

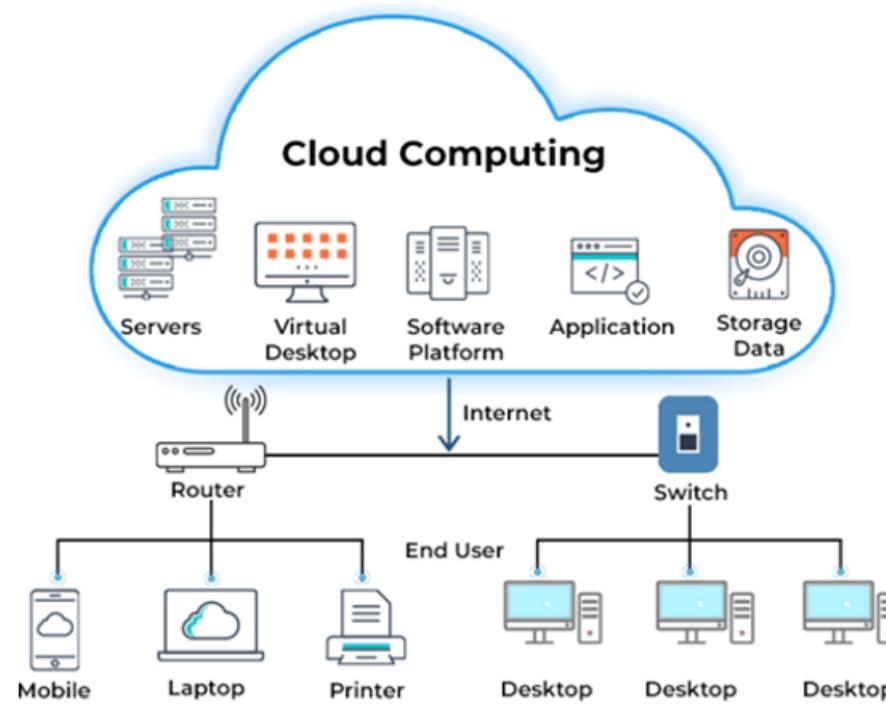


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# Cloud Computing

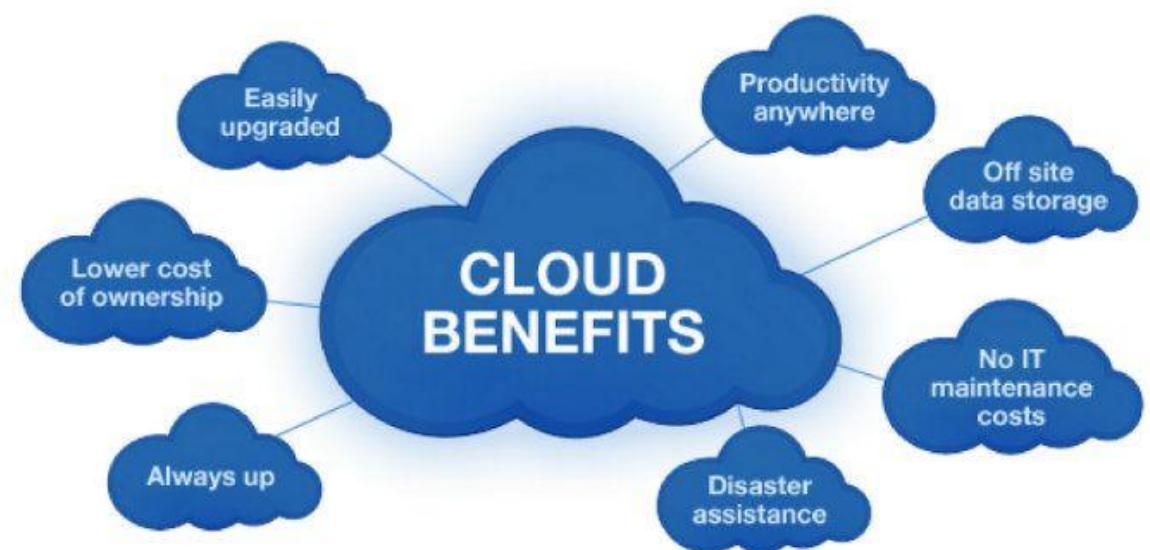
# Cloud Computing

- "The cloud" refers to servers that are accessed over the Internet.
- Cloud computing is delivery of computing services—including servers, storage, databases, networking, software and analytics and more - over the Internet
- Instead of keeping everything on our own computer or company servers, rent space and power from big companies (called cloud providers) who have huge data centers.
- We can use these services whenever we need them, and only pay for what we use — like renting instead of buying.

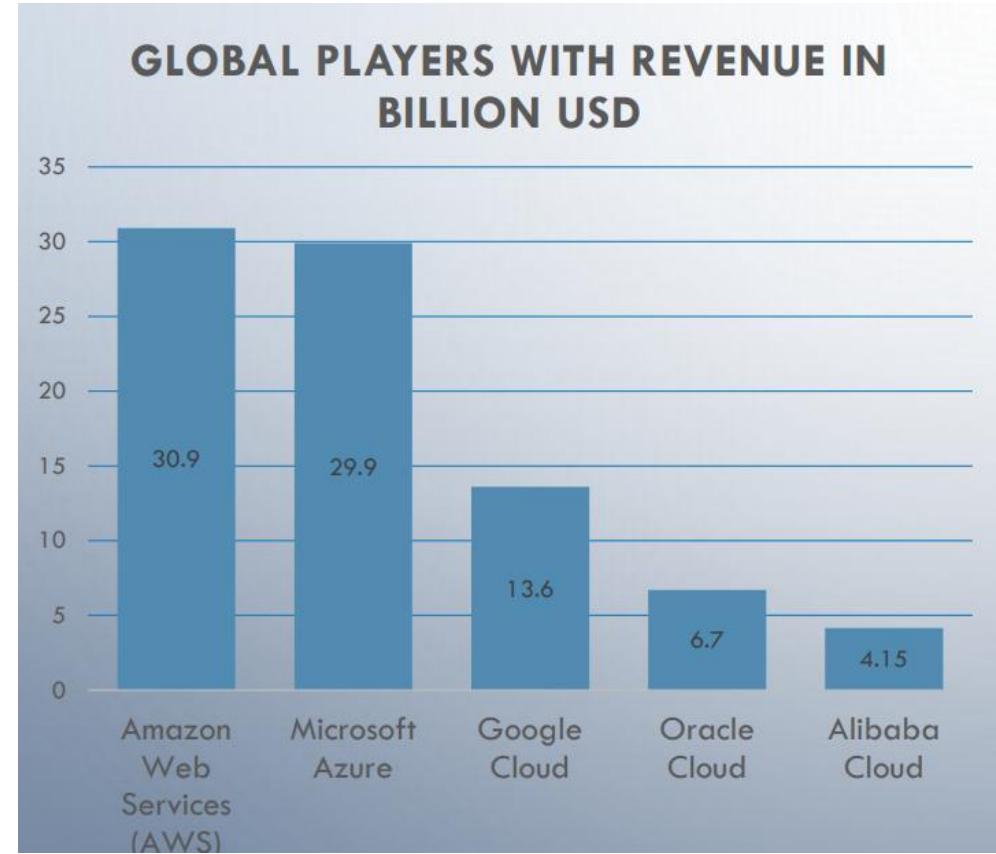
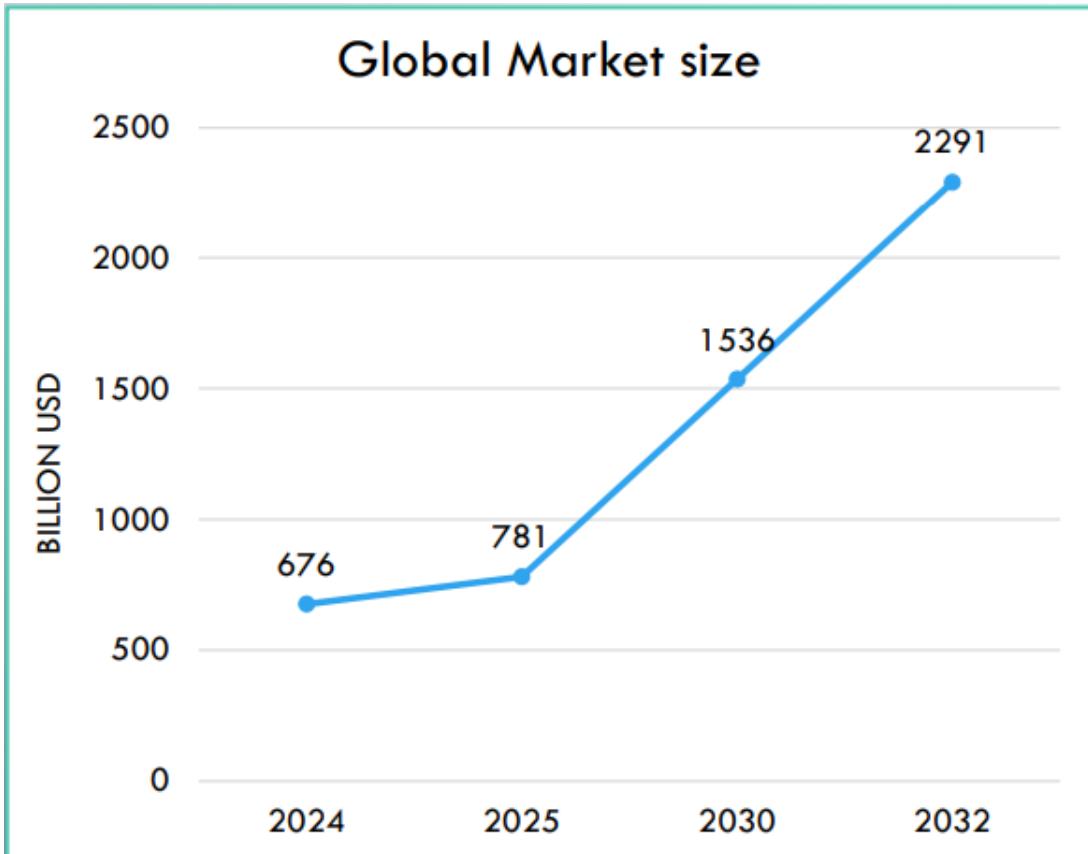


# Cloud Computing - Benefits

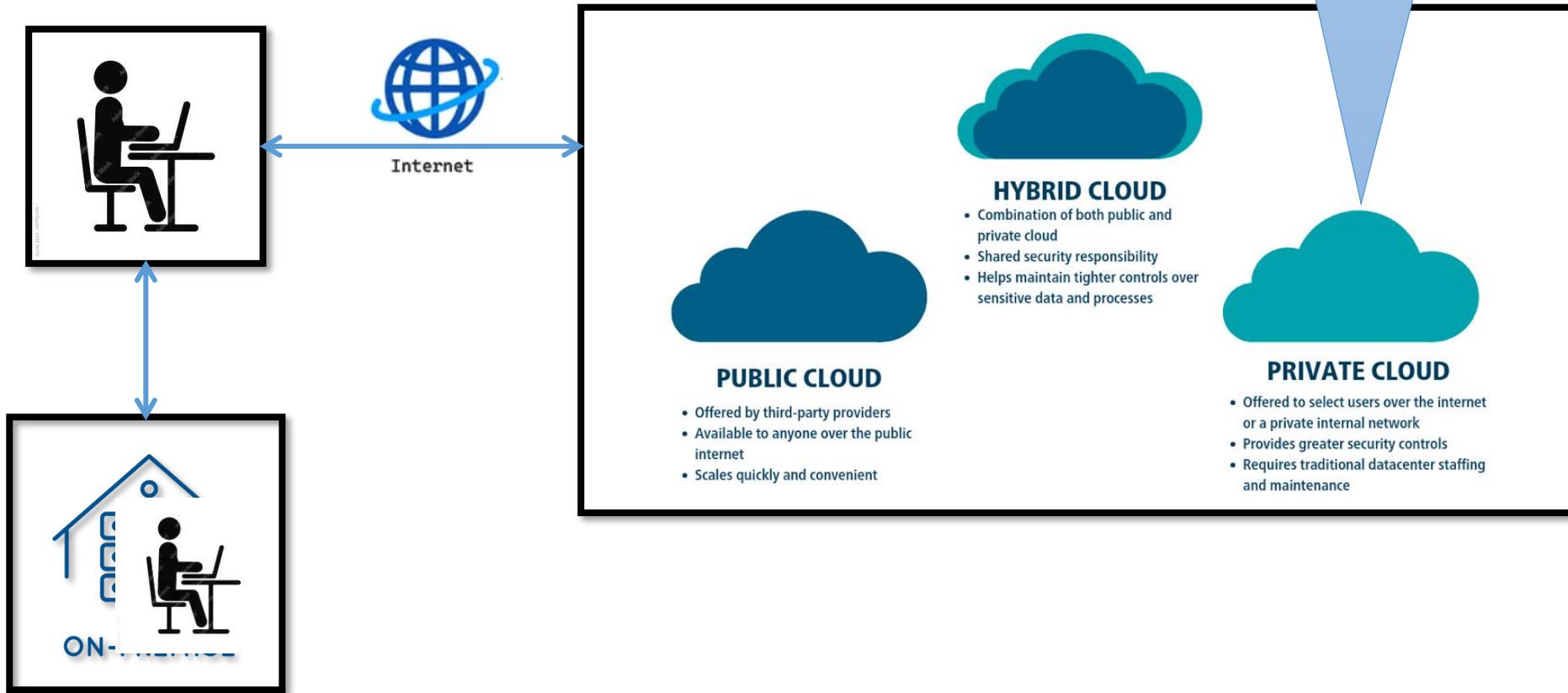
- Rent as many servers you want. Pay as you go.
- Access from anywhere
- Auto scaling on your server fleet.
- Highly available – always up
- Hardware updates/Breakdown. No worries



# Market Size of Cloud Computing



# Types of Cloud



## Private cloud –

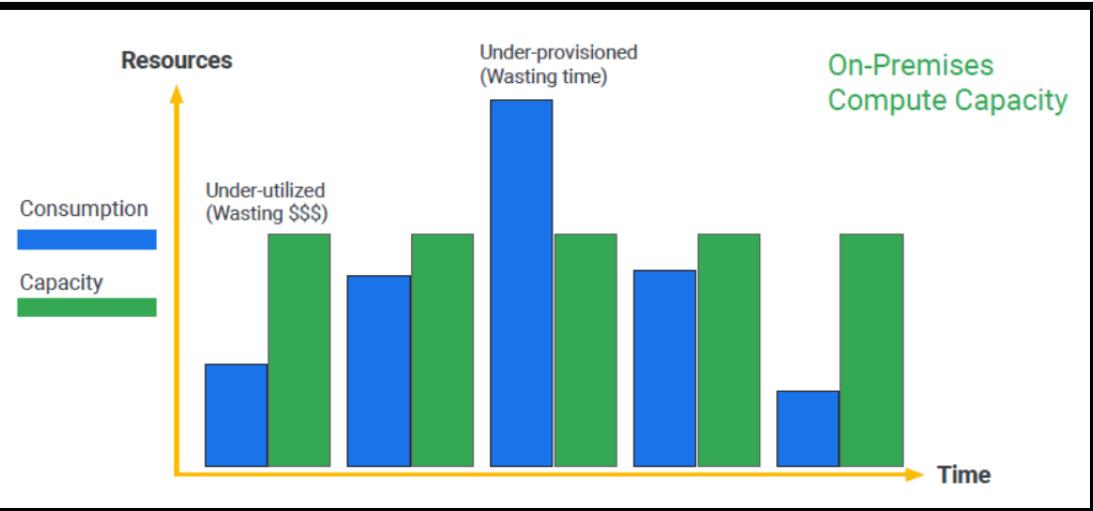
1. Cloud infra built on-premises
2. Dedicated network/resources in 3rd party cloud platform
3. We can have our own dedicated/customized/curated environment set in the public cloud datacenters
4. Cloud providers enable some of the service in the on-premises based on demand.

## Public vs Private Cloud

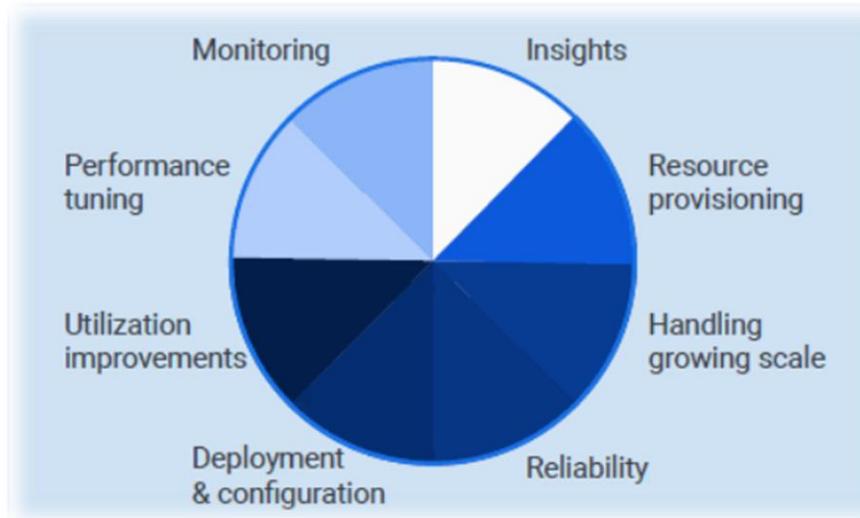
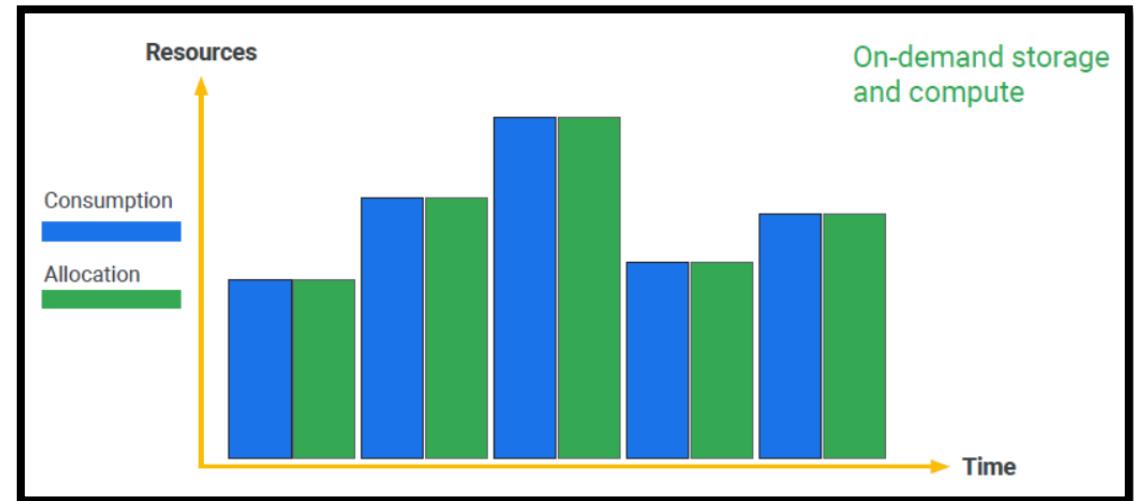
	<b>PRIVATE CLOUD (INTERNAL –ON PREM / HOSTED PRIVATE CLOUD)</b>	<b>PUBLIC CLOUD</b>
Infrastructure	Dedicated hardware and network for your business managed by an in-house technical team.	Multi-Tenant: Shared network hosted off site and managed by your service provider.
Business requirement	High performance, security, and customization.	Affordable solutions that provide room for growth.
Scalability	Limited	Linear Scalable
Support and maintenance	Org administrators.	Service Provider.
Cost	CapEx.	OpEx
Security	Isolated network environment. Enhanced security to meet data protection legislation.	Security compliant
Performance	High performance from dedicated server.	Competing users can reduce performance levels.

## Why Cloud

### Onprem



### Cloud



## Major Cloud Providers

**AWS** comprises over **200+** products and services including computing, storage, networking, database, analytics, application services, deployment, management, mobile, developer tools, and tools for the Internet of Things.

### **History –**

**Jeff Bezos - 1994**

Started – 2000, Launched – 2002, EC2 – 2003, SQS – 2004, S3 – 2006 .....

**GCP** is a public cloud vendor that offers a suite of **100+** services to do everything from data management to delivering web and video over the web to AI and machine learning tools.

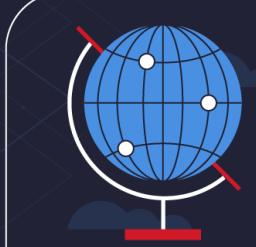
### **History –**

In April 2008,

Google announced a preview release of App Engine

## **CLOUD PROVIDER STRENGTHS**

### **AWS**



- Greatest global reach
- Long record of reliable service
- Flexibility and wide range of services
- Ideal for larger companies

### **AZURE**



- Offers a hybrid solution
- Easy first time cloud migration
- Ideal for startups and developers
- Great for Windows-based organizations

### **GOOGLE**



- Complete container-based model
- For sites in a hyperscale networking environment
- Most cost-efficient and eco-conscious option
- Ideal for creators of cloud-based apps and software

# Cloud Services

## OnPrem:

**Capex:** Defined workload with near recent changes expected in the Infra.

## Cloud:

**Opex:** Variable workload with frequent changes expected in the Infra.

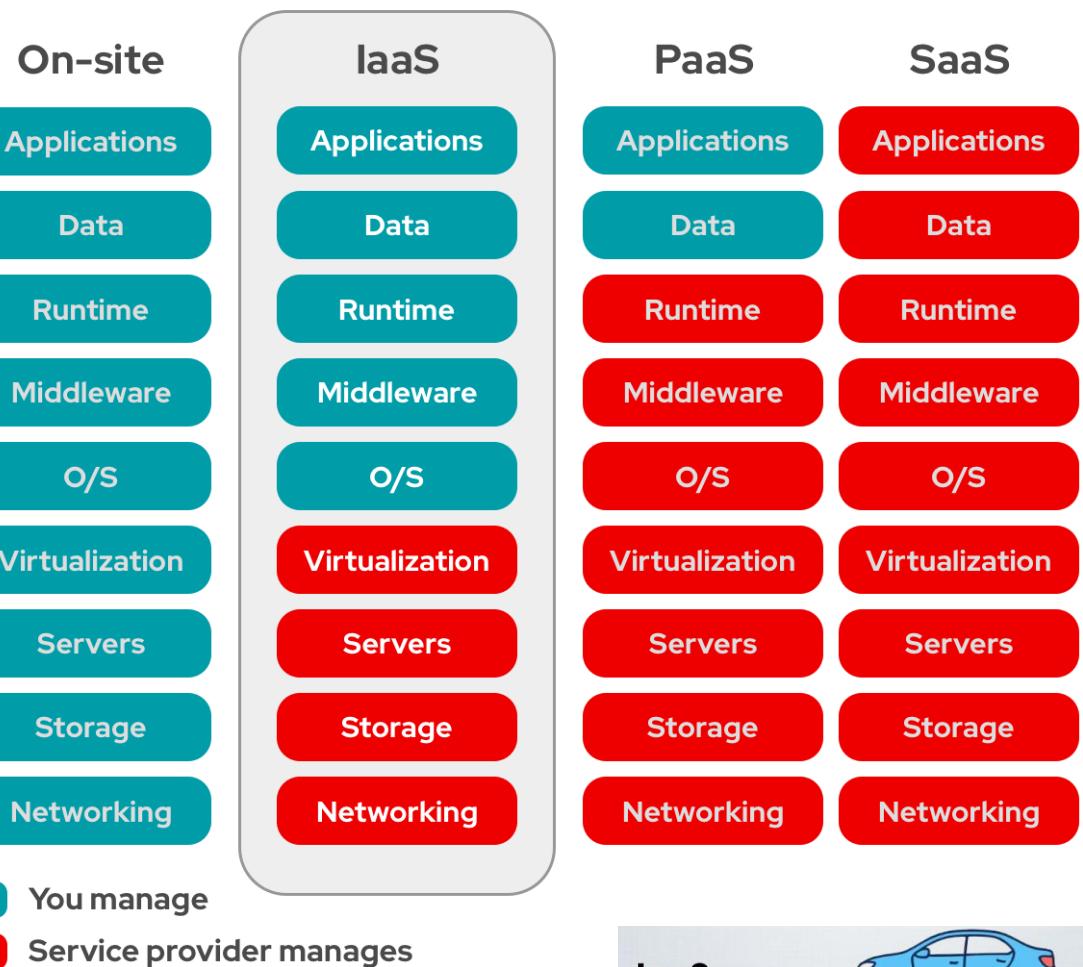
**IaaS:** cloud-based services, pay-as-you-go for services such as storage, networking, and virtualization.

**PaaS:** Software tools like middleware, OS available over the internet.

**SaaS:** software like applications, DB servers, Clusters that's available via a third-party over the internet.

## Hybrid:

Features of CapEx of On Prem & OpEx of Cloud



## Cloud Computing Solutions – Unmanaged, Managed & Serverless



Unmanaged cloud

The in house IT team takes full control of customising the cloud, installing applications and general maintenance.

All responsibilities of management, maintenance and configuration are managed in house with no support from the provider.

Unmanaged services have a lower average subscription fee, but costs are likely to fluctuate.

The in-house team must accommodate sudden spikes in traffic.

In-house teams are responsible for maintaining the security and safety of data.



Managed cloud

### Management

The provider will configure and manage infrastructure depending on customer predefined requirements.

### Support

Uninterrupted access to a team of knowledgeable experts, who offer technical advice and support 24/7/365.

### Costs

Managed services help prevent unexpected price increases, by offering a consistent subscription fee.

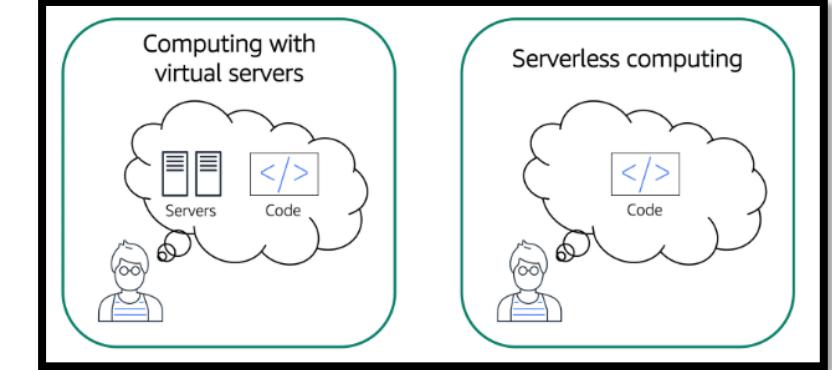
### Reliability

The provider monitors traffic and scales resources according to demand.

### Security

Guaranteed safety and security as the provider has access to resources to enforce additional security.

## Server vs Server less Computing



## Server less Computing Benefits

### Operational Model



No Server Management



Fully Managed Security



Pay only for usage

### Programming Model



Service-based



Event-driven



Open



Run anything



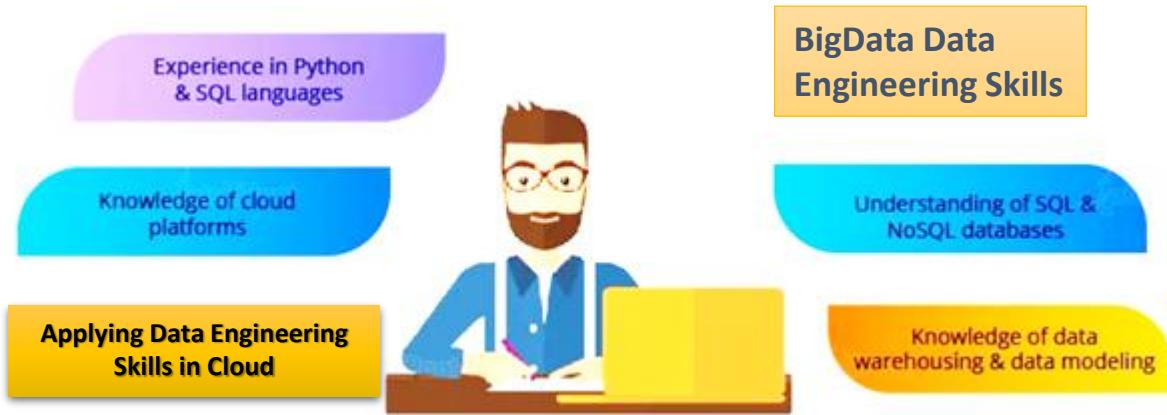
Run anywhere



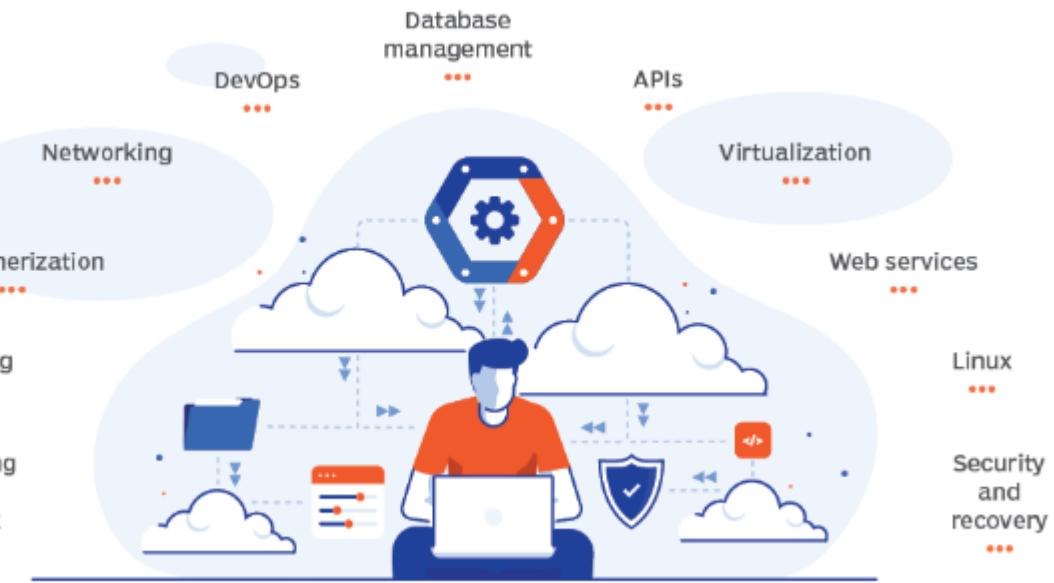
Integrate anything

## Assumptions & Scope of Learning Cloud

### Cloud Data Engineer



### Cloud Engineer



### Caveat:

1. Try to learn about minimum one specific cloud, specific cloud components and the security features (*only name varies but performs same operations and works in a same architecture*).
2. Try to understand the Scope of the cloud Services for a Data Engineer
3. Keep in mind Features/Options used can be changed by the providers
4. Think how to make use of the platform/infra/software for my BigData components.
5. *How can I smartly create some Business use cases to show my cloud proficiency integrated with Bigdata components*

# BigData components Comparison of Different Cloud Providers

<https://comparecloud.in/>

Service Category	Service Type	OnPrem	AWS	MS Azure	GCP	Description
Storage	Object storage	HDFS	AWS Simple Storage Service (S3)	Azure Blob Storage Azure Data Lake Service Gen2	Cloud Storage	Store any amount of data and retrieve it as often as you'd like, using Google Cloud's object storage offering.
Storage	Block Storage	HDD/SSD	Amazon Elastic Block Store (EBS)	Azure Managed Disks	Persistent Disk	Reliable, high-performance block storage for VM instances.
Compute	Core compute	Physical Node/VM	Amazon Elastic Compute Cloud (EC2)	Azure Virtual Machines	Compute Engine	Accelerate your digital transformation with high-performance VMs.
Database	RDBMS	MySQL/Derby	Amazon Aurora	Azure SQL Database	Cloud Spanner	Manage relational data with massive scale, strong consistency worldwide, and up to 99.999% availability.
Database	RDBMS	Postgres/MySQL	Amazon Relational Database Service (RDS), Amazon Aurora	Azure Database for MySQL and Azure Database for PostgreSQL	Cloud SQL	Manage relational data for MySQL, PostgreSQL, and SQL Server for workloads under 30TB.
Data analytics	Business intelligence	Kibana/Grafana/Tableau..	Amazon QuickSight	Microsoft Power BI	Looker	Explore, share, and visualize your company's data so that you can make better business decisions.
Data analytics	Data warehouse	Hive/Presto/Impala	Amazon Athena, Amazon Redshift	Azure Synapse Analytics	Big Query	Serverless, highly scalable, and cost-effective multi-cloud data warehouse designed for business agility.
Data analytics	Stream data ingest	Kafka, Nifi	Amazon Kinesis	Azure Event Hubs	Pub/Sub	Create scalable messaging and ingestion for event-driven systems and streaming analytics.
Data analytics	Open source processing	Apache Hadoop/Cloudera/DB Community Distributions	Amazon Elastic MapReduce (EMR), AWS Batch, AWS Glue, DataBricks	Azure DataBricks, HDInsight	Dataproc, DataBricks	Deploy open-source data and analytics processing services (Apache Hadoop, Apache Spark, etc.) with improved efficiency and security.
Data analytics	Workflow orchestration	Oozie/Cron	Amazon Data Pipeline, AWS Glue, Managed Workflows for Apache Airflow	Azure Data Factory	Cloud Composer	Author, schedule, and monitor pipelines that span across hybrid and multi-cloud environments using this fully managed workflow orchestration service built on Apache Airflow.
Networking	Virtual networks	VPN	Amazon Virtual Private Cloud (VPC)	Azure Virtual Network	Virtual Private Cloud	Provide managed networking functionality for your cloud-based services running on Compute Engine VM instances, Google Kubernetes Engine, App Engine flexible environment instances, and other Google Cloud products built on Compute Engine VMs.
Operations	Monitoring	Ganglia/Nagios/Ambari/Cloudera Manager	Amazon CloudWatch	Azure Monitor	Cloud Monitoring	Monitor the performance, availability, and health of your applications and infrastructure.
Security & identity	IAM	SSL/LDAP/SSO	Amazon Identity and Access Management	Azure Identity Management	Identity and Access Management	Provide fine-grained access control and visibility for centrally managing resources.



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# Azure Cloud

# Microsoft Azure Overview

## 1. What is Azure?

- Microsoft's cloud computing platform
- It provides wide range of services that use to
  - Build, deploy, and manage applications
  - Runs workloads on a global network of data centers
  - Use our preferred tools, frameworks and languages



## 2. Key Capabilities

- 200+ services: Compute, Storage, AI-ML, IOT, Database
- Scale apps & data storage dynamically
- Support for both existing apps and modern cloud-native solutions

## 3. Why Azure?

- 90+ compliance certifications, making it a top choice for finance, healthcare, and public sector.
- Integration with Microsoft Ecosystem
- Largest number of data center regions worldwide
- Tight integration with GitHub, Visual Studio, Power Platform, and OpenAI services.

# Azure Global Infrastructure

## 1. Regions

- A **region** is a set of **data centers** deployed within a specific geographic area.
- Each region provides **redundancy and scalability**.
- More than **70 regions worldwide** (largest among cloud providers).
- Example: *East US, West Europe, Central India*.

## 2. Availability Zones (AZs)

- Physically **separate data centers** within a region.
- Each AZ has **independent power, cooling, and networking**.
- Provides **high availability (99.99%)** for critical workloads.
- By hosting apps across multiple AZs, you protect against **data center failures**.

Geography	Regional Pair A	Regional Pair B
Canada	Canada Central	Canada East
China	China North	China East
India	Central India	South India
Japan	Japan East	Japan West
North America	East US	West US

[Region and Availability Zones](#)

## 3. Region Pairs

Each Azure region is paired with another within the same geography (e.g., *East US ↔ West US*).

Region pairs enable:

**Disaster recovery** – one region acts as a backup.

**Updates & maintenance** – never rolled out simultaneously to both regions.

**Data residency & compliance** – ensures local/regional failover.

# Azure Account and Subscriptions

## 1. Azure Account - main login & identity for Azure services

- Your **identity in Azure** (usually tied to a Microsoft/organization email).
- Created using **Microsoft Entra ID (formerly Azure AD)**.
- Provides access to manage and use Azure resources.

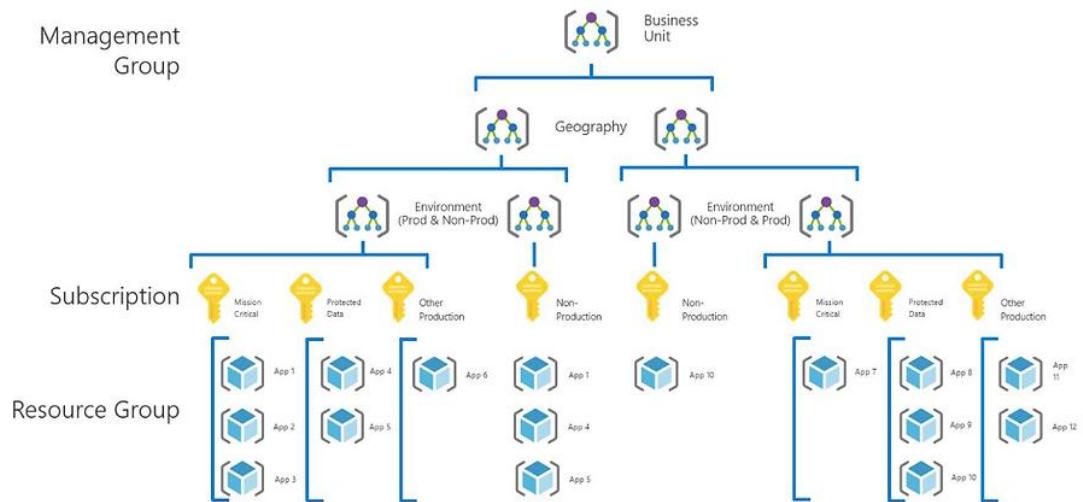
## 2. Azure Subscription

A **logical container** that holds Azure resources (VMs, databases, storage, etc.).

Linked to an **Azure account** but can have **multiple subscriptions**.

Used for:

- **Billing** (each subscription has its own bill).
- **Resource management** (grouping, organizing resources).
- **Access control** (assigning RBAC roles at subscription level).



## 3. Management Group

- A **higher-level container** used to organize **multiple subscriptions**.
- Allows centralized **governance, security, and compliance**.
- Policies and RBAC applied at management group level **inherit down** to all subscriptions inside.

# Azure Resource Group and Resources

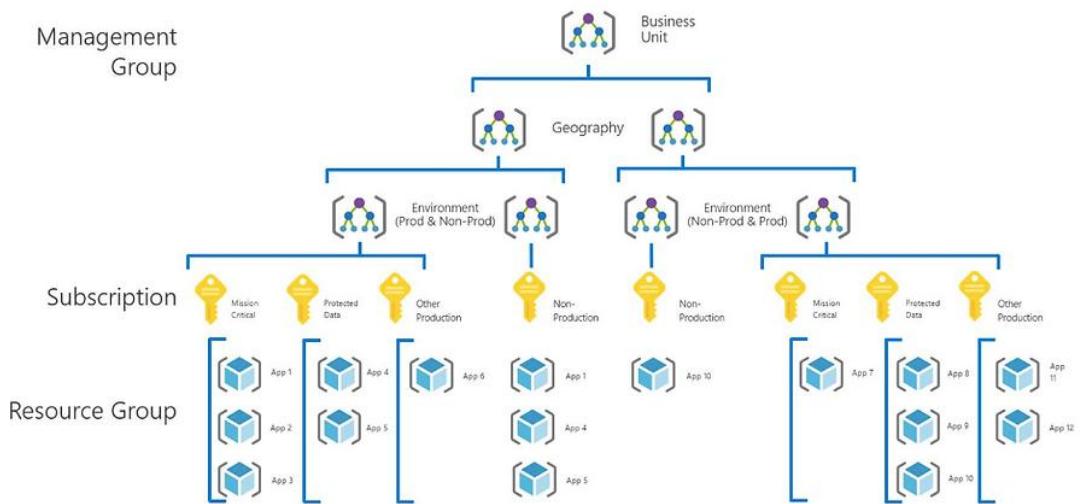
## 1. Resources

**Definition:** An individual **service instance** you create in Azure.

Examples:

- Virtual Machine (VM)
- SQL Database
- Storage Account
- Virtual Network (VNet)

Each resource belongs to **exactly one resource group**.



## 2. Resource Groups (RGs)

**Definition:** A **logical container** that holds related resources for an Azure solution.

Purpose:

- Organize and manage resources as a single unit.
- Apply **access control (RBAC)**, **policies**, and **tags** consistently.
- Support **lifecycle management** → you can delete the resource group and remove all resources inside it.

Think of a **resource group** as a **folder** that organizes and manages resources.

# Azure Subscription Types

## ◆ Free Subscriptions

- **Azure Free Account** → 12 months free on selected services + \$200 credit for 30 days.
- Best for learning, trials, and POCs.

## ◆ Pay-As-You-Go (PAYG)

- Standard model → pay only for what you use.
- No upfront cost, billed monthly.
- Flexible and scalable.
- promotional credits.

## ◆ Enterprise Agreement (EA)

- For **large organizations** with high-volume usage.
- Provides **discounted pricing**, consolidated billing, and multiple subscription management.

## ◆ Student & Sponsorship Subscriptions

- **Azure for Students** → Free credit + free developer tools (no credit card needed).
- **Sponsorship subscriptions** → Provided for research, startups, or

# Azure Storage Account

## 1 Definition

- A **storage account** is a **top-level container** in Azure that provides a **unique namespace** to store and manage data.
- It gives you access to **Azure Storage services**: blobs, files, queues, tables, and disks.
- Every storage account has a **unique name** and is accessible via a **REST endpoint** (e.g., <https://mystorageaccount.blob.core.windows.net>).

## 2 Types of Storage Services in a Storage Account

### Blob Storage

Stores unstructured data (documents, images, videos, backups).

Supports block blobs, append blobs, page blobs.

### File Storage

Fully managed file shares accessible via **SMB/NFS protocols**.

Useful for lift-and-shift apps needing shared drives.

### Queue Storage

Stores large numbers of messages for communication between components.

Supports **asynchronous messaging** (used in decoupled architectures).

### Table Storage

NoSQL key-value store for structured, non-relational data.

Used for fast and scalable access.

# Blob Storage vs ADLS Gen2

Feature	<b>Blob Storage</b>	<b>ADLS Gen2 (Data Lake)</b>
<i>Purpose</i>	General object storage	Big data analytics + object storage
<i>Namespace</i>	Flat (pseudo-folders)	Hierarchical (real directories)
<i>Performance</i>	Good for simple storage & retrieval	Optimized for analytics & parallelism
<i>Integration</i>	Apps, backups, media, static hosting	Spark, Hadoop, Synapse, Databricks
<i>Cost</i>	Cheaper (general use)	Slightly higher (analytics features)
<i>Use Case</i>	Images, backups, logs, static files	Data lakes, ML, IoT, ETL pipelines

# Azure Databricks

- Azure Databricks is a data analytics and AI platform built on Apache Spark, fully integrated into the Azure ecosystem.
- Jointly developed by **Microsoft + Databricks**.
- Provides a **unified platform** for:
  - **Data Engineering** - Ingest, clean, and transform data.
  - **Data Science & Machine Learning** - Train & deploy ML models.
  - **Analytics & BI** - Analyze large-scale data interactively.
- Azure Databricks acts as the analytics and AI engine that sits in the middle of Azure's ecosystem, seamlessly integrating with storage, analytics, AI/ML, security, and DevOps services.

## Databricks Integration with Azure Service

- **Azure Data Lake Storage Gen2 (ADLS)**: Primary storage for raw, curated, and processed data (Lakehouse architecture).
- **Azure Blob Storage**: For object storage (backups, unstructured data).
- **Azure Synapse Analytics**:
  - Push processed data from Databricks into Synapse for BI reporting.
  - Query Synapse tables from Databricks notebooks.
- **Power BI**: Directly connect Databricks tables for **dashboards & visualization**.
- **Azure Data Factory (ADF)**: Orchestrates pipelines that trigger Databricks notebooks or jobs.
- **Event Hubs / IoT Hub / Kafka**: Real-time streaming ingestion into Databricks.

# Azure IAM

## Identity and Access Management (IAM) in Azure

IAM in Azure is handled through **Microsoft Entra ID (formerly Azure Active Directory)** and the **Role-Based Access Control (RBAC)** system.

It ensures that **only the right people** have the **right access** to the **right resources**.

### 1. Key Components of IAM in Azure

- **Identities**

- Represent users, groups, service principals (apps) or managed identities.
- Used to authenticate into Azure.

- **Roles**

- Define **what actions** an identity can perform.
- Roles are assigned using **RBAC**.
- Examples: Owner, Contributor, Reader, Storage Blob Data Reader.

- **Assignments**

- *IAM = Identity + Role + Scope.*
- Example: *User A → Contributor → Resource Group X.*

- **Scope Levels**

- Access can be applied at different layers:
  - **Management Group** → Inherited by all subscriptions/resources under it.
  - **Subscription** → Applies to all resource groups/resources inside.
  - **Resource Group** → Applies to all resources in that group.
  - **Resource** → Specific to one resource only.

# Azure IAM

## 2. How IAM Works in Azure

1. A user signs in with their Azure AD identity.
2. RBAC policies check what role(s) the user has.
3. Permissions flow down the hierarchy (from management group → subscription → resource group → resource).
4. User can perform only the actions defined in the role.

## 3. IAM Features in Azure

- **Role-Based Access Control (RBAC)** → Fine-grained access management.
  - **Conditional Access** → Policies based on location, device, risk, MFA, etc.
  - **Privileged Identity Management (PIM)** → Just-in-time admin access.
  - **Multi-Factor Authentication (MFA)** → Adds extra security to login.
  - **Identity Protection** → Detects risky sign-ins and accounts.
- | <b>Example</b>                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------|
| • <i>Alice (Developer)</i> → Contributor on <b>Resource Group: WebApp-RG</b> → Can create/update/delete resources in that RG. |
| • <i>Bob (Auditor)</i> → Reader on <b>Subscription: Prod-Sub</b> → Can only view resources, not modify them.                  |

# Types of Identities in Azure (Microsoft Entra ID)

## 1 User Identities

- Represent **people** who need access to Azure, Microsoft 365, or apps.
- Can be:
  - **Member users** → Employees in your organization's tenant.
  - **Guest users (B2B collaboration)** → External users invited (e.g., partner, vendor).
- Example: *alice@contoso.com*

## 3 Service Principals

- An **identity for applications or services** to access Azure resources.
- Like a "user account" for apps, APIs, or automation scripts.
- Used when apps need to authenticate securely without a user's credentials.
- Example: *Service Principal for CI/CD pipeline accessing Azure Storage.*

## 2 Group Identities

- A **collection of users** managed as a single unit.
- Useful for assigning **roles/permissions** to many users at once.
- Types of groups:
  - **Security Groups** → Used for RBAC and access control.
  - **Microsoft 365 Groups** → Used for collaboration (Teams, Outlook, SharePoint).
- Example: *Finance-Team-Group*

## 4 Managed Identities

- A special type of identity **managed by Azure** (no password/secret needed).
- Assigned to Azure resources (VMs, Functions, Logic Apps, etc.).
- Used to let resources authenticate to other Azure services securely.
- Two types:
  - **System-assigned** → Tied to a single resource.
  - **User-assigned** → Can be shared across multiple resources.
- Example: A VM accessing Azure Key Vault using a managed identity

# Types of Identities in Azure (Microsoft Entra ID)

## Summary

- **User** → Employees, guests.
- **Group** → Collection of users for easier access control.
- **Service Principal** → Identity for apps/services.
- **Managed Identity** → Auto-managed identity for Azure resources.
- **Device** → Registered devices for secure access.

In short: **Identities in Azure can represent people, groups, apps, services, or devices**, all managed through Microsoft Entra ID.

# Creating a New User & Assigning Access in Azure

## Step 1: Create a New User in Microsoft Entra ID (Azure AD)

1. Sign in to Azure Portal.
2. In the left menu, search for **Microsoft Entra ID** (formerly Azure Active Directory).
3. Select **Users** → **+ New user**.
4. Choose **Create user** (or Invite external user if adding a guest).
5. Fill in details:
  1. **Username** → User's login name.
  2. **Name** → Display name.
  3. **Password** → Auto-generated (can be reset later).
6. Click **Create** → The new user is now added to your tenant.

### Example Scenario

- You create user **john@company.com** in Entra ID.
- Assign him the **Contributor role** at the **Resource Group: WebApp-RG**.
- John can now deploy and manage resources inside that RG, but cannot assign roles.

## Step 2: Assign Role/Access to the User

1. Go to the **scope** where you want to give access:
  1. **Management Group** → for broad governance.
  2. **Subscription** → for billing & resource-wide access.
  3. **Resource Group** → for project-specific access.
  4. **Resource** → for one service only.
2. Select the scope → in the left panel, click **Access control (IAM)**.
3. Click **+ Add** → **Add role assignment**.
4. Choose a **Role**:
  1. **Owner** → Full control, including access management.
  2. **Contributor** → Can create/manage resources but not assign roles.
  3. **Reader** → View-only access.
  4. Or select from **custom roles**.
5. Under **Members** → select the new user.
6. Review and click **Assign**.

👉 In short:

- **Create user in Entra ID** → identity creation.
- **Assign role via IAM** → access & permissions.

Microsoft Entra ID = Identity + Access + Security for cloud and on-premises resources.  
It ensures the right people get the right access to the right resources securely.

[←](#) Microsoft

azurede25@gmail.com

## Add some details

Add your country/region and birthdate to help us apply age-appropriate settings to your Microsoft account.

Country/Region — India

Month — January Day — 1 Year — 2000

If a child is using this device, create a child account by entering your child's date of birth.

A child account enables you to enforce parental controls and impose usage limits for this device for reasons of privacy and safety. You can manage these settings at [microsoft.com/family](https://microsoft.com/family)

**Next**

[←](#) Microsoft

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## Add your name

Add your name to your Microsoft account.

First name — Azure25

Last name — DataEngr

I would like information, tips, and offers about Microsoft products and services.

By selecting Next, I agree to the [Microsoft Services Agreement](#) and [Privacy Statement](#).

**Next**

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## Sign in faster with your face, fingerprint, or PIN



Create a passkey to sign in to your Microsoft account. No passwords, apps, or codes needed.

**Next**

**Skip for now**

Welcome to Azure!

Don't have a subscription? Check out the following options.



**Start with an Azure free trial**  
Get \$200 free credit toward Azure products and services, plus 12 months of popular [free services](#).

[Start](#)



**Manage Microsoft Entra ID**  
Manage access, set smart policies, and enhance security with Microsoft Entra ID.

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## Azure services



Create a  
resource



Quickstart  
Center



Azure AI  
Foundry



Kubernetes  
services



Virtual  
machines



App Services



Storage  
accounts



SQL databases



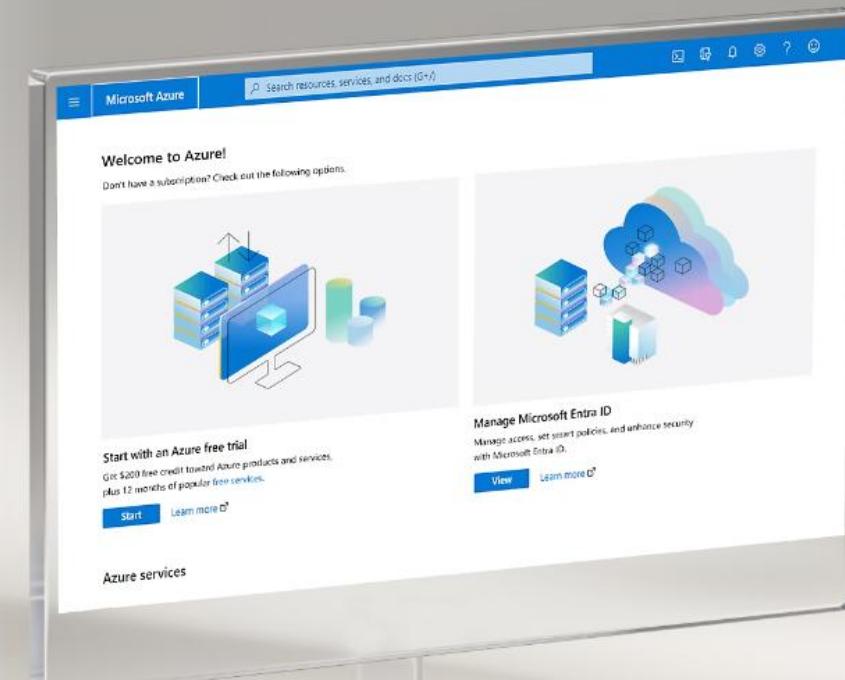
Azure Cosmos  
DB



[More services](#)

# Build in the cloud with an Azure account

Get started creating, deploying, and managing applications—across multiple clouds, on-premises, and at the edge—with scalable and cost-efficient Azure services.

[Try Azure for free](#)[Pay as you go](#)

## Your profile



How do you plan to use your Azure account?

- For personal use
- For use in connection with an organization, university, research group, NGO

Country/Region

Choose the location that matches your billing address. **You cannot change this selection later.** If your country is not listed, the offer is not available in your region.  
[Learn More](#)

First name

Middle name (optional)

Last name

## Create your Azure free account



Popular services free for 12 months



55+ services always free



USD200 credit to use in your first 30 days

### No automatic charges

After your credit is over, we'll ask you if you want to continue with pay-as-you-go. If you do, you'll only pay if you use more than the free amounts of services.

I understand that Microsoft may contact me about my free account.

I represent that I am the individual identified on this account.  
I agree to the terms and conditions of the [Microsoft Customer Agreement](#) including the Supplemental Individual User Terms.

I will receive information, tips, and offers about Azure and other Microsoft products and services.

I would like Microsoft to share my information with select partners so I can receive relevant information about their products and services.

Read our [privacy statement](#) for information on how your data is handled.

Next

## Azure services

Create a  
resourceQuickstart  
CenterAzure AI  
FoundryKubernetes  
servicesVirtual  
machines

App Services

Storage  
accounts

SQL databases

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DB

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