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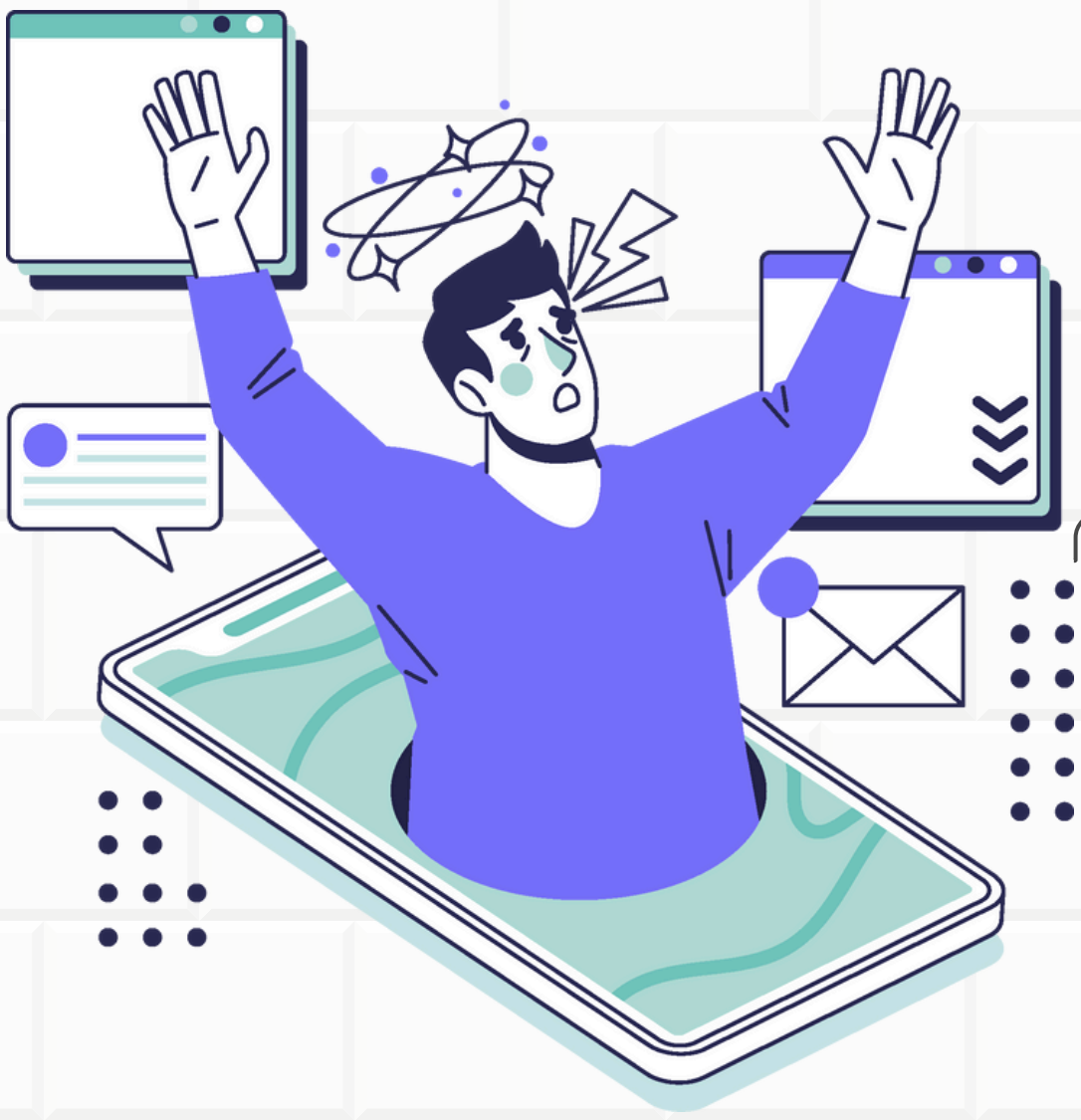
Why Do Apps Crash?

Understanding Load Balancers & Fault Tolerance



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Introduction

Have you ever used an app that suddenly crashed or became unresponsive? App crashes can be frustrating, especially during high traffic. But how do companies like Netflix, Google, and Amazon keep their services running smoothly? The answer lies in load balancing and fault tolerance.

What You'll Learn:

- **Common reasons why apps crash**
- **The role of load balancers in handling traffic**
- **How fault tolerance keeps apps running smoothly**

Why Do Apps Crash?

👉 **Apps crash for many reasons, including:**

- **High Traffic Overload** – Too many users at once can overwhelm servers.
- **Memory Leaks** – Apps consume too much memory without releasing it.
- **Uncaught Exceptions** – Unexpected errors that aren't handled properly.
- **Database Failures** – If the database goes down, apps may stop working.
- **Network Issues** – Slow or lost connections affect cloud-based apps.

What is Load Balancing?

Load balancing distributes incoming traffic across multiple servers to prevent overload and improve performance.

👉 How It Works:

- A user sends a request to an app.
- The load balancer decides which server should handle it.
- The request is sent to the chosen server, ensuring no single server is overwhelmed.

👉 Types of Load Balancers:

- Hardware Load Balancers – Physical devices that distribute traffic.
- Software Load Balancers – Cloud-based or software-defined balancing.

Load Balancing Algorithms

👉 Round Robin

- Requests are distributed sequentially to each server.
- Useful for simple, equal workloads.

👉 Least Connections

- Sends traffic to the server with the fewest active connections.
- Best for dynamic workloads.

👉 IP Hashing

- Assigns users to specific servers based on their IP.
- Helps with session persistence (e.g., staying logged in).

Fault Tolerance – Keeping Apps Online

Fault tolerance ensures that even when part of the system fails, the app continues to function without downtime.

👉 Radix Sort

- Redundancy – Duplicate systems that take over if one fails.
- Failover Mechanisms – Automatic switching to a backup system.
- Database Replication – Keeping copies of the database on multiple servers.

Real-World Examples of Load Balancing & Fault Tolerance

Netflix – Uses global load balancing to handle millions of streams.

Google Search – Distributes queries across thousands of servers.

Amazon – Uses fault-tolerant architecture to prevent downtime.

These companies invest heavily in scalability, redundancy, and failover mechanisms to keep their platforms running.

Preventing Crashes with Auto-Scaling

Auto-scaling allows apps to automatically add or remove servers based on demand.

👉 **How It Works:**

- **Traffic increases** → More servers are added.
- **Traffic decreases** → Unused servers are removed.

This keeps costs low while ensuring stability during peak times

Monitoring & Error Handling

To prevent crashes, companies use real-time monitoring and error-handling techniques:

👉 **How It Works:**

- **Logging & Alerts –** Detect issues before they cause downtime.
- **Rate Limiting –** Controls traffic to prevent server overload.
- **Circuit Breakers –** Automatically stop failing requests to prevent a system-wide crash.

The Future of App Stability

Advancements in AI and predictive analytics help detect potential failures before they happen.

👉 **Trends in Fault Tolerance:**

- Self-healing systems that fix errors automatically.
- AI-powered traffic management to optimize server loads.
- Edge computing to reduce latency and improve resilience.

Conclusion & Further Reading

👉 Key Takeaways:

- Apps crash due to traffic overload, memory issues, and network failures.
- Load balancers distribute traffic across multiple servers.
- Fault tolerance ensures apps stay online even when failures occur.
- Auto-scaling and monitoring help prevent crashes in real-time.

👉 Further Reading:

- Load Balancing Explained (Cloudflare)
- How Netflix Ensures Uptime
- AWS Auto-Scaling Guide

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