Introduction to cloud computing

What is Cloud Computing?

To be precise, cloud computing is the delivery of computing services like servers, storages and more over the Internet. The companies that offer these computing services are called cloud providers. They charge for **cloud computing** services based on usage.

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

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 organizations 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

Introduction to cloud computing

What do you mean by cloud computing?

In the simplest terms, cloud computing means storing and accessing data and programs over the Internet instead of your computer's hard drive. The cloud is just a metaphor for the Internet. When you store data on or run programs from the hard drive, that's called local storage and computing.

What is the main use of cloud computing?

Uses of the cloud include data storage, offering remote access to any work related data. The role of cloud computing on a corporate level can be either for the in house operations, or as a deployment tool for software or services the company develops for the public.

How do cloud applications work?

A cloud application, or cloud app, is a software program where cloud-based and local components work together. This model relies on remote servers for processing logic that is accessed through a web browser with a continual internet connection.

What are the advantages of cloud computing?

Efficiency. Cloud-based applications and data are accessible from virtually any internet-connected device. Developing in the cloud enables users to get their applications to market quickly. Hardware failures do not result in data loss because of networked backups.

Top 5 Cloud Platforms and Solutions to Choose From

IBM cloud

Amazon Web Services

Google Cloud Platform

Microsoft Azure

Alibaba cloud

Is Netflix a SaaS?

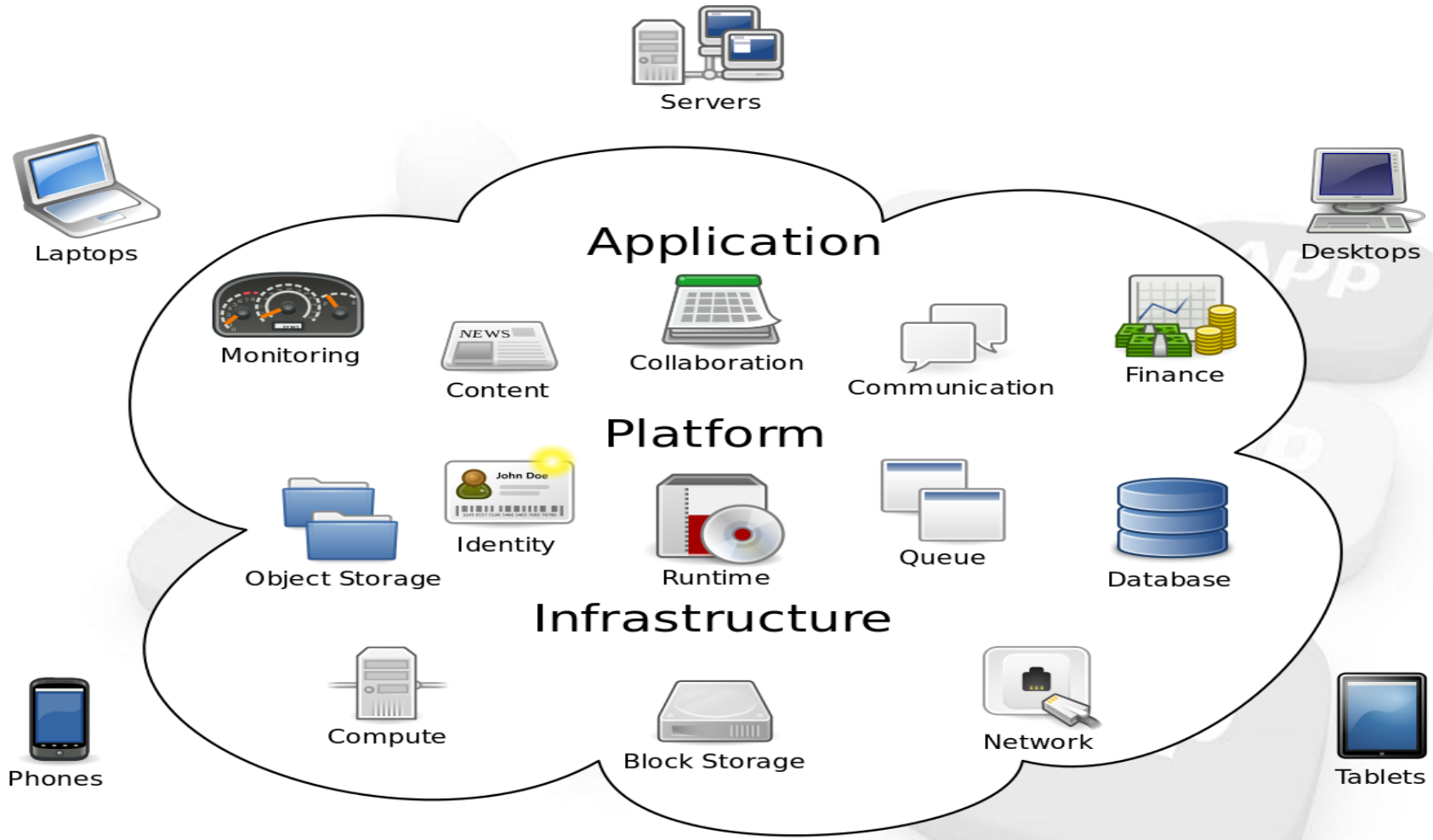
Yes, Netflix exclusively uses the Software as a Service (SaaS) model. They run on Amazon Web Services (AWS).

Does Netflix use AWS?

Netflix uses AWS for nearly all its computing and storage needs, including databases, analytics, recommendation engines, video transcoding, and more—hundreds of functions that in total use more than 100,000 server instances on AWS.

Is Gmail An example of cloud computing?

Cloud Computing is the use of hardware and software to deliver a service over a network (typically the Internet). ... An example of a Cloud Computing provider is Google's Gmail. Gmail users can access files and applications hosted by Google via the internet from any device.



Cloud computing

IBM CLOUD COMPUTING

Which fields or industries use IBM cloud computing?

Education

Finance

Healthcare

Retail

Technology

What companies use IBM cloud?

IBM claimed in April 2011 that 80% of Fortune 500 companies were using IBM cloud, and that their software and services were used by more than 20 million end-user customers, with clients including American Airlines, Aviva, Carfax, Frito-Lay, India First Life Insurance Company, and 7-Eleven.

What does IBM cloud do?

IBM Cloud is a suite of cloud computing services from IBM that offers both platform as a service (PaaS) and infrastructure as a service (IaaS). With IBM Cloud IaaS, organizations can deploy and access virtualized IT resources -- such as compute power, storage and networking -- over the internet.

Where using IBM Cloud Computing:

American Airlines:

IBM is helping American Airlines migrate some of its critical applications to the IBM Cloud while using new methodology to create innovative applications quickly and improve the customer experience.

Allianz:

Allianz wanted a mobile assistant solution that worked across platforms to better serve customers. Using IBM Cloud and IBM Watson Assistant, the company created an AI-powered virtual assistant that can field 80 percent of its most frequent customer requests — for real help in real time.

Panasonic:

Panasonic teamed with IBM to build the Panasonic Digital Concierge Platform. Built on IBM Watson technology and hosted on IBM Cloud, the solution provides the foundation on which Panasonic can develop innovative solutions that create conversational, interactive and personalized guest experiences.

Whirlpool:

Whirlpool Corporation is migrating SAP ERP powered by SAP HANA to IBM Power Systems in the IBM Cloud, with IBM Services for Managed SAP Applications, freeing up resources for innovation.

Vodafone:

Together, IBM and Vodafone Business will help companies remove the complexity and barriers from their technology choices and ensure data and applications flow freely and securely across their organizations. Under the new venture, Vodafone Business customers will immediately have access to the full portfolio of IBM Cloud offerings, underpinned by IBM's deep industry expertise and open technologies.

FaceMe:

FaceMe uses IBM technologies, including IBM Cloud and IBM Watson, to create incredibly lifelike Digital Humans who can see, hear, talk with and remember customers — for real-time, always-on, personalized service.

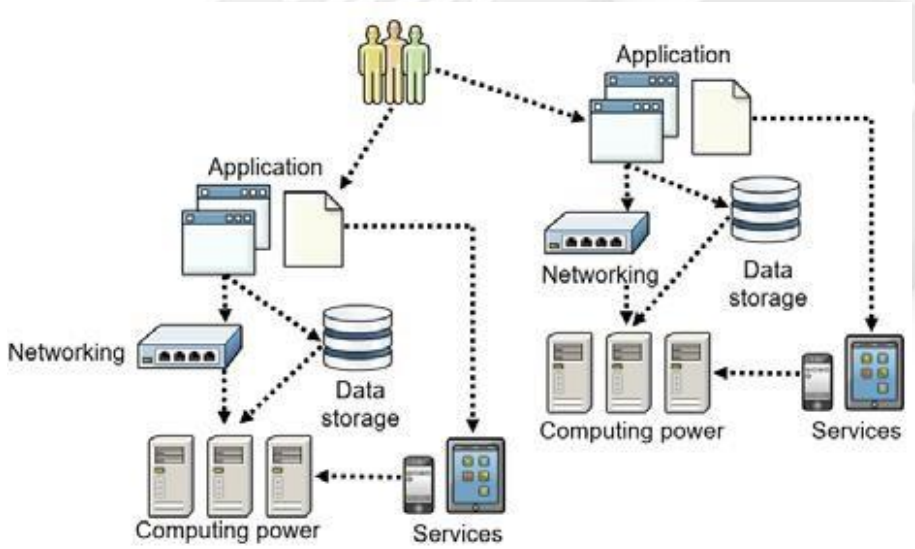
Introduction to cloud computing

Before Cloud Computing:

Before you learn about cloud computing, you should know more about the software industry before cloud computing.

Before cloud computing, when you created a basic website for your clients, you started by developing your application with a programming language, such as Java, Node.js, or PHP. Then, you deployed it on a physical machine (server). On this server, you had an operating system and set up the configurations and middleware that were needed to run your application. Also, you needed a run time to run your application, such as Apache Tomcat or IBM WebSphere Liberty application server (if you used Java). Your application had to be linked to a database.

Then, to expose this application to your client, you needed an IP and domain name, and handled the network configurations, the physical location for your servers, and the electricity that was required for your servers. Security had to be set up and maintained. You had to manage the upgrades for these resources. You needed a large team of experts to install, configure, test, run, secure, and update these resources to keep your website running.



Challenges faced before cloud computing:

Here some of the challenges that were faced before cloud computing:

Cost:

It was costly to build reliable and maintainable software. You likely built you own infrastructure that might be needed to be turned into a whole data center, which included servers, network equipment, data storage, and so on. You needed to hire a team of experts to handle all these resources. All these factors made it difficult for small and midsized business to develop their own software and keep updating it.

Scalability

If there was high demand from your clients for your application, you needed to scale up the capacity of your application, which required more resources and some downtime to integrate and upgrade those resources. If demand decreased, you had some resources that were not used effectively.

Reliability

With any operation that is done to your server, such as maintenance and updates, you need downtime to perform those operations. Some issues that might have caused downtime for your application are power outages, hardware problems, general network issues, or even natural disasters.

Security

Security is necessary for all levels: application, network, infrastructure, and physical resources.

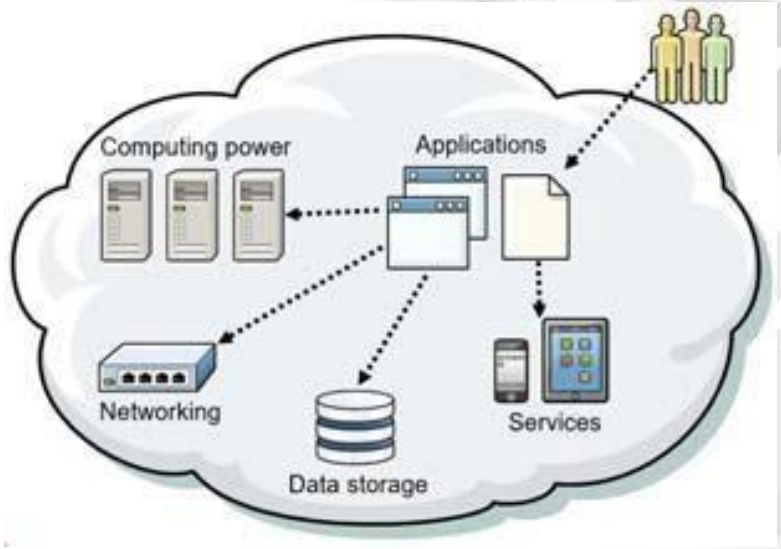
Mobility

Part of the team worked onsite to, at least, set up the infrastructure and configured the network.

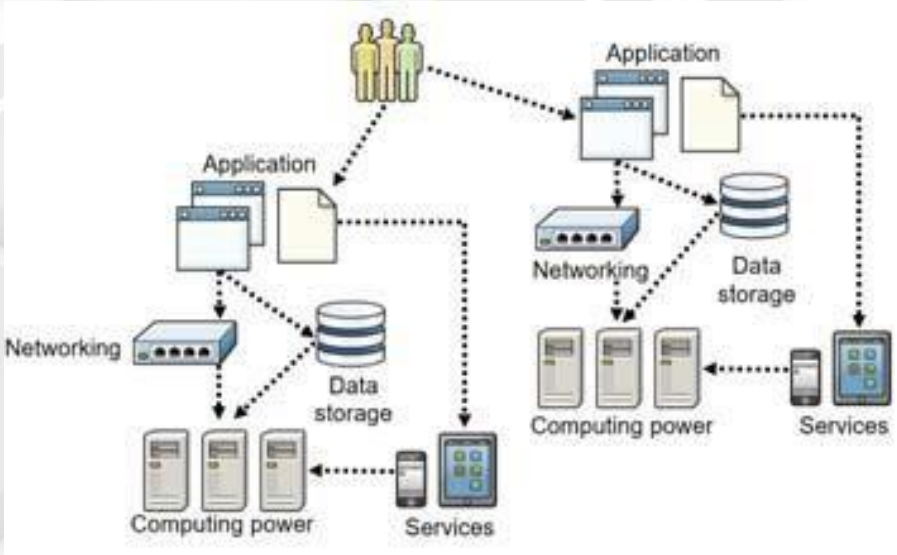
What is cloud computing:

Cloud computing often referred to as **“the cloud”** , is the delivery of on-demand computing resources (application to data centers) on a pay-as-you-go basis.

- Elastic resources
- Metered services
- Self-service



Cloud computing model



Traditional on-premises computing model

Cloud computing is a model for enabling convenient, on-demand access to provider-managed suite of both hardware and software resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cloud computing is a disruptive change in the IT industry that represents a new model for the IT infrastructure that is different from traditional IT computing models. Cloud computing enables ubiquitous computing, where computing is available anytime and everywhere, using any device, in any location, and in any format. The surge of mobile devices is greatly contributing to this model.

This new model demands a dynamic and responsive IT infrastructure due to short application lifecycles. To support this model, new development processes, application design, and development tools are required.

Elastic resources: Scale up or down quickly and easily to meet changing demand.

Metered services: Pay only for what you use.

Self-service: Find all the IT resources that you need by using self-service access.

Characteristics of the cloud:

Modern applications must be delivered quickly. Developers are pressured to get their product to market as soon as possible. They want to get feedback quickly, and then iterate on the idea to make the product better and faster.

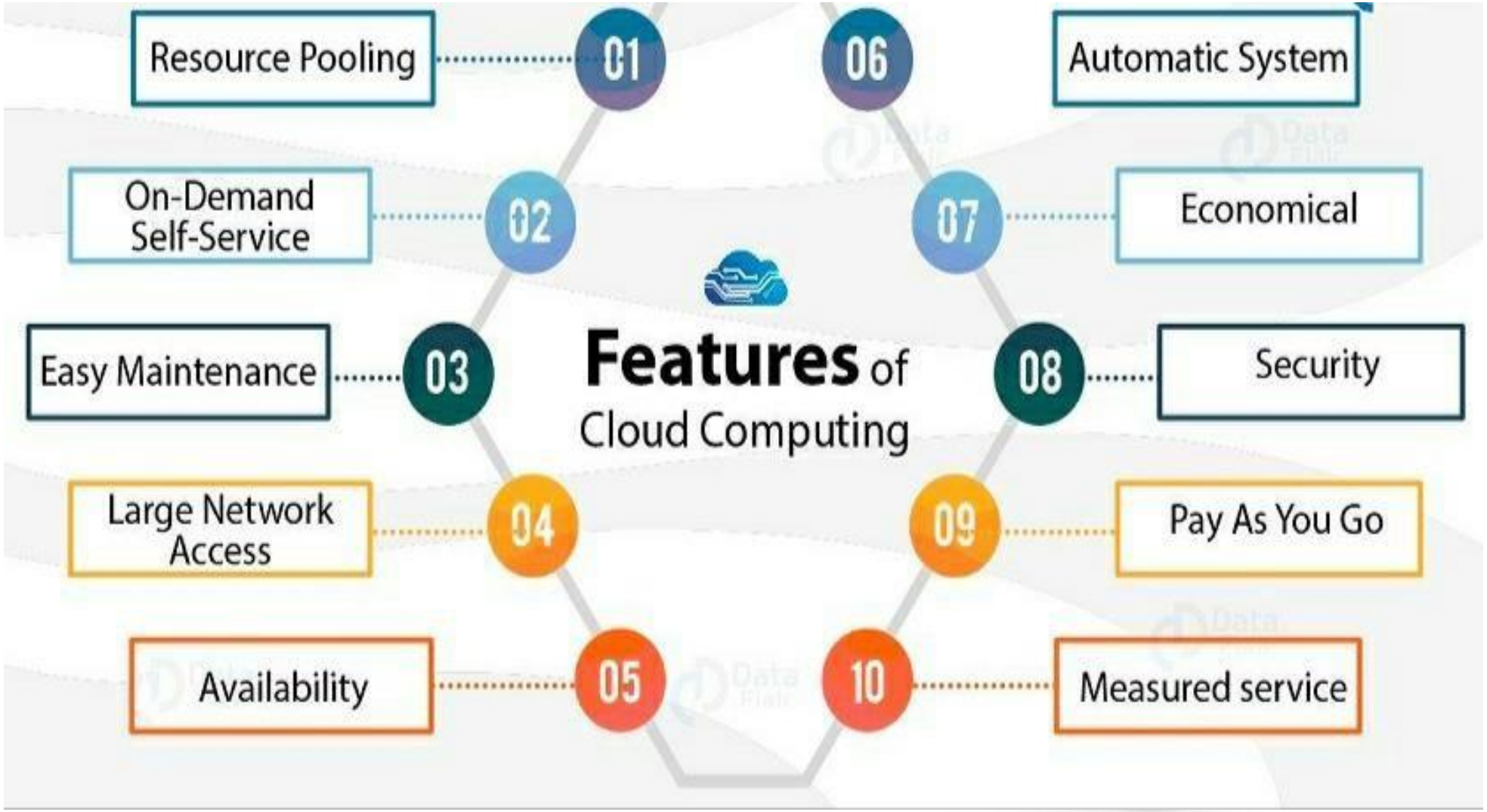
The cloud makes hardware resources readily available and quick to configure, which shortens the time that is required for developers to show a working version of their products. Also, cloud allows the reuse of the same resources for multiple successive projects, which is more cost-efficient.

Characteristics of the cloud:

- **On-demand resources:** Have it when you need it with no need for tiresome preparation, downloads, and installations.
- **Self-service:** A customer can provision resources themselves by accessing a self-service portal and requesting the resource that they want.
- **Ubiquitous access:** Access the cloud from anywhere just by using an internet connection and a cloud account (user name and password).
- **Resource pooling:** Pooling hardware resources and abstracting them so that when resources are not being used by one customer, instead of sitting idle, those resources can be used by another customer.
- **Rapid elasticity:** Scaling up or down resource consumption is available on demand with any quantity and at any time.
- **Measured service:** Pay only for what you use, which helps you monitor any wastage of resources.

Examples of cloud resources include:

- Servers
- Storage
- Networks
- Security
- Applications
- Platforms
- Runtimes
- Databases


Features of
Cloud Computing
01
Resource Pooling
02
On-Demand
Self-Service
03
Easy Maintenance
04
Large Network
Access
05
Availability
06
Automatic System
07
Economical
08
Security
09
Pay As You Go
10
Measured service

Benefits of the cloud:

Enterprises eager to undergo digital transformations and modernize their applications are quick to see the value of adopting a cloud-computing platform. They are increasingly finding business agility or cost savings by renting software and infrastructure. Each cloud-computing service and deployment model type provides you with different levels of control, flexibility, and management.

- **Achieves economies of scale (do more with less):** Economies of scale decrease costs because of increased production. These economies became achievable in software because of the flexibility of the cloud.

- **GOES from CAPEX to OPEX:** Reduces capital expenditure (CAPEX) by moving to the operational expenditure (OPEX) model (use only when needed).CAPEX is the money that is used to acquire or update the assets of a firm. OPEX is the money that is used on running operations. So, in the software industry the “pay as you go” model helps you go from CAPEX to OPEX.

- **Runs anytime and anywhere:** It means access to services, on any device, and anywhere in the world.

- **Facilitates agile methodology (faster time to market):** Agile methodology is a development methodology where you engage the client with the development team and constantly get changing requirements that are embraced for the client’s competitive advantage. Applying the agile methodology became achievable because of the cloud.

- **Ensures Global Availability:** It’s focus on developing applications, and the rest automatically follows.It helps to improve reliability and provide a good disaster recovery plan with high availability.

- **Built-in security**

Cloud providers typically have standards to build their environments and standardized practices to run operations that meet the security needs of enterprise clients. As a user of cloud, your application could benefit from higher orders of security by virtue of it being built into the cloud offering for all.

•**Provides advanced capabilities:** There are many advanced technology that is readily available and you can experiment with. Many advanced technologies, such as big data and AI services that need high-computing-power capabilities would not be available without cloud computing.

Factors contributing to the growth of the cloud:

•**Application with a short lead time to delivery:** One factor contributing to the growth of cloud computing is that today's applications must be delivered quickly. Developers are pressured to get their product to market as soon as possible. They want to get feedback quickly, and then iterate on the idea to make the product better and faster.

The cloud makes hardware resources readily available and quick to configure, which shortens the time that is required for developers to show a working version of their products.

•**Developers expect to have programming language options and interact with predefined services:** Another factor contributing to the growth of cloud computing is that developers expect to use many languages and interact with predefined services. Cloud computing provides prepackaged language support, which enables the support of many more languages than the traditional do-it-yourself environment. Cloud computing can also make available shared services that provide an externally managed way of delivering frequently used functions.

•**Modern Applications must be able to scale and be managed dynamically:** Another factor that drives the adoption of cloud computing is that developers want to be able to add resources to a specific application (scaling up, or vertical scaling), or add duplicate instances of an application (scaling out, or horizontal scaling) to handle increased customer load. Cloud platforms provide standardized methods to scale applications.

• **Developers expect the "pay-as-you-go utility" computing billing method that cloud provides.**

Cloud service models:

There are three types of cloud service models.

- **IAAS (**Infrastructure as a Service**)**
- **PAAS (**Platform as a Service**)**
- **SAAS (**Software as a Service**)**

IAAS:

A cloud provider offers clients pay-as-you-go access to storage, networking, servers, and other computing resources in the cloud.

PAAS:

A cloud provider offers access to a cloud-based development environment in which users can build and deliver applications. The provider supplies and manages the underlying infrastructure.

SAAS:

A cloud provider delivers software and applications through the internet that are ready to be consumed. Users subscribe to the software and access it through the web or vendor application programming interfaces (APIs).

Infrastructure as a Service:

Infrastructure as a service (IAAS) is a cloud computing offering in which a vendor provides users access to computing resources such as servers, storage, and networking. Organizations use their own platforms and applications within a service provider's infrastructure.

IAAS offerings are built on top of a standardized, secure, and scalable infrastructure. The virtualization of the hardware is performed by a program that is known as a hypervisor. A hypervisor manages virtual machines (VMs) or virtual servers, which hosts multiple operating system instances that are running on a specific physical machine. Each operating system appears to have the host's processor, memory, and other resources all to itself, but in reality the hypervisor is controlling and provisioning access.

Key features:

- Instead of purchasing hardware outright, users pay for IAAS on demand.
- Infrastructure is scalable depending on processing and storage needs.
- Saves enterprises the costs of buying and maintaining their own hardware.
- Because data is on the cloud, there is no single point of failure.
- Enables the virtualization of administrative tasks, freeing up time for other work.

Platform as a Service:

Platform as a service (PAAS) is a cloud computing offering that provides users a cloud environment in which they can develop, manage, and deliver applications. In addition to storage and other computing resources, users can use a suite of prebuilt tools to develop, customize and test their own applications.

PAAS also gives the developer an automatic method for scaling. For example, consider a situation where the developer wants more hardware resources that are dedicated to an application (scaling up or vertical scaling) or more instances of the application to handle the load (scaling out or horizontal scaling). PAAS also provides built-in application monitoring. For example, the platform sends notifications to inform developers when their application crashes.

Key features:

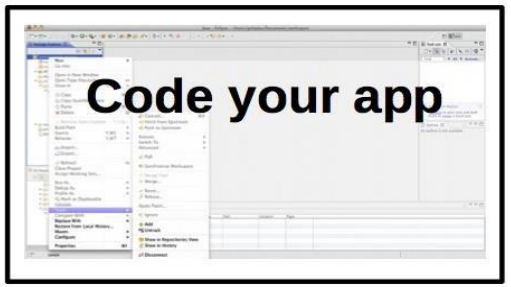
- PAAS provides a platform with tools to test, develop, and host applications in the same environment.
- Enables organizations to focus on development without having to worry about underlying infrastructure.
- Providers manage security, operating systems, server software, and backups.
- Facilitates collaborative work even if teams work remotely.

PAAS typically entails the developer uploading the application code, or pointing to it and letting the PAAS complete the following tasks:

- Obtain the runtime binary files and dependencies for the application.
- You can update and redeploy the application with zero downtime.
- Provision a container (or set of containers) on which the application can run.
- Automatically generate a simple and basic networking configuration for access to the application

PaaS = Platform as a Service

A Cloud Application Platform



Software as a Service:

Software as a service (SAAS) is a cloud computing offering that provides users with access to a vendor's cloud-based software. Users do not install applications on their local devices. Instead, the applications reside on a remote cloud network accessed through the web or an API. Through the application, users can store and analyze data and collaborate on projects.

Key features:

- SAAS vendors provide users with software and applications on a subscription model.
- Users do not have to manage, install, or upgrade software; SAAS providers manage this.
- Data is secure in the cloud; equipment failure does not result in loss of data.
- Use of resources can be scaled depending on service needs.
- Applications are accessible from almost any Internet-connected device, from virtually anywhere in the world.

SaaS Business Model: Software as a service for your business

Example of cloud services:

This slide shows examples of the services that are available for each model.

IaaS

- Virtual servers
- Bare metal machines
- Block storage
- File share storage
- Object storage
- Backup
- IP management
- Virtual private networks
- Firewalls
- Load balancers
- Automation

PaaS

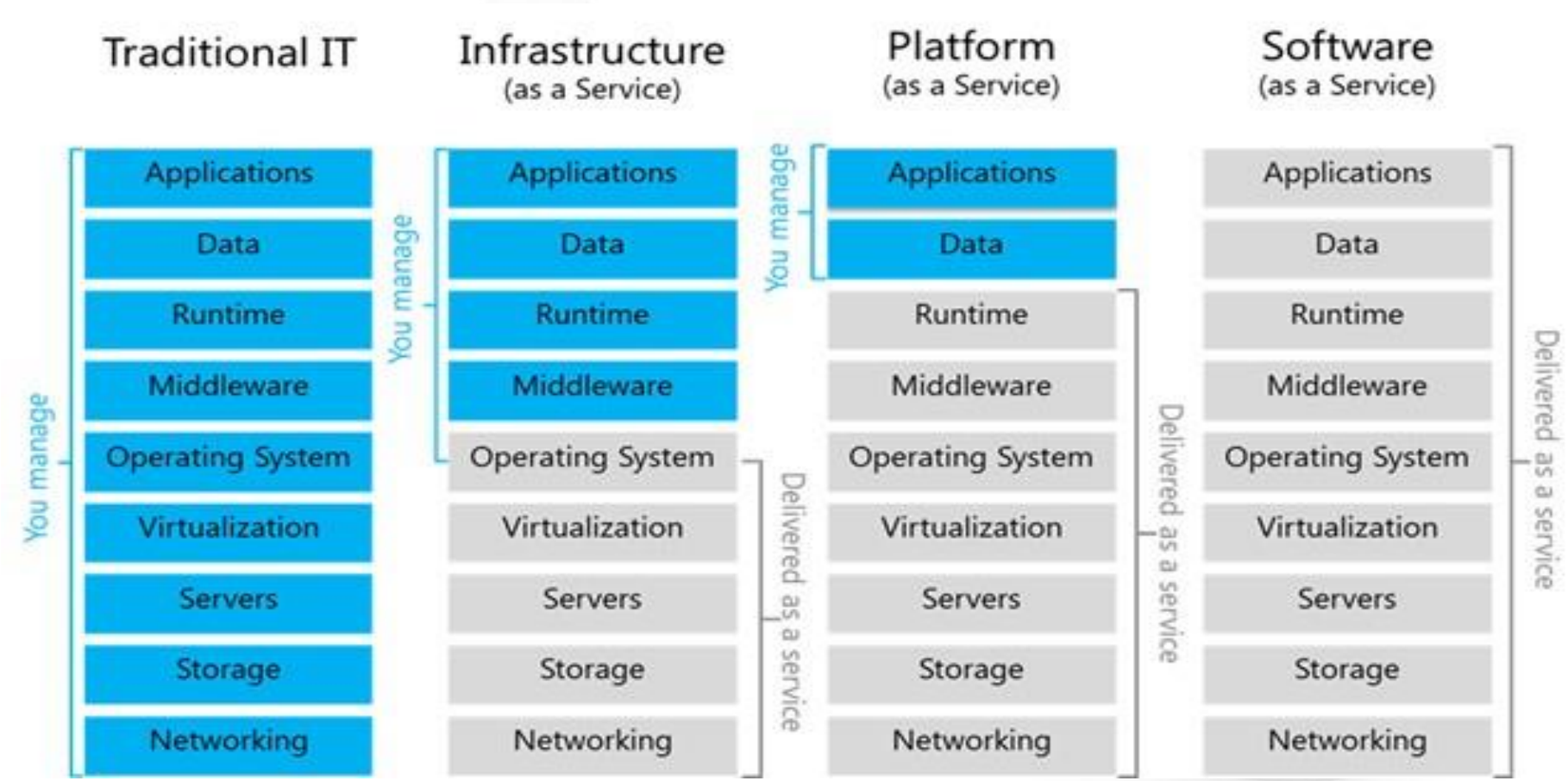
- Run times and development platforms
- Databases
- Analytics
- Integration
- Starter kits
- Mobile platforms
- Push notifications
- Messaging
- Developer tools
- Continuous integration / continuous delivery

SaaS

- Email and Collaboration
- Customer relationship manager (CRM)
- Enterprise resource planning (ERP)
- Video streaming
- Marketing
- Talent management
- Advertising

Cloud provider and client responsibilities:

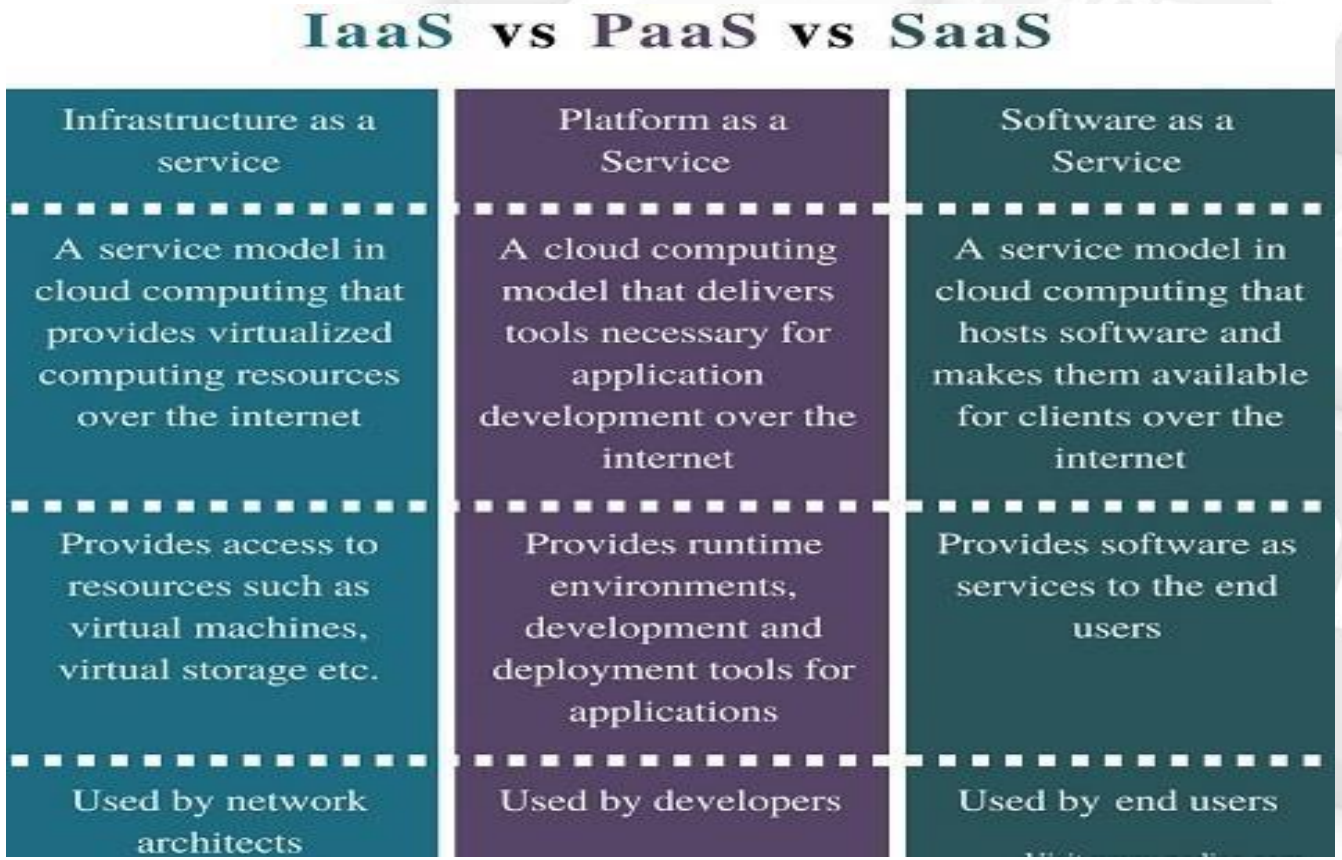
This slide shows the split between the provider and client responsibilities when dealing with **on-premises** or "**as a service**" scenarios.



Typically, the cost decreases as you move to the right in the scenarios that are shown in the slide; however, the flexibility also is reduced.

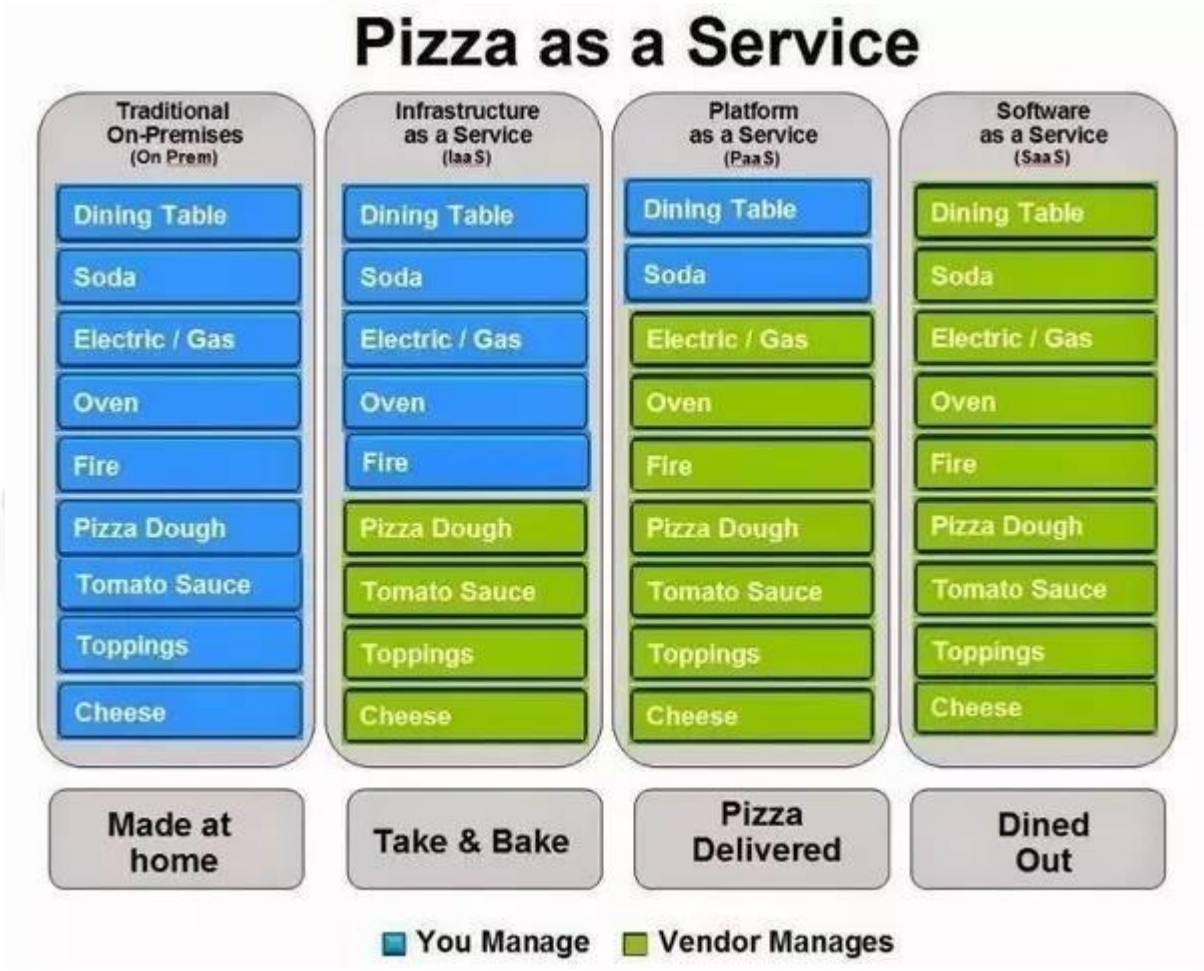
Organizations or departments within an organization make their own cost-based decisions about which delivery model to use for individual applications or projects.

Most enterprises end up using some combination of all of the models that are shown in the slide.



The Pizza Analogy:

The cloud has different service models. With platform, infrastructure, and software offered as services, the pizza analogy is an easy way to understand this approach



Cloud computing can be explained by using the pizza analogy:

•You build a pizza by preparing the dough, purchasing certain toppings, heating the oven, baking it, and then serving and eating the pizza along with drinks at home.

• Infrastructure as a Service (IAAS) is like buying a pre-made pizza from the supermarket. You bake it in your oven, serve it with drinks, and eat the pizza at home.

•Platform as a Service (PAAS) is like ordering a pizza from a pizza delivery restaurant. The pizza is prepared by the restaurant and delivered to your front door. You provide the drinks and eat it at home.

•Software as a Service (SAAS) is like going to a restaurant and eating the pizza there while enjoying the company of others and sharing the atmosphere of the restaurant.

When translating this analogy to the cloud, we can say that:

•To build an application, you must provide the infrastructure, platforms, operating systems, networking components, and so on, which is like making a pizza at home.

•**With IAAS**, you order hardware and an infrastructure. Often, this infrastructure is managed for you. You deploy only the middleware, runtime, and your application. The infrastructure is like the pizza that is pre-made, and you bake it to your liking.

•**PAAS** is like getting a pizza delivered. The pizza is ready to be eaten, and need only to provide drinks to go with it. In the cloud, this means that the cloud provider offers access to the platform and runtime and you only need to push the application.

•**SAAS** is using an application that is hosted at the cloud provider, which is similar to going to a restaurant and enjoying your pizza there.

Pizza as a service

The variety of cloud services can obfuscate the level of an organization's ownership of the stack. Albert Barron, executive software client architect at IBM, uses this analogy to provide clarity:

ON-PREMISES MANAGEMENT

Making a pizza at home

IAAS

Take-and-bake service

PAAS

Delivery

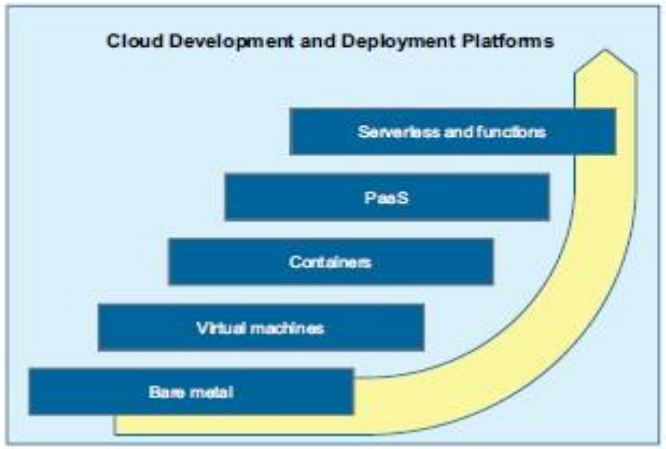
SAAS

Eat-in restaurant

Choices when building cloud applications:

When developing applications for the cloud, developers have many options to choose from in terms of platforms, frameworks, tools, and services:

1. Traditional development
   - Example: Bare metal or VMs
2. Containerization
   - Example: Docker or Kubernetes
3. PaaS
   - Example: Cloud Foundry
4. Serverless and functions
   - Example: OpenWhisk



Developers have many options when deploying their applications to the cloud:

•Traditional development involves deploying applications to bare metal servers or VMs. Bare metal servers enable isolation and single tenancy, and VMs enable shared resources and multi-tenancy. Whenusing traditional deployment, the developers are responsible for deploying and managing all the needed runtimes and dependencies for the application.

•With containers, developers can package applications with runtimes by using a lightweight packaging medium that is called containers. Unlike VMs, which provide hardware virtualization, containers provide operating system-level virtualization.

•PAAS solutions such as Cloud Foundry enable developers to focus on coding and pushing code to a platform that takes care of deployment and scaling. Developers do not need to worry about packaging or maintaining the host that runs the applications.

•Server-less is a way for developers to focus on the development of event-based applications. The application code is broken into separate functions, and each function can be independently triggered by an event or an action, such as an API call.

Cloud deployment models:

The various types of cloud-computing deployment models include public cloud, private cloud and hybrid cloud

Public cloud:

Public clouds are owned and operated by cloud providers that offer rapid access over a public network to affordable computing resources.

Here are key aspects of a public cloud:

• Enables flexible and scalable IAAS for storage and compute services at a moment's notice.

• Enables powerful PAAS for cloud-based application development and deployment environments.

•Gives access to innovative SAAS business apps for applications ranging from customer resource management (CRM) to transaction management and data analytics.

Example : Some of the most common examples of public cloud offerings are: SAAS – Gmail, Microsoft 365, Dropbox, etc… PAAS – Google App Engine, Heroku… IAAS – Microsoft Azure, Amazon Web Services

Private cloud:

A private cloud is an infrastructure that is operated solely for a single organization. Private clouds can take advantage of cloud's efficiencies while providing more control of resources and allowing clients to steer clear of multitenancy.

Here are key aspects of a private cloud:

•Provides self-service interface controls services, which enable IT staff to provision, allocate, and deliver quickly on-demand IT resources.

• Facilitates highly automated management of resource pools for everything from compute capability to storage, analytics, and middleware.

• Provides sophisticated security and governance for a company's specific requirements.

Examples: Some of the largest players in the private cloud market include: Hewlett Packard Enterprise (HPE) -- offers the Helion Cloud Suite software, Helion Cloud System hardware, Helion Managed Private Cloud and Managed Virtual Private Cloud services

Hybrid cloud:

A hybrid cloud uses a private cloud foundation that is combined with the strategic integration and use of public cloud services. Most companies with private clouds evolve to manage workloads across data centers, private clouds, and public clouds, which creates hybrid clouds.

Here are key aspects of a hybrid cloud:

•Enables companies to keep critical applications and sensitive data within a traditional data center environment or private cloud**.**

•Enables taking advantage of public cloud resources like SAAS for the latest applications and IAAS for elastic virtual resources.

• Facilitates portability of data, apps, and services and more choices for deployment models.

Hybrid cloud is a cloud computing environment that uses a mix of on-premises, private cloud and third-party, public cloud services with orchestration between the two platforms.

Used: One of the leading video game manufacturers in the world, SEGA, **is using hybrid cloud** to provide scalable and agile development and test environments for developers that they employ around the world. In doing so, they reached new levels of development performance

Hybrid cloud refers to a mixed computing, storage, and services environment made up of on-premises infrastructure, private cloud services, and a public cloud—such as Amazon Web Services (AWS) or Microsoft Azure—with orchestration among the various platforms. Using a combination of public clouds, on-premises computing, and private clouds in your data center means that you have a hybrid cloud infrastructure.

Public, Private and Hybrid-Cloud Options for Your Business

- Connect via the Internet
- Hard to prevent loss or sharing of information
- Requires little support
- User-friendly
- Inexpensive
- Ideal for smaller companies

- Public and private systems work together
- Information moved between systems may be hacked
- Reasonably priced
- IT can control on-premises storage components

- Connect via company Intranet
- Easy to track and safeguard data
- IT department required
- High initial investment
- High security: Businesses storing sensitive information should use a private-cloud system to minimize hacks