

CC - Assignment 1

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CSE - 16

Case Studies:

Q1 Public vs Private cloud for mobile application

Ans Public Cloud Advantages:

- (i) Cost Saving: Do not have to buy/install servers.
- (ii) Scalability: Offer elastic resources allowing dynamic scaling with user demand.
- (iii) No maintenance: Provider handles infrastructure updates.
- (iv) Location Independence: Services are delivered through the internet.
- (v) Flexibility: Easy to integrate with private cloud.

Public Cloud Disadvantages:

- (i) Lacks proper control: The business has less control over configurations and optimizations.
- (ii) Weak on Security: Since infrastructure is shared with other orgs, user data is at higher risk.
- (iii) Performance: Due to sharing resources among multiple clients, there might be performance issues.

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Private cloud Advantages:

- (i) Enhanced Security: Company has full control over security protocols, ensuring sensitive data is safe.
- (ii) Total Control: Infrastructure can be tailored to meet specific performance & compliance requirements.
- (iii) Better Performance: Since resources are dedicated, there is no risk of performance fluctuations.
- (iv) Improved Compliance: Private cloud allows better adherence to industry regulations.

Private cloud Disadvantages:

- (i) Higher costs: Requires significant capital expenditures.
- (ii) Limited Scalability
- (iii) Maintenance Responsibility
- (iv) Geographic Limitations: Private cloud may not have the global presence of a public cloud, potentially affecting user experience.

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O2 Root cause:

- Connectivity issues in a cloud-hosted app can arise due to:
 - (i) Network Congestion
 - (ii) Cloud Provider Downtime
 - (iii) Insufficient Resources
 - (iv) Misconfigured Load Balancer
 - (v) Database bottlenecks.

Steps to resolve the issue:

- Monitor cloud services using tools like AWS Cloud Watch or Azure Monitor to identify bottlenecks.
- Upgrade to a more reliable network.
- Implement auto-scaling to automatically provision more resources during peak demand.

Ensuring High Availability & Performance:i) Load Balancing:

- Distribute incoming traffic across multiple servers to prevent overload.

2) Have data redundancy in case of data loss

3) Use failover systems to ensure high availability

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4) Multi-Region Deployment:

- Deploying the app across multiple locations

5) Content Delivery Network (CDN)

- Cache static content closer to users.

6) Auto Scaling: Add or remove cloud resources based on real-time demand automatically.Comparison of Major Cloud Providers:1) AWS:

- Largest cloud provider, vast services, good security
- Complex pricing, steep learning curve
- Pay-as-you-go payment model
- Good for scalable web apps

2) Microsoft Azure:

- Strong integration with Microsoft products.
- Can be expensive, limited global data centers.
- Pay-as-you-go, reserved VM pricing
- Good for hybrid cloud, enterprise software.

3) GCP:

- Has AI/ML capabilities, strong networking
- Smaller market share, fewer enterprise services.

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- Pay-as-you-go, sustained use discounts.
- Best for AI/ML workloads, network heavy apps.

Recommended Cloud Providers:

- AWS is the best choice due to its scalability, robust security features and wide range of services.
- It offers auto scaling & load balancing.

Scenarios Questions:

Q1 Cloud-Based Disaster Recovery with IaaS:

- IaaS providers like AWS offer automated backup solutions that create frequent snapshots of data.
- If an attack occurs, IaaS allows company to failover to a different cloud region and scale accordingly.
- Data can be replicated across multiple regions to prevent data loss due to local failures.

Q2 Virtualization for Cost Reduction & Efficiency:

- Virtualization allows multiple VMs to run on a single physical server, reducing no. of machines needed.
- Fewer physical servers mean lower power consumption, cooling costs and hardware expenses.

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- Virtualized machines can be backed up, cloned or moved b/w physical servers without downtime.

Q3 Load Balancing for Website - Performance during traffic:

- Load balancers distribute traffic across multiple servers, preventing a server from being overloaded.
- If demand spikes, auto-scaling provisions additional servers dynamically.
- If a server fails, traffic is rerouted to healthy servers, ensuring zero downtime.

Q4 Load Balancing for High Availability in Banking App:

- Load balancing spreads traffic across multiple data centers for redundancy.
- If a primary server fails, traffic is redirected to a backup server with no downtime.
- Load balancers continuously monitor server health, rerouting traffic away from failing nodes.

Q5 Best Hosting Service for a Small Bakery Website:

- The best hosting service is shared hosting or Website Builder on a Public cloud.

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Why?

- Low cost: Shared hosting is affordable as multiple websites share a server.
- Easy setup: No technical expertise is required.
- Managed services: The provider handles maintenance, security and updates.
- Sufficient for low traffic: A basic shared hosting plan or cloud hosting on AWS Lightsail or Google Sites is enough.

Outcome: The bakery gets an affordable, easy-to-maintain website that meets its needs without overspending.

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- Note: 7 questions total are answered in this assignment.

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Q1 (i) AWS:

Strengths:

- Largest market share and longest history in cloud services.
- Most extensive portfolio with 200+ services
- Robust global infrastructure present in most regions.

Weakness:

- Complex pricing structure
- Steeper learning curve due to vast service offerings.
- Management overhead for complex deployments

(ii) GCP:

Strengths:

- Leader in data analytics, AI and machine learning solutions.
- Strong containerization and Kubernetes support
- Competitive pricing with sustained use discounts
- Open-source friendly approach.

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Weakness:

- Smaller global infrastructure footprint compared to AWS and Azure.
- Fewer services and enterprise-focused features.
- Less mature enterprise support system.

(iii) Azure:Strengths:

- Seamless integration with Microsoft's ecosystem.
- Strong hybrid cloud capabilities with Azure stack.
- Comprehensive enterprise compliance certifications.
- Strong in PaaS offerings & developer tools.

Weakness:

- Documentation can be inconsistent.
- Management interfaces sometimes less intuitive.
- Performance variability reported by some users.

Application Scenarios:

- 1) Enterprise Applications: Azure tends to excel due to Microsoft ecosystem integration.
- 2) Big Data & Analytics: GCP often preferred for its analytical capabilities.

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- 3) General-purpose Web applications: AWS provides the most comprehensive toolset
- 4) Cost-sensitive projects: GCP often is used.

O2(i) IaaS: Infrastructure as a Service

- Provides virtualized computing resources over the internet (VMs, storage, networking)

Examples: AWS EC2, Azure Virtual Machines

Advantages:

- Maximum flexibility and control over infrastructure
- No hardware maintenance costs
- Pay-as-you-go pricing model

Disadvantages:

- Requires significant technical expertise.

(ii) PaaS: Platform as a Service

- Provides platforms allowing customers to develop, run and manage applications without dealing with underlying infrastructure.

Examples: Google App Engine, Azure App Service, AWS Elastic Beanstalk

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Advantages:

- Faster time to market for applications
- Reduced development complexity
- Automatic scaling & load balancing

Disadvantages:

- Less flexibility than IaaS
- Potential vendor lock in
- May have performance limitations

(iii) SaaS: Software as a Service

- Delivers software applications over the internet, on a subscription basis.

Examples: Slack, Zoom, Microsoft 365Advantages:

- Minimal setup & technical knowledge required
- Automatic updates & maintenance
- Quick implementation

Disadvantages:

- Limited control
- Minimal customization options
- Internet dependency

* Perfect for non technical businesses.

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Q3 Public Cloud Advantages:

- Lower initial capital expenditure
- Rapid updates & new features
- Reduced management overhead
- Built-in disaster recovery.

Public Cloud Disadvantages:

- Less control over infrastructure
- Data security concerns
- Dependency on provider's infrastructure.

Private Cloud Advantages:

- Greater control over security
- Customizable to specific organizational needs
- Better control over sensitive data

Private Cloud Disadvantages:

- Higher initial capital expenditure
- Requires specialized skills for maintenance
- Limited geographic distribution.

Q4 (i) IaaS Interactions:

Networking: Provides virtual networks, load balancers, and firewalls that users must configure.

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Storage: Offers various storage options (block, object, file) that users must manage.

(i) PaaS Interactions:

Networking: Abstracts most networking details but provides configuration options

Storage: Integrates storage seamlessly with development environments.

(ii) SaaS Interactions:

Networking: Completely abstracted from users.

Storage: It is managed by the provider.

Q5 Role of cloud service models:

1) Accelerating Innovation:

- Cloud platforms allow businesses to develop, test and deploy new applications quickly.

2) Enhancing Agility:

- Organizations can scale computing resources up or down as needed, optimizing costs & performance.

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3) Cost efficiency & operational effectiveness:

- Companies only pay for the resources they use, reducing capital expenditure.

4) Strengthening Security & Compliance:

- Cloud providers offer robust security frameworks, including encryption, identity management.

5) Enabling Remote Work & Collaboration:

- Cloud-based applications support remote work, allowing employees to collaborate seamlessly from any location.

Q6 Virtual machine migration refers to the process of moving a VM from one physical host to another.

Types of VM Migration:

- 1) Cold Migration
- 2) Warm Migration
- 3) Live Migration

Improving Availability & Reliability:

- Load Balancing is used to migrate overloaded hosts to underutilized ones.

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- VMs can be migrated to different geographic regions to avoid disasters
- Consolidating VMs onto fewer hosts during low-demand periods

Q7 Wireless Sensor Networks are networks of distributed autonomous devices that monitor physical or environmental conditions. They consist of: Sensor Nodes, Base station and Network Topology.

Integration Methods:

- 1) Direct Integration → Sensors interact via protocols
- 2) Gateway Mediated → Edge gateways collect data
- 3) Hybrid approach → Local & cloud processing.

Benefits:

- Scalable storage for sensor data
- Enables complex analysis of sensor data.
- Data can be accessed from anywhere
- Easy integration with other services

Q8 Innovative cloud computing use cases:

1) Healthcare:

- Using cloud computing for DNA sequencing analysis.

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- Cloud platforms collect and analyze patient data from wearable devices for remote patient monitoring.

2) Smart Infrastructure:

- AI-powered traffic optimization using cloud computing for traffic management.
- Digital twin technology to create replicas of physical assets for optimization.

3) Media and Entertainment:

- Global content distribution using cloud infrastructure.
- Cloud based rendering for visual effects & animation.
- AI-driven content recommendations using cloud.

4) Financial Services Innovation:

- Machine learning models deployed in cloud to detect fraudulent transactions.
- Blockchain-as-a-Service are offered by cloud providers for managed blockchain platforms.
- Algorithmic Trading from cloud-based high frequency trading platforms.

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O9 Cloud Computing for Edge & IoT:

1) Edge -Cloud Continuum:

- Determining optimal processing location (edge vs cloud)
- Edge caching is used to store frequently accessed data closer to users.
- State synchronization to maintain consistent state.

2) IoT Support Models:

- Cloud platforms for provisioning, updating and monitoring IoT devices
- Rules Engine are used for event processing systems.

3) Hybrid Architecture:

- Edge computing gateways are used for processing data before cloud transmission
- Fog computing is the intermediate layer between edge devices and cloud.

Use Cases:

- Smart Manufacturing for real-time quality control
- Connected Vehicles use edge processing
- Retail Analysis use in-store edge computing with cloud-based inventory management.
- Smart cities use distributed edge nodes with central cloud co-ordination.

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Q10 Cloud Computing for AI and ML:

1) Infrastructure Support:

- Specialized Hardware Access: like cloud based GPU's for ML training
- Model deployment infrastructure for end points for model infrastructure.

2) Platform Services:

- It offers pre trained models for common ML tasks, eg: Hugging Face.
- Automated model selection and hyperparameter tuning.

3) AI Specific Services:

- Computer Vision APIs for image recognition and processing services
- Natural Language Processing like text analysis, translation and generation services.
- Cloud based personalization engines are used as recommendation systems.

4) Data Management:

- Big data processing like Hadoop
- Cloud based data labelling services for supervised learning in Machine Learning -

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