1. Content Delivery Networks (CDN) Basics

- **Definition:** A CDN is a network of servers distributed across various locations to deliver content to users more efficiently and reliably.
- **Purpose:** Reduces latency, increases availability, and improves the user experience by caching content closer to the user.

2. Edge Computing

- **Definition:** Edge computing brings computation and data storage closer to the location where it is needed, improving response times and saving bandwidth.
- **Role in CDN:** Edge servers cache content locally, perform real-time processing, and reduce the load on origin servers.

3. Latency and Performance Optimization

- **Latency Reduction:** Minimize the distance data travels by strategically placing edge servers near users.
- **Caching Strategies:** Implement effective caching policies (e.g., TTL, cache purging, cache warming) to ensure frequently accessed content is readily available.

4. Load Balancing

- **Definition:** Distribute incoming network traffic across multiple servers to ensure no single server becomes a bottleneck.
- **Techniques:** Use DNS-based load balancing, Anycast routing, and intelligent request routing based on factors like server load, user proximity, and network conditions.

5. Scalability

- **Horizontal Scaling:** Add more servers to handle increased load.
- **Vertical Scaling:** Increase the capacity of existing servers (more CPU, memory).
- **Auto-scaling:** Dynamically add or remove resources based on current demand.

6. Fault Tolerance and High Availability

- **Redundancy:** Ensure multiple copies of data and services are available across different servers and locations.
- **Failover Mechanisms:** Automatically switch to backup servers or data centers in case of failures.
- **Health Monitoring:** Continuously monitor server health and user requests to detect and respond to failures promptly.

7. Data Consistency

- **Caching Consistency:** Maintain consistency between cached content and the origin server.
- **Invalidation Strategies:** Use techniques like cache purging and TTL (Time-to-Live) settings to ensure outdated content is not served.

8. Security

- **Encryption:** Use HTTPS/TLS to secure data in transit.
- **DDoS Protection:** Implement measures to mitigate Distributed Denial of Service attacks.
- **Access Control:** Ensure secure access to edge servers and sensitive content.

9. Monitoring and Analytics

- **Real-time Monitoring:** Track server performance, user access patterns, and network conditions.
- **Logging and Alerts:** Collect logs for auditing and troubleshooting, and set up alerts for unusual activities or failures.
- **Analytics:** Analyze data to optimize content distribution, predict traffic patterns, and improve user experience.

10. Cost Management

- **Resource Optimization:** Efficiently use resources to minimize costs.
- **Bandwidth Management:** Optimize data transfer to reduce bandwidth costs.
- **Cloud Integration:** Leverage cloud services for elasticity and cost efficiency.

11. Content Delivery Strategies

- **Geographical Distribution:** Place edge servers in strategic locations based on user demographics.
- **Content Pre-fetching:** Anticipate and cache content likely to be requested by users.
- **Personalization:** Use user data to deliver personalized content dynamically.

12. Scheduling and Traffic Management

- **Request Routing:** Direct user requests to the most appropriate edge server.
- **Scheduling Algorithms:** Implement algorithms to prioritize and manage content updates, balancing load and freshness.
- **QoS (Quality of Service):** Ensure high-quality delivery by managing traffic based on priority and resource availability.

Example Design Considerations for TikTok

When designing an Edge CDN scheduling system for a platform like TikTok, consider:

1. **User-generated Content:** High volume and variability in content type and size.
2. **Real-time Streaming:** Low latency and high throughput requirements.
3. **Global Audience:** Need for widespread edge server placement and efficient routing.
4. **Dynamic Content:** Frequent updates and personalized content delivery.
5. **Mobile Optimization:** Ensure content is optimized for mobile users, who make up a large portion of TikTok's user base.

By understanding and applying these concepts, you'll be well-prepared to discuss the design and optimization of an Edge CDN scheduling system in your interview.

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