Lecture 1: AWS Introduction

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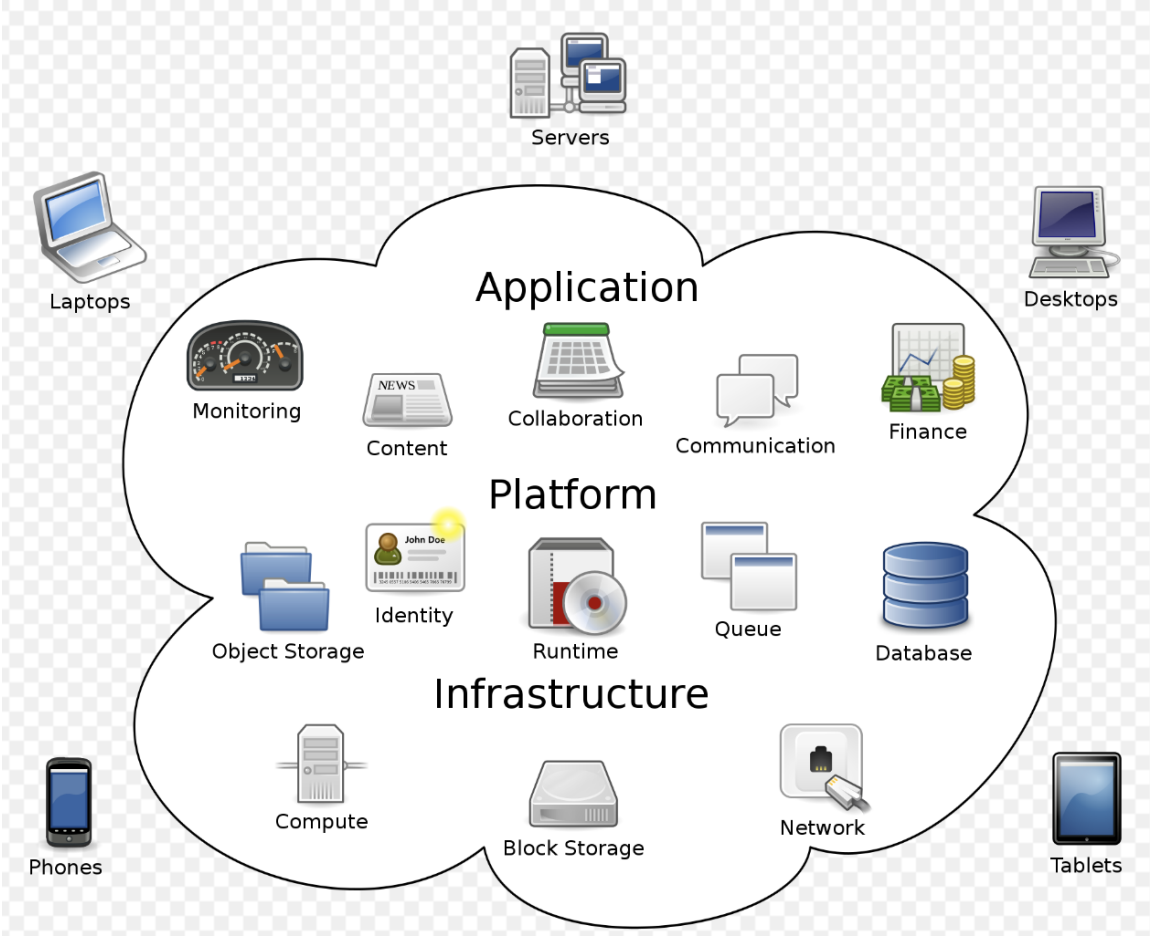
Agenda

- Cloud Computing
- AWS Overview

Cloud Computing

- The group of networked elements providing services does not need to be addressed and managed by users.

https://en.wikipedia.org/wiki/Cloud_computing



Cloud Computing

- Security
- Scalability and flexibility
- Cost Efficiency
- Ease of Access
- Disaster Recovery and Data Loss Prevention
- Automatic Software updates

Cloud Computing

- Major players
  - **AWS**
  - Microsoft Azure
  - Google Cloud Platform (GCP)
  - IBM Cloud
  - Oracle Cloud
  - Salesforce

Cloud computing SERVICE

- **Infrastructure** as a service
- **Platform** as a service
- **Software** as a service
- **Function** as a service
- **Container** as a service
- **Data** as a service
- **Desktop** as a service
- **Integration** as a service
- **Network** as a service
- **Security** as a service

Cloud Computing model

Hosted applications/apps	Development tools, database management, business analytics	Operating systems	Servers and storage	Networking firewalls/security	Data center physical plant/building

https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-paas/

Infrastructure as a Service (IaaS)

- Rent hardware such as servers from the cloud provider.
- Choose the operating system, memory, hard drive, and CPU size.
- Receive a credential to log in to your server after it is created . Once the server is provisioned, you can do whatever you want in the server such as hosting a website you developed.
- The IaaS service in the AWS cloud is an EC2.

Container as a Service

- Containerized deployments took over deployments on virtual machines. Because it is much lighter and faster to deploy apps.
- A Container as a Service (CaaS) model allows you to run containerized applications in the cloud.
- Containerized applications are platform-agnostic (cross-platform)
- Docker is the most popular containerization technology. In AWS, there 2 ways to run containerized applications, on servers (ECS or EKS) or serverless (ECS Fargate).

Function as a Service (FaaS)

- FaaS allows customers to develop, run, and manage application functionalities **without the complexity** of building and maintaining the infrastructure and servers.
- Achieve a **serverless** architecture and is typically used when building modern event-driven and microservices applications.
- Serverless computing is a cloud computing execution model in which the cloud provider allocates machine resources on demand, taking care of the servers on behalf of their customers.
- The FaaS service in the AWS cloud is a Lambda.

	IaaS	CaaS	FaaS
The application runs on	Virtual Machines (VM)	Cluster of VMs managed by you or the cloud provider	In the cloud
Your responsibility	A lot of things, such as patching, networking, OS, runtime, and so on.	Container image	Application code
Scaling duration	Minutes	In a minute	In a second
Cost	A lot	Similar to IaaS	Least expensive when the number of calls is low.

Platform as a Service (PaaS)

- If you're new to the cloud and just want to run your code without worrying about provisioning resources, **PaaS (Platform as a Service)** is a great option. It handles the underlying infrastructure for you, allowing you to focus on deploying your app.
- With **PaaS (Platform as a Service)**, you can deploy applications or services without managing the underlying infrastructure. Whether you're deploying application code or setting up a managed database, PaaS handles provisioning, configuration, and scaling for you.
- For application platforms, you typically upload your code, click deploy, and your app becomes publicly available. For services like databases, you just choose a configuration (e.g., engine type, size), and the platform manages setup, backups, and maintenance.
- PaaS is ideal for traditional apps, monoliths, and even microservices—letting developers focus on writing code, not managing servers.
- In AWS, **Elastic Beanstalk** is a PaaS solution that leverages IaaS services like EC2, Load Balancers, and RDS under the hood. Other PaaS providers include **Heroku, Vercel**, and **DigitalOcean**.

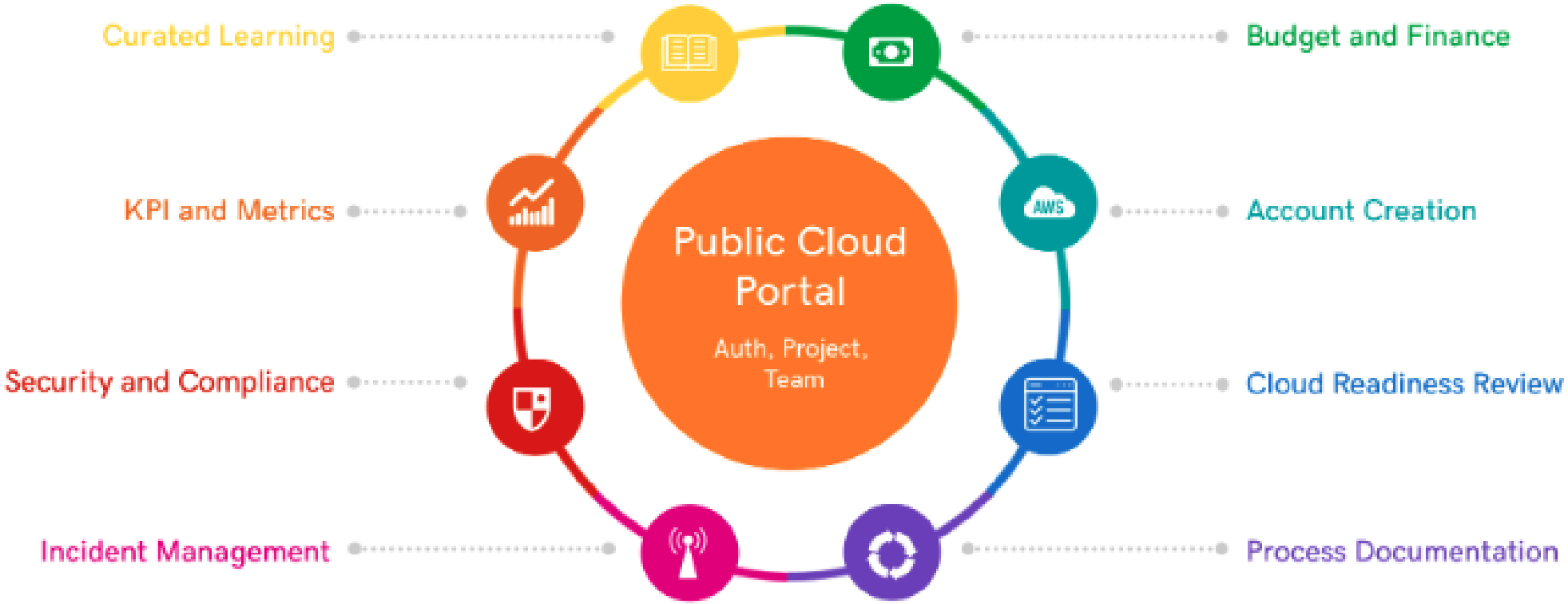
Software as a Service (SaaS)

- **SaaS (Software as a Service)** provides applications over the internet, where customers use the software without managing underlying infrastructure like servers, load balancing, or DNS.
- For example, **Amazon Rekognition** is a SaaS that enables developers to add AI-powered image and video analysis to their applications, even without advanced machine learning expertise.
- SaaS applications can run on various cloud models, including **IaaS**, **PaaS**, and **FaaS**, depending on the underlying architecture.

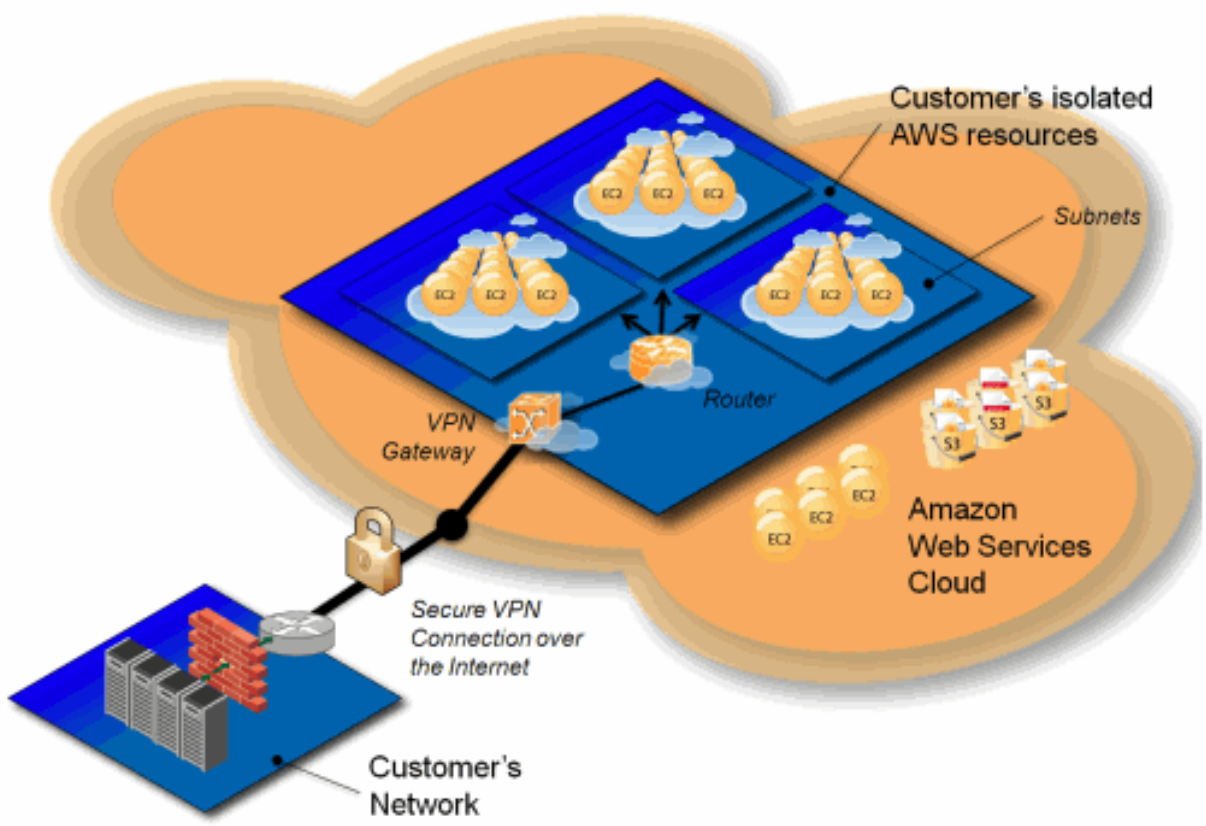
Cloud Computing Deployments

- Public Cloud
- Private Cloud
- Hybrid Cloud

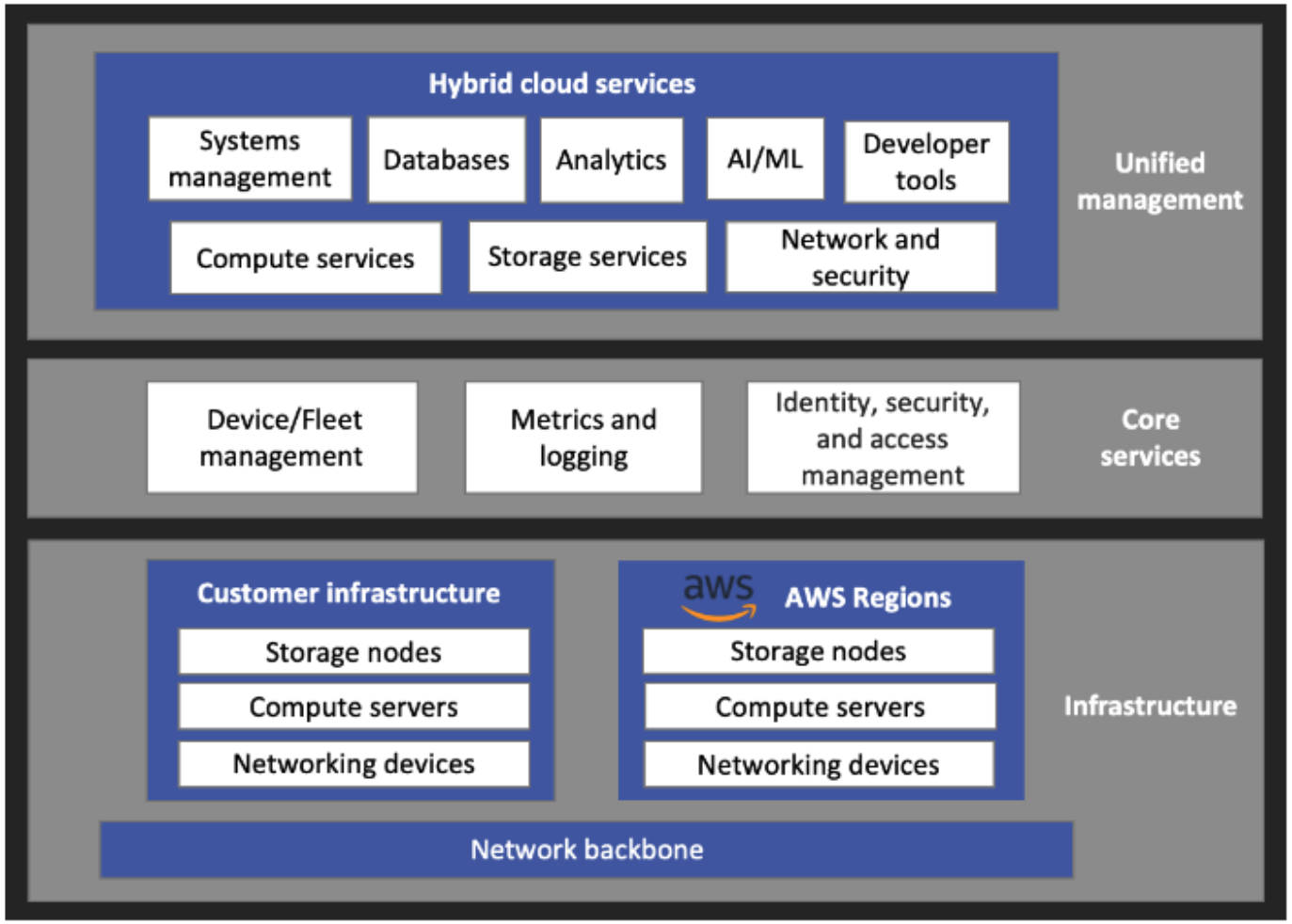
Public Cloud



Private Cloud



Hybrid Cloud



AWS

- Amazon Web Service.
- AWS was publicly launched in 2006, with the initial offerings including Simple Storage Service (S3), Elastic Compute Cloud (EC2), and SQS.
- The largest Cloud Computing provider.
- Provide a variety of scalable computing resources and services that can be used to build, deploy, manage applications on a global network.

Compute
- EC2
- Lightsail
- Lambda
- Batch
- Elastic Beanstalk
- Serverless Application Repository
- AWS Outposts
- EC2 Image Builder
- AWS App Runner

Containers
- Elastic Container Registry
- Elastic Container Service
- Elastic Kubernetes Service
- Red Hat OpenShift Service on AWS

Storage
- S3
- EFS
- FSx
- S3 Glacier
- Storage Gateway
- AWS Backup

Customer Enablement
- AWS IQ
- Support
- Managed Services
- Activate for Startups

Robotics
- AWS RoboMaker

Blockchain
- Amazon Managed Blockchain

Satellite
- Ground Station

Quantum Technologies
- Amazon Braket

Management & Governance
- AWS Organizations
- CloudWatch
- AWS Auto Scaling
- CloudFormation
- CloudTrail

Machine Learning
- Amazon SageMaker
- Amazon Augmented AI
- Amazon CodeGuru
- Amazon DevOps Guru
- Amazon Comprehend
- Amazon Forecast
- Amazon Fraud Detector
- Amazon Kendra
- Amazon Lex
- Amazon Personalize
- Amazon Polly
- Amazon Rekognition
- Amazon Textract
- Amazon Transcribe
- Amazon Translate
- AWS DeepComposer
- AWS DeepLens
- AWS DeepRacer
- AWS Panorama
- Amazon Monitron
- Amazon HealthLake
- Amazon Lookout for Vision
- Amazon Lookout for Equipment

AWS Cost Management
- AWS Cost Explorer
- AWS Budgets
- AWS Marketplace Subscriptions
- AWS Application Cost Profiler

Front-end Web & Mobile
- AWS Amplify
- Mobile Hub
- AWS AppSync
- Device Farm
- Amazon Location Service

AR & VR
- Amazon Sumerian

Application Integration
- Step Functions
- Amazon AppFlow
- Amazon EventBridge
- Amazon MQ
- Simple Notification Service
- Simple Queue Service
- SWF

AWS Infrastructure

- Compute: EC2, ECS, LightSail, Lambda, Batch.
- Storage: EBS, EFS, S3, Glacier, Storage Gateway, Storage Migration Services.
- Network: CloudFront, VPC, Direct Connect, Load Balancing, Route 53.

AWS Database

- Relational Database Service (RDS)
- Aurora: Relational DB Cluster
- DynamoDB: Nonrelational DB
- DocumentDB: Mongodb-compatible database cluster
- Neptune: Graph DB
- ElasticCache: Managed Redis and Memecached (in-memory data)

Security, Identity & compliance

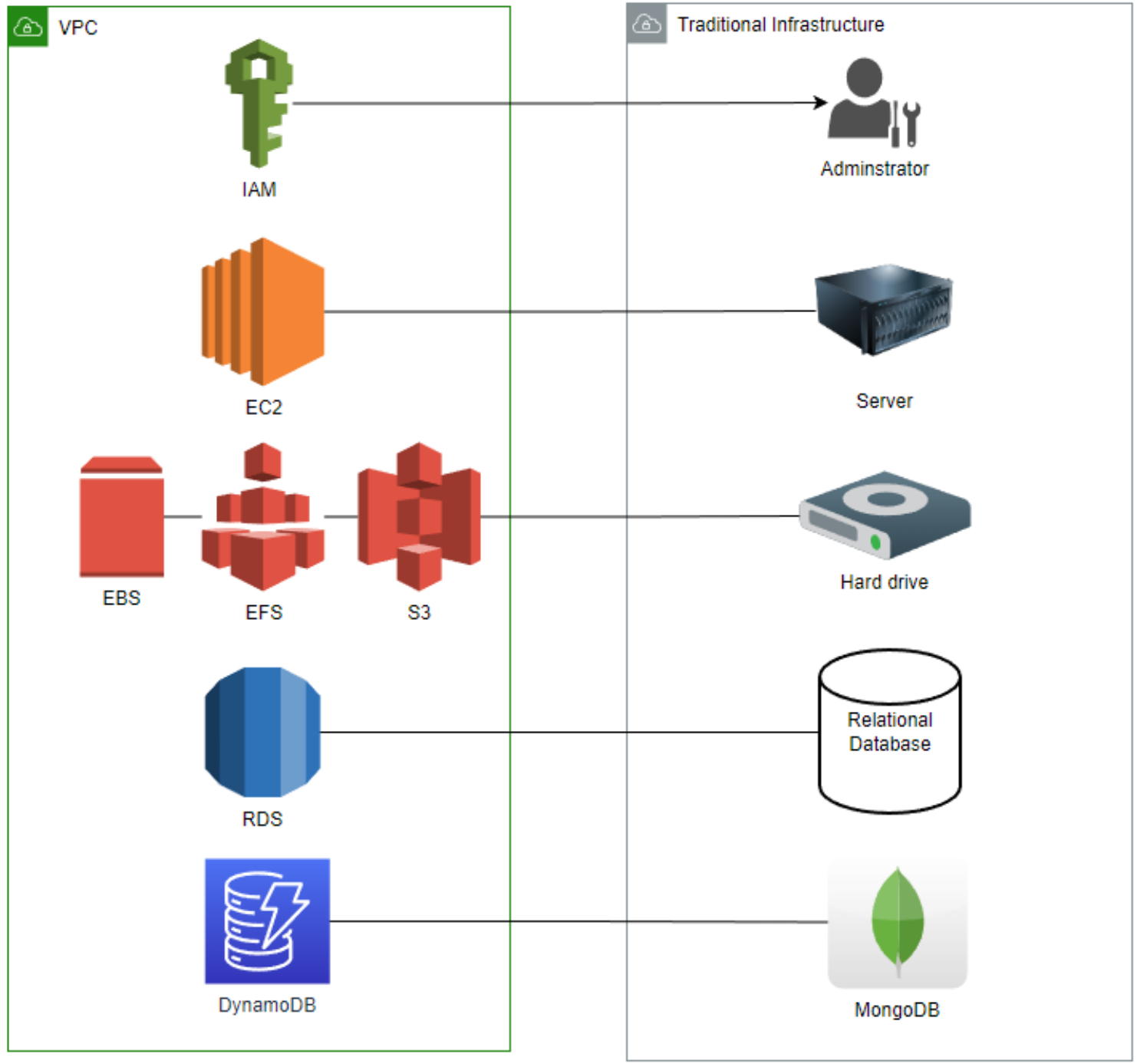
- IAM (identity and Access Management): Controls who can access AWS resources and what actions they can perform.
- Cognition: Provides OAuth support, enabling secure sign-ups, sign-ins, and access control for web and mobile apps.
- Certificate manager: Ensures secure communication for your domains, particularly for domains registered with **AWS Route 53**.
- Guard Duty: Monitors AWS accounts for malicious activity, such as unauthorized access or unusual API calls.
- Inspector: Uses an agent to identify vulnerabilities in your AWS workloads, such as outdated software or exposed ports.
- Macie: Uses machine learning to identify **Personally Identifiable Information (PII)** and sensitive data within your application, helping ensure compliance with data protection laws.

Security, Identity & compliance

- Cloud Hardware Security Module (HSM): A physical device that stores private and public keys, providing strong encryption for accessing applications and EC2 instances.
- Directory Services: Works similarly to **Microsoft Active Directory**, enabling user authentication, group management, and access control within AWS or hybrid environments.
- WAF (Web Application Firewall): Filters and blocks threats like **SQL injection** and **cross-site scripting (XSS)** by inspecting incoming web traffic before it reaches the server.
- Shield: Defense against Distributed Denial of Service (DDoS) attacks
- Artifact: Provides access to AWS compliance reports and agreements, helping organizations meet regulatory requirements.

Application Integration

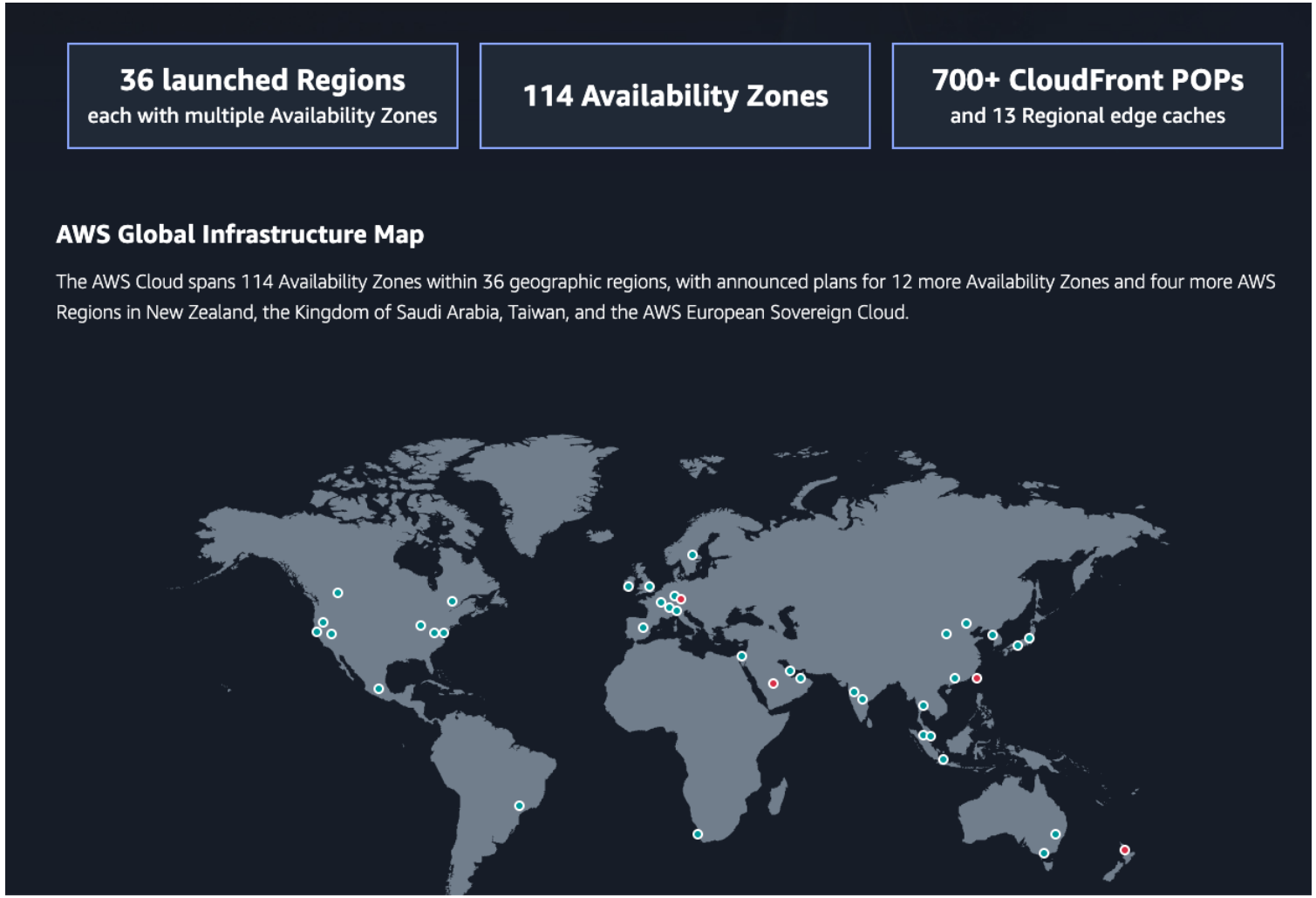
- Amazon MQ: Message broker Service (RabbitMQ/ActiveMQ)
- SNS (Simple Notification Service): Push-based messaging service.
- SQS (Simple Queue Service): Pull-based message queuing service.
- SWF (Simple WorkFlow Service): Task orchestration for complex and manual workflows.


VPC
IAM
EC2
EBS
EFS
S3
RDS
DynamoDB
Traditional Infrastructure
Adminstrator
Server
Hard drive
Relational Database
MongoDB

Available Zones (AZ) & regions

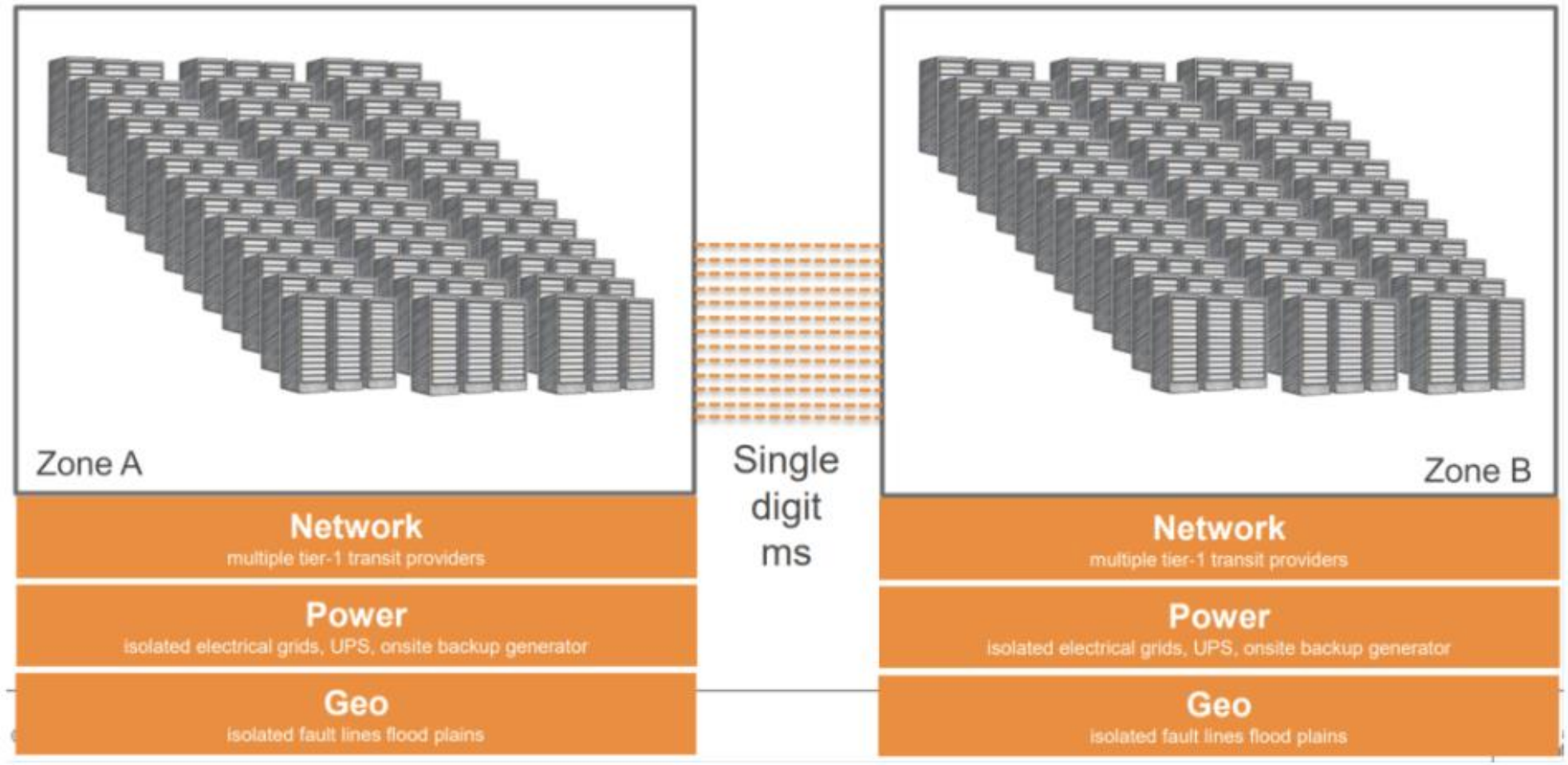
- A region is a geographically distinct area, completely isolated.
- AZs are datacenters within a region.
- Each AZ is independent of other AZs

AWS Global Map



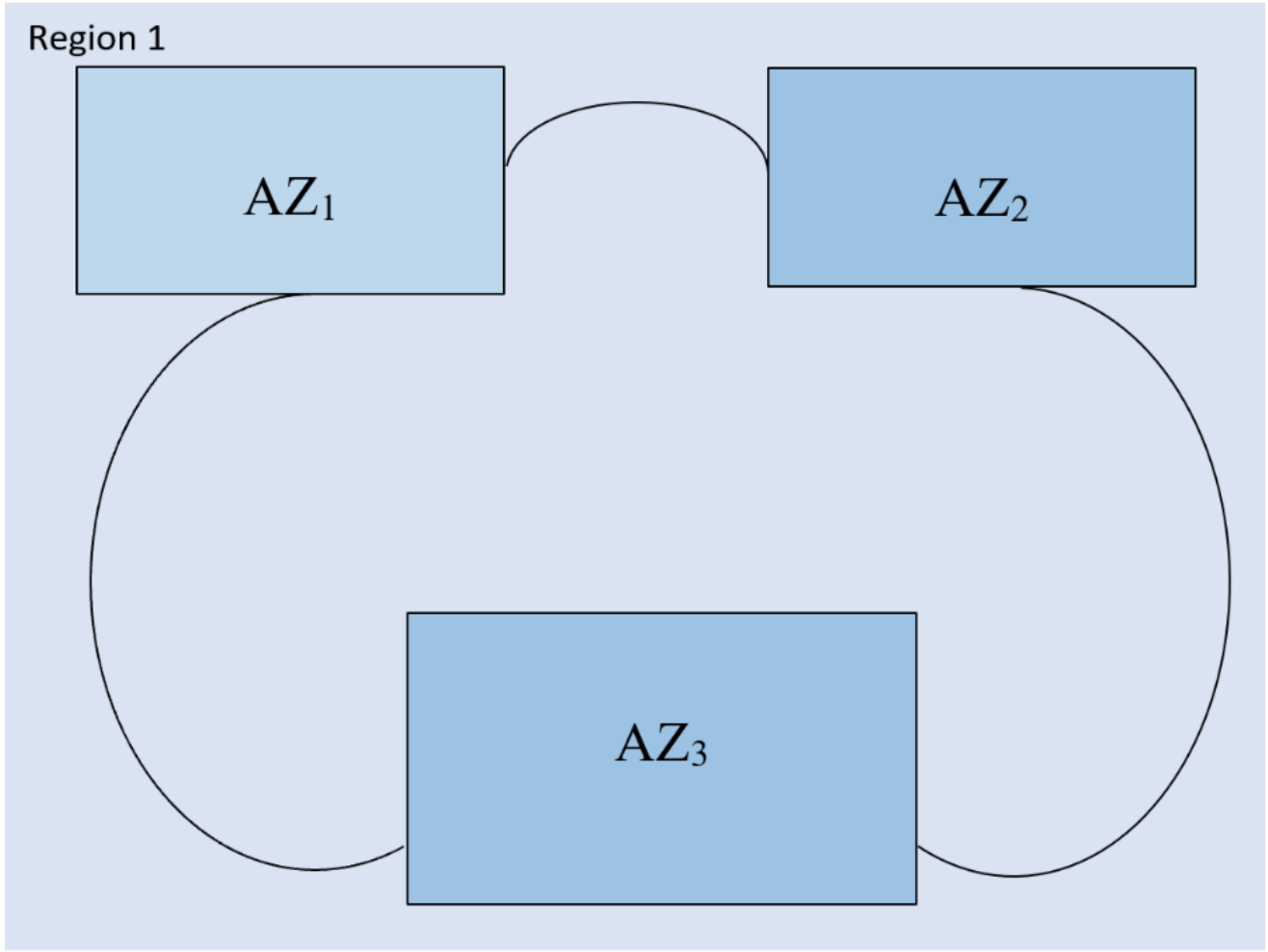
Reference: https://aws.amazon.com/about-aws/global-infrastructure/

AZs and regions



Availability Zones are independent of other

Redundant AZs



Redundant AZs

Regular AWS accounts

- Homepage: https://aws.amazon.com/
- Full access to all services without limitation.
- Long-term access
- Production-level project
- Practical experience: Gain industry-like exposure.
- Credit/Debit card required.
- Free tier available: Up to 12 months for new accounts.
- Caution: If your usage exceeds the free tier limits, you may incur unexpected charges reflected in your credit card. You are solely responsible for this charge.

AWS Free Tier

- **Amazon EC2:**
  - 750 hours per month of Linux or Windows t2.micro/t3.micro instances (for the first 12 months).
  - 750 hours of public IPv4 address usage per month.
- **Amazon S3:**
  - 5 GB of storage in the S3 Standard storage tier (for the first 12 months).
  - 2000 PUT, POST, COPY, or LIST requests per month.
  - 20,000 GET requests per month.
  - 15 GB of data transfer out per month.
- **Other Services:**
  - **AWS Lambda:** 1 million free requests per month.
  - **Amazon RDS:** 750 hours of a t2.micro instance.
  - **Amazon Simple Email Service (SES):** Up to 3,000 message charges free each month for the first 12 months.
  - **Amazon DynamoDB:** First 25 GB of storage and first 10 custom CloudWatch metrics are free.
  - **Amazon OpenSearch Service:** 750 hours per month of a single-AZ t2.small.search or t3.small.search instance.

AWS Account

- Best practices to ensure cost-efficiency
  - Frequently monitor your resource usage.
  - Setup billing alert.
  - Check the bill daily.
  - Shutdown all unused instances/resources:
    - EC2 (Elastic Compute Cloud).
    - RDS (Relational Database Service), Aurora
    - ECS/EKS (Elastic Container Service/Elastic Kubernetes Service).
    - EBS (Elastic Block Store).
    - EFS (Elastic File System).
    - Unused Elastic IP addresses (EIP)
    - DocumentDB
    - DynamoDB.
    - CloudFront.
    - AWS Lambda.
    - SNS/SQS
    - VPC: NAT Gateway, Data transfer, VPN connections. You can keep the default VPC, which is already connected to the internet, so there is no need to create a new one when launching EC2 or other instances. Additionally, the default VPC does not incur significant cost.
    - S3: Particularly important when storing vast amounts of data.

Demo: S3

References

- https://docs.aws.amazon.com/
- ChatGPT: https://chatgpt.com/
- Google AI: https://gemini.google.com/app