

MCQs - Clock Synchronization

MCQs - Distributed System Communication

MCQs - Fault Tolerance

MCQs - Data Replication and Consistency

MCQs - Distributed System Architectures

MCQ Questions - Clock Synchronization

Easy Questions

Q1. What is the primary reason clock synchronization is critical in distributed systems?

- A. To ensure all machines display the same local time
- B. To facilitate time zone conversions
- C. To maintain consistency in event ordering and coordination
- D. To improve CPU scheduling
- E. To enable faster computation

Answer: Option C

Q2. Which protocol provides sub-microsecond accuracy and is ideal for financial systems?

- A. SNTP
- B. HTTP
- C. PTP
- D. NTP
- E. RTP

Answer: Option C

Q3. According to Cristian's algorithm, what assumption must generally hold true for accuracy?

- A. Time server must be distributed
- B. Round Trip Time must be minimal compared to accuracy required
- C. Time server should use HTTP
- D. Network jitter is necessary
- E. Messages must be encrypted

Answer: Option B

Q4. In the context of clock drift, what does the constant p represent?

- A. The speed of message transmission
- B. Maximum clock skew between two clocks
- C. Maximum drift rate specified by the manufacturer
- D. Minimum transmission time
- E. Network bandwidth limit

Answer: Option C

Q5. What does the Berkeley algorithm primarily do to achieve synchronization?

- A. Synchronize clocks to a GPS source
- B. Adjust all clocks to the maximum delay observed
- C. Use a master node to average out times and set all clocks accordingly
- D. Broadcast a standard time to all nodes
- E. Discard outlier timestamps and use minimum delay

Answer: Option C

Q6. Which physical phenomenon is used in atomic clocks for time measurement?

- A. Gravitational waves
- B. Oscillation of Quartz crystal
- C. Transition of Cesium-133 atoms
- D. Sunlight movement

E. Earth's rotation

Answer: Option C

Q7. Which of the following protocols uses a hierarchical structure with Grandmaster, Boundary, and Transparent Clocks?

A. RTP

B. HTTP

C. SNTP

D. PTP

E. POP3

Answer: Option D

Q8. What type of clock synchronization does Cristian's algorithm provide?

A. External synchronization

B. Internal synchronization

C. Logical synchronization

D. Absolute synchronization

E. Time zone alignment

Answer: Option B

Q9. Which component sends a Delay Request message in PTP?

A. Master clock

B. Slave clock

C. Backup clock

D. NTP client

E. GPS receiver

Answer: Option B

Q10. Which of the following is NOT a factor affecting clock drift?

A. Temperature changes

B. Voltage fluctuations

C. Hardware differences

D. CPU speed

E. Manufacturing defects

Answer: Option D

Moderate Questions

Q11. What is the formula used to estimate max clock difference between two clocks drifting in opposite directions?

A. $\rho * \Delta t$

B. $2\rho * \Delta t$

C. $\rho + \Delta t$

D. $\rho / \Delta t$

E. $\Delta t / \rho$

Answer: Option B

Q12. Which assumption does the Berkeley algorithm relax compared to Cristian's algorithm?

A. Single time server

B. Need for synchronized UTC time

C. Symmetric delays

D. Low network traffic

E. Real-time timestamp accuracy

Answer: Option C

Q13. Which term best describes the clock synchronization model used when processes do not sync to UTC but to each other?

A. External synchronization

B. Hierarchical synchronization

C. Logical clocking

D. Internal synchronization

E. Geosynchronous model

Answer: Option D

Q14. What kind of errors can occur if clocks are not synchronized in distributed databases?

- A. Improved throughput
- B. Precise time-stamping
- C. Data corruption
- D. Low latency
- E. Accurate replication

Answer: Option C

Q15. Which algorithm assumes predictable delay bounds to estimate event ordering?

- A. Vector clock
- B. Berkeley
- C. Cristian's
- D. Lamport
- E. PTP

Answer: Option C

Q16. In a partially synchronous system, what is the uncertainty of message transmission time defined as?

- A. T_{\min}
- B. T_{\max}
- C. T_{delay}
- D. $u = \max - \min$
- E. $\Delta t / \rho$

Answer: Option D

Q17. What is the optimal bound for synchronizing N clocks in a partially synchronous system?

- A. $u * (1 + 1/N)$
- B. $u * (1 - 1/N)$
- C. $u + N$
- D. $N * \Delta t$
- E. u / N

Answer: Option B

Q18. Which logical clock mechanism can detect causality violations in distributed systems?

- A. Lamport timestamps
- B. Cristian's algorithm
- C. PTP hierarchy
- D. Vector clocks
- E. NTP

Answer: Option D

Q19. Which of the following does NOT apply to logical clocks?

- A. Ensure event ordering
- B. Synchronize to real time
- C. Internal consistency matters
- D. Do not rely on physical time
- E. Used in distributed event tracking

Answer: Option B

Q20. Why is frequent synchronization necessary even with physical clocks?

- A. To adjust for power failures
- B. Because atomic clocks are expensive
- C. To handle network congestion
- D. To avoid drift and maintain accuracy
- E. To reset timestamps

Answer: Option D

Hard Questions

Q21. Which decentralized clock synchronization technique prevents m faulty clocks from skewing time?

- A. Berkeley averaging
- B. Discard m high and low values
- C. NTP polling
- D. PTP sync tree
- E. Broadcast threshold sync

Answer: Option B

Q22. What is a key vulnerability in Cristian's algorithm?

- A. Slow response time
- B. Heavy network traffic
- C. Single point of failure
- D. Asynchronous protocol mismatch
- E. Lack of timestamping

Answer: Option C

Q23. What is a limitation of PTP in distributed systems?

- A. Inaccurate timestamps
- B. High propagation delay
- C. Hardware dependency for accuracy
- D. Does not support sub-microsecond precision
- E. Fails in LAN environments

Answer: Option C

Q24. Why is NTP considered partially synchronous?

- A. Uses real-time clocks only
- B. Message delays are bounded
- C. Has centralized control
- D. Depends on vector timestamps
- E. No transmission delay

Answer: Option B

Q25. How does a process in internal synchronization estimate the skew using transmission time?

- A. Set to T_{\min} only
- B. Set to T_{\max} only
- C. Set to $(\min + \max)/2$
- D. Skew equals zero
- E. Clock resetting to UTC

Answer: Option D

Q26. What is a drawback of using a single time server in a distributed environment?

- A. More throughput
- B. Better replication
- C. Single point of failure
- D. Congestion risk
- E. Overhead cost

Answer: Option C

Q27. How does the Gossip-based synchronization approach reduce fault impact?

- A. Central failure detection
- B. Fixed timeout window
- C. Peer voting
- D. Discard upper half
- E. Self-correcting model

Answer: Option A

Q28. Which algorithm uses hardware timestamping to enhance precision?

- A. NTP

- B. PTP
- C. Cristian's algorithm
- D. RTP
- E. SNTP

Answer: Option B

Q29. What is the main trade-off when choosing between NTP and PTP?

- A. Precision vs. security
- B. Hardware complexity
- C. Real-time vs. latency
- D. Precision vs. network cost
- E. Software versioning

Answer: Option D

Q30. What kind of systems typically use vector clocks?

- A. Centralized databases
- B. Version control tools
- C. Distributed logging systems
- D. Chat apps
- E. Map-reduce tasks

Answer: Option D

MCQ Questions - Distributed System communication

Easy Questions

Q1. Which communication pattern is most suited for real-time notifications in distributed systems?

- A. Blocking
- B. Polling
- C. Remote Callback
- D. Message Broker
- E. Shared Memory

Answer: Option C

Q2. Which of these is a key disadvantage of polling in distributed communication?

- A. High throughput
- B. Efficient resource usage
- C. Wastes CPU cycles
- D. Real-time update
- E. Low latency

Answer: Option C

Q3. Which pattern enables asynchronous message passing with decoupling between sender and receiver?

- A. Remote Callback
- B. Polling
- C. Blocking
- D. Message Broker
- E. WebSocket

Answer: Option D

Q4. In which communication pattern do multiple processes communicate through a shared data space?

- A. Callback
- B. Polling
- C. Shared Distributed Memory
- D. REST API
- E. RPC

Answer: Option C

Q5. Which protocol is commonly used in asynchronous client-server communication?

- A. HTTP

- B. gRPC Async
- C. SOAP
- D. RMI
- E. TCP

Answer: Option B

Q6. Which communication pattern is most suited for real-time notifications in distributed systems?

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Answer: Option C

Q8. Which pattern enables asynchronous message passing with decoupling between sender and receiver?

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- B. Polling
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MCQ Questions - Fault tolerance

Easy Questions

Q1. Which of the following is an example of a Byzantine failure?

- A. System crash
- B. Message omission
- C. Incorrect response
- D. Malicious data sending
- E. Delayed response

Answer: Option D

Q2. What does MTBF stand for in fault tolerance metrics?

- A. Mean Time Before Failure
- B. Maximum Time Between Faults
- C. Mean Time Between Failures
- D. Measured Time Before Fallback
- E. Maximum Time Before Failure

Answer: Option C

Q3. Which fault detection method periodically sends heartbeat messages?

- A. Timeout detection
- B. Gossip protocol
- C. Watchdog timer
- D. Log analysis
- E. Heartbeat mechanism

Answer: Option E

Q4. Which redundancy type duplicates tasks for retrying transient faults?

- A. Hardware
- B. Software
- C. Time
- D. Data
- E. Functional

Answer: Option C

Q5. What does a strong failure detector guarantee?

- A. High availability
- B. No false positives
- C. Quick recovery
- D. Eventual consistency
- E. Minimum retries

Answer: Option B

Q6. Which of the following is an example of a Byzantine failure?

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MCQ Questions - Data Replication and Consistency

Easy Questions

Q1. What is the main goal of data replication in distributed systems?

- A. To increase memory usage
- B. To allow data loss
- C. To improve availability and fault tolerance
- D. To reduce disk I/O
- E. To enhance encryption

Answer: Option C

Q2. Which consistency model ensures all replicas eventually reach the same state?

- A. Strong consistency
- B. Session consistency

- C. Eventual consistency
- D. Causal consistency
- E. Monotonic reads

Answer: Option C

Q3. In quorum-based replication, what condition ensures strong consistency?

- A. $R > W$
- B. $R + W < N$
- C. $R + W > N$
- D. $R = W$
- E. $R + W = N$

Answer: Option C

Q4. Which replication strategy has multiple master nodes that accept updates?

- A. Master-slave
- B. Passive replication
- C. Quorum replication
- D. Multi-master replication
- E. Eventual replication

Answer: Option D

Q5. Which tool is commonly used for tracking causal history in replicated data?

- A. Hash table
- B. Vector clock
- C. Lamport timestamp
- D. CRDT
- E. Last-write-wins

Answer: Option B

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Answer: Option B

MCQ Questions - Distributed System Architectures
Easy Questions

Q1. Which architecture uses a vertical separation of concerns across tiers?

- A. Peer-to-peer
- B. Layered
- C. Hybrid
- D. Event-driven
- E. Ring-based

Answer: Option B

Q2. In which system architecture do nodes act as both clients and servers?

- A. Client-server
- B. Layered
- C. Peer-to-peer
- D. N-tier
- E. Microkernel

Answer: Option C

Q3. What is the role of connectors in software architecture?

- A. To store data
- B. To manage memory
- C. To link components and enable communication
- D. To execute business logic
- E. To secure applications

Answer: Option C

Q4. Which architecture supports Publish/Subscribe communication style?

- A. Layered
- B. Component-based
- C. Event-driven
- D. Data-centered
- E. Client-server

Answer: Option C

Q5. Which P2P architecture uses Distributed Hash Tables (DHTs)?

- A. Unstructured P2P
- B. Client-server
- C. Component-based
- D. Structured P2P
- E. Hybrid cloud

Answer: Option D

Q6. Which architecture uses a vertical separation of concerns across tiers?

- A. Peer-to-peer
- B. Layered
- C. Hybrid
- D. Event-driven
- E. Ring-based

Answer: Option B

Q7. In which system architecture do nodes act as both clients and servers?

- A. Client-server
- B. Layered
- C. Peer-to-peer
- D. N-tier
- E. Microkernel

Answer: Option C

Q8. What is the role of connectors in software architecture?

- A. To store data

- B. To manage memory
- C. To link components and enable communication
- D. To execute business logic
- E. To secure applications

Answer: Option C

Q9. Which architecture supports Publish/Subscribe communication style?

- A. Layered
- B. Component-based
- C. Event-driven
- D. Data-centered
- E. Client-server

Answer: Option C

Q10. Which P2P architecture uses Distributed Hash Tables (DHTs)?

- A. Unstructured P2P
- B. Client-server
- C. Component-based
- D. Structured P2P
- E. Hybrid cloud

Answer: Option D

Moderate Questions

Q11. Which architecture uses a vertical separation of concerns across tiers?

- A. Peer-to-peer
- B. Layered
- C. Hybrid
- D. Event-driven
- E. Ring-based

Answer: Option B

Q12. In which system architecture do nodes act as both clients and servers?

- A. Client-server
- B. Layered
- C. Peer-to-peer
- D. N-tier
- E. Microkernel

Answer: Option C

Q13. What is the role of connectors in software architecture?

- A. To store data
- B. To manage memory
- C. To link components and enable communication
- D. To execute business logic
- E. To secure applications

Answer: Option C

Q14. Which architecture supports Publish/Subscribe communication style?

- A. Layered
- B. Component-based
- C. Event-driven
- D. Data-centered
- E. Client-server

Answer: Option C

Q15. Which P2P architecture uses Distributed Hash Tables (DHTs)?

- A. Unstructured P2P
- B. Client-server

C. Component-based

D. Structured P2P

E. Hybrid cloud

Answer: Option D

Q16. Which architecture uses a vertical separation of concerns across tiers?

A. Peer-to-peer

B. Layered

C. Hybrid

D. Event-driven

E. Ring-based

Answer: Option B

Q17. In which system architecture do nodes act as both clients and servers?

A. Client-server

B. Layered

C. Peer-to-peer

D. N-tier

E. Microkernel

Answer: Option C

Q18. What is the role of connectors in software architecture?

A. To store data

B. To manage memory

C. To link components and enable communication

D. To execute business logic

E. To secure applications

Answer: Option C

Q19. Which architecture supports Publish/Subscribe communication style?

A. Layered

B. Component-based

C. Event-driven

D. Data-centered

E. Client-server

Answer: Option C

Q20. Which P2P architecture uses Distributed Hash Tables (DHTs)?

A. Unstructured P2P

B. Client-server

C. Component-based

D. Structured P2P

E. Hybrid cloud

Answer: Option D

Hard Questions

Q21. Which architecture uses a vertical separation of concerns across tiers?

A. Peer-to-peer

B. Layered

C. Hybrid

D. Event-driven

E. Ring-based

Answer: Option B

Q22. In which system architecture do nodes act as both clients and servers?

A. Client-server

B. Layered

C. Peer-to-peer

- D. N-tier
- E. Microkernel

Answer: Option C

Q23. What is the role of connectors in software architecture?

- A. To store data
- B. To manage memory
- C. To link components and enable communication
- D. To execute business logic
- E. To secure applications

Answer: Option C

Q24. Which architecture supports Publish/Subscribe communication style?

- A. Layered
- B. Component-based
- C. Event-driven
- D. Data-centered
- E. Client-server

Answer: Option C

Q25. Which P2P architecture uses Distributed Hash Tables (DHTs)?

- A. Unstructured P2P
- B. Client-server
- C. Component-based
- D. Structured P2P
- E. Hybrid cloud

Answer: Option D

Q26. Which architecture uses a vertical separation of concerns across tiers?

- A. Peer-to-peer
- B. Layered
- C. Hybrid
- D. Event-driven
- E. Ring-based

Answer: Option B

Q27. In which system architecture do nodes act as both clients and servers?

- A. Client-server
- B. Layered
- C. Peer-to-peer
- D. N-tier
- E. Microkernel

Answer: Option C

Q28. What is the role of connectors in software architecture?

- A. To store data
- B. To manage memory
- C. To link components and enable communication
- D. To execute business logic
- E. To secure applications

Answer: Option C

Q29. Which architecture supports Publish/Subscribe communication style?

- A. Layered
- B. Component-based
- C. Event-driven
- D. Data-centered
- E. Client-server

Answer: Option C

Q30. Which P2P architecture uses Distributed Hash Tables (DHTs)?

- A. Unstructured P2P
- B. Client-server
- C. Component-based
- D. Structured P2P
- E. Hybrid cloud

Answer: Option D