**1. Cloud Computing Fundamentals**

**1.1) INTRODUCTION TO SALESFORCE**

**Cloud Computing:**

Cloud computing refers to the **delivery of computing services**, including servers, storage, databases, networking, software, analytics, and more over the Internet (“the cloud”) to offer **faster innovation, flexible resources.**

Instead of **owning and maintaining physical hardware and software resources.** on premises, cloud computing allows individuals and organizations to access and use these resources on a **pay-as-you-go or subscription basis** from cloud service providers.

Example of cloud service provider such **as Amazon Web Services (AWS)**,**Microsoft Azure** **,Google Cloud Platform (GCP)**.

### **Key Features of Cloud Computing:**

1. **On-Demand Self-Service**: Users can access computing resources as needed, without human interaction with the provider.
2. **Broad Network Access**: Services are available over the network and accessed through standard mechanisms like web browsers.
3. **Resource Pooling**: Multiple users share a pool of resources dynamically assigned based on demand.
4. **Rapid Elasticity**: Resources can scale up or down quickly to meet demand.
5. **Measured Service**: Resource usage is monitored, controlled, and reported, providing transparency for both the provider and consumer.

### **1.2)Evolution of Cloud Computing**

The evolution of cloud computing is a journey **that spans over several decades**. It reflects how **computing models have advanced from traditional centralized systems to the modern-day cloud.** Here is a timeline and summary of key stages:

### **1960s – The Concept Begins (Mainframe & Time-Sharing)**

### **1970s – Virtualization Era**

### **1990s – Rise of Internet and Grid Computing**

### **4. Early 2000s – Birth of Modern Cloud Computing**

### **5. 2010s – Growth of Cloud Models**

### **6. 2020s – Multi-Cloud, Edge Computing, and AI Integration**

### **1. 1960s – The Concept Begins (Mainframe & Time-Sharing)**

* **Key Idea**: Time-sharing on mainframe computers.
* Large, expensive computers were shared among multiple users.
* Introduced the concept of **utility computing** — where computing resources are used as a utility, like electricity.

### **2. 1970s – Virtualization Era**

* **IBM** introduced the **virtual machine (VM)** concept.
* This **allowed multiple operating systems** to run on a single physical machine.
* Marked the early foundation of **resource pooling and isolation**, key to cloud computing.

### **3. 1990s – Rise of Internet and Grid Computing**

* The **Internet boom** led to a surge in web-based applications.
* **Grid computing** allowed the use of a network of loosely coupled computers to perform large tasks.
* Companies began using distributed computing for scientific and commercial tasks.

### **4. Early 2000s – Birth of Modern Cloud Computing**

* In 2006, **Amazon Web Services (AWS)** launched its first cloud services like **EC2** (Elastic Compute Cloud) and **S3** (Simple Storage Service).
* \*Marked the beginning of **Infrastructure as a Service (IaaS)**.
* Cloud became **commercially viable**, with businesses using cloud to **avoid hardware costs.**

### **5. 2010s – Growth of Cloud Models**

* **\*PaaS and SaaS** models gained popularity (e.g: Google App Engine, Salesforce, and Microsoft Azure).
* Cloud providers expanded services including AI, IoT, big data, and server less computing.
* Cloud adoption grew rapidly in businesses, education, healthcare, and government.

### **6. 2020s – Multi-Cloud, Edge Computing, and AI Integration**

* Rise of **multi-cloud strategies** (using multiple cloud providers).
* **Edge computing** emerged to bring processing closer to users/devices.
* Integration of **Artificial Intelligence (AI)**, **Machine Learning (ML)**, and **cloud automation**.
* Cloud computing became **essential infrastructure** during COVID-19 for remote work, online learning, and virtual services.

### **Conclusion:**

Cloud computing has evolved from basic time-sharing systems to complex, scalable platforms enabling global innovation. It continues to grow and adapt, shaping the future of technology.

### **3.3) Comparison of Cloud Computing with Other Computing Techniques**

### Here’s a detailed comparison between **Cloud Computing** and other major computing techniques such as **Traditional Computing**, **Grid Computing**, and **Fog/Edge Computing**, focusing on key features:

| **Feature** |  | **Cloud** Computing | **Traditional Computing** | **Grid Computing** | **Edge/Fog Computing** |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| **Definition** |  | Internet-based delivery of computing services | Local computing with in-house infrastructure | Distributed computing across networks | Computation done near data source (devices) |
|  |  |  |  |  |  |
| **Infrastructure Ownership** |  | Managed by third-party providers (e.g. AWS) | Owned & maintained by the organization | Shared across multiple systems | Usually owned by the user or local network |
| **Scalability** |  | Highly scalable (on-demand resources) | Limited scalability (fixed resources) | Scalable but complex to manage | Scalable locally, but limited compared to cloud |
| **Cost** |  | Pay-as-you-use, cost-effective | High initial and maintenance cost | Moderate cost depending on setup | Cost-effective for real-time applications |
| **Accessibility** |  | Accessible via Internet from anywhere | Access limited to local network or devices | Accessible but requires proper network | Local access with some internet dependence |
| **Performance** |  | High, due to powerful servers and redundancy | Depends on hardware capacity | Good for parallel tasks, but latency exists | High for local tasks, very low latency |
| **Latency** |  | Medium to high latency (depends on distance) | Low (local processing) | Higher latency than edge | Very low latency (near real-time response) |
| **Maintenance & Management** |  | Handled by cloud provider | Requires in-house IT team | Shared management | Mostly managed locally |
| **Security** |  | High security but dependent on provider | Controlled internally | Depends on security across nodes | Can be more secure for local data |
| **Use Cases** |  | Web apps, AI, big data, SaaS, storage | Office apps, legacy systems | Scientific simulations, research | IoT, smart devices, autonomous vehicles |

### **Key Takeaways:**

1. **Cloud Computing** is ideal for scalable, cost-efficient, and flexible services delivered over the internet.
2. **Traditional Computing** is suitable for smaller, in-house operations with lower scalability needs.
3. **Grid Computing** is best for collaborative, high-performance tasks distributed across multiple systems.
4. **Edge/Fog Computing** is optimized for real-time applications where low latency is crucial (like IoT).

### **1.4)Key Characteristics of Cloud Computing**

Cloud computing offers a set of essential characteristics that make it powerful, flexible, and cost-effective. These features are defined by the **National Institute of Standards and Technology (NIST)** and are widely accepted across the industry.

### **1. on-Demand Self-Service**

* Users can automatically provision computing resources like servers, storage, or applications without human interaction with the service provider.

Example: You can launch a virtual server on AWS in seconds.

### **2. Broad Network Access**

* Services are accessible over the network (typically the internet) from a variety of devices such as laptops, tablets, and smartphones.
* Enables remote work and global access.

### **3. Resource Pooling**

* Cloud providers use multi-tenant models to serve multiple customers using shared resources (e.g., storage, processing, memory).
* Resources are dynamically assigned and reassigned based on demand.

### **4. Rapid Elasticity**

* Cloud resources can scale up or down **quickly and automatically** to meet workload demands.
* From small startups to large enterprises, cloud can handle variable traffic loads easily.

### **5. Measured Service (Metering and Billing)**

* Cloud systems automatically control and optimize resource use using metering tools.
* Customers are billed based on **actual usage**, like per hour, per GB, or per user.

### **6. High Availability and Reliability**

* Cloud providers offer redundant infrastructure and failover systems, ensuring uptime and business continuity.
* Example: Auto backup and failover features in services like Microsoft Azure or AWS.

### **7. Multi-Tenancy**

* Multiple customers share the same infrastructure but have isolated data and resources.
* Improves efficiency and reduces costs.

### **8. Automation**

* Many operations (like provisioning, scaling, monitoring) are automated, reducing manual effort and errors

### 1.5) **Advantages and Disadvantages of Cloud Computing**

**Advantages of Cloud Computing:**

1. **Cost-Effective**
   * No need to invest in physical hardware or infrastructure.
   * Pay only for the resources you use (pay-as-you-go model).
2. **Scalability and Flexibility**
   * Easily scale resources up or down based on demand.
   * Suitable for both small businesses and large enterprises.
3. **Accessibility**
   * Access data and applications anytime, anywhere with an internet connection.
4. **Disaster Recovery and Backup**
   * Automatic data backup and disaster recovery options provided by cloud vendors.
5. **Automatic Software Updates**
   * Cloud providers handle software updates, security patches, and maintenance.
6. **Improved Collaboration**
   * Multiple users can access and work on data or applications in real-time.
7. **High Availability**
   * Most cloud providers offer 99.9% or higher uptime guarantees.
8. **Environmentally Friendly**
   * Efficient use of shared data centers reduces overall energy consumption.

**Disadvantages of Cloud Computing:**

1. **Internet Dependency**
   * Cloud services require a reliable internet connection; without it, access is limited.
2. **Security and Privacy Risks**
   * Sensitive data stored in the cloud may be vulnerable to hacking or data breaches.
3. **Limited Control**
   * Users have less control over infrastructure and back-end systems managed by cloud providers.
4. **Downtime**
   * Although rare, cloud outages can disrupt business operations.
5. **Data Transfer Cost**
   * Moving large volumes of data in or out of the cloud may incur additional costs.
6. **Vendor Lock-In**
   * Switching between cloud providers can be complex and expensive due to different architectures.
7. **Compliance Challenges**
   * Organizations handling sensitive or regulated data must ensure cloud compliance with laws (e.g., GDPR, HIPAA).