



Lecture 29 – Microsoft Azure, Cloud Computing

💡 What is Microsoft Azure?

Microsoft Azure is a **cloud computing platform** developed by Microsoft that provides a wide range of **services** such as:

- Virtual Machines (VMs)
- Databases
- Networking
- AI and Machine Learning
- Web Hosting
- Storage and Backup
and many more...

Azure allows businesses and individuals to **build, deploy, and manage applications** through Microsoft's global network of **data centers**.

💰 Why Azure? (Key Advantages)

1. Cost-Effective 💰

- You don't need to buy expensive physical servers or maintain them.
 - Pay only for what you use (**Pay-as-you-go model**).
 - Reduces **maintenance, electricity, and hardware costs**.
 - No need to purchase licenses separately — Azure provides them in service plans.
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2. Service-Oriented 🌐

Azure provides **over 200+ services** under various categories such as:

- **Compute Services:** Virtual Machines, Azure Functions

- **Storage Services:** Blob Storage, File Storage
- **Networking:** Virtual Network, Load Balancer
- **Database:** SQL Database, Cosmos DB
- **Security:** Azure Defender, Key Vault

Everything is managed and scalable via the **Azure Portal** or **CLI**.

3. Integration with VMware

- Azure supports **VMware virtualization** through **Azure VMware Solution**.
 - You can migrate existing **VMware workloads** to Azure **without changing configurations**.
 - This helps enterprises use both **on-premises + cloud infrastructure** efficiently.
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Hardware Concepts (RAM, SSD, Processor)

- **RAM (Random Access Memory):**
Used for running programs and processes temporarily.
Increasing RAM improves multitasking and application speed only if the CPU supports it.
 - **SSD (Solid State Drive):**
Stores data permanently. Faster than HDD.
Increasing SSD improves read/write speed and application loading time.
 - **Processor (CPU):**
Mounted on the motherboard — cannot be upgraded in cloud manually, but **Azure allows you to upgrade virtual processors (vCPUs)** easily.
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In the Cloud (Scalability Example):

In Azure, you can upgrade from a **12th Gen processor VM** to a **13th Gen processor VM** or change specifications (RAM, Storage, Network) **without shutting down the system** or losing data.

- ➡ This ability to **increase or decrease resources dynamically** is called **Scalability**.
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Scalability in Cloud Computing

Scalability means the ability of the system to **increase or decrease resources** (like RAM, CPU, or storage) according to demand — **without affecting performance or uptime**.

Azure provides two types of scalability:

1. Vertical Scalability (Scale Up)

- Increasing or decreasing the **power of existing resources**.
- Example: Upgrading a VM from 4GB RAM to 8GB RAM.
- It enhances performance of the same system.

 *Used when you need more processing power or memory for the same application.*

2. Horizontal Scalability (Scale Out)

- Adding or removing **multiple servers (VMs)** to handle increased load.
- Example: When website traffic increases, Azure automatically adds more servers to balance the load.

 *Used for large-scale applications, e-commerce sites, or data processing workloads.*

Elasticity in Cloud Computing

Elasticity = Auto-scaling + Load balancing

It allows the system to **automatically adjust resources** based on real-time demand.

Example:

If one server is overloaded due to high traffic, the cloud engineer can increase it from **1 to 4 servers automatically** using **Azure Auto-Scaling**.

Benefits:

- Reduces downtime.
 - Optimizes performance.
 - Saves cost by releasing unused resources when not needed.
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Maintenance (No Hardware Hassle)

- Traditional hardware (like Dell, HP) comes with **3-year warranties** and has conditions.
 - You need to replace or repair it manually.
 - In the cloud, **maintenance is managed by Azure**, which:
 - Handles hardware failures.
 - Ensures updates, patches, and monitoring.
 - Minimizes downtime.
 - Hence, **maintenance cost is saved**, and system uptime improves.
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Reliability in Cloud

Reliability ensures that your system continues to operate correctly even when there are hardware or network failures.

Azure achieves reliability through:

1. **Multiple Data Centers:** If one fails, another takes over (Load Shifting).
2. **Data Backup:** Automatic data replication across regions.
3. **Disaster Recovery:** Quick restoration of services in emergencies.
4. **Redundancy:** Duplicates of data to prevent loss.

 *Azure guarantees 99.9% uptime (SLA – Service Level Agreement).*

Security in Cloud

Cloud security is divided into **two parts**:

1. Physical Security

- Azure data centers have **restricted access**, CCTV monitoring, and biometric security.
- Only authorized personnel can enter server rooms.

2. Digital Security

- Uses **firewalls, encryption, antivirus, and identity management (Azure AD)**.
- Supports **Multi-Factor Authentication (MFA) and Zero Trust Architecture**.
- Regular security audits ensure **data confidentiality and integrity**.

Availability

Availability refers to the **ability to access data or services anytime, anywhere** without interruption.

Azure achieves this using:

- **Global Data Centers**  (spread worldwide)
- **Load Balancing**
- **Failover Clusters**
- **High Uptime (24x7x365 availability)**

 *Example:* You can access your Azure VM or database anytime even if one data center is under maintenance — it automatically switches to another.

Cloud Deployment Models (Detailed Explanation)

Azure offers **three main deployment models**, each with its own use cases 



1. Public Cloud

- Cloud infrastructure is **owned and managed by third-party providers** like Microsoft, AWS, or Google.
- Services are shared across multiple customers.
- Users pay only for what they use.



Examples: Microsoft Azure, AWS, Google Cloud Platform.



Advantages:

- Cost-effective
- No hardware maintenance
- Easy scalability
- Global accessibility



Disadvantages:

- Limited control over data location
- Security concerns for sensitive data



2. Private Cloud

- Dedicated infrastructure used **only by one organization**.
- Provides **higher security, customization, and control**.
- Hosted on-premises or in a dedicated data center.



Example: A bank or government using a private cloud for sensitive data.



Advantages:

- High privacy and security
- Better control and customization
- Ideal for compliance-heavy industries



Disadvantages:

- Expensive setup and maintenance
 - Limited scalability compared to public cloud
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3. Hybrid Cloud

- A **combination of Public + Private Cloud**.
- Sensitive data is stored on **private cloud**, while less critical workloads run on **public cloud**.
- Enables data and application sharing between both environments.

 *Example:*

A company hosts customer data privately but runs its website on the public cloud.

Advantages:

- Balanced security and flexibility
- Cost-effective and scalable
- Disaster recovery and backup options

Disadvantages:

- Complex to manage
- Requires high network connectivity

Summary Table

| Feature | Public Cloud | Private Cloud | Hybrid Cloud |
|--------------------|----------------------|---------------------|---------------------|
| Ownership | Third-party provider | Single organization | Combination of both |
| Security | Moderate | High | Very High |
| Cost | Low | High | Medium |
| Scalability | Very High | Limited | High |

| Feature | Public Cloud | Private Cloud | Hybrid Cloud |
|-------------|---------------------|----------------------|-----------------------|
| Maintenance | Managed by provider | Managed internally | Shared responsibility |
| Example | Azure, AWS | VMware Private Cloud | Azure Hybrid Setup |



In Summary

Microsoft Azure is a cost-effective, reliable, and secure cloud platform that provides on-demand computing resources and services worldwide. It offers **scalability, elasticity, high availability, and strong security** with flexible **deployment models (Public, Private, Hybrid)** to suit every business need.

