**🌐 Virtual Private Cloud (VPC)**

**🔹 What is a VPC?**

A **Virtual Private Cloud (VPC)** is a logically isolated section of a public cloud where you can run your resources securely. It behaves like your **own private data centre** within AWS, giving you full control over networking, IP ranges, routing, and gateways — all while maintaining privacy from the public internet.

**🎯 Purpose of a VPC**

In AWS, a VPC lets you:

* Launch resources inside a secure and private environment.
* Customize your **IP address range**.
* Configure **subnets, route tables, and gateways**.
* Control inbound and outbound traffic with precision.

**🚀 Why Choose Amazon VPC?**

Amazon VPC removes the need for traditional hardware or VPNs and allows you to:

* Define and manage your **networking environment** entirely in the cloud.
* Control how your Amazon EC2 instances are accessed.
* Ensure granular security with **fine-tuned access rules**.
* Scale applications without worrying about on-prem infrastructure.

**🛠️ Key Components of a VPC**

* **VPC** → The private network environment you define.
* **Subnets** → Logical partitions of your VPC for grouping resources.
* **Internet Gateway (IGW)** → Enables connectivity between your VPC and the internet.
* **NAT Gateway** → Lets private subnet resources access the internet securely.
* **Virtual Private Gateway** → AWS side of a VPN connection.
* **VPC Peering** → Private network link between two VPCs.
* **VPC Endpoints** → Direct AWS service connectivity without public internet.
* **Egress-only IGW** → IPv6 traffic outbound-only gateway.

**📝 How to Plan a VPC**

1. Sign up for AWS & verify permissions.
2. Choose **IP address ranges (CIDR)**.
3. Select **Availability Zones**.
4. Plan **subnetting (public & private)**.
5. Design **internet connectivity** strategy.
6. Create the VPC and deploy applications.

**📌 CIDR (Classless Inter-Domain Routing)**

CIDR is a flexible IP allocation system that optimizes routing efficiency and reduces wastage.

* **Format** → IP + /prefix (e.g., 192.168.1.0/24).
* **Advantages**:
  + Reduces wasted IPs
  + Improves routing efficiency
  + Supports flexible supernetting

**Classful Address Examples**

* **Class A** → /8 → 44.0.0.1 → Large networks
* **Class B** → /16 → 128.16.0.2 → Medium networks
* **Class C** → /24 → 192.168.1.100 → Small networks

**🌍 VPC Addressing Options**

* **IPv4 only** → VPC has just an IPv4 CIDR block.
* **Dual Stack** → VPC supports both IPv4 and IPv6 CIDR blocks.

**⚙️ VPC Configuration Workflow**

**VPC (Name + CIDR + Tenancy)**  
⬇  
**Availability Zones**  
⬇  
**Subnets (Public & Private)**  
⬇  
**Route Tables**  
⬇  
**NAT Gateways (Private Subnets)**  
⬇  
**Internet Gateway (Public Subnets)**  
⬇  
**DNS Options (Enable DNS Hostnames + Resolution)**