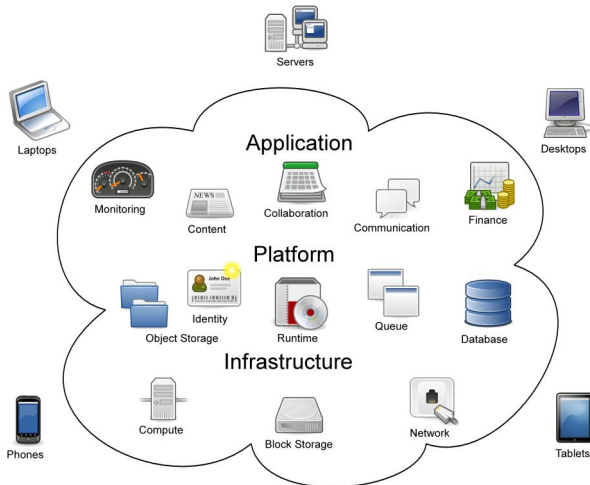


UNIT 2: CLOUD COMPUTING**# Cloud computing**

Cloud computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet.

Cloud computing is an application-based software infrastructure that stores data on remote servers, which can be accessed through the internet. The front end enables a user to access data stored in the cloud using an internet browser or a cloud computing software.

**# Cloud Computing Classification**

Cloud computing is usually classified on the basis of location, or on the service that the cloud is offering.

(I) Cloud Types: Private, Public and Hybrid, Community

There are three main types of cloud environment, also known as cloud deployment models. Businesses can choose to run applications on public, private or hybrid clouds – depending on their specific requirements.

1. **Public Cloud** – Whole computing infrastructure is located on the premises (sites) of a cloud computing company that offers the **cloud service**. It is accessible to many businesses through the internet on a pay-per-use model.
2. **Private Cloud** – Hosting all your computing infrastructure yourself and is not shared. The security and control level is highest while using a private network.
3. **Hybrid Cloud** – using both private and public clouds, depending on their purpose. You host your most important applications on your own servers to keep them more secure and secondary applications elsewhere.
4. **Community Cloud** – A community cloud is shared between organizations with a common goal or that fit into a specific community (professional community, geographic community, etc.).

(II) Types of cloud services: IaaS, PaaS, SaaS, FaaS

These are sometimes called the cloud computing stack, because they build on top of one another.

1. Infrastructure-as-a-service (IaaS)

IaaS is the most basic category of cloud computing services that allows you to rent IT infrastructure (servers, network, operating systems, data storage drives or VM's) from a cloud provider on a pay-as-you-go basis.

Examples - Microsoft Azure, Amazon Web Services (AWS), Google Cloud Platform, Dropbox, etc.

2. Platform as a service (PaaS)

Platform-as-a-service (PaaS) refers to the supply of an on-demand environment for developing, testing, delivering and managing software applications. It is designed to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network and databases needed for development.

Examples - AWS Elastic Beanstalk, Google App Engine, Microsoft Azure.

3. Software as a service (SaaS)

Software-as-a-service (SaaS) is a method for delivering software applications over the Internet as per the demand and on a subscription basis. SaaS helps you host and manage the software application and underlying infrastructure and handle any maintenance (software upgrades and security patching).

Examples - Microsoft Office 365, Google Drive, Adobe Creative Cloud, Gmail, Google Apps, etc.

4. FaaS (functions as a service)

FaaS adds another layer of abstraction to PaaS, so that developers are completely insulated from everything in the stack below their code. Instead of handling the hassles of virtual servers, containers, and application runtimes, they upload narrowly functional blocks of code, and set them to be triggered by a certain event. FaaS applications consume no IaaS resources until an event occurs, reducing pay-per-use fees.

Examples - AWS Lambdas, Azure Functions.

Uses of Cloud Computing

Although you do not realize you are probably using cloud computing right now, most of us use an online service to send email, edit documents, watch movies, etc. It is likely that cloud computing is making it all possible behind the scenes. Today a variety of organisations ranging from tiny startups to government agencies are embracing this technology for the following:

- ✓ Create new apps and services as well as store, back up and recover data
- ✓ Host websites and blogs
- ✓ Stream audio and video
- ✓ Deliver on demand software services
- ✓ Analyze data for patterns
- ✓ Make predictions

Advantages of Cloud Computing**1) Back-up and restore data**

Once the data is stored in the cloud, it is easier to get back-up and restore that data using the cloud.

2) No Hardware Required

Since everything will be hosted in the cloud, a physical storage center is no longer needed.

3) Improved collaboration

Cloud applications improve collaboration by allowing groups of people to quickly and easily share information in the cloud via shared storage.

4) Excellent accessibility

Cloud allows us to quickly and easily access store information anywhere, anytime in the whole world, using an internet connection.

5) Low maintenance cost

Cloud computing reduces both hardware and software maintenance costs for organizations.

6) Mobility

Cloud computing allows us to easily access all cloud data via mobile.

7) Services in the pay-per-use model

Cloud computing offers Application Programming Interfaces (APIs) to the users for access services on the cloud and pays the charges as per the usage of service.

8) Unlimited storage capacity

Cloud offers us a huge amount of storing capacity for storing our important data such as documents, images, audio, video, etc. in one place.

9) Data security

Data security is one of the biggest advantages of cloud computing. Cloud offers many advanced features related to security and ensures that data is securely stored and handled.

Disadvantages of Cloud Computing**1) Internet Connectivity**

As you know, in cloud computing, every data (image, audio, video, etc.) is stored on the cloud, and we access these data through the cloud by using the internet connection. If you do not have good internet connectivity, you cannot access these data. However, we have no any other way to access data from the cloud.

2) Vendor lock-in

Vendor lock-in is the biggest disadvantage of cloud computing. Organizations may face problems when transferring their services from one vendor to another. As different vendors provide different platforms, that can cause difficulty moving from one cloud to another.

3) Limited Control

As we know, cloud infrastructure is completely owned, managed, and monitored by the service provider, so the cloud users have less control over the function and execution of services within a cloud infrastructure.

4) Security

Although cloud service providers implement the best security standards to store important information. But, before adopting cloud technology, you should be aware that you will be sending all your organization's sensitive information to a third party, i.e., a cloud computing service provider. While sending the data on the cloud, there may be a chance that your organization's information is hacked by Hackers.

5) Bandwidth issues

For ideal performance, clients have to plan accordingly and not pack large amounts of servers and storage devices into a small set of data centers.

VENDORS OF CLOUD COMPUTING

Cloud Service providers are vendors which provide Information Technology (IT) as a service over the Internet. Cloud computing is a term which is used for storing and accessing data over the internet. Cloud companies helps you to access your data from a remote server.

There are many Cloud Service providers in the market:

- 1) Amazon Web Service (AWS)
- 2) Google Cloud Platform
- 3) Microsoft Azure
- 4) IBM Cloud Services
- 5) Dropbox
- 6) Oracle Clouds
- 7) Adobe Creative Cloud

Services Provided by Cloud Providers

| Name of Company | IaaS | Paas | SaaS |
|------------------|-------------------------|---|----------------------|
| AWS | Amazon EC2 | Amazon Web Services | Amazon Web Services |
| Microsoft | Microsoft Private Cloud | Microsoft Azure | Microsoft Office 365 |
| Google | — | Google App Engine (Python, Java and many) | Google Applications |
| IBM | Smart Cloud Enterprise | Smart Cloud Application Services | SaaS Products |

1. AWS (Amazon Web Services)

AWS is Amazon's cloud web hosting platform which offers fast, flexible, reliable and cost-effective solutions. It is one of the top cloud service providers which offers a service in the form of building block which can be used to create and deploy any kind of application in the cloud. It is the most popular as it was the first to enter the cloud computing space.

Features:

- Easy sign-up process
- Fast Deployments
- Allows easy management of add or remove capacity
- Access to effectively limitless capacity
- Centralized Billing and management
- It is one of the cloud companies that offers Hybrid Capabilities and per hour billing

Companies using AWS

- Instagram
- Pinterest
- Netflix
- Dropbox

Applications of AWS services

Amazon Web services are widely used for various computing purposes like:

- Web site hosting
- Application hosting/SaaS hosting
- Media Sharing (Image/ Video)
- Mobile and Social Applications
- Content delivery and Media Distribution
- Storage, backup, and disaster recovery
- Development and test environments
- Academic Computing
- Search Engines
- Social Networking

Advantages of AWS

Following are the pros of using AWS services:

- AWS allows organizations to use the already familiar programming models, operating systems, databases, and architectures.
- It is a cost-effective service that allows you to pay only for what you use, without any up-front or long-term commitments.
- You will not require to spend money on running and maintaining data centers.
- Offers fast deployments
- You can easily add or remove capacity.
- You are allowed cloud access quickly with limitless capacity.
- Total Cost of Ownership is very low compared to any private/dedicated servers.
- Offers Centralized Billing and management
- Offers Hybrid Capabilities
- Allows you to deploy your application in multiple regions around the world with just a few clicks

Disadvantages of AWS

- If you need more immediate or intensive assistance, you'll have to opt for paid support packages.
- Amazon Web Services may have some common cloud computing issues when you move to a cloud. For example, downtime, limited control, and backup protection.
- AWS sets default limits on resources which differ from region to region. These resources consist of images, volumes, and snapshots.
- Hardware-level changes happen to your application which may not offer the best performance and usage of your applications.

AWS Services

Here are some of AWS's essential offerings:

1. Amazon S3

This tool is used for internet back up, and it's the cheapest storage option in the object-storage category. The best part: you can retrieve stored data from almost anywhere whenever you need it.

2. AWS Data Transfer Products

As the name suggests, these are migration, data collection, and data transfer products that help you collect data seamlessly. They also enable you to monitor and analyze data in real-time.

3. Amazon EC2 (Elastic Compute Cloud)

EC2 is a virtual machine in the cloud on which you have OS level control. You can run this cloud server whenever you want.

4. Amazon SNS (Simple Notification Services)

This is a notification tool that delivers messages to a large number of subscribers through email or SMS. You can send alarms, service notifications, and other messages intended to call attention to important information.

5. Amazon KMS (Key Management System)

This is a security tool that uses 256-bit encryption for your data. It also safeguards it from hackers and cyber attacks.

6. Amazon Lambda

This service runs your code depending on specific events and manages the dependent resources. You need neither managing nor provisioning servers, and how much you pay depends on how long it takes to execute your code. It saves a lot of money compared with services that charge hourly rates.

7. Route 53

This is a DNS service in the cloud that doesn't require you to maintain a separate DNS account. It's designed to provide businesses with a reliable and cost-effective method to route users to internet applications.

2. Google Cloud Platform

Google Cloud is a set of solution and products which includes GCP & G suite. It is one of the top cloud service providers which helps you to solve all kind of business challenges with ease.

Google Cloud Services

- Compute Services
- Storage Services

- Networking
- Big Data Services
- Security and Identity Management
- Management Tools
- Cloud AI
- IoT

Features:

- It is one of the cloud companies that allows you to scale with open, flexible technology
- Solve issues with accessible AI & data analytics
- Eliminate the need for installing costly servers
- Allows you to transform your business with a full suite of cloud-based services.

Services:

1. **Google Compute Engine**, which is an infrastructure-as-a-service (IaaS) offering that provides users with virtual machine instances for workload hosting.
2. **Google App Engine**, which is a platform-as-a-service (PaaS) offering that gives software developers access to Google's scalable hosting. Developers can also use a software developer kit (SDK) to develop software products that run on App Engine.
3. **Google Cloud Storage**, which is a cloud storage platform designed to store large, unstructured data sets. Google also offers database storage options, including Cloud Datastore for NoSQL nonrelational storage, Cloud SQL for MySQL fully relational storage and Google's native Cloud Bigtable database.
4. **Google Container Engine**, which is a management and orchestration system for Docker containers that runs within Google's public cloud. Google Container Engine is based on the Google Kubernetes container orchestration engine.

3. Microsoft Azure

Azure is a cloud platform which is launched by Microsoft in February 2010. This open source and flexible cloud platform which helps in development, data storage, service management & hosting solutions.

Features:

- Windows Azure offers the most effective solution for your data needs
- Provides scalability, flexibility, and cost-effectiveness
- Offers consistency across clouds with familiar tools and resources
- Allow you to scale your IT resources up and down according to your business needs

Services:

- **Cloud Services:** PaaS (Platform as a Service) can be utilised to build applications and services.
- **Websites:** Azure allows its users to develop sites on ASP.NET, Node.js, PHP, or Python.
- **Virtual Machines:** Primarily a migration tool, allowing developers to migrate apps and infrastructure without altering code.
- **Data:** SQL Database extends applications into the cloud, utilising SQL Server.
- **Media:** This is a Platform as a Service feature that can be utilised for protecting content, streaming media, and more.

4. IBM Cloud

IBM cloud is a full stack cloud platform which spans public, private and hybrid environments. It is one of the best cloud providers which is built with a robust suite of advanced and AI tools.

Features:

- IBM cloud offers infrastructure as a service (IaaS), software as a service (SaaS) and platform as a service (PaaS)
- IBM Cloud is used to build pioneering which helps you to gain value for your businesses
- It offers high performing cloud communications and services into your IT environment

Services:

- **Compute Infrastructure** — includes its bare metal servers (single-tenant servers that are highly customizable), virtual servers, GPU computing, POWER servers (based on IBM's POWER architecture) and server software
- **Compute Services** — includes OpenWhisk serverless computing, containers and Cloud Foundry runtimes
- **Storage** — includes object, block and file storage, as well as server-backup capabilities
- **Network** — includes load balancing, Direct Link private secure connections, network appliances, content delivery network and domain services
- **Mobile** — includes IBM's Swift tools for creating iOS apps, its MobileFirst Starter package for getting a mobile app up and running, and its Mobile Foundation app back-end services
- **Data and analytics** — includes data services, analytics services, big data hosting, Cloudera hosting, MongoDB hosting and Riak hosting
- **Internet of Things** — includes IBM's IoT platform and its IoT starter packages
- **Security** — includes tools for securing cloud environments, such as a firewall, hardware security modules (physical devices with key management capabilities), Intel Trusted Execution Technology, security software and SSL certificates
- **Application services** — includes Blockchain, Message hub and business rules, among others
- **Integration** — includes tools for building virtual bridges for hybrid cloud and multi-cloud environments, such as API Connect and Secure Gateway