

INTRODUCTION TO CLOUD COMPUTING

PREPARED BY:

DHAVAL R. GANDHI

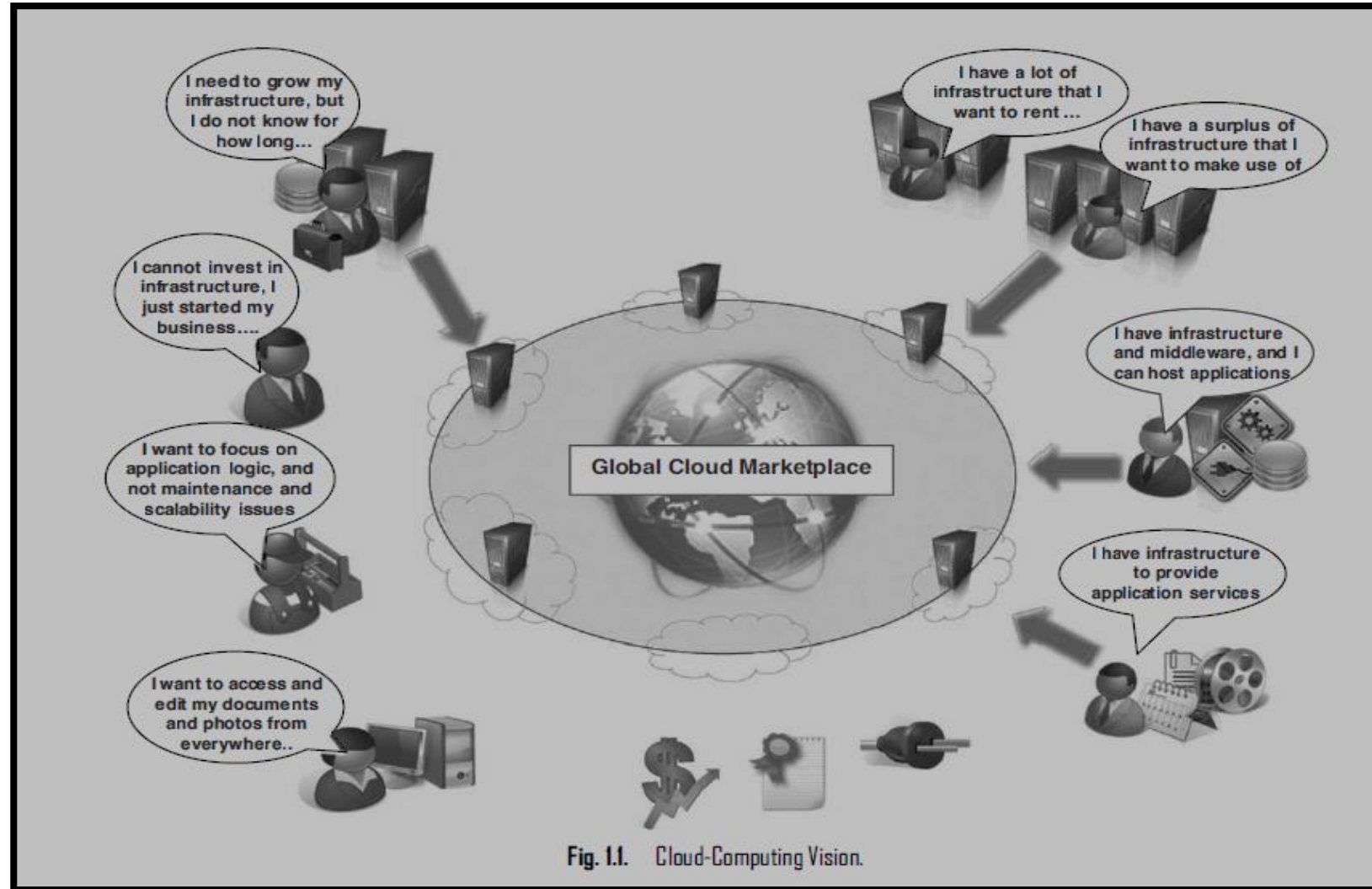
LECT IN IT

DR. S & S. S. GHANDHY COLLEGE OF ENGINEERING & TECHNOLOGY, SURAT

Learning Outcomes:-

- ❑ 1.1 Defining Cloud Computing
- ❑ 1.2 Roots of Cloud Computing
 - ❑ 1.2.1 Mainframes to cloud
 - ❑ 1.2.2 Grid and Utility computing
 - ❑ 1.2.3 Hardware virtualization
- ❑ 1.3 The Cloud Service Models
 - ❑ 1.3.1 Cloud Architecture and Platforms
 - ❑ 1.3.2 IaaS
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- ❑ 1.4 Layers and Types of Clouds
 - ❑ 1.4.1 Deployment Model
 - ❑ 1.4.2 Private cloud, Public cloud and Hybrid cloud
- ❑ 1.5 Desired Features of a Cloud
- ❑ 1.6 Pros and Cons of Cloud computing
- ❑ 1.7 Applications of cloud computing

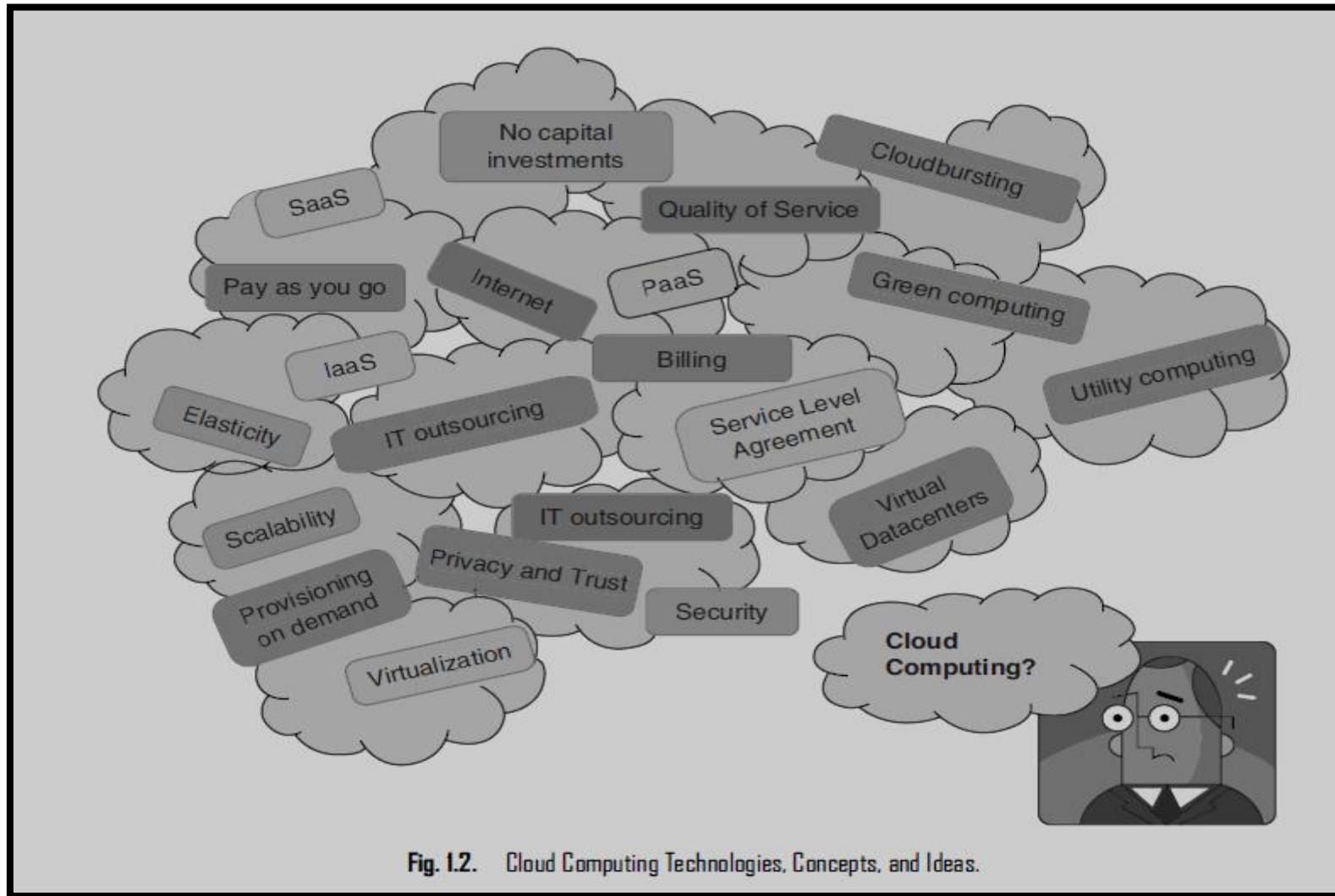
INTRODUCTION TO CLOUD COMPUTING



INTRODUCTION TO CLOUD COMPUTING

- ❑ Cloud computing refers to both the applications delivered as services over the Internet, and the hardware and system software in the datacenters that provide those services.”
- ❑ Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”
- ❑ The term cloud refers to a network or the internet. It is a technology that uses remote servers on the internet to store, manage, and access data online rather than local drives.
- ❑ Cloud computing means storing and accessing the data and programs on remote servers that are hosted on the internet instead of the computer’s hard drive or local server.
- ❑ Cloud computing is also referred to as Internet-based computing, it is a technology where the resource is provided as a service through the Internet to the user.
- ❑ The data which is stored can be files, images, documents, or any other storable document.

INTRODUCTION TO CLOUD COMPUTING



INTRODUCTION TO CLOUD COMPUTING

- ❑ Another important aspect of Cloud computing is its **utility-oriented approach**. More than any other trend in distributed computing, Cloud computing focuses on delivering services with a given pricing model; in most of the cases a **“pay-per-use”** strategy.
- ❑ It makes possible to access online storage, to rent virtual hardware, or to use development platforms and pay only for their effective usage, with no or minimal upfront costs.
- ❑ All these operations can be performed and billed simply by entering the credit card details, and accessing the exposed services through a Web browser.

INTRODUCTION TO CLOUD COMPUTING

- ❑ Our definition of cloud computing is based on five attributes: **multitenancy (shared resources)**, **massive scalability**, **elasticity**, **pay as you go**, and **self-provisioning of resources**.
- ❑ ***Multitenancy (shared resources):-***
 - ❑ Unlike previous computing models, which assumed dedicated resources (i.e., computing facilities dedicated to a single user or owner), cloud computing is based on a business model in which resources are shared (i.e., multiple users use the same resource) at the network level, host level, and application level.
- ❑ ***Massive scalability:-***
 - ❑ Although organizations might have hundreds or thousands of systems, cloud computing provides the ability to scale to tens of thousands of systems, as well as the ability to massively scale bandwidth and storage space.

INTRODUCTION TO CLOUD COMPUTING

❑ *Elasticity:-*

- ❑ Users can rapidly increase and decrease their computing resources as needed, as well as release resources for other uses when they are no longer required.

❑ *Pay as you go:-*

- ❑ Users pay for only the resources they actually use and for only the time they require them.

❑ *Self-provisioning of resources:-*

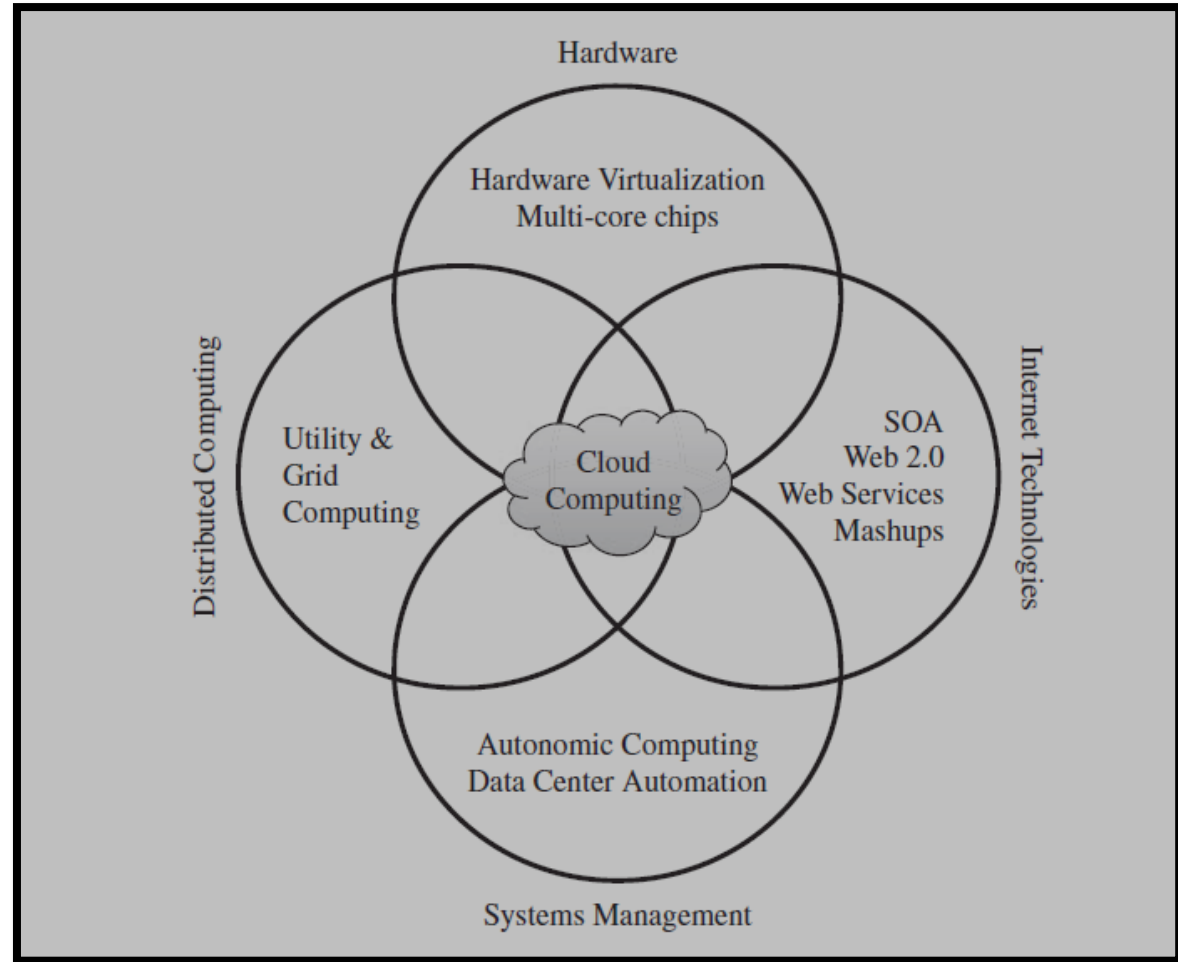
- ❑ Users self-provision resources, such as additional systems (processing capability, software, storage) and network resources.

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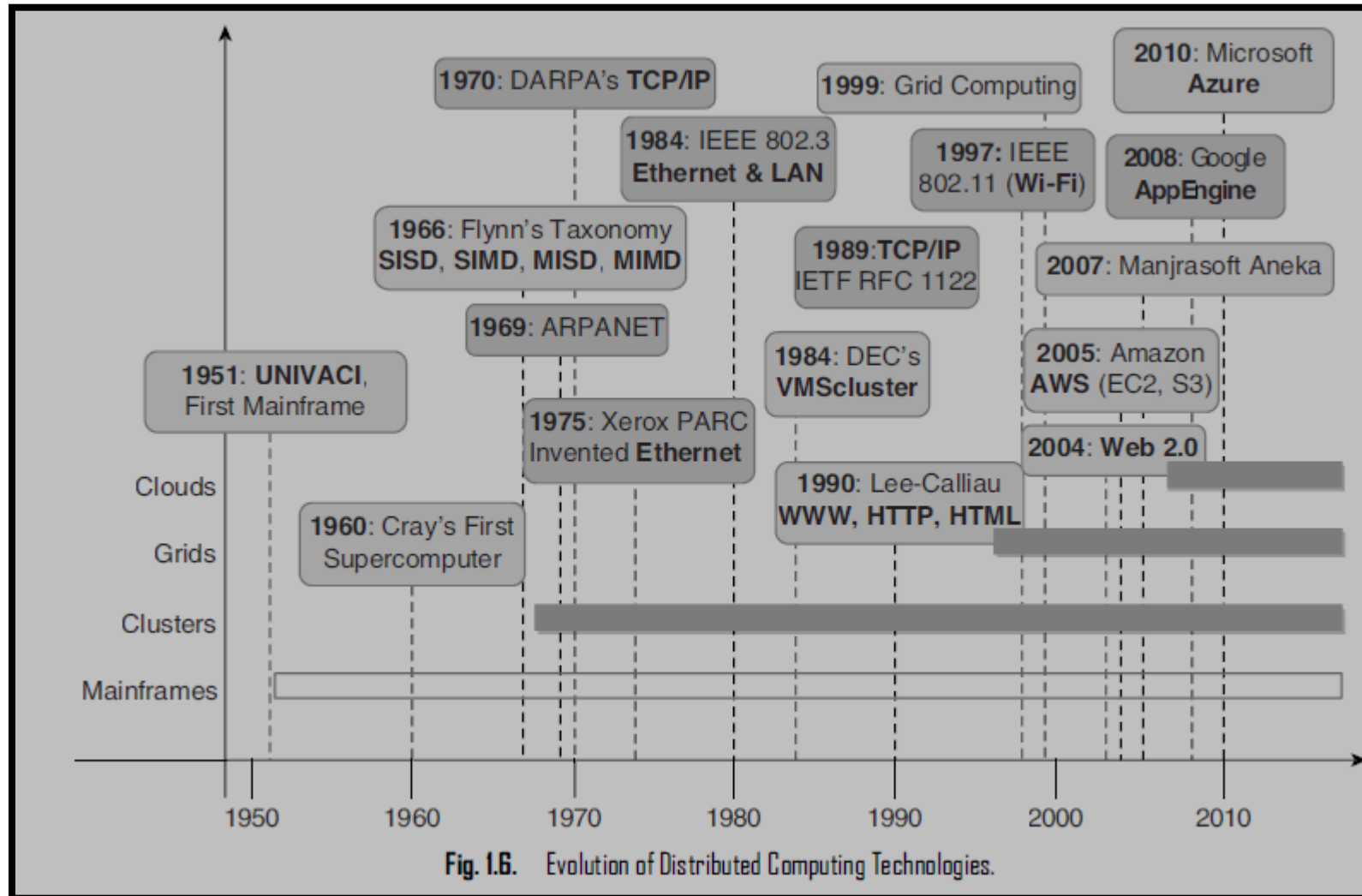
- ❑ The main purpose of cloud computing is to give access to data centers to many users. Users can also access data from a remote server.
- ❑ There are the following operations that we can do using cloud computing:
 - ❑ **Developing new applications and services**
 - ❑ **Storage, back up, and recovery of data**
 - ❑ **Hosting blogs and websites**
 - ❑ **Delivery of software on demand**
 - ❑ **Analysis of data**
 - ❑ **Streaming videos and audios**

ROOTS OF CLOUD COMPUTING

- ❑ From Mainframes To Clouds
- ❑ Soa, Web Services
- ❑ Grid Computing
- ❑ Utility Computing
- ❑ Hardware Virtualization
- ❑ Autonomic Computing



ROOTS OF CLOUD COMPUTING



ROOTS OF CLOUD COMPUTING

❑ From Mainframes To Clouds:-

- ❑ The concept of sharing computing resources traces back to the era of mainframe computers in the 1950s and 1960s. Mainframes were large, powerful machines that multiple users accessed through terminals.
- ❑ This idea of centralized computing laid the groundwork for the idea of shared resources.
- ❑ Mainframe computing is used by large organizations because it can deal with huge amounts of data.
- ❑ Mainframe computers are used for Mainframe computing. They can perform various tasks like processing bulk data and exchanging hardware etc. But Main computing is very expensive.

ROOTS OF CLOUD COMPUTING

❑ From Mainframes To Clouds:-

- ❑ These were the first examples of large computational facilities leveraging multiple processing units.
- ❑ Mainframes were powerful, highly reliable computers specialized for large data movement and massive IO operations.
- ❑ They were mostly used by large organizations for bulk data processing such as online transactions, enterprise resource planning, and other operations involving the processing of significant amount of data.
- ❑ Even though mainframes cannot be considered distributed systems, they were offering large computational power by using multiple processors, which were presented as a single entity to users.
- ❑ One of the most attractive features of mainframes was the ability to be highly reliable computers that were “always on” and capable of tolerating failures transparently.
- ❑ No system shut down was required to replace failed components, and the system could work without interruptions. Batch processing was the main application of mainframes.

ROOTS OF CLOUD COMPUTING

❑ Cluster Computing:-

- ❑ In cluster computing, many computers work together and act as a single entity where each computer linked to the network is called a node.
- ❑ In cluster computing, all the computers are linked together with the help of specialized network connections. Cluster computing can be resized by removing or adding nodes.
- ❑ To manage and handle a large set of data, the networked computers are connected to perform the operations. The group of computers joins as a cluster to simplify the task.

ROOTS OF CLOUD COMPUTING

❑ Grid (Late 1990s - Early 2000s):

- ❑ Grid computing emerged in the late 1990s and early 2000s, emphasizing the pooling of resources for solving complex problems.
- ❑ Grid Computing This involved the pooling of computing resources to solve large-scale problems.
- ❑ It focused on computational power and sharing resources among multiple users.

ROOTS OF CLOUD COMPUTING

❑ Utility Computing (Early 2000s) :-

- ❑ It aimed at harnessing the collective power of disparate computers across networks. Utility computing, inspired by the pay-per-use model of utilities, allowed users to consume computing resources as needed, much like electricity or water.
- ❑ Utility computing is a model where computing resources, such as computation power, storage, and applications, are provided to users on-demand, similar to the way utilities like electricity or water are consumed. Users pay for the resources they use, typically on a subscription or metered usage basis, rather than owning the infrastructure outright.
- ❑ Companies like Amazon and Salesforce started offering services resembling cloud computing.

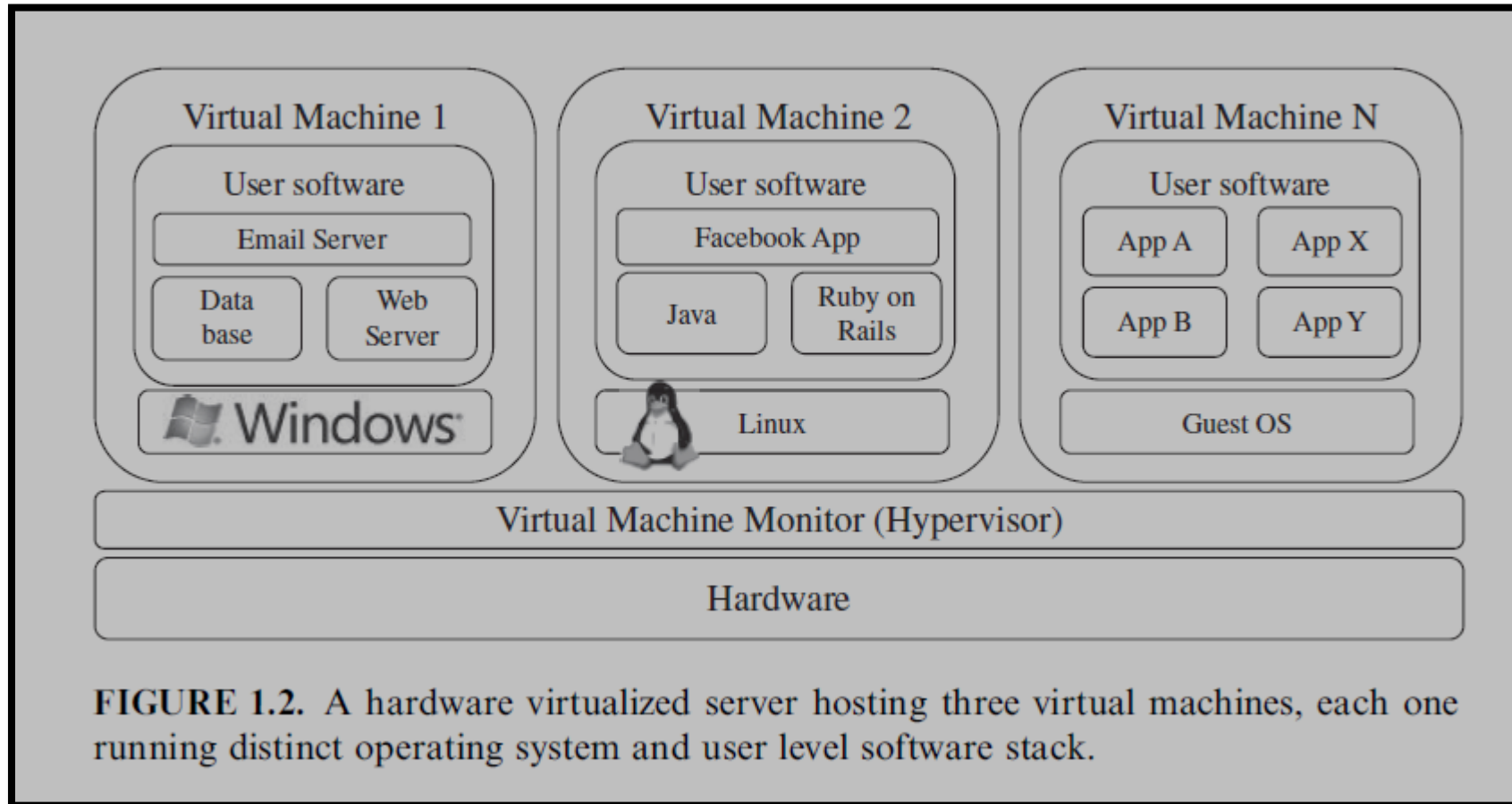
ROOTS OF CLOUD COMPUTING

❑ Hardware Virtualization:-

- ❑ Virtualization is another core technology for Cloud computing.
- ❑ It encompasses a collection of solutions allowing the abstraction of some of the fundamental elements for computing such as: hardware, runtime environments, storage, and networking.
- ❑ Virtualization is essentially a technology that allows creation of different computing environments.
- ❑ These environments are named as virtual, because they simulate the interface that is expected by a guest. The most common example of virtualization is **hardware virtualization**.
- ❑ The idea of virtualizing a computer system's resources, including processors, memory, and I/O devices, has been well established for decades, aiming at improving sharing and utilization of computer systems .
- ❑ Hardware virtualization allows running multiple operating systems and software stacks on a single physical platform.
- ❑ a software layer, the virtual machine monitor (VMM), also called a hypervisor, mediates access to the physical hardware presenting to each guest operating system a virtual machine (VM), which is a set of virtual platform interfaces.
- ❑ This is the base technology that enables Cloud computing solutions delivering virtual server on demands, such as Amazon EC2, RightScale, VMware vCloud, and others.

ROOTS OF CLOUD COMPUTING

❑ Hardware Virtualization:-



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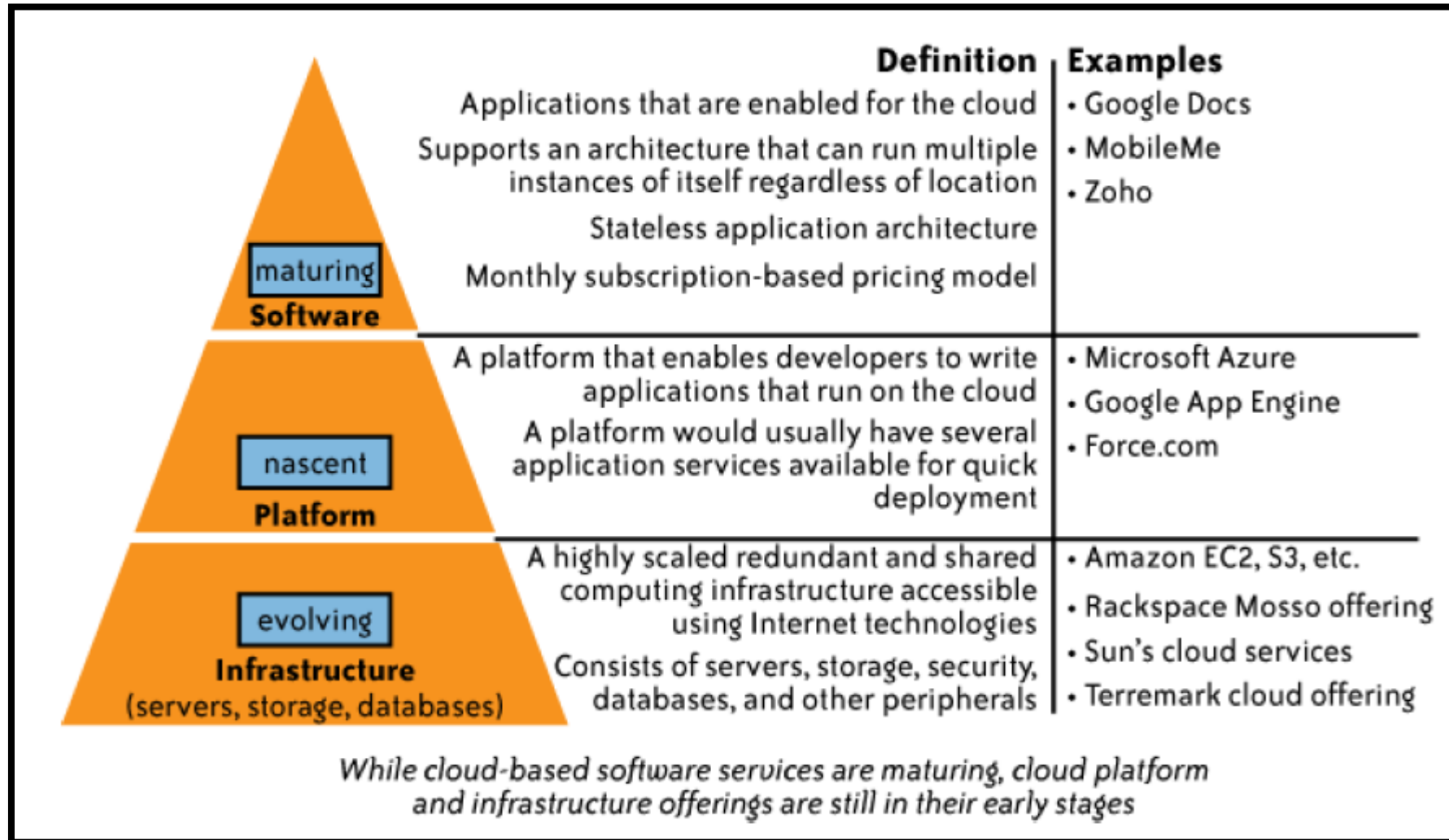
❑ **Service-Oriented Architecture (SOA) and web services:-**

- ❑ As the business grows, there is a large number of implementation of software and hardware requirements, which is difficult to manage. Hence SOA helps to maintain and implement the architecture.
- ❑ SOA is an architectural approach where software components or services are designed to be reusable and interoperable.
- ❑ It breaks down applications into modular, self-contained services that can be accessed and combined to perform larger tasks. SOA promotes flexibility, scalability, and reusability, essential characteristics later reflected in cloud services.
- ❑ **Web Services:** Web services are a standardized way of interoperability between different software applications over the internet.
- ❑ They utilize a set of protocols and standards like XML, SOAP, WSDL, and UDDI to enable communication and data exchange between systems across various platforms. This interoperability was a crucial precursor to the seamless integration and interaction of services in the cloud.

The Cloud Service Models

- ❑ There are the following three types of cloud service models -
- ❑ Infrastructure as a Service (IaaS)
- ❑ Platform as a Service (PaaS)
- ❑ Software as a Service (SaaS)

The Cloud Service Models



The Cloud Service Models

❑ Infrastructure as a Service (IaaS):-

- ❑ It is the most flexible type of cloud service which lets you rent the hardware and contains the basic building blocks for cloud and IT.
- ❑ IaaS is also known as Hardware as a Service (HaaS). It is one of the layers of the cloud computing platform.
- ❑ It allows customers to outsource their IT infrastructures such as servers, networking, processing, storage, virtual machines, and other resources. Customers access these resources on the Internet using a pay-as-per use model.
- ❑ It gives complete control over the hardware that runs your application (servers, VMs, storage, networks & operating systems).
- ❑ It's an instant computing infrastructure, provisioned and managed over the internet.
- ❑ It is almost like the prevailing IT resources with which many IT departments and developers are familiar.
- ❑ **Examples of IaaS are virtual Machines or AWS EC2, Storage or Networking. DigitalOcean, Amazon Web Services (AWS), Microsoft Azure, Google Compute Engine (GCE), Rackspace, and Cisco Metacloud.**

The Cloud Service Models

❑ Characteristics of IaaS:-

- ❑ Resources are available as a service
- ❑ Services are highly scalable
- ❑ Dynamic and flexible
- ❑ GUI and API-based access
- ❑ Automated administrative tasks

The Cloud Service Models

❑ Advantages of IaaS:-

- ❑ **Cost savings:** IaaS is more cost-effective than building your own data center. You pay only for what you need — storage space, CPU power, bandwidth, and other resources. This makes it easier to scale up or down as needed.
- ❑ **On-demand access:** You can instantly provision new resources whenever they're needed without having to invest in new hardware and software or hire additional IT staff members. The cloud provider takes care of all the maintenance and upgrades required to keep your servers online 24/7 with 99 percent uptime guarantees (or better).
- ❑ **Flexibility:** With cloud computing, you can easily add more resources when demand increases without having to upgrade equipment or hire more IT professionals.

The Cloud Service Models

❑ Disadvantages of IaaS:-

- ❑ **Limited infrastructure control:** Although IaaS providers normally handle upkeep, upgrades, and management of the underlying infrastructure, this might also imply that users have less control over the environment and might not be able to make some adjustments.
- ❑ **Security issues:** Users must take responsibility for protecting their data and apps, which can be very demanding.
- ❑ **Restricted access:** Owing to legal regulations, cloud computing may not be available in some states or nations.

The Cloud Service Models

❑ Platform as a Service (PaaS):-

- ❑ PaaS is a cloud service model that gives a ready-to-use development environment where developers can specialize in writing and executing high-quality code to make customized applications.
- ❑ It helps to create an application quickly without managing the underlying infrastructure. For example, when deploying a web application using PaaS, you don't have to install an operating system, web server, or even system updates. However, you can scale and add new features to your services.
- ❑ This cloud service model makes the method of developing and deploying applications simpler and it is more expensive than IaaS but less expensive than SaaS.
- ❑ This helps you be more efficient as you don't get to worry about resource procurement, capacity planning, software maintenance, patching, or any of the opposite undifferentiated work involved in running your application.
- ❑ **Examples of PaaS: Elastic Beanstalk or Lambda from AWS, WebApps, Functions or Azure SQL DB from Azure, Cloud SQL DB from Google Cloud, or Oracle Database Cloud Service from Oracle Cloud.**

The Cloud Service Models

❑ Characteristics of PaaS:-

- ❑ Accessible to various users via the same development application.
- ❑ Integrates with web services and databases.
- ❑ Builds on virtualization technology, so resources can easily be scaled up or down as per the organization's need.
- ❑ Support multiple languages and frameworks.
- ❑ Provides an ability to "Auto-scale".

The Cloud Service Models

❑ Advantages of PaaS:-

- ❑ **Faster development time** – You don't have to build infrastructure before you can start coding.
- ❑ **Reduced costs** – Your IT department won't need to spend time on manual deployments or server management.
- ❑ **Enhanced security** – PaaS providers lock down your applications so that they're more secure than traditional web apps.
- ❑ **High availability** – A PaaS provider can make sure your application is always available, even during hardware failures or maintenance windows.

The Cloud Service Models

❑ Disadvantages of PaaS:-

- ❑ **Limited infrastructure control:** Although PaaS providers normally handle upkeep, upgrades, and management of the underlying infrastructure, this might also imply that users have less control over the environment and may not be able to make certain adjustments.
- ❑ **Dependency on the provider:** Customers rely on the PaaS provider to maintain the platform's scalability, availability, and dependability; however, this poses a risk if the provider encounters disruptions or other problems.
- ❑ **Restricted flexibility:** The usefulness of PaaS solutions for some organizations may be limited if they cannot handle particular workloads or applications.

The Cloud Service Models

❑ Software as a Service (SaaS):-

- ❑ SaaS delivers software applications over the internet, eliminating the need for users to install, maintain, or run the applications on their devices.
- ❑ SaaS provides you with a complete product that is run and managed by the service provider.
- ❑ The software is hosted online and made available to customers on a subscription basis or for purchase in this cloud service model.
- ❑ With a SaaS offering, you don't need to worry about how the service is maintained or how the underlying infrastructure is managed. It would help if you believed how you'd use that specific software.
- ❑ **Examples of SaaS: Microsoft Office 365, Oracle ERP/HCM Cloud, Salesforce, Gmail, or Dropbox.**

The Cloud Service Models

❑ Characteristics of SaaS:-

- ❑ Managed from a central location
- ❑ Hosted on a remote server
- ❑ Accessible over the internet
- ❑ Users are not responsible for hardware and software updates. Updates are applied automatically.
- ❑ The services are purchased on the pay-as-per-use basis

The Cloud Service Models

❑ Advantages of SaaS:-

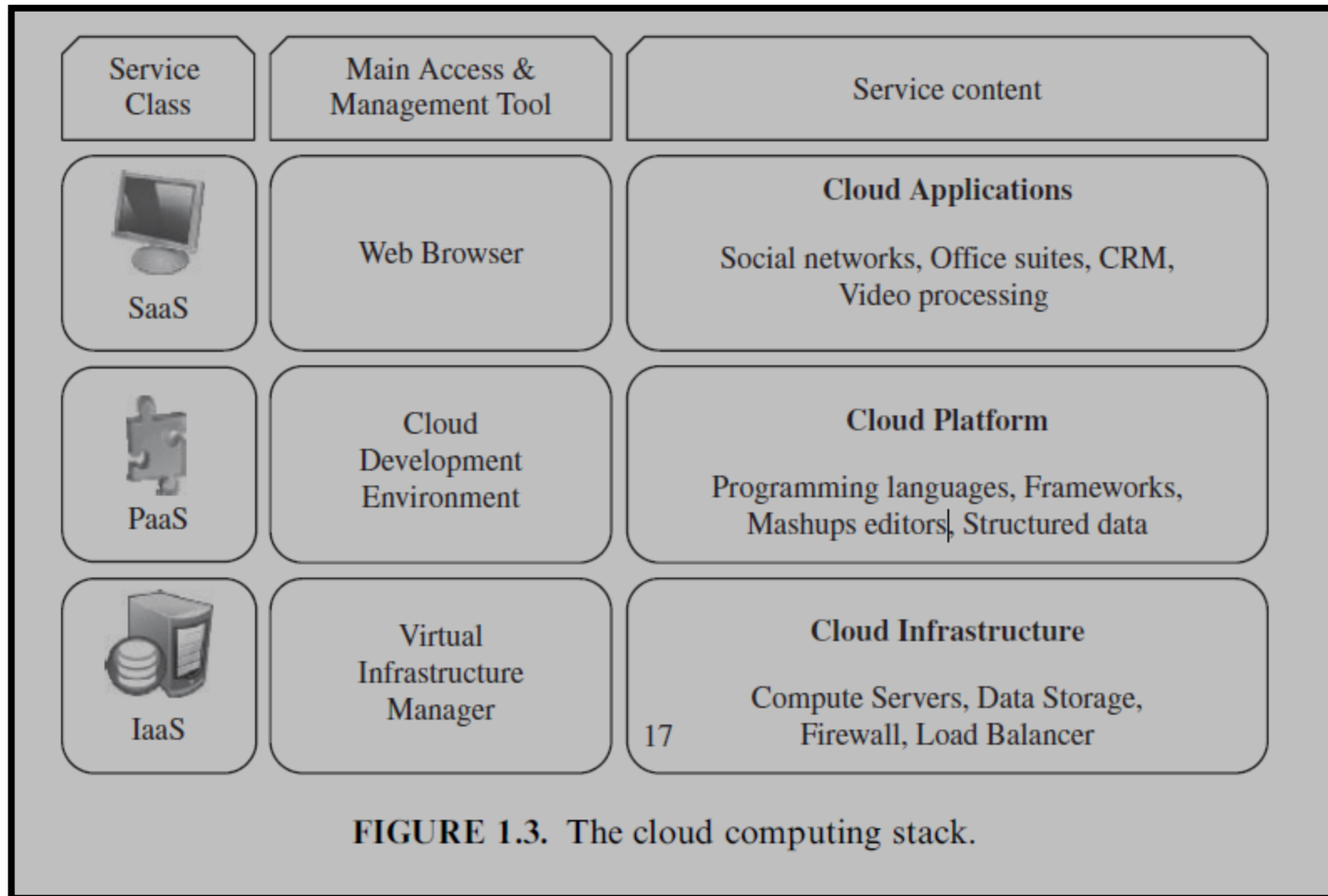
- ❑ **Lower Total Cost of Ownership:** One of the biggest benefits of SaaS is that it lowers your total cost of ownership (TCO) by eliminating hardware expenses and maintenance costs.
- ❑ **Better Security:** Another benefit of SaaS is improved security. Since most services are hosted on secure servers in data centers with 24/7 monitoring, there's less chance for hackers to gain access or steal your data.
- ❑ **Multidevice support:** SaaS services can be accessed from any device such as desktops, laptops, tablets, phones, and thin clients.

The Cloud Service Models

❑ Disadvantages of SaaS:-

- ❑ **Limited customization:** SaaS solutions are usually less customizable than software that is hosted on-premises. As a result, customers may not be able to customize the program to meet their unique requirements and may be forced to operate within the platform limitations of the SaaS provider.
- ❑ **Dependency on Internet connectivity:** Since SaaS solutions are usually cloud-based, a steady Internet connection is necessary for them to operate as intended. Users who need to access the software offline or in places with spotty connectivity may find this troublesome.
- ❑ **Security issues:** Although SaaS providers are in charge of ensuring the security of the information kept on their servers, security incidents and data breaches are still a possibility.
- ❑ **Limited control over data:** Organizations who must maintain stringent control over their data for regulatory or other reasons may be concerned that SaaS providers may have access to a user's data.

The Cloud Service Models

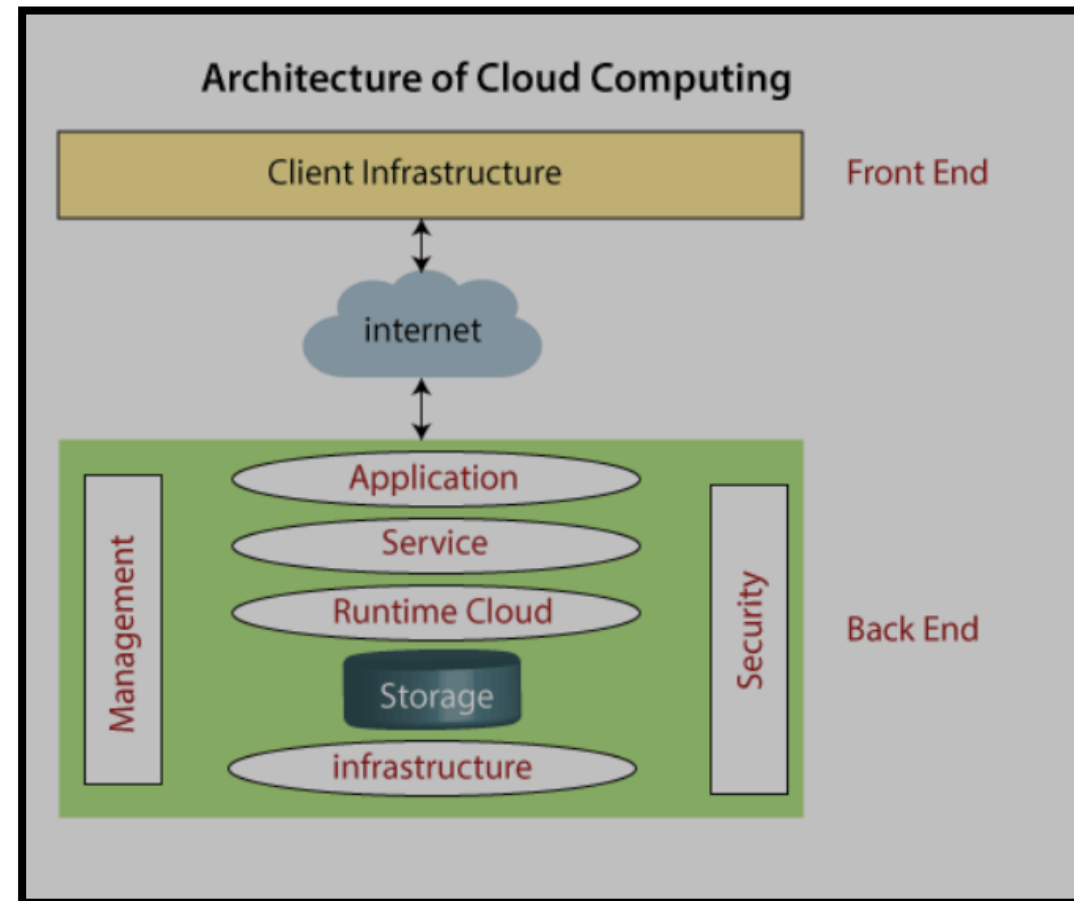


IaaS Vs PaaS Vs SaaS

IaaS	Paas	SaaS
It provides a virtual data center to store information and create platforms for app development, testing, and deployment.	It provides virtual platforms and tools to create, test, and deploy apps.	It provides web software and apps to complete business tasks.
It provides access to resources such as virtual machines, virtual storage, etc.	It provides runtime environments and deployment tools for applications.	It provides software as a service to the end-users.
It is used by network architects.	It is used by developers.	It is used by end users.
IaaS provides only Infrastructure.	PaaS provides Infrastructure+Platform.	SaaS provides Infrastructure Platform +Software.

Cloud Architecture:

- ❑ Cloud computing architecture is a combination of service-oriented architecture and event-driven architecture.
- ❑ Cloud computing architecture is divided into the following two parts -
 - ❑ Front End
 - ❑ Back End



Cloud Architecture:

❑Front End:-

- ❑The front end is used by the client.
- ❑It contains client-side interfaces and applications that are required to access the cloud computing platforms.
- ❑The front end includes web servers (including Chrome, Firefox, internet explorer, etc.), thin & fat clients, tablets, and mobile devices.

❑Back End:-

- ❑The back end is used by the service provider.
- ❑It manages all the resources that are required to provide cloud computing services.
- ❑It includes a huge amount of data storage, security mechanism, virtual machines, deploying models, servers, traffic control mechanisms, etc.

Cloud Architecture:

- ❑ There are the following components of cloud computing architecture -
- ❑ **Client Infrastructure:** It is a Front end component. It provides GUI (Graphical User Interface) to interact with the cloud.
- ❑ **Application:** It may be any software or platform that a client wants to access.
- ❑ **Service:** A Cloud Services manages that which type of service you access according to the client's requirement.
- ❑ i. **Software as a Service (SaaS)** – It is also known as cloud application services. Mostly, SaaS applications run directly through the web browser means we do not require to download and install these applications.
- ❑ ii. **Platform as a Service (PaaS)** – It is also known as cloud platform services. It is quite similar to SaaS, but the difference is that PaaS provides a platform for software creation, but using SaaS, we can access software over the internet without the need of any platform.
- ❑ iii. **Infrastructure as a Service (IaaS)** – It is also known as cloud infrastructure services. It is responsible for managing applications data, middleware, and runtime environments.

Cloud Architecture:

- ❑ **Runtime Cloud:** It provides the execution and runtime environment to the virtual machines.
- ❑ **Storage:-** Storage is one of the most important components of cloud computing. It provides a huge amount of storage capacity in the cloud to store and manage data.
- ❑ **Infrastructure:** It provides services on the host level, application level, and network level. Cloud infrastructure includes hardware and software components such as servers, storage, network devices, virtualization software, and other storage resources that are needed to support the cloud computing model.
- ❑ **Management:** Management is used to manage components such as application, service, runtime cloud, storage, infrastructure, and other security issues in the backend and establish coordination between them.
- ❑ **Security:** It is an in-built back end component of cloud computing. It implements a security mechanism in the back end.
- ❑ **Internet:** It is medium through which front end and back end can interact and communicate with each other.

Cloud Platforms:

- ❑ Cloud platforms, on the other hand, are the providers of the underlying infrastructure, services, and tools necessary for building and deploying applications and services in the cloud. Major cloud platforms include:
- ❑ **Amazon Web Services (AWS):** Offers a wide range of services, including computing power, storage options, databases, machine learning, and more.
- ❑ **Microsoft Azure:** Provides services for computing, analytics, databases, networking, AI, and developer tools, integrated with Microsoft products.
- ❑ **Google Cloud Platform (GCP):** Offers computing, storage, databases, machine learning, analytics, and various tools for application development and deployment.
- ❑ **IBM Cloud:** Provides IaaS, PaaS, and SaaS solutions along with AI, blockchain, and other specialized services.
- ❑ Each cloud platform has its unique set of services and strengths, catering to different use cases, industries, and preferences of developers and businesses.

Layers and Types of cloud

Layers of cloud computing:-

- ❑ **Infrastructure as a Service (IaaS):** At the bottom layer, IaaS provides virtualized computing resources over the internet. Users can rent virtual machines, storage, and networking infrastructure on a pay-as-you-go basis.
- ❑ This model allows users to have more control over the operating system, applications, and other software components.
- ❑ **Examples: Amazon Web Services (AWS) EC2, Microsoft Azure Virtual Machines, Google Cloud Platform Compute Engine.**
- ❑ **Platform as a Service (PaaS):** PaaS abstracts away even more of the underlying infrastructure, focusing on providing a platform that allows users to develop, run, and manage applications without dealing with the complexities of the underlying hardware and software.
- ❑ It typically includes tools and services for application development, such as databases, middleware, and development frameworks.
- ❑ **Examples: Heroku, Google App Engine, Microsoft Azure App Service.**

Layers and Types of cloud

Layers of cloud computing:-

- ❑ **Software as a Service (SaaS):** At the top layer, SaaS provides complete applications over the internet on a subscription basis. Users can access the software through a web browser without needing to install, manage, or maintain any infrastructure or software components.
- ❑ SaaS applications are ready-to-use and often cover a broad range of business functions.
- ❑ **Examples: Salesforce, Microsoft 365, Google Workspace.**

Layers and Types of cloud

Cloud Deployment model:-

- ❑ It works as your virtual computing environment with a choice of deployment model depending on how much data you want to store and who has access to the Infrastructure.
- ❑ A cloud deployment model essentially defines where the infrastructure for your deployment resides and determines who has ownership and control over that infrastructure. It also determines the cloud's nature and purpose.
- ❑ Cloud deployment models can be divided into five main types
 - ❑ Public Cloud
 - ❑ Private Cloud
 - ❑ Hybrid Cloud
 - ❑ Multi-Cloud
 - ❑ Community cloud

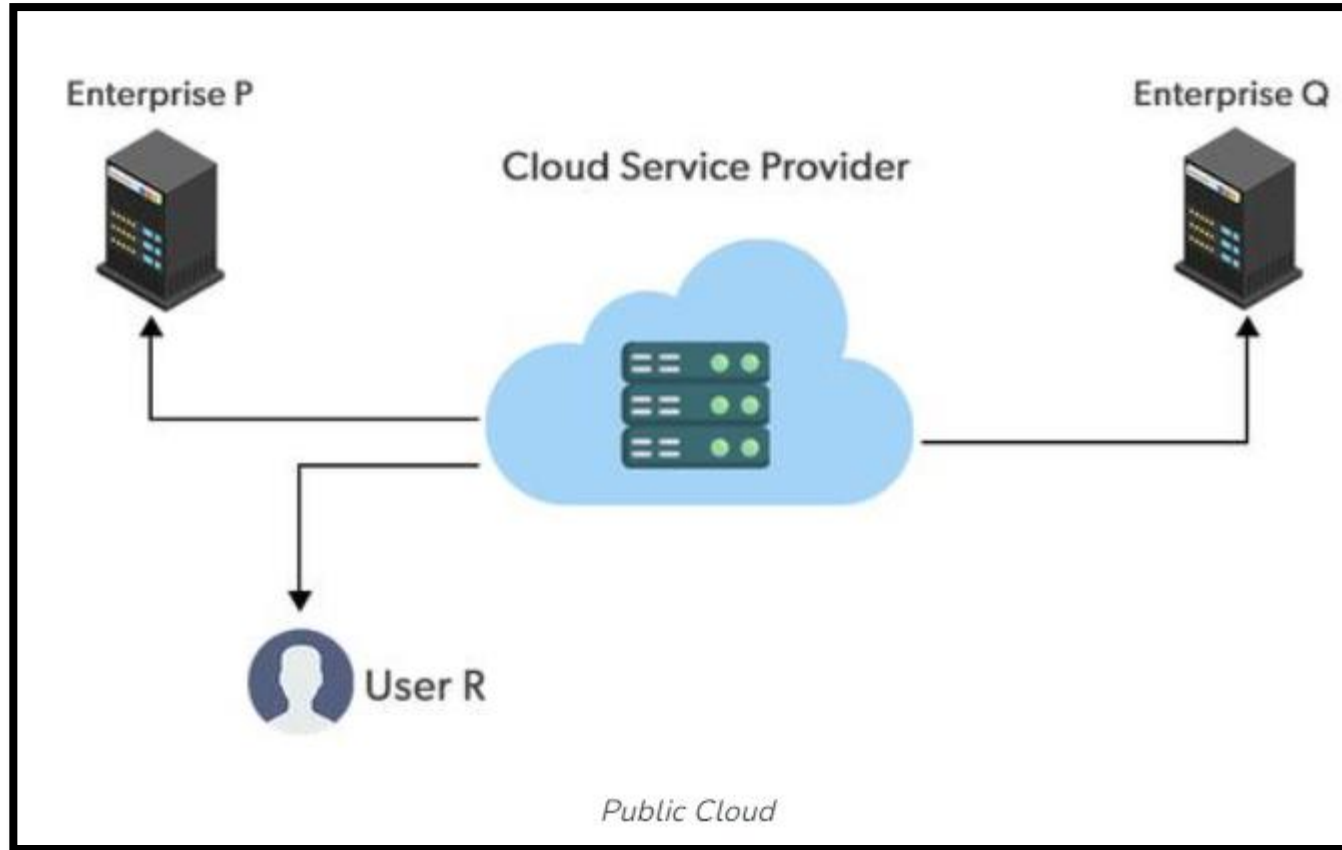
Layers and Types of cloud

Public Cloud:-

- ❑ The public cloud makes it possible for anybody to access systems and services.
- ❑ The public cloud is one in which cloud infrastructure services are provided over the internet to the general people or major industry groups.
- ❑ The infrastructure in this cloud model is owned by the entity that delivers the cloud services, not by the consumer.
- ❑ It is a type of cloud hosting that allows customers and users to easily access systems and services.
- ❑ The public cloud may be less secure as it is open to everyone.
- ❑ In this arrangement, storage backup and retrieval services are given for free, as a subscription, or on a per-user basis.
- ❑ **For example, Amazon EC2 , Google App Engine, Microsoft Azure and IBM Cloud.**

Layers and Types of cloud

Public Cloud:-



Layers and Types of cloud

Advantages of the Public Cloud Model:-

- ❑ **Minimal Investment:** Because it is a pay-per-use service, there is no substantial upfront fee, making it excellent for enterprises that require immediate access to resources.
- ❑ **No setup cost:** The entire infrastructure is fully subsidized by the cloud service providers, thus there is no need to set up any hardware.
- ❑ **Infrastructure Management is not required:** Using the public cloud does not necessitate infrastructure management.
- ❑ **No maintenance:** The maintenance work is done by the service provider (not users).
- ❑ **Dynamic Scalability:** To fulfill your company's needs, on-demand resources are accessible.

Disadvantages of the Public Cloud Model:-

- ❑ **Less secure:** Public cloud is less secure as resources are public so there is no guarantee of high-level security.
- ❑ **Low customization:** It is accessed by many public so it can't be customized according to personal requirements.

Layers and Types of cloud

Private Cloud:-

- ❑ It means that it will be integrated with your data center and managed by your IT team. Alternatively, you can also choose to host it externally.
- ❑ The private cloud offers bigger opportunities that help meet specific organizations' requirements when it comes to customization.
- ❑ It's also a wise choice for mission-critical processes that may have frequently changing requirements.
- ❑ The cloud platform is implemented in a cloud-based secure environment that is protected by powerful firewalls and under the supervision of an organization's IT department.
- ❑ The private cloud gives greater flexibility of control over cloud resources.
- ❑ **For example, Amazon Web Services, Microsoft Azure, Google Cloud Platform, Dell and Cisco**

Layers and Types of cloud

Private Cloud:-

- ❑ It has two types:-

Dedicated:-

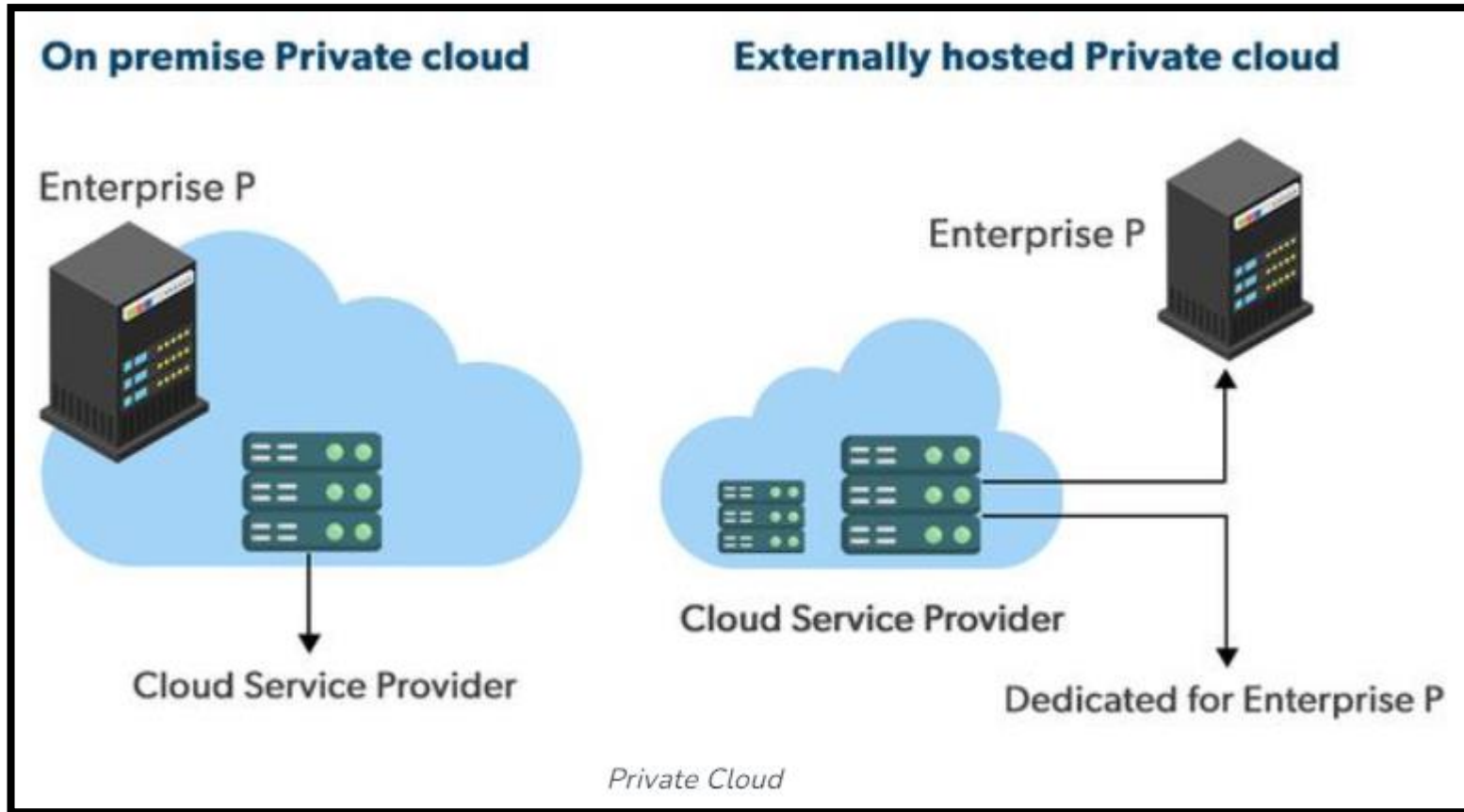
- ❑ Private clouds hosted within a customer-owned data center or at a collocation facility, and operated by internal IT departments.

Managed:-

- ❑ Private cloud infrastructure owned by a customer and managed by a vendor.

Layers and Types of cloud

Private Cloud:-



Layers and Types of cloud

Private Cloud:-

Advantages of the Private Cloud Model:-

- ❑ **Better Control:** You are the sole owner of the property. You gain complete command over service integration, IT operations, policies, and user behavior.
- ❑ **Data Security and Privacy:** It's suitable for storing corporate information to which only authorized staff have access. By segmenting resources within the same infrastructure, improved access and security can be achieved.
- ❑ **Supports Legacy Systems:** This approach is designed to work with legacy systems that are unable to access the public cloud.
- ❑ **Customization:** Unlike a public cloud deployment, a private cloud allows a company to tailor its solution to meet its specific needs.

Disadvantages of the Private Cloud Model:-

- ❑ **Less scalable:** Private clouds are scaled within a certain range as there is less number of clients.
- ❑ **Costly:** Private clouds are more costly as they provide personalized facilities.

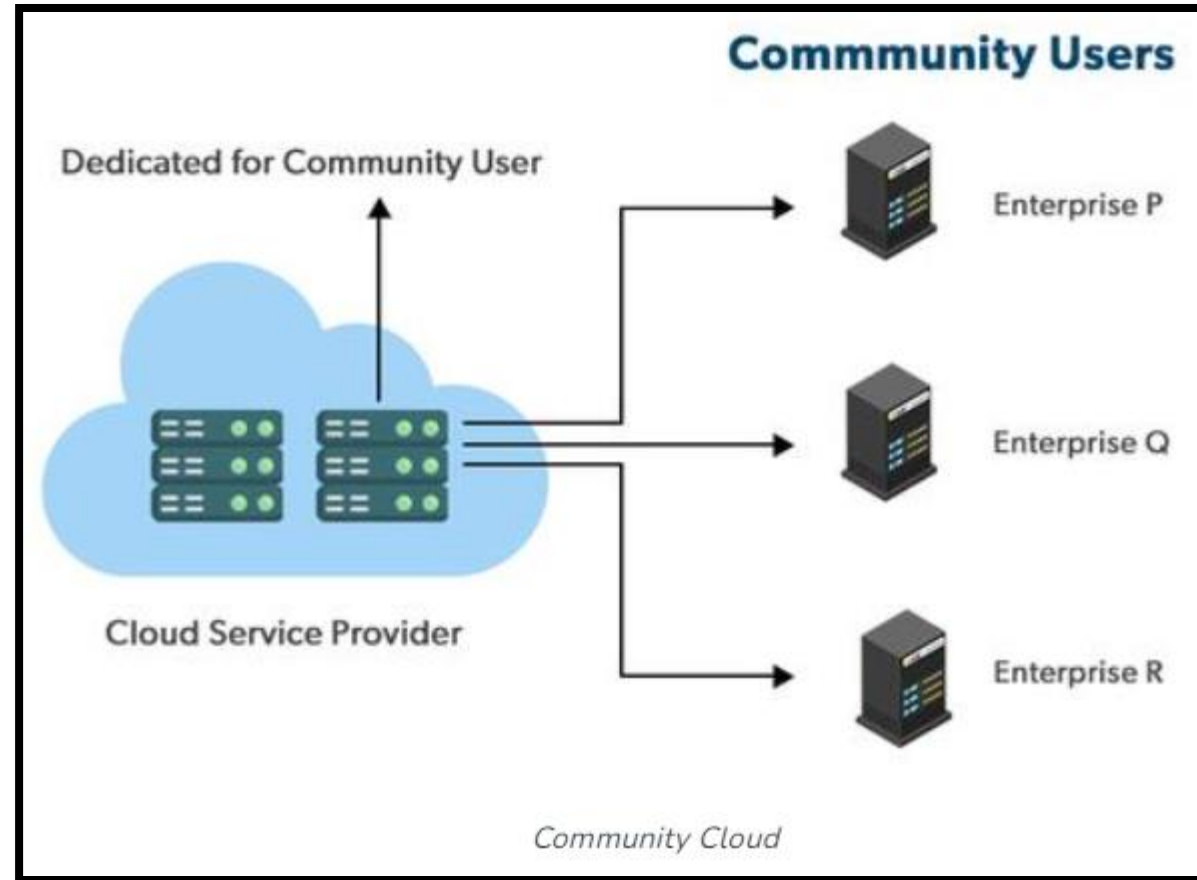
Layers and Types of cloud

Community Cloud:-

- ❑ The community Deployment Model is somewhat similar to the Private cloud. In the private cloud, only one user or organization owns the cloud server.
- ❑ In Community Cloud, several companies with the same backgrounds share the cloud server.
- ❑ If all organizations or companies have the same set of security protocols and performance requirements, and goals, this multi-tenant architecture can help them save cost and boost efficiency.
- ❑ This model can be used in the case of project development, implementation, and maintenance.
- ❑ It is a distributed system that is created by integrating the services of different clouds to address the specific needs of a community, industry, or business.
- ❑ It is generally managed by a third party or by the combination of one or more organizations in the community.

Layers and Types of cloud

Community Cloud:-



Layers and Types of cloud

Community Cloud:-

Advantages of the Community Cloud Model:-

- ❑ **Cost Effective:** It is cost-effective because the cloud is shared by multiple organizations or communities.
- ❑ **Security:** Community cloud provides better security.
- ❑ **Shared resources:** It allows you to share resources, infrastructure, etc. with multiple organizations.
- ❑ **Collaboration and data sharing:** It is suitable for both collaboration and data sharing.

Disadvantages of the Community Cloud Model:-

- ❑ **Limited Scalability:** Community cloud is relatively less scalable as many organizations share the same resources according to their collaborative interests.
- ❑ **Rigid in customization:** As the data and resources are shared among different organizations according to their mutual interests if an organization wants some changes according to their needs they cannot do so because it will have an impact on other organizations.

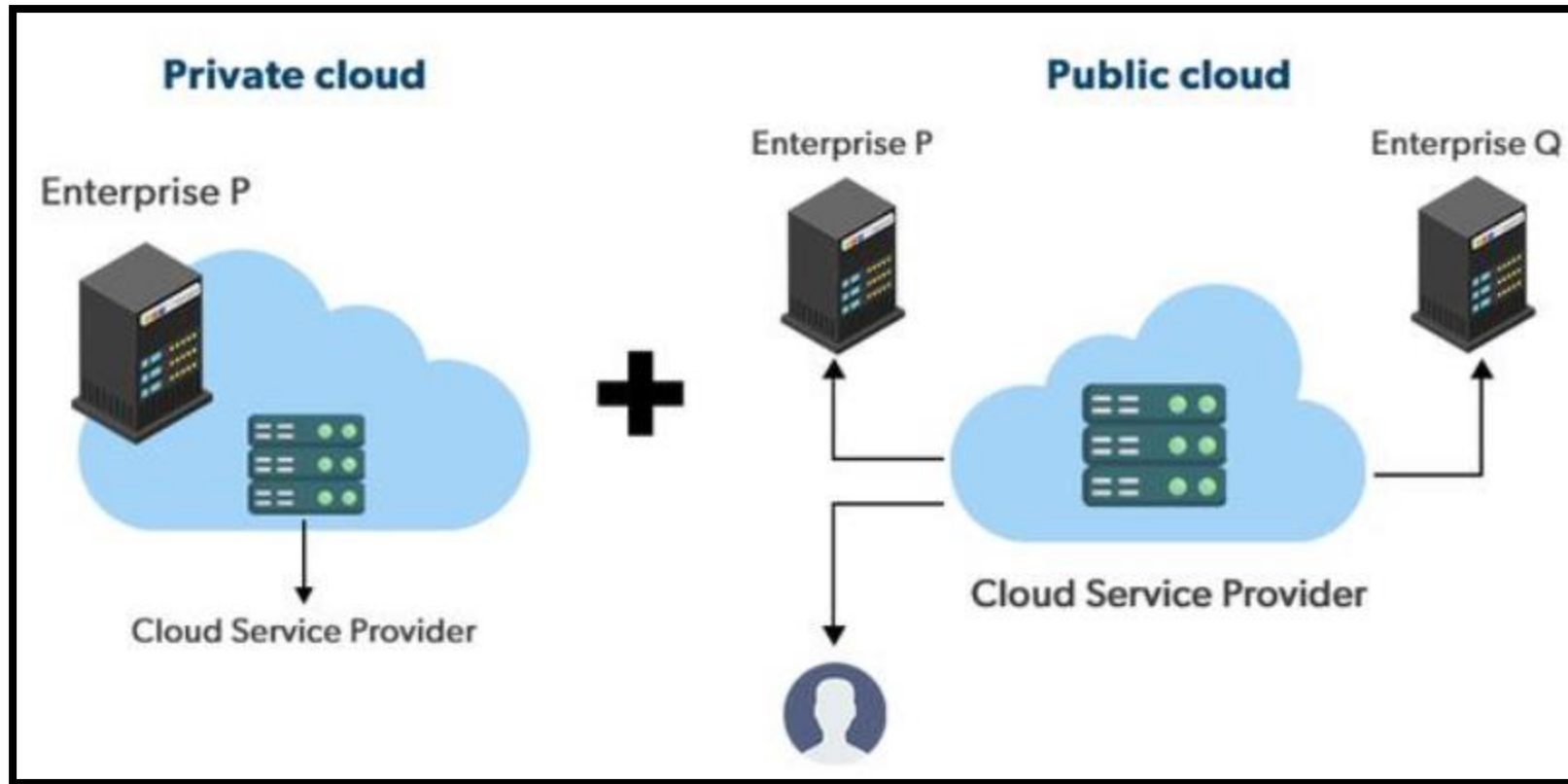
Layers and Types of cloud

Hybrid Cloud:-

- ❑ The Hybrid Cloud is a combination of both public and private clouds.
- ❑ Very few companies and organizations can migrate their tech stack to cloud computing rapidly in one go.
- ❑ Hence, Cloud vendors came up with a hybrid cloud that offers a smooth transition with public and private cloud facilities.
- ❑ They keep the sensitive data in the private cloud and non-sensitive data in the public cloud.
- ❑ With a hybrid solution, you may host the app in a safe environment while taking advantage of the public cloud's cost savings.
- ❑ Organizations can move data and applications between different clouds using a combination of two or more cloud deployment methods, depending on their needs.

Layers and Types of cloud

Hybrid Cloud:-



Layers and Types of cloud

Hybrid Cloud:-

Advantages of the Hybrid Cloud Model:-

- ❑ **Flexibility and control:** Businesses with more flexibility can design personalized solutions that meet their particular needs.
- ❑ **Cost:** Because public clouds provide scalability, you'll only be responsible for paying for the extra capacity if you require it.
- ❑ **Security:** Because data is properly separated, the chances of data theft by attackers are considerably reduced.

Disadvantages of the Hybrid Cloud Model:-

- ❑ **Difficult to manage:** Hybrid clouds are difficult to manage as it is a combination of both public and private cloud. So, it is complex.
- ❑ **Slow data transmission:** Data transmission in the hybrid cloud takes place through the public cloud so latency occurs.

Desire Features of cloud

- ❑ multitenancy (shared resources),
 - ❑ massive scalability,
 - ❑ elasticity,
 - ❑ pay as you go,
 - ❑ self-provisioning of resources
-
- ❑ *Multitenancy (shared resources):-*
 - ❑ Unlike previous computing models, which assumed dedicated resources (i.e., computing facilities dedicated to a single user or owner), cloud computing is based on a business model in which resources are shared (i.e., multiple users use the same resource) at the network level, host level, and application level.

Desire Features of cloud

❑ *Massive scalability:-*

- ❑ Although organizations might have hundreds or thousands of systems, cloud computing provides the ability to scale to tens of thousands of systems, as well as the ability to massively scale bandwidth and storage space.

❑ *Elasticity:-*

- ❑ Users can rapidly increase and decrease their computing resources as needed, as well as release resources for other uses when they are no longer required.

❑ *Pay as you go:-*

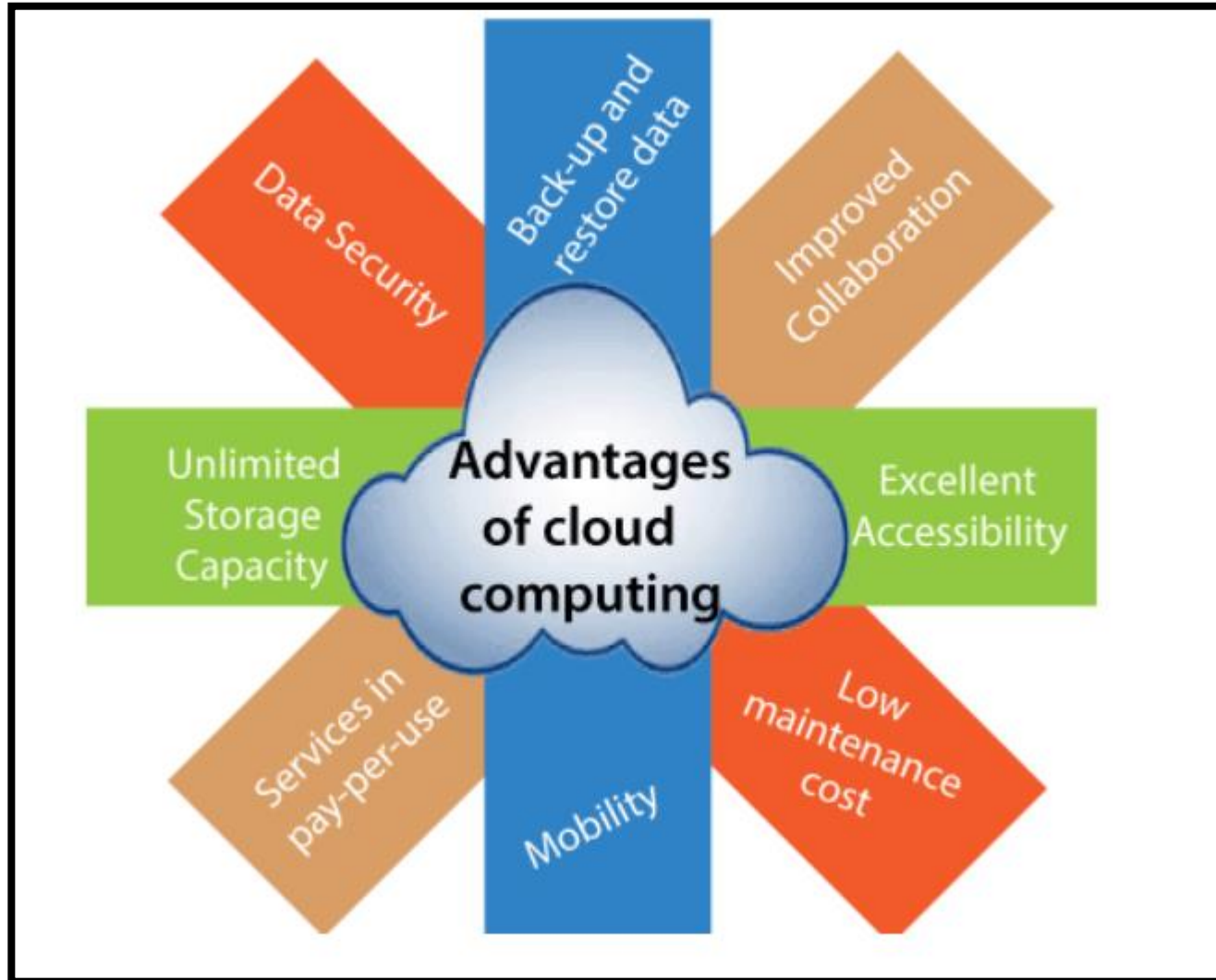
- ❑ Users pay for only the resources they actually use and for only the time they require them.

❑ *Self-provisioning of resources:-*

- ❑ Users self-provision resources, such as additional systems (processing capability, software, storage) and network resources.

Advantages and Disadvantages of Cloud Computing:-

□ Advantages:-



Advantages and Disadvantages of Cloud Computing:-

Advantages:-

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.

Improved collaboration

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

Excellent accessibility

- ❑ Cloud allows us to quickly and easily access store information anywhere, anytime in the whole world, using an internet connection.
- ❑ An internet cloud infrastructure increases organization productivity and efficiency by ensuring that our data is always accessible.

Low maintenance cost

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

Advantages and Disadvantages of Cloud Computing:-

Advantages:-

Mobility

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

API 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.

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.

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.

Advantages and Disadvantages of Cloud Computing:-

Disadvantages:-

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.

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.

Advantages and Disadvantages of Cloud Computing:-

Disadvantages:-

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.

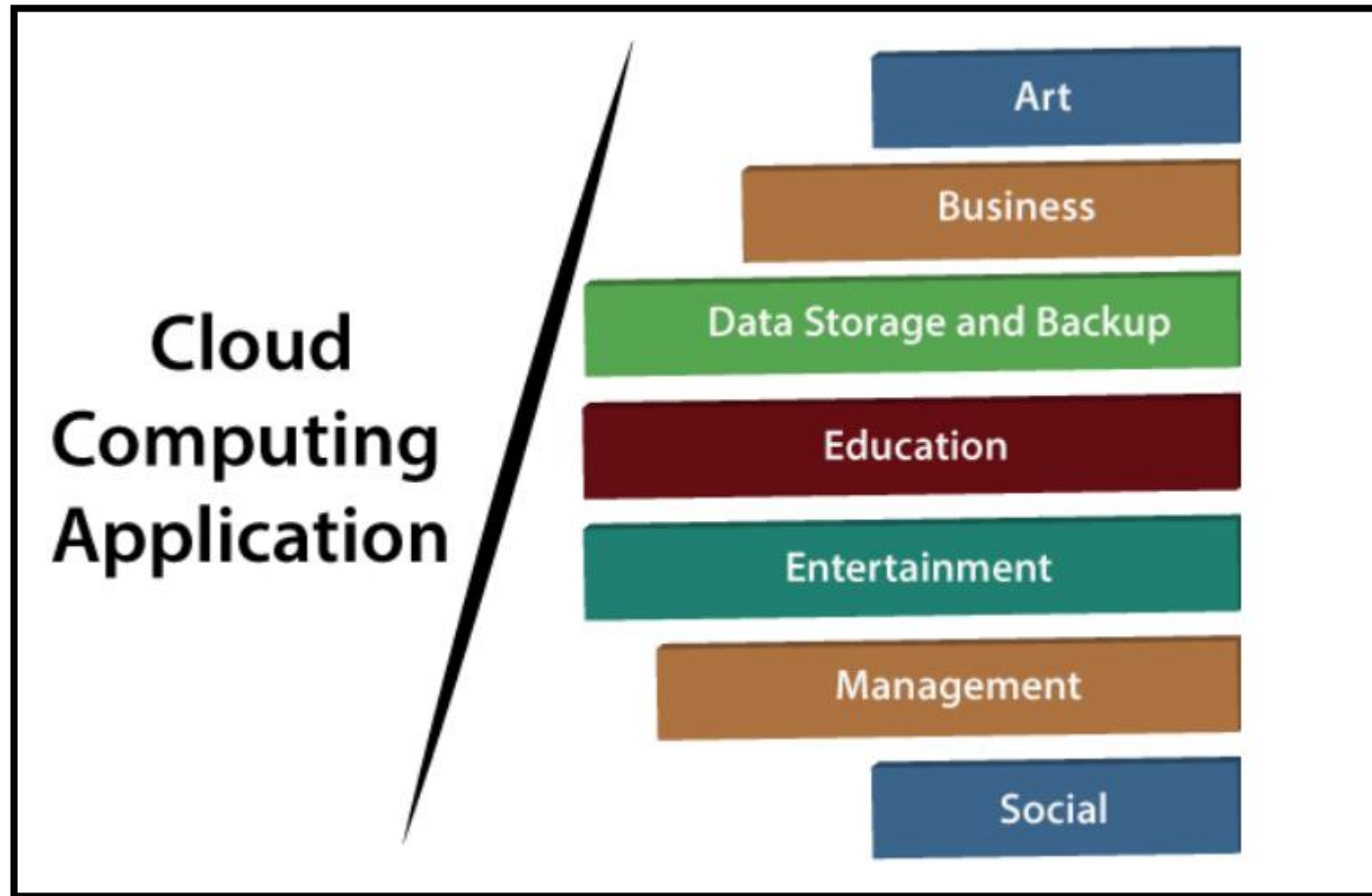
Security:-

- ❑ 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.

Downtime

- ❑ We can't access the data if there is downtime (internet loss at the cloud provider's end). Other than this, downtime also includes cloud providers that may face power loss, service maintenance, etc.

Applications of Cloud Computing:-



Applications of Cloud Computing:-

Art Applications:-

Cloud computing offers various art applications for quickly and easily design attractive cards, booklets, and images. Some most commonly used cloud art applications are given below:

Moo

- ❑ Moo is one of the best cloud art applications. It is used for designing and printing business cards, postcards, and mini cards.

Vistaprint

- ❑ Vistaprint allows us to easily design various printed marketing products such as business cards, Postcards, Booklets, and wedding invitations cards.

Adobe Creative Cloud

- ❑ Adobe creative cloud is made for designers, artists, filmmakers, and other creative professionals.
- ❑ It is a suite of apps which includes PhotoShop image editing programming, Illustrator, InDesign, TypeKit, Dreamweaver, XD, and Audition.

Applications of Cloud Computing:-

Business Applications

Business applications are based on cloud service providers. There are the following business applications of cloud computing -

MailChimp

MailChimp is an email publishing platform which provides various options to design, send, and save templates for emails.

Salesforce

Salesforce platform provides tools for sales, service, marketing, e-commerce, and more. It also provides a cloud development platform.

Chatter

Chatter helps us to share important information about the organization in real time.

Paypal

Paypal offers the simplest and easiest online payment mode using a secure internet account. Paypal accepts the payment through debit cards, credit cards, and also from Paypal account holders.

Applications of Cloud Computing:-

Data Storage and Backup Applications

Cloud computing allows us to store information (data, files, images, audios, and videos) on the cloud and access this information using an internet connection.

A list of data storage and backup applications in the cloud are given below -

Box.com

Box provides an online environment for secure content management, workflow, and collaboration. It allows us to store different files such as Excel, Word, PDF, and images on the cloud.

Mozy

Mozy provides powerful online backup solutions for our personal and business data. It schedules automatic back up for each day at a specific time.

Google G Suite

Google G Suite is one of the best cloud storage and backup applications. It includes Google Calendar, Docs, Forms, Google+, Hangouts, as well as cloud storage and tools for managing cloud apps.

Applications of Cloud Computing:-

Education Applications:-

Cloud computing in the education sector becomes very popular. It offers various online distance learning platforms and student information portals to the students. There are the following education applications offered by the cloud -

Google Apps for Education

Google Apps for Education is the most widely used platform for free web-based email, calendar, documents, and collaborative study.

Chromebooks for Education

Chromebook for Education is one of the most important Google's projects. It is designed for the purpose that it enhances education innovation.

AWS in Education

AWS cloud provides an education-friendly environment to universities, community colleges, and schools.

Entertainment Applications

Entertainment industries use a multi-cloud strategy to interact with the target audience.

Applications of Cloud Computing:-

Social Applications:-

Social cloud applications allow a large number of users to connect with each other using social networking applications such as Facebook, Twitter, LinkedIn, etc.

Facebook

Facebook is a social networking website which allows active users to share files, photos, videos, status, more to their friends, relatives, and business partners using the cloud storage system. On Facebook, we will always get notifications when our friends like and comment on the posts.

Twitter

Twitter is a social networking site. It is a microblogging system. It allows users to follow high profile celebrities, friends, relatives, and receive news. It sends and receives short posts called tweets.

LinkedIn

LinkedIn is a social network for students, freshers, and professionals.