# **Day 12 - Cloud Computing & Azure**

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## **What is Cloud Computing?**

Cloud Computing is the delivery of computing services—including servers, storage, databases, networking, software, and more—over the **internet ("the cloud")**. It allows users to store and access data and applications on remote servers without relying on local infrastructure.

**Key Features:**

* Internet-based access
* Eliminates local/server dependencies
* Scalable, secure, and on-demand
* Pay-as-you-go model

## **☁️ Types of Cloud Computing Services**

| **Model** | **Description** | **Example** |
| --- | --- | --- |
| **IaaS** (Infrastructure as a Service) | Provides virtualized computing resources via the internet. | AWS EC2, Azure VMs |
| **PaaS** (Platform as a Service) | Provides platforms and tools for developers to build and deploy apps. | Google App Engine, Azure App Services |
| **SaaS** (Software as a Service) | Ready-to-use apps delivered over the internet. | Gmail, Google Docs |
| **FaaS** (Function as a Service) | Serverless model that runs code only in response to events. | AWS Lambda, Azure Functions |

## **Cloud Deployment Models**

| **Model** | **Description** |
| --- | --- |
| **Private Cloud** | Exclusive to one organization. Offers high control and security. |
| **Public Cloud** | Open to multiple users. Scalable and cost-efficient. |
| **Hybrid Cloud** | Mix of public and private clouds to balance control and scalability. |

## **Understanding Virtualization in Cloud**

Virtualization is the foundation of cloud computing. It enables a single physical machine to run multiple virtual environments using software called hypervisors.

### **Types of Virtualization:**

1. **Application Virtualization** – Run apps remotely without local installation (e.g., Azure-hosted apps).
2. **Network Virtualization** – Create multiple virtual networks on the same physical network (e.g., Google Cloud).
3. **Desktop Virtualization** – Access desktop environments remotely (e.g., Amazon Workspaces).
4. **Storage Virtualization** – Combine physical storage across servers (e.g., Amazon S3).
5. **Server Virtualization** – Multiple VMs on a single server (e.g., VMware, Hyper-V).
6. **Data Virtualization** – Access and analyze data from different sources without knowing their physical location (e.g., Oracle, IBM).

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### **Benefits of Virtualization:**

* Optimized hardware utilization
* Cost-effective and scalable
* High availability and disaster recovery
* Enables remote access and multi-OS environments

## **Virtualization vs Cloud Computing**

| **Aspect** | **Virtualization** | **Cloud Computing** |
| --- | --- | --- |
| What it is | Creating multiple virtual versions of hardware | Accessing computing resources over the internet |
| Where it runs | On local/physical machines | On remote servers managed by cloud providers |
| Focus | Resource efficiency | On-demand scalability |
| Example | Running multiple VMs on one server | Hosting data on Google Drive or using Azure VM |
| Control | Full control over VM and environment | Limited to resource management within provided services |

## **☁️ Azure Resource Management Hierarchy**

Microsoft Azure uses a **hierarchical management structure** to control access, set policies, and organize cloud resources effectively.

### **🔹 Levels of Hierarchy:**

1. **Management Groups**
   * Top-level structure to organize subscriptions.
   * Apply RBAC and policies across subscriptions.
   * Can include other management groups or subscriptions.
2. **Subscriptions**
   * Logical containers for resources.
   * Used to manage billing, quotas, and governance.
   * Design Strategies: Workload-based, BU-based, App category, Geography.
3. **Resource Groups**
   * Logical containers that group related resources (VMs, Storage, etc.)
   * Simplify management, billing, and access control.
4. **Resources**
   * Actual instances like Virtual Machines, Storage Accounts, Databases, etc.

## **Summary**

| **Concept** | **Key Points** |
| --- | --- |
| **Cloud Services** | IaaS, PaaS, SaaS, FaaS provide flexibility at different levels. |
| **Virtualization** | Backbone of cloud; allows optimal use of hardware. |
| **Azure Resource Hierarchy** | Enables structured access, governance, and cost tracking. |
| **Deployment Models** | Public, Private, and Hybrid clouds suit different business needs. |
| **Comparison** | Virtualization gives local control, while cloud computing emphasizes on-demand internet-based access. |