# Cloud Computing

Introduction to Cloud Computing Cloud Computing

# Why Cloud Computing

Ex.: Website host Farm house saloon

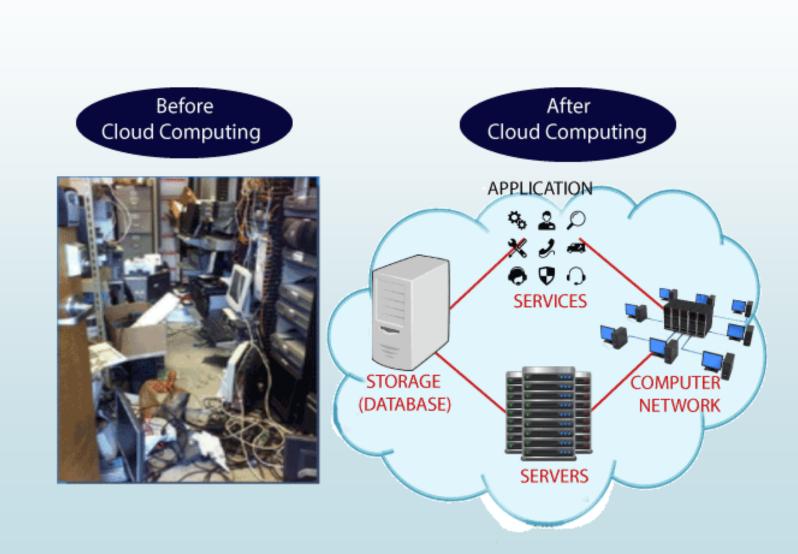
Local server: purchase,

maintain

security issues

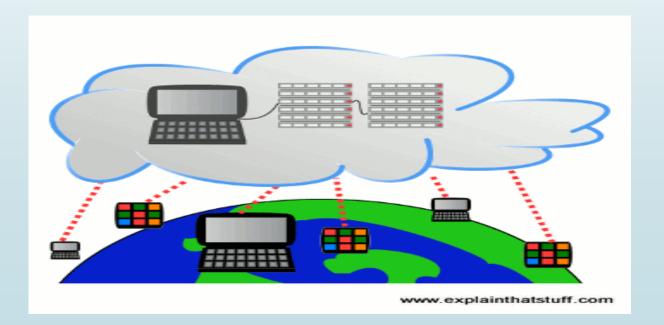
maintain

 Resources on rent: avoid all headache focus on main business.



### Cloud

- Water vapor's molecules combine and made cloud(resources)
- Not a fixed structure in size(scalable)
- Not stationary at one place(mobile)
- Through rain serve many people together()
- Cloud Internet

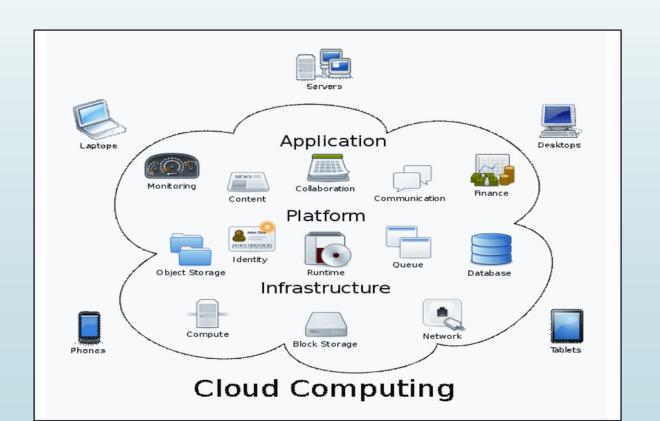


### Computing

- Any activity that uses computers.
- To solve any goal oriented activity.
- Includes designing and building h/w and s/w systems for a wide range of purposes:
  - Processing
  - Structuring
  - Managing data/information
  - Scientific study
  - Artificial Intelligence.....

### Cloud Computing

Definition: "It is the use of remote servers on the internet to store, manage and process the data rather then local servers."



### Cloud Computing

- Simply put, "cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale."
- ➤ You typically pay only for cloud services you use, helping lower your operating costs, run your infrastructure more efficiently and scale as your business needs change.

### Characteristics of Cloud Computing

#### 1) Agility(ability to move quickly and easily)

The cloud works in a distributed computing environment. It shares resources among users and works very fast.

#### 2) High availability and reliability(trustworthy)

The availability of servers is high and more reliable because the chances of infrastructure failure are minimum.

#### 3) High Scalability

Cloud offers "on-demand" provisioning of resources on a large scale, without having engineers for peak loads.

#### 4) Multi-Sharing

With the help of cloud computing, **multiple users** and **applications** can work more efficiently with cost reductions by **sharing common infrastructure**.

#### 5) Device and Location Independence

Cloud computing enables the users to access systems using a **web browser** regardless of their location or what device they use e.g. PC, mobile phone, etc.

As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, users can connect from anywhere.

#### 6) Maintenance

Maintenance of cloud computing applications is **easier**, since they **do not need to be installed** on each user's computer and can be accessed from **different places**. So, it reduces the **cost** also.

#### 7) Low Cost

By using cloud computing, the cost will be reduced because to take the services of cloud computing, IT company need not to set its own infrastructure and pay-as-per usage of resources.

#### 8) Services in the pay-per-use mode

Application Programming Interfaces (APIs) are provided to the users so that they can access services on the cloud by using these APIs and pay the charges as per the **usage of services**.

### 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) Improved collaboration

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

#### 3) 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. Ex. **Softcopy of documents.** 

#### 4) Low maintenance cost

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

#### 5) Mobility

Cloud computing allows us to easily access all cloud data through internet.

#### 6) 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.

#### 7) 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.

#### 8) 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.

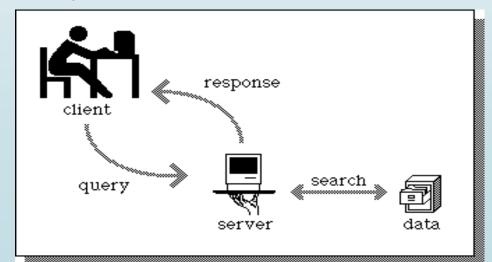
#### 4) Security

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**.

### History of Cloud Computing

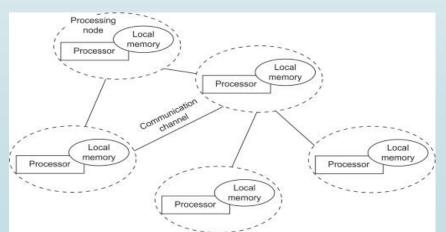
#### 1. Client Server Computing:

- Before emerging the cloud computing, there was Client/Server computing which is basically a centralized storage in which all the software applications, all the data and all the controls are resided on the server side.
- If a single user wants to access specific data or run a program, he/she need to connect to the server and then gain appropriate access, and then he/she can do his/her business. Ex. email



#### 2. Distributed Computing:

- Then after, distributed computing came into picture, where all the computers are networked together and share their resources when needed.
- **Ex..** Telecommunication networks: Telephone networks and Cellular networks.

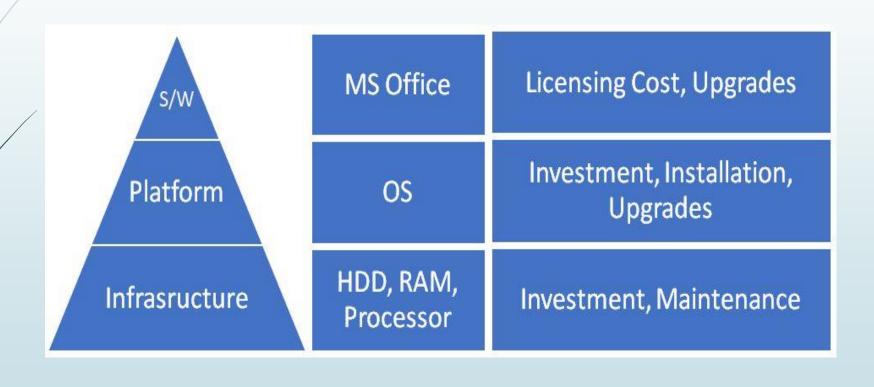


#### 3. Cloud Computing:

- At around in 1961, John MacCharty suggested in a speech at MIT that computing can be sold like a utility, just like a water or electricity. It was a brilliant idea, but like all brilliant ideas, it was ahead if its time, as for the next few decades, despite interest in the model, the technology simply was not ready for it.
- But of course time has passed and the technology caught that idea and after few years we mentioned that:
- In 1999, **Salesforce.com** started delivering of applications to users using a simple website. The applications were delivered to enterprises over the Internet, and this way the dream of computing sold as utility were true.

- In 2002, Amazon started Amazon Web Services, providing services like storage, computation and even human intelligence.
- In 2009, Google Apps also started to provide cloud computing enterprise applications.
- Of course, all the big players are present in the cloud computing evolution, some were earlier, some were later.
- In 2009, Microsoft launched Windows Azure, and companies like Oracle and HP have all joined the game. This proves that today, cloud computing has become mainstream.

### Layers of Cloud Computing



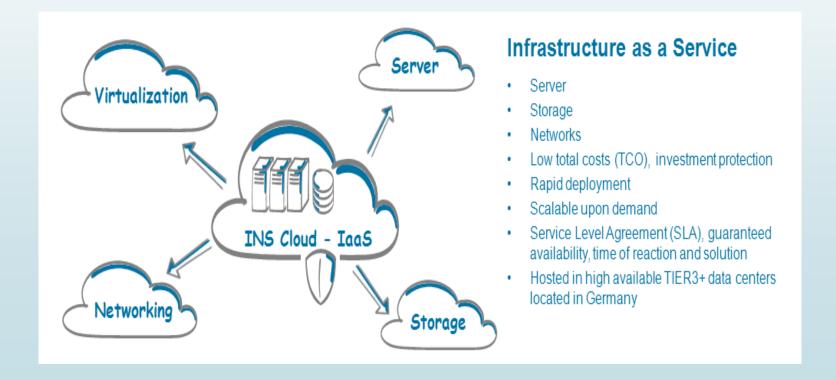
### Infrastructure as a Service (laaS)

- laaS is also known as Hardware as a Service (HaaS).
- It is a computing infrastructure managed over the internet.
- The main advantage of using laaS is that it helps users to avoid the cost and complexity of purchasing and managing the physical servers.

#### Characteristics of laas:

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

**■ Example:** DigitalOcean, Amazon Web Services (AWS).

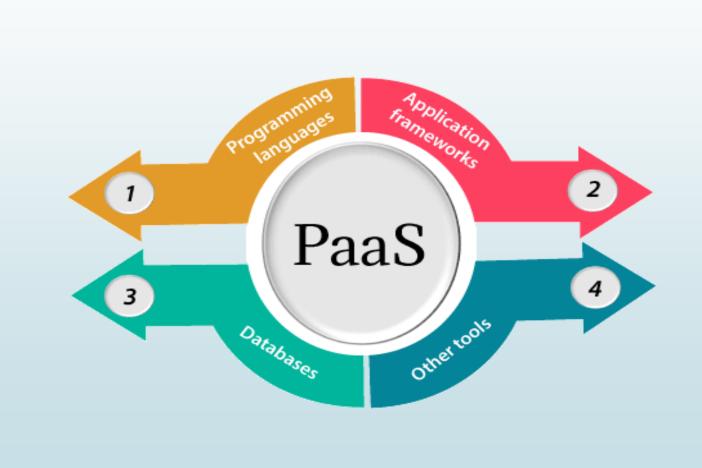


### Platform as a Service (PaaS)

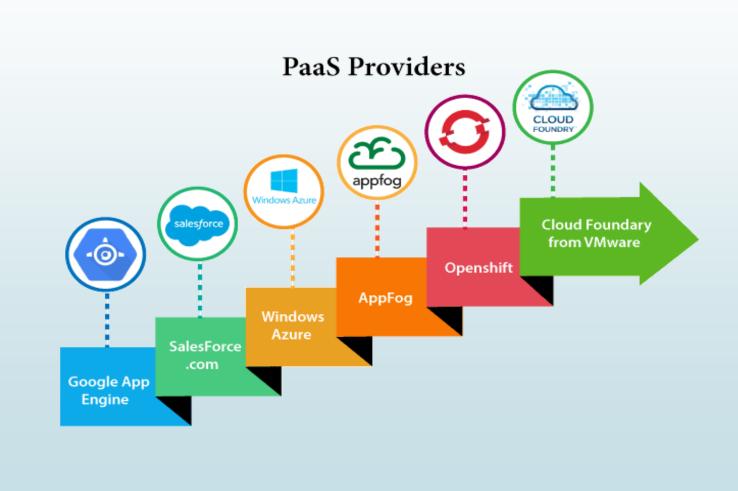
PaaS cloud computing platform is created for the programmer to develop, test, run, and manage the applications.

#### **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".



# Examples



## Software as a Service (SaaS)

- SaaS is also known as "on-demand software".
- It is a software in which the applications are hosted by a cloud service provider.
- Users can access these applications with the help of internet connection and web browser.

#### 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

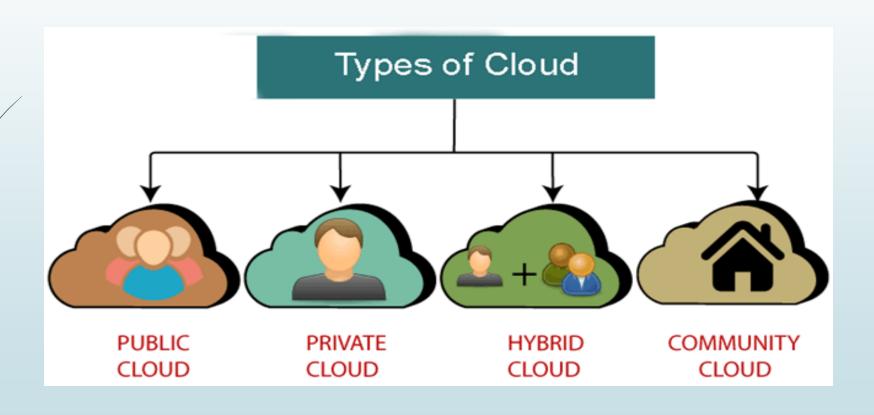




### Difference between laaS, PaaS, and SaaS

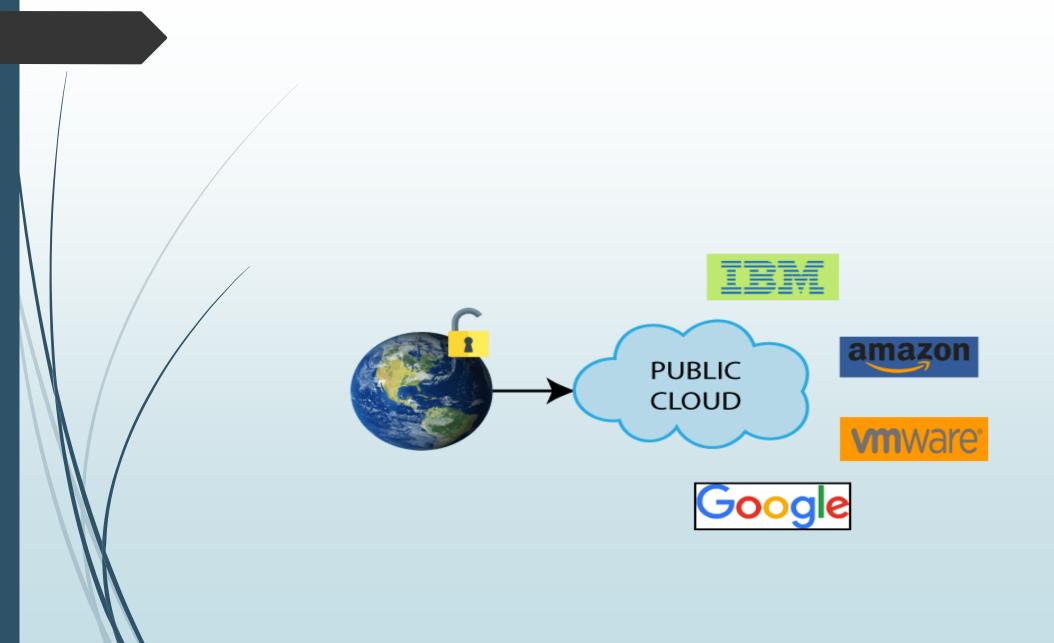
laaS		Paas	SaaS
to sto	ovides a virtual data center ore information and create orms for app development, ag, and deployment.	platforms and tools to create, test, and	software and apps to
such	ovides access to resources as virtual machines, virtual ge, etc.	•	a service to the end-
It is u	sed by network architects.	It is used by developers.	It is used by end users.

# Types of Cloud



### Public Cloud

- Public Cloud provides a shared platform that is accessible to the general public through an Internet connection.
- Public cloud operated on the pay-as-per-use model and administrated by the third party, i.e., Cloud service provider.
- In the Public cloud, the same storage is being used by multiple users at the same time.
- Public cloud is owned, managed, and operated by businesses, universities, government organizations, or a combination of them.
- Example: Amazon elastic compute cloud (EC2), IBM SmartCloud Enterprise, Microsoft, Google App Engine, Windows Azure Services Platform.



#### **Advantages of Public Cloud:**

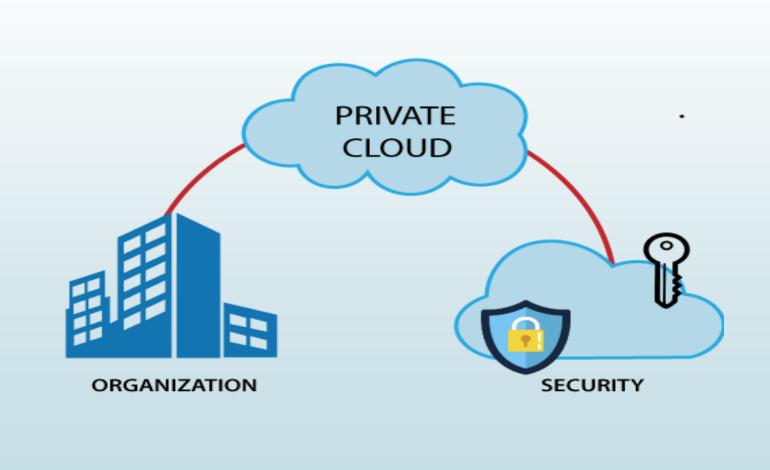
- Public cloud is owned at a lower cost than the private and hybrid cloud.
- Public cloud is maintained by the cloud service provider, so do not need to worry about the maintenance.
- Public cloud is easier to integrate. Hence it offers a better flexibility approach to consumers.
- Public cloud is location independent because its services are delivered through the internet.
- Public cloud is highly scalable as per the requirement of computing resources.
- It is accessible by the general public, so there is no limit to the number of users.

#### Disadvantages of Public Cloud:

- Public Cloud is **less secure** because resources are shared publicly.
- Performance depends upon the high-speed internet network link to the cloud provider.
- The Client has no control of data.

### Private Cloud

- Private cloud is also known as an internal cloud or corporate cloud.
- Private cloud provides computing services to a **private internal network** (within the organization) and selected users instead of the general public.
- Private cloud provides a **high level of security** and **privacy** to data through firewalls and internal hosting. It also ensures that operational and sensitive data are not accessible to third-party providers.
- **Example:** HP Data Centers, Microsoft, Elastra-private cloud, and Ubuntu



#### **Advantages of Private Cloud:**

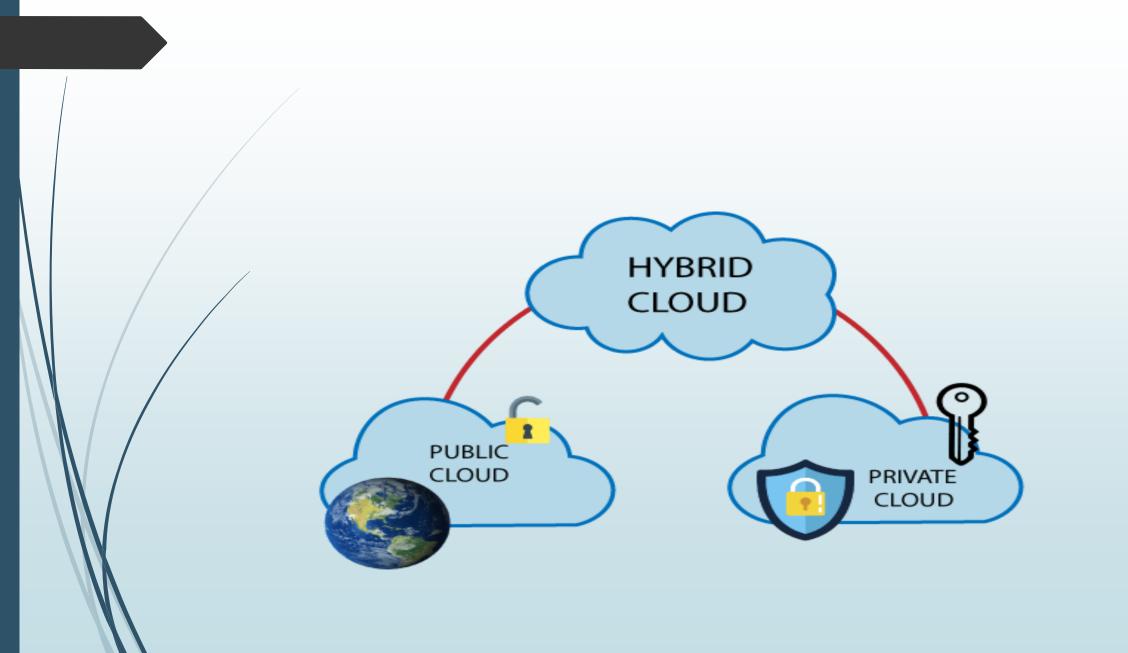
- Private cloud provides a high level of security and privacy to the users.
- Private cloud offers better performance with improved speed and space capacity.
- It allows the IT team to quickly allocate and deliver on-demand IT resources.
- The organization has full control over the cloud because it is managed by the organization itself. So, there is no need for the organization to depends on anybody.
- It is suitable for organizations that require a separate cloud for their personal use and data security is the first priority.

### Disadvantages of Private Cloud:

- **Skilled people** are required to manage and operate cloud services.
- Private cloud is accessible within the organization, so the area of operations is limited.
- Private cloud is not suitable for organizations that have a high user base, and organizations that do not have the prebuilt infrastructure, sufficient manpower to maintain and manage the cloud.

## Hybrid Cloud

- Hybrid cloud is a combination of public and private clouds.
  Hybrid cloud = public cloud + private cloud
- The main aim to combine these cloud (Public and Private) is to create a unified, automated, and well-managed computing environment.
- In the Hybrid cloud, non-critical activities are performed by the public cloud and critical activities are performed by the private cloud.
- Mainly, a hybrid cloud is used in finance, healthcare, and Universities.
- **Example:** Amazon, Microsoft, Google, Cisco, and NetApp.



#### **Advantages of Hybrid Cloud:**

- Hybrid cloud is suitable for organizations that require more security than the public cloud.
- Hybrid cloud helps you to deliver new products and services more quickly.
- Hybrid cloud provides an excellent way to reduce the risk.
- Hybrid cloud offers flexible resources because of the public cloud and secure resources because of the private cloud.

### Disadvantages of Hybrid Cloud:

- In Hybrid Cloud, **security feature** is not as good as the private cloud.
- Managing a hybrid cloud is complex because it is difficult to manage more than one type of deployment model.
- In the hybrid cloud, the reliability of the services depends on cloud service providers.

# Community Cloud

- Community cloud allows systems and services to be accessible by a group of several organizations to share the information between the organization and a specific community.
- It is owned, managed, and operated by one or more organizations in the community, a third party, or a combination of them.
- **Example:** Health Care community cloud



#### **Advantages of Community Cloud:**

- Community cloud is cost-effective because the whole cloud is being shared by several organizations or communities.
- Community cloud is suitable for organizations that want to have a collaborative cloud with more security features than the public cloud.
- It provides better **security** than the public cloud.
- It provides collaborative and distributive environment.
- Community cloud allows us to share cloud resources, infrastructure, and other capabilities among various organizations.

### **Disadvantages of Community Cloud:**

- Community cloud is not a good choice for every organization.
- Security features are not as good as the private cloud.
- It is not suitable if there is no collaboration.
- The fixed amount of data storage and bandwidth is shared among all community members.

# Difference between public cloud, private cloud, hybrid cloud, and community cloud

Parameter	Public Cloud	Private Cloud	Hybrid Cloud	Community Cloud
Host	Service provider	Enterprise (Third party)	Enterprise (Third party)	Community (Third party)
Users	General public	Selected users	Selected users	Community members
Access	Internet	Internet, VPN	Internet, VPN	Internet, VPN
Owner	Service provider	Enterprise	Enterprise	Community

## Security Risks of Cloud Computing

#### Data Loss

- It is also known as **data leakage**.
- Data loss is the process in which data is being deleted, corrupted, and unreadable by a user, software, or application.
- In a cloud computing environment, data loss occurs when our sensitive data is somebody else's hands, one or more data elements can not be utilized by the data owner, hard disk is not working properly, and software is not updated.
- Hacked Interfaces and Insecure APIs
- In cloud computing, few services are available in the public domain. These services can be accessed by third parties, so there may be a chance that these services easily harmed and hacked by hackers.

#### Data Breach

■ Data Breach is the process in which the confidential data is viewed, accessed, or stolen by the third party without any authorization, so organization's data is hacked by the hackers.

#### Vendor lock-in

- Organizations may face problems when transferring their services from one vendor to another.
- As different vendors provide different platforms, that can cause difficulty moving one cloud to another.

- Increased complexity strains IT staff
- Migrating, integrating, and operating the cloud services is complex for the IT staff.
- IT staff must require the extra capability and skills to manage, integrate, and maintain the data to the cloud.
- Spectre & Meltdown
- Spectre & Meltdown allows programs to view and steal data which is currently processed on computer.
- It can run on personal computers, mobile devices, and in the cloud. It can store the password, your personal information such as images, emails, and business documents in the memory of other running programs.

- hen the system receives too much traffic to buffer the server. Denial of Service (DoS) attacks
- Denial of service (DoS) attacks occur w
- Mostly, DoS attackers target web servers of large organizations such as banking sectors, media companies, and government organizations.
- To recover the lost data, DoS attackers charge a great deal of time and money to handle the data.
- Account hijacking
- Account hijacking is a serious security risk in cloud computing.
- It is the process in which individual user's or organization's **cloud account** (bank account, e-mail account, and social media account) is stolen by hackers.
- The hackers use the stolen account to perform unauthorized activities.

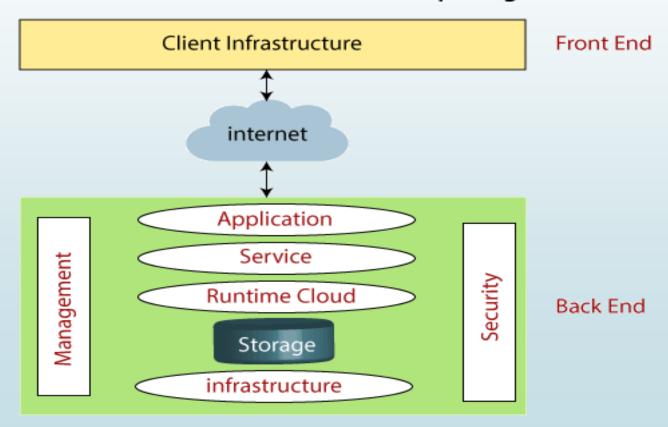
# Cloud Computing

**Cloud Computing Architecture and Vitalization** 

# Cloud Computing Architecture

- As we know, cloud computing technology is used by both small and large organizations to store the information in cloud and access it from anywhere at anytime using the internet connection.
- 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

### **Architecture of Cloud Computing**



#### 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.), 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.

# Components of Cloud Computing Architecture

#### 1. Client Infrastructure

■ Client Infrastructure is a Front end component. It provides **GUI** (Graphical User Interface) to interact with the cloud.

#### 2. Application

■ The application may be any software or platform that a client wants to access.

#### 3. Service

- A Cloud Services manages that which type of service you access according to the client's requirement.
- Cloud computing offers the following three type of services:

- i. Software as a Service (SaaS)
- ii. Platform as a Service (PaaS)
- iii. Infrastructure as a Service (laaS)

#### 4. Runtime Cloud

Runtime Cloud provides the execution and runtime environment to the virtual machines.

#### 5. 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.

#### 6. 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.

#### 7. 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.

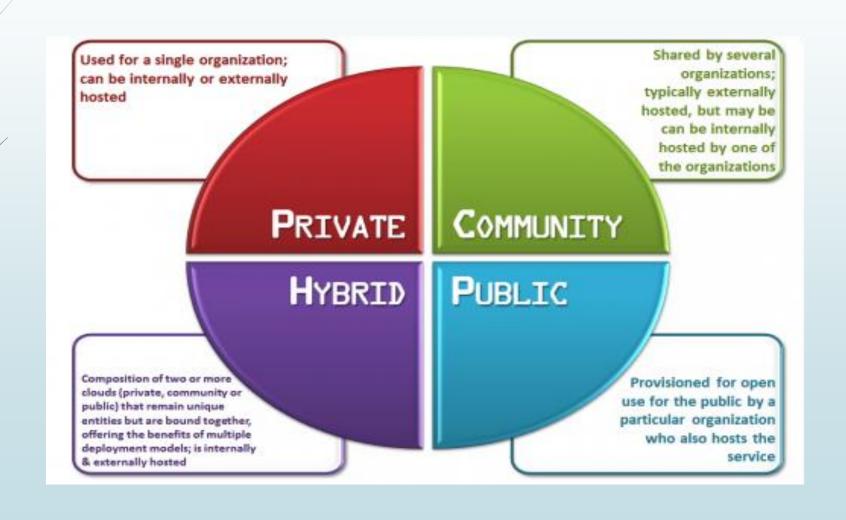
#### 8. Security

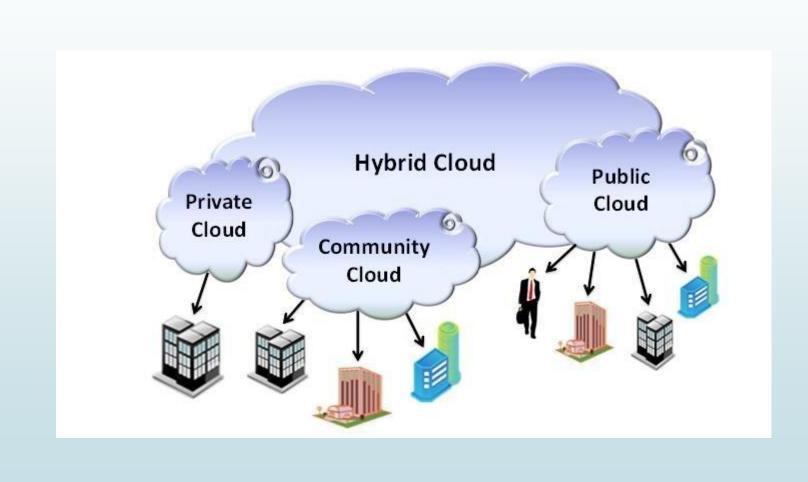
Security is an in-built back end component of cloud computing. It implements a security mechanism in the back end.

### 9. Internet

■ The Internet is medium through which front end and back end can interact and communicate with each other.

## Deployment Models





# Cloud Computing Technologies

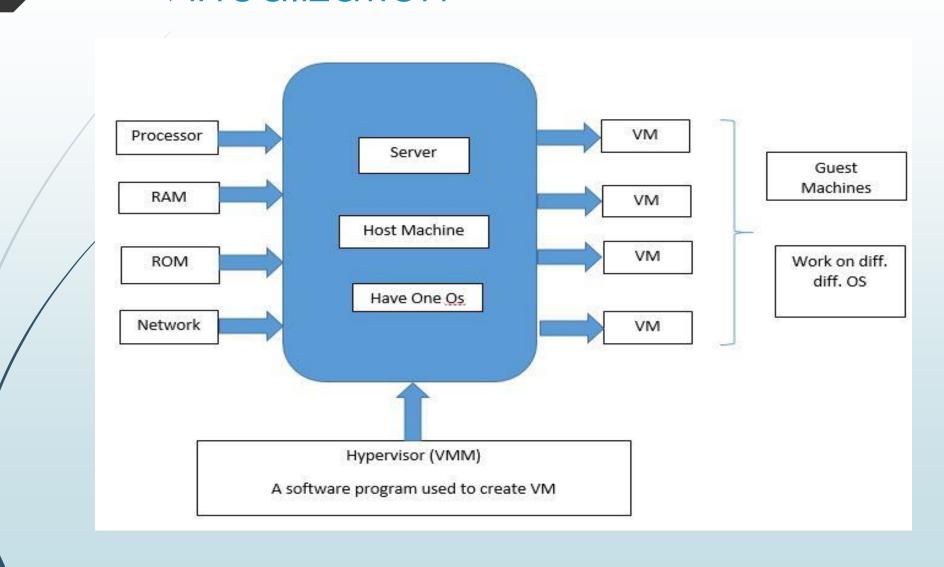
1. Virtualization

2. Service-Oriented Architecture (SOA)

3. Grid Computing

4. Utility Computing

### Virtualization



- ► Virtualization is the "creation of a virtual (rather than actual) version of something, such as a server, a desktop, a storage device, an operating system or network resources".
- In other words, Virtualization is a **technique**, which allows to share a single physical instance of a resource or an application among multiple customers and organizations.
- The concept of Virtualization in cloud computing increases the use of virtual machines.
- A virtual machine is a software computer or software program that not only works as a physical computer but can also function as a physical machine and perform tasks such as running applications or programs as per the user's demand.

# Types of Virtualization

- 1. Hardware virtualization
- 2. Server virtualization
- 3. Storage virtualization
- 4. Operating system virtualization

#### 1) Hardware Virtualization:

- When the virtual machine software or virtual machine manager (VMM) is directly installed on the hardware system is known as hardware virtualization.
- The main job of hypervisor is to control and monitoring the processor, memory and other hardware resources.
- After virtualization of hardware system we can install different operating system on it and run different applications on those OS.

#### Usage:

Hardware virtualization is mainly done for the server platforms, because controlling virtual machines is much easier than controlling a physical server.

### 2) Operating System Virtualization:

■ When the virtual machine software or virtual machine manager (VMM) is installed on the Host operating system instead of directly on the hardware system is known as operating system virtualization.

### Usage:

Operating System Virtualization is mainly used for **testing** the applications on different platforms of OS.

#### 3) Server Virtualization:

■ When the virtual machine software or virtual machine manager (VMM) is directly installed on the Server system is known as server virtualization.

#### Usage:

■ Server virtualization is done because a single physical server can be divided into multiple servers on the demand basis and for balancing the load.

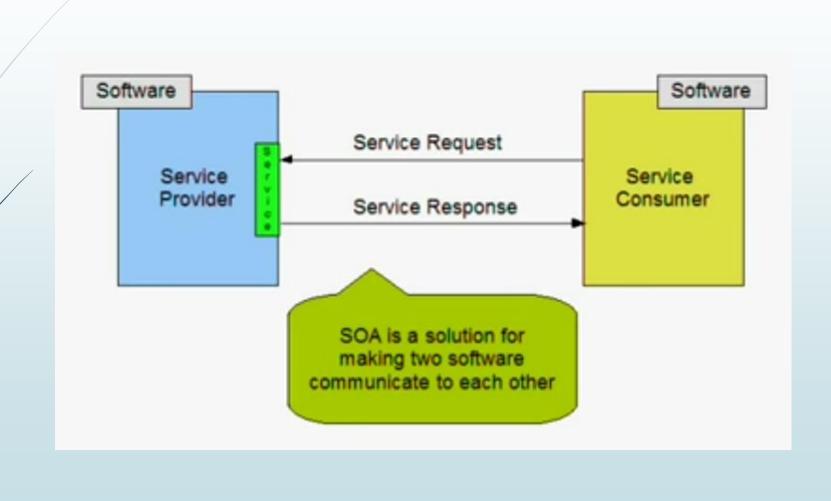
### 4) Storage Virtualization:

- Storage virtualization is the process of **grouping** the physical storage from multiple network storage devices so that it looks like a single storage device.
- Storage virtualization is also implemented by using software applications.

#### Usage:

Storage virtualization is mainly done for back-up and recovery purposes.

# Service-Oriented Architecture (SOA)



### What is Service Oriented Architecture (SOA)

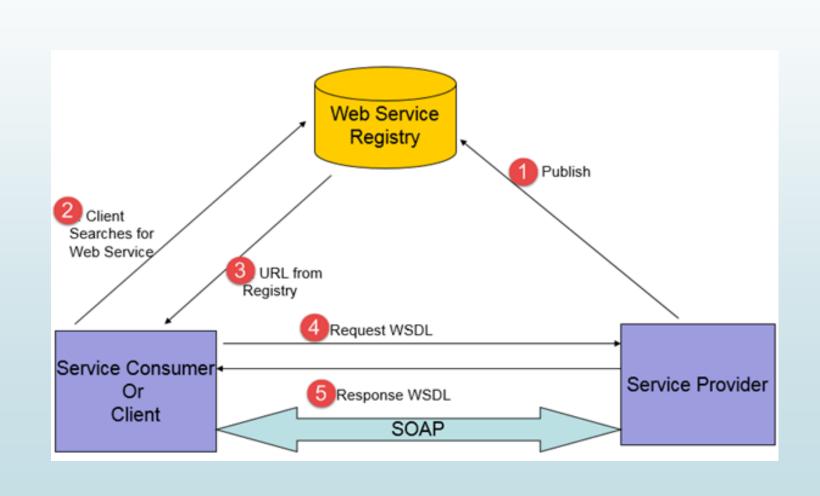
- The Service Oriented Architecture is an **architectural design** which includes collection of **services** in a network which **communicate** with each other.
- The complication of each service is not noticeable to other service.
- The service is a kind of operation which is well defined, self contained that provides separate functionality such as checking customer account details, printing bank statements etc. and does not depend on the sate of other services.

# Why to use SOA

- SOA is widely used in market which **responds quickly** and makes **effective changes** according to market situations.
- The SOA keep secret the implementation details of the subsystems.
- It allows interaction of new channels with customers, partners and suppliers.
- It authorizes the companies to select software or hardware of their choice as it acts as platform independence.

# Features

- SOA uses interfaces which solves the difficult integration problems in large systems.
- SOA communicates customers, providers and suppliers with messages by using the XML schema.
- It uses the **message monitoring** to improve the performance measurement and detects the security attacks.
- As it reuses the service, there will be lower software development and management costs.

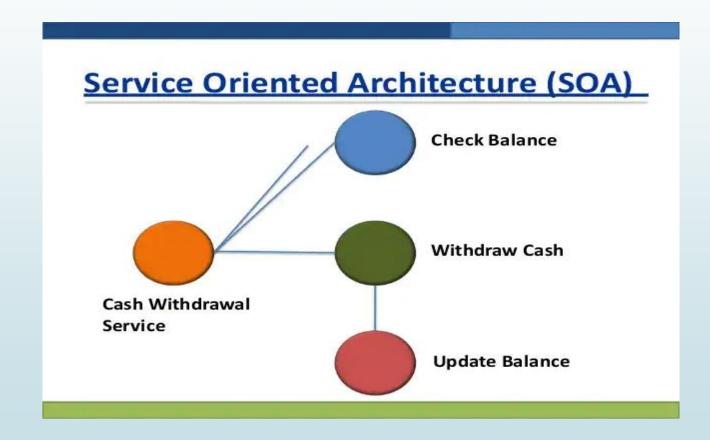


#### SOAP

■ SOAP (formerly an acronym for Simple Object Access Protocol) is a messaging protocol specification for exchanging structured information in the implementation of web services in computer networks. It uses XML Information Set for its message format, and relies on application layer protocols.

#### **WSDL**

■ WSDL, or Web Service Description Language, is an XML based definition language. It's used for describing the functionality of a SOAP based web service.



# Advantages

- SOA allows reuse the service of an existing system alternately building the new system.
- It allows plugging in new services or upgrading existing services to place the new business requirements.
- It can enhance the performance, functionality of a service and easily makes the system upgrade.
- SOA has capability to adjust or modify the different external environments and large applications can be managed easily.
- The companies can develop applications without replacing the existing applications.
- It provides reliable applications in which you can test and debug the independent services easily as compared to large number of code.

# Disadvantages

- SOA requires high investment cost (means large investment on technology, development and human resource).
- There is greater overhead when a service interacts with another service which increases the response time and machine load while validating the input parameters.

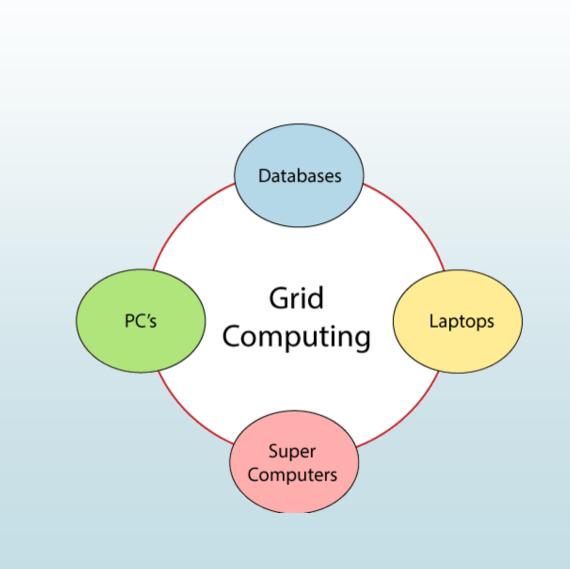
# Applications of Service-Oriented Architecture

- It is used in the healthcare industry.
- It is used to create many mobile applications and games.
- In the air force, SOA infrastructure is used to deploy situational awareness systems.

# Grid Computing

- Grid computing is also known as distributed computing.
- It is a processor architecture that combines various different computing resources from multiple locations to achieve a common goal.
- In grid computing, the grid is connected by parallel nodes to form a computer cluster.
- These computer clusters are in different sizes and can run on any operating system.

- Grid computing contains the following three types of machines -
- **Control Node:** It is a group of server which administrates the whole network.
- Provider: It is a computer which contributes its resources in the network resource pool.
- User: It is a computer which uses the resources on the network.
- Mainly, grid computing is used in the ATMs, back-end infrastructures, and marketing research.



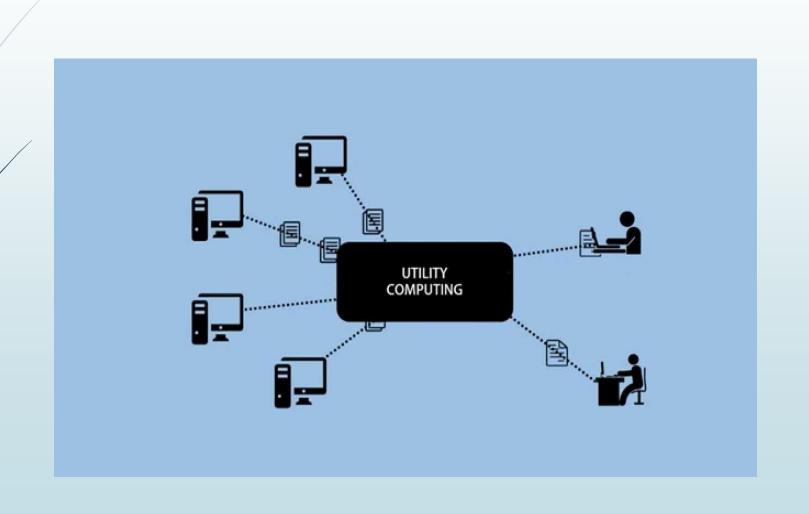
# **Utility Computing**

- Utility computing is the most trending IT service model.
- It provides on-demand computing resources (computation, storage, and programming services via API) and infrastructure based on the pay per use method.
- It minimizes the associated costs and maximizes the efficient use of resources.
- The advantage of utility computing is that it reduced the IT cost, provides greater flexibility, and easier to manage.

- Utility computing is the process of providing computing service through an on-demand, pay-per-use billing method.
- Utility computing is a computing business model in which the provider owns, operates and manages the computing infrastructure and resources, and the subscribers accesses it as and when required on a rental or metered basis.
- This model is based on that used by conventional utilities such as telephone services, electricity and gas.
- The principle behind utility computing is simple. The consumer has access to a virtually unlimited supply of computing solutions over the Internet or a virtual private network, which can be sourced and used whenever it's required.

## The example of utility computing are:

- CPU time
- Hard drive space and its access time
- Virtual and physical memory
- Network bandwidth
- Environment variable
- Storage space



# Cloud Computing Applications

## 1. 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:

i Moo

ii. Vistaprint

iii. Adobe Creative Cloud

## 2. Business Applications

- Business applications are based on cloud service providers.
- Today, every organization requires the cloud business application to grow their business.
- It also ensures that business applications are 24\*7 available to users.
- i. MailChimp
- ii. Salesforce

## 3. 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.
- As the cloud provider is responsible for providing security, so they offer various backup recovery application for retrieving the lost data.
- A list of data storage and backup applications in the cloud are given below -
- i. Box.com
- ii. Mozy
- iii. Google G Suite

## 4. 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.
- The advantage of using cloud in the field of education is that it offers strong virtual classroom environments, Ease of accessibility, secure data storage, scalability, greater reach for the students, and minimal hardware requirements for the applications.
- There are the following education applications offered by the cloud –
- i. Google Apps for Education
- ii. Chromebooks for Education

## 5. Entertainment Applications

- Entertainment industries use a **multi-cloud strategy** to interact with the target audience.
- Cloud computing offers various entertainment applications such as online games and video conferencing.
- i. Online games
- ii. GoToMeeting

## 7. 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.

# web Services

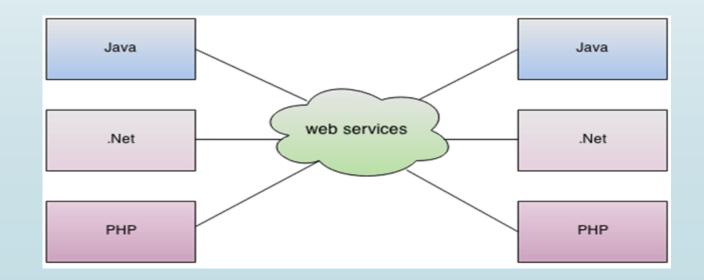
- Essentially, web services include any software, application, or cloud technology that provides standardized web protocols to interoperate, communicate, and exchange data messaging – usually XML (Extensible Markup Language) – throughout the internet.
- In other words, web services are XML-centered data exchange systems that use the internet for A2A (application-to-application) communication and interfacing.
- These processes involve programs, messages, documents, and/or objects.

- A key feature of web services is that applications can be written in **various** languages and are still able to **communicate** by exchanging data with one another via a **web service** between clients and servers.
- A client requests a web service by sending a request via XML, and the service then responses with an XML response.
- Web services are also often associated with SOA (Service-Oriented Architecture).

- To break that down, a web service comprises these essential functions:
- Available over the internet or intranet networks.
- Standardized XML messaging system
- Independent of a single operating system or programming language
- Self-describing via standard XML language
- Discoverable through a simple location method
- A web service supports communication among numerous apps with HTML, XML, WSDL, SOAP, and other open standards.
- XML tags the data, SOAP transfers the message, and WSDL describes the service's accessibility.

# How web services work

- A web service sits between two sets of java, .net, or PHP apps providing a way for these applications to communicate over a network.
- On one side, for example, a java app interacts with the java, .net, and PHP apps on the other end by way of the web service communicating an independent language.



- Web services offer different benefits across business operations.
- The technology helps IT pros and web architects streamline connectivity by minimizing development time.
- And with this simplified infrastructure, company executives begin to see higher ROI (return on investment).
- In a B2B operation where both parties understand how the process works, web services provide efficient technology distribution throughout an entire network.

# What are the Different Types of Web Services?

#### XML-RPC

- (Remote Procedure Call) is the most basic XML protocol to exchange data between a wide variety of devices on a network.
- It uses **HTTP** to quickly and easily transfer data and communication other information from client to server.

#### **UDDI**

- Universal Description, Discovery, and Integration) is an XML-based standard for detailing, publishing, and discovering web services.
- It's basically an internet registry for businesses around the world.
- The goal is to streamline digital transactions and e-commerce among company systems.

#### **SOAP**

- It is an XML-based Web service protocol to exchange **data** and **documents** over HTTP or SMTP (Simple Mail Transfer Protocol).
- It allows independent processes operating on disparate systems to communicate using XML.

#### **REST**

- It provides communication and connectivity between devices and the internet for API-based tasks.
- Most RESTful services use HTTP as the supporting protocol.

- ► Here are some well-known web services that use markup languages:
- Web template
- Web Services Description Language (WSDL)
- Web Services Conversation Language (WSCL)
- Web Services Flow Language (WSFL)
- Web Services Metadata Exchange (WS-MetadataExchange)
- XML Interface for Network Services (XINS)

# XML Basics

- Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.
- The design goals of XML focus on simplicity, generality, and usability across the Internet.
- It is a textual data format with strong support via Unicode for different human languages.

- XML stands for Extensible Markup Language
- ► XML is a **markup** language like HTML
- XML is designed to store and transport data
- XML is designed to be self-descriptive

# Differences between XML and HTML

- XML and HTML were designed with different goals:
- XML is designed to carry data emphasizing on what type of data it is.
- HTML is designed to display data emphasizing on how data looks
- XML tags are not predefined like HTML tags.
- ► HTML is about displaying data, hence it is **static** whereas XML is about carrying information, which makes it **dynamic**.

# Example

```
<subjectsList>
    <subjects>
        <name>Cloud Computing</name>
    </subjects>
    <subjects>
        <name>Artificial Intelligence</name>
    </subjects>
    <subjects>
        <name>Data Mining</name>
    </subjects>
    <elective>
        <name>Data Mining</name>
    </elective>
</subjectsList>
```

# Advantages

## XML makes web development User Friendly:

- Many computer systems contain data in incompatible formats.
- Exchanging data between incompatible systems or upgraded systems is a time-consuming task for web developers.
- Large amounts of data must be converted, and incompatible data is often lost.
- XML stores data in plain text format.
- This provides a software- and hardware-independent way of storing, transporting, and sharing data.

### XML is Extensible:

- XML applications will work as expected even if data is edited i.e. added or removed.
- **Example :**The above note is edited into a newer version by adding date tag and hour tag , and by removing the heading tag.

# Applications

### Web publishing:

- ► XML allows you to create **interactive** pages, allows the customer to **customize** those pages, and makes creating **e-commerce** applications more **intuitive**.
- With XML, you store the data once and then deliver that content for different viewers.

#### Web searching and automating Web tasks:

- XML defines the type of information contained in a document, making it easier to return useful results when searching the Web:
- For example, using HTML to search for books authored by Tom Brown is likely to return instances of the term 'brown' outside of the context of author.
- Using XML restricts the search to the correct context (for example, the information contained in the <author> tag) and returns only the information that you want.
- By using XML, Web agents and robots (programs that automate Web searches or other tasks) are more efficient and produce more useful results.

## General applications:

➤ XML provides a standard method to access information, making it easier for applications and devices of all kinds to use, store, transmit, and display data.

## e-business applications:

■ XML implementations make **electronic data interchange (EDI)** more accessible for information **interchange**, **business-to-business transactions**, and **business-to-consumer transactions**.

## Metadata applications:

XML makes it easier to express metadata in a portable, reusable format.

## Pervasive computing:

► XML provides portable and structured information types for display on pervasive (wireless) computing devices such as personal digital assistants (PDAs), cellular phones, and others.