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**AWS DEVSECOPS**  
**PROJECT-1: 3 TIER ARCHITECTURE**

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A **3-Tier Architecture** is a software design pattern that divides an application into three interconnected layers or tiers. This separation helps improve scalability, maintainability, and security.

**Web Tier (Presentation Layer):**

- **Purpose:** Handles the user interface and user interactions.
- **Components:** Web browsers, web servers, or front-end applications.
- **Functionality:** Receives user requests, displays information, and sends requests to the application tier.
- **AWS Examples:** Amazon S3 (static website hosting), Amazon CloudFront (content delivery), or EC2 instances running web servers like Apache or Nginx

**Application Tier (Business Logic Layer)**

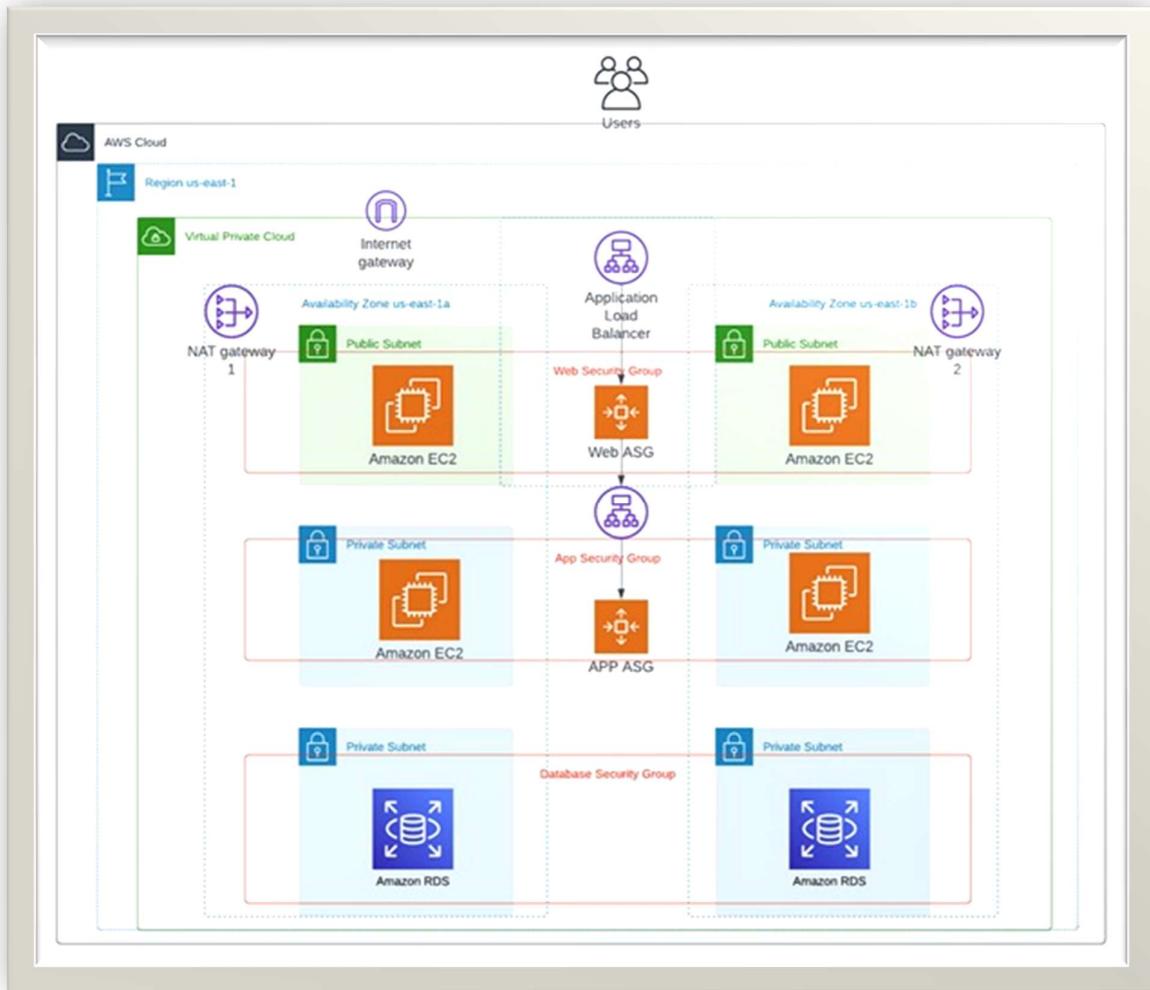
- **Purpose:** Processes data, applies business rules, and coordinates between the web and database tiers.
- **Components:** Application servers, APIs, or microservices.
- **Functionality:** Handles the core logic, processes user requests, and communicates with the database tier.
- **AWS Examples:** EC2 instances running application code, AWS Elastic Beanstalk, or containerized services like Amazon ECS or EKS.

**Database Tier (Data Layer)**

- **Purpose:** Stores, retrieves, and manages data.
- **Components:** Databases and data storage systems.
- **Functionality:** Ensures data integrity, security, and efficient data retrieval.
- **AWS Examples:** Amazon RDS (for relational databases like MySQL, PostgreSQL), Amazon DynamoDB (NoSQL), or Amazon Aurora.

### **Benefits of 3-Tier Architecture**

- **Scalability:** Each tier can be scaled independently based on demand.
- **Security:** Isolation of tiers enhances security; for example, the database can be placed in a private subnet.
- **Maintainability:** Modular design simplifies updates and troubleshooting.
- **Flexibility:** Different technologies can be used for each tier.



Select One Region for 3-tier project region like US East (N. Virginia) us-east-1 .

Go to AWS Search bar type vpc you can redirect to VPC and then you can start the project.

### Step -1:

- ❖ Create VPC
- ❖ Select VPC Only
- ❖ Name it as project-1
- ❖ CIDR as 10.0.0.0/16
- ❖ Click on create

- ❖ Go to action edit vpc
- ❖ Enable DNS hostname

The screenshot shows the AWS VPC dashboard with the following details:

- EC2 Global View:** Subnets, Route tables, Internet gateways, Egress-only internet gateways, Carrier gateways, DHCP option sets, Elastic IPs, Managed prefix lists, NAT gateways, Peering connections.
- Your VPCs (2) Info:**

Name	VPC ID	State	Block Public...	IPv4 CIDR	IPv6 CIDR
-	vpc-0b457314554030e71	Available	Off	172.31.0.0/16	-
project-1	vpc-08cd02c64a252e758	Available	Off	10.0.0.0/16	-
- Select a VPC above:** A dropdown menu listing the VPCs available for selection.

## Step -2:

- ❖ Go to subnets
- ❖ Create subnets click on it
- ❖ Attach VPC for subnets
- ❖ Create two public and four private
- ❖ my-public-subnet-01(10.0.1.0/24) in eu-west-3a, my-public-subnet-02(10.0.2.0/24) in eu-west-3b
- ❖ my-pvt-subnet-01(10.0.3.0/24) in eu-west-3a, my-pvt-subnet-02(10.0.3.0/24) in eu-west-3b, my-pvt-subnet-03(10.0.5.0/24) in eu-west-3a, my-pvt-subnet-04(10.0.6.0/24) in eu-west-3b
- ❖ Click on create

The screenshot shows the AWS Subnets dashboard with the following details:

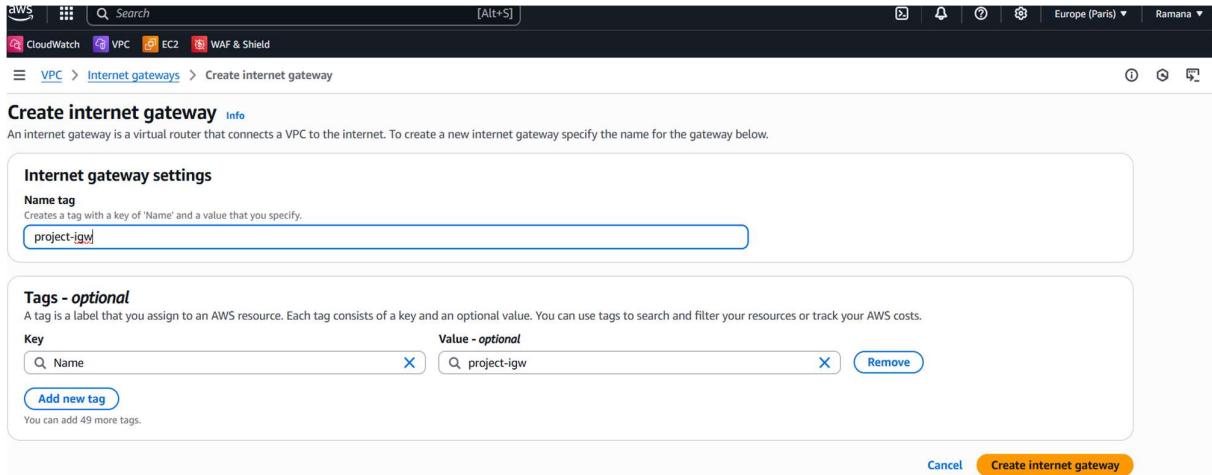
- EC2 Global View:** Subnets, Route tables, Internet gateways, Egress-only internet gateways, Carrier gateways, DHCP option sets, Elastic IPs, Managed prefix lists, NAT gateways, Peering connections.
- Subnets (9) Info:**

Name	Subnet ID	State	VPC	Block Public...	IPv4 CIDR
privatesubnet-1	subnet-0ffb6c0ff1edca4e	Available	vpc-08cd02c64a252e758   proj...	Off	10.0.3.0/24
privatesubnet-2	subnet-054abc403ce4268e6	Available	vpc-08cd02c64a252e758   proj...	Off	10.0.4.0/24
privatesubnet-3	subnet-0185a1c6c37713cf	Available	vpc-08cd02c64a252e758   proj...	Off	10.0.5.0/24
privatesubnet-6	subnet-0429dc166458affd	Available	vpc-08cd02c64a252e758   proj...	Off	10.0.6.0/24
publicsubnet-1	subnet-0c1831c5eedad49a6	Available	vpc-08cd02c64a252e758   proj...	Off	10.0.1.0/24
publicsubnet-2	subnet-0b124d465d6d91e9f	Available	vpc-08cd02c64a252e758   proj...	Off	10.0.2.0/24
- Select a subnet:** A dropdown menu listing the subnets available for selection.

A green notification bar at the top states: "You have successfully created 6 subnets: subnet-0c1831c5eedad49a6, subnet-0b124d465d6d91e9f, subnet-0ffb6c0ff1edca4e, subnet-054abc403ce4268e6, subnet-0185a1c6c37713cf, subnet-0b429dc166458affd".

### Step-3:

- ❖ Create internet gateway for communication through internet
- ❖ Name it as “project-igw”, and click on create
- ❖ Attach it to VPC (project-1)



### Step-4:

- ❖ Now goto Route Tables
- ❖ Select main VPC and edit it add route table
- ❖ Create public and private route tables (Public-RT) and (Private-RT)
- ❖ Edit subnets associations and add igw to public route
- ❖ Select all subnets, so it can connect to the internet for better interaction.

PUBLIC -ROUTE TABLE

aws | Search [Alt+S] | Europe (Paris) | Ramana

CloudWatch VPC EC2 WAF & Shield

VPC > Route tables > Create route table

### Create route table Info

A route table specifies how packets are forwarded between the subnets within your VPC, the internet, and your VPN connection.

#### Route table settings

**Name - optional**  
Create a tag with a key of 'Name' and a value that you specify.  
public-RT

**VPC**  
The VPC to use for this route table.  
vpc-08cd02c64a252e758 (project-1)

#### Tags

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.

Key	Value - optional
<input type="text" value="Name"/>	<input type="text" value="public-RT"/> <span>X</span> <span>Remove</span>

**Add new tag**  
You can add 49 more tags.

Cancel Create route table

## PRIVATE-ROUTE TABLE

aws | Search [Alt+S] | Europe (Paris) | Ramana

CloudWatch VPC EC2 WAF & Shield

VPC > Route tables > Create route table

### Create route table Info

A route table specifies how packets are forwarded between the subnets within your VPC, the internet, and your VPN connection.

#### Route table settings

**Name - optional**  
Create a tag with a key of 'Name' and a value that you specify.  
private-RT

**VPC**  
The VPC to use for this route table.  
vpc-08cd02c64a252e758 (project-1)

#### Tags

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.

Key	Value - optional
<input type="text" value="Name"/>	<input type="text" value="private-RT"/> <span>X</span> <span>Remove</span>

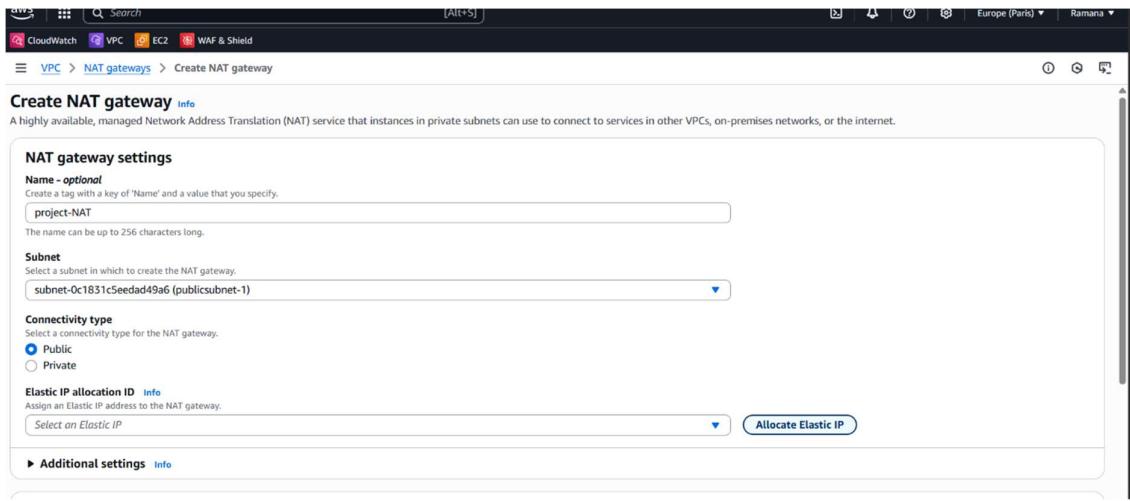
**Add new tag**  
You can add 49 more tags.

Cancel Create route table

## Step-5:

- ❖ Now create NAT gateway(project-NAT)
- ❖ Select public access and select subnets public(public-1a, public-1b)

- ❖ Allocate elastic ip for NAT gateway
- ❖ Add NAT Gateway to private routes(my-pvt-route)



## Step-6 :

- ❖ Navigate to EC2 in Console
- ❖ Create instances names as (web-1,web-2,app-1,app-2)
- ❖ Select application and OS (Ubuntu) for all instances
- ❖ Select t2.micro for all instances
- ❖ Create one key pair and use one key pair for all instances
- ❖ Edit network settings
- ❖ Select VPC
- ❖ Select subnets for specific instances as same as subnets for

Ex: Instance web-01 and subnet as publicsubnet—1(3a)

Instance web-02 and subnet as publicsubnet—2(3b)

Instance app-1 and subnet as privatesubnet—1(3a)

Instance app-2 and subnet as privatesubnet—2(3b)

- ❖ Enable auto assign ip
- ❖ Create one security group and use this for all instances
- ❖ SSH-22port, anywhere – 0.0.0.0/0
- ❖ HTTP-80port, anywhere – 0.0.0.0/0
- ❖ Click create instance

Screenshot of the AWS EC2 Instances page showing two running t2.micro instances: Web-1 and Web-2.

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IP
Web-1	i-0a053a5590c463e9f	Running	t2.micro	2/2 checks passed	<a href="#">View alarms</a>	eu-west-3a	ec2-35-11
Web-2	i-02a84c22b4d4d9bf	Running	t2.micro	2/2 checks passed	<a href="#">View alarms</a>	eu-west-3b	ec2-52-41

Screenshot of the "Launch an instance" wizard step 1: Name and tags.

**Name and tags** Info

Name: App-1 [Add additional tags](#)

**Application and OS Images (Amazon Machine Image)** Info

An AMI contains the operating system, application server, and applications for your instance. If you don't see a suitable AMI below, use the search field or choose [Browse more AMIs](#).

Recent AMIs: [Amazon](#), [Ubuntu](#), [Windows](#), [Red Hat](#), [SUSE Linux](#), [Debian](#)

**Summary**

Number of instances: 1

Software Image (AMI): Amazon Linux 2023 AMI 2023.8.2... [read more](#)

Virtual server type (instance type): t2.micro

Firewall (security group): New security group

Storage (volumes): 1 volume(s) - 8 GiB

**Free tier:** In your first year of opening an AWS account, you get 750 hours per month of

Screenshot of the "Launch an instance" wizard step 1: Name and tags.

**Name and tags** Info

Name: App-2 [Add additional tags](#)

**Application and OS Images (Amazon Machine Image)** Info

An AMI contains the operating system, application server, and applications for your instance. If you don't see a suitable AMI below, use the search field or choose [Browse more AMIs](#).

Recent AMIs: [Amazon](#), [Ubuntu](#), [Windows](#), [Red Hat](#), [SUSE Linux](#), [Debian](#)

**Summary**

Number of instances: 1

Software Image (AMI): Canonical, Ubuntu, 24.04, amd64... [read more](#)

Virtual server type (instance type): t2.micro

Firewall (security group): New security group

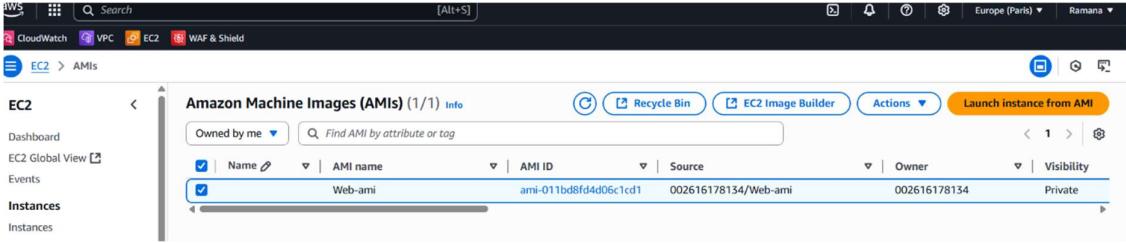
Storage (volumes): 1 volume(s) - 8 GiB

**Free tier:** In your first year of opening an AWS account, you get 750 hours per month of

[Cancel](#) [Launch instance](#) [Preview code](#)

## Step-7:

- ❖ Create launch template
- ❖ Name as template(web-template,app-template)
- ❖ Description as template asg
- ❖ Application and osi as created AMI(web-ami)
- ❖ Select instance type and key pair
- ❖ In network configuration, enable auto-assign public IP



The screenshot shows the AWS EC2 interface with the 'AMIs' tab selected. A single AMI entry is displayed:

Name	AMI ID	Source	Owner	Visibility
Web-ami	ami-011bd8fd4d06c1cd1	002616178134/Web-ami	002616178134	Private

Below the main interface, a detailed 'Create image' form is shown:

**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 an image from the configuration of an existing instance.

**Image details**

Instance ID:  i-037c3d947dc26de85 (App-1)

Image name:

Maximum 127 characters. Can't be modified after creation.

Image description - optional:

Maximum 255 characters

Reboot instance  
When selected, Amazon EC2 reboots the instance so that data is at rest when snapshots of the attached volumes are taken. This ensures data consistency.

Instance volumes

Storage type	Device	Snapshot	Size	Volume type	IOPS	Throughput	Delete on termination	Encrypted
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## Step-8:

- ❖ Create two targets groups for web& app to show data
- ❖ Name it as web-tg, app-tg
- ❖ In register targets select web-tg target for (web-1(3a), web-2(3b)), app-tg target for (app-1(3a), app-2(3b))
- ❖ Select include as pending below
- ❖ Create target groups for both web&app.

The screenshot shows the 'Create target group' wizard for an Application Load Balancer. The 'Protocol' is set to 'HTTP' and the 'Port' is '80'. The 'IP address type' is set to 'IPv4'. The target group name is 'Web-tg'. The description notes that this is accessible to Application Load Balancers only and offers flexibility for accepting and routing TCP requests within a specific VPC, facilitating static IP addresses and PrivateLink.

**Target group name:** Web-tg

**Protocol:** HTTP

**Port:** 80

**IP address type:** IPv4

**Target group name:** App-tg

**Protocol:** HTTP

**Port:** 80

**IP address type:** IPv4

## Step-9:

- ❖ Create load balancer for balancing load between to servers
- ❖ Create load balancer names as (Web-lb, App-lb)
- ❖ Select target groups for specified load balancer only i..e,web-tg for Web-LB,app-tg for App-LB

The screenshot shows the 'Create Application Load Balancer' wizard in the AWS Management Console. The top navigation bar includes 'EC2 > Load balancers > Create Application Load Balancer'. A message box at the top states: 'Application Load Balancers now support public IPv4 IP Address Management (IPAM). You can get started with this feature by configuring IP pools in the Network mapping section.' Below this, the main section is titled 'Create Application Load Balancer' with a 'Info' link. It describes the function of an Application Load Balancer. A 'How Application Load Balancers work' section is shown below. The 'Basic configuration' section is expanded, showing fields for 'Load balancer name' (set to 'App-LB'), 'Scheme' (set to 'Internet-facing'), and 'Internal' options. A note says 'Name must be unique within your AWS account and can't be changed after the load balancer is created.' and 'A maximum of 32 alphanumeric characters including hyphens are allowed, but the name must not begin or end with a hyphen.'

EC2 > Load balancers > Create Application Load Balancer

Application Load Balancers now support public IPv4 IP Address Management (IPAM)  
You can get started with this feature by configuring IP pools in the Network mapping section.

Create Application Load Balancer [Info](#)

The Application Load Balancer distributes incoming HTTP and HTTPS traffic across multiple targets such as Amazon EC2 instances, microservices, and containers, based on request attributes. When the load balancer receives a connection request, it evaluates the listener rules in priority order to determine which rule to apply, and if applicable, it selects a target from the target group for the rule action.

▶ How Application Load Balancers work

**Basic configuration**

**Load balancer name**  
Name must be unique within your AWS account and can't be changed after the load balancer is created.  
App-LB  
A maximum of 32 alphanumeric characters including hyphens are allowed, but the name must not begin or end with a hyphen.

**Scheme** [Info](#)  
Scheme can't be changed after the load balancer is created.

<input checked="" type="radio"/> <b>Internet-facing</b> <ul style="list-style-type: none"><li>• Serves internet-facing traffic.</li><li>• Has public IP addresses.</li><li>• DNS name resolves to public IPs.</li><li>• Requires a public subnet.</li></ul>	<input type="radio"/> <b>Internal</b> <ul style="list-style-type: none"><li>• Serves internal traffic.</li><li>• Has private IP addresses.</li><li>• DNS name resolves to private IPs.</li><li>• Compatible with the IPv4 and Dualstack IP address types.</li></ul>
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**Create Application Load Balancer** Info

The Application Load Balancer distributes incoming HTTP and HTTPS traffic across multiple targets such as Amazon EC2 instances, microservices, and containers, based on request attributes. When the load balancer receives a connection request, it evaluates the listener rules in priority order to determine which rule to apply, and if applicable, it selects a target from the target group for the rule action.

**How Application Load Balancers work**

### Basic configuration

**Load balancer name**  
Name must be unique within your AWS account and can't be changed after the load balancer is created.

A maximum of 32 alphanumeric characters including hyphens are allowed, but the name must not begin or end with a hyphen.

**Scheme** Info  
Scheme can't be changed after the load balancer is created.

**Internet-facing**

- Serves internet-facing traffic.
- Has public IP addresses.
- DNS name resolves to public IPs.
- Requires a public subnet.

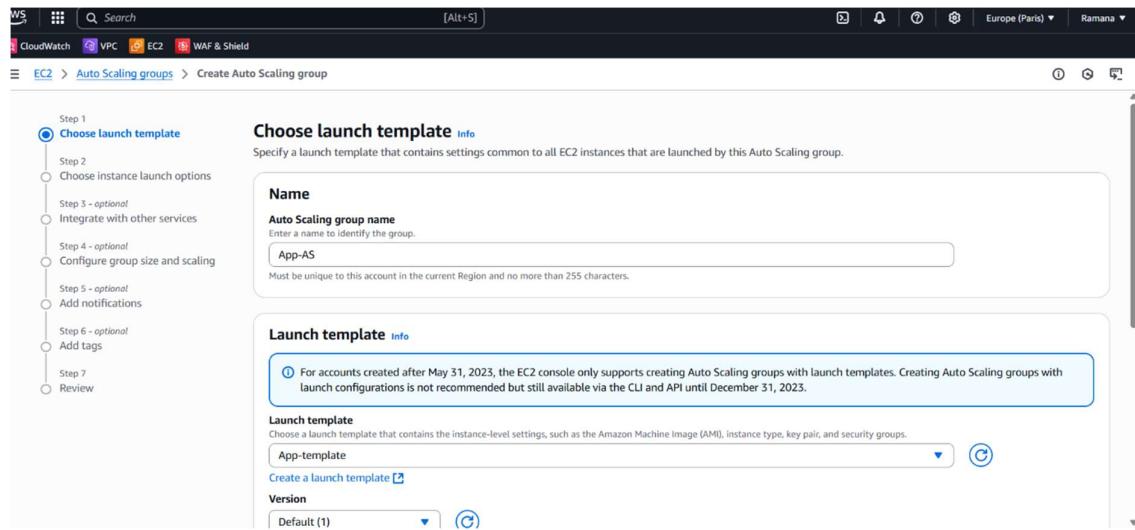
**Internal**

- Serves internal traffic.
- Has private IP addresses.
- DNS name resolves to private IPs.
- Compatible with the IPv4 and Dualstack IP address types.

## Step-10:

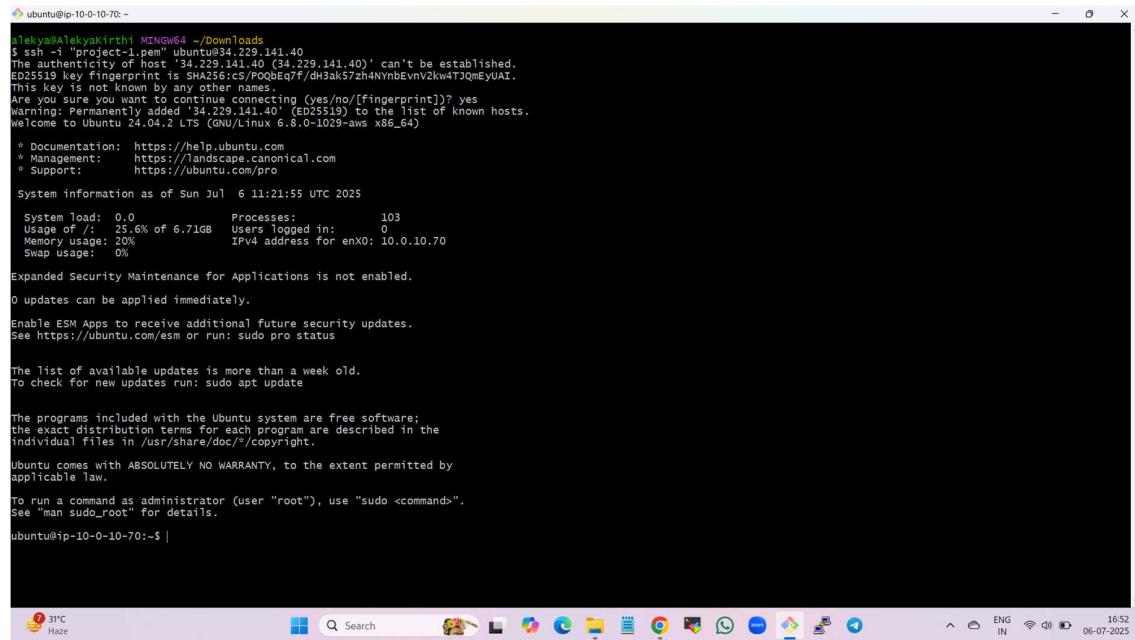
- ❖ Create Auto scaling for both load balancers (Web-LB,App-LB)
- ❖ Create asg (web-asg&app-asg) and attach created launch template(mytemplate)
- ❖ Select instance launch option
- ❖ Attach existing load balancers for both asg's
- ❖ Create asg's
- ❖ Now you can see desired instance launched in instances.Edit it and named as s1&s2.

Launch Template ID	Launch Template Name	Default Version	Latest Version	Create Time	Created By
lt-0507607a0b263a245	App-template	1	1	2025-08-05T07:05:25.000Z	arn:aws:iam::0026
lt-0bd9d93bd9ff58b38	web-template	1	1	2025-08-05T06:29:19.000Z	arn:aws:iam::0026



## Step:12

- ❖ Connect webtier-01 to apptier-01 by following these below steps:
  - ❖ Copy ssh of webtier-01 and paste it in gitbash.
- 
- ❖ sudo -i
  - ❖ apt update -y



```
Ubuntu@AtekyaKirithi:~$ /Downloads
Warning: Permanently added '34.229.141.40' (IP: 34.229.141.40) to the list of known hosts.
The authenticity of host '34.229.141.40' (34.229.141.40) can't be established.
ED25519 key fingerprint is SHA256:cS/POObEq7f/dH3ak57zh4NYnbEvnv2kw4TJQmEyUAI.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
warning: Permanently added '34.229.141.40' (ED25519) to the list of known hosts.
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1029-aws x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Sun Jul  6 11:21:55 UTC 2025

System load: 0.0      Processes:          103
Usage of /: 25.6% of 6.71GB  Users logged in:    0
Memory usage: 20%           IPv4 address for enX0: 10.0.10.70
Swap usage:  0%          

Expanded Security Maintenance for Applications is not enabled.
0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

Ubuntu@ip-10-0-10-70:~$
```

❖ apt install apache2 -y

- ❖ systemctl restart apache2
- ❖ cd /var/www/html
- ❖ rm index.html
- ❖ vi index.html
- ❖ insert some data and check it is connected or not by copying public ip:80 in browser
- ❖ now connect to apptier-1 by following steps:
  - ❖ vi project-1.pem (pem file name)
  - ❖ Copy encrypted password in pem file and paste in vi project-1.pem and save it
  - ❖ Give the permission to the pem file by chmod 400 project-1.pem
  - ❖ Copy ssh of webtier-1 and use apptier-1 private ip address in ssh command instead of using webtier ip address.
  - ❖ Now it will be connected to app-01 instance.

```

ubuntu@ip-10-0-0-35:~#
root@ip-10-0-10-70:~# vi project-1.pem
root@ip-10-0-10-70:~# chmod 400 project-1.pem
root@ip-10-0-10-70:~# ssh -i "project-1.pem" ubuntu@10.0.0.35
The authenticity of host '10.0.0.35' (10.0.0.35) can't be established.
ED25519 key fingerprint is SHA256:F0YAy3Q1X5SETTKUn2JnprAVVK16K7sz2jSSOAV2EGs.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
warning: Permanently added '10.0.0.35' (ED25519) to the list of known hosts.
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1029-aws x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Sun Jul 6 11:26:19 UTC 2025

System load: 0.08      Processes:          103
Usage of /: 25.4% of 6.71GB  Users logged in:    0
Memory usage: 20%           IPV4 address for enx0: 10.0.0.35
Swap usage:  0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

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applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-10-0-0-35:~$
```

- ❖ Check here its connected to internet or not by using ping facebook.com/google.com

### Step:13

- ❖ Connect web-02 to app-02 by following these below steps:
- ❖ Copy ssh of web-02 and paste it in gitbash.

```

ubuntu@ip-10-0-2-6:~#
alekya@AlekyaKirithi MINGW64 ~/Downloads
$ ssh -i "project-1.pem" ubuntu@54.174.7.117
The authenticity of host '54.174.7.117' (54.174.7.117) can't be established.
ED25519 key fingerprint is SHA256:k3w9gLz/97l5mb50y88Yhv4b6o9TbXEZYfGRpcUHTyg.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
warning: Permanently added '54.174.7.117' (ED25519) to the list of known hosts.
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1029-aws x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Sun Jul 6 11:28:53 UTC 2025

System load: 0.0      Processes:          103
Usage of /: 25.4% of 6.71GB  Users logged in:    0
Memory usage: 20%           IPV4 address for enx0: 10.0.2.6
Swap usage:  0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

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applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-10-0-2-6:~$ |
```

- ❖ sudo -i
- ❖ apt update -y

```

root@ip-10-0-2-6:~#
Get:15 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main Translation-en [251 kB]
Get:16 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [162 kB]
Get:17 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe amd64 Packages [1103 kB]
Get:18 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe Translation-en [281 kB]
Get:19 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe amd64 Components [376 kB]
Get:20 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe amd64 c-n-f Metadata [26.0 kB]
Get:21 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/restricted amd64 Packages [1391 kB]
Get:22 http://security.ubuntu.com/ubuntu noble-security/main Translation-en [173 kB]
Get:23 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/restricted Translation-en [298 kB]
Get:24 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/restricted amd64 Components [212 kB]
Get:25 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 Packages [22.8 kB]
Get:26 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/multiverse Translation-en [5456 kB]
Get:27 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 Components [940 kB]
Get:28 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 c-n-f Metadata [592 kB]
Get:29 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [39.2 kB]
Get:30 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/main Translation-en [8676 kB]
Get:31 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/main amd64 Components [7076 kB]
Get:32 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/main amd64 c-n-f Metadata [272 kB]
Get:33 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/universe amd64 Packages [27.5 kB]
Get:34 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/universe Translation-en [16.5 kB]
Get:35 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/universe amd64 Components [16.5 kB]
Get:36 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/universe amd64 c-n-f Metadata [1304 kB]
Get:37 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/restricted amd64 Components [216 kB]
Get:38 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/restricted amd64 c-n-f Metadata [116 kB]
Get:39 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/multiverse amd64 Components [212 kB]
Get:40 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/multiverse amd64 c-n-f Metadata [116 kB]
Get:41 http://security.ubuntu.com/ubuntu noble-security/main amd64 Components [21.5 kB]
Get:42 http://security.ubuntu.com/ubuntu noble-security/universe amd64 Packages [869 kB]
Get:43 http://security.ubuntu.com/ubuntu noble-security/universe Translation-en [191 kB]
Get:44 http://security.ubuntu.com/ubuntu noble-security/universe amd64 Components [52.2 kB]
Get:45 http://security.ubuntu.com/ubuntu noble-security/universe amd64 c-n-f Metadata [17.0 kB]
Get:46 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Packages [1347 kB]
Get:47 http://security.ubuntu.com/ubuntu noble-security/restricted Translation-en [290 kB]
Get:48 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Components [212 kB]
Get:49 http://security.ubuntu.com/ubuntu noble-security/multiverse amd64 Packages [18.5 kB]
Get:50 http://security.ubuntu.com/ubuntu noble-security/multiverse Translation-en [4288 kB]
Get:51 http://security.ubuntu.com/ubuntu noble-security/multiverse amd64 Components [212 kB]
Get:52 http://security.ubuntu.com/ubuntu noble-security/multiverse amd64 c-n-f Metadata [380 kB]
Fetched 35.2 MB in 6s (5440 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
34 packages can be upgraded. Run 'apt list --upgradable' to see them.
root@ip-10-0-2-6:~#

```

❖ apt install apache2 -y

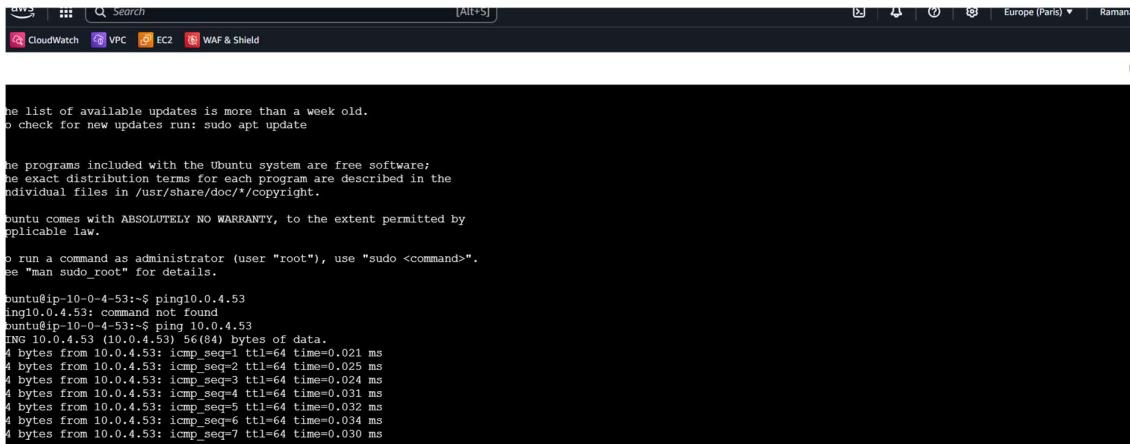
```

root@ip-10-0-2-6:~# apt install apache2 -y
Reading package lists... done
Building dependency tree... done
Reading state information... done
The following additional packages will be installed:
  apache2-bin apache2-data apache2-utils libapr1t64 libaprutil1-dbd-sqlite3 libaprutil1-ldap libaprutil1t64 liblua5.4-0 ssl-cert
Suggested packages:
  apache2-doc apache2-suexec-pristine | apache2-suexec-custom www-browser
The following NEW packages will be installed:
  apache2-bin apache2-data apache2-utils libapr1t64 libaprutil1-dbd-sqlite3 libaprutil1-ldap libaprutil1t64 liblua5.4-0 ssl-cert
0 upgraded, 10 newly installed, 0 to remove and 34 not upgraded.
Need to get 2084 kB of archives.
After this operation, 8094 kB of additional disk space will be used.
Get:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 libapr1t64 amd64 1.7.2-3.ubuntu0.1 [108 kB]
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1t64 amd64 1.6.3-1.ubuntu7 [91.9 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1-dbd-sqlite3 amd64 1.6.3-1.ubuntu7 [111.2 kB]
Get:4 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1-ldap amd64 1.6.3-1.ubuntu7 [9116 kB]
Get:5 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 liblua5.4-0 amd64 5.4.6-3build2 [166 kB]
Get:6 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2-bin amd64 2.4.58-1ubuntu8.6 [1330 kB]
Get:7 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2 all 2.4.58-1ubuntu8.6 [163 kB]
Get:8 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2-utils amd64 2.4.58-1ubuntu8.6 [97.2 kB]
Get:9 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2 amd64 2.4.58-1ubuntu8.6 [90.2 kB]
Get:10 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 ssl-cert all 1.1.2ubuntu1 [17.8 kB]
Fetched 2084 kB in 0s (34.1 MB/s)
Preconfiguring packages ...
Selecting previously unselected package libapr1t64:amd64.
(Reading database ... 70681 files and directories currently installed.)
Preparing to unpack .../0-libapr1t64_1.7.2-3.ubuntu0.1_amd64.deb ...
Unpacking libapr1t64:amd64 (1.7.2-3.ubuntu0.1) ...
Selecting previously unselected package libaprutil1t64:amd64.
Preparing to unpack .../1-libaprutil1t64_1.6.3-1.ubuntu7_amd64.deb ...
Unpacking libaprutil1t64:amd64 (1.6.3-1.ubuntu7) ...
Selecting previously unselected package libaprutil1-dbd-sqlite3:amd64.
Preparing to unpack .../2-libaprutil1-dbd-sqlite3_1.6.3-1.ubuntu7_amd64.deb ...
Unpacking libaprutil1-dbd-sqlite3:amd64 (1.6.3-1.ubuntu7) ...
Selecting previously unselected package libaprutil1-ldap:amd64.
Preparing to unpack .../3-libaprutil1-ldap_1.6.3-1.ubuntu7_amd64.deb ...
Unpacking libaprutil1-ldap:amd64 (1.6.3-1.ubuntu7) ...
Selecting previously unselected package liblua5.4-0:amd64.
Preparing to unpack .../4-liblua5.4-0_amd64.deb ...
Unpacking liblua5.4-0:amd64 (5.4.6-3build2) ...
Selecting previously unselected package apache2-bin.
Preparing to unpack .../5-apache2-bin_2.4.58-1ubuntu8.6_amd64.deb ...
Unpacking apache2-bin (2.4.58-1ubuntu8.6) ...

```

- ❖ systemctl restart apache2
- ❖ cd /var/www/html
- ❖ rm index.html
- ❖ vi index.html
- ❖ insert some data and check it is connected or not by copying public ip:80 in browser
- ❖ now connect to apptier-1 by following steps:

- ❖ vi project.pem (pem file name)
- ❖ copy encrypted password in pem file and paste in vi project-1.pem and save it
- ❖ Give the permission to the pem file by chmod 400 project-1.pem
- ❖ Copy ssh of web-2 and use app-2 private ip address in ssh command instead of using webtier ip address.
- ❖ Now it will be connected to app02 instance.
- ❖ Check here its connected to internet or not by using ping facebook.com/google.com



```

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

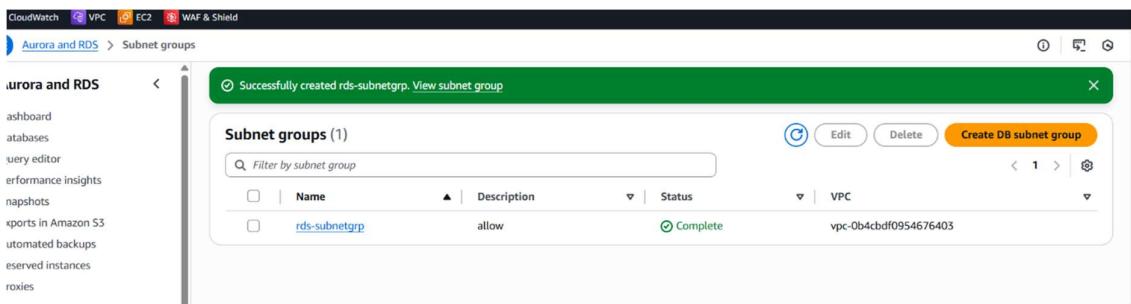
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-10-0-4-53:~$ ping 10.0.4.53
PING 10.0.4.53: command not found
ubuntu@ip-10-0-4-53:~$ ping 10.0.4.53
PING 10.0.4.53(10.0.4.53) 56(84) bytes of data.
4 bytes from 10.0.4.53: icmp_seq=1 ttl=64 time=0.021 ms
4 bytes from 10.0.4.53: icmp_seq=2 ttl=64 time=0.025 ms
4 bytes from 10.0.4.53: icmp_seq=3 ttl=64 time=0.024 ms
4 bytes from 10.0.4.53: icmp_seq=4 ttl=64 time=0.031 ms
4 bytes from 10.0.4.53: icmp_seq=5 ttl=64 time=0.032 ms
4 bytes from 10.0.4.53: icmp_seq=6 ttl=64 time=0.034 ms
4 bytes from 10.0.4.53: icmp_seq=7 ttl=64 time=0.030 ms

```

## Step:14

- ❖ Create rds
- ❖ Create subnets groups where we can launch databases
- ❖ Select private-subnet-3(3a),private-subnet-04(3b)and create DB subnet group



- ❖ Create DB security group and select mysql/aurora,port number-3306

**BASIC DETAILS**

Security group name [Info](#)  
rds-SG  
Name cannot be edited after creation.

Description [Info](#)  
allow

VPC [Info](#)  
vpc-0b4cbdf0954676403 (project-1)

**Inbound rules [Info](#)**

Type <a href="#">Info</a>	Protocol <a href="#">Info</a>	Port range <a href="#">Info</a>	Source <a href="#">Info</a>	Description - optional <a href="#">Info</a>
SSH	TCP	22	Anyw... <a href="#">Delete</a>	0.0.0.0/ <a href="#">X</a>
MySQL/Aurora	TCP	3306	Anyw... <a href="#">Delete</a>	0.0.0.0/ <a href="#">X</a>

[Add rule](#)

**sg-090931151821cab87 - rds-SG**

**Details**

Security group name <a href="#">rds-SG</a>	Security group ID <a href="#">sg-090931151821cab87</a>	Description <a href="#">allow</a>	VPC ID <a href="#">vpc-0b4cbdf0954676403</a>
Owner <a href="#">002616178134</a>	Inbound rules count 2 Permission entries	Outbound rules count 1 Permission entry	

**Inbound rules** | Outbound rules | Sharing - new | VPC associations - new | Tags

**Inbound rules (2)**

Name	Security group rule ID	IP version	Type	Protocol	Port range
-	sgr-0d085d999ea1c7837	IPv4	MySQL/Aurora	TCP	3306
-	sgr-04b38eb13a1948ef0	IPv4	SSH	TCP	22

- ❖ Now come to database
- ❖ Create database(named as Database-1) and select mysql engine type
- ❖ Select free-tier template, edit user as any name and set password and confirm password
- ❖ Add created vpc and DB security group
- ❖ Click on Create Database.

**Choose a database creation method**

Standard create  
You set all of the configuration options, including ones for availability, security, backups, and maintenance.

Easy create  
Use recommended best-practice configurations. Some configuration options can be changed after the database is created.

**Engine options**

**Engine type [Info](#)**

<input type="radio"/> Aurora (MySQL Compatible) 	<input type="radio"/> Aurora (PostgreSQL Compatible) 	<input checked="" type="radio"/> MySQL 
<input type="radio"/> PostgreSQL 	<input type="radio"/> MariaDB 	<input type="radio"/> Oracle 
<input type="radio"/> Microsoft SQL Server	<input type="radio"/> IBM Db2	

Aurora and RDS > Create database

Production  
Use defaults for high availability and fast, consistent performance.

Dev/Test  
This instance is intended for development use outside of a production environment.

Free tier  
Use RDS Free Tier to develop new applications, test existing applications, or gain hands-on experience with Amazon RDS. [Info](#)

### Availability and durability

**Deployment options** [Info](#)

Choose the deployment option that provides the availability and durability needed for your use case. AWS is committed to a certain level of uptime depending on the deployment option you choose. Learn more in the [Amazon RDS service level agreement \(SLA\)](#).

Multi-AZ DB cluster deployment (3 instances)  
Creates a primary DB instance with two readable standbys in separate Availability Zones. This setup provides:

- 99.95% uptime
- Redundancy across Availability Zones
- Increased read capacity
- Reduced write latency

Multi-AZ DB instance deployment (2 instances)  
Creates a primary DB instance with a non-readable standby instance in a separate Availability Zone. This setup provides:

- 99.95% uptime
- Redundancy across Availability Zones

Single-AZ DB instance deployment (1 instance)  
Creates a single DB instance without standby instances. This setup provides:

- 99.95% uptime
- No data redundancy

**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

DB instance identifier is case-insensitive, but is stored as all lowercase (as in "mydbinstance"). Constraints: 1 to 63 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

to 16 alphanumeric characters. The first character must be a letter.

**Credentials management**  
You can use AWS Secrets Manager or manage your master user credentials.

Managed in AWS Secrets Manager - most secure  
RDS generates a password for you and manages it throughout its lifecycle using AWS Secrets Manager.

Self managed  
Create your own password or have RDS create a password that you manage.

**Auto generate password**  
Amazon RDS can generate a password for you, or you can specify your own password.

**Master password** [Info](#)  
\*\*\*\*\*

**Password strength** Neutral

Minimum constraints: At least 8 printable ASCII characters. Can't contain any of the following symbols: / \* @

**Confirm master password** [Info](#)

Aurora and RDS > Create database

**Virtual private cloud (VPC)** [Info](#)  
Choose the VPC. The VPC defines the virtual networking environment for this DB instance.

project-1 (vpc-0b4cbdf0954676403)  
6 Subnets, 2 Availability Zones

Only VPCs with a corresponding DB subnet group are listed.

**After a database is created, you can't change its VPC.**

**DB subnet group** [Info](#)  
Choose the DB subnet group. The DB subnet group defines which subnets and IP ranges the DB instance can use in the VPC that you selected.

rds-subnetgrp  
2 Subnets, 2 Availability Zones

**Public access** [Info](#)  
 Yes  
RDS assigns a public IP address to the database. Amazon EC2 instances and other resources outside of the VPC can connect to your database. Resources inside the VPC can also connect to the database. Choose one or more VPC security groups that specify which resources can connect to the database.

No  
RDS doesn't assign a public IP address to the database. Only Amazon EC2 instances and other resources inside the VPC can connect to your database. Choose one or more VPC security groups that specify which resources can connect to the database.

**VPC security group (firewall)** [Info](#)  
Choose one or more VPC security groups to allow access to your database. Make sure that the security group rules allow the appropriate incoming traffic.

Choose existing  
Choose existing VPC security groups

Create new  
Create new VPC security group

**Existing VPC security groups**

Choose one or more options

default  rds-SG

**DS Proxy**  
DS Proxy is a fully managed, highly available database proxy that improves application scalability, resiliency, and security.

Create an RDS Proxy [Info](#)  
RDS automatically creates an IAM role and a Secrets Manager secret for the proxy. RDS Proxy has additional costs. For more information, see [Amazon RDS Proxy pricing](#).

**Certificate authority - optional** [Info](#)  
Using a server certificate provides an extra layer of security by validating that the connection is being made to an Amazon database. It does so by checking the server certificate that is automatically installed on all databases that you provision.

rds-ca-rsa2048-g1 (default)  
Expiry: May 26, 2061  
you don't select a certificate authority, RDS chooses one for you.

**Additional configuration**

**Tags - optional**  
Tag consists of a case-sensitive key-value pair.  
tags associated with the resource

**Aurora and RDS** <

**Databases** > **database-1**

**Summary**

DB identifier database-1	Status <span style="color: green;">Available</span>	Role Instance	Engine MySQL Community	Recommendations
CPU 	Class db.m7g.large	Current activity 	Region & AZ eu-west-3b	

**Connectivity & security** | Monitoring | Logs & events | Configuration | Zero-ETL integrations | Maintenance & backups | Data | >

**Connectivity & security**

<b>Endpoint</b> database-1.c32am8y6aw8.eu-west-3.rds.amazonaws.com	<b>Networking</b> Availability Zone eu-west-3b	<b>Security</b> VPC security groups default (sg-064f8058ddec6aa50) rds-SG (sg-090931151821cab87)
Port 3306	Subnet group rds-subnetgrp	Publicly accessible Yes
	Subnets	Certificate authority <a href="#">Info</a>

Success Successfully created database **database-1** [View connection details](#)

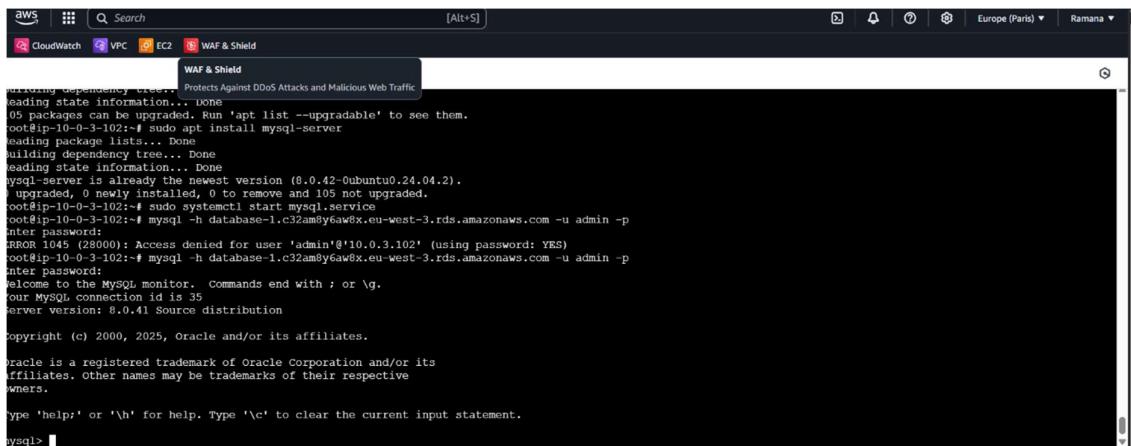
You can use settings from database-1 to simplify configuration of suggested database add-ons while we finish creating your DB for you.

**Databases (1)** Group resources [Modify](#) Actions [Create database](#)

DB identifier	Status	Role	Engine	Region ...	Size
database-1	<span style="color: green;">Available</span>	Instance	MySQL Co...	eu-west-3b	db.m7g.large

## Step:15

- ❖ Install mysql server in webtier and apptier instances below are the steps
- ❖ apt install mysql-server
- ❖ systemctl status mysql-server
- ❖ mysql –version



The screenshot shows a terminal window within the AWS CloudWatch interface. The title bar says "aws [Alt+S]". The menu bar includes "Search", "CloudWatch", "VPC", "EC2", and "WAF & Shield". The main area displays a MySQL command-line session:

```
root@ip-10-0-3-102:~# sudo apt install mysql-server
Reading package lists... Done
05 packages can be upgraded. Run 'apt list --upgradable' to see them.
root@ip-10-0-3-102:~# sudo apt install mysql-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
mysql-server is already the highest version (8.0.42-0ubuntu0.24.04.2).
Upgraded, 0 newly installed, 0 to remove and 105 not upgraded.
root@ip-10-0-3-102:~# sudo systemctl start mysql.service
root@ip-10-0-3-102:~# mysql -h database-1.c32ambyaw8x.eu-west-3.rds.amazonaws.com -u admin -p
Enter password:
ERROR 1045 (28000): Access denied for user 'admin'@'10.0.3.102' (using password: YES)
root@ip-10-0-3-102:~# mysql -h database-1.c32ambyaw8x.eu-west-3.rds.amazonaws.com -u admin -p
Enter password:
Welcome to the MySQL monitor. Commands end with ; or \q.
Your MySQL connection id is 35
Server version: 8.0.41 Source distribution

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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>
```

- ❖ it connects to mysql.Create database here

Show databases;

Create database project;

Here “venky” is created database name.

Use venky;

- ❖ Create Table in Database by using query:

```
CREATE TABLE contacts (
    id INT AUTO_INCREMENT PRIMARY KEY,
    name VARCHAR(100) NOT NULL,
    mail_id VARCHAR(255) NOT NULL
);
```

- ❖ And next Insert Data:

```
INSERT INTO users (name, mail_id)
VALUES ('bhanu', 'manu@gmail.com');
```

```
INSERT INTO users (name, mail_id)
VALUES ('bablu', 'venky@gmail.com');
```

```
Show TABLES;
Select * from Contacts;
```

**OUTPUT:**

**APP-01 INSTANCE:**

```
mysql> create database venky;
Query OK, 1 row affected (0.00 sec)

mysql> show databases;
+-----+
| Database      |
+-----+
| information_schema |
| mysql          |
| performance_schema |
| sys            |
| venky          |
+-----+
5 rows in set (0.00 sec)

mysql> |
```

```
+-----+  
| sys |  
| venky |  
+-----+  
rows in set (0.00 sec)  
  
mysql> use venky;  
Database changed  
mysql> CREATE TABLE users ( id INT AUTO_INCREMENT PRIMARY KEY );  
Query OK, 0 rows affected (0.04 sec)  
  
mysql> INSERT INTO users (name, email) VALUES ('bhanu', 'bhanu@bhanu.com');  
Query OK, 1 row affected (0.01 sec)  
  
mysql> INSERT INTO users (name, email) VALUES ('bablu ', 'bablu@bablu.com');  
Query OK, 1 row affected (0.00 sec)  
  
mysql> show tables;  
ERROR 1064 (42000): You have an error in your SQL syntax;  
line 1  
mysql> show tables;  
+-----+  
| Tables_in_venky |  
+-----+  
| users |  
+-----+  
row in set (0.00 sec)
```

```

mysql> show tables;
+-----+
| Tables_in_venky |
+-----+
| users           |
+-----+
1 row in set (0.00 sec)

mysql> select * from users;
+----+----+----+
| id | name | email        |
+----+----+----+
| 1  | bhanu | manu@gmail.com |
| 2  | bablu | venky@gmail.com |
+----+----+----+
2 rows in set (0.00 sec)

```

❖ Same output will display as well as in web&app instances.

#### **APP-2 INSTANCE:**

```

mysql> select * from users;
ERROR 1046 (3D000): No database selected
mysql> use venky;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> show tables;
+-----+
| Tables_in_venky |
+-----+
| users           |
+-----+
1 row in set (0.00 sec)

mysql> select * from users;
+----+----+----+
| id | name | email        |
+----+----+----+
| 1  | bhanu | manu@gmail.com |
| 2  | bablu | venky@gmail.com |
+----+----+----+
2 rows in set (0.00 sec)

```

## WEB-1 INSTANCE:

```
> Select * from users;
-> INSERT INTO users (name, email) VALUES ('bablu ', ' venky@gmail.com');
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MySQL server version for the right syntax to use near 'select
m
show databases
select* from users
INSERT INTO users (name, email) ' at line 3
mysql> show databases
-> select* from users;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MySQL server version for the right syntax to use near 'select
users' at line 2
mysql> show tables;
+-----+
| Tables_in_venky |
+-----+
| users           |
+-----+
1 row in set (0.00 sec)

mysql> select * from users;
+----+-----+-----+
| id | name | email        |
+----+-----+-----+
| 1  | bhanu | manu@gmail.com |
| 2  | bablu | venky@gmail.com |
+----+-----+-----+
2 rows in set (0.00 sec)
```

i-0a053a5590c463e9f (Web-1)

PublicIPs: 35.180.132.6 PrivateIPs: 10.0.1.253

## WEB-2 INSTANCE:

```
mysql> SHOW TABLES venky;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MySQL server version for the right syntax to use near 'venky' at li
ne 1
mysql> select * from users;
ERROR 1046 (3D000): No database selected
mysql> use venky;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> show tables;
+-----+
| Tables_in_venky |
+-----+
| users           |
+-----+
1 row in set (0.00 sec)

mysql> select * from users;
+----+-----+-----+
| id | name | email        |
+----+-----+-----+
| 1  | bhanu | manu@gmail.com |
| 2  | bablu | venky@gmail.com |
+----+-----+-----+
2 rows in set (0.00 sec)
```

i-02a84c22b42d4d9bf (Web-2)

PublicIPs: 52.47.79.240 PrivateIPs: 10.0.2.21

---

***Thank yoU***

---

**VENKY M**

**Venky024m@gmail.com**