AWS Reference

Main Reasons for Using AWS

1. Scalability

- Auto Scaling and Elastic Load Balancing let you scale your applications up or down based on demand.
- Perfect for startups, growing businesses, and enterprise-level workloads.

2. Cost-Effectiveness

- Pay-as-you-go pricing model: you only pay for what you use.
- Avoids the need for upfront hardware investments.

3. High Availability & Reliability

- AWS offers multiple Availability Zones (AZs) and Regions worldwide.
- Redundant systems ensure minimal downtime

4. Security

- Strong security infrastructure, including:
    - Data encryption
    - Identity and Access Management (IAM)
    - Compliance with major certifications (ISO, SOC, HIPAA, etc.)

5. Wide Range of Services

- Compute (EC2, Lambda)
- Storage (S3, EBS, Glacier)
- Databases (RDS, DynamoDB)
- AI/ML, IoT, DevOps, Big Data tools, and more

6. Global Infrastructure

- Deploy applications anywhere in the world.
- Low-latency access for users across different regions.

7. Fast Deployment

- You can spin up servers, databases, and entire environments in minutes.
- Great for DevOps and CI/CD practices.

8. Managed Services

- AWS handles backups, updates, and maintenance with services like:
    - RDS (managed databases)
    - Lambda (serverless computing)
    - Fargate (serverless containers)

What is a Region

- A **physical location** in the world (e.g. ap-south-1 = Asia Pacific (Mumbai),)
- Comprised of **multiple, isolated Availability Zones**.
- Each Region is **isolated** from others for fault tolerance and latency control.

Why Are Regions Important

- **Latency**: Choose a region closest to your users to reduce response time.
- **Data residency**: Some organizations must store data in a specific country for compliance.
- **Disaster recovery**: You can replicate systems across regions for fault tolerance.
- **Cost differences**: Some regions may be cheaper than others for the same services.

What is an Availability Zone

- It is **one or more discrete data centers** with **redundant power, networking, and connectivity**.
- Each **Region** contains **at least two Availability Zones** (usually 2 to 6).
- AZs in a Region are **separate from each other**, so if one AZ fails (due to power outage, natural disaster, etc.), the others can keep running.
- All AZs in a Region are connected via **low-latency, high-bandwidth networking**.

Example :- **Mumbai Region (ap-south-1)**

- **Region Code** : ap-south-1
- **Number if Azs** : 3
- **AZ Names** : ap-south-1a, ap-south-1b, and ap-south-1c.

Why are AZs important

- **High availability**: If one AZ goes down, your application can still run from another.
- **Disaster recovery**: You can replicate data and systems across AZs.
- **Scalability**: You can spread workloads across multiple AZs.
- **Fault isolation**: Issues in one AZ won't affect the others.

Regions


Ireland
London
Montreal
Paris
Frankfurt
Oregon
Ohio
Zurich
Seoul
Tokyo
Virginia
UAE
Osaka
Mumbai
Hong Kong
Singapore
Jakarta
Core region
Satellite region
São Paulo
Cape Town
FedRAMP region
Sydney

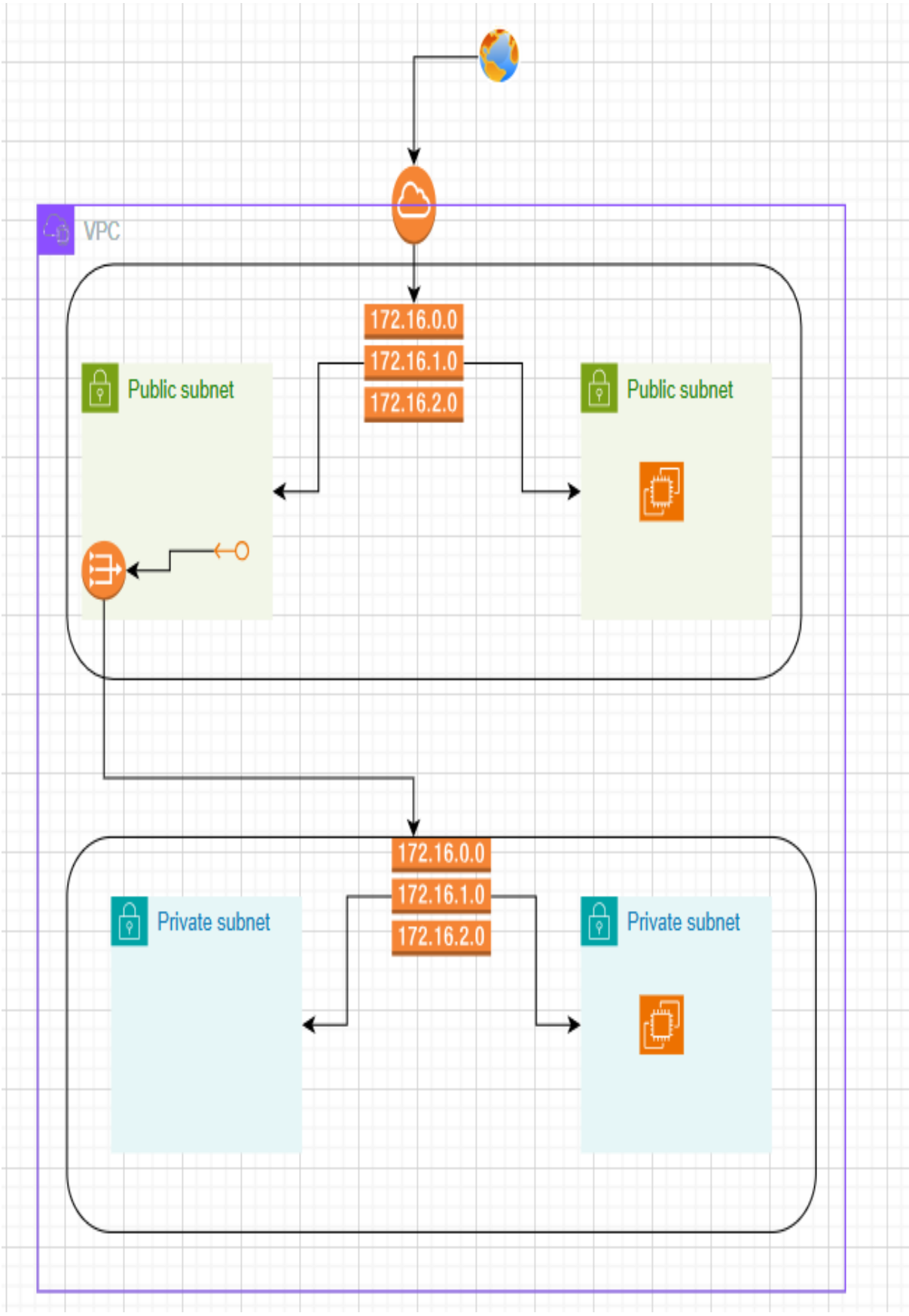
What is a VPC (Virtual Private Cloud)

A **VPC** is like our **own private data center in the cloud**. It gives you **full control** over ou networking environment, including:

- IP address ranges (CIDR blocks)
- Subnets
- Route tables
- Internet gateways
- NAT gateways
- Security groups and network ACLs

Why do we use a VPC

- **Security :-** Keep our resources isolated from other customers. Use firewalls and routing rules to control traffic.
- **Custom Networking :-** Define our own private IP ranges, subnets, and control over routing.
- **Internet Access Control :-** Decide which resources are public (internet-facing) and which are private.
- **VPN / Direct Connect :-** Connect our AWS VPC to our on-premise data center for hybrid cloud setups.
- **Fine-grained Access :** Use security groups and NACLs (Network ACLs) to tightly control inbound/outbound traffic.
- **Multi-Tier Architectures :-** our can separate application layers (e.g., web, app, DB) using public and private subnets.


VPC
172.16.0.0
172.16.1.0
172.16.2.0
Public subnet
Public subnet
172.16.0.0
172.16.1.0
172.16.2.0
Private subnet
Private subnet

What is a Public Subnet :- **A** Public Subnet **is a** subnet inside a VPC **that is configured to allow** direct communication between its resources and the internet**.**

We use a Public Subnet **in AWS** to host resources that need direct access to the internet — **such as web servers, bastion hosts, or load balancers.**

To be a public subnet, it must meet both of these conditions:

1. It is **associated with a route table** that has a route to an **Internet Gateway (IGW)**.
2. Resources (like EC2 instances) in that subnet have a **public IPv4 address or Elastic IP**.

Example VPC Architecture

```
VPC
├── Public Subnet (with Internet Gateway)
│    ├── Web Server (EC2) - has public IP
│    ├── NAT Gateway
│
├── Private Subnet (no direct internet access)
     ├── App Server (EC2) - no public IP
     ├── Database (RDS) - fully private
```

In this setup:

- The **public subnet** contains things that **must talk to the internet**.
- The **private subnet** contains sensitive components that should **not be directly reachable** from the internet.
-

Public Route Table:- A **public route table** is associated with a **public subnet**, which is defined by the presence of a route to the internet through an **Internet Gateway (IGW).**

- Give internet access to specific resources
- Host public-facing services
- Allow private subnets to connect outward via a NAT Gateway

Example Scenario in AWS:

- **Public Subnet** (associated with a public route table):
  - Contains route: `0.0.0.0/0` → **Internet Gateway**
  - Can host:
    - Load Balancers
    - NAT Gateways
    - Bastion Hosts
    - Public-facing EC2 instances
- **Private Subnet** (associated with private route table):
  - No direct IGW route.
  - May access internet **indirectly via NAT Gateway** in public subnet.

To **route internet-bound traffic** from a **public subnet** through an **Internet Gateway (IGW)**. Without it, even if an instance has a **public IP**, it **cannot send or receive traffic** from the internet.

Private Route Table:- A **private route table** is associated with a **private subnet**—a subnet that **does not have a direct route to the internet** through an Internet Gateway (IGW). This ensures that resources like databases or internal services are **not exposed publicly**.

- We use **private route tables** in a cloud network (like AWS, Azure, GCP) to control and restrict traffic **within private subnets.**

Why Use a Private Route Table

- **Security:-** Keeps internal resources like databases, application servers, or cache instances **isolated from the public internet**.

- **Access Control:-** Enables fine-grained routing rules—e.g., traffic to the internet only goes through a **NAT Gateway**, or inter-VPC peering is allowed.
- **Internal Communication:-** Allows routing within private subnets or to internal services (e.g., within the same VPC or peered VPCs).
- **Controlled Internet Access**:- If outbound internet access is needed, it's routed through a **NAT Gateway** or **NAT instance**, which is placed in a public subnet.
- **Compliance & Auditing:-** Helps meet compliance requirements by ensuring that sensitive systems are **not internet-accessible**.

Private route tables are used to:

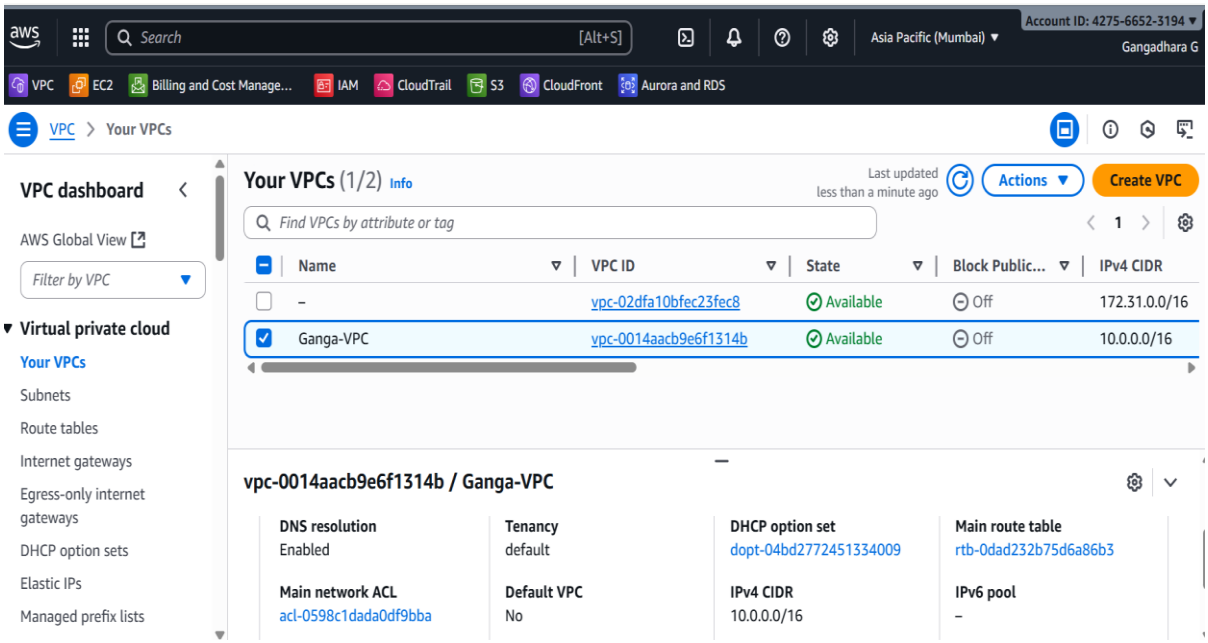
- Protect internal resources
- Avoid direct exposure to the internet
- Control routing policies for private networks

They are essential for **secure, scalable, and compliant network architectures**.

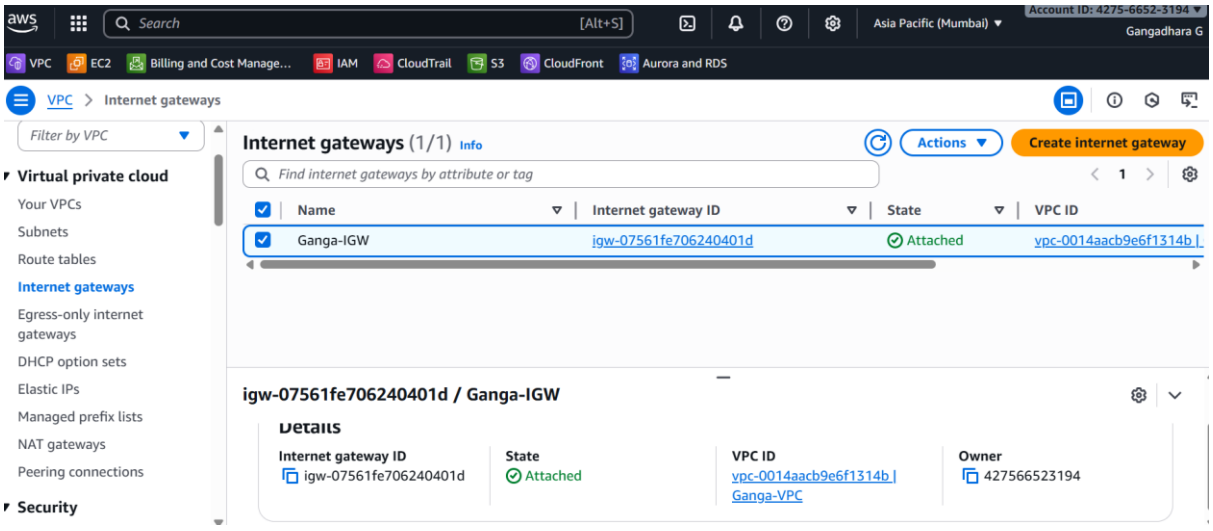
Example Scenario in AWS:

- **Public Subnet** (with public route table):
  - Has a route to `0.0.0.0/0` via an **Internet Gateway**
  - Used for web servers or load balancers
- **Private Subnet** (with private route table):
  - No direct route to IGW
  - Route to `0.0.0.0/0` via a **NAT Gateway** (in a public subnet)
  - Used for DB servers, backend apps, etc.

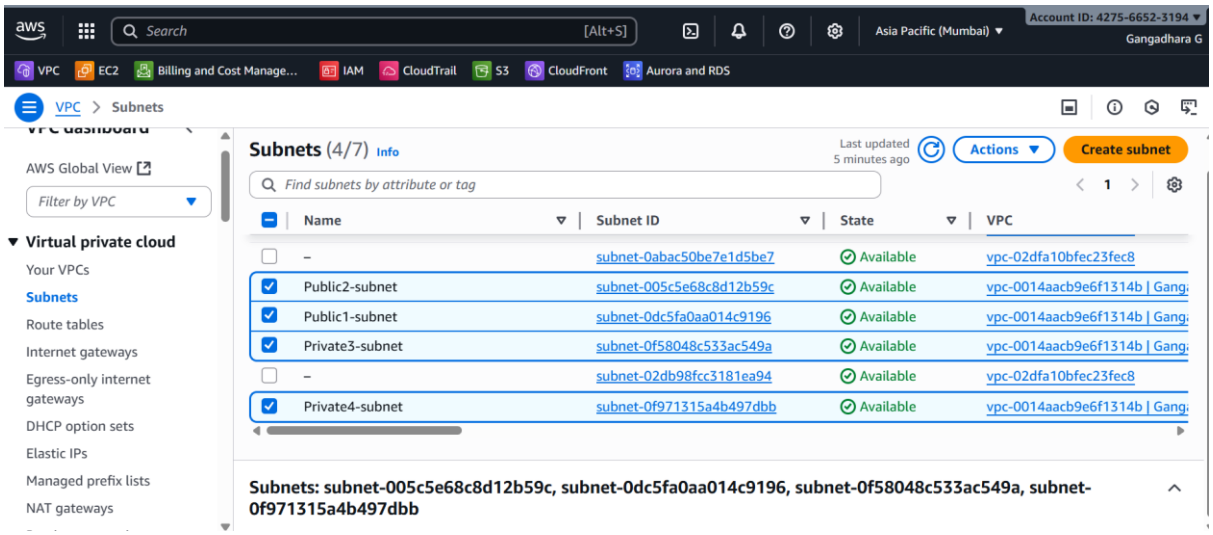
VPC :- I created a custom VPC named **Ganga-VPC** and assigned it a Class A IPv4 CIDR block of **10.0.0.0/16.**



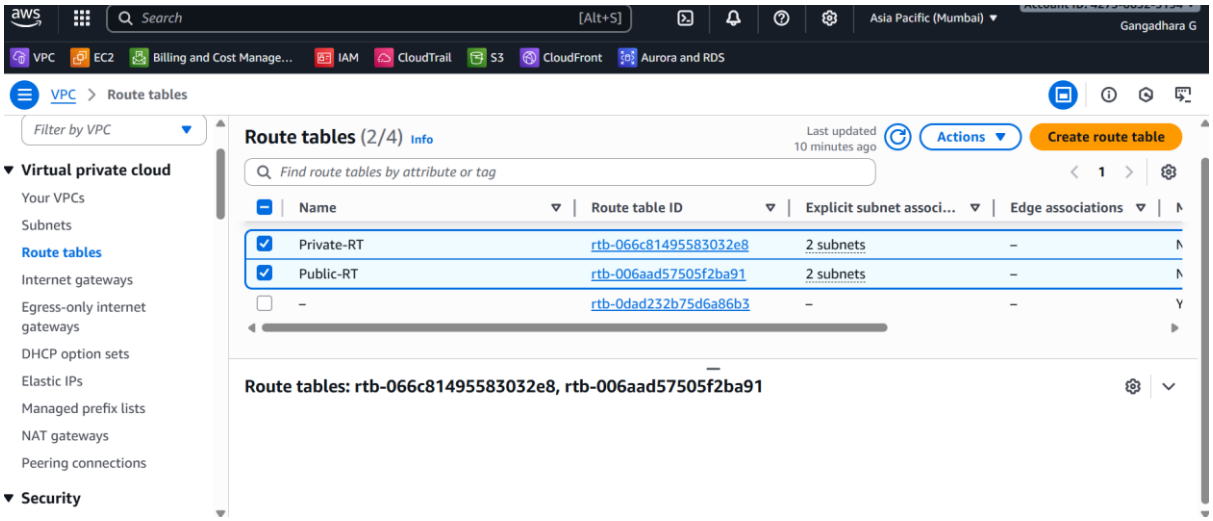
Internet gateway (IGW):- It's allows communication between instances in our **VPC** and the **internet**. Need to **attached from our VPC**.



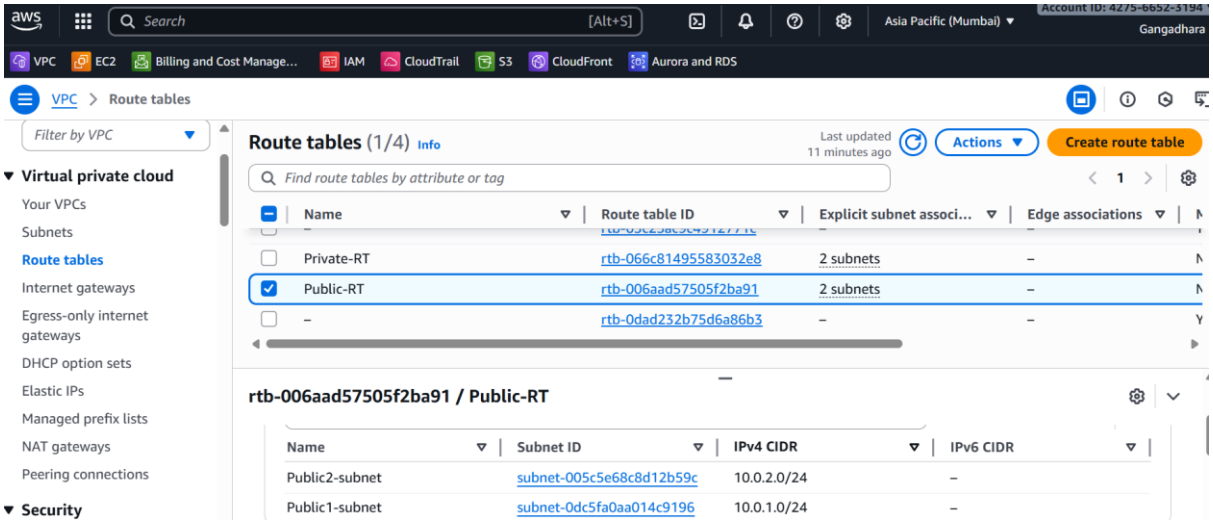
Subnets:- a **subnet** is a segment of a **VPC's IP address range** where we can place groups of **resources** like **EC2 instances**. I Given name as Public-1-subnet, Public-2-subnet, with range of 10.0.1.0/24 , 10.0.2.0/24. And Private-3-subnet, private-4-subnet with range of 10.0.3.0/24,10.0.4.0/24 Respectively.



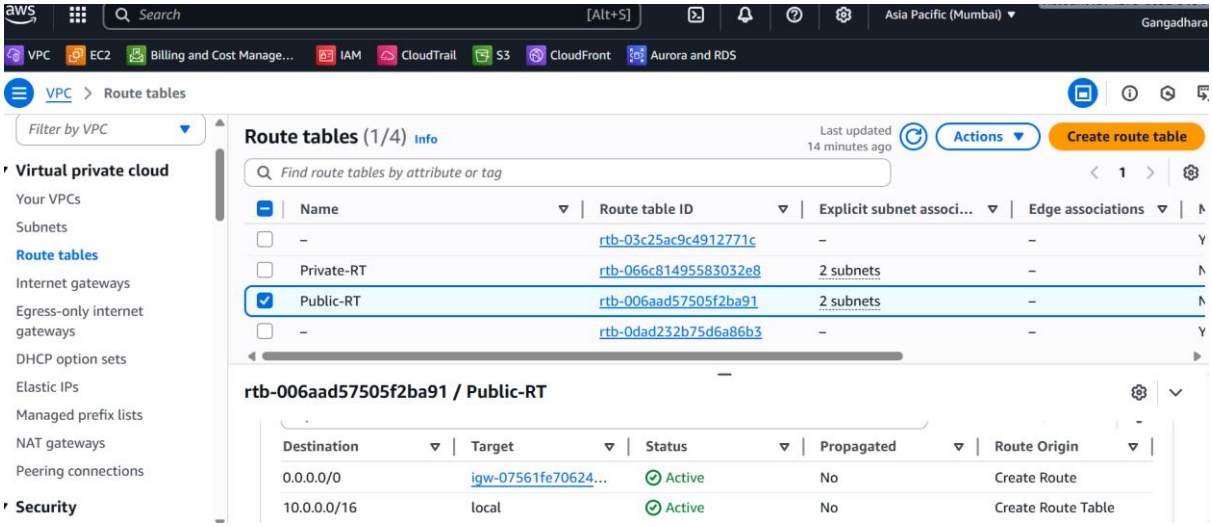
Route Table :- a **Route Table** is a set of rules, called **routes**, that control **how network traffic is directed** within a **VPC**. I created custom Route tables within **Ganga-vpc** named Public-RT and Private-RT and associated with **subnet association** and **Routes** each othes**.**



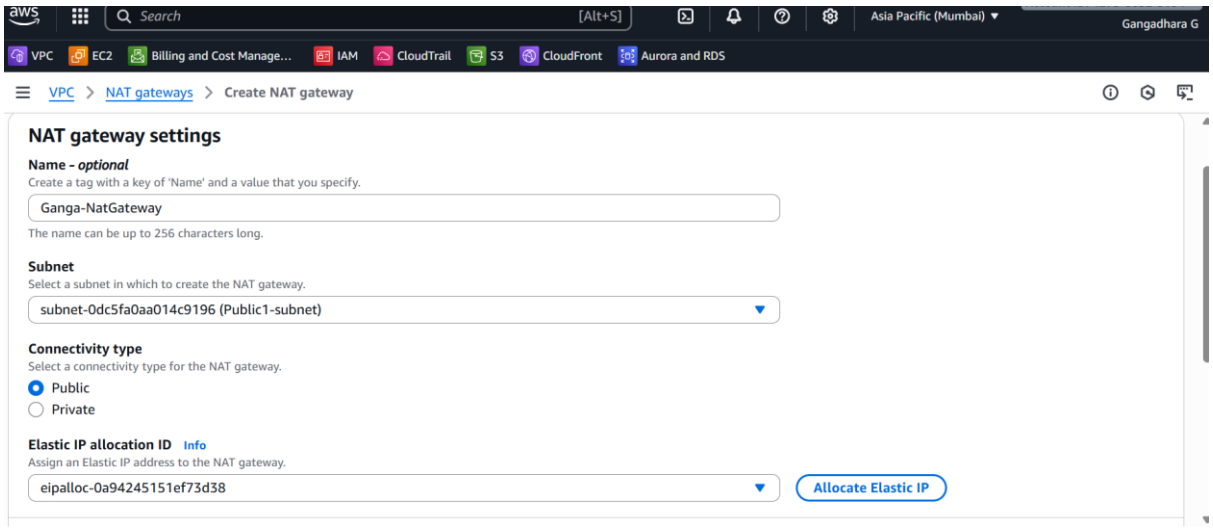
Public subnet associations:- It's a subnet association, establish the communication between public subnets to public route table. We need to associations the respective subnets.



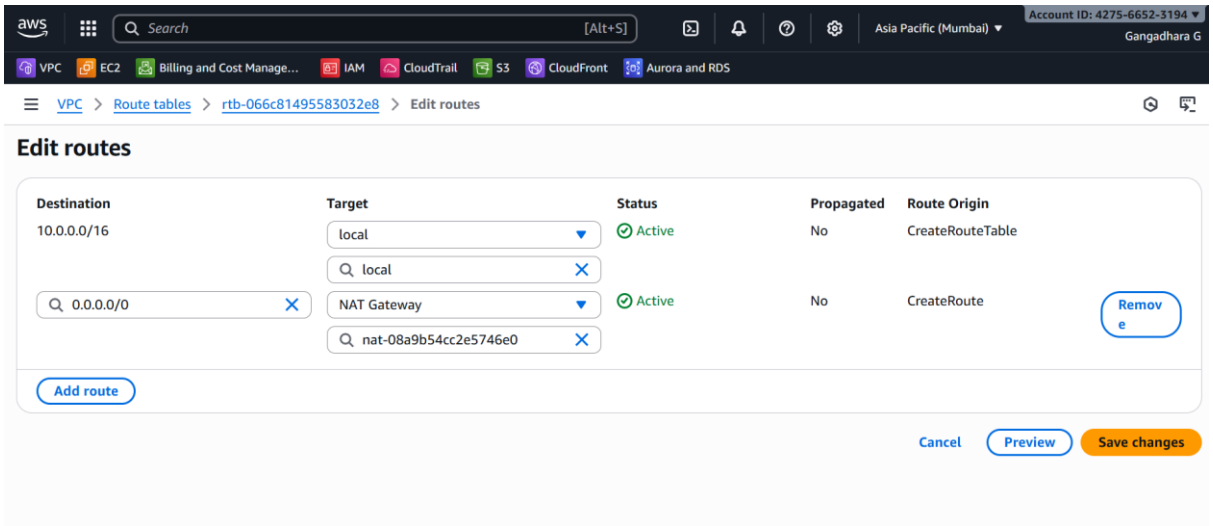
Routes :- Its allows the commination between the internet and Public EC2 instance through the Public Route table.



Nat Gateway :- is a **network device** that allows **instances in a private subnet** to **access the internet**, when we create the Nat gateway need to allocate the Elastic IP Because An **Elastic IP** in **AWS** is a **static.**



- After creating Nat gateway need to Routes with in the Public subnets



EC2 :- **EC2 is a virtual machine (VM)** running on AWS infrastructure that you can use to host applications, websites, databases, or anything else you'd run on a computer or server.

Amazon EC2 provides **flexible, resizable, and secure virtual servers** in the AWS cloud. You can use it to run anything from small personal apps to large-scale enterprise workloads.

Features

- Scalable Compute
- Wide Range of Types
- Pay-as-You-Go
- Secure
- Flexible OS Choices

Common Use Cases:

- Hosting **web servers** or **APIs**
- Running **databases** or **backend services**
- Performing **data processing** or **batch jobs**
- Hosting **applications** in different environments (dev, test, prod)

Key Components of EC2

Instance :- A virtual server running in AWS

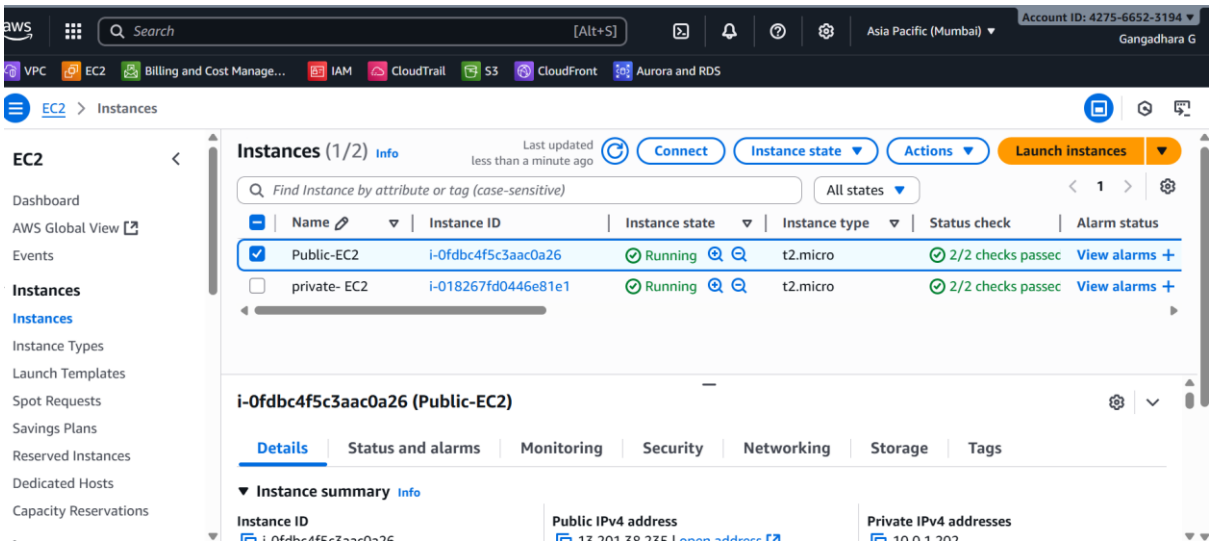
AMI (Amazon Machine Image);- A preconfigured image used to launch an instance (includes OS, software, etc.)

Instance Type:- Defines hardware (CPU, RAM, etc.) for the instance (e.g., t2.micro, m5.large)

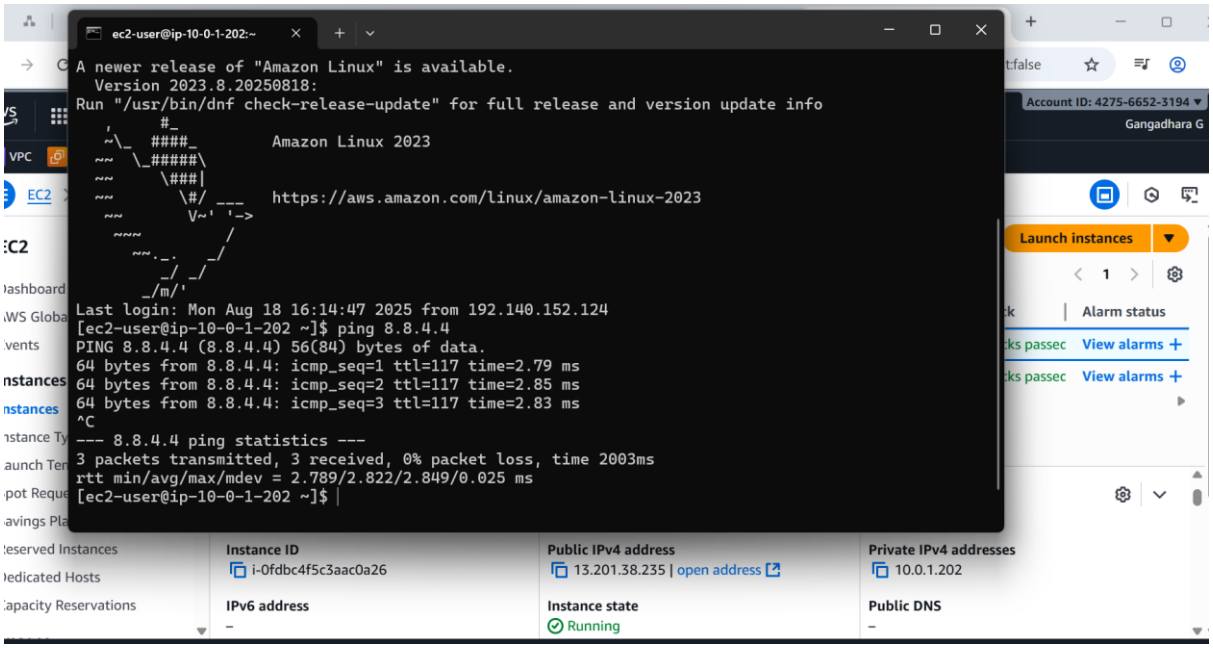
Key Pair:- SSH key used to securely connect to your instance

Security Group:- Acts like a virtual firewall to control inbound/outbound traffic

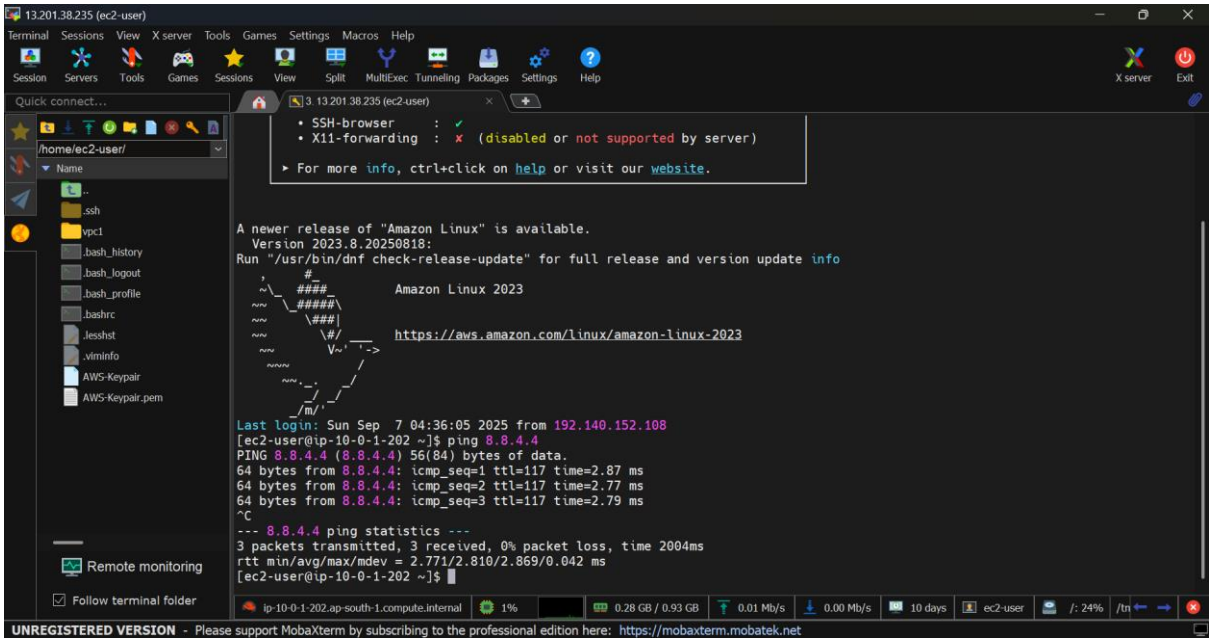
Elastic IP (optional):- A static public IP address for the instance



Here, I used the **command line**. Now, communication happens between the internet and the public subnet instance



Here, I used the MobaXtream, communication happens between the internet and the public EC2 instance. 10.0.1.202 -→ private IPv4 under Public subnet instance.



Here, communicate happens between internet and Private EC2 instance through the public EC2 instance. 10.0.3.222 → this IPv4 belongs to private subnet.