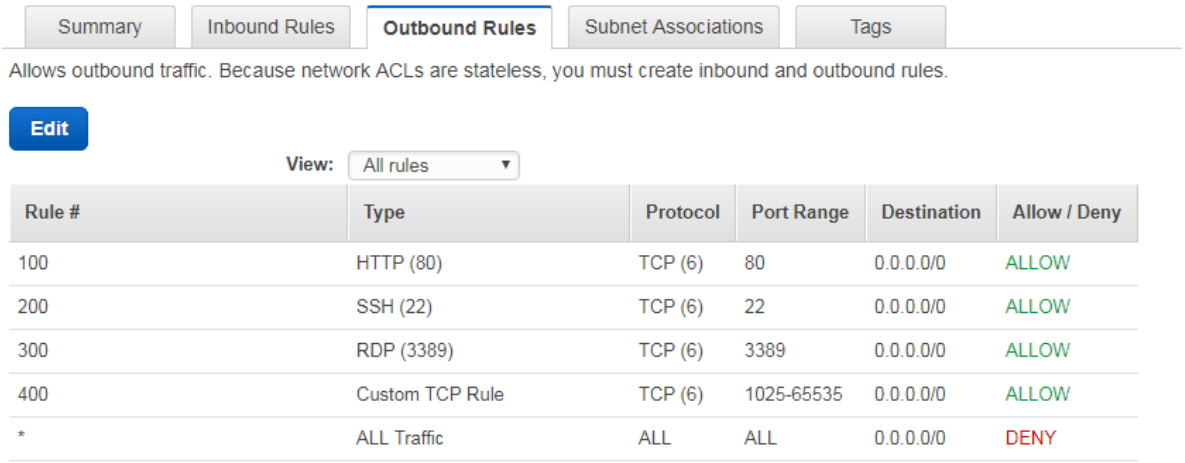
  Elastic Load Balancing use ports 1024-65535.

  Windows Server 2008 and later versions use ports 49152-65535.

  A NAT gateway uses ports 1024-65535.



- Perform the same for Outbound Rules also, as the Network ACLs are Stateless.



- We have Deny option also here with Network ACLs. We can create another rule for same Protocol and we can set it to Allow/Deny based on our requirement. **Lowest Rule will takes the Highest Priority.**

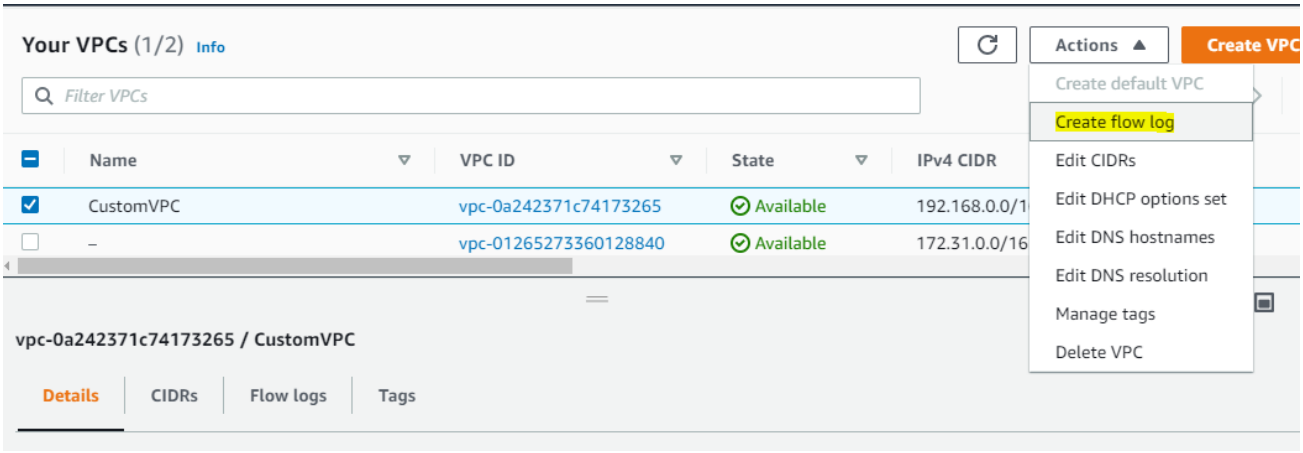
VPC Peering

- Allows you to connect one VPC with another via a direct network route using private IP addresses.
- Instances behave as if they were on the same private network
- You can peer VPC's with other AWS accounts as well as with other VPCs in the same account.
- Peering is in a star configuration, ie 1 central VPC peers with 4 others. NO TRANSITIVE PEERING!!!

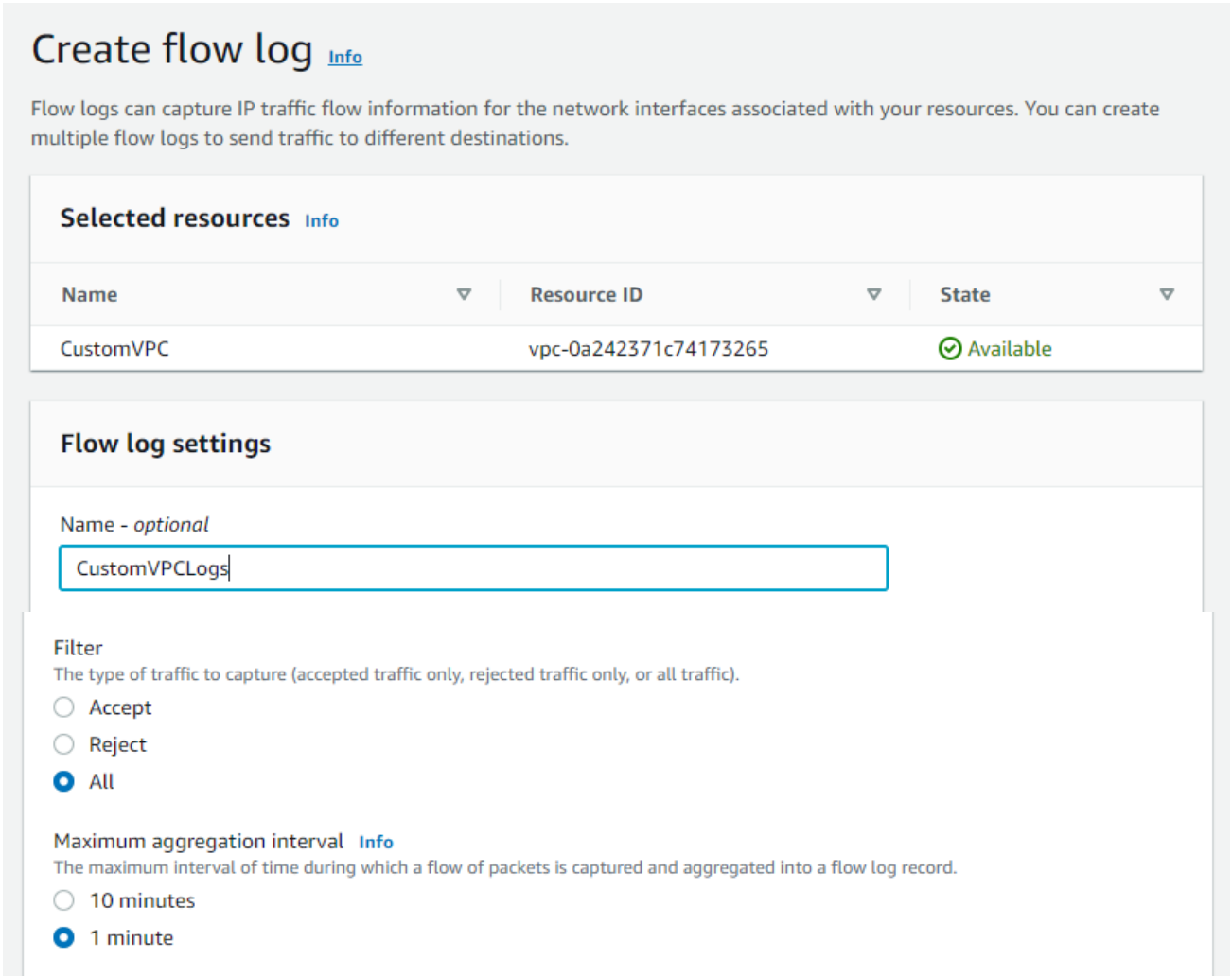
VPC Flow log Creation:

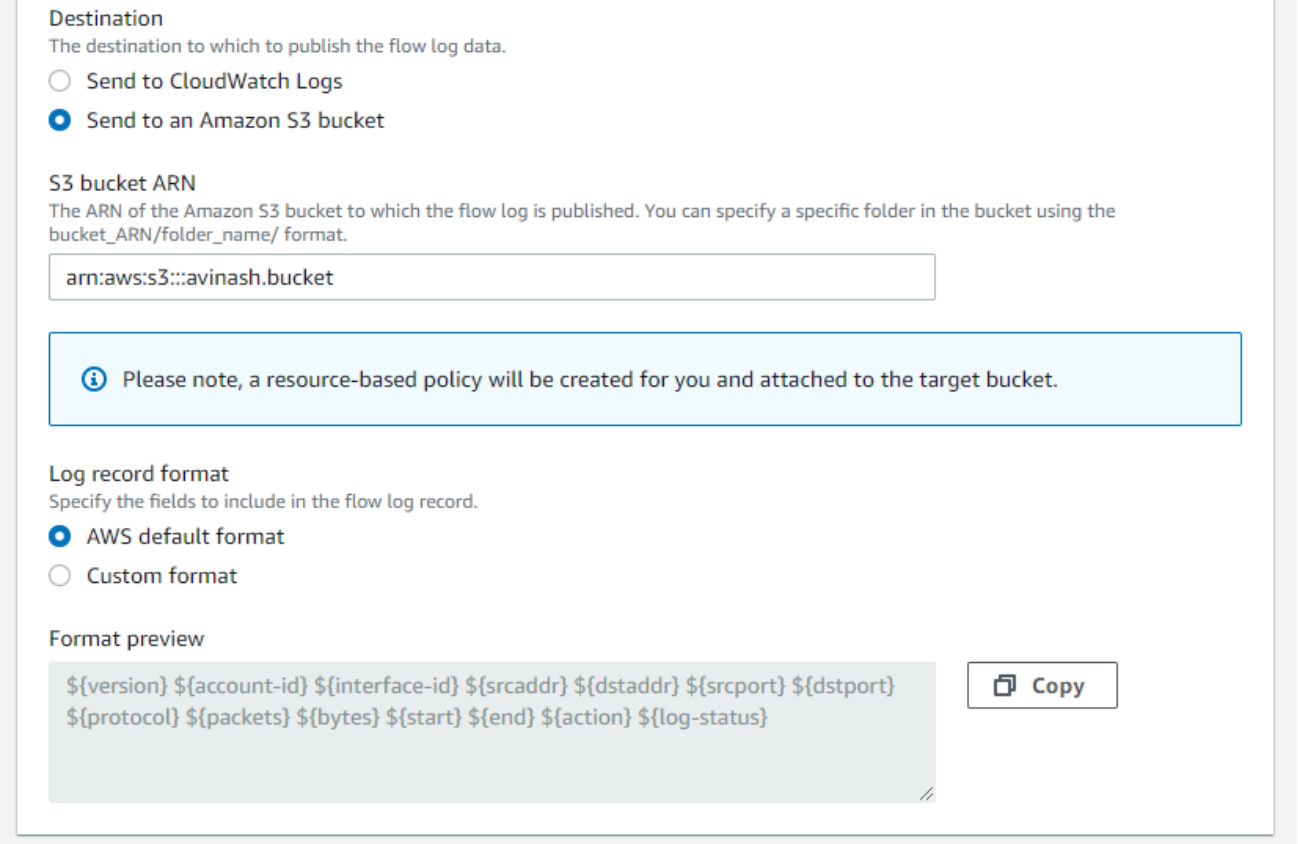
VPC Flow Logs is a feature that enables you to capture information about the IP traffic going to and from network interfaces in your VPC. Flow log data is stored using Amazon CloudWatch Logs. After you've created a flow log, you can view and retrieve its data in Amazon CloudWatch Logs.

1. To enable the VPC Flow Log, Select the VPC and navigate to Create Flow Log under Actions.



2. Before creating the Flow Log on VPc, We need to Create log Group in cloudwatch. Navigate to cloudwatch and select the Logs option and select the Create log group option.

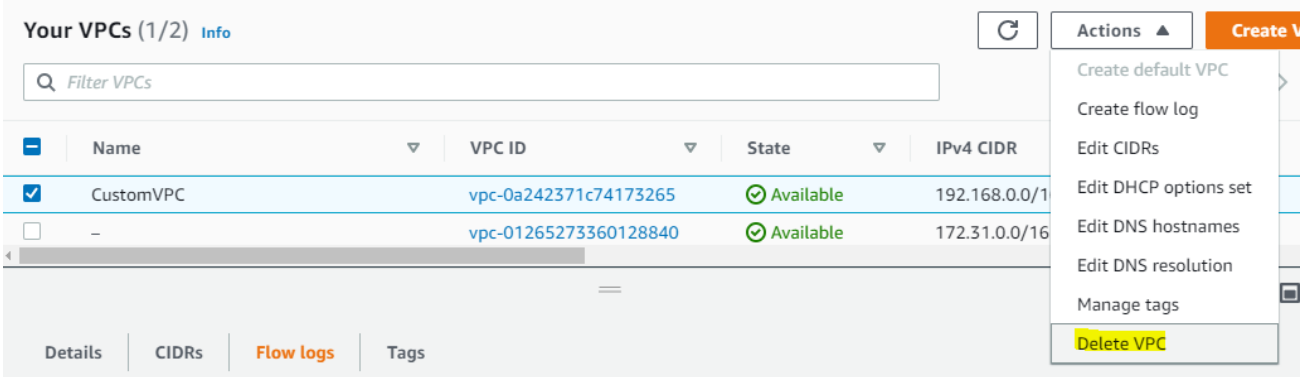


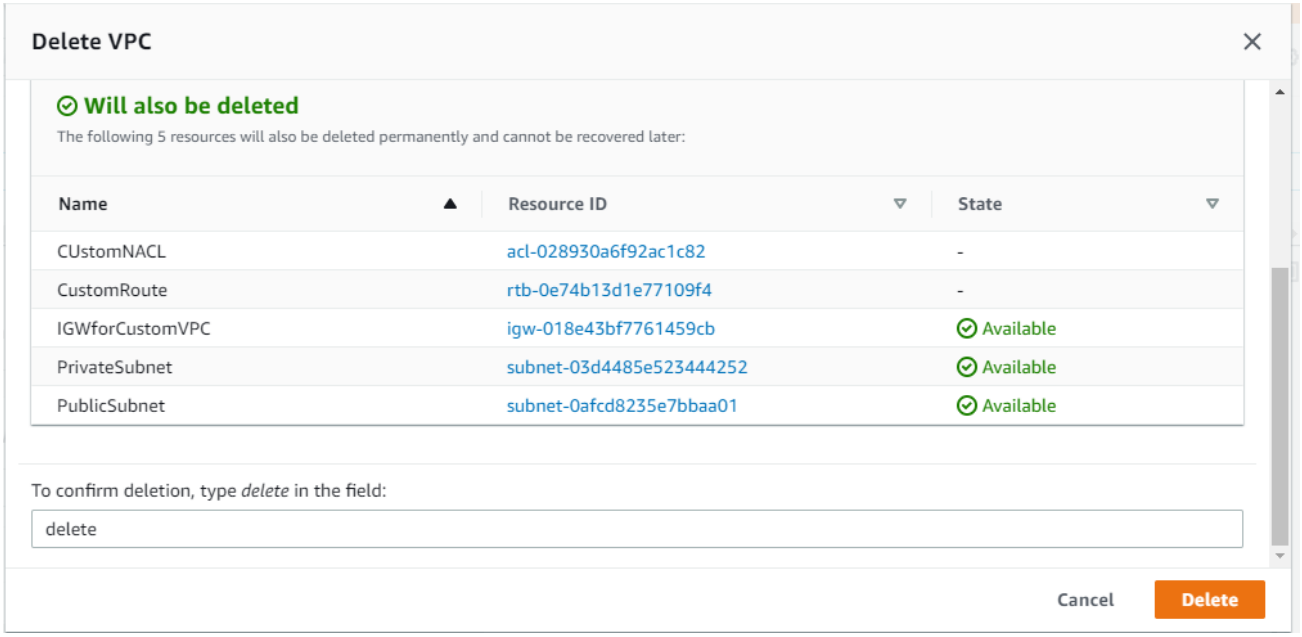


3. Select the Filter and choose what traffic (All/Accept/Reject) you want to gets in Log.
4. We are storing all the vpc logs to an s3 bucket.

VPC Cleanup:

When you delete the VPC, Automatically all the resources attached to the VPC also deletes. As mentioned below image, Subnets, Security groups, Network ACLs, interent Gateways, Route tables etc will delete along with VPC.





Bastion host:

Bastion hosts are instances that sit within our public subnet and are typically accessed using SSH or RDP. Once remote connectivity has been established with the bastion host, it then acts as a 'jump' server, allowing you to use SSH or RDP to log in to other instances (within private subnets) deeper within your VPC. When properly configured through the use of security groups and Network ACLs (NACLs), the bastion essentially acts as a bridge to your private instances via the internet.

If we want to enable communication between On-Premise and AWS environment, we need to implement VPN solutions. Please refer to the below video for VPC creation and OpneVPN deployement.

VPC Creation Step by Step Process:

https://www.youtube.com/watch?v=Ze_X53wdogA

OpenVPN Deployment Creation Step by Step Process:

https://www.youtube.com/watch?v=JSTyjISscNg

Databases on AWS

In AWS we have wide range of database services to fit our application requirements. These database services are fully managed and can be launched in minutes with just a few clicks.
AWS database services include:

- Amazon Relational Database Service (Amazon RDS) support for six commonly used database engines
  - Amazon Aurora,
  - MySQL,
  - PostgreSQL
  - Oracle
  - MS SQL
  - Maria DB
- Amazon DynamoDB, a fast and flexible NoSQL database service,
- Amazon Redshift, a petabyte-scale data warehouse service, and
- Amazon Elasticache, an in-memory cache service with support for Memcached and Redis.
- AWS also provides the AWS Database Migration Service, a service which makes it easy and inexpensive to migrate your databases to AWS cloud.

Amazon Relational Database Service (Amazon RDS)

The most common type of database in use today is the relational database. The relationaldatabase has roots going back to the 1970s when Edgar F. Codd, working for IBM, developedthe concepts of the relational model. Today, relational databases power all types ofapplications from social media apps, e-commerce websites, and blogs to complex enterpriseapplications.
Amazon Relational Database Service (Amazon RDS) makes it easy to set up, Operate, and scale a relational database in the cloud. It provides cost-efficient and resizable capacity while managing time-consuming database administration taskssuch as hardware provisioning, database setup, patching and backups.

- A relational database consists of one or more tables, and a table consists of columns and rows similar to a spreadsheet.
- A database column contains a specific attribute of the record, such as a person's name, address, and telephone number.
- Each attribute is assigned a data type such as text, number, or date, and the database engine will reject invalid inputs.

StudentID	FirstName	LastName	Gender	Age
101	Avinash	Reddy	M	29
102	Anudeep	T	M	27
103	Aravind	Reddy	M	25
104	Vikas	Ch	M	23

Here is an example of a basic table that would sit in a relational database. There are five fieldswith different data types:

StudentID = Number or integer
FirstName = String
LastName = String
Gender = String (Character Length = 1)
Age = Integer
This sample table has four records, with each record representing an individual student. Eachstudent has a *StudentID* field, which is usually a unique number per student. A uniquenumber that identifies each student can be called a **primary key.**

A relational database can be categorized as either an Online Transaction Processing (OLTP)or Online Analytical Processing (OLAP) database system, depending on how the tables areorganized and how the application uses the relational database.
OLTP refers to transactionorientedapplications that are frequently writing and changing data (for example, data entryand e-commerce).
OLAP is typically the domain of data warehouses and refers to reporting or analyzing large data sets.

Data Warehouses: A data warehouse is a central repository for data that can come from one or more sources.This data repository is often a specialized type of relational database that can be used forreporting and analysis via OLAP. Organizations typically use data warehouses to compilereports and search the database using highly complex queries.

NoSQL Databases

NoSQL databases have gained significant popularity in recent years because they are oftensimpler to use, more flexible, and can achieve performance levels that are difficult orimpossible with traditional relational databases.
Traditional relational databases are difficultto scale beyond a single server without significant engineering and cost, but a NoSQLarchitecture allows for horizontal scalability on commodity hardware.

- NoSQL databases are non-relational and do not have the same table and column semantics of a relational database.
- NoSQL databases are instead often key/value stores or document stores with flexible schemas.

Advantages if you with RDS over On-Premise or EC2

Responsibility	Database On-Premise	Database on Amazon EC2	Database on Amazon RDS
App Optimization	You	You	You
Scaling	You	You	AWS
High Availability	You	You	AWS
Backups	You	You	AWS
DB Engine Patches	You	You	AWS
Software Installation	You	You	AWS
OS Patches	You	You	AWS
OS Installation	You	AWS	AWS
Server Maintenance	You	AWS	AWS
Rack and Stack	You	AWS	AWS
Power and Cooling	You	AWS	AWS

Database Engines

Amazon RDS supports six database engines: MySQL, PostgreSQL, MariaDB, Oracle, SQLServer, and Amazon Aurora.

MySQL: MySQL is one of the most popular open source databases in the world, and it is used to power a wide range of applications, from small personal blogs to some of the largest websites in the world.Amazon RDS MySQL allows you toconnect using standard MySQL tools such as MySQL Workbench or SQL Workbench/J.

PostgreSQL: PostgreSQL is a widely used open source database engine with a very rich set of features and advanced functionality.Amazon RDS PostgreSQL can be managed usingstandard tools like pgAdmin and supports standard JDBC/ODBC drivers.

MariaDB: MariaDB is apopular open source database engine built by the creators of MySQL and enhanced withenterprise tools and functionality.

Oracle: Oracle is one of the most popular relational databases used in the enterprise and is fullysupported by Amazon RDS. Amazon RDS supports access to schemas on a DB Instance using any standard SQL client application, such as Oracle SQL Plus.

Microsoft SQL Server

Microsoft SQL Server is another very popular relational database used in the enterprise.Amazon RDS allows Database Administrators (DBAs) to connect to their SQL Server DBInstance in the cloud using native tools like SQL Server Management Studio.

Amazon RDS SQL Server also supports four different editions of SQL Server: Express Edition,Web Edition, Standard Edition, and Enterprise Edition.

Licensing: AWS offers two licensing models: **License Included** and **Bring Your Own License (BYOL)**for Amazon RDS Oracle and Microsoft SQL Server as they are commercial software products.

Amazon Aurora: Amazon Aurora is a fully managed service, is MySQLcompatible, and provides for increased reliability and performance overstandard MySQL deployments. Amazon Aurora can deliver up to five times better performance compared to MySQL.We can usethe same code, tools, and applications that we use with existing MySQL databases withAmazon Aurora.

- 2 copies of your data is contained in each availability zone, with minimum of 3 availability zones. 6 copies of your data.
- Aurora is designed to transparently handle the loss of up to two copies of data without affecting database write availability and up to three copies without affecting read availability.
- Aurora storage is also self-healing. Data blocks and disks are continuously scanned for errors and repaired automatically.
- We can create two types of replications for Aurora
    - Aurora Replicas (currently 15)
    - MySQL Read Replicas (currently 5)

Storage Options

Amazon RDS is uses Amazon Elastic Block Store (Amazon EBS).Based on your performance and cost requirements we can select Magnetic, General Purpose (Solid State Drive [SSD]), or Provisioned IOPS (SSD). Depending on the database engine and workload, you can scale up to 4 to 16TB in provisioned storage andup to 30,000 IOPS.

Backup and Recovery

Amazon RDS provides two mechanisms for backing upthe database:

1. Automated backups and
2. Manual snapshots.

Automated Backups: An automated backup is an Amazon RDS feature that continuously tracks changes and backsup your database.

- You can set the backup retention period when you create a DB Instance. Default of 7 days, but you can modify the retention period up to a maximum of 35 days.
- When you delete a DB Instance, all automated backup snapshots are deleted and cannot be recovered.
- Automated backups will occur daily during a configurable 30-minute maintenance windowcalled the backup window.
- Automated backups are kept for a configurable number of days,called the backup retention period.
- You can restore your DB Instance to any specific timeduring this retention period, creating a new DB Instance.

Manual DB Snapshots: This is a manually initiated task. We have to perform this backup manually.

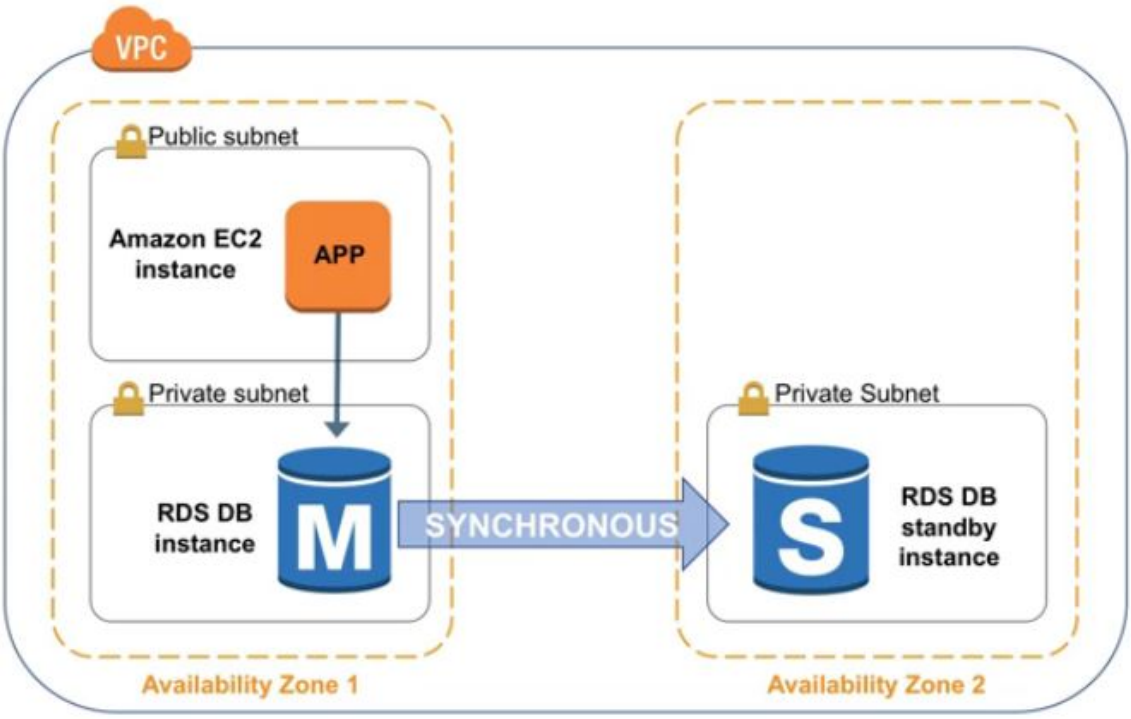
- A DB manual snapshot is initiated by us and can be created as frequently as we want.
- We can then restore the DB Instance to the specific state in the DB snapshot at any time.
- Manual DB snapshots are kept until you explicitly delete them with the Amazon RDS console.

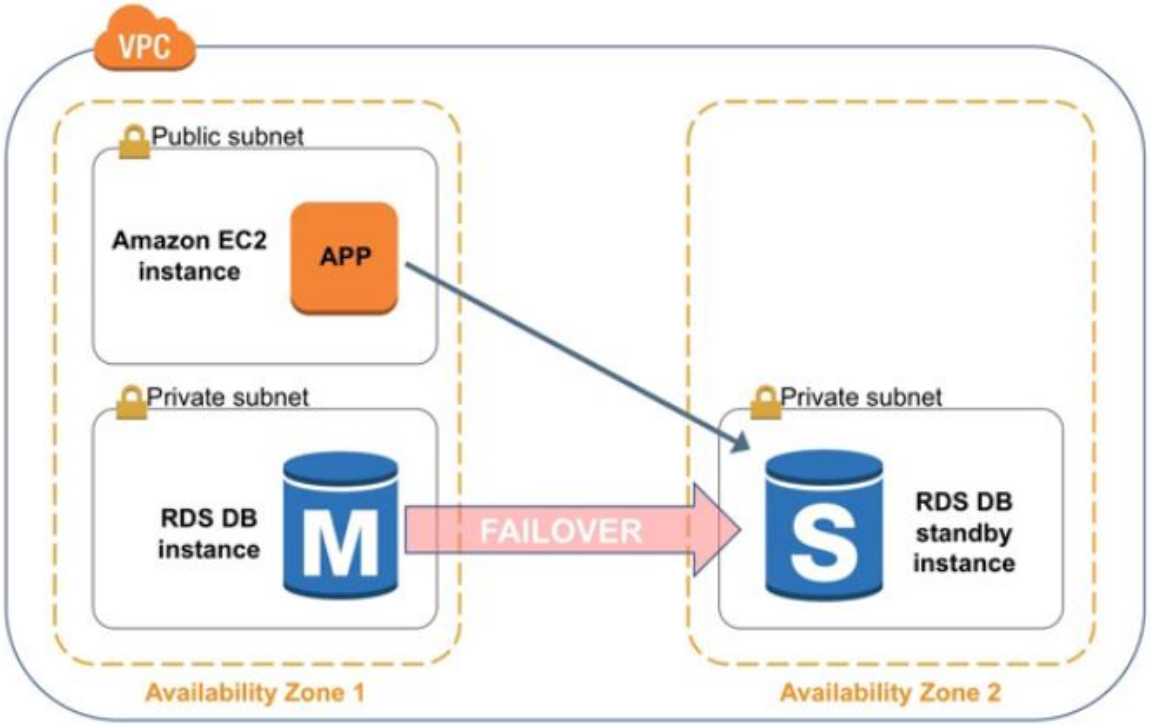
Recovery: We can use automated backup or manual snapshot to recovery the database.

- Amazon RDS allows you to recover your database using automated backups or manual DB snapshots.
- You cannot restore from a DB snapshot to an existing DB Instance; a new DB Instance is created when you restore.

- When using automated backups, Amazon RDS combines the daily backups performed during your predefined maintenance window in conjunction with transaction logs to enable you to restore your DB Instance to any point during your retention period, typically up to the last five minutes.

Multi-AZ: By using Multi-AZ we can increase the availability of the database using replication. We will get a same copy of production database in another availability zone for DR purpose (Disaster Recovery).

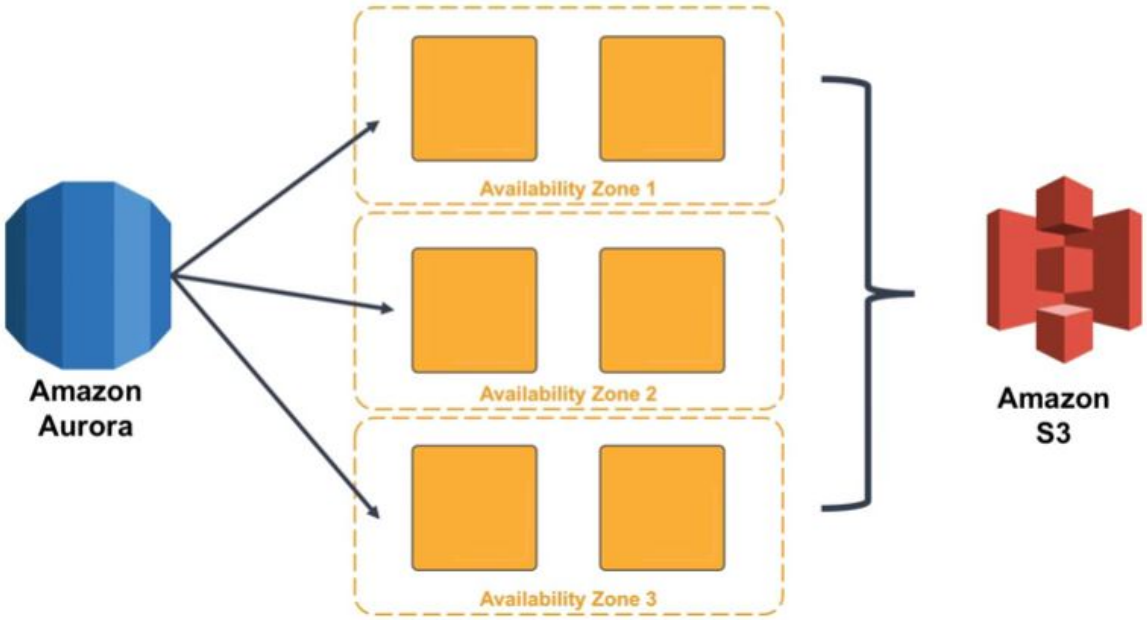




- Multi-AZ allows you to place a secondary copy of your database in another Availability Zone for disaster recovery purposes.
- Multi-AZ deployments are available for all types of Amazon RDS database engines.
- When you create a Multi-AZ DB Instance, a primary instance is created in one Availability Zone and a secondary instance is created in another Availability Zone.
- Amazon will takes care about the replication between primary Database and Secondary database.
- Amazon RDS detects and automatically recovers from most common failures for Multi-AZ deployments so that we will not get any downtimes and recovers without administrative intervention.
- Multi-AZ deployments are for disaster recoveryonly; they are not meant to enhance database performance.
- To improve database performance/Scaling we have to use read replicas or ElastiCache.

Read Replicas:

Read replica's allow you to have a read only copy of your production database. This is achieved by using Asynchronous replication from the primary RDS instance to the read replica. You use read replica's primarily for very read-heavy database workloads.



Read replicas are currently supported for:

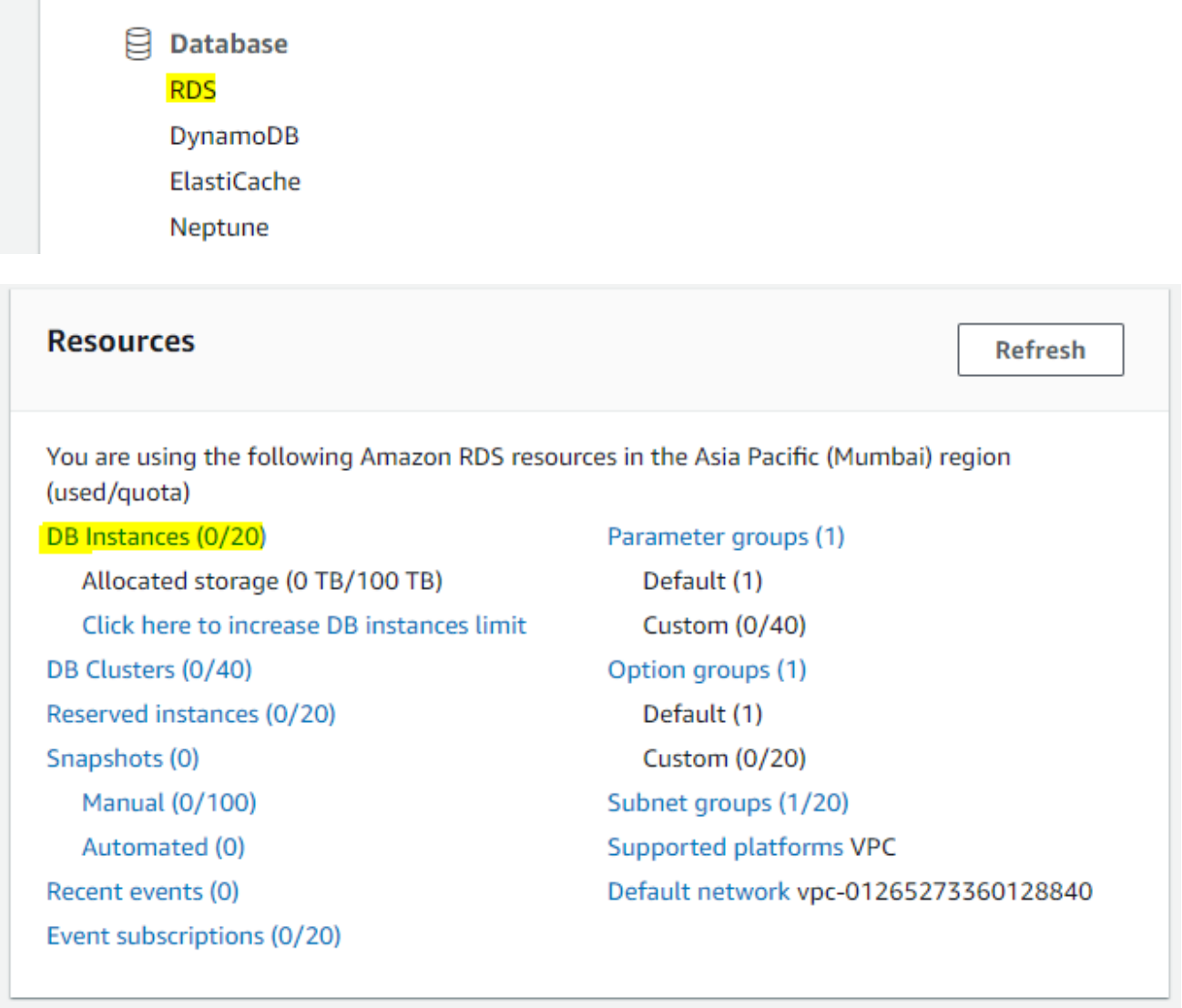
- MySQL,
- PostgreSQL,
- MariaDB, and
- Amazon Aurora.

- Updates made to the source DB Instance are asynchronously copied to the read replica.
- You can create one or more replicas of a database within a single AWS Region or across multiple AWS Regions.
- We can use Read replicas for Scaling!!! Not for DR!
- Must have automatic backups turned on in order to deploy a read replica.
- You can have up to 5 read replicas copies of any databases
- You can have read replicas of read replicas and each read replica will have its own DNS end point.

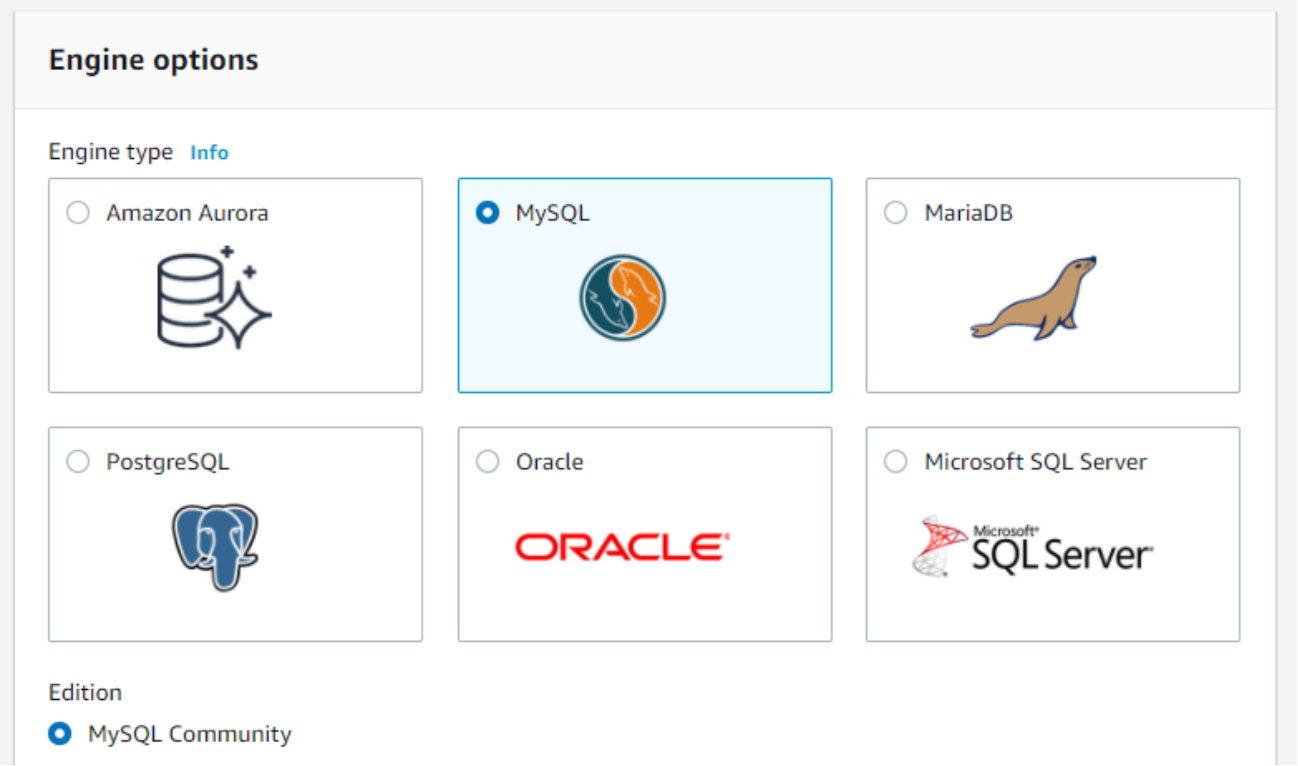
- You cannot have Read Replicas that have Multi-AZ
- You can create Read Replica's of Multi-AZ source databases however.
- Read Replicas can be promoted to be their own databases. This breaks the replication.

Launching RDS instance:

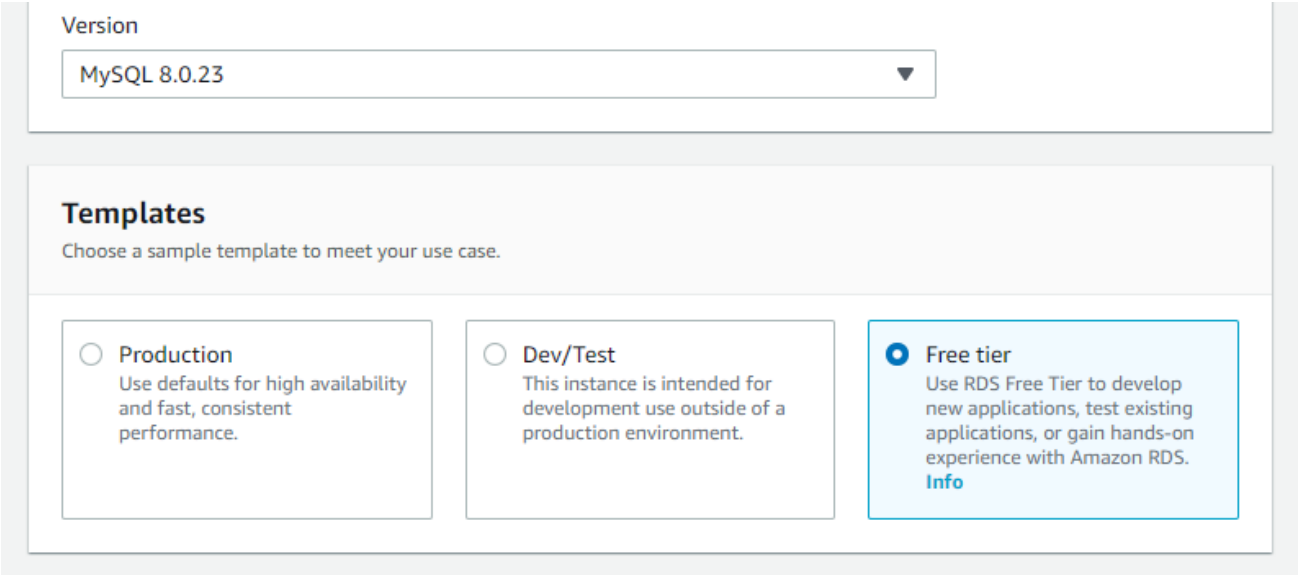
1. Log on to AWS account using the IAM credentials, and from the AWS Management Console, select the Relational Database Service option underDatabase.



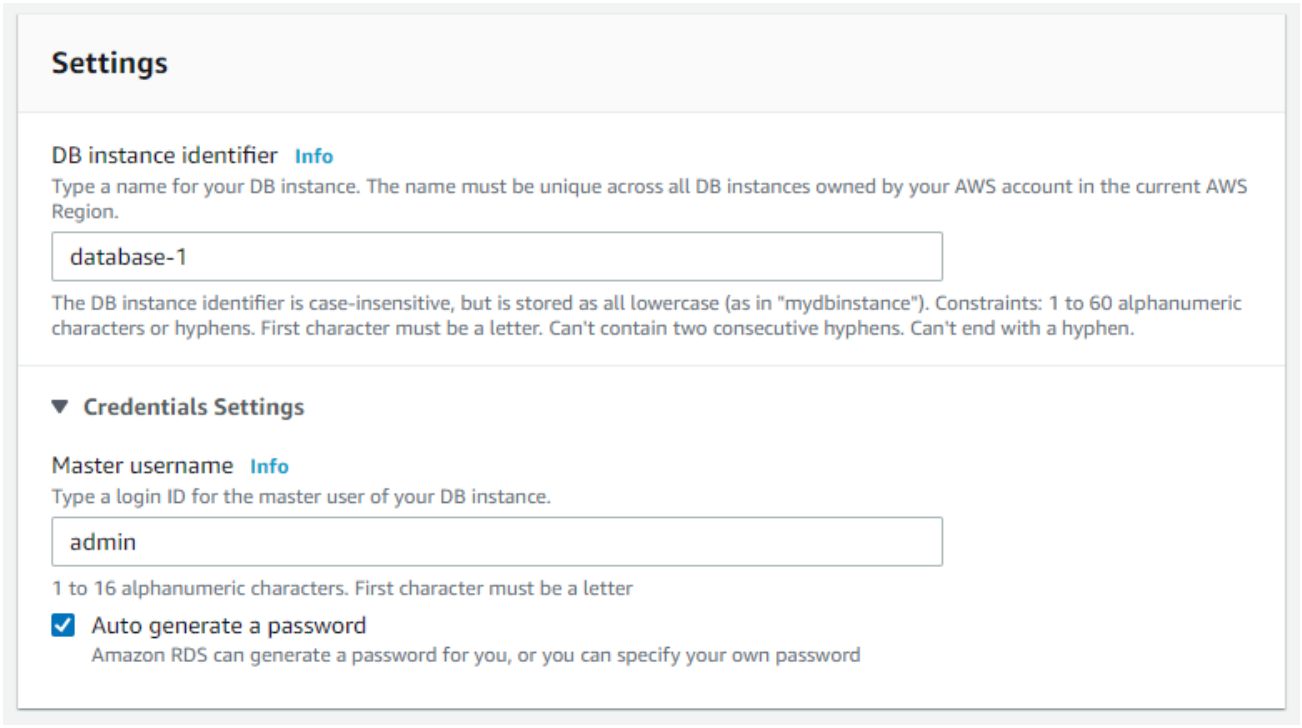
2. Click on the **"Create database"** option.

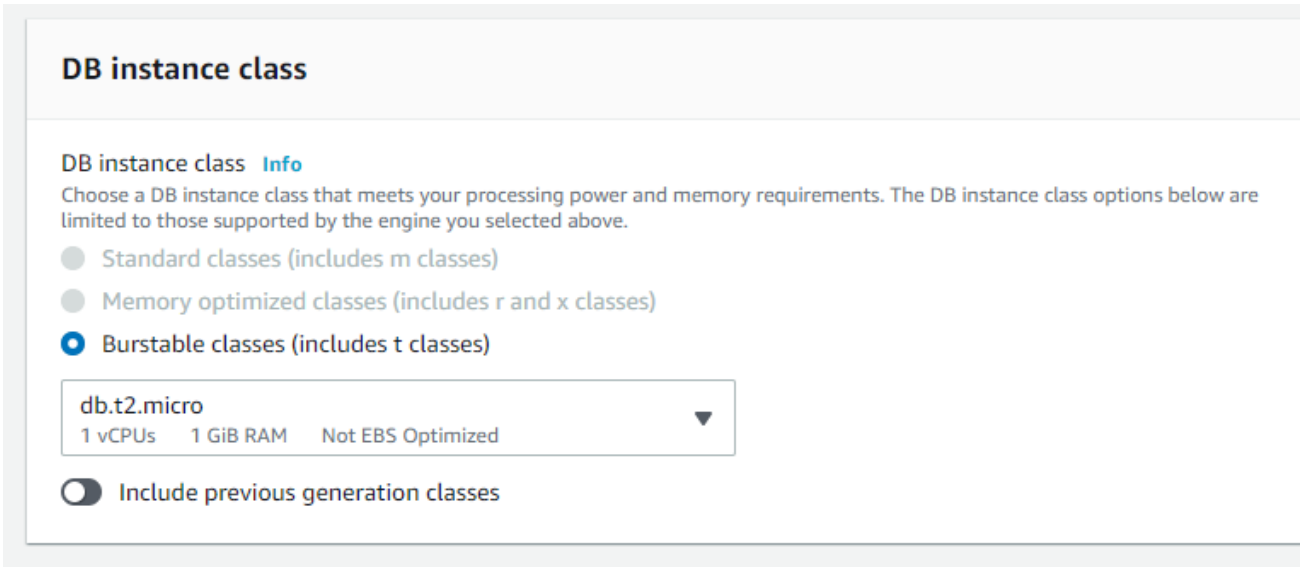


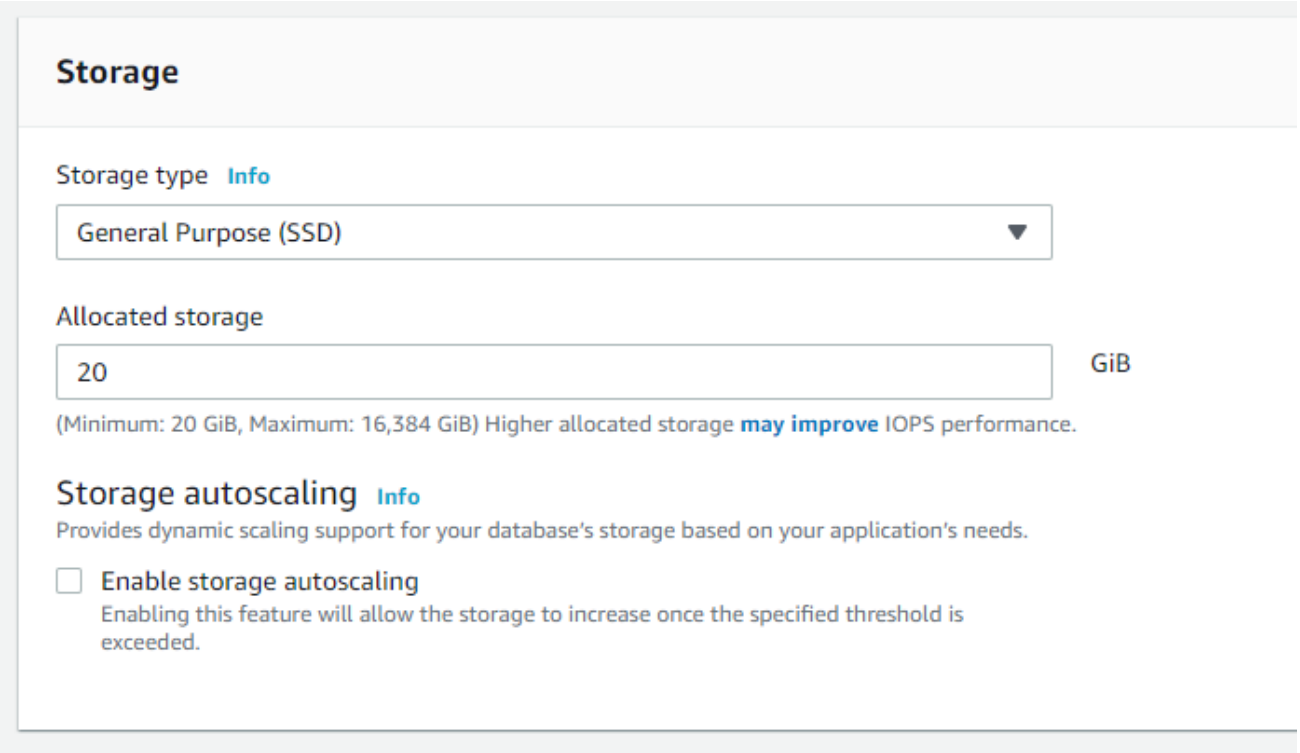
3. As we discussed earlier, we have six relational db engines are available with amazon RDS, Now am going to launch MySQL.
   - If you want to use **Free Tier eligibility** make sure you select the **"Free tier".**

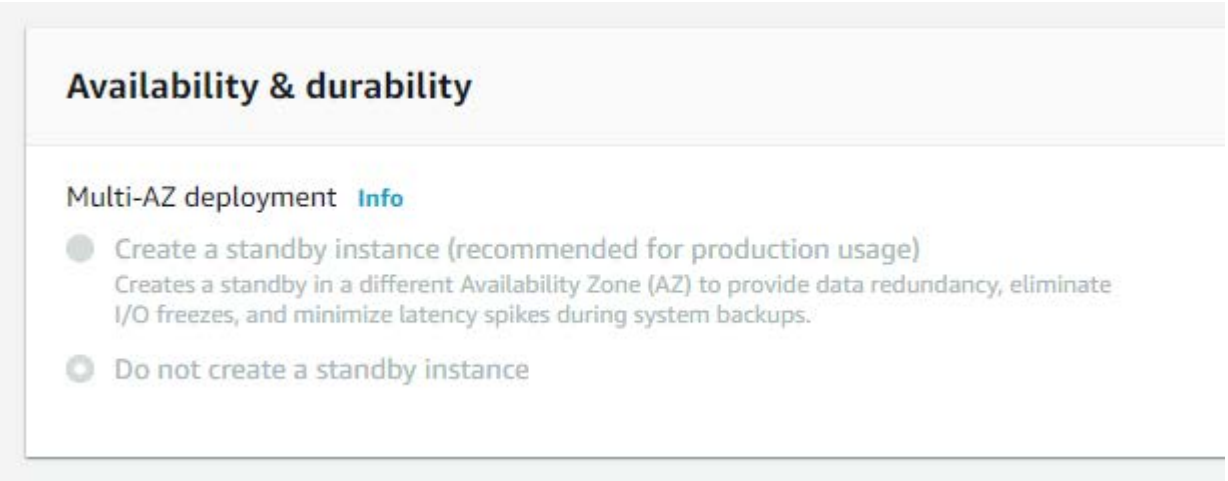


4. I want to use free trier for the DB instance, so selecting MySQL community edition, in next we have to specify the DB Details.


Settings
DB instance identifier Info
Type a name for your DB instance. The name must be unique across all DB instances owned by your AWS account in the current AWS Region.
database-1
The DB instance identifier is case-insensitive, but is stored as all lowercase (as in "mydbinstance"). Constraints: 1 to 60 alphanumeric characters or hyphens. First character must be a letter. Can't contain two consecutive hyphens. Can't end with a hyphen.
Credentials Settings
Master username Info
Type a login ID for the master user of your DB instance.
admin
1 to 16 alphanumeric characters. First character must be a letter
Auto generate a password
Amazon RDS can generate a password for you, or you can specify your own password

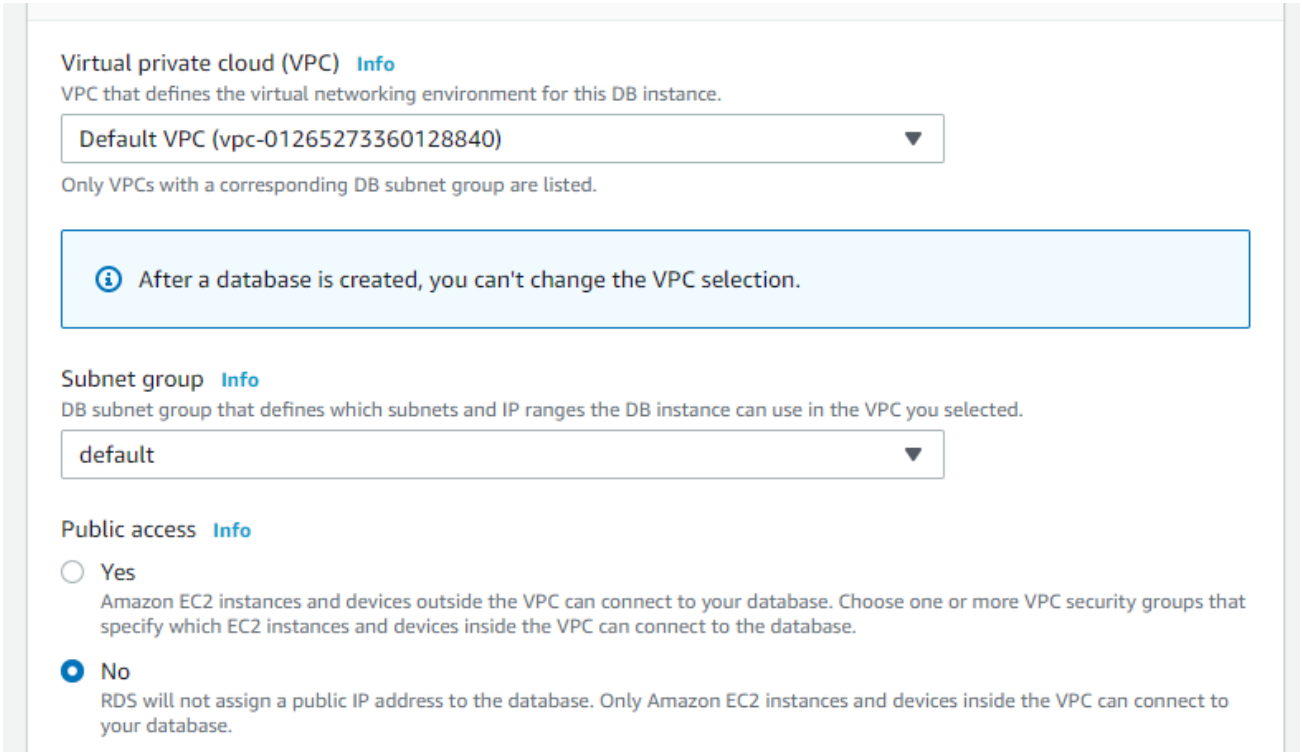

DB instance class
DB instance class Info
Choose a DB instance class that meets your processing power and memory requirements. The DB instance class options below are limited to those supported by the engine you selected above.
Standard classes (includes m classes)
Memory optimized classes (includes r and x classes)
Burstable classes (includes t classes)
db.t2.micro
1 vCPUs 1 GiB RAM Not EBS Optimized
Include previous generation classes

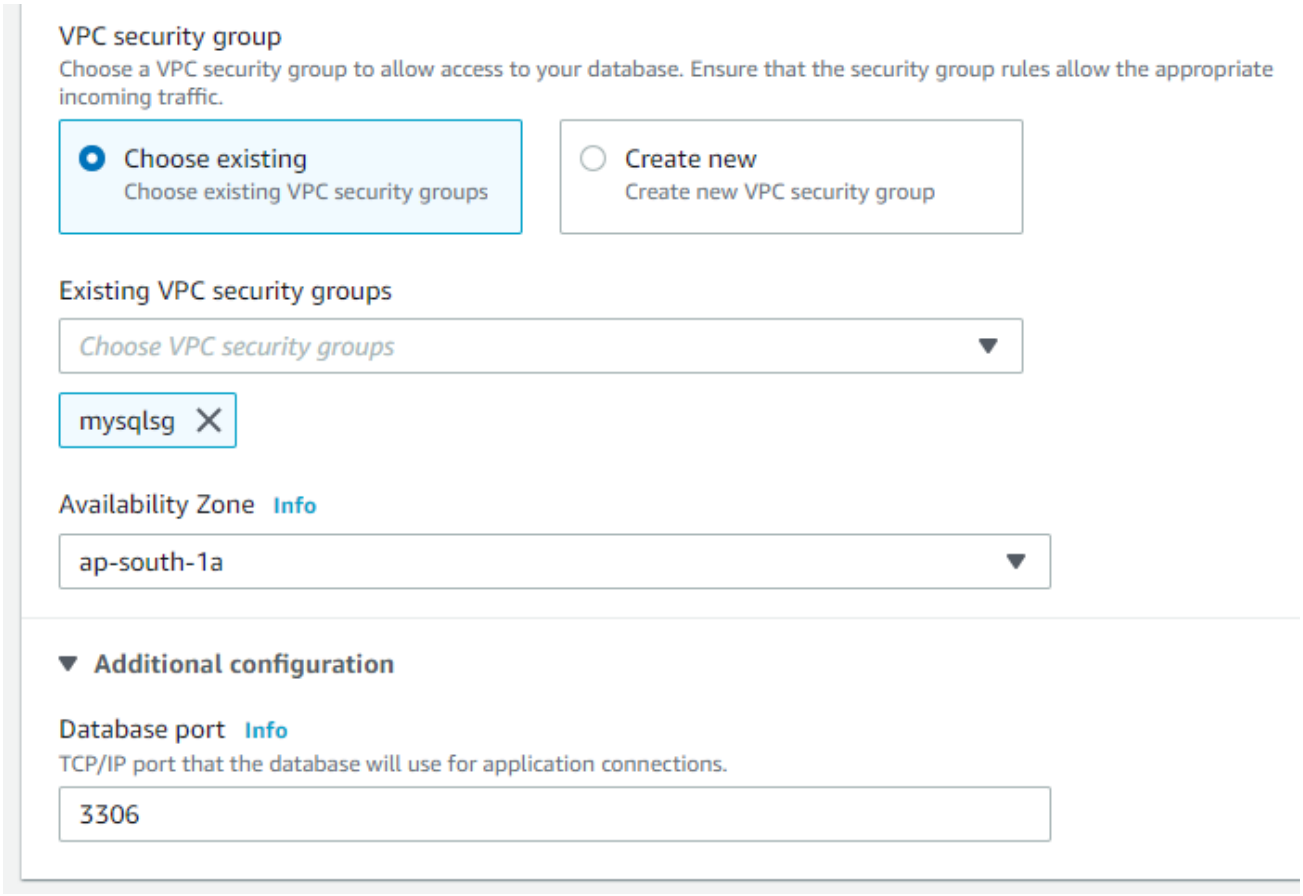




- **DB Engine:** We have selected the Db Engine as MySQL.
- **DB Engine Version:**Select the appropriate DB Engine Version as per yourrequirements. RDS provides and supports a variety of database engine versions that you can choose from.
- **DB Instance Class:** We have multiple DB Instance Classes with various configurations (vCPU & RAM), Select the appropriate one as per requirement.
- **Multi-AZ Deployment:** Select "Yes/No" for Multi-AZ based on requirement.
- **Storage Type:**Select the Storage Type between **"General purpose SSD"** and **"Provisioned IOPS".**
- **Allocated Storage:** We can allocate the storage for db instance. We can select from **20 GB to 6TB**.
- **DB Instance Identifier:** Give a valid name for the DB instance and this must be unique in the selected region.
- **Master Username:**Give a valid username to login to the Db instance.

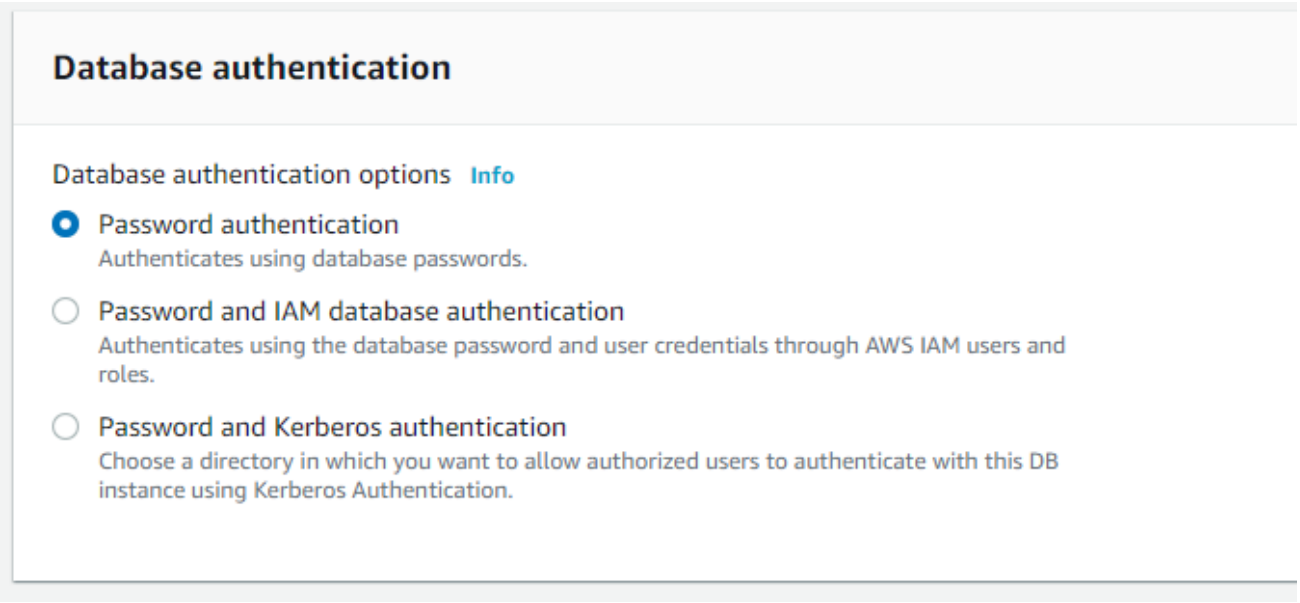
- **Master Password:** Give a valid password for the master username or choose to **"auto Generate"** password.

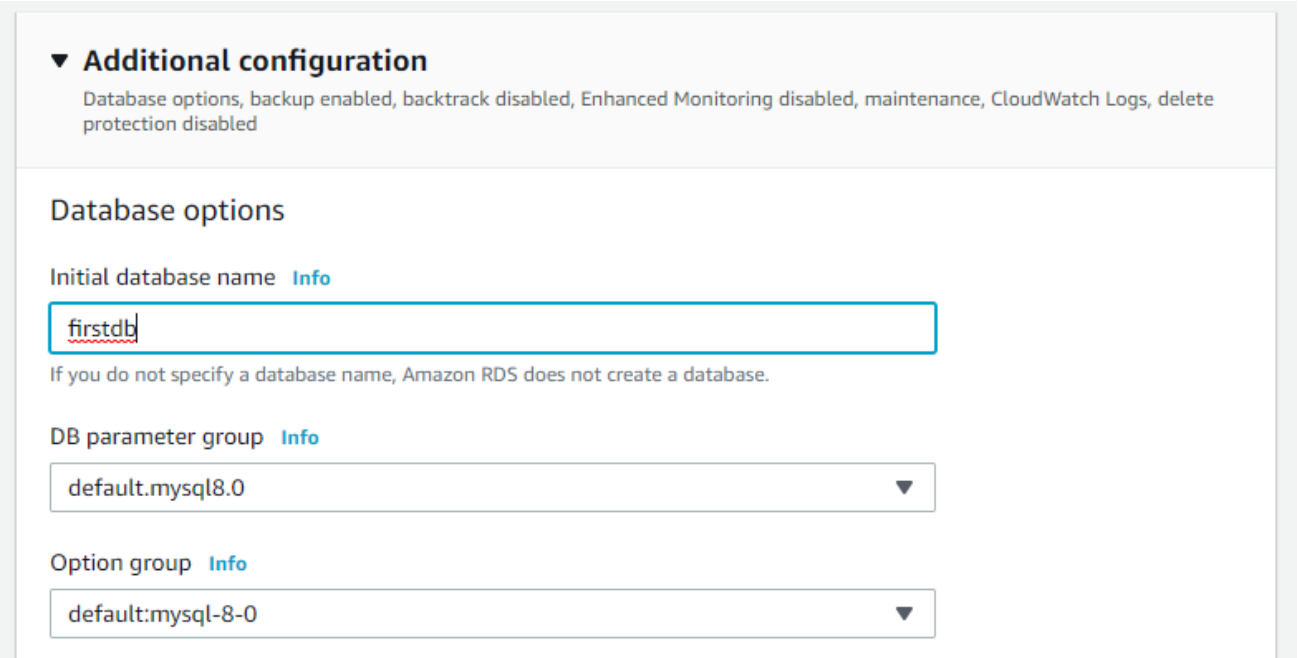




- **VPC:**Select the name of the VPC that will host your MySQL DB instance. Here am selecting Default VPC to host this instance.
- **Subnet Group:** Selecting the default Subnet Group.
- **Public Accessible:**Select "**Yes"** if you want EC2 instances and devices outside of the VPC hosting the DB instance to connect to the DB instance. If you select "**No"**, Amazon RDS will not get a public IP address to the DB instance, so we cannot connect over internet.
- **Availability Zone:**We can select the desired AZ based on the region.

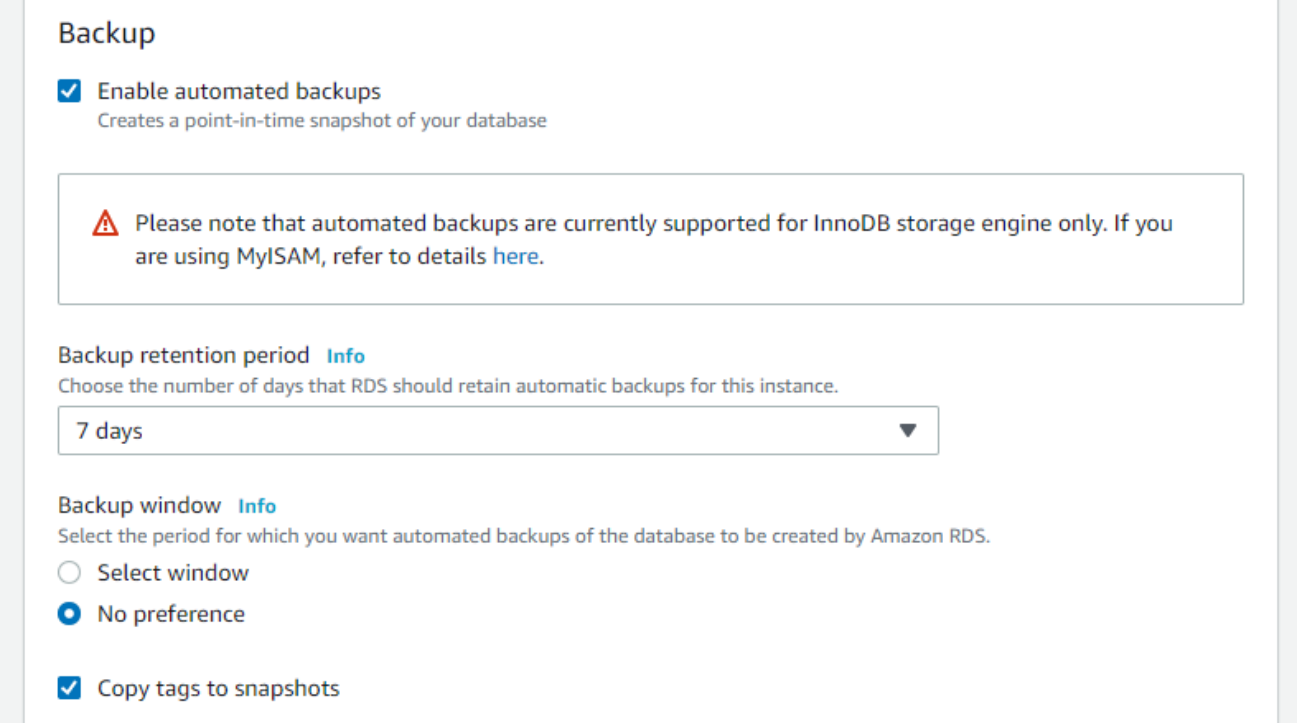
VPC Security Groups: We have to attach a security group to the Db instance. It works same as the EC2 instance security group, As we are launch **MySQL port number 3306** must be opened. For **MsSQL port number is 1433**.



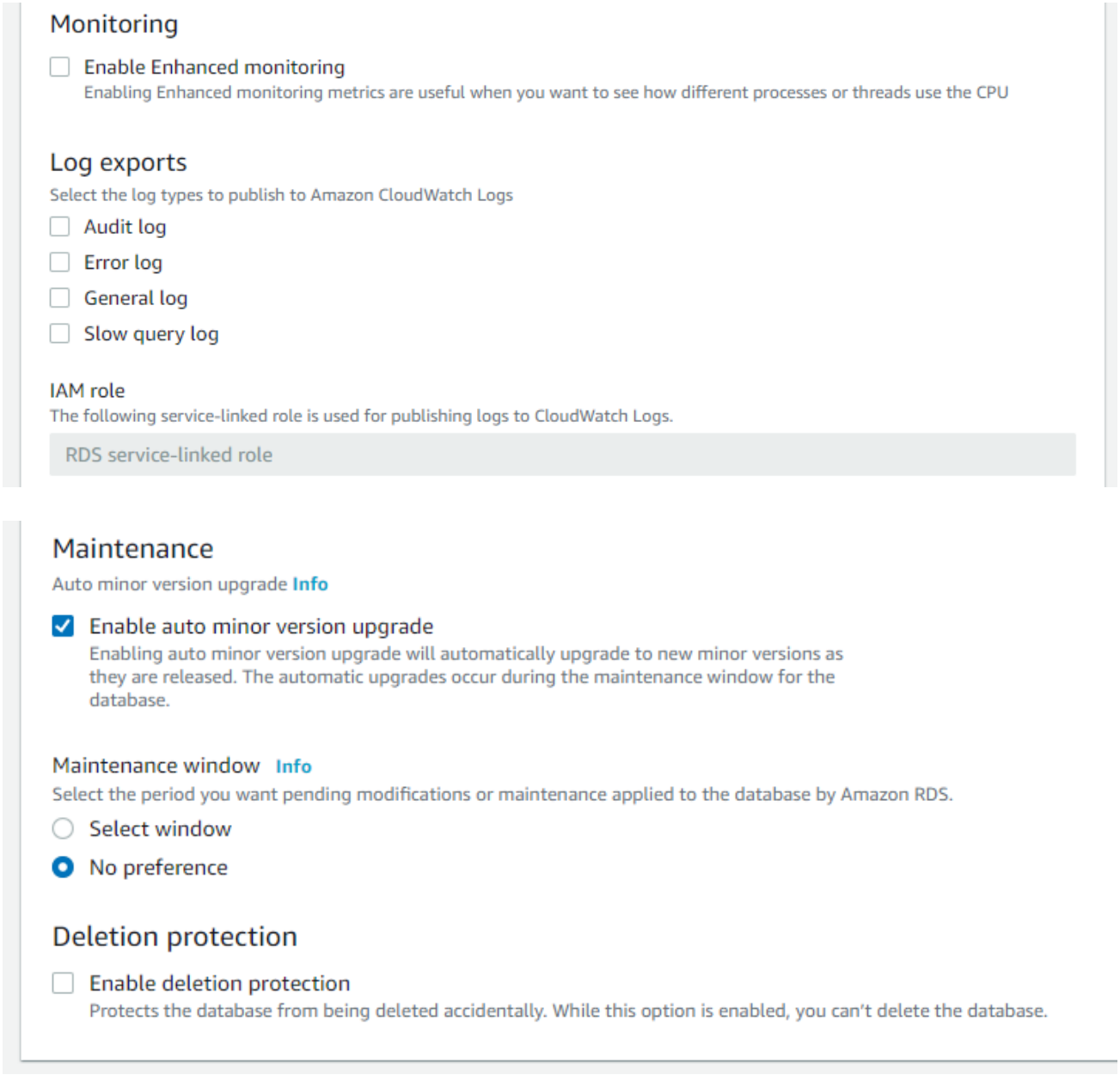


- **Database Name:** Provide a suitable database name here. RDS will not create and initialize any database unless you specify a name here.

- **Database Port:** Provide the port number using which you wish to access the database. MySQL's default port number is 3306. We cannot change the default port number after db instance launch.
- **DB parameter Group:** DB parameter groups are logical groupings of databaseengine configurations that you can apply to one or more DB instances at the same time. Go with the default option here.
- **Option Group:** This option is similar to DB parameter groups in that they tooprovide and support few additional configuration parameters that make it easy to manage databases
- **Copy Tags To Snapshots:** Give a tick on checkbox if you want to copy the tags to created snapshots of the db instance.
- **Enable IAM DB Authentication:** We can use IAM users to use the db, but the IAM user need to have appropriate permissions. Select **"Yes"** to manage your database user credentials through AWS IAM users and roles.



We can set the BackupRetention Period as well as the Backup window's Start Time and Duration.



- **Enable Enhanced Monitoring:** We can use Cloudwatch to monitor the db instances, give yes if you want to change the default monitoring period to detailed monitoring.
- **Log Exports:**We can get the required logs for the Cloudwatch service.
- **Auto Minor Version upgrade:** Specify Yes to enable automatic upgrades to new minor versions as they are released. The automatic upgrades occur during the maintenance window for the DB instance.
- **Maintenance Window:** We can select the period in which you want pending modifications or patches applied to the DB instance by Amazon RDS. Any such maintenance should be started and completed within the selected period. If you do not select a period, Amazon RDS will assign a period randomly.

5. After configuring all the above steps, choose Launch DB instance option. DB instance creation will be initiate now.

We have four steps for instance launch stage: Creating, Modifying, Backing-Up and Available.

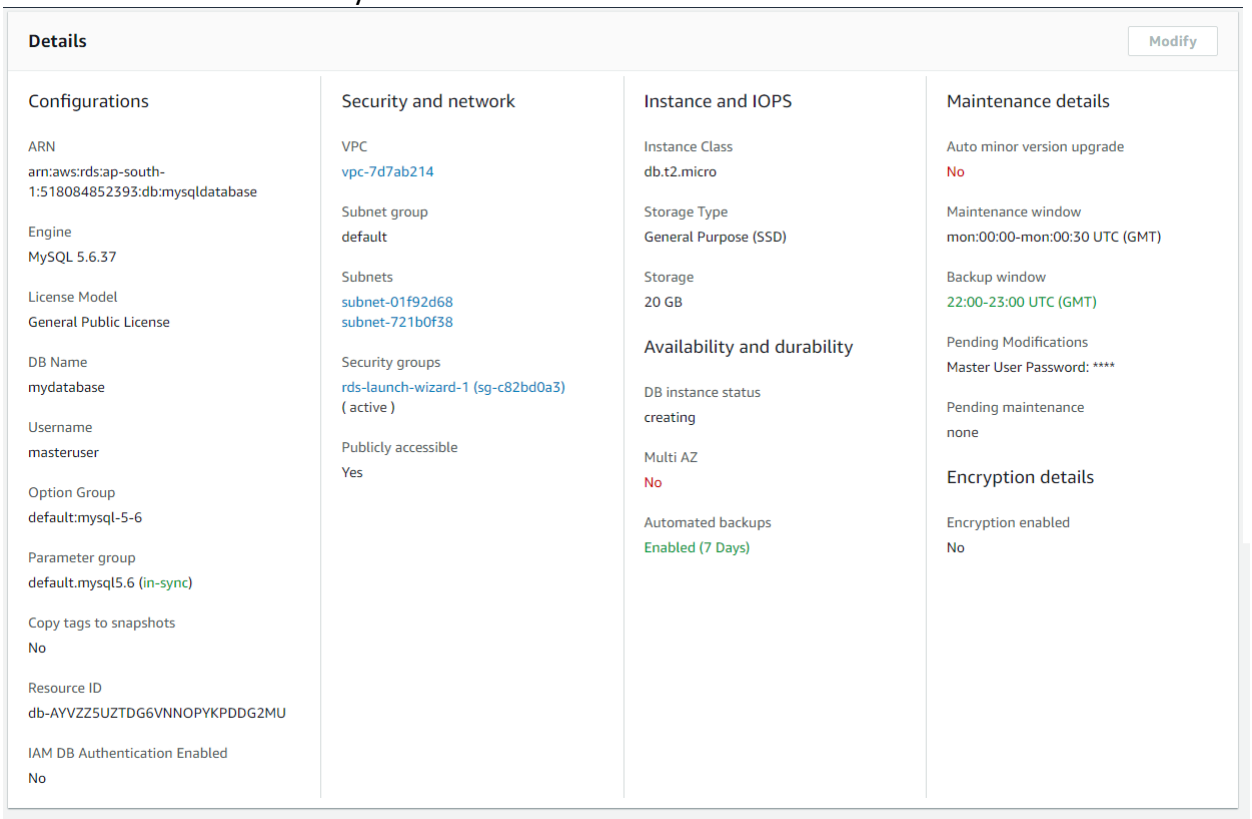
Creating: This is the first stage of any DB instance's lifecycle where the instance isactually created by RDS. During this time, your database will remain inaccessible.

Modifying: This state occurs whenever the DB instance enters any modificationseither set by you or by RDS itself.

Backing-up: RDS will automatically take a backup of your DB instance when it isfirst created. You can view all your DB instance snapshots using the Snapshots optionon the navigation pane.

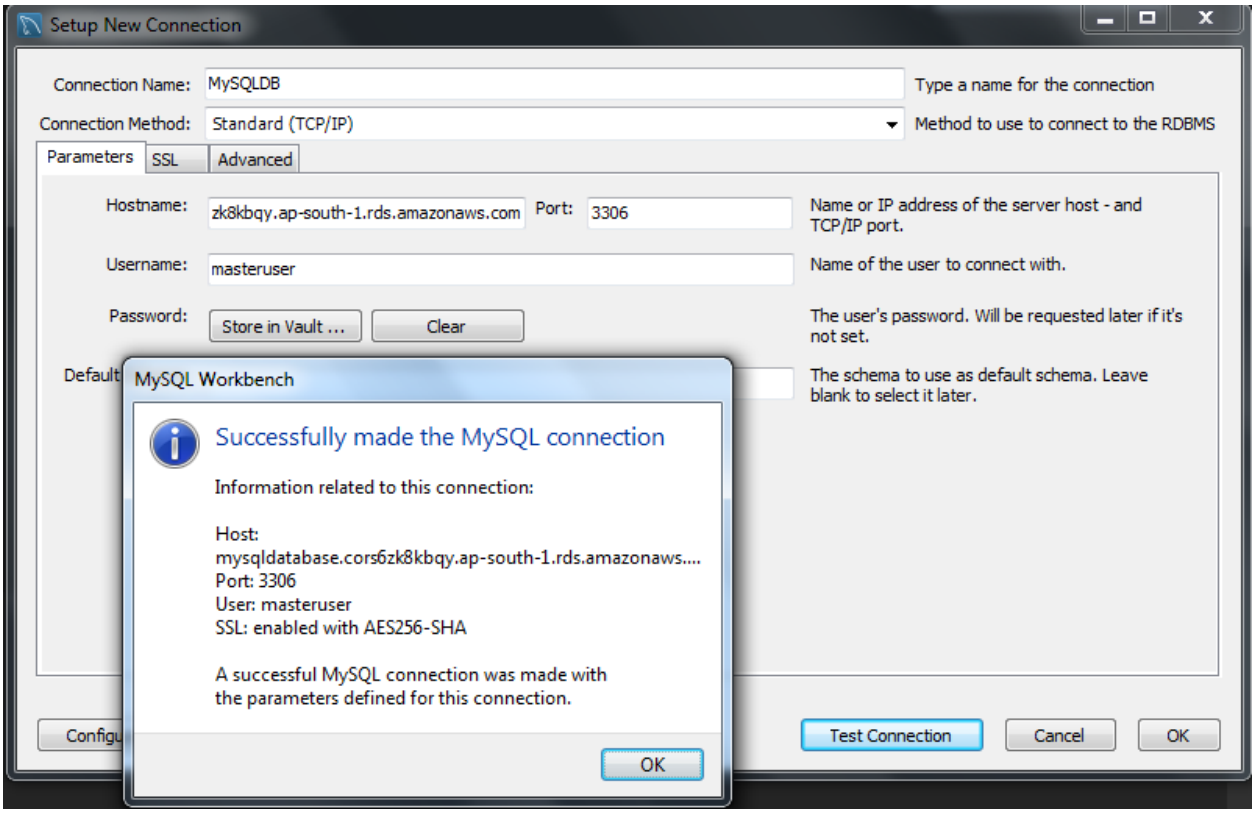
Available: This status indicates that your DB instance is available and ready for use.You can now access your database remotely by copying the database's endpoint.

Here is the details for newly launched RDS instance.

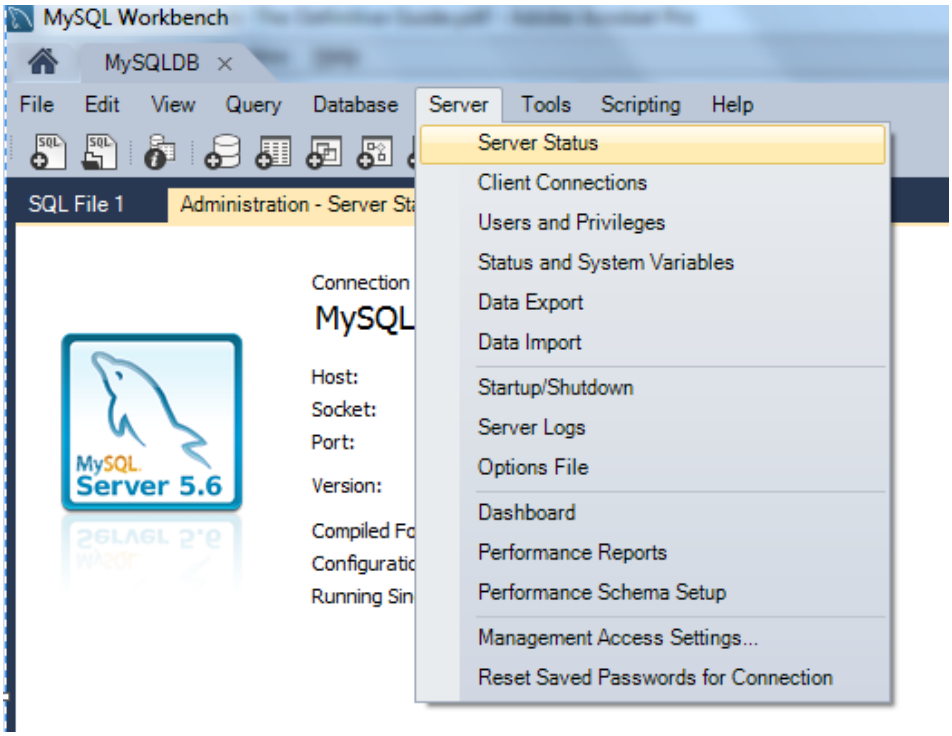


6. To test the connectivity we are going to use MySQL Workbench application, Download and install on any of the local machine or EC2 instance if you want to test it in graphical manner. You can download the MySQL workbench from the following URL: https://dev.mysql.com/downloads/workbench/

7. I've copied the Endpoint URL of my DB instance and opened the installed MySQL workbench application and add a connection and give a name for the connection, Enter the **Endpoint name in Hostname field**, port number is **3306**, Enter **username** and click on **Test Connection** and Give the password, you should get a Successful rest result.



8. We can verify the Server Status by navigating to Server and selecting the Server Status option.



9. By using the workbench, we can create databases, schemas and we can manage the database graphically.

To test the MySql from Linux machine, Launch a Linux instance and install the mysql package by running **yum install mysql**option.
After launching the Linux instance, Installmysql package by running
yum install mysql

Then run **# mysql -u <USERNAME> -h <DATABSE_ENDPOINT> -p**and press enter, It'll ask you to enter the password of connecting user, then you can access the mysql database.

```
[root@ip-172-31-24-253 ec2-user]# mysql -u masteruser -h mysqldatabase.cors6zk8k
bqy.ap-south-1.rds.amazonaws.com -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 36
Server version: 5.6.37-log MySQL Community Server (GPL)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> show databases
    ->
```
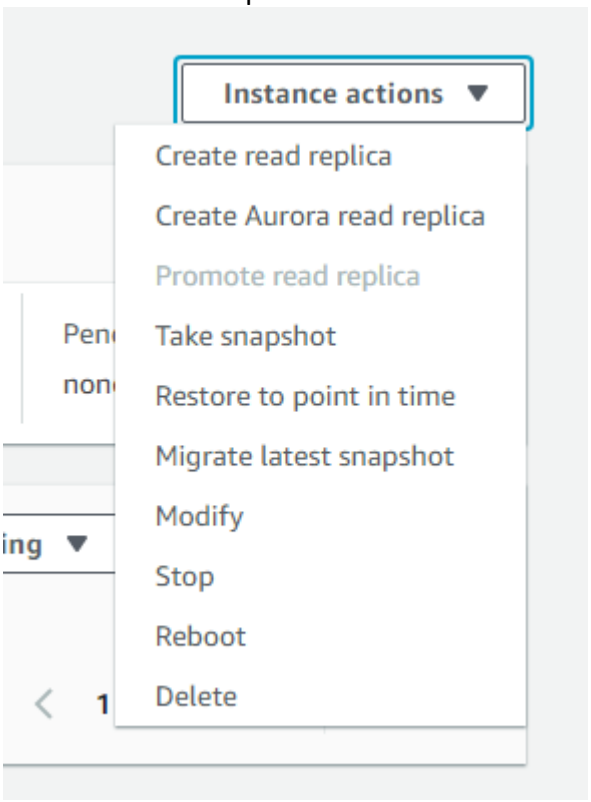

DB Instance Actions: We can find the below options when you select the **db instance** and choose **Instance Actions** option.



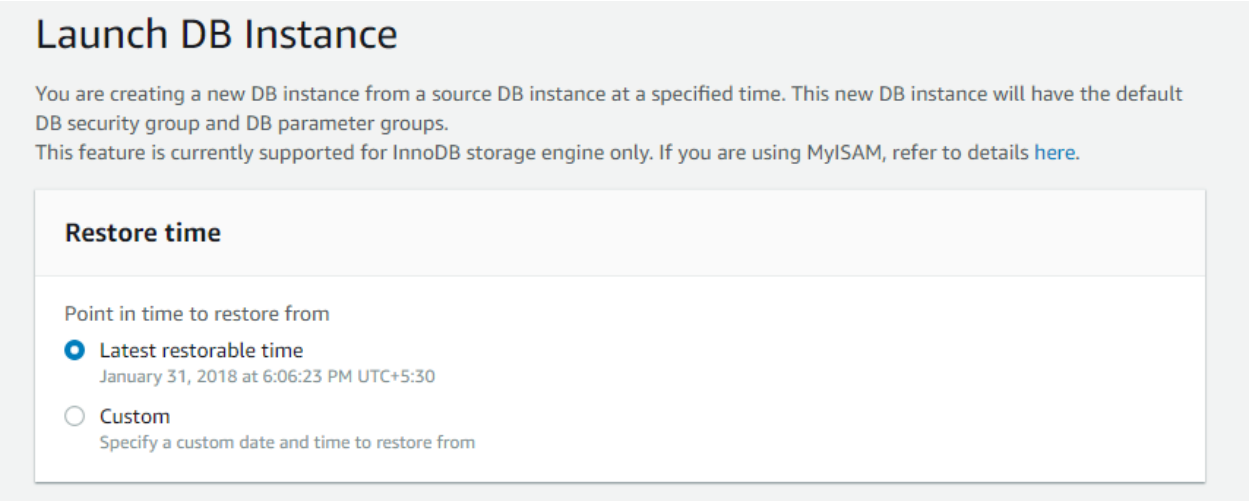
Create Read Replica: As we discussed above, we can create read replicas of the primary db instance for scaling purpose, We'll get a new endpoint for read replicas and the launch wizard is almost same new db instance launch.

Create Aurora Read Replica: If we need a replica with aurora db engine, we can choose this option and follow wizard. Read replica will create with aurora db engine.

Promote Read Replica: If you want to promote read replica to a standalone db instance, we can select this option, But the replication between primary db and read replica will breakdown.

Take Snapshot: For backups of the db instance we can use the snapsots.

Restore to Point in Time: With this option we can create a new DB Instance from a source DB Instance at a specified time. This new DB Instance will have the default DB Security Group and DB Parameter Groups.



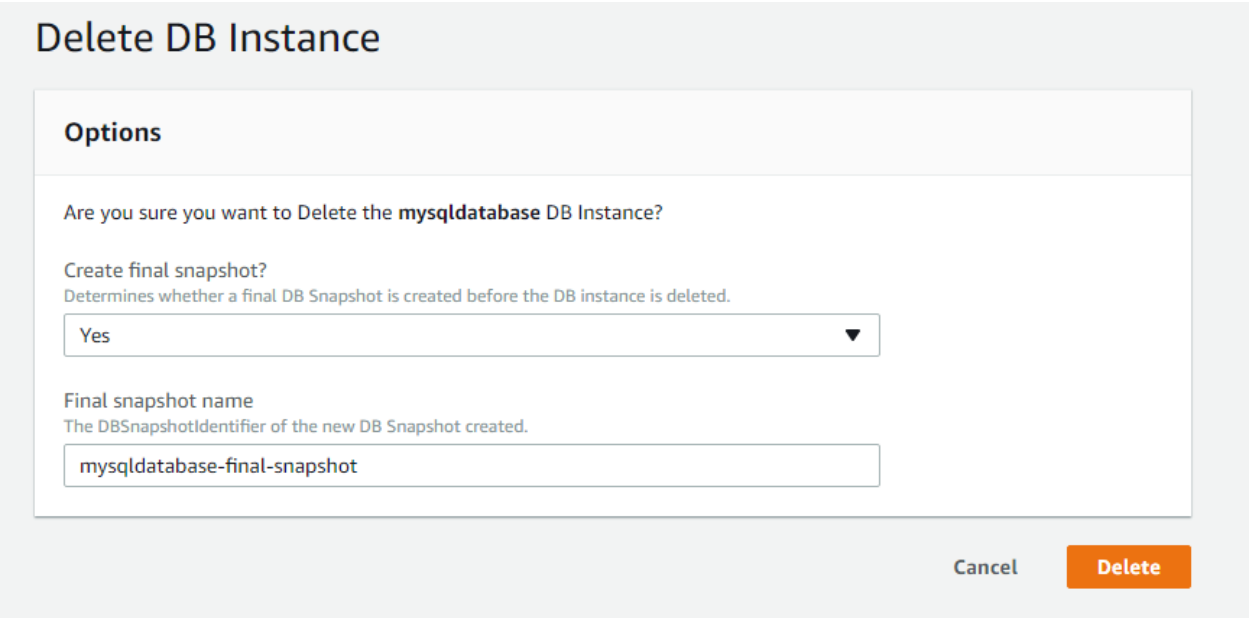
Migrate Latest Snapshot: We can migrate the selected database to a new DB Engine by selecting desired options for the migrated instance. For mysql “Aurora” and “mariadb”.

Modify: By using modify option, we can change the db instance properties i.e; DB engine version, instance class, storage options, master password, backup retention period and maintenance periods.

Stop: Instance will changes it status to Stopped state, we can start at anytime.

Reboot: underlying instances operating system will reboot.

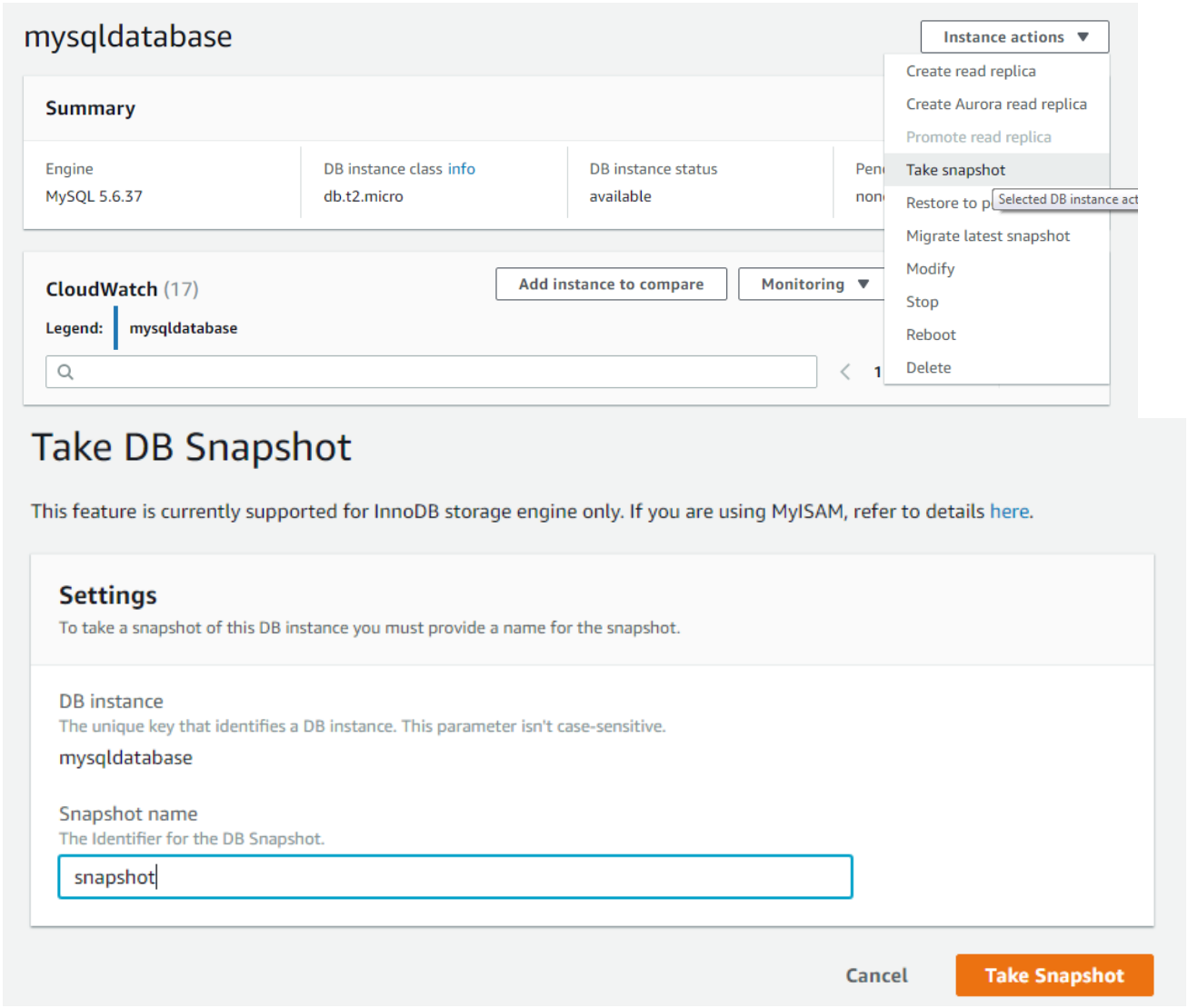
Delete: Db instance will delete. When you perform delete option AWS will ask you to create a final snapshot. If the data in the db is important, we can take a final snapshot to launch it in future, otherwise we can select No and delete the db instance.



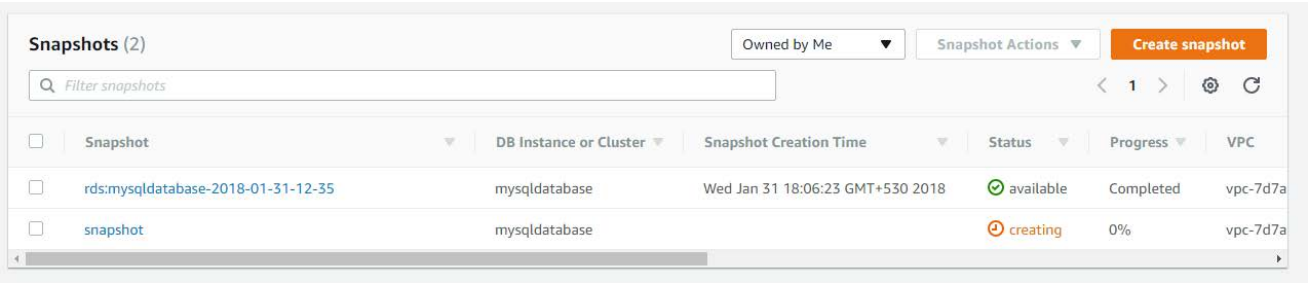
DB INSTANCE BACKUP OPTIONS:

As we discussed above, we have two options for backing up 1. Automated backup and 2. Manual Snapshots.

To create a manual snapshot, select the **“instance Actions”** and choose **“Take Snapshot”** Option.

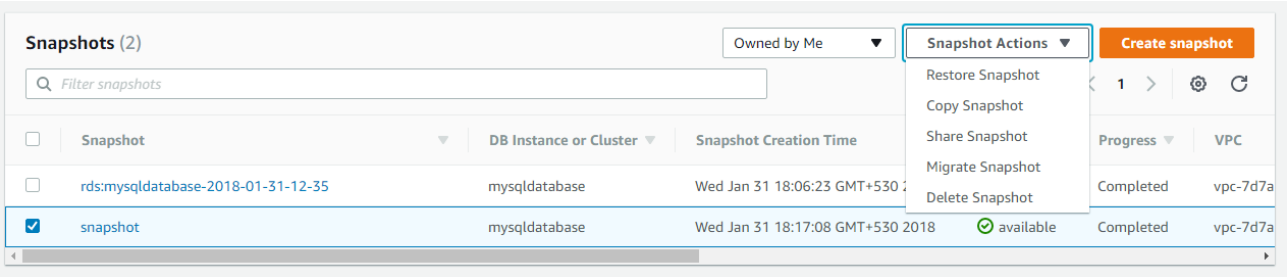


Give a name for the newly creating Snapshot and here is the status of Snapshot creation.

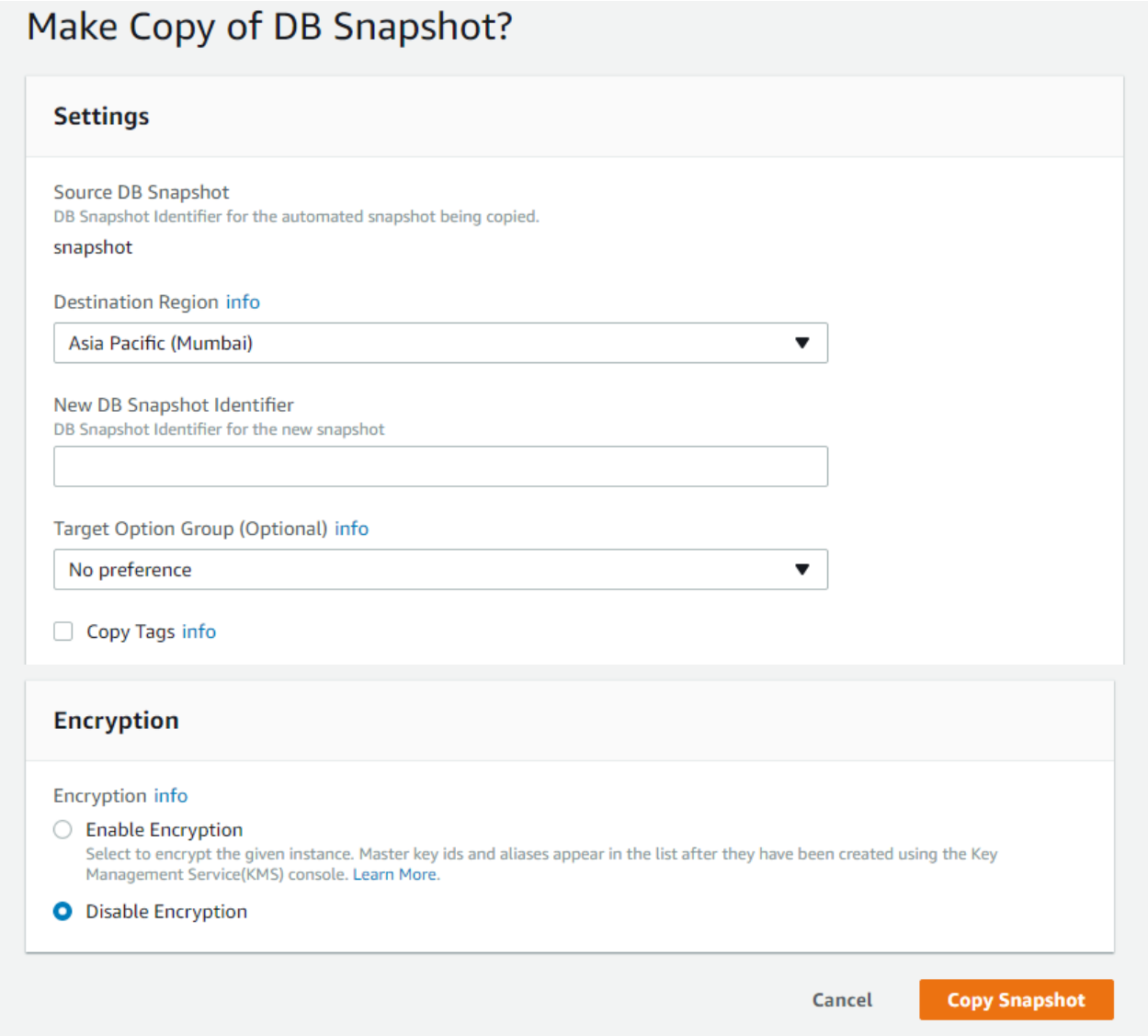


Launching Instance from the Snapshot.

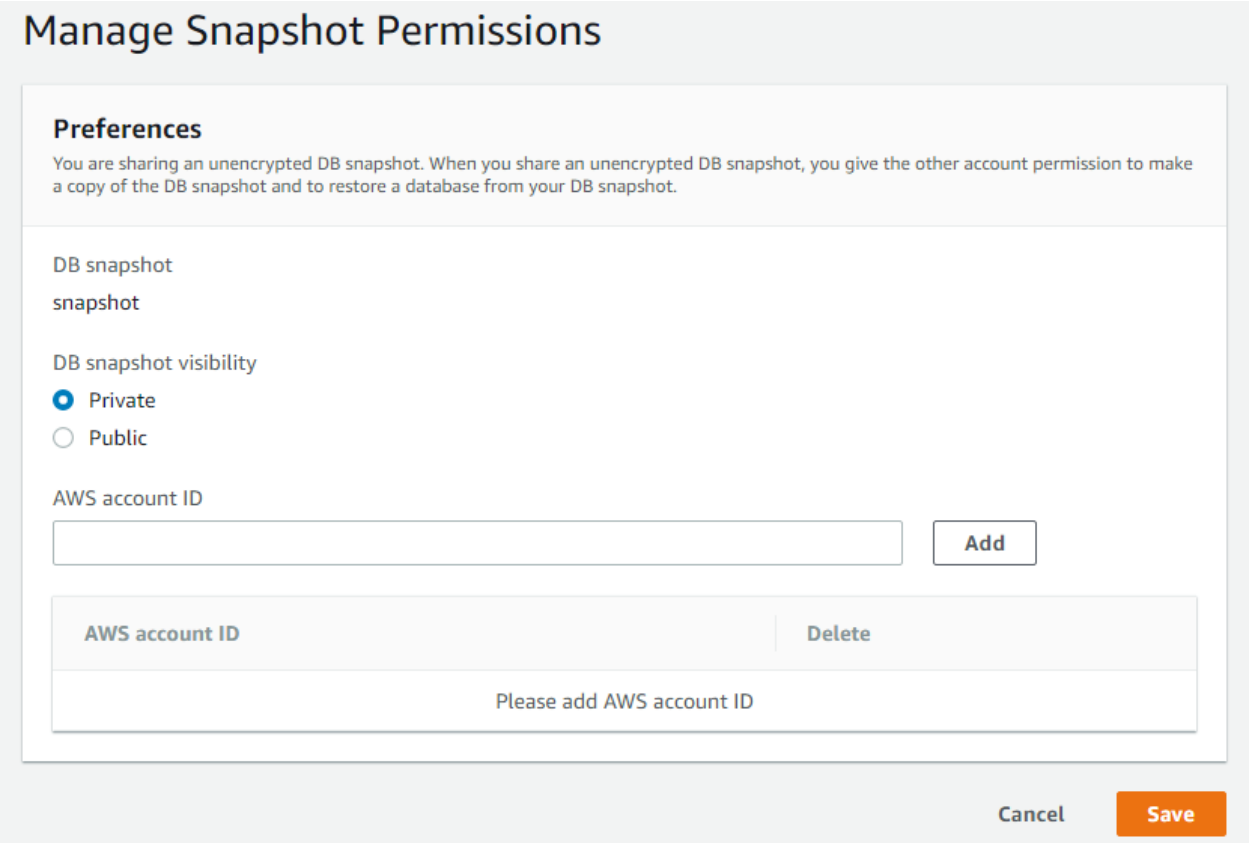
We can use either automated backups or manual snapshots to launch a new instance, but remember we'll get a new endpoint. To create a snapshot, select the snapshot and choose the "**Snapshot Actions"** and choose "**Restore Snapshot"**option, Then automatically an instance launch wizard will launch. You'll find almost all same as the regular instance launch.



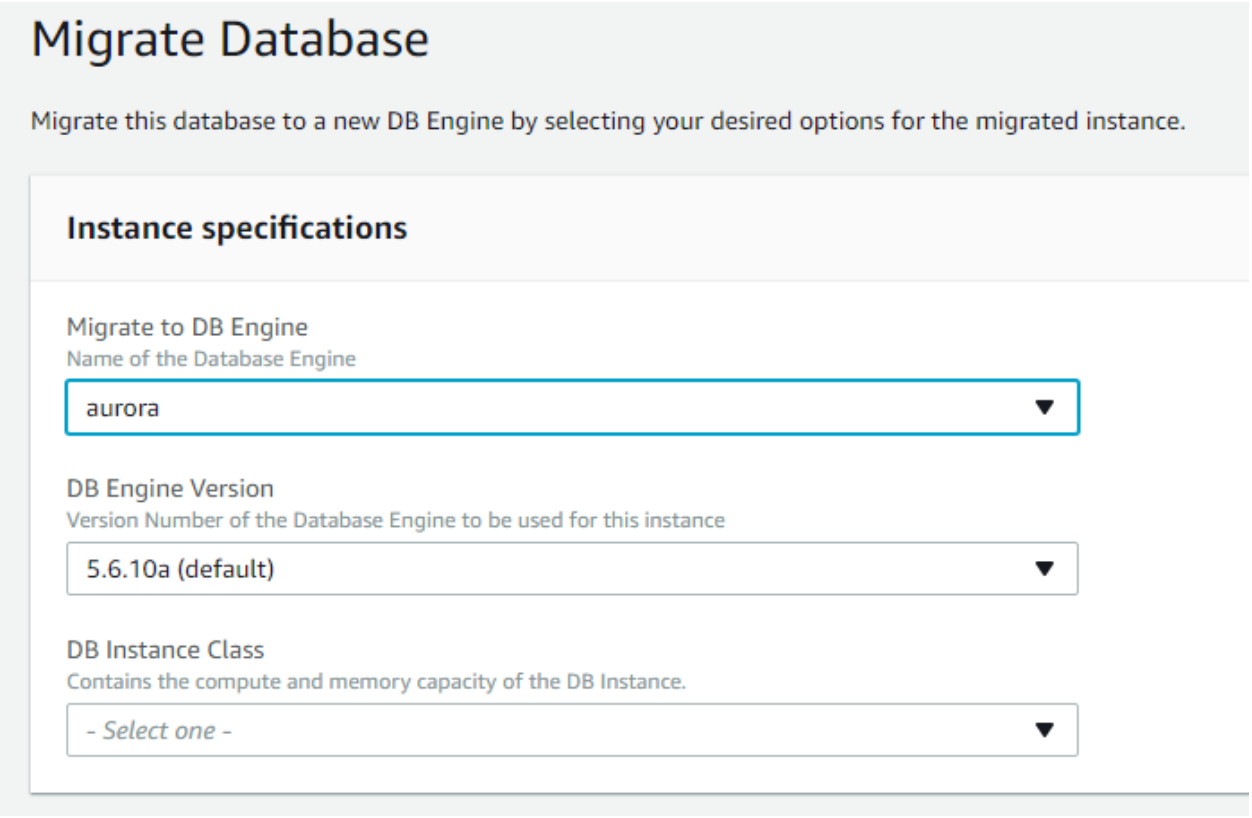
Copy Snapshot: We can make a copy the snapshot in another region. Choose the **"Destination region"**give a name for the new DB snapshot identifier, we can enable the encryption, if required while copying the snapshot.



Share Snapshot: We can share the snapshot with any other AWS account user or make it available for public by selecting the Share Snapshot option.



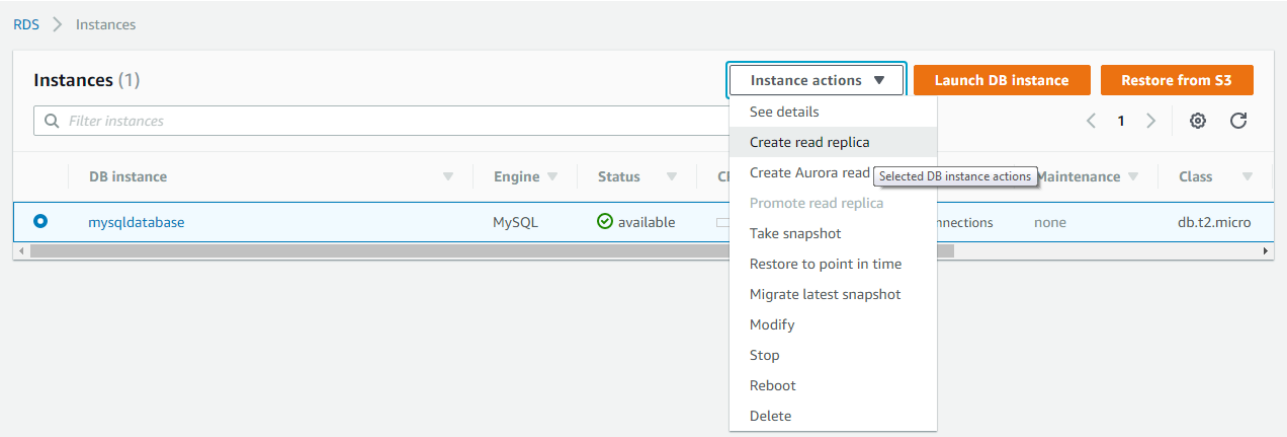
Migrate Snapshot: We can migrate the snapshot to a different db engine by using this option. Choose the Migrate snapshot option and select the **Aurora or Mariadb** and follow the wizard, we'll get a new endpoint with the selected db engine.

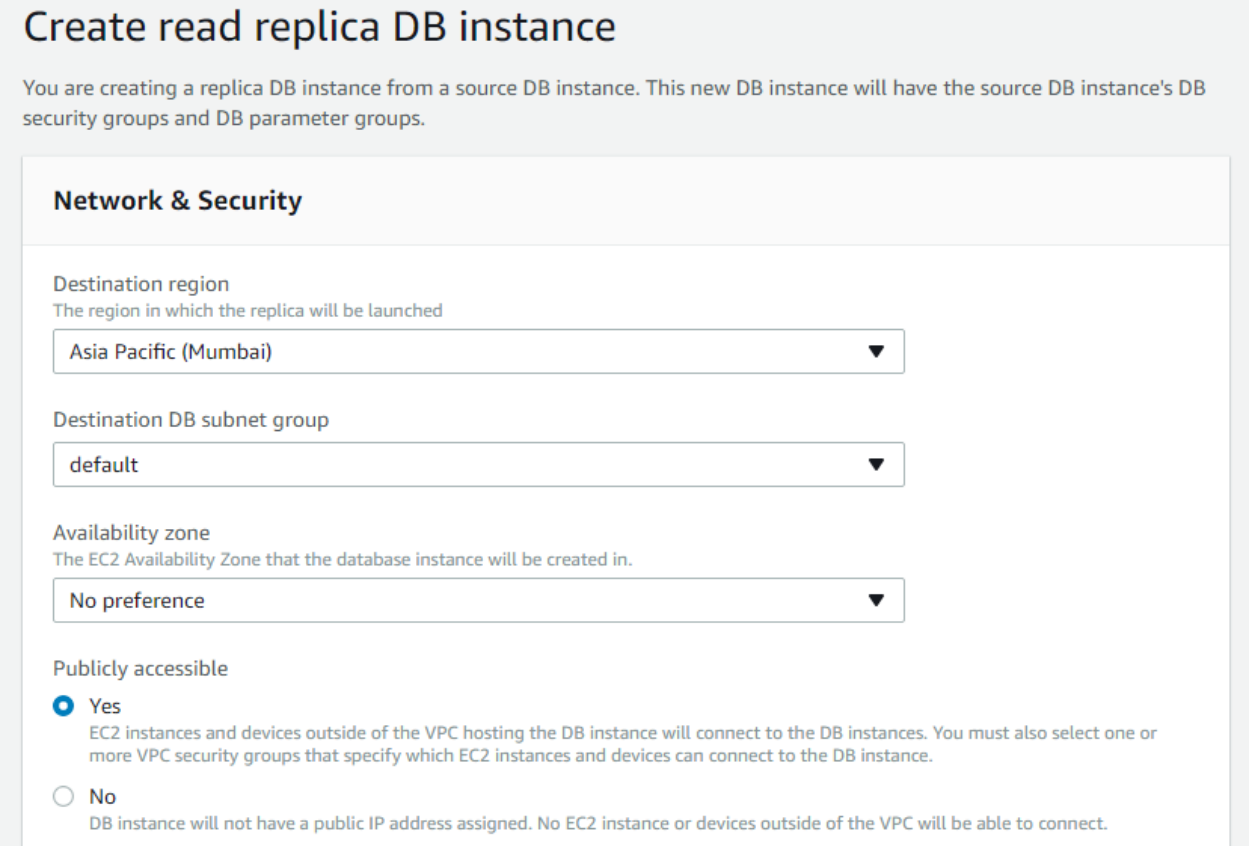


Creating Read Replicas and promoting them

Read replica's allow you to have a read only copy of your production database. This is achieved by using Asynchronous replication from the primary RDS instance to the read replica. You use read replica's primarily for very read-heavy database workloads.

To create a read replica select the Instance Actions tab and select the Create ReadReplica option.





Instance specifications

DB instance class
Contains the compute and memory capacity of the DB instance.

db.t2.micro — 1 vCPU, 1 GiB RAM

Multi-AZ deployment
Specifies if the DB instance should have a standby deployed in another availability zone.

- Yes
- No

Storage type info

General Purpose (SSD)

Settings

Read replica source
Source DB instance Identifier

mysqldatabase

DB instance identifier
DB instance identifier. This is the unique key that identifies a DB instance. This parameter is stored as a lowercase string (e.g. mydbinstance).

Database options

Database port
Port number on which the database accepts connections.

3306

- Copy tags to snapshots

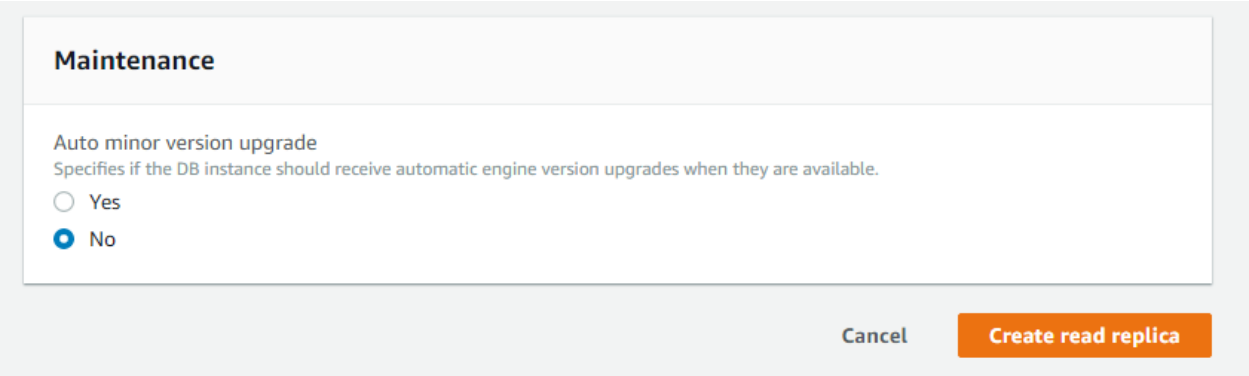
IAM DB authentication info

- Enable IAM DB authentication
  Manage your database user credentials through AWS IAM users and roles.
- Disable

Monitoring

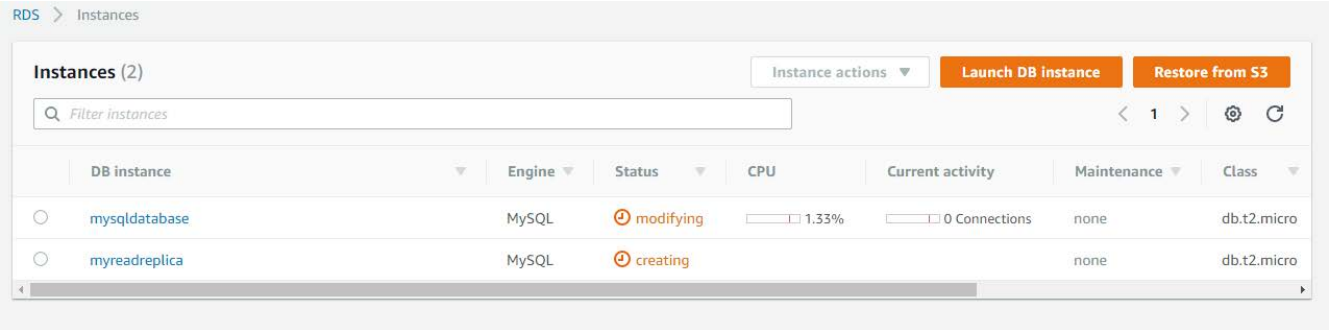
Enhanced monitoring

- Enable enhanced monitoring
  Enhanced monitoring metrics are useful when you want to see how different processes or threads use the CPU.
- Disable enhanced monitoring

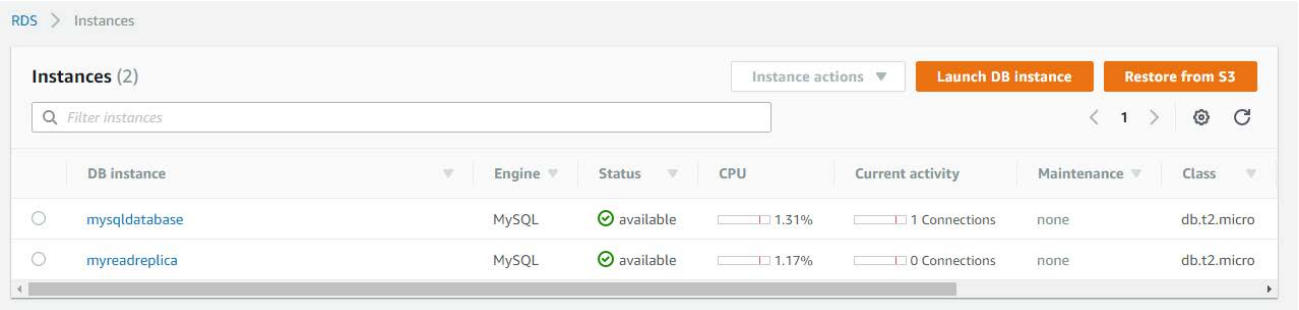


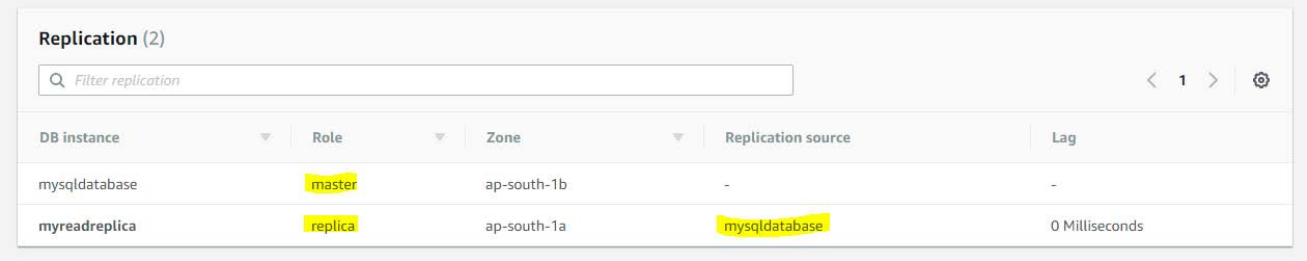
Select the Read replica source and give a name for the replica and choose in what availability zone you want to deploy and even we can select the desired availability zone in the destination region also.

Select the appropriate options and click on Create read replica option. Read replica creation will start and we can see the status in dashboard.



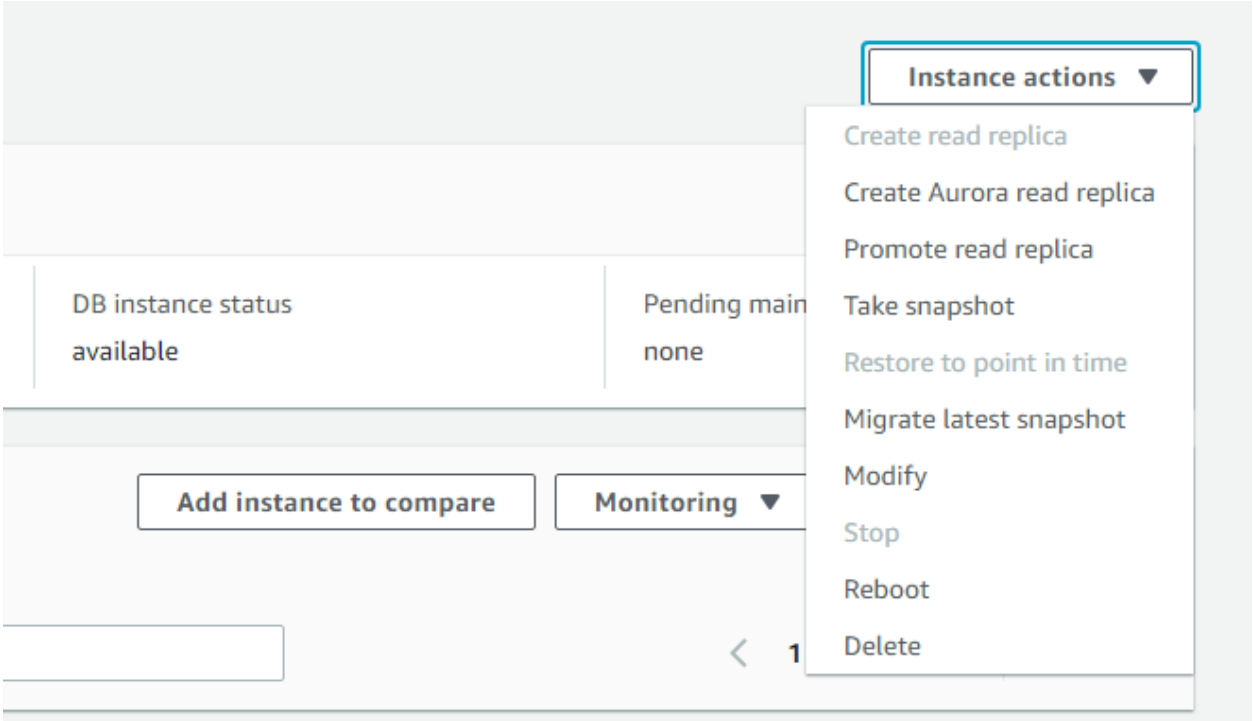
Now read replica is created. To verify the master and slave status we can go to details and verify.

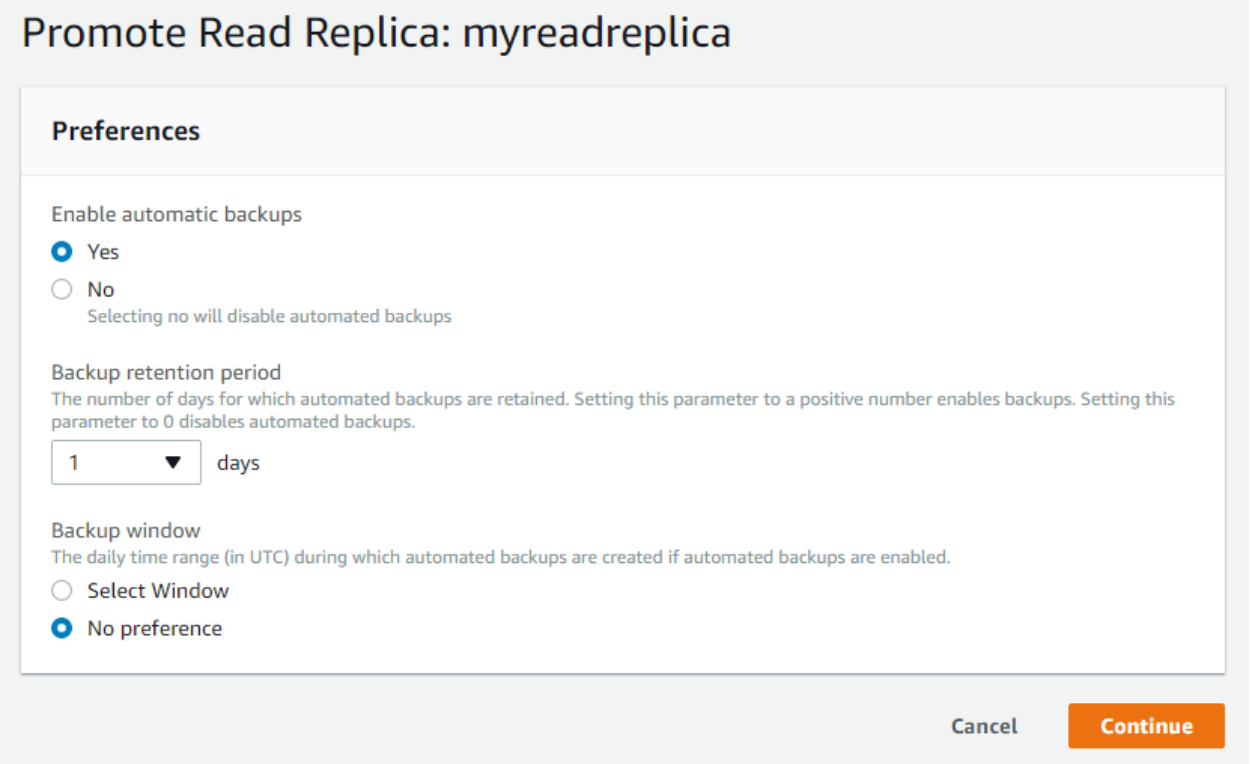




- And we can promote the read replica to a standalone db instance, but this breaks the replication.

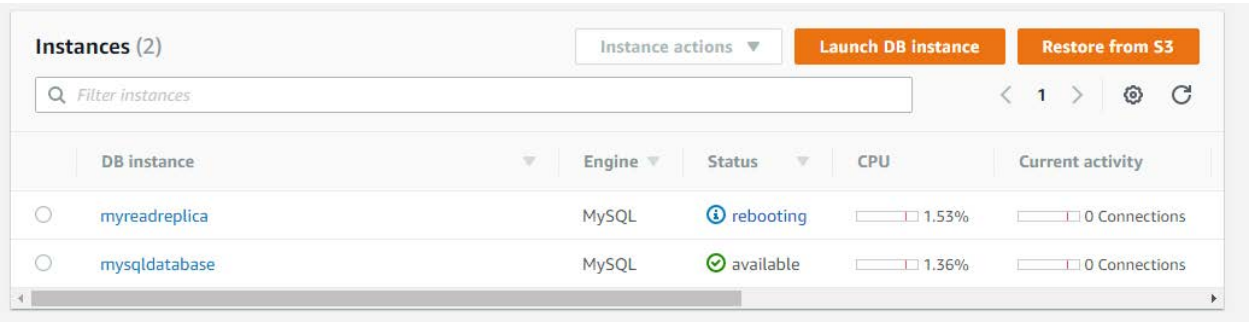
To promote a read replica, choose the **"Promote Read Replica"** option from "Instance Actions"



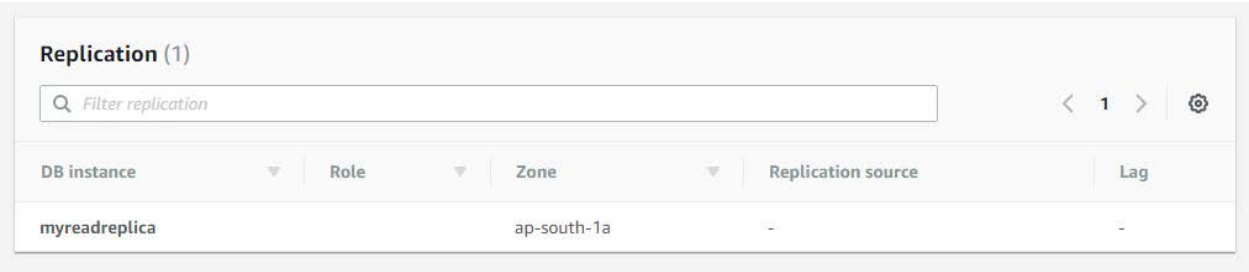


- If we want to promote a read replica, we must enable the automated backups and need to select the backup retention period, and you can select the backup window.

We will get a note with the following information:



Now the read replica is promoted as an individual db instance and no replication is enabled with any other db instances.



Amazon DynamoDB:

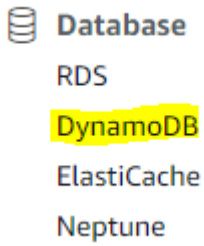
Amazon DynamoDB is a fully managed NoSQL database service that provides fast and lowlatencyperformance that scales with ease.Amazon DynamoDB significantly simplifies the hardware provisioning, setup andconfiguration, replication, software patching, and cluster scaling of NoSQL databases.

Amazon DynamoDB can provide consistent performance levels by automatically distributingthe data and traffic for a table over multiple partitions. After you configure a certain read orwrite capacity, Amazon DynamoDB will automatically add enough infrastructure capacity tosupport the requested throughput levels. As your demand changes over time, you can adjustthe read or write capacity after a table has been created, and Amazon DynamoDB will add orremove infrastructure and adjust the internal partitioning accordingly.

- All table data is stored on high performance SSD disk drives.
- Applications can connect to the Amazon DynamoDB service endpoint and submit requestsover HTTP/S to read and write items to a table or even to create and delete tables.

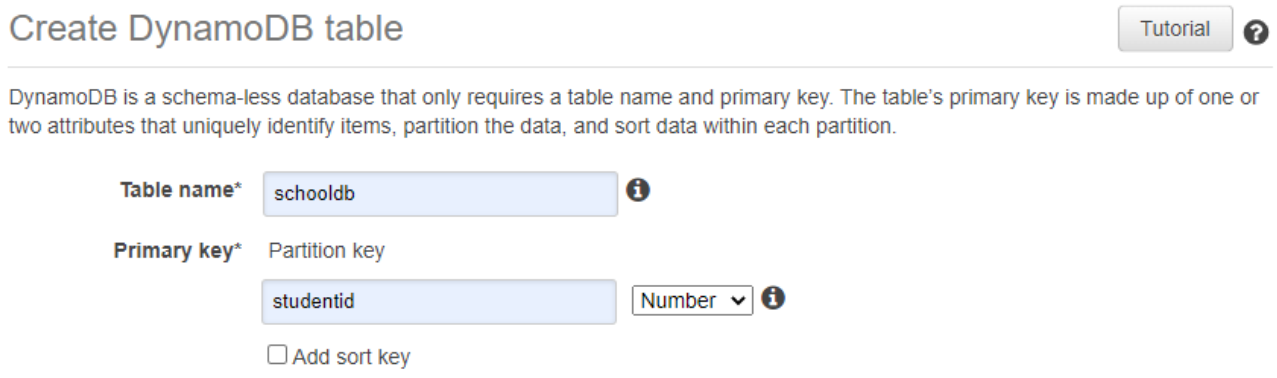
Provisioned Capacity: When you create an Amazon DynamoDB table, you are required to provision a certainamount of read and write capacity to handle your expected workloads.

1. We can find Dynamo DB under Database module

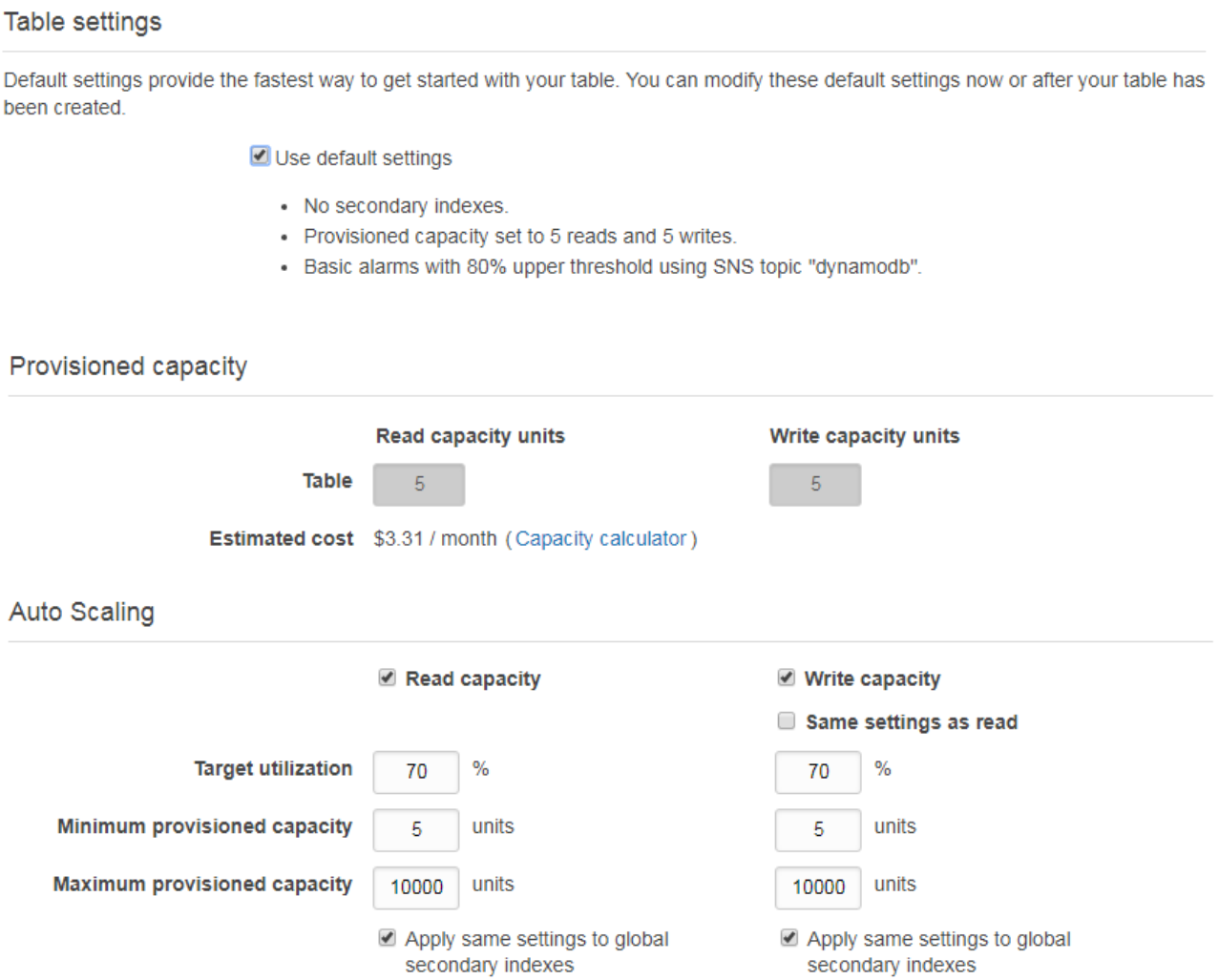


2. Choose “Create table” option to start creating tables in DynamoDB

3. Choose a Table Name and Primary key for the database table.

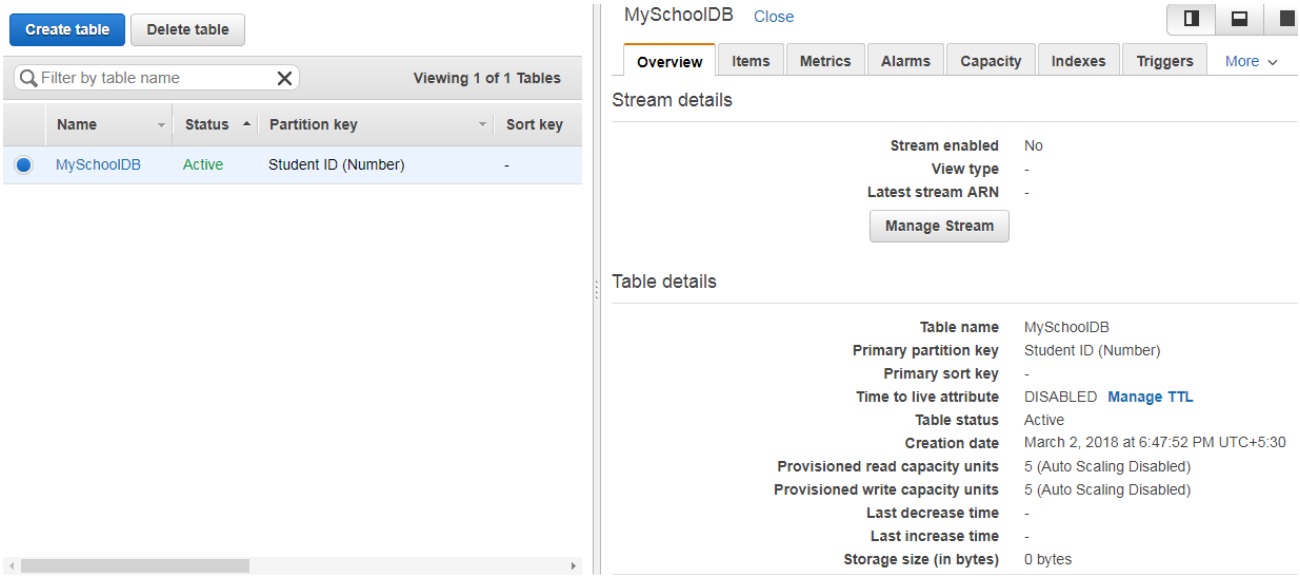


4. We choose default settings as mentioned below, or you can customize the setting by unchecking “use default settings” option



5. If you don't want to enable auto scaling of DynamoDB, simply uncheck the "Read capacity" & "Write ccapacity" options.

6. As shown below, a table is created and you can navigate to **"Items"** and you can start adding items.



Amazon Redshift

Amazon Redshift is a fast, powerful, fully managed, petabyte-scale data warehouse service in the cloud. Amazon Redshift is a relational database designed for OLAP scenarios andoptimized for high-performance analysis and reporting of very large datasets. Traditional datawarehouses are difficult and expensive to manage, especially for large datasets. AmazonRedshift not only significantly lowers the cost of a data warehouse, but it also makes it easyto analyze large amounts of data very quickly.

Amazon Redshift gives you fast querying capabilities over structured data using standard SQLcommands to support interactive querying over large datasets. With connectivity via ODBC orJDBC, Amazon Redshift integrates well with various data loading, reporting, data mining, andanalytics tools. Amazon Redshift is based on industry-standard PostgreSQL, so most existingSQL client applications will work with only minimal changes.

Amazon Redshift manages the work needed to set up, operate, and scale a data warehouse,from provisioning the infrastructure capacity to automating ongoing administrative tasksssuch as backups and patching. Amazon Redshift automatically monitors your nodes anddrives to help you recover from failures.

Clusters and Nodes

The key component of an Amazon Redshift data warehouse is a cluster. A cluster is composed of a leader node and one or more compute nodes. The client application interacts directlyonly with the leader node, and the compute nodes are transparent to external applications.

- Single Node (160Gb)
- Multi-Node
  - Leader Node (manages client connections and receives queries).
  - Compute Node (store data and perform queries and computations). Up to 128 Compute Nodes.

Read the FAQs on Redshift at given URL: https://aws.amazon.com/redshift/faqs/

Elasticache

ElastiCache is a web service that makes it easy to deploy, operate, and scale an in-memory cache in the cloud. The service improves the performance of web applications by allowing you to retrieve information from fast, managed, in-memory caches, instead of relying entirely on slower disk-based databases.

Amazon ElastiCache can be used to significantly improve latency and throughput for many read-heavy application workloads or compute-intensive workloads. Caching improves application performance by storing critical pieces of data in memory for low-latency access. Cached information may include the results of I/O-intensive database queries or the results of computationally-intensive calculations.
Elasticache is a good choice if your database is particularly read heavy and not prone to frequent changing.
Memcached: High-performance, distributed memory object caching system, intended for use in speeding up dynamic web applications.

Redis: A popular open-source in-memory key-value store that supports data structures such as sorted sets and lists. ElastiCache supports Master / Slave replication and Multi-AZ which can be used to achieve cross AZ redundancy.

Read the FAQs on Elasticcache at given URL:
https://aws.amazon.com/elasticache/faqs/

Please refer below video for Database migration service.

https://www.youtube.com/watch?v=iRhJDGp-ew8

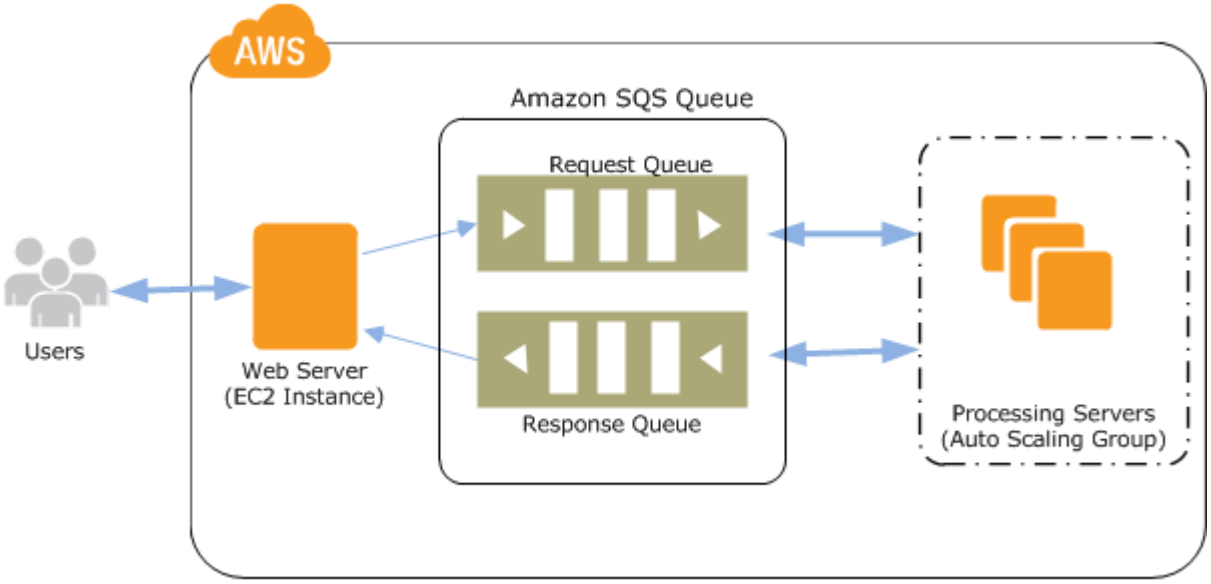
APPLICATION SERVICES:

Amazon Simple Queue Service (Amazon SQS)

Amazon SQS is a fast, reliable, scalable, and fully managed message queuing service. AmazonSQS makes it simple and cost effective to decouple the components of a cloud application.

- Amazon SQS is a web service that gives you access to a message queue that can be used to store messages while waiting for a computer to process them.
- A queue is a temporary repository for messages that are awaiting processing.
- An Amazon SQS queue is basically a buffer between the application components that receive data and those components that process the data in your system.
- Messages can contain up to 256 KB of text in any format.
- Amazon SQS ensures delivery of each message at least once, and supports multiple readers and writers interacting with the same queue.
- Message Retention period is 14 Days
- Amazon SQS is engineered to provide "**at least once**" delivery of all messages in its queues. Although most of the time each message will be delivered to your application exactly once.
- A single queue can be used simultaneously by many distributed application components, with no need for those components to coordinate with each other to share the queue.
- Maximum message size 256kb now available
- AWS will Billed as Chunks, Each Chunk size is 64kb, That means a 256kb message will be 4 x 64kb "chunks".
- First 1 million Amazon SQS Requests per month are fre
- $0.50 per 1 million Amazon SQS Requests per month thereafter ($0.00000050 per SQS Request)
- A single request can have from 1 to 10 messages, up to a maximum total payload of 256KB.
- Each 64KB 'chunk' of payload is billed as 1 request. For example, a single API call with a 256KB payload will be billed as four requests.

For example, suppose that you have a web app that receives orders from customers. The app runs on EC2 instances in an Auto Scaling group that is configured to handle a typical number of orders. The app places the orders in an Amazon SQS queue until they are picked up for processing, processes the orders, and then sends the processed orders back to the customer. The following diagram illustrates the architecture of this example.



Amazon SQS is a distributed queue system that enables web service applications to quickly and reliably queue messages that one component in the application generates to be consumed by another component.

UsingAmazon SQS, you can store application messages on reliable and scalable infrastructure,enabling you to move data between distributed components to perform different tasks asneeded.

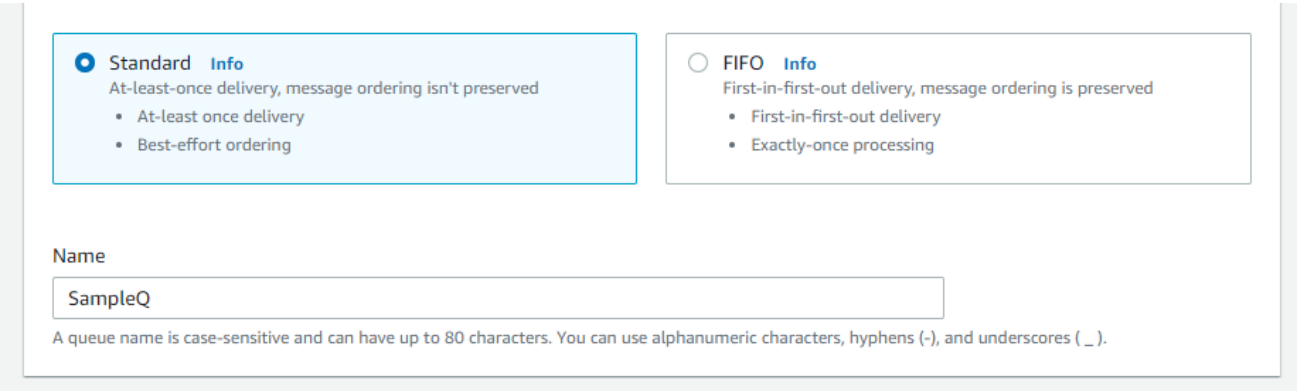
Amazon SQS ensures delivery of each message at least once and supports multiple readersand writers interacting with the same queue. A single queue can be used simultaneously bymany distributed application components, with no need for those components to coordinatewith one another to share the queue. Although most of the time each message will be delivered to your application exactly once, you should design your system to be idempotent

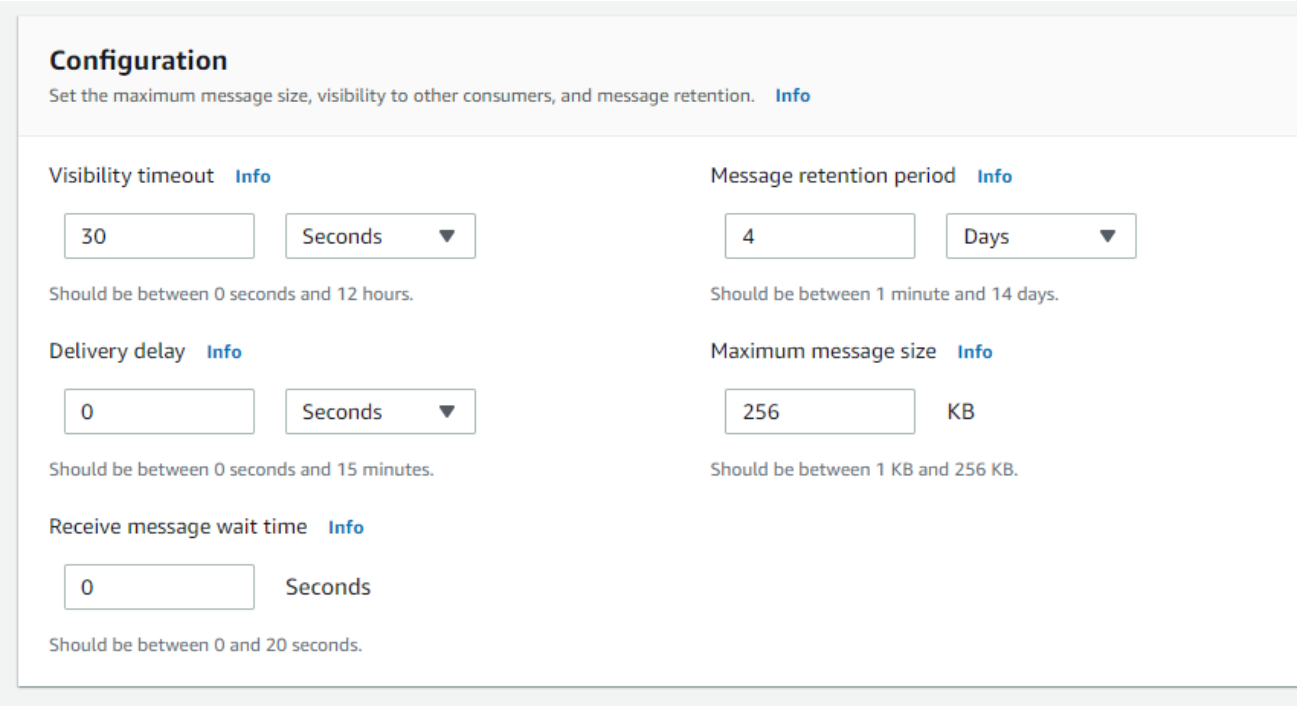
SQL service does not guarantee First In, First Out (FIFO) delivery ofmessages.

Amazon SQS supports up to 12 hours' maximum visibility timeout.

When creating a new queue, you must provide a queue name that is unique within the scopeof all of your queues. Amazon SQS assigns each queue an identifier called a queue URL,which includes the queue name and other components that Amazon SQS determines.Whenever you want to perform an action on a queue, you must provide its queue URL.

- TO create a Queue, Navigate to "Messaging" section and select the "Simple Queue Service".
- Here is the default values we are getting with the Queue.



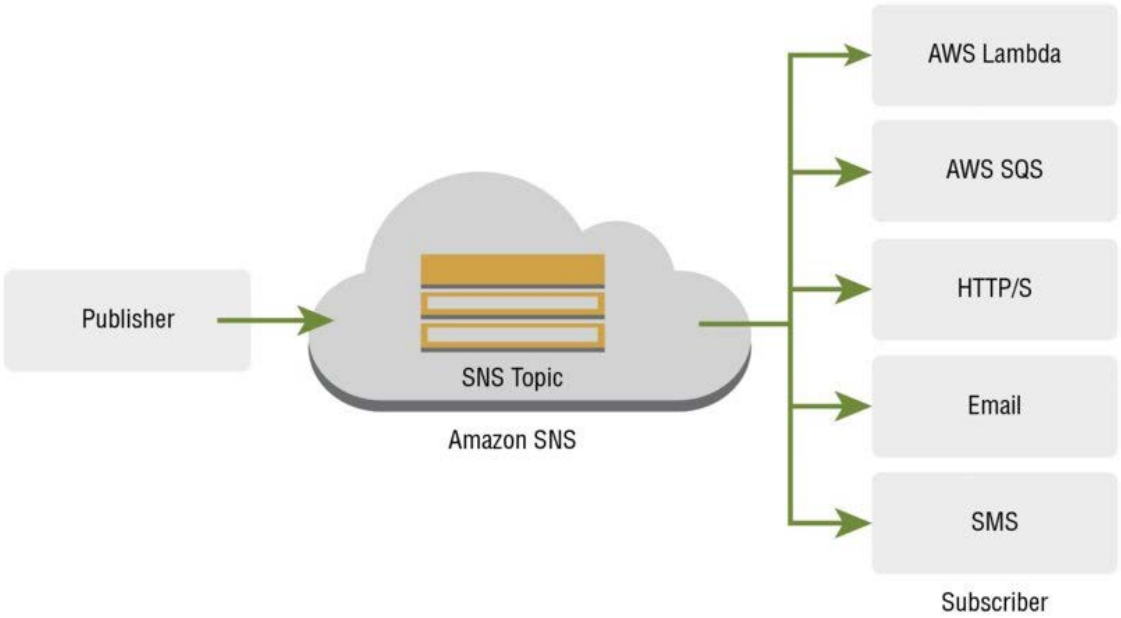


Amazon Simple Notification Service (Amazon SNS)

Amazon Simple Notification Service (Amazon SNS) is a web service that makes it easy to set up, operate, and send notifications from the cloud.
It provides developers with a highly scalable, flexible, and cost-effective capability to publish messages from an application and immediately deliver them to subscribers or other applications.
Push notifications to Apple, Google, Fire OS, and Windows devices, as well as Android devices in China with Baidu Cloud Push.
Amazon SNS consists of two types of clients: publishers and subscribers (sometimes knownas producers and consumers).

- Publishers communicate to subscribers asynchronously by sending a message to a topic.
- A topic is simply a logical access point/communication channel that contains a list of subscribers and the methods used to communicate to them.
- When you send a message to a topic, it is automatically forwarded to each subscriber of that topic using the communication method configured for that subscriber.

Besides pushing cloud notifications directly to mobile devices, Amazon SNS can also deliver notifications by SMS text message or email, to Amazon Simple Queue Service (SQS) queues, or to any HTTP endpoint.



To prevent messages from being lost, all messages published to Amazon SNS are stored redundantly across multiple availability zones.
SNS allows you to group multiple recipients using topics. A topic is an "access point" for allowing recipients to dynamically subscribe for identical copies of the same notification.

Application and System Alerts
Application and system alerts are SMS and/or email notifications that are triggered bypredefined thresholds. For example, we can receive immediate notification when an event occurs, such as a specific change to yourAuto Scaling group in AWS.

Push Email and Text Messaging
Push email and text messaging are two ways to transmit messages to individuals or groups via email and/or SMS. For example, you can use Amazon SNS to push targeted newsheadlines to subscribers by email or SMS. Upon receiving the email or SMS text, interestedreaders can then choose to learn more by visiting a website or launching an application.

Mobile Push Notifications
Mobile push notifications enable you to send messages directly to mobile applications. Forexample, you can use Amazon SNS for sending notifications to an application, indicating thatan update is available. The notification message can include a link to download and install the update.

SNS Benefits

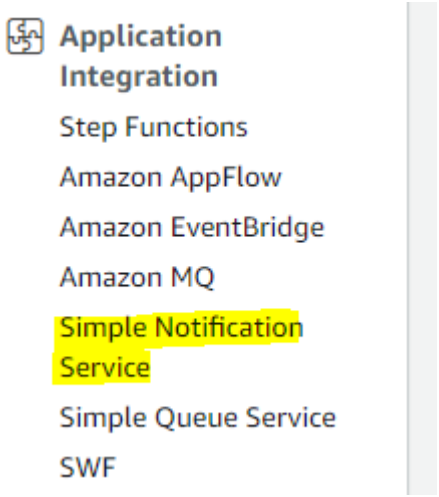
- Instantaneous, push-based delivery (no polling)
- Simple APIs and easy integration with applications
- Flexible message delivery over multiple transport protocols
- Inexpensive, pay-as-you-go model with no up-front costs
- Web-based AWS Management Console offers the simplicity of a
- point-and-click interface

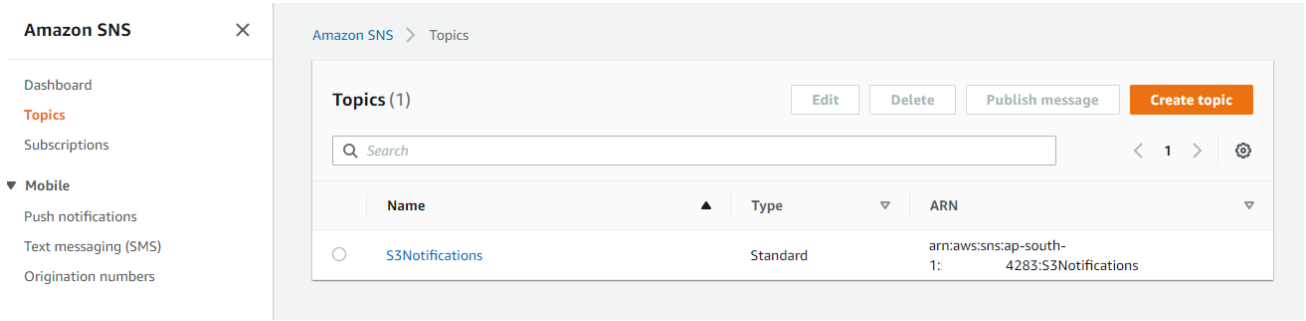
SNS vs SQS
• Both Messaging Services in AWS
• SNS - Push

• SQS - Polls (Pulls)

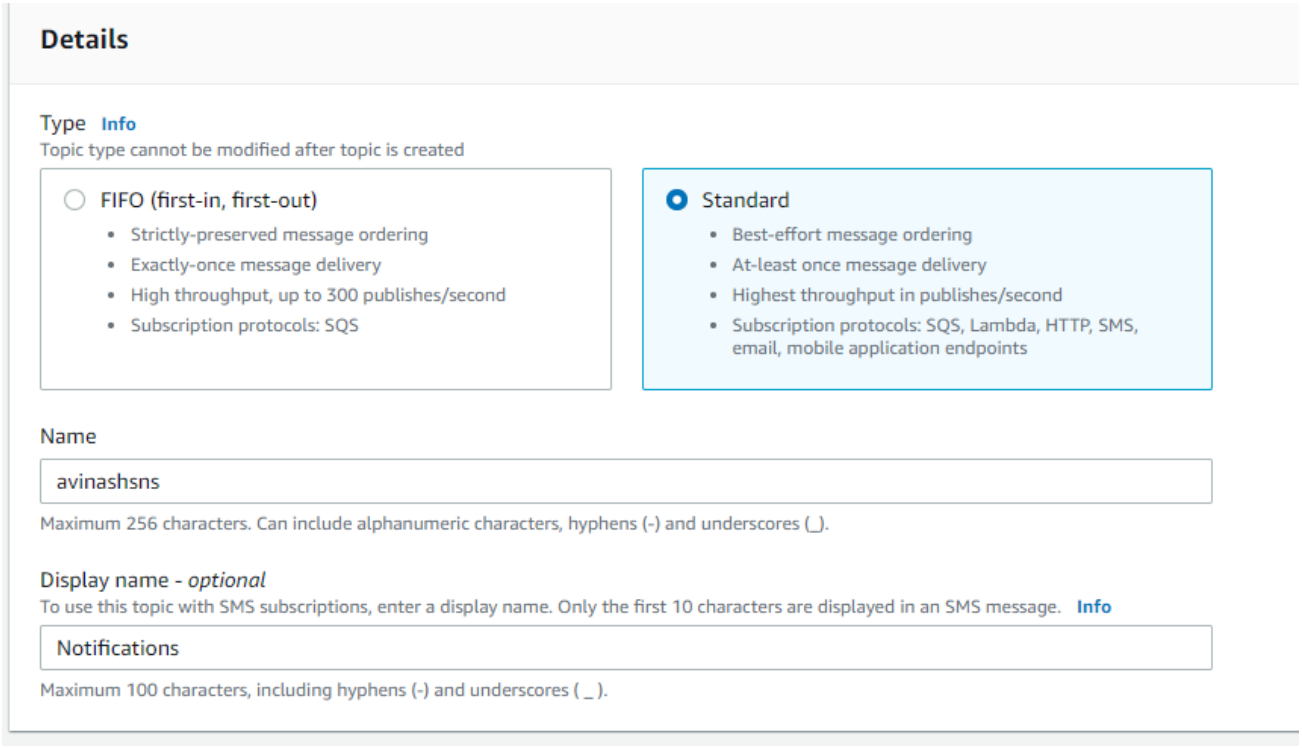
Creating SNS Topic and Publishing:

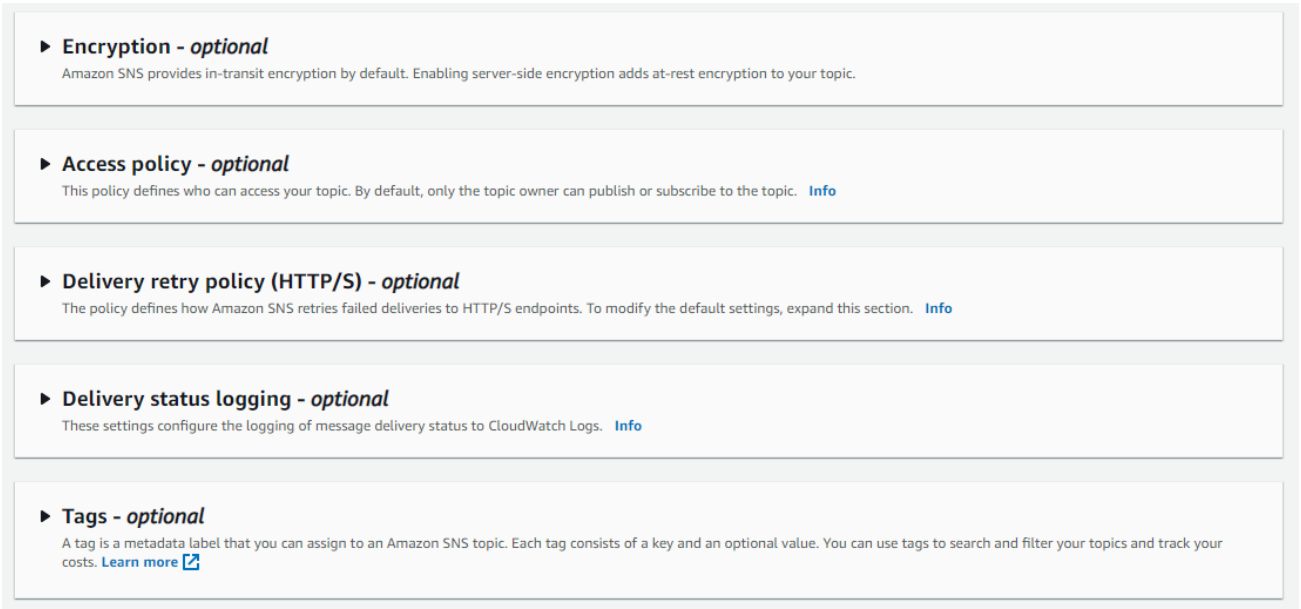
- Sign in to AWS account and Navigate to Mobile Services and then Amazon SNS to load the Amazon SNS dashboard.



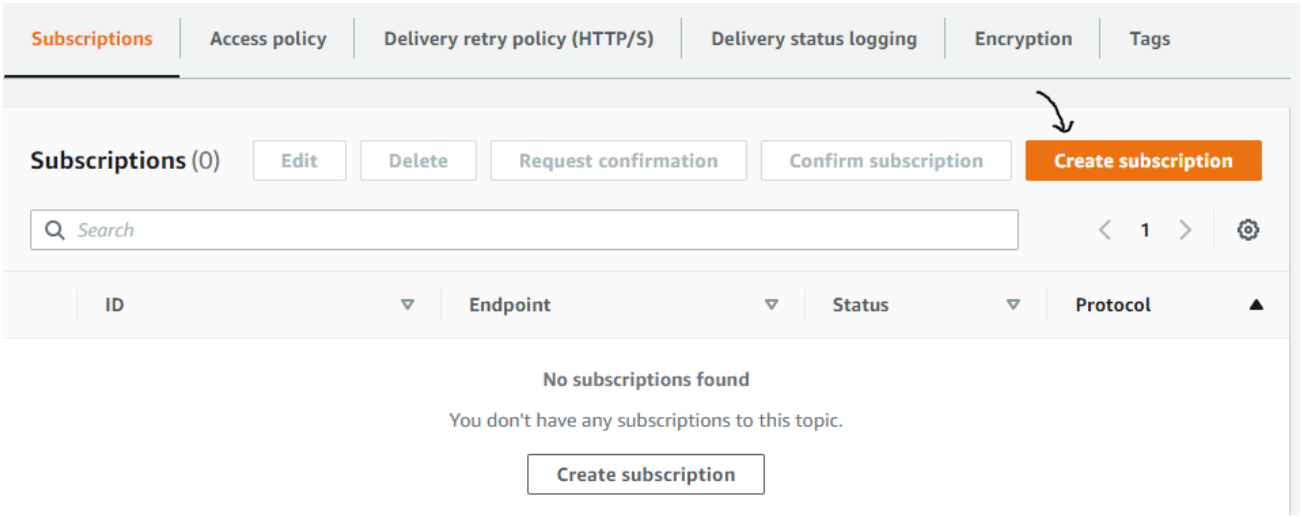


- Create a new topic by selecting "**Create topic"** option, and give a name for Topic and Display Name.

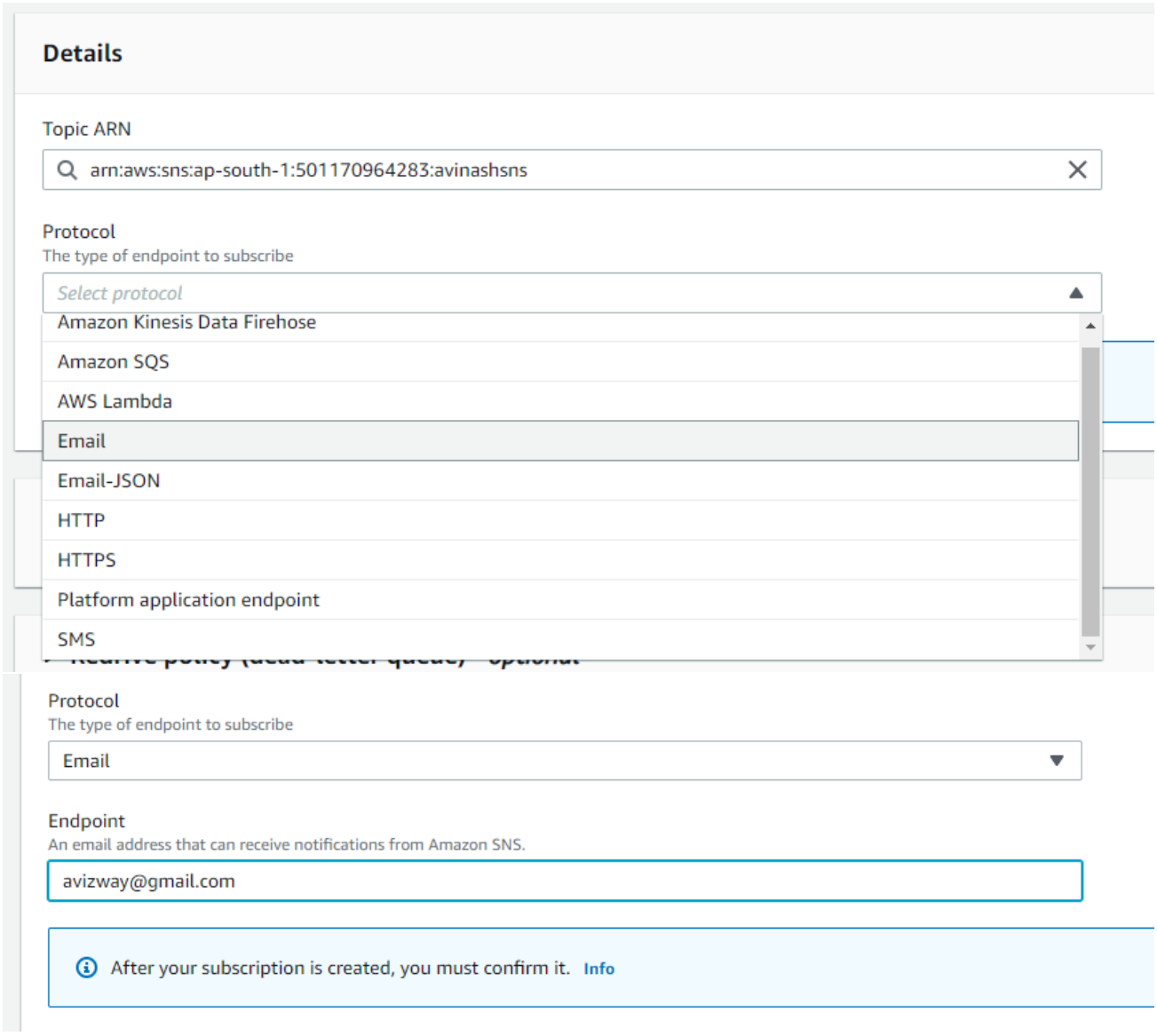




- Once topic is created, We can publish to Topic, but we don't have any Subscribers to this topic, we need to add the subscribers then we can publish to all the Subscribers at a time.
  - Click on Create Subscription option and choose the Protocol as Email and Enter the Email ID you want to subscribe to this topic.

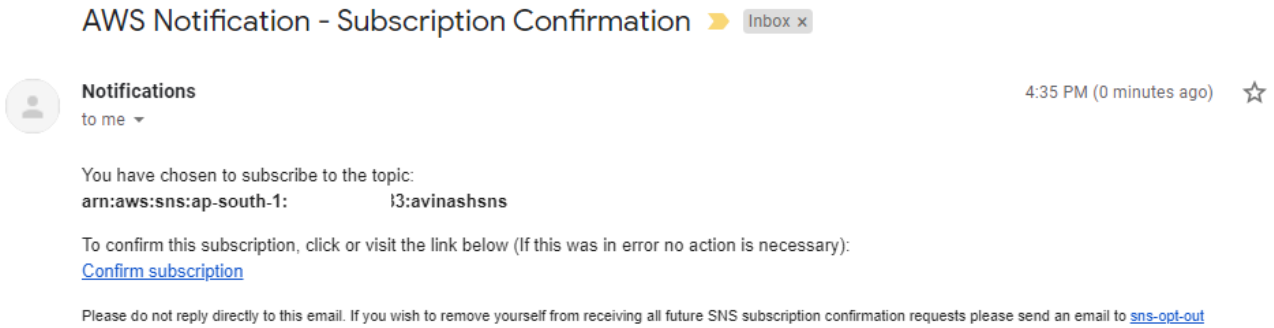


Create a subnscription and choose **"Protocol"** as **"Email" and** enter a valid email address. **Make sure you login to email to confirm the subscription.**



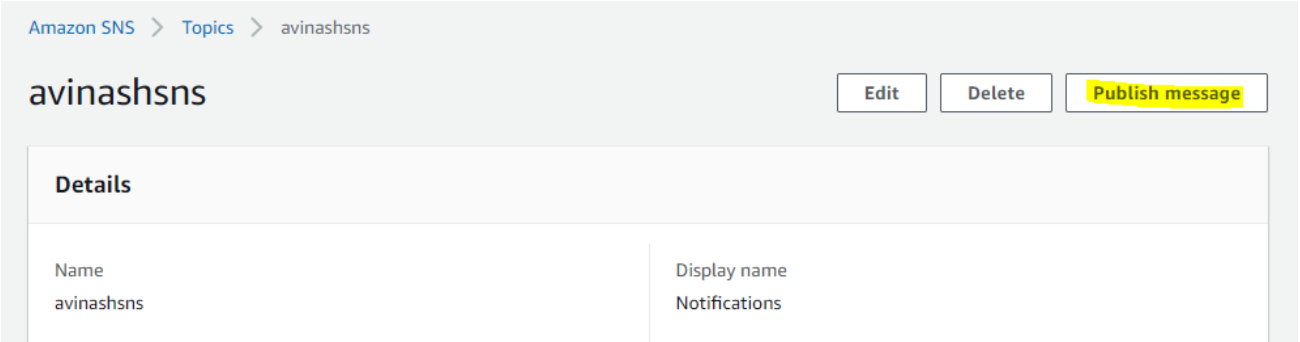
- Now login to the mentioned Email ID and verify the Email from AWS SNS, and it'll ask you to subscribe to the topic.

- You'll get an Email as mentioned below image.



- Click on the Confirm Subscription Link, it'll redirect to another page which shows the subscription status page.
- Now we can publish to the Topic, all the subscribed users will get the email/notification.

- Now select the **"Publish to Topic"** Option Then provide the Subject to the email and enter the Message to send to all the subscribers.



- Give TTL value as 300 Seconds and click on Publish message, immediately all the subscribed users will get the email.
- We can unsubscribe to the Topic at any time, and in every email we'll get unsubscribed URL, we can click on that when we want to opt-out from the topic.

Amazon CloudFront

Amazon CloudFront is a global Content Delivery Network (CDN) service. It integrates with other AWS products to give developers and businesses an easy way to distribute content to end users with low latency, high data transfer speeds, and no minimum usage commitments.

Amazon CloudFront is AWS CDN. It can be used to deliver your web content using Amazon's global network of edge locations. When a user requests content that you're serving with Amazon CloudFront, the user is routed to the edge location that provides the lowest latency (time delay), so content is delivered with the best possible performance. If the content is already in the edge location with the lowest latency, Amazon CloudFront delivers it immediately. If the content is not currently in that edge location, Amazon CloudFront retrieves it from the origin server, such as an Amazon Simple Storage Service (Amazon S3) bucket or a web server, which stores the original, definitive versions of your files.

Amazon CloudFront is optimized to work with other AWS cloud services as the origin server, including Amazon S3 buckets, Amazon S3 static websites, Amazon Elastic Compute Cloud (Amazon EC2), and Elastic Load Balancing. Amazon CloudFront also works seamlessly with any non-AWS origin server, such as an existing on-premises web server. Amazon CloudFront also integrates with Amazon Route 53.

Amazon CloudFront supports all content that can be served over HTTP or HTTPS. This includes any popular static files that are a part of your web application, such as HTML files, images, JavaScript, and CSS files, and also audio, video, media files, or software downloads. Amazon CloudFront also supports serving dynamic web pages, so it can actually be used to deliver your entire website. Finally, Amazon CloudFront supports media streaming, using both HTTP and RTMP.

Amazon CloudFront Basics

Below are the concepts, we can easily use CloudFront to speed up delivery of static content from your websites.

1. Distributions
2. Origins
3. Cache control.

Distributions: To use Amazon CloudFront, you start by creating a distribution, which is identified by a DNS domain name such as d111111abcdef8.cloudfront.net. To serve files from Amazon CloudFront, you simply use the distribution domain name in place of your website's domain name; the rest of the file paths stay unchanged.

Origins: When you create a distribution, you must specify the DNS domain name of the origin-the Amazon S3 bucket or HTTP server-from which you want Amazon CloudFront to get the definitive version of your objects (web files).

CacheControl: Once requested and served from an edge location, objects stay in the cache until they expire. By default,objects expire from the cache after24hours.

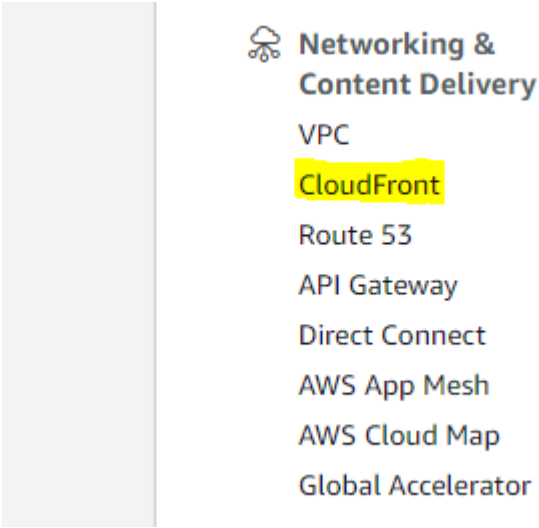
SignedURLs Use URLs that are valid only between certaintimes and optionally from certain IP addresses.

SignedCookies Require authentication via public and private keypairs.

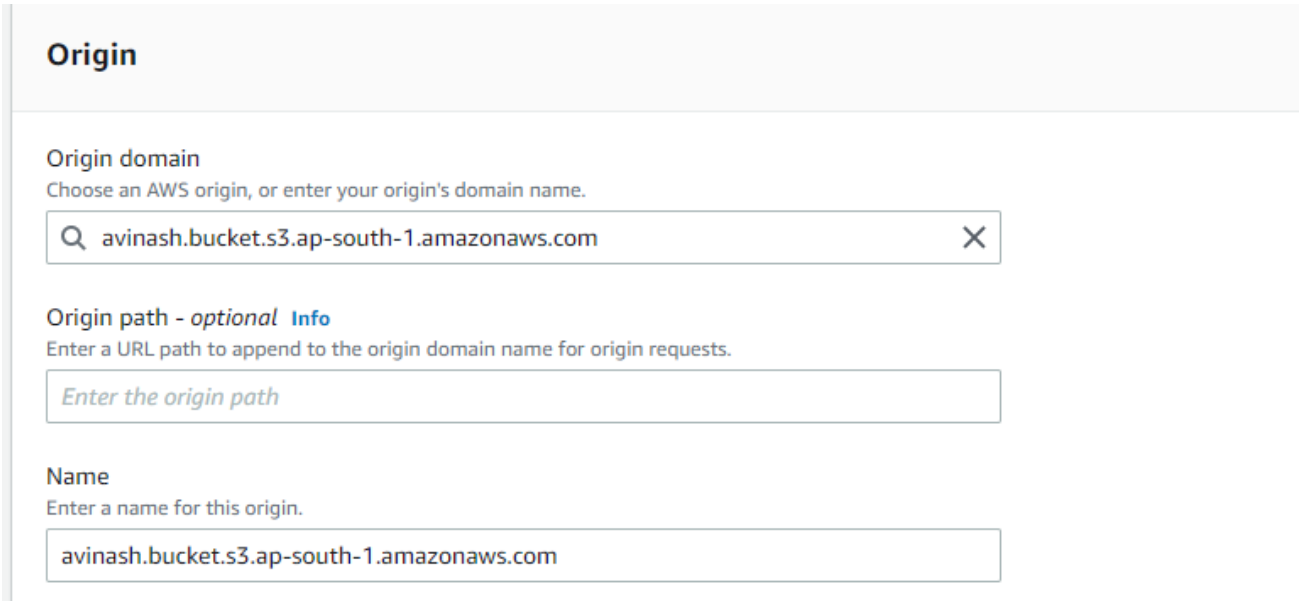
Origin Access Identities(OAI): Restrict access to an Amazon S3 bucket only to a special Amazon Cloud Front user associated with your distribution. This is the easiest way to ensure that content in a bucket is only accessed by Amazon CloudFront.

Creating a Cloudfront Distribution: (Mostly am choosing all the default options)

1. We can find the CloudFront distribution under **"Networking & Content Delivery"**

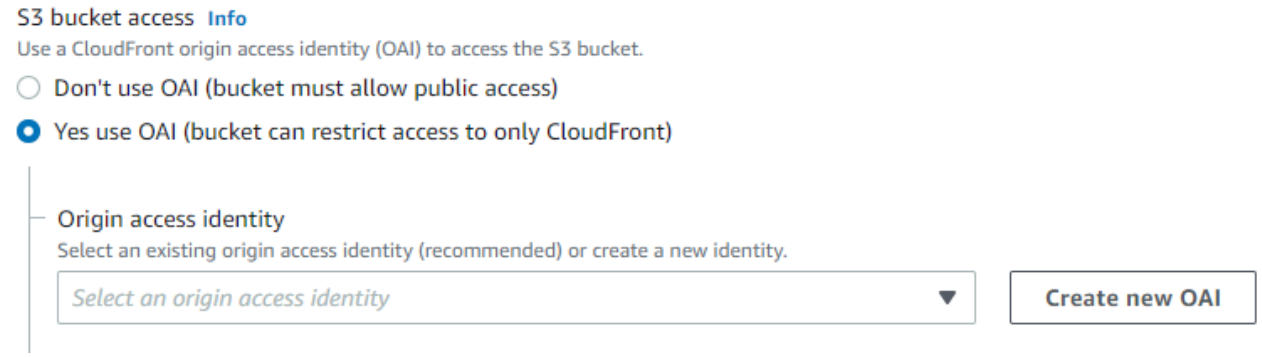


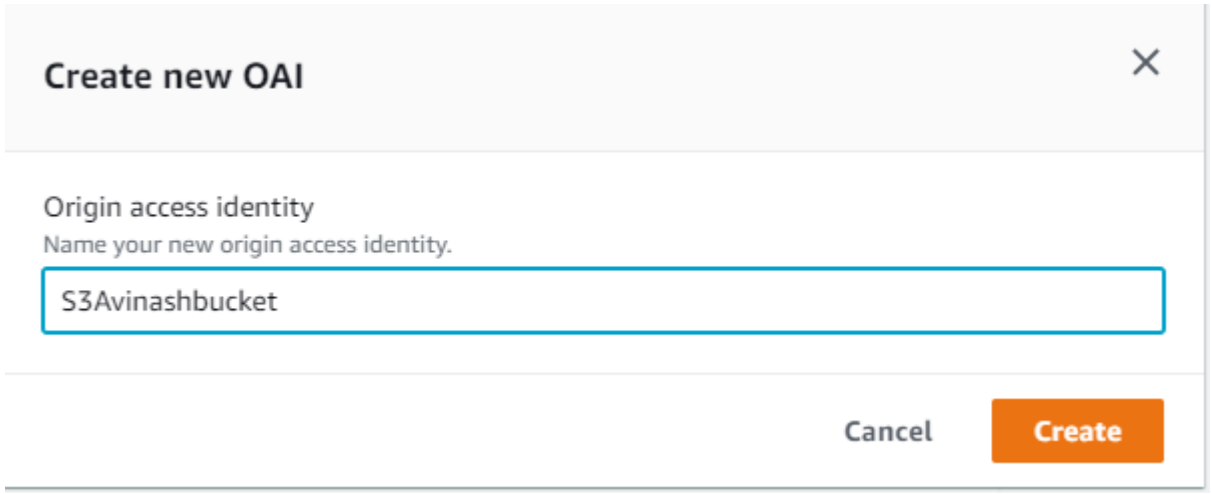
2. Click on **"Create Distribution"** then we need to choose the **"Origin Settings".** In below example am using S3 bucket as Origin.

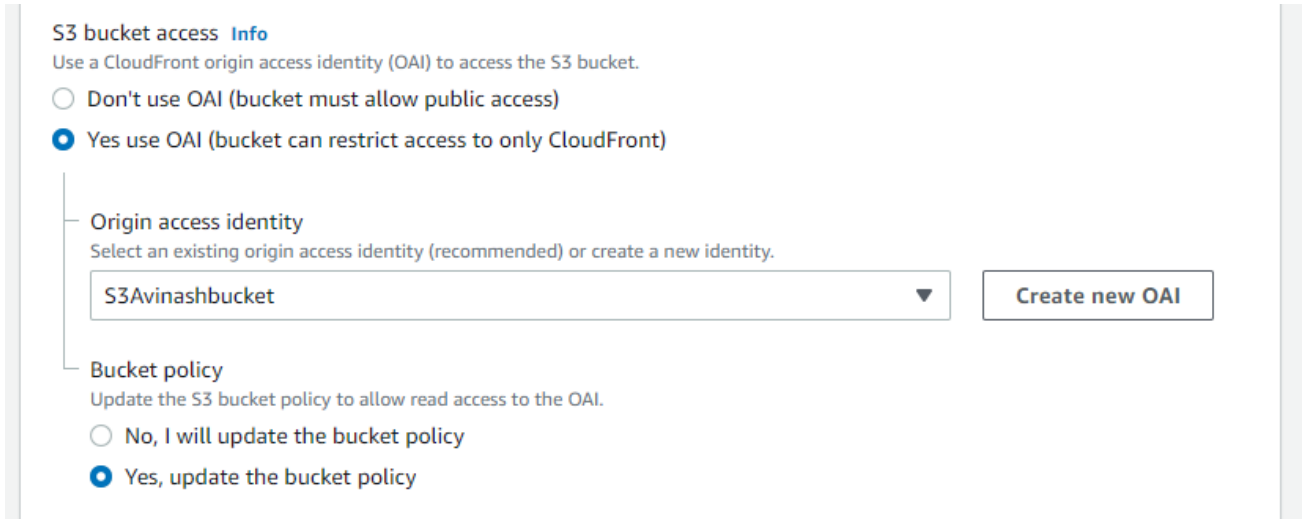


3. It's always recommended to use OAI (Origin Access Identity is used for sharing private content via CloudFront. The OAI is a virtual user identity that will be used to give your CF distribution permission to fetch a private object from your origin server (e.g. S3 bucket)).

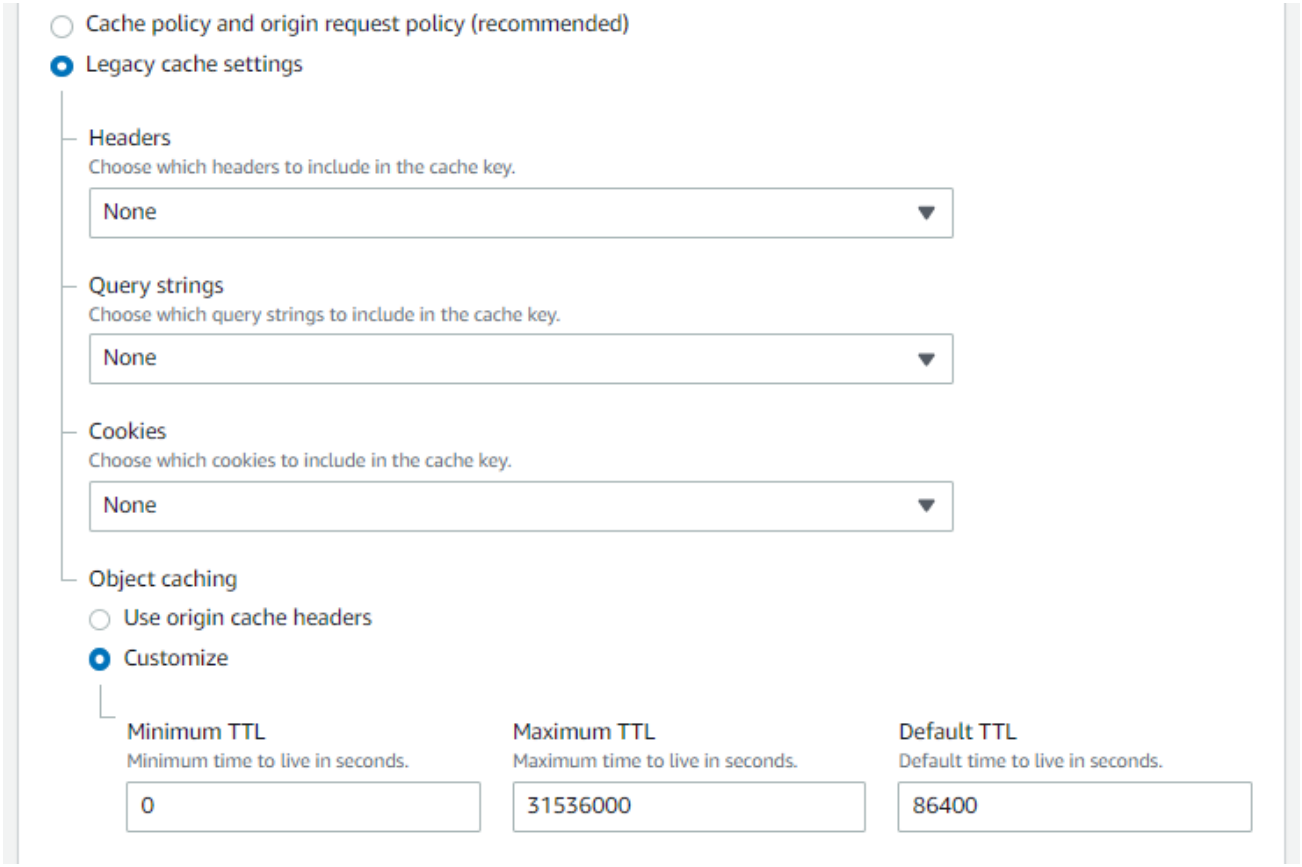
4. Choose "Create new OAI"



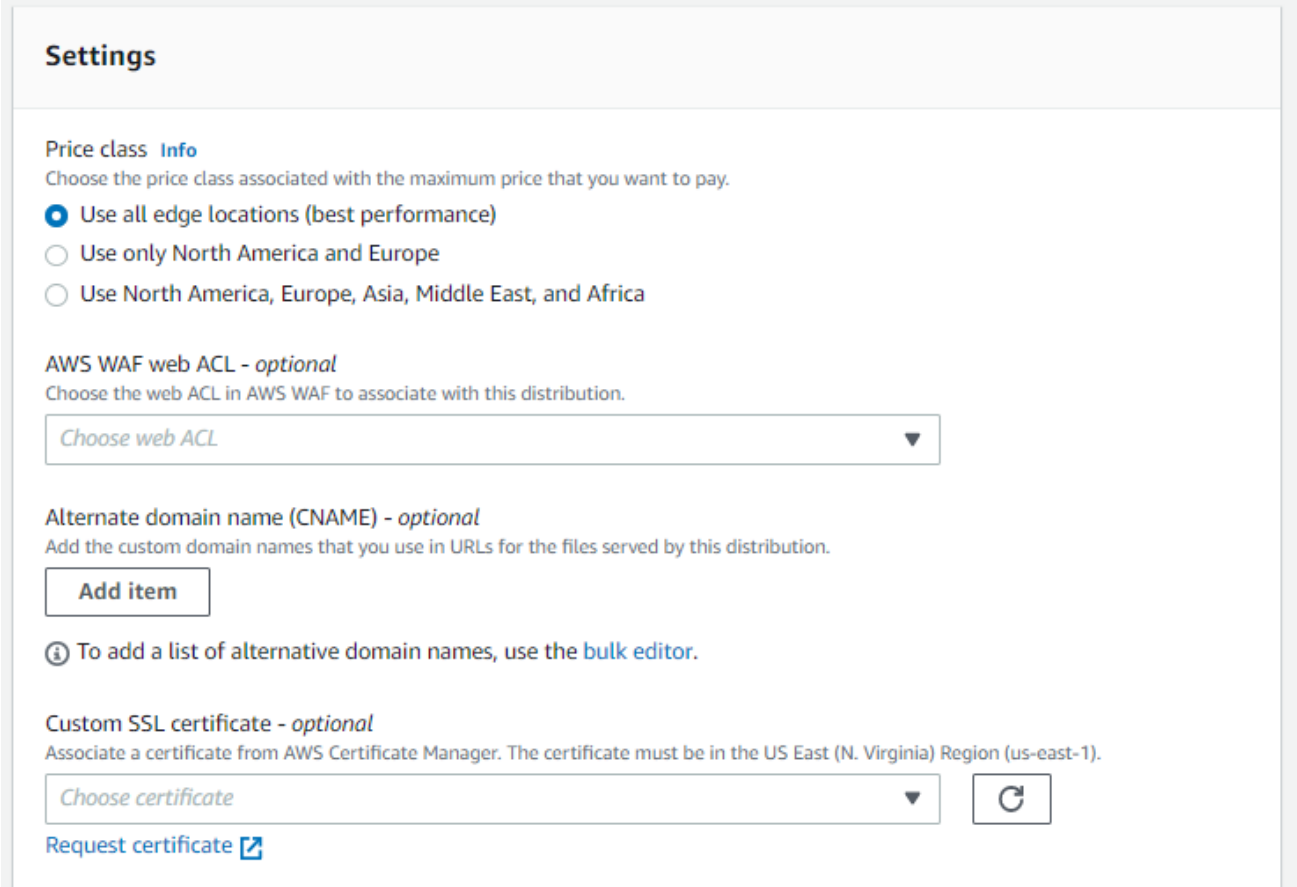




5. In this example am Choose “Legacy Cache settings”. Default TTL is 86400 Sec (1 Day), Max TTL is 365 Days.



6. Choose the Distribution Settings

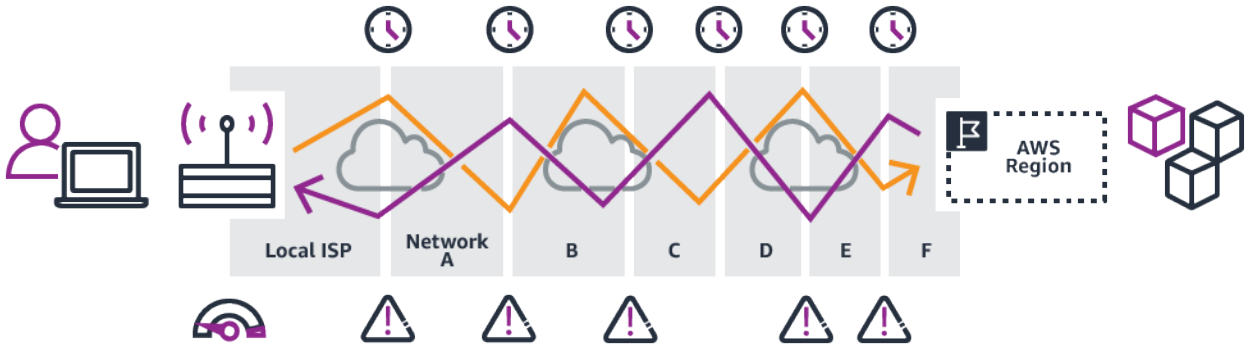


7. For Cloudfront we will get a domain name In this format http://d111111abcdef8.cloudfront.net/ . We can access the Objects with Cloudfront distribution, the objects are going to deliver from near by edge location.

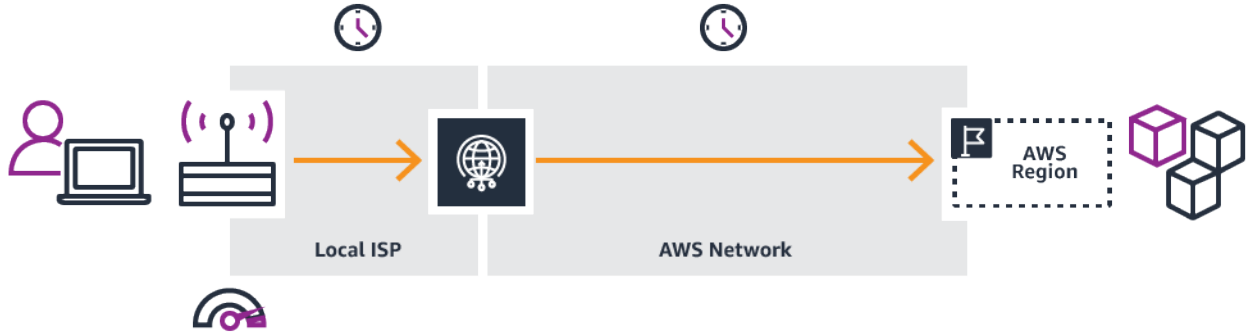
AWS Global Accelerator

AWS Global Accelerator is a networking service that improves the availability and performance of the applications that you offer to your global users. AWS Global Accelerator uses the AWS global network to direct internet traffic from your users to your applications on AWS, making your users' experience more consistent.

Example diagram without Global Accelerator:



With AWS Global Accelerator:

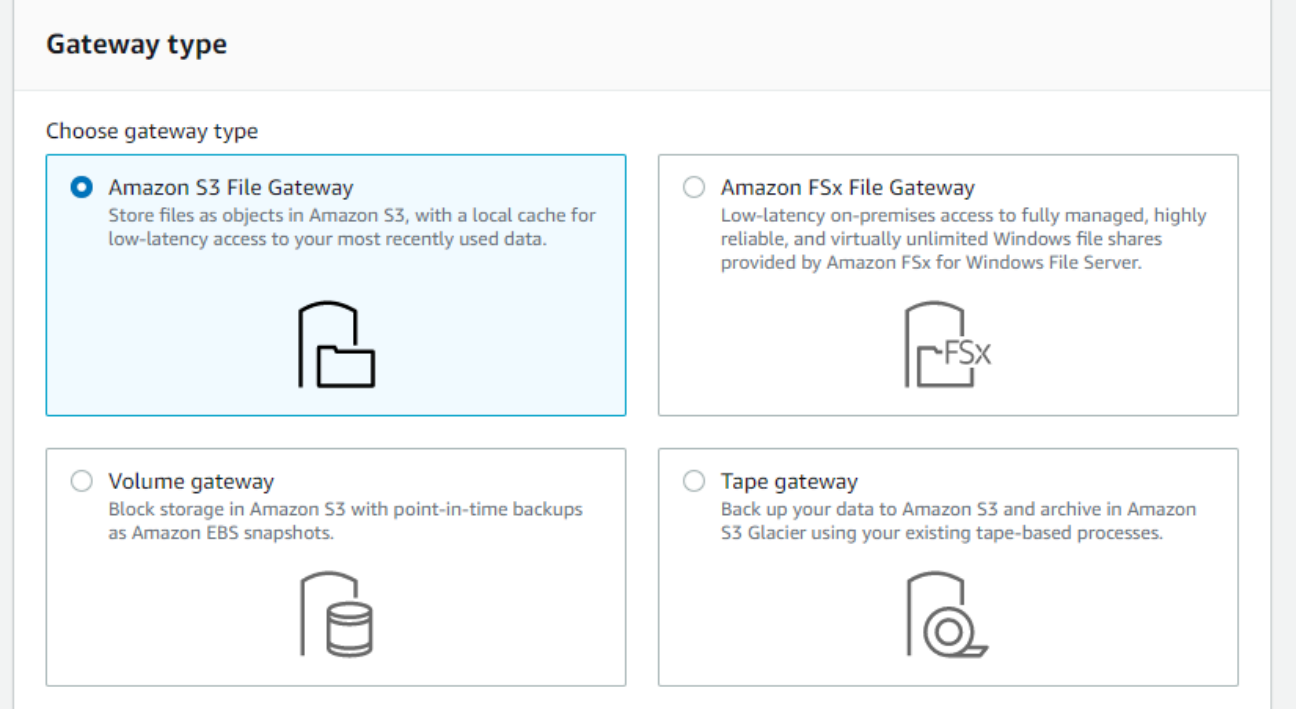


We can perform the Speed comparison using below link before deploying our application via Global accelerator.
https://speedtest.globalaccelerator.aws/#/

AWS Storage Gateway

AWS Storage Gateway is a service connecting an on-premises software appliance with cloud-based storage to provide seamless and secure integration between an organization's on-premises IT environment and AWS storage infrastructure.

The service enables you to store data securely on the AWS cloud in a scalable and cost-effective manner. AWS Storage Gateway supports industry-standard storage protocols that work with your existing applications. It provides low-latency performance by caching frequently accessed data on-premises while encrypting and storing all of your data in Amazon S3 or Amazon Glacier.



1. **Amazon S3 File Gateway** : presents a file interface that enables you to store files as objects in Amazon S3 using the industry-standard NFS and SMB file protocols, and access those files via NFS and SMB from your data center or Amazon EC2, or access those files as objects directly in

Amazon S3.

2. **Amazon FSx File Gateway** provides fast, low-latency on-premises access to fully managed, highly reliable, and scalable file shares in the cloud using the industry-standard SMB protocol. Customers can store and access file data in Amazon FSx with Windows-native compatibility including full NTFS support, shadow copies, and Access Control Lists (ACLs). Use Amazon FSx File Gateway for your on-premises file-based business applications and workloads such as user or group file shares, web content management, and media workflows.
3. **Tape Gateway** : presents a virtual tape library (VTL) consisting of virtual tape drives and a virtual media changer to your backup application using storage industry standard iSCSI protocol. You can continue to use your existing backup applications and workflows while writing to a nearly limitless collection of virtual tapes. Each virtual tape is stored in Amazon S3.
4. **Volume Gateway** : presents your applications block storage volumes using the iSCSI protocol. Data written to these volumes can be asynchronously backed up as point-in-time snapshots of your volumes, and stored in the cloud as Amazon EBS snapshots. You can back up your on-premises Volume Gateway volumes using the service's native snapshot scheduler or by using the AWS Backup service. In both cases, volume backups are stored as Amazon EBS snapshots in AWS. These snapshots are incremental backups that capture only changed blocks. All snapshot storage is also compressed to minimize your storage charges.

Refer to this video to configure AWS storagegateway :
https://www.youtube.com/watch?v=wmcBSHpoHhs

AWS CloudTrail:

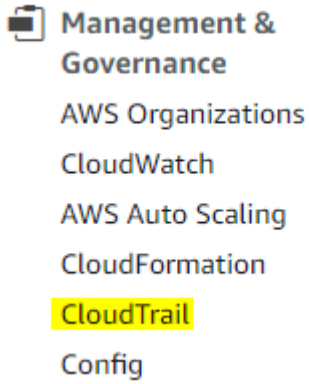
AWS CloudTrail is a service that enables governance, compliance, operational auditing, and risk auditing of your AWS account. With CloudTrail, you can log, continuously monitor, and retain account activity related to actions across your AWS infrastructure.

CloudTrail provides event history of your AWS account activity, including actions taken through the AWS Management Console, AWS SDKs, command line tools, and other AWS services. This event history simplifies security analysis, resource change tracking, and troubleshooting.

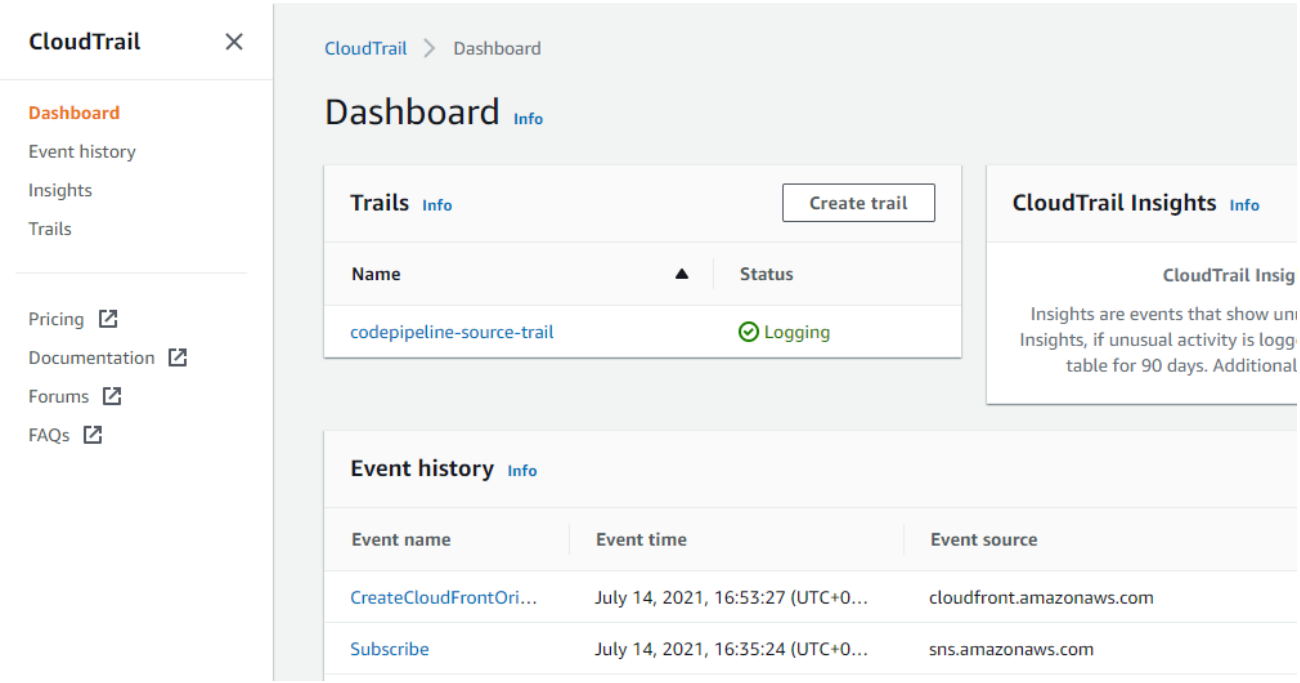
Cloudtrail supports 3 types of events.

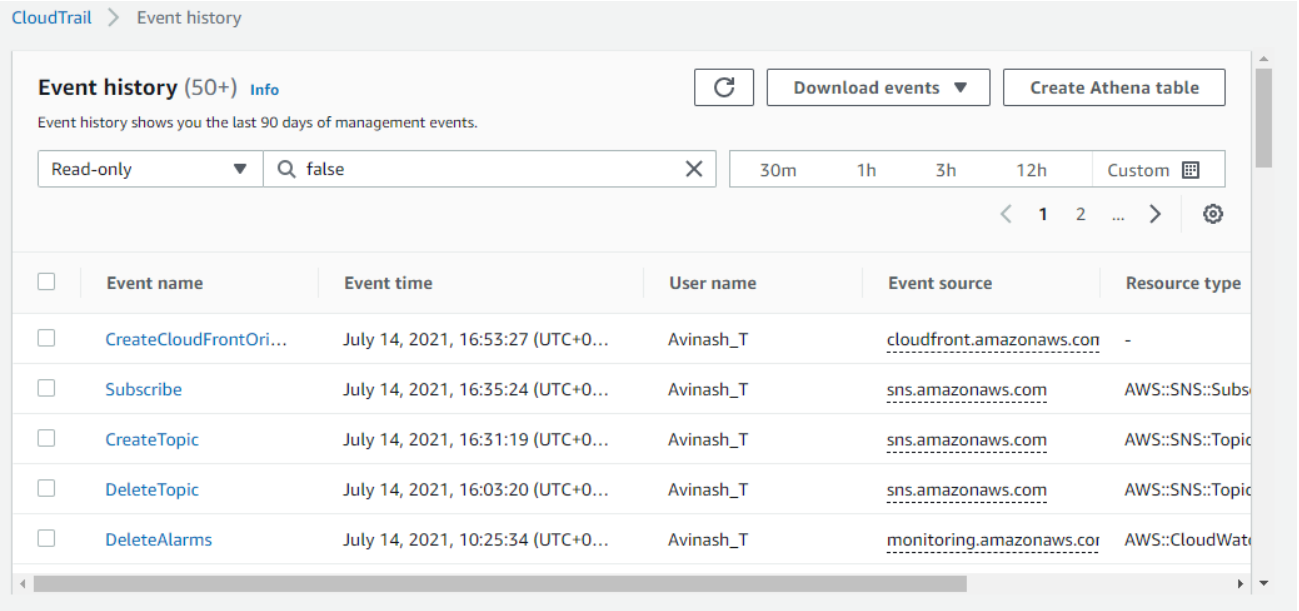
- **Management events** provide information about management operations that are performed on resources in your AWS account. These are also known as control plane operations.
- **Data events** provide information about the resource operations performed on or in a resource. These are also known as data plane operations. Data events are often high-volume activities. Data events can log s3, Dynamodb and Lambda services.
- **Insight Events :** CloudTrail Insights events capture unusual activity in your AWS account. If you have Insights events enabled, and CloudTrail detects unusual activities.

We can find the Cloudtrail under Management Tool in AWS dashboard.



Here is the cloudTrail dashboard, By default we can view the last 90 days all events here.

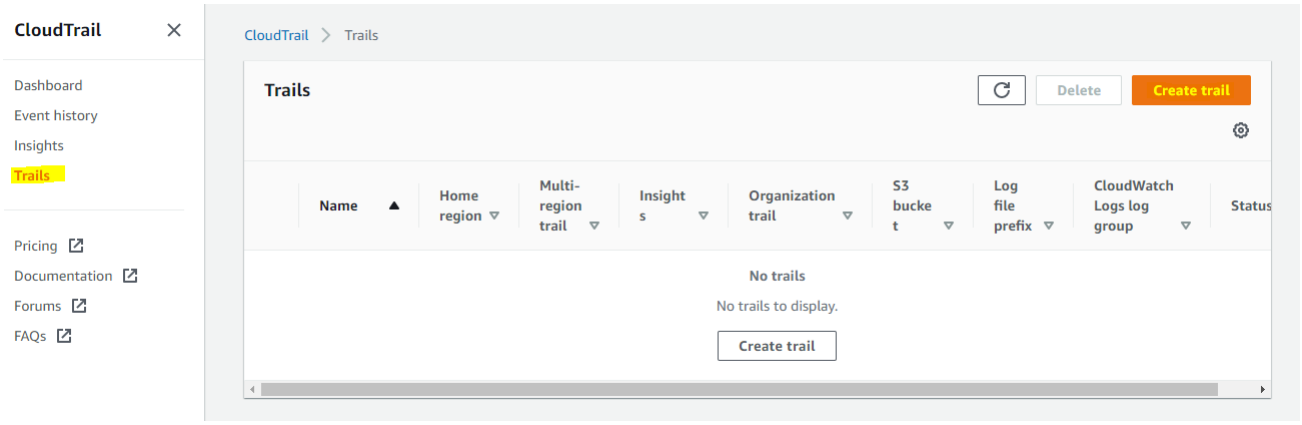




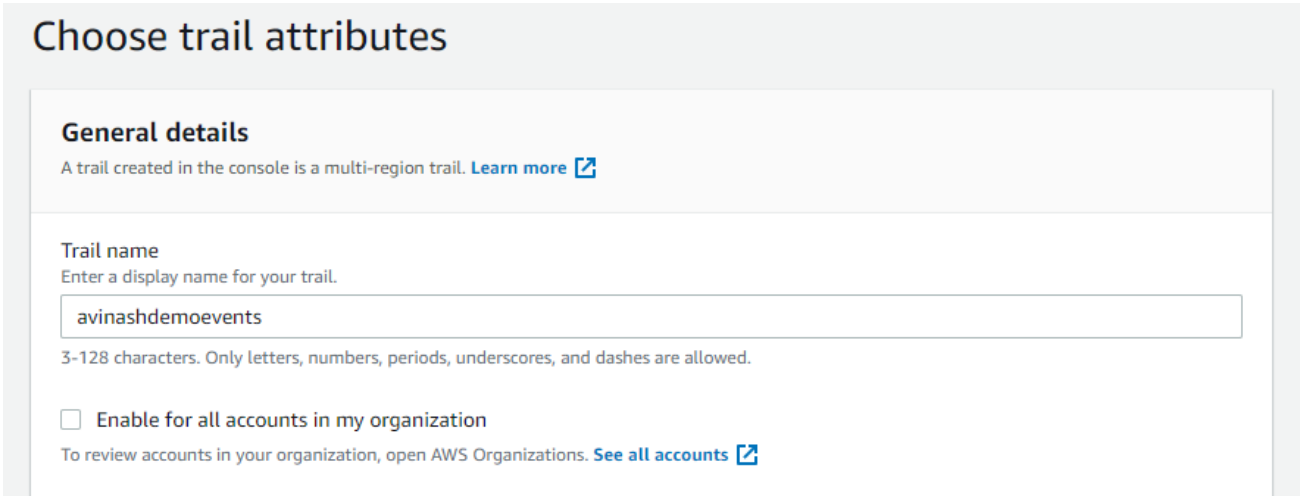
If you want to store the logs more than 90 days, we need to create a Trail and need to copy into S3 bucket. Click on “Trail” option from left pane.

Select the **“Create trail”**option to start. And give a Trail Name

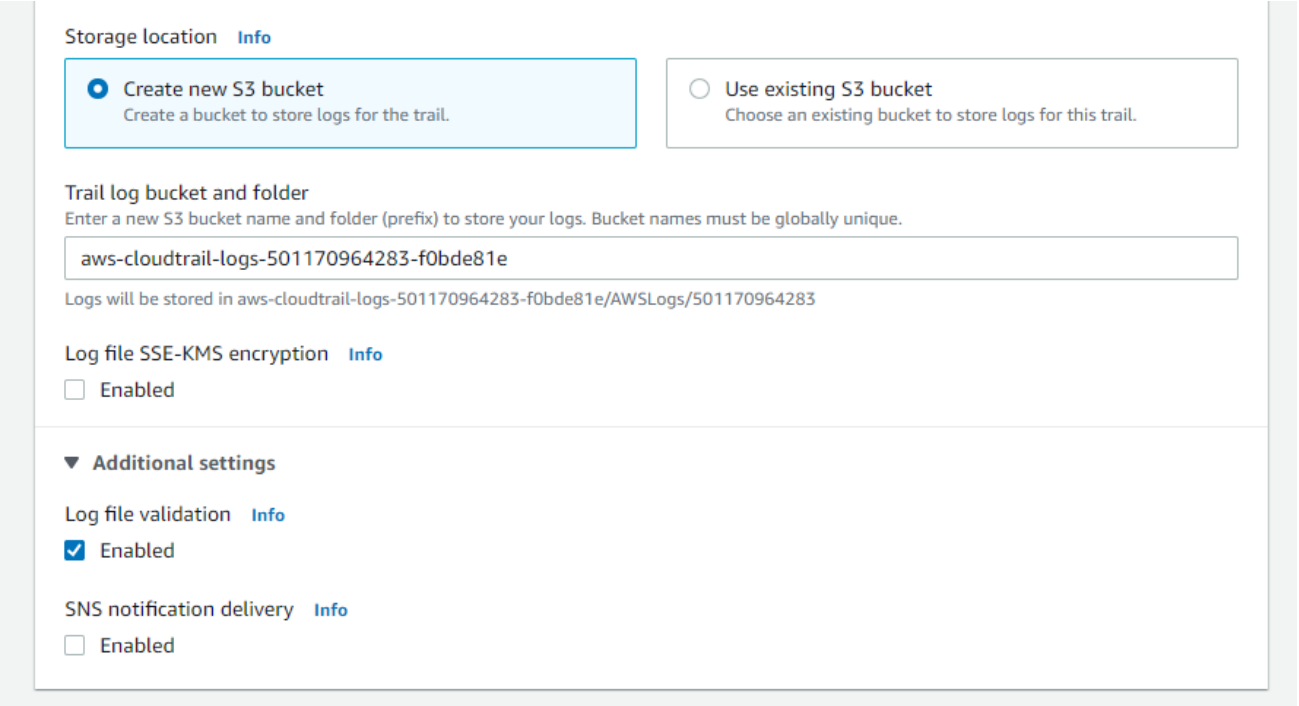
Choose the Management events you want to track (All/Read-Only/Write-only/None)



Provide a Valid name for Trail and if you want to enable trail for AWS Organization, choose “Enable for all accounts in my Org”.

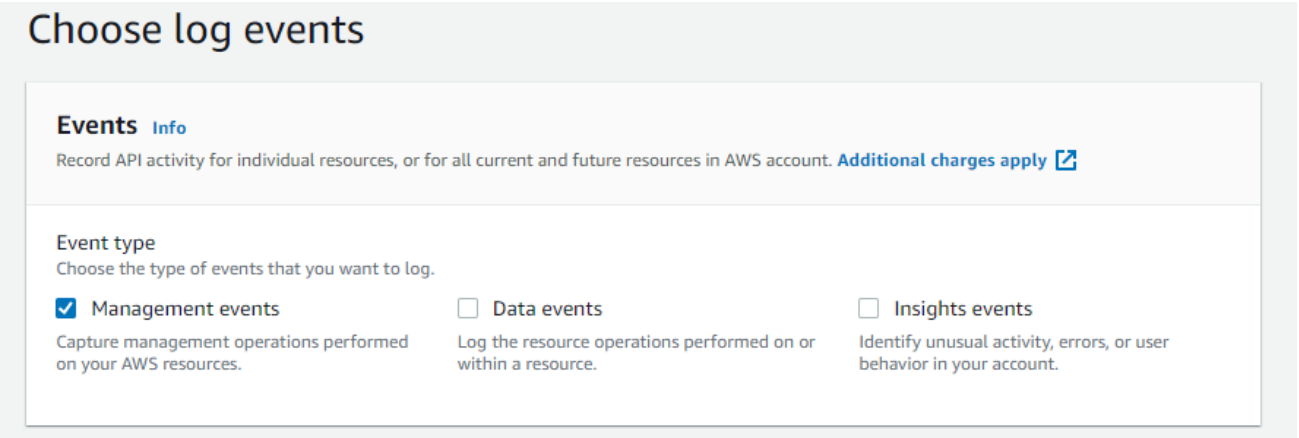


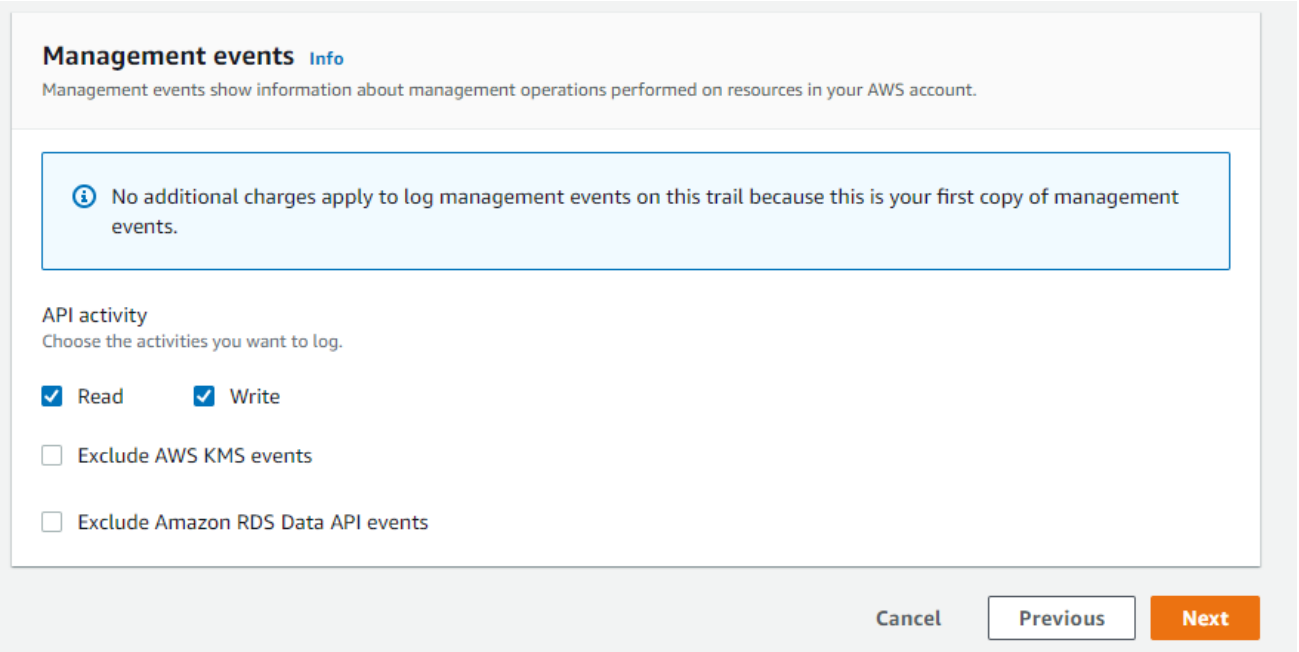
We can store the Cloudtrail logs to S3 Bucket, Either an existing bucket or we can initiate to create a new bucket in account.



Log file validation : To determine whether a log file was modified, deleted, or unchanged after CloudTrail delivered it, you can use CloudTrail log file integrity validation.

Choose the desired event.





Once you configure Review all the option and Click on “create trail”. We can see the logs in selected/created s3 bucket.

Every Log Contains the below data:

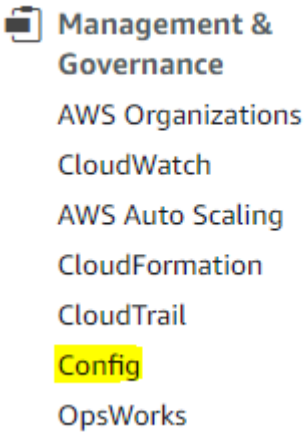
1. Metadata around API calls
2. The identity of the API caller
3. The time of the API call
4. The source IP address of the API caller
5. The request parameters
6. The response elements returned by the service.

AWS Config:

AWS Config is a fully managed service that provides you with an AWS resource inventory, configuration history, and configuration change notifications to enable security and governance. With AWS Config, you can discover existing and deleted AWS resources, determine your overall compliance against rules, and dive into configuration details of are source at any point in time. These capabilities enable compliance auditing, security analysis, resource change tracking, and troubleshooting.

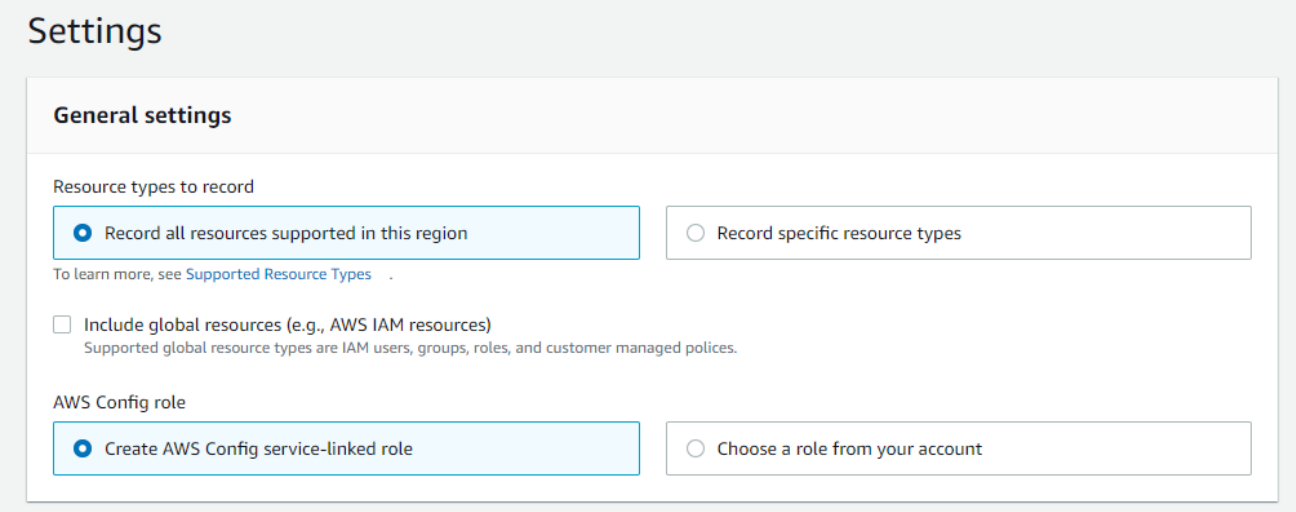
AWS Config is a service that enables us to assess, audit, and evaluate the configurations of our AWS resources. Config continuously monitors and records our AWS resource configurations and allows us to automate the evaluation of recorded configurations against desired configurations.

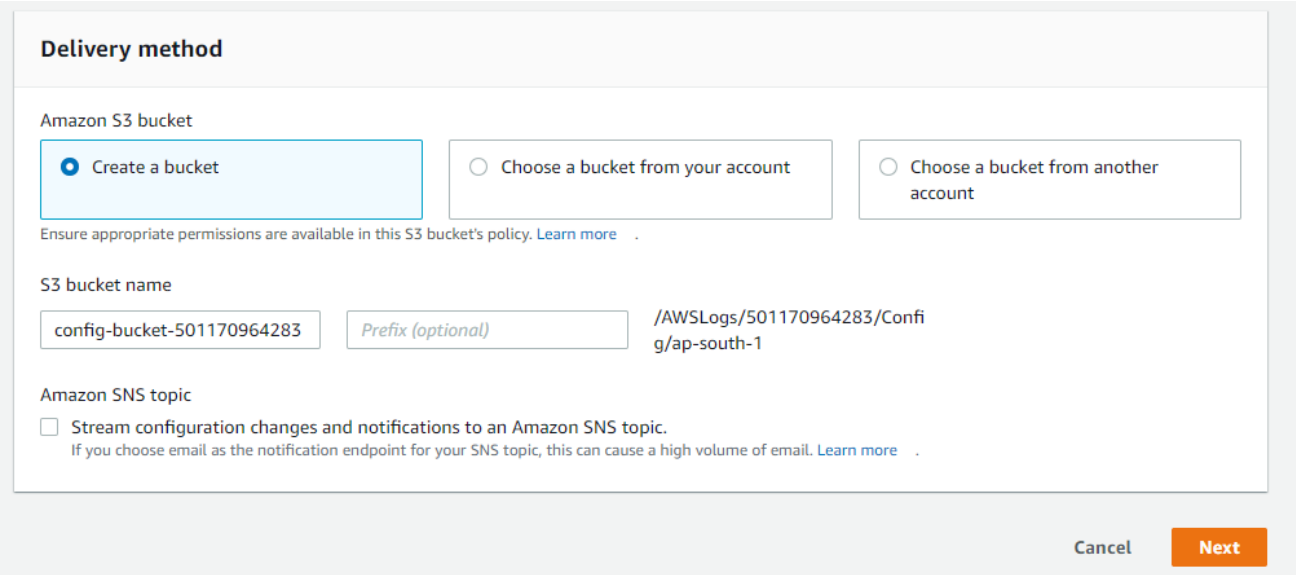
You will find the “Config” service under Management Tools.



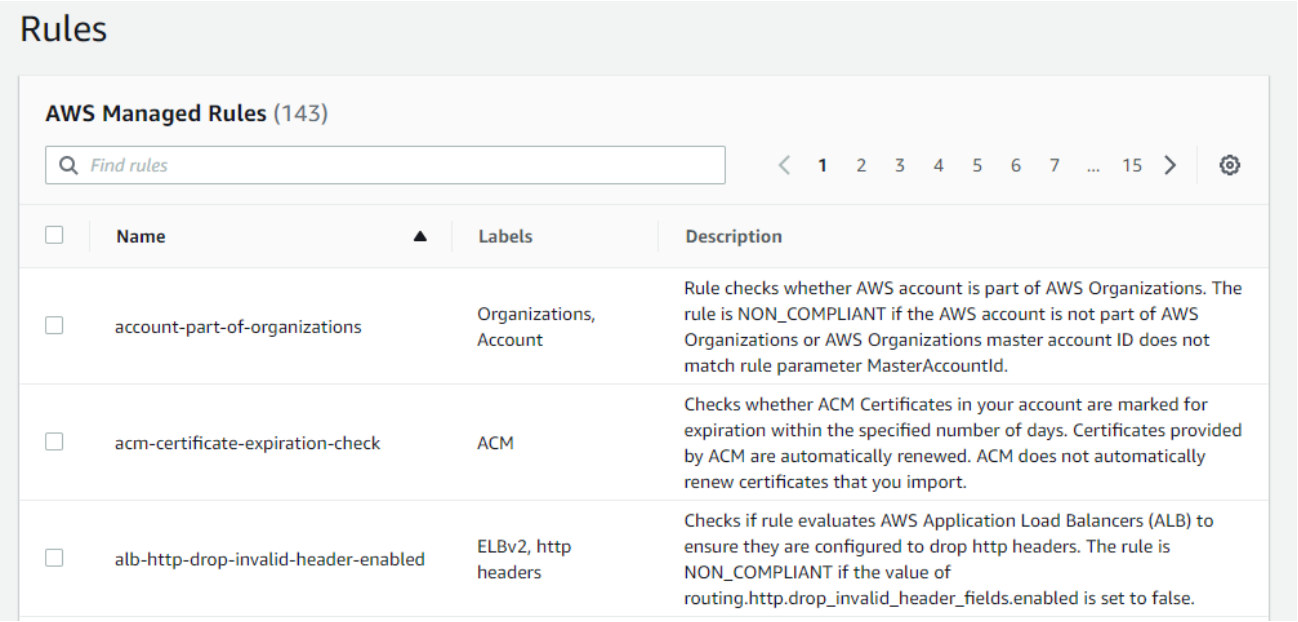
When you navigate to Config for the first time, it'll ask you to setup the AWS config. Here is the steps to configure the AWS config.

1. Choose what resource types to record with AWS config.
    a. You can choose all the resources in Selected region and even you can choose global resources i.e; S3, IAM
2. Choose the S3 bucket to store all the logs for the AWS Config. You can opt to create a new bucket or choose an existing bucket.

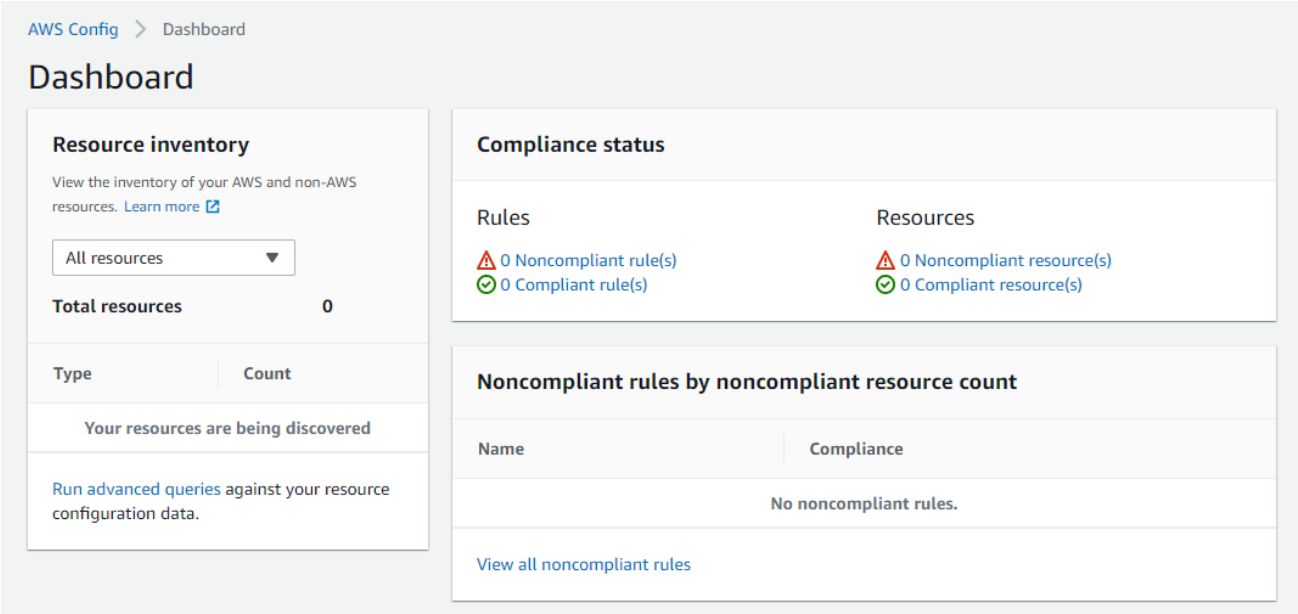




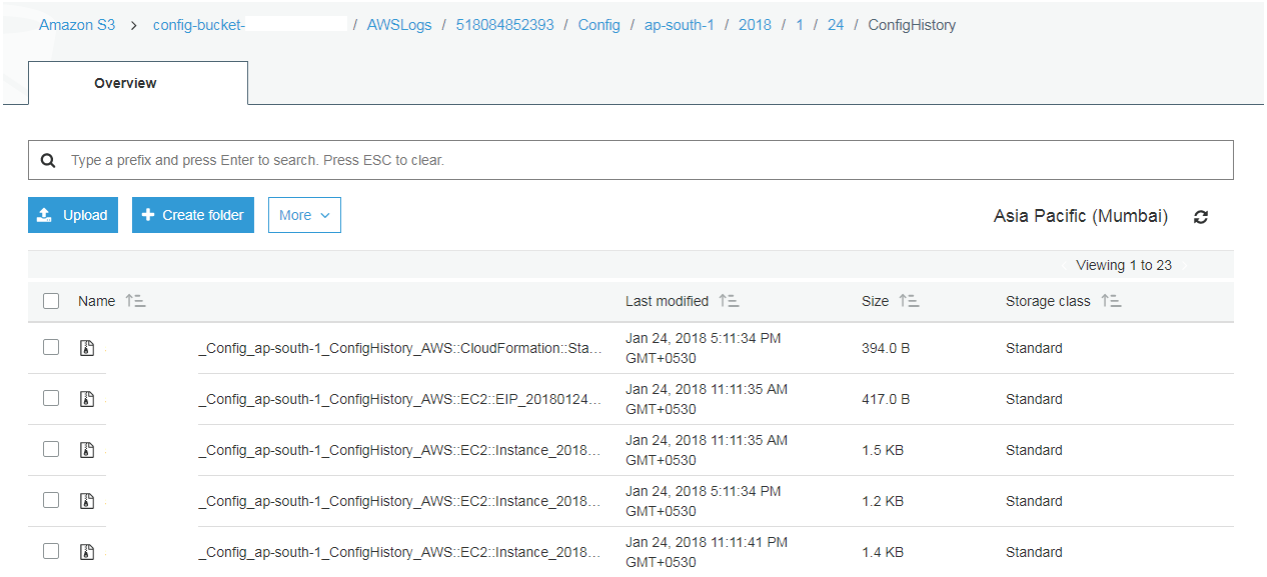
3. If you want to monitor any specific rule, you can select, otherwise you can choose or skip it.



4. Review and click on confirm to complete the AWS config service setup.
5. Here is the Config service dashboard, you can choose the specific service and get the details about the changes, events happened.



6. Let me navigate to S3 bucket to verify the logs, Log path looks similar to CloudTrail path.



We can see the below details with AWS Config service:

1. Resource Type
2. Resource ID
3. Compliance
4. Timeline
    a. Configuration Details
    b. Relationships
    c. Changes
    d. CloudTrail Events

AWS Cloud Formation

AWS Cloud Formation is a service that helps you model and setup your AWS resources so that you can spend less time managing those resources and more time focusing on your applications that run in AWS. AWS CloudFormation allows organizations to deploy, modify, and update resources in a controlled and predictable way, in effect applying version control to AWS infrastructure the same way one would do with software.

Overview

AWS CloudFormation gives developers and systems administrators an easy way to create and manage a collection of related AWS resources, provisioning and updating them in an orderly and predictable fashion. When you use AWS CloudFormation, you work with templates and stacks.

Use Case

By allowing you to replicate your entire infrastructure stack easily and quickly, AWS CloudFormation enables a variety of use cases:

- **Quickly Launch New Test Environments:** AWS CloudFormation let's testing teams quickly create a clean environment to run tests without disturbing on going efforts in other environments.
- **Reliably Replicate Configuration:** between Environments Because AWS CloudFormation scripts the entire environment, human error is eliminated when creating new stacks.
- **Launch Applications in New AWS Regions**: A single script can be used across multiple regions to launch stacks reliably in different markets.

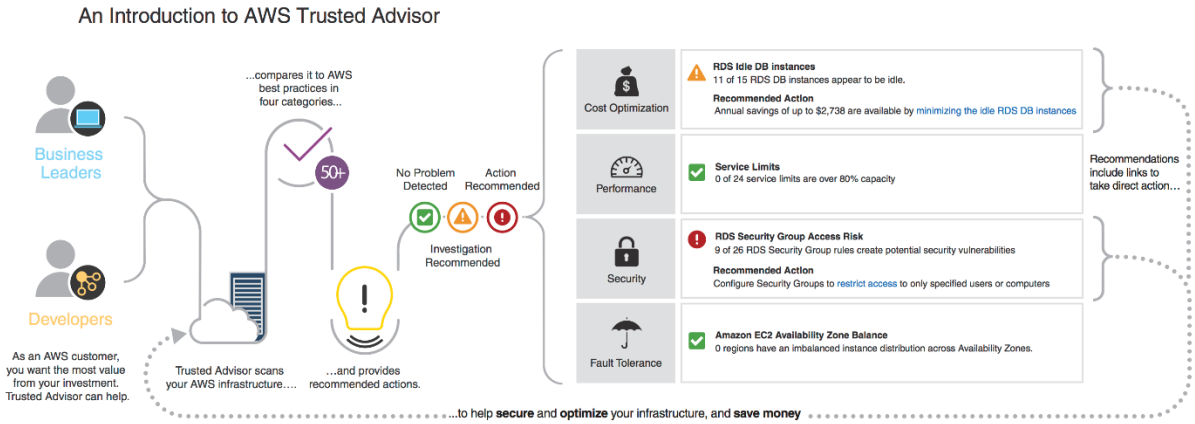
AWS Trusted Advisor:

AWS trusted advisor is an online resource to help us to reduce cost, increase performance, and improve security by optimizing AWS environment.

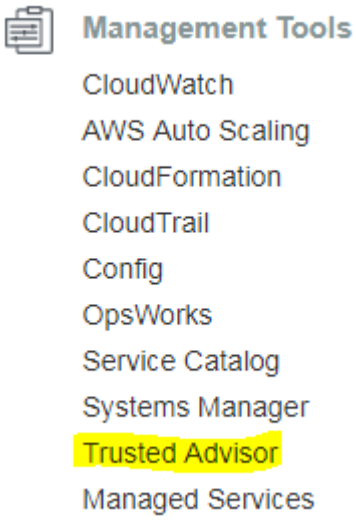
It gives suggestion for

1. Cost Optimization

2. Performance
3. Security
4. Fault Tolerance
5. Service Limit



We can find the Trusted Advisor under Management tools



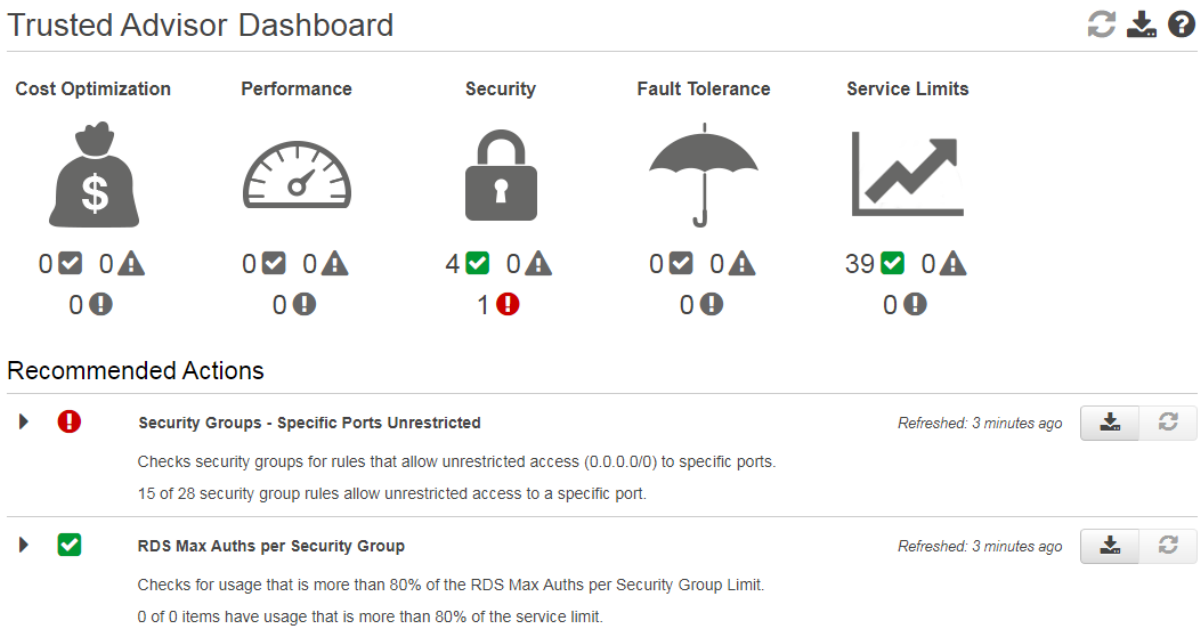
Here is the trusted manager dashboard, it automatically analyzed the AWS environment and given suggestions to improve the listed categories.

The color coding reflects the following information:

Red: Action recommended

Yellow: Investigation recommended

Green: No problem detected



Customers with a Business or Enterprise AWS Support plan can view all AWS Trusted Advisor checks- over 50 checks. We need to upgrade the support plan from Basic to any other to get technical support from Amazon support engineer.

Amazon Elastic Map Reduce (AmazonEMR)

Amazon Elastic Map Reduce (Amazon EMR) provides you with a fully managed, on-demand Hadoop framework. Amazon EMR reduces the complexity and up-front costs of setting up Hadoopa nd, combined with the scale of AWS gives you the ability to spinup large Hadoop clusters instantly and start processing with in minutes.

Use Cases for EMR:

Amazon EMR is well suited for a large number of use cases, including, but not limited to:

Log Processing: Amazon EMR can be used to process logs generated by web and mobile applications. Amazon EMR helps customers turn peta bytes of unstructured or semi-structured data in to useful insights about their applications or users.

Clickstream Analysis: Amazon EMR can be used to analyze clickstream data in order to segment users and understand user preferences. Advertisers can also analyze click streams and advertising impression logs to deliver more effective ads.

AWS Data Pipeline:

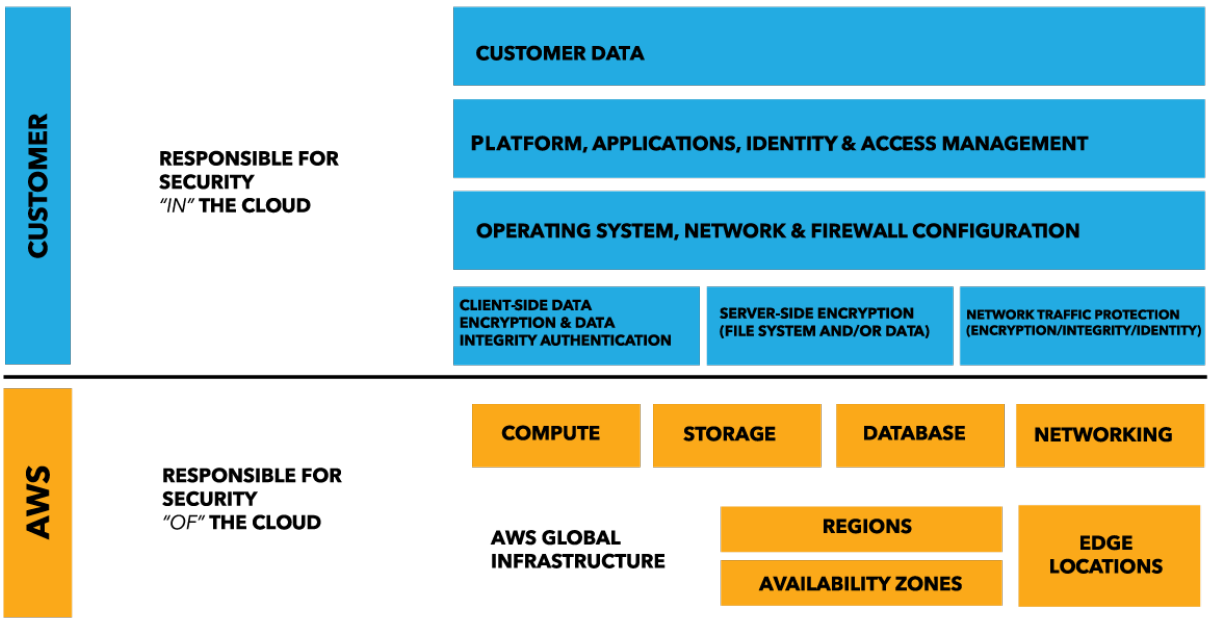
AWS Data Pipeline is a web service that helps you reliably process and move data between different AWS compute and storage services, and also on-premises data sources, at specified intervals. With AWS Data Pipeline, you can regularly access your data where it's stored, transform and process it at scale, and efficiently transfer the results to AWS services such as Amazon S3, Amazon Relational Database Service (AmazonRDS), Amazon Dynamo DB, and Amazon EMR.

Security:

Security and Compliance is a shared responsibility between AWS and the customer.

AWS responsibility "Security of the Cloud" - AWS is responsible for protecting the infrastructure that runs all of the services offered in the AWS Cloud. This infrastructure is composed of the hardware, software, networking, and facilities that run AWS Cloud services.

Customer responsibility "Security in the Cloud" – Customer responsibility will be determined by the AWS Cloud services that a customer selects. This determines the amount of configuration work the customer must perform as part of their security responsibilities. For example, services such as Amazon Elastic Compute Cloud (Amazon EC2), Amazon Virtual Private Cloud (Amazon VPC), and Amazon S3 are categorized as Infrastructure as a Service (IaaS) and, as such, require the customer to perform all of the necessary security configuration and management tasks. If a customer deploys an Amazon EC2 instance, they are responsible for management of the guest operating system (including updates and security patches), any application software or utilities installed by the customer on the instances, and the configuration of the AWS-provided firewall (called a security group) on each instance.



AWS Well-Architected framework

The AWS Well-Architected framework includes strategies to help you compare your workload against our best practices, and obtain guidance to produce stable and efficient systems so you can focus on functional requirements.

AWS has 5 security pillars for Well Architected framework.

Operational Excellence

The operational excellence pillar focuses on running and monitoring systems to deliver business value, and continually improving processes and procedures. Key topics include managing and automating changes, responding to events, and defining standards to successfully manage daily operations.

Security

The security pillar focuses on protecting information & systems. Key topics include confidentiality and integrity of data, identifying and managing who can do what with privilege management, protecting systems, and establishing controls to detect security events.

Reliability

The reliability pillar focuses on the ability to prevent, and quickly recover from failures to meet business and customer demand. Key topics include foundational elements around setup, cross project requirements, recovery planning, and how we handle change.

Performance Efficiency

The performance efficiency pillar focuses on using IT and computing resources efficiently. Key topics include selecting the right resource types and sizes based on workload requirements, monitoring performance, and making informed decisions to maintain efficiency as business needs evolve.

Cost Optimization

Cost Optimization focuses on avoiding un-needed costs. Key topics include understanding and controlling where money is being spent, selecting the most appropriate and right number of resource types, analyzing spend over time, and scaling to meet business needs without overspending.