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### **1) Cloud Computing Architecture**

Cloud computing architecture is the framework that enables on-demand delivery of computing services—such as storage, processing power, and applications—over the internet. It typically consists of two main components: **front-end** and **back-end**.

- **Front-End:** This is the user-facing side, including the client devices (computers, smartphones) and software (browsers, applications) through which users access cloud services.
- **Back-End:** The back-end includes the cloud infrastructure, with servers, storage, databases, and networks maintained by cloud providers. It also includes management and security mechanisms that ensure data integrity and availability.

The architecture is organized into layers:

- **Infrastructure Layer (IaaS):** Provides virtualized computing resources like servers, storage, and networks.
- **Platform Layer (PaaS):** Provides platforms for developers to build, deploy, and manage applications.
- **Application Layer (SaaS):** Delivers software applications to users over the internet on a subscription basis.

This layered architecture enables scalability, flexibility, and cost-efficiency, as users only pay for what they use, and infrastructure is managed by the cloud provider.

### **2) Infrastructure as a Service (IaaS)**

Infrastructure as a Service (IaaS) is a cloud computing model where users rent virtualized computing resources over the internet. IaaS provides the foundational building blocks of cloud environments, allowing users to provision and manage virtual machines, storage, and networks without managing the physical hardware.

- **Key Benefits of IaaS:**
  - **Scalability:** Users can quickly scale up or down based on demand.
  - **Cost Savings:** No need for upfront hardware investment; users pay only for what they use.
  - **Flexibility:** IaaS supports a variety of operating systems, tools, and configurations, allowing users to tailor resources to their needs.

- **Managed Infrastructure:** Cloud providers handle maintenance, backups, and physical security, enabling users to focus on application and service delivery.
- **Use Cases of IaaS:**
  - **Development and Testing:** Developers can quickly spin up environments for building and testing applications.
  - **Data Backup and Recovery:** IaaS offers reliable storage for backups and disaster recovery.
  - **Hosting Websites and Applications:** Companies can host applications and websites on virtual servers that scale with user demand.

### 3) Amazon Web Services (AWS)

Amazon Web Services (AWS) is a leading cloud computing platform that offers a wide range of on-demand services to organizations worldwide. AWS supports IaaS, PaaS, and SaaS models, with services that cover computing power, storage, databases, machine learning, analytics, and much more. AWS's architecture is built to offer high availability, security, and scalability across a global network of data centers.

- **Core Services in AWS:**
  - **Compute:** Services like **Amazon EC2** (virtual servers), **Lambda** (serverless computing), and **Elastic Beanstalk** (platform for deploying applications).
  - **Storage:** Services like **Amazon S3** (object storage), **EBS** (block storage), and **Glacier** (archive storage) for data storage and management.
  - **Database:** Options like **RDS** (relational databases), **DynamoDB** (NoSQL database), and **Redshift** (data warehousing).
  - **Networking:** Services like **VPC** (Virtual Private Cloud) for network isolation, **Route 53** for DNS, and **Direct Connect** for secure network connectivity.
  - **Machine Learning and AI:** Tools like **SageMaker** for building and deploying ML models and **Rekognition** for image recognition.
- **Advantages of AWS:**
  - **Global Reach:** AWS operates in numerous regions worldwide, allowing organizations to serve customers globally with low latency.
  - **Scalability:** AWS services scale easily, handling demand from startups to enterprises.
  - **Security:** AWS offers robust security features, including identity and access management, encryption, and compliance with industry standards.
  - **Cost Efficiency:** AWS uses a pay-as-you-go pricing model, reducing costs by charging only for used resources.

In summary, AWS provides a comprehensive cloud computing ecosystem, supporting everything from small projects to large enterprise applications, with IaaS as one of its foundational offerings that allows companies to avoid the complexities of managing physical infrastructure.