5 ARCHITECTURAL PROBLEMS:

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Twitter's Scalability Crisis (2010)

Problem: Scalability in Software Architecture

The Architectural Issue:

Twitter's system was built as a monolithic architecture, meaning all features and components were part of one large system. This caused major problems as the user base and activity grew. The system couldn't efficiently handle the increasing traffic and often crashed during high-traffic events like breaking news.

Solution: Architectural Changes to Address Scalability

Adopting Microservices Architecture: To solve this issue, Twitter transitioned to a microservices architecture. This change divided the monolithic system into smaller, independent components, each responsible for a specific function. For example:

- **Timeline Service:** Handles displaying tweets.
- **User Service:** Manages user accounts and authentication.

How to Fix It: Steps in Detail

1. **Breaking Down the System:**
    - Identify the major components of the monolithic system.
    - Separate these into smaller services that operate independently.
    - Ensure each service communicates with others through well-defined APIs.

2. **Improving Databases:**
    - Replace a single, centralized database with multiple distributed databases.
    - Use sharding to divide data into smaller parts across different servers.
3. **Using Caches:**
    - Implement caching mechanisms like Redis or Memcached.
    - Store frequently accessed data temporarily to reduce database load.
4. **Real-Time Data Processing:**
    - Adopt tools like Apache Kafka for real-time streaming of data.
    - Ensure updates to timelines and other features are processed quickly.
5. **Adding More Servers:**
    - Use horizontal scaling by adding more servers instead of upgrading existing ones.
    - Distribute workload evenly across servers to handle more users simultaneously.
6. **Monitoring and Alerting Systems:**
    - Deploy monitoring tools to track the health and performance of the system.
    - Set up alerts to notify engineers of issues before they impact users.

Outcome of the Fix

By implementing these architectural solutions, Twitter transformed its infrastructure into a scalable, reliable system. The platform could handle rapid growth and high-traffic events without crashing, ensuring a better user experience. These improvements were reflected in updated system versions, marking the transition to a robust architecture.
