1. Limitation of Client-Server Model in Distributed System

- In the client-server model, the server is the main control point, so if it fails, the whole system stops working.
- When many clients connect at the same time, the server can become slow or overloaded.
- It is difficult to scale because adding more clients may require upgrading the server hardware.
- Maintenance is complex as all client requests depend on the server's performance.
- Security is concentrated on the server, making it a potential target for attacks.

2. TCP and UDP Based Cloud Application

- **TCP (Transmission Control Protocol)** ensures data is delivered reliably without errors.
- Cloud applications like email, file storage, and online backup use TCP for safe data transfer.
- **UDP (User Datagram Protocol)** is faster but does not guarantee delivery.
- Applications like live video streaming, VoIP calls, and online gaming use UDP for speed.
- TCP is good for accuracy, UDP is good for real-time performance.

3. Different Types of Topologies

- **Bus Topology:** All devices share a single cable; simple but if the cable fails, the network stops.
- **Star Topology:** Devices are connected to a central hub; easy to manage and troubleshoot.
- **Ring Topology:** Data travels in a circular path; each device passes data to the next one.
- **Mesh Topology:** Every device connects to every other device; highly reliable but expensive.
- Different topologies affect network speed, reliability, and cost.

4. Horizontal vs Vertical Scaling

- **Horizontal Scaling:** Add more machines or servers to handle more users; also called scaling out.
- **Vertical Scaling:** Increase resources like CPU or RAM in an existing server; also called scaling up.
- Horizontal scaling is more flexible and cost-effective for large systems.
- Vertical scaling is limited by the maximum hardware capacity of a single machine.
- Both are used to improve performance and handle higher workloads.

5. Describe IP Addressing

- An IP address is a unique number assigned to each device in a network.
- It helps devices identify and communicate with each other.
- There are two types: **IPv4** (32-bit) and **IPv6** (128-bit) addresses.
- An IP address has two parts: the network part and the host part.
- IP addressing ensures proper data delivery across networks and the internet.

6. Distributed File Sharing

- Files are stored across multiple computers instead of a single server.
- Multiple users can access and work on the same files at the same time.
- This reduces the load on a single system and prevents downtime.
- It increases speed, reliability, and fault tolerance of the network.
- Examples include cloud storage systems like Google Drive and Dropbox.

7. Distributed System for Resource Sharing

- A distributed system connects multiple computers to work as a single system.
- Resources like CPU, memory, storage, and applications are shared among all machines.
- It improves performance and can handle larger tasks than a single computer.
- Distributed systems are more reliable because if one machine fails, others continue working.
- It allows cost-effective and efficient use of available resources.

8. Circuit Switching and Packet Switching

- **Circuit Switching:** A dedicated path is set up between two devices for the entire communication.
- It is used in traditional telephone networks; connection is reliable but inefficient.
- **Packet Switching:** Data is broken into small packets that travel independently over the network.
- It is used in the internet and cloud applications; more flexible and efficient.
- Packet switching allows multiple communications to share the same network simultaneously.

9. Significance of Cloud Computing

- Cloud computing allows users to access data and applications from anywhere with the internet.
- Reduces the need for expensive hardware and maintenance.
- Provides scalable resources as per demand, avoiding wastage.
- Supports collaboration and remote work by multiple users at the same time.
- Improves efficiency, flexibility, and business productivity.

10. Role of DNS for Network Access

- DNS (Domain Name System) translates human-friendly website names into IP addresses.
- It makes it easy for users to access websites without remembering long numbers.
- Helps route internet traffic efficiently across multiple servers.
- Ensures fast and reliable access to websites.
- DNS also supports load balancing and distributed network management.

11. Centralised vs Distributed Computing System

- **Centralised Computing:** One main computer controls all processing; simple to manage but risky if it fails.

- **Distributed Computing:** Tasks and resources are shared across multiple computers; more reliable.
- Distributed systems are scalable and can handle large workloads efficiently.
- Centralised systems are easier to maintain but have lower fault tolerance.
- Distributed computing is used in cloud services, online banking, and big data processing.

12. Cloud Service Providers

- Companies that provide cloud-based services for computing, storage, and networking.
- Examples include **AWS, Google Cloud, Microsoft Azure**, and IBM Cloud.
- They offer **IaaS** (Infrastructure), **PaaS** (Platform), and **SaaS** (Software) services.
- Help businesses avoid buying and managing their own servers.
- Support global accessibility and scalability for applications.

13. Cloud Computing: Mainframe to Distributed System

- **Mainframe Computing:** Single powerful computer serves multiple users; limited flexibility.
- **Distributed Systems:** Many computers share tasks and resources; scalable and reliable.
- Cloud computing uses distributed systems with elastic and on-demand resources.
- It allows businesses to scale easily without buying expensive hardware.
- Cloud improves availability, performance, and reduces operational costs.

14. AWS vs Google Cloud

- **AWS:** Offers a wide range of services, has global data centers, and is very popular.
- **Google Cloud:** Focused on AI, machine learning, and data analytics services.
- AWS is known for scalability and flexibility in enterprise solutions.
- Google Cloud integrates well with Google Workspace and big data tools.
- Both provide IaaS, PaaS, and SaaS services but differ in strengths and pricing.

15. Distinguish LAN, MAN, and WAN

- **LAN (Local Area Network):** Covers small areas like homes, offices; high speed, low cost.
- **MAN (Metropolitan Area Network):** Covers cities or large campuses; medium speed, connects multiple LANs.
- **WAN (Wide Area Network):** Covers large areas like countries or continents; slower, expensive.
- LAN is private, WAN is often public or leased lines.
- Choice depends on distance, speed requirements, and cost.

16. Cloud Monitoring and Traditional Infrastructure Monitoring

- **Cloud Monitoring:** Tracks performance, availability, and health of cloud resources online.
- **Traditional Monitoring:** Monitors on-premise hardware and software systems.
- Cloud monitoring can scale automatically and handle virtual resources.
- Traditional monitoring requires manual updates and fixed hardware.
- Cloud monitoring provides real-time alerts and predictive insights.

17. Deployment of Web Application Over Cloud Using Service Middleware

- Middleware acts as a bridge between the web application and cloud services.
- Helps handle database connections, authentication, and API calls efficiently.
- Cloud deployment allows apps to be accessible globally via the internet.
- Reduces need for managing physical servers or network infrastructure.
- Middleware ensures smooth communication between application layers.

18. Difference Between Elastic Computing and Utility Computing

- **Elastic Computing:** Resources can automatically increase or decrease based on demand.
- **Utility Computing:** Users pay only for the computing resources they use.
- Elastic computing improves performance under varying loads.
- Utility computing reduces cost by charging per usage instead of fixed rates.
- Both concepts make cloud computing flexible and cost-effective.

19. Working of Cloud Monitoring

- Cloud monitoring keeps track of cloud servers, applications, and services continuously.
- Sends alerts if resources are underperforming or overloaded.
- Helps in predicting failures and improving system reliability.
- Monitors metrics like CPU usage, memory, disk space, and network traffic.
- Supports automated actions to maintain smooth operations.

20. Use of Middleware with Distributed Cloud Applications Using SOAP

- Middleware acts as a communication layer between different applications.
- SOAP (Simple Object Access Protocol) allows structured data exchange over networks.
- Middleware manages requests, responses, and data format conversions.
- Enables cloud applications to work across different systems and platforms.
- Helps achieve reliability, security, and interoperability in distributed apps.

21. Concept of Load Balancing Services in Real-Time Applications

- Load balancing distributes incoming network or application traffic across multiple servers.
- Ensures no single server is overloaded, improving performance and reliability.
- Used in web applications, online gaming, streaming platforms.
- Helps in fault tolerance and high availability.
- Supports auto-scaling and efficient resource utilization.

22. Hybrid Cloud Diagram Workload Distribution

- Hybrid cloud combines **private and public cloud** environments.
- Sensitive data can stay on private cloud; high-demand workloads can go to public cloud.
- Balances cost, security, and performance efficiently.
- Supports flexible scaling and disaster recovery.
- Commonly used in enterprises needing both control and scalability.

23. Describe AWS CloudWatch

- AWS CloudWatch monitors AWS resources and applications in real-time.
- Tracks metrics like CPU, memory, storage, and network activity.
- Sends alarms if thresholds are crossed, helping prevent downtime.
- Can automate actions like scaling or restarting servers.
- Helps improve performance, reliability, and cost management.

24. Importance of Elasticity in Cloud Computing

- Elasticity allows cloud systems to automatically adjust resources as demand changes.
- Prevents overloading or wasting resources during low usage.
- Supports cost efficiency because users pay only for what they use.
- Improves performance during high traffic or peak workloads.
- Essential for web applications, e-commerce sites, and real-time services.

25. Advantages of Cloud Monitoring

- Detects issues in real-time and reduces downtime.
- Provides performance metrics and resource usage insights.
- Supports automated scaling and maintenance actions.
- Helps in cost optimization by tracking unused resources.
- Improves reliability, security, and user experience.

26. Comparison Between IaaS, PaaS, and SaaS

- **IaaS (Infrastructure as a Service):** Provides virtual machines, storage, and networking; user manages OS and apps.
- **PaaS (Platform as a Service):** Provides development platform; user focuses on applications, not infrastructure.
- **SaaS (Software as a Service):** Fully ready-to-use applications accessed online; user only uses software.
- IaaS is flexible, PaaS is development-friendly, SaaS is easy and maintenance-free.
- All reduce the need for physical hardware and improve efficiency.

27. How Load Balancing Helps Workload Distribution

- Divides incoming requests evenly across multiple servers.
- Prevents server overload and ensures fast response times.
- Supports high availability and reliability of applications.
- Helps in auto-scaling by directing traffic to new servers.
- Used in cloud web apps, online stores, and streaming platforms.

28. Cloud Bursting and Auto Scaling

- **Cloud Bursting:** On-premise applications use public cloud resources when demand spikes.
- **Auto Scaling:** Cloud automatically adds or removes resources based on traffic.

- Both help handle sudden high workloads efficiently.
- Reduce costs by using extra resources only when needed.
- Improves performance, reliability, and customer experience.

29. Describe Resource Management

- Cloud resource management controls computing, storage, and network resources efficiently.
- Ensures optimal allocation to applications based on priority and demand.
- Helps reduce costs and prevents resource wastage.
- Supports scaling, load balancing, and high availability.
- Essential for maintaining smooth operations in distributed cloud systems.

1. Dynamic Scaling and Elasticity

- **Dynamic Scaling** automatically adjusts cloud resources based on current demand.
- Adds resources during high traffic and removes them during low traffic.
- **Elasticity** allows flexible use of resources without manual intervention.
- Helps prevent overloading and ensures optimal performance.
- Reduces cost because users pay only for the resources they actually use.
- Essential for web apps, e-commerce, and real-time cloud services.

2. SOAP Service Technology in Cloud Computing

- **SOAP (Simple Object Access Protocol)** is a protocol for exchanging structured data over a network.
- Uses XML format for message communication between applications.
- Enables cloud applications to work across different platforms and programming languages.
- Middleware often manages SOAP requests and responses for reliability and security.
- Supports distributed computing by allowing remote procedure calls over the cloud.
- Ensures interoperability, reliability, and standardization in cloud services.

Set 1

1. What are the two main deployment scenarios of the Private Cloud model?

- A **Private Cloud** is dedicated to a single organization for better control and security.
- **On-Premise Private Cloud**: Hosted within the company's own data center. Provides high security, customization, and compliance. Example: Banks hosting critical apps.
- **Externally Hosted Private Cloud**: Managed by a third-party vendor but not shared with others. Offers scalability and reduces IT management burden.
- On-premise gives **full control but high cost**, while external hosting gives **flexibility and less cost**.
- Both ensure that resources are **isolated and secure** for one organization only.

2. Describe the benefits of the Community Cloud scenario.

- A **Community Cloud** is shared by multiple organizations with **similar needs** (e.g., hospitals, universities, or government agencies).
- It reduces **infrastructure cost** as expenses are shared among members.
- Provides **better security** than Public Cloud because only trusted members share it.
- Encourages **collaboration** by allowing organizations to work on common platforms.
- Prevents duplication of resources and supports industry-specific compliance.
- Example: Multiple hospitals sharing a community cloud for storing patient data securely.
- Overall, it balances **cost-effectiveness, privacy, and cooperation**.

3. Differentiate between service orchestration and service choreography in the context of SOA.

- **Service Orchestration**: A **centralized controller** manages the order in which services interact.
  - Example: An online order system where a central engine controls payment, shipping, and notification services.
- **Service Choreography**: A **decentralized model** where services interact directly with each other without a central controller.
  - Example: In banking, services like account, notification, and fraud detection can interact based on rules.
- Orchestration = **centralized, controlled, easier debugging**.
- Choreography = **decentralized, flexible, scalable**.
- Both are important in SOA for managing service-to-service communication.

Set 2

2. List and briefly explain three essential characteristics of cloud computing according to the NIST definition.

- **On-Demand Self-Service**: Users can access resources (like storage or computing power) whenever needed without manual intervention.
- **Broad Network Access**: Cloud services are available over the internet and can be accessed through laptops, mobiles, or tablets.
- **Resource Pooling**: Cloud providers share computing resources among multiple users, ensuring cost efficiency.
- (Other NIST features include **Rapid Elasticity** and **Measured Service**).
- These characteristics ensure **flexibility, scalability, and cost savings** in cloud usage.

3. What are the four deployment models of cloud computing? Provide a brief description of each.

- **Public Cloud**: Services are available to the general public over the internet (e.g., AWS, Azure). Cost-effective but less secure.
- **Private Cloud**: Dedicated to one organization. Provides high control and security but is expensive.

- **Hybrid Cloud**: Mix of public and private clouds, allowing sensitive data to stay private while other services run on public cloud.
- **Community Cloud**: Shared among organizations with similar needs (e.g., government departments).
- Each model is chosen based on **security, cost, and scalability** requirements.

6. What is the Cloud Cube Model, and how does it categorize cloud networks based on different dimensions?

- The **Cloud Cube Model**, introduced by Jericho Forum, categorizes cloud services based on **four dimensions**.
- **Internal vs External**: Whether services are hosted inside the organization or by a third party.
- **Proprietary vs Open**: Whether services use closed (vendor-specific) or open standards.
- **Perimeterised vs De-perimeterised**: Security boundaries, whether traditional firewalls or open collaboration.
- **Insourced vs Outsourced**: Whether the organization manages it internally or a provider handles it.
- This model helps businesses **choose the right cloud setup** based on control, security, and openness.

7. Write about software defined network (SDN).

- **SDN** is a modern networking approach that separates the **control plane** (decision-making) from the **data plane** (traffic forwarding).
- Unlike traditional networks, SDN is **centrally managed** by software controllers.
- It allows dynamic configuration of routers, switches, and firewalls using software.
- Benefits: **Flexibility, automation, cost reduction, and faster deployment** of services.
- Widely used in cloud data centers where networks need rapid scaling.
- Example: Google's B4 SDN controls its global data traffic efficiently.

8. Write about Network Interconnection Equipment.

- Network interconnection equipment connects multiple devices or networks to allow communication.
- **Routers**: Connect different networks and direct data packets.
- **Switches**: Connect devices within the same network, improving speed and efficiency.
- **Hubs**: Basic devices that broadcast data to all devices in a network.
- **Gateways**: Translate data between different protocols.
- **Firewalls**: Control and secure traffic between trusted and untrusted networks.
- These devices form the **backbone of networking** in both traditional and cloud systems.

10. What are the goals of distributed system.

- A **distributed system** is a collection of independent computers that work together as one system.
- **Resource Sharing**: Share hardware, software, and data across multiple machines.
- **Transparency**: Users should not notice whether resources are local or remote.

- **Fault Tolerance**: System should continue working even if one node fails.
- **Scalability**: Support growth by adding more machines without performance loss.
- **Concurrency**: Allow multiple users or processes to work at the same time.
- **Performance**: Improve speed and efficiency by distributing workload.
- These goals make distributed systems **reliable, efficient, and user-friendly**.