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Cloud Computing Assignment 1

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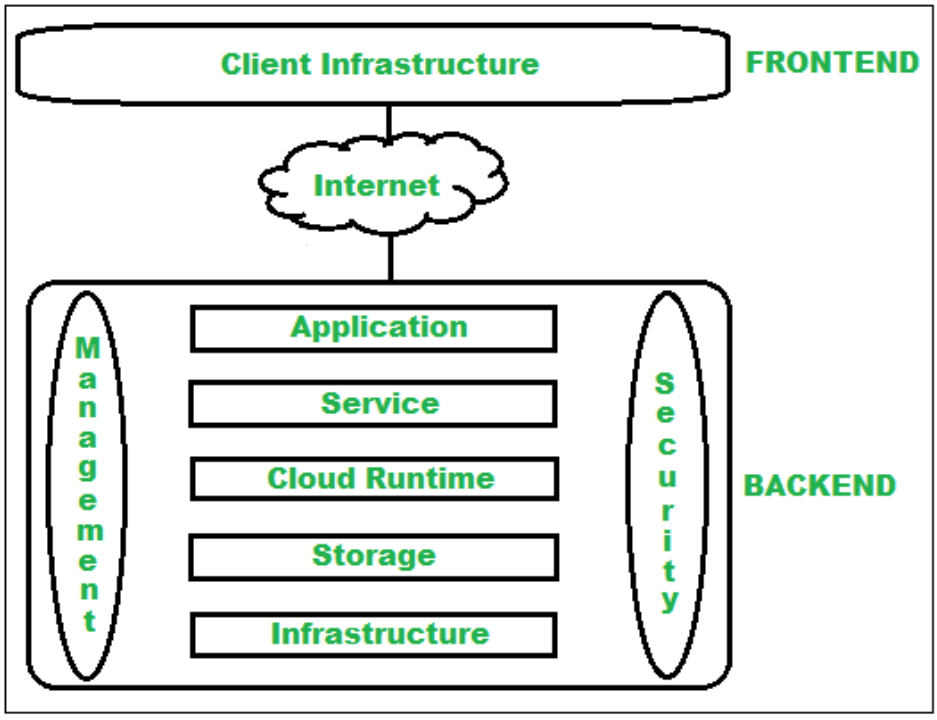
- **What is the meaning of terms Cloud and Computing in Cloud Computing.**

Cloud: In the context of cloud computing, "Cloud" refers to a global network of servers, each with a unique function. These servers are designed to store and manage data, run applications, or deliver content or a service such as streaming videos, web mail, office productivity software, or social media.

Computing: In cloud computing, "Computing" refers to the on-demand availability of computing resources (such as storage and infrastructure), as services over the internet. It eliminates the need for individuals and businesses to self-manage physical resources themselves, and only pay for what they use. This includes servers, storage, databases, networking, software, analytics, and intelligence.

- **Explain the pictorial view of cloud computing scenario.**



1. Frontend:

Frontend of the cloud architecture refers to the client side of cloud computing system. Means it contains all the user interfaces and applications which are used by the client to access the cloud computing services/resources. For example, use of a web browser to access the cloud platform.

2. Backend:

Backend refers to the cloud itself which is used by the service provider. It contains the resources as well as manages the resources and provides security mechanisms. Along with this, it includes huge storage, virtual applications, virtual machines, traffic control mechanisms, deployment models, etc.

- **Application –**

Application in backend refers to a software or platform to which client accesses. Means it provides the service in backend as per the client requirement.

- **Service –**

Service in backend refers to the major three types of cloud-based services like SaaS, PaaS and IaaS. Also manages which type of service the user accesses.

- **Runtime Cloud-**

Runtime cloud in backend provides the execution and Runtime platform/environment to the Virtual machine.

- **Storage –**

Storage in backend provides flexible and scalable storage service and management of stored data.

- **Infrastructure –**

Cloud Infrastructure in backend refers to the hardware and software components of cloud like it includes servers, storage, network devices, virtualization software etc.

- **Management –**

Management in backend refers to management of backend components like application, service, runtime cloud, storage, infrastructure, and other security mechanisms etc.

- **Security –**

Security in backend refers to implementation of different security mechanisms in the backend for secure cloud resources, systems, files, and infrastructure to end-users.

➢ **What is cloud computing? How does it differ from traditional IT infrastructure?**

Cloud computing is a model of delivering computing services over the internet, often referred to as “the cloud”. It provides on-demand availability of system resources, including data storage and computing power, without direct active management by the user.

Here are some key differences between cloud computing and traditional IT infrastructure:

Ownership: In traditional IT infrastructure, an organization owns its own hardware and software. But in cloud computing, the infrastructure is owned by a cloud service provider, and the organization rents the services.

Cost: Traditional IT infrastructure requires a significant upfront investment in hardware and software, whereas cloud computing follows a pay-as-you-go model, reducing the initial investment.

Scalability: Cloud computing provides on-demand scalability, meaning you can increase or decrease your resources based on your needs. In contrast, traditional IT infrastructure requires manual intervention to scale up or down.

Maintenance: With cloud computing, the service provider takes care of maintenance, including system upgrades and security. In traditional IT infrastructure, these tasks are the responsibility of the organization's IT department.

Accessibility: Cloud services can be accessed from anywhere with an internet connection, while traditional IT infrastructure is typically accessed via a local network.

Disaster Recovery: Cloud computing often includes disaster recovery solutions, reducing the risk of data loss. Traditional IT infrastructure requires a separate disaster recovery plan.

- **Explain the necessity for switching to Cloud Computing.**

Fault Tolerance: Cloud computing provides fault tolerance, which is the ability of a system to continue operating without interruption when one or more of its components fail.

Cost Savings: Instead of investing in on-site servers and data centers, businesses pay cloud providers to handle these resources. This eliminates the cost of maintaining and updating physical hardware.

Scalability: Cloud computing offers improved scalability. Businesses can easily scale up or down their IT requirements as needed, which is not always possible with traditional on-premises systems.

Enhanced Security: Cloud providers invest heavily in security measures to protect their infrastructure, which can be more robust than what a small or medium-sized business could provide on its own.

Environmental Impact: Switching to the cloud can also be better for the environment, as it reduces the need for physical hardware and data centers.

- **Enumerate the core characteristics of cloud computing that makes its use so popular. Explain each one in detail.**

  Resources Pooling: Resource pooling is a strategy where a cloud service provider shares resources among multiple clients, each providing a different set of services according to their needs. This can be applied to data storage, processing, and bandwidth-delivered services. The allocation of resources in real-time does not conflict with the client's experience.

  On-Demand Self-Service: This feature enables the client to continuously monitor server uptime, capabilities, and allocated network storage. A customer can also control the computing capabilities according to their needs.

  Easy Maintenance: Servers are easily maintained, and downtime is minimal or sometimes zero. Cloud computing powered resources often undergo several updates to optimize their capabilities and potential.

  Scalability And Rapid Elasticity: This feature enables cost-effective handling of workloads that require many servers but only for a short period. Many customers have workloads that can be run very cost-effectively due to the rapid scalability of cloud computing.

  Economical: This feature helps in reducing the IT expenditure of the organizations. In cloud computing, clients need to pay the administration for the space used by them. There are no hidden or additional charges that need to be paid.

  Measured And Reporting Service: This feature is helpful for both cloud providers and their customers. It enables both the provider and the customer to monitor and report which services have been used and for what purposes. It helps in monitoring billing and ensuring optimum utilization of resources.

  Security: Data security is one of the best features of cloud computing. Cloud providers invest heavily in security measures to protect their users' data and ensure the privacy of sensitive information.

  Automation: Cloud computing services are often highly automated, allowing users to deploy and manage resources with minimal manual intervention.

  Sustainability: Cloud providers are increasingly focused on sustainable practices, such as energy-efficient data centers and the use of renewable energy sources, to reduce their environmental impact.

- **How do architectural, technological, and operational influences contribute to the development of cloud computing?**

  Architectural Influences: Cloud computing architecture is a combination of Service Oriented Architecture (SOA) and Event Driven Architecture (EDA). It is divided into two parts: Frontend and Backend. The frontend refers to the client side of the cloud computing system, which contains all the user interfaces and applications used to access the cloud computing services. The backend refers to the cloud itself, which contains the resources and manages them, providing security mechanisms. This architecture has reshaped the way organizations store, access, and manage data and applications.

  Technological Influences: Technological advances have significantly shaped the landscape of cloud computing. Developments in hardware technology, containerization, edge computing, and AI integration have fueled the growth of cloud platforms. Cloud computing has also been influenced by multicore technology, parallel programming, virtualization and containerization, grid and utility computing, WAN, internet, Web 2.0, service-oriented architecture, microservices architecture (MSA), DevOps, Agile software development, open-source software tools, software-defined networks, and software-defined security.

  Operational Influences: Cloud computing directly impacts operational efficiency by streamlining processes and reducing the time to market for new innovations. The ability to quickly deploy and scale applications globally, without the need for significant capital expenditure on infrastructure, means that organizations can respond more rapidly to market opportunities. Cloud Operations (CloudOps) has become the industry standard for cloud-powered enterprises that intend to get the most out of their cloud services. CloudOps refers to a combination of activities that seek to optimize IT services, tools, workloads, and processes in the cloud.

- **Draw the architectural model of Cloud Computing and explain each of the important constituents of cloud computing.**

  Front End (User Interaction Enhancement): The User Interface of Cloud Computing consists of 2 sections of clients. The Thin clients are the ones that use web browsers facilitating portable and light weight accessibilities and others are known as Fat Clients that use many functionalities for offering a strong user experience.

  Back-end Platforms (Cloud Computing Engine): The core of cloud computing is made at back-end platforms with several servers for storage and processing computing. Management of Applications logic is managed through servers and effective data handling is provided by storage.

  Cloud-based delivery and a network (Internet, Intranet, Intercloud): This refers to the method of delivering the services over the internet or intranet or intercloud.

Virtualization in Cloud Computing: Virtualization is the software technology that helps in providing the logical isolation of physical resources. Creating logical isolation of physical resources such as RAM, CPU, and Storage... over the cloud is known as Virtualization in Cloud Computing.

- **Explain terms with respect to cloud architecture: Client, Broker, Cloud provider, Cloud Consumer, Cloud Auditor, Cloud Carrier**

Client: A client in cloud architecture refers to the front-end platforms such as servers, fat (or thick) clients, thin clients, zero clients, tablets, and mobile devices that users directly interact with. These clients are used to access and interact with the cloud services.

Broker: A cloud broker is an entity that manages the use, performance, and delivery of cloud services, and negotiates relationships between cloud providers and cloud consumers. They provide services in three categories: aggregation (combining multiple services into one), arbitrage (flexibility to choose services from multiple providers), and intermediation (enhancing a given service by improving some specific capability and providing value-added services to cloud consumers).

Cloud Provider: A cloud provider is an IT company that provides on-demand, scalable computing resources like computing power, data storage, or applications over the internet. They typically offer services defined as IaaS (Infrastructure as a Service), PaaS (Platform as a Service), or SaaS (Software as a Service).

Cloud Consumer: A cloud consumer is the end-user who utilizes the services provided by Cloud Service Providers (CSP). They set up service contracts with the cloud provider and pay per use of the service provisioned.

Cloud Auditor: A cloud auditor is a third-party entity that conducts an independent assessment of cloud services, security, performance, and information system operations of the cloud implementations. They perform audits to verify compliance with standards and express their opinion through a report.

Cloud Carrier: A cloud carrier is an intermediary that provides connectivity and transport of cloud services from cloud providers to cloud consumers. It allows access to the services of the cloud through Internet networks, telecommunication, and other access devices.

- **Discuss the potential benefits of adopting cloud computing for businesses and individuals.**

Cost Savings: Cloud computing can be more cost-efficient as it reduces the need for businesses to invest in and maintain their own IT infrastructure.

Security: Providing and monitoring security is a full-time job for cloud service providers, which can lead to enhanced security.

Scalability: Businesses can easily scale their IT resources up or down based on demand, making it highly flexible.

Mobility: Employees can access data and applications from anywhere, improving productivity.

Insight: Cloud computing can provide businesses with valuable insights from their data.

Increased Collaboration: Cloud services can enhance collaboration by allowing employees to work together more easily.

Quality Control: All documents are stored in one place and in a single format, reducing the risk of errors.

Disaster Recovery: Cloud computing can help businesses recover their data in case of disasters.

- **Alongside the benefits, what are the key challenges associated with cloud computing?**

Data Security and Privacy: Data security is a major concern when switching to cloud computing. User or organizational data stored in the cloud is critical and private. Security issues on the cloud include identity theft, data breaches, malware infections, and more which eventually decrease the trust amongst the users of your applications.

Cost Management: Even though most cloud service providers have a "Pay As You Go" model, there are times when there are huge costs incurred to the enterprise using cloud computing. This can happen due to under optimization of the resources, degraded application performance, sudden spikes in usage, or unused resources.

Multi-Cloud Environments: Managing multi-cloud environments can be challenging due to configuration errors, lack of security patches, data governance issues, and lack of granularity.

Performance Challenges: The performance of cloud services can vary, and issues such as latency can impact the user experience.

Interoperability and Flexibility: Ensuring that different cloud services and infrastructures work together seamlessly can be a challenge.

High Dependence on Network: Since cloud computing is internet-based, any connectivity issues can disrupt access to important data and software applications.

Lack of Knowledge and Expertise: There can be a lack of necessary skills and understanding to effectively implement and manage cloud solutions.

- **Differentiate between the three main cloud service models: Software as a Service (SaaS) , Platform as a Service (PaaS), Infrastructure as a Service (IaaS)**

  Infrastructure as a Service (IaaS): IaaS provides virtualized computing resources over the internet. It delivers on-demand infrastructure resources to organizations via the cloud, such as compute, storage, networking, and virtualization. Customers don't have to manage, maintain, or update their own data center infrastructure, but are responsible for the operating system, middleware, virtual machines, and any apps or data.

  Platform as a Service (PaaS): PaaS provides a platform for developers to build and deploy applications. It delivers and manages all the hardware and software resources to develop applications through the cloud. It provides a framework for quickly developing and deploying applications by automating infrastructure provisioning and management. Developers can use PaaS to develop, run, and manage applications without having to build and maintain the infrastructure or platform to run and manage containers.

  Software as a Service (SaaS): SaaS allows users to run existing online applications. It hosts various software and makes them available for the clients. It provides access to software applications over the internet. An application is hosted centrally and provides access to multiple users across various locations via the internet.

- **Provide examples of how each service model is used in practice.**

Reactive Service Model: This traditional model is focused on responding to customer inquiries and issues as they arise. It relies heavily on customer-initiated contact, such as calls or emails, to address problems. For example, a customer might call a company's support line to report an issue with a product, and the support team would then work to resolve the issue.

Proactive Service Model: This model takes a more forward-thinking approach. It involves anticipating customer needs and addressing them before they become issues. This could include regular check-ins, personalized recommendations based on past purchases, or educational content about product usage. For instance, a software company might send out regular updates and tips to its users to help them get the most out of their product.

Convenient Service Model: In this model, the customer may not get personalized service, but they continue to use your business because of its convenience and possibly its cost-effectiveness. For example, a fast-food restaurant might focus on providing quick and convenient service rather than personalized attention.

One Team Service Model: In this model, any employees who perform customer service tasks are fully trained to handle all aspects of customer service. Rather than a customer needing to be referred to a different person or department, every customer service employee knows how to help customers. For instance, in a retail store, all staff members might be trained to handle returns, answer product questions, and assist with purchases.

Self-Service Model: The self-service model gives customers the tools and resources they need to resolve their issues on their own, such as through a knowledge base or a community

forum. An example of this might be a tech company that provides extensive online documentation and forums for its users to find answers to their questions.

- **Explain the four primary cloud deployment models.**

Public Cloud: The public cloud is a type of cloud computing where services are delivered over the internet. These services are open to anyone who wants to use or purchase them. The infrastructure in this model is owned by the entity that delivers the cloud services, not by the consumer. Examples include Google App Engine, Amazon Web Services (AWS), and Microsoft Azure. The advantages of the public cloud model include minimal investment, no setup cost, no need for infrastructure management, and dynamic scalability1. However, it may be less secure as resources are public.

Private Cloud: A private cloud is a cloud service that is not shared with any other organization. The infrastructure is either located on-premises or hosted by a third-party service provider. It offers greater control and security than a public cloud, but it requires companies to manage and maintain their own data centers, which can be costly.

Hybrid Cloud: A hybrid cloud is a combination of public and private cloud services. This model allows organizations to take advantage of the scalability and cost-effectiveness of the public cloud while maintaining control over mission-critical applications and sensitive data that reside in the private cloud.

Community Cloud: A community cloud is a collaborative platform in which infrastructure is shared between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally.

- **Discuss the advantages and disadvantages of each deployment model.**

Public Cloud:

Minimal Investment: It's a pay-per-use service, so there's no substantial upfront fee.

No setup cost: The entire infrastructure is fully subsidized by the cloud service providers.

No maintenance: The maintenance work is done by the service provider.

Dynamic Scalability: On-demand resources are available to fulfill your company's needs.

Private Cloud:

Organization specific: Tailored to meet the specific needs of an organization.

High degree of security and level of control: Offers more control over data and processes compared to other models.

Ability to choose your resources: You can choose specialized hardware.

Hybrid Cloud:

Flexibility: Offers the flexibility of both private and public clouds.

Scalability: Can handle bursts of traffic by utilizing the public cloud component.

Security: Sensitive data can be kept on the private cloud component for enhanced security.

Community Cloud:

Shared Costs: Costs are spread over the members of the community.

Collaboration: Enables collaboration and resource sharing among community members.

- **What are the cloud best practices?**

1. **Start with an end-to-end assessment**: Understand your organization's needs and requirements before moving to the cloud. This includes assessing your current IT infrastructure, applications, data, and security needs.
2. **Adopt a cloud-based-as-a-service business model**: This model allows organizations to use cloud services on a pay-as-you-go basis, reducing upfront costs and allowing for scalability.
3. **Devise an all-encompassing adoption strategy**: This should include a clear roadmap for cloud adoption, including timelines, roles and responsibilities, and key performance indicators (KPIs).
4. **Educate and train resources as early as possible**: Ensure that your team has the necessary skills and knowledge to manage and operate in a cloud environment.
5. **Choose the right model**: Depending on your needs, you may choose from various cloud models such as public, private, or hybrid cloud.
6. **Plan and follow a cloud governance framework**: This includes policies and procedures for security, compliance, and operations in the cloud.
7. **Select a single workload**: Start with migrating a single workload to the cloud and gradually increase the scale as you gain more experience and confidence.
8. **Automate as much as possible**: Automation can help reduce manual errors, increase efficiency, and save time and resources.

- **If you want to run your software development business using the cloud computing model, how can you decide on choosing a specific service and deployment model? Explain.**

1. **Understand Your Business Needs:** Identify the specific needs of your business. This includes understanding the type of applications you'll be running, the level of control you need over your data and applications, and your budget.
2. **Identify the Right Service Model:** Cloud services are typically categorized into three models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
    - IaaS provides you with the highest level of flexibility and management control over your IT resources. It's most similar to existing IT resources that many IT departments and developers are familiar with today.
    - PaaS removes the need for your organization to manage the underlying infrastructure (usually hardware and operating systems) and allows you to focus on the deployment and management of your applications.
    - SaaS provides you with a completed product that is run and managed by the service provider. In most cases, people referring to Software as a Service are referring to end-user applications.
3. **Choose the Right Deployment Model:** There are four primary cloud deployment models, each with specific characteristics that support the needs of the service and deployment models: Private cloud, Public cloud, Hybrid cloud, and Multi-cloud.
    - Private cloud is characterized by a secure, dedicated environment in which only a single client can operate.
    - Public cloud is where cloud resources (like servers and storage) are owned and operated by a third-party cloud service provider and delivered over the Internet.
    - Hybrid cloud is a solution that combines a private cloud with one or more public cloud services, with proprietary software enabling communication between each distinct service.
    - Multi-cloud is the use of multiple cloud computing and storage services in a single network architecture.
4. **Consider Security and Compliance:** Depending on the nature of your data and applications, you may need to consider the security and compliance offerings of the cloud service provider.
5. **Evaluate Service Level Agreements (SLAs):** SLAs are a critical component of any cloud services agreement. They set the expectations for availability and performance, and they lay out the remedies for service levels not met.
6. **Cost Analysis:** Conduct a thorough cost analysis considering all the costs involved including the cost of migration, cost of services, and any hidden costs.

- **Write a note on the Cloud Service Providers you know.**

Amazon Web Services (AWS): AWS is a subsidiary of Amazon providing on-demand cloud computing platforms and APIs to individuals, companies, and governments. It offers over 200 fully-featured services from data centers globally.

Microsoft Azure: Azure is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services through Microsoft-managed data centers. It provides software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) and supports many different programming languages, tools, and frameworks.

Google Cloud Platform (GCP): GCP is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-user products, such as Google Search, Gmail, file storage, and YouTube. Alongside a set of management tools, it provides a series of modular cloud services including computing, data storage, data analytics, and machine learning.