Cloud Computing Overview

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Topics

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On Premises

- An **on-premises (on-prem) server** is a physical server that a company or individual hosts within their own infrastructure rather than relying on cloud-based services. These servers are typically located in data centers or office environments and are managed by in-house IT teams.

Key Features of On-Prem Servers

- Full Control: Organizations have complete ownership and control over their data and infrastructure.
- Security & Compliance: On-prem servers allow businesses to enforce strict security policies and meet regulatory compliance needs.
- Performance & Customization: Resources can be fully dedicated to applications, providing higher performance and greater customization.
- Initial Cost: Requires significant upfront investment in hardware, licensing, and IT management.
- Maintenance Responsibility: IT teams are responsible for updates, security patches, backups, and hardware failures.

Advantages of On-Prem Servers

- Full Control – You have complete ownership over hardware, software, and data, allowing for custom configurations and optimizations.
- Enhanced Security – Data stays within the company's network, reducing the risk of breaches from third-party cloud providers.
- Regulatory Compliance – Helps meet strict data compliance requirements (e.g., HIPAA, GDPR, PCI DSS) by maintaining control over data location and access.
- Predictable Costs – No recurring cloud service fees; once hardware is purchased, ongoing costs are mostly maintenance and electricity.
- Performance & Low Latency – No dependency on internet speed; on-prem solutions can provide better performance for critical applications.
- Customization & Integration – Ability to tailor infrastructure, networking, and security settings to business-specific needs
- Data Sovereignty – Organizations can ensure that sensitive data remains within their jurisdiction and complies with local laws.

Disadvantages of On-Prem Servers

- High Upfront Cost – Requires significant investment in hardware, software licenses, and infrastructure setup.
- Ongoing Maintenance – IT teams must handle updates, security patches, backups, and hardware replacements.
- Limited Scalability – Expanding capacity requires purchasing additional hardware, which can be slow and costly.
- Risk of Downtime – If there is hardware failure or power outage, operations may be disrupted unless backups and redundancies are in place.
- Requires Skilled IT Staff – On-prem servers need dedicated personnel for administration, troubleshooting, and security management.
- Disaster Recovery Challenges – If not properly managed, physical threats like fires, floods, or theft can result in data loss.
- Less Flexibility for Remote Access – Setting up secure remote access (e.g., VPNs) requires additional configuration and security measures.

Use Cases

- Hosting internal applications (e.g., ERP, CRM, databases)
- Running virtual machines and containers
- Data storage and backup solutions
- Web hosting for private or public-facing services

Cloud Infrastructure

- Cloud infrastructure refers to the virtualized IT environment provided by cloud service providers (CSPs) like **Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP),** and others. It includes computing resources such as **servers, storage, networking, databases, and security tools** that are available on-demand over the internet.

Key Components of Cloud Infrastructure

- Compute – Virtual machines (VMs), containers (e.g., Kubernetes, Docker), serverless computing (AWS Lambda, Azure Functions).
- Storage – Object storage (AWS S3, Google Cloud Storage), block storage (EBS, Azure Disks), file storage (EFS, FSx).
- Networking – Virtual networks (VPCs), firewalls, load balancers, content delivery networks (CDNs).
- Databases – Relational (Amazon RDS, Azure SQL), NoSQL (DynamoDB, CosmosDB, MongoDB), Data Warehousing (BigQuery, Redshift).
- Security & Identity – IAM (Identity & Access Management), encryption, firewalls, monitoring tools.
- Management & Monitoring – Tools for performance tracking, logging, and automated scaling.

Advantages of Cloud Infrastructure

- Scalability – Easily scale resources up or down based on demand.
- Cost Efficiency – Pay-as-you-go pricing eliminates upfront hardware costs.
- Global Accessibility – Access from anywhere with an internet connection.
- High Availability & Disaster Recovery – Redundant data centers ensure uptime and business continuity.
- Automatic Updates & Maintenance – Providers manage patches, updates, and security improvements.
- Security & Compliance – CSPs offer advanced security features, encryption, and compliance certifications.
- Faster Deployment – Infrastructure can be provisioned in minutes instead of weeks or months.

Disadvantages of Cloud Infrastructure

- Ongoing Costs – Can be expensive over time if not managed properly.
- Limited Control – Cloud providers handle hardware and some configurations, limiting customization.
- Security Concerns – Data is hosted externally, requiring strong security policies.
- Latency Issues – Performance depends on internet connectivity and provider locations.
- Vendor Lock-in – Migrating between providers (AWS to Azure, etc.) can be complex.
- Compliance & Legal Risks – Data sovereignty laws may require careful planning.

Cloud Infrastructure Models

- Public Cloud – Hosted by third-party providers (AWS, Azure, GCP).
- Private Cloud – Dedicated infrastructure for a single organization (VMware, OpenStack).
- Hybrid Cloud – Combines public and private cloud for flexibility (AWS Outposts, Azure Arc).
- Multi-Cloud – Using multiple cloud providers to avoid dependency on one.

Popular Cloud Providers

- AWS (Amazon Web Services) – Market leader with services like EC2, S3, Lambda.
- Microsoft Azure – Strong enterprise integration with Microsoft products.
- Google Cloud (GCP) – Best for AI, machine learning, and data analytics.
- IBM Cloud, Oracle Cloud – Used for specialized enterprise solutions.

On-Prem vs. Cloud Infrastructure

Feature	On-Prem Infrastructure	Cloud Infrastructure
Control	Full control	Limited to provider's options
Scalability	Manual upgrades	On-demand, automatic scaling
Cost	High upfront, low operational	Pay-as-you-go, variable costs
Security	In-house security	Managed security by provider
Maintenance	Requires IT staff	Provider handles updates
Disaster Recovery	Needs backups & redundancy	Built-in solutions

Should You Use Cloud Infrastructure

- **Ideal for:**
- Businesses that need **agility, scalability, and global reach**
- Companies looking to **reduce hardware & maintenance costs**
- Startups and enterprises needing **fast deployment of apps**

Not ideal for:

- Organizations with **strict data sovereignty** requirements
- Companies requiring **full control over infrastructure**
- Workloads with **consistent, predictable performance needs** (better suited for on-prem)

Cloud Service Models: IaaS, PaaS, and SaaS

- Cloud computing is categorized into three main service models: **IaaS (Infrastructure as a Service), PaaS (Platform as a Service), and SaaS (Software as a Service).** Each model provides different levels of control, flexibility, and management responsibility.

Infrastructure as a Service (IaaS)

IaaS provides virtualized computing resources over the internet. It offers access to servers, storage, networking, and operating systems without the need for on-premise hardware.

Features:

- On-demand computing resources (VMs, storage, networking).
- Fully scalable with pay-as-you-go pricing.
- Users manage OS, applications, and data.
- Providers manage infrastructure (hardware, virtualization).

Examples:

- **AWS EC2 (Elastic Compute Cloud)**
- **Microsoft Azure Virtual Machines**
- **Google Compute Engine**
- **IBM Cloud Infrastructure**

Use Cases:

- Hosting applications and websites.
- Running virtual machines or containers.
- Disaster recovery and backup.
- High-performance computing.

Platform as a Service (PaaS)

PaaS provides a development and deployment environment in the cloud. It includes infrastructure (servers, storage, networking) plus additional tools like databases, middleware, and frameworks.

Features:

- Pre-configured environments for software development.
- Developers focus on coding, not infrastructure management.
- Built-in scalability and security.
- Automatic software updates and maintenance.

Examples:

- **AWS Elastic Beanstalk**
- **Google App Engine**
- **Microsoft Azure App Services**
- **Heroku**

Use Cases:

- Application development without infrastructure management.
- Hosting web applications and APIs.
- Data analytics and machine learning pipelines.
- Enterprise app development.

Software as a Service (SaaS)

SaaS provides fully managed software applications over the internet. Users access the software through a web browser, without managing hardware or infrastructure.

Features:

- No installation or maintenance required.
- Subscription-based pricing (monthly/yearly).
- Providers handle updates, security, and storage.
- Access from anywhere with an internet connection.

Examples:

- **Google Workspace (Gmail, Drive, Docs)**
- **Microsoft 365 (Word, Excel, Outlook)**
- **Salesforce (CRM)**
- **Dropbox, Zoom, Slack, Shopify**

Use Cases:

- Cloud-based email, communication, and collaboration.
- CRM (Customer Relationship Management).
- Project management and productivity tools.
- E-commerce platforms.

Comparison: IaaS vs. PaaS vs. SaaS

Feature	IaaS (Infrastructure as a Service)	PaaS (Platform as a Service)	SaaS (Software as a Service)
User Control	High (OS, storage, networking)	Medium (code & apps)	Low (only application settings)
Scalability	High (on-demand resources)	High (scales automatically)	Limited (depends on provider)
Maintenance	User manages OS & software	Provider handles infra, user manages apps	Fully managed by provider
Use Case	Hosting apps, VMs, storage	App development, databases	End-user software solutions
Examples	AWS EC2, Azure VMs, Google Compute Engine	AWS Elastic Beanstalk, Google App Engine	Gmail, Microsoft 365, Dropbox

Other Cloud Models

- FaaS (Function as a Service) – Serverless computing, where you run code without managing servers (e.g., AWS Lambda, Google Cloud Functions).
- DaaS (Desktop as a Service) – Virtual desktops in the cloud (e.g., Amazon WorkSpaces, Microsoft Windows 365).
- BaaS (Backend as a Service) – Cloud-based backend services for mobile & web apps (e.g., Firebase, AWS Amplify).

Which Cloud Model Should You Choose?

- IaaS – If you need full control over infrastructure, want to host applications, and require scalability.
- PaaS – If you're a developer and want a ready-to-use environment for coding and deploying apps.
- SaaS – If you're a business or individual looking for software solutions without infrastructure management.

AWS Cloud Services

- Amazon Web Services (AWS) is the **leading cloud platform**, offering **scalable, secure, and cost-effective** cloud computing solutions. It provides a **wide range of services**, including **compute, storage, networking, AI, security, and databases**.

Key AWS Cloud Services

AWS has **over 200 services** across multiple categories. Here are the most important ones:

Compute

- **Amazon EC2 (Elastic Compute Cloud)** – Virtual machines for hosting applications.
- **AWS Lambda** – Serverless computing for running functions without managing servers.
- **Amazon ECS (Elastic Container Service)** – Container management using Docker.
- **Amazon EKS (Elastic Kubernetes Service)** – Managed Kubernetes clusters.

Storage

- **Amazon S3 (Simple Storage Service)** – Object storage for files, backups, and websites.
- **Amazon EBS (Elastic Block Store)** – Block storage for EC2 instances.
- **Amazon Glacier** – Low-cost, long-term data archiving.
- **AWS Backup** – Centralized backup management for AWS resources.

Databases

- **Amazon RDS (Relational Database Service)** – Managed SQL databases (MySQL, PostgreSQL, Oracle, SQL Server).
- **Amazon DynamoDB** – NoSQL database for high-performance applications.
- **Amazon Redshift** – Data warehousing and analytics.
- **Amazon Aurora** – High-performance relational database with MySQL/PostgreSQL compatibility.

Networking & Content Delivery

- **Amazon VPC (Virtual Private Cloud)** – Private network for AWS resources.
- **Amazon Route 53** – Scalable DNS service.
- **AWS CloudFront** – Content delivery network (CDN) for fast global distribution.
- **AWS Direct Connect** – Dedicated network connection to AWS.

Security & Identity

- **AWS IAM (Identity and Access Management)** – User access control and permissions.
- **AWS Shield** – DDoS protection.
- **AWS WAF (Web Application Firewall)** – Security against web threats.
- **AWS KMS (Key Management Service)** – Encryption key management.

AI & Machine Learning

- **Amazon SageMaker** – Build, train, and deploy ML models.
- **Amazon Rekognition** – Image and video analysis.
- **Amazon Lex** – Chatbot and voice recognition service.
- **Amazon Polly** – Text-to-speech conversion.

DevOps & Monitoring

- **AWS CloudFormation** – Infrastructure as Code (IaC) for automating deployments.
- **AWS CloudWatch** – Monitoring and logging service.
- **AWS CodeDeploy** – Automated application deployment.
- **AWS X-Ray** – Distributed application tracing.

Internet of Things (IoT)

- **AWS IoT Core** – Connect and manage IoT devices.
- **AWS Greengrass** – Extend cloud capabilities to edge devices.

Benefits of AWS Cloud

- Scalability – Auto-scaling ensures resources match demand.
- Cost-Effective – Pay-as-you-go pricing with savings plans.
- Global Reach – 30+ AWS regions worldwide for low-latency performance.
- Security & Compliance – AWS follows strict security standards (ISO 27001, HIPAA, GDPR).
- High Availability – Multi-region backups and disaster recovery options.
- Flexibility – Supports hybrid and multi-cloud architectures.
- Automation – Infrastructure as Code (IaC) via AWS CloudFormation and Terraform.

Challenges of AWS Cloud

- Complex Pricing – Requires cost monitoring to avoid unexpected charges.
- Learning Curve – Over 200+ services, making it complex for beginners.
- Vendor Lock-in – Migrating from AWS can be difficult and costly.
- Security Responsibility – Users must configure security properly (shared responsibility model).

AWS Cloud Use Cases

For Startups & Enterprises:

- Hosting applications, websites, and APIs.
- Running databases, AI/ML workloads, and analytics.
- IoT device management and automation.

For Developers & IT Teams:

- DevOps workflows, CI/CD automation, and microservices.
- Serverless applications using AWS Lambda.
- High-performance computing and edge computing.

For Data-Driven Businesses:

- Big data analytics with AWS Redshift & AWS Glue.
- Machine learning with AWS SageMaker.
- Data warehousing & business intelligence.

How to Get Started with AWS

- Sign Up for AWS Free Tier – Offers free usage of select AWS services for 12 months.
- Use AWS Management Console – Web UI for managing AWS resources.
- Deploy Resources Using AWS CLI – Automate tasks with AWS Command Line Interface.
- Learn AWS Best Practices – Use AWS Well-Architected Framework for guidance.
- Monitor Costs – Set up AWS Budgets and AWS Cost Explorer to track usage.

Thank You