What is a VPC?

A **Virtual Private Cloud (VPC)** in AWS is a logically isolated network within the AWS cloud. It allows you to launch and manage AWS resources like EC2 instances in a virtual network that you define. You have full control over the network configuration, including IP address ranges, subnets, routing tables, gateways, and security settings.

Key Concepts

1️⃣ **Subnet**:
A **subnet** is a range of IP addresses within a VPC. Subnets can be:

- **Public Subnets**: Connected to the internet via an Internet Gateway. Used for resources that need public access, like web servers.
- **Private Subnets**: Isolated from the internet, typically used for sensitive resources like databases.

2️⃣ **Gateway**:

- **Internet Gateway (IGW)**: A component that allows communication between your VPC and the internet.
- **NAT Gateway**: Allows private subnet resources to access the internet without being directly exposed to incoming traffic.

3️⃣ **Route Table**:
A **route table** contains rules (routes) that determine how network traffic is directed within the VPC, between subnets, and to external networks (e.g., internet or other VPCs).

4️⃣ **Routable**:
"Routable" means traffic can find a defined path to its destination. For instance:

- A public subnet with an IGW is routable to the internet.
- A private subnet with only a NAT Gateway is routable *to* the internet but not exposed to incoming traffic.

AWS VPC Diagram Explanation

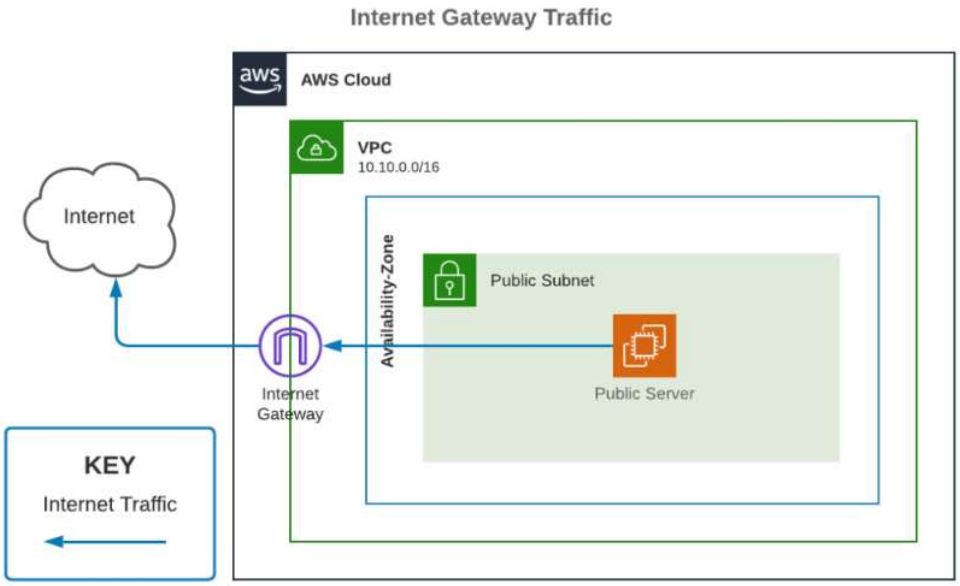
Here's a simple diagram structure for a VPC:

1. **VPC**: A large network (e.g., 10.0.0.0/16).
2. **Subnets**:
    - Public Subnet (10.0.1.0/24)
    - Private Subnet (10.0.2.0/24)
3. **Gateways**:

- Internet Gateway connected to the public subnet.
- NAT Gateway for outbound access from the private subnet.

4. **Route Tables**:
   - Public Subnet's route table with a route to the Internet Gateway.
   - Private Subnet's route table with a route to the NAT Gateway.

Visualizing the Diagram



Step 1: Create a VPC

1. Go to the **VPC Dashboard** in the AWS Management Console.
2. Click **Create VPC**.
3. Choose **VPC only** or **VPC and more** depending on whether you want additional components created automatically.
   - **Name tag**: Provide a name (e.g., `MyVPC`).
   - **IPv4 CIDR block**: Enter a range, e.g., `10.0.0.0/16`.
   - (Optional) Add an IPv6 CIDR block for dual-stack networking.
4. Click **Create VPC**.

Step 2: Create Subnets

1. In the VPC Dashboard, click **Subnets** > **Create Subnet.**
2. Select your VPC and define subnets:
   - **Public Subnet**:

        - Name: `Public-Subnet`.
        - IPv4 CIDR block: `10.0.1.0/24`.
        - Availability Zone: Pick one (e.g., `us-east-1a`).
    - **Private Subnet**:
        - Name: `Private-Subnet`.
        - IPv4 CIDR block: `10.0.2.0/24`.
        - Availability Zone: Pick another (e.g., `us-east-1b`).
3. Click **Create Subnet**.

Step 3: Attach an Internet Gateway (IGW)

1. In the VPC Dashboard, click **Internet Gateways** > **Create Internet Gateway**.
    - Name tag: `MyInternetGateway`.
2. Click **Attach to VPC** and select your VPC.
3. Click **Attach Internet Gateway**.

Step 4: Update the Route Table for the Public Subnet

1. In the VPC Dashboard, click **Route Tables** > **Create Route Table**.
    - Name tag: `Public-Route-Table`.
    - VPC: Select your VPC.
2. Click **Create Route Table**.
3. Select the new route table and click **Edit Routes**.
    - **Destination**: `0.0.0.0/0`.
    - **Target**: Select your Internet Gateway.
4. Click **Save Changes**.
5. Associate the route table with the public subnet:
    - Go to the **Subnet associations** tab and click **Edit subnet associations**.
    - Select the public subnet and save.

Step 5: Create a NAT Gateway for the Private Subnet

1. In the VPC Dashboard, click **NAT Gateways** > **Create NAT Gateway**.
    - Subnet: Select the public subnet.
    - Elastic IP: Click **Allocate Elastic IP** and associate it.
2. Click **Create NAT Gateway**.

Step 6: Update the Route Table for the Private Subnet

1. Create a new route table for the private subnet:
    - Name tag: `Private-Route-Table`.
    - VPC: Select your VPC.
2. Click **Edit Routes**.
    - **Destination**: `0.0.0.0/0`.
    - **Target**: Select your NAT Gateway.
3. Associate the private subnet with this route table:
    - Go to the **Subnet associations** tab and click **Edit subnet associations**.
    - Select the private subnet and save.

Step 7: Verify Your Setup

1. **Public Subnet**:
    - Launch an EC2 instance in the public subnet and associate a public IP address.
    - Check if the instance is accessible via SSH or HTTP.
2. **Private Subnet**:
    - Launch an EC2 instance in the private subnet.
    - Verify it can access the internet (e.g., `ping google.com`) via the NAT Gateway but cannot be accessed externally.
