**Introduction to Cloud Computing**

Cloud computing is the **on-demand delivery of IT resources**—like servers, storage, databases, networking, software—over the internet. Instead of owning physical infrastructure, users rent what they need from cloud providers.

**Key Benefits**

* **Scalability**: Instantly scale resources up or down
* **Cost-efficiency**: Pay only for what you use
* **Accessibility**: Access services from anywhere
* **Speed**: Rapid deployment of applications
* **Reliability**: Built-in redundancy and disaster recovery

**Security Management in AWS**

Amazon Web Services (AWS) offers a robust security framework based on the **Shared Responsibility Model**:

* **AWS is responsible** for securing the infrastructure (hardware, software, networking)
* **You are responsible** for securing your data, apps, and configurations

**Key AWS Security Services**

* **AWS IAM**: Manage user access and permissions
* **Amazon GuardDuty**: Threat detection and monitoring
* **AWS Security Hub**: Centralized security posture management
* **AWS Shield & WAF**: DDoS protection and web app firewall
* **AWS KMS**: Key management for encryption
* **Amazon Inspector**: Automated security assessments

**What Cloud Providers Offer**

Cloud providers deliver services across three main models:

* **IaaS** (Infrastructure as a Service): Virtual machines, storage, networking
* **PaaS** (Platform as a Service): Development platforms, databases, runtime environments
* **SaaS** (Software as a Service): Ready-to-use applications like Gmail, Salesforce

**AWS vs Azure vs GCP: Comparison**

|  |  |  |  |
| --- | --- | --- | --- |
| Feature | AWS | Azure | GCP |
| Launch Year | 2006 | 2010 | 2008 |
| Market Share | ~33% | ~22% | ~9% |
| Strengths | Broadest service offering, maturity | Enterprise integration (Microsoft) | AI/ML, Big Data, pricing |
| Compute | EC2, Lambda | Azure VMs, Functions | Compute Engine, Cloud Run |
| Storage | S3, EBS | Blob Storage, Azure Files | Cloud Storage, Bigtable |
| Security | IAM, GuardDuty, Security Hub | Azure AD, Defender, Key Vault | Security Command Center |
| AI/ML | SageMaker | Azure ML, Cognitive Services | Vertex AI, AutoML |

Each provider has its own strengths depending on your use case.

**Types of Cloud Deployment**

|  |  |  |
| --- | --- | --- |
| Type | Description | Use Case |
| Public | Services offered over the internet by third-party providers (e.g., AWS, Azure) | Startups, scalable apps |
| Private | Dedicated infrastructure for one organization | Banks, healthcare, compliance-heavy |
| Hybrid | Combines public and private clouds | Enterprises needing flexibility |

Hybrid models allow data and apps to move between environments.

**Advantages of Cloud Computing**

* Cost savings (no hardware investment)
* High scalability and flexibility
* Automatic updates and maintenance
* Disaster recovery and backup
* Global accessibility
* Collaboration and mobility

**Disadvantages of Cloud Computing**

* Internet dependency
* Downtime risks
* Security concerns (shared environments)
* Limited control over infrastructure
* Potential vendor lock-in

**Cloud Service Models Explained**

**IaaS (Infrastructure as a Service)**

* **What it is**: Virtualized computing resources (VMs, storage, networks)
* **User manages**: OS, apps, data
* **Examples**: AWS EC2, Azure VMs, GCP Compute Engine
* **Use case**: Custom app hosting, scalable infrastructure

**PaaS (Platform as a Service)**

* **What it is**: Environment for app development and deployment
* **User manages**: Code and data
* **Examples**: AWS Elastic Beanstalk, Azure App Services, GCP App Engine
* **Use case**: Rapid development without managing servers

**SaaS (Software as a Service)**

* **What it is**: Ready-to-use software delivered via the cloud
* **User manages**: Just usage
* **Examples**: Gmail, Salesforce, Microsoft 365
* **Use case**: Email, CRM, collaboration tools

Visual breakdown of responsibilities:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Layer | On-Prem | IaaS | PaaS | SaaS |
| Applications | ✅ | ✅ | ✅ | ❌ |
| Data | ✅ | ✅ | ✅ | ❌ |
| Runtime | ✅ | ✅ | ❌ | ❌ |
| Middleware | ✅ | ✅ | ❌ | ❌ |
| OS | ✅ | ✅ | ❌ | ❌ |
| Virtualization | ✅ | ❌ | ❌ | ❌ |
| Servers/Storage | ✅ | ❌ | ❌ | ❌ |
| Networking | ✅ | ❌ | ❌ | ❌ |