

# Cloud Computing Fundamentals

Cloud Computing delivers computing services over the internet.

## CLOUD SERVICE MODELS:

### 1. IaaS (Infrastructure as a Service)

- Provides virtualized computing resources
- User manages: OS, middleware, applications
- Provider manages: Hardware, networking, storage
- Examples: AWS EC2, Google Compute Engine, Azure VMs
- Use case: Full control over infrastructure

### 2. PaaS (Platform as a Service)

- Provides development and deployment platform
- User manages: Applications, data
- Provider manages: OS, middleware, runtime
- Examples: Heroku, Google App Engine, Azure App Service
- Use case: Focus on development, not infrastructure

### 3. SaaS (Software as a Service)

- Provides ready-to-use software
- User manages: Data within application
- Provider manages: Everything else
- Examples: Gmail, Salesforce, Office 365, Dropbox
- Use case: Use software without installation

## CLOUD DEPLOYMENT MODELS:

### 1. Public Cloud

- Shared infrastructure
- Cost-effective, scalable
- Examples: AWS, Azure, Google Cloud
- Less control over security

### 2. Private Cloud

- Dedicated to single organization
- More control and security
- Higher cost
- On-premises or hosted

### 3. Hybrid Cloud

- Combination of public and private
- Flexibility and optimization
- Sensitive data in private, public for scalability

### 4. Multi-Cloud

- Multiple public cloud providers
- Avoid vendor lock-in
- Best-of-breed services

## MAJOR CLOUD PROVIDERS:

### 1. Amazon Web Services (AWS)

- Market leader
  - Services:
    - \* EC2: Virtual servers
    - \* S3: Object storage
    - \* RDS: Managed databases
    - \* Lambda: Serverless computing
    - \* CloudFront: CDN
  - Pay-as-you-go pricing
2. Microsoft Azure
- Strong enterprise integration
  - Services:
    - \* Virtual Machines
    - \* Azure SQL Database
    - \* Azure Functions
    - \* Azure Active Directory
  - Hybrid cloud strength
3. Google Cloud Platform (GCP)
- Data analytics and ML strength
  - Services:
    - \* Compute Engine
    - \* Cloud Storage
    - \* BigQuery: Data warehouse
    - \* TensorFlow on cloud
  - Competitive pricing

#### CLOUD COMPUTING BENEFITS:

1. Cost Savings
  - No upfront hardware cost
  - Pay only for what you use
  - Reduced IT maintenance
2. Scalability
  - Scale up/down based on demand
  - Auto-scaling
  - Handle traffic spikes
3. Accessibility
  - Access from anywhere
  - Internet connection needed
  - Collaboration made easy
4. Disaster Recovery
  - Automatic backups
  - Geographic redundancy
  - Quick recovery
5. Automatic Updates
  - Provider handles patches
  - Latest features automatically

- Security updates

## VIRTUALIZATION:

Core technology behind cloud computing.

### 1. Virtual Machines (VMs)

- Multiple OS on single hardware
- Hypervisor manages VMs
- Types: Type 1 (bare-metal), Type 2 (hosted)
- Examples: VMware, VirtualBox, KVM

### 2. Containers

- Lightweight virtualization
- Share OS kernel
- Docker: Container platform
- Kubernetes: Container orchestration
- Faster startup than VMs

## CLOUD STORAGE:

### 1. Object Storage

- Store files as objects
- Scalable, durable
- Examples: AWS S3, Google Cloud Storage
- Use case: Backups, media files

### 2. Block Storage

- Fixed-size blocks
- Low latency
- Examples: AWS EBS, Azure Disk Storage
- Use case: Databases, applications

### 3. File Storage

- Hierarchical file system
- Shared access
- Examples: AWS EFS, Azure Files
- Use case: Shared documents

## SERVERLESS COMPUTING:

- No server management
- Pay only for execution time
- Auto-scaling
- Examples: AWS Lambda, Azure Functions, Google Cloud Functions

Use cases:

- API backends
- Data processing
- Scheduled tasks
- Event-driven applications

## CLOUD NETWORKING:

### 1. Virtual Private Cloud (VPC)

- Isolated network in cloud
- Subnets, route tables

- Security groups
- 2. Load Balancers
  - Distributes traffic across servers
  - High availability
  - Health checks
- 3. Content Delivery Network (CDN)
  - Caches content at edge locations
  - Faster content delivery
  - Reduced latency
  - Examples: CloudFront, Cloudflare

#### CLOUD SECURITY:

1. Shared Responsibility Model
  - Provider: Security OF the cloud
  - Customer: Security IN the cloud
  - Clear boundaries
2. Identity and Access Management (IAM)
  - User authentication and authorization
  - Roles and permissions
  - Principle of least privilege
3. Encryption
  - Data at rest: Encrypted storage
  - Data in transit: TLS/SSL
  - Key management services
4. Security Groups & Firewalls
  - Control inbound/outbound traffic
  - Network segmentation
  - Defense in depth

#### CLOUD MIGRATION:

##### Strategies (6 R's):

1. Rehost (Lift and Shift)
  - Move as-is to cloud
  - Quick migration
  - Minimal changes
2. Replatform
  - Minor optimizations
  - Use managed services
  - Example: Database to RDS
3. Refactor
  - Re-architect for cloud
  - Serverless, microservices
  - Maximum cloud benefits
4. Repurchase
  - Move to SaaS
  - Example: CRM to Salesforce

## 5. Retain

- Keep on-premises
- Not ready for cloud

## 6. Retire

- Decommission unused applications
- Cost savings

## CLOUD COST MANAGEMENT:

### 1. Right-sizing

- Choose appropriate instance types
- Don't over-provision

### 2. Reserved Instances

- Commit for 1-3 years
- Up to 75% discount

### 3. Spot Instances

- Unused capacity at discount
- Interruptible
- Good for batch jobs

### 4. Auto-scaling

- Scale based on demand
- Reduce costs during low usage

### 5. Monitoring

- Track usage and costs
- Set budgets and alerts
- Tools: AWS Cost Explorer, Azure Cost Management