**Fleet Nexa: On-Demand Logistics Platform for Goods Transportation**

**INTRODUCTION**

Fleet Nexa is a modern, on-demand logistics platform designed to streamline the transportation of goods for both users and drivers. Built with microservice architecture, Fleet Nexa enables real-time booking, live tracking, dynamic pricing, and seamless fleet management. By utilizing cutting-edge technologies such as WebSocket, Redis, Kafka, and PostgreSQL, the platform provides fast, reliable, and scalable services to handle high-volume traffic while ensuring real-time data flow.

With its intuitive interface and intelligent backend, Fleet Nexa is tailored to efficiently connect users to a vast fleet of drivers, ensuring timely deliveries and transparent communication at every step of the process. From booking a vehicle to real-time tracking and feedback, every aspect is designed to enhance the user experience while keeping operations smooth for drivers and administrators alike.

**SYSTEM DESIGN DECISIONS**

* **Microservice Architecture**: Chose a modular, service-based design to manage complexity and scale individual services independently. This allows each service, such as booking, real-time tracking, and admin, to operate autonomously, promoting flexibility and fault isolation.
* **Real-Time Location and Web Sockets**: For live tracking, we integrated WebSocket to ensure continuous, low-latency communication between users and drivers. This approach keeps users engaged and up to date on deliveries in real-time.
* **Redis for Live Location Storage**: Redis was selected for its low-latency and high-speed read-write capabilities. Storing real-time GPS data in Redis ensures quick retrieval, crucial for real-time updates.
* **Database Sharding**: Implemented sharding based on the user's email to distribute the data across multiple databases, reducing bottlenecks, and ensuring faster data access for a high volume of users.
* **Pricing Service with Dynamic Calculation**: We developed a flexible pricing service that dynamically adjusts based on factors such as distance, vehicle type, and time slot, ensuring scalability as the system grows and global traffic increases.
* **Scheduled Bookings**: Added support for future bookings to accommodate user preferences. This introduces additional considerations for efficient scheduling and resource allocation.

A diagram of a flowchart

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**TECH STACK**

* Next.js: Ensures fast, server-side rendered pages for a smooth user experience.
* TypeScript: Enhances code quality and scalability with type safety.
* Node.js & Express.js: Efficiently handles multiple concurrent requests with a flexible API structure.
* PostgreSQL: Provides reliable, persistent storage for users, bookings, drivers, and vehicles.
* Redis: Ensures fast reads and writes for real-time tracking with live location data.
* Kafka: Manages asynchronous communication between services for seamless event-driven processing.
* WebSockets: Facilitates real-time updates between users and drivers for location tracking and job status changes.
* Supabase: Simplifies database operations and authentication with seamless integration into PostgreSQL.

**SCALING THE SYSTEM**

1. Horizontal Scaling

* Microservices: Scale services like booking and real-time tracking independently based on demand.
* API Gateway: Use load balancing techniques (e.g., round-robin) to distribute traffic across service instances.

2. Auto-Scaling

* Cloud Services: Implement auto-scaling to adjust instances based on demand, increasing during peak times and reducing during off-peak.
* Serverless Functions: Use AWS Lambda for event-driven tasks to ensure instant scalability.

3. Database Scaling

* Sharding: Distribute users across PostgreSQL shards to minimize bottlenecks.
* Master Slave Architecture: Use replicas to offload read traffic from the master instance.
* Partitioning: Apply table partitioning for bookings to enhance query performance.

4. Caching

* Redis: Cache frequently accessed data to reduce database load.
* CDN: Distribute static content globally to improve delivery speed.

5. Real-Time Data Handling

* Redis for Locations: Use Redis clustering for efficient location updates.
* WebSocket Scaling: Load balance WebSocket connections to handle active users effectively.

6. Message Queue with Kafka

* Kafka Clustering: Scale Kafka by increasing partitions and brokers to support higher event throughput.

7. Geographical Scaling

* Multi-Region Deployment: Deploy services in multiple regions to reduce latency and enhance failover capabilities.
* Geo-Partitioning: Store user data closer to their location for better performance and compliance.

**FEATURES IMPLEMENTED**

1. User Booking System

* Booking Process: Users can easily book deliveries through a user-friendly interface.
* Driver Acceptance: Upon receiving a booking request, the delivery driver can view and accept the request.

2. Location Management

* Pickup and Drop-off Locations: Drivers initially see only the pickup location. After accepting the request, they gain access to the drop-off location.
* Real-Time Location Tracking: Both users and drivers can track each other's real-time locations, ensuring transparency and safety during the delivery process.
* Shortest Route Guidance: Drivers receive the shortest route to reach the pickup and drop-off locations efficiently.

3. Booking History

* View All Bookings: Users and drivers can access their booking history, providing a comprehensive overview of past deliveries and interactions.
* Driver Ratings: After successful deliveries, users can rate the driver based on their experience, contributing to quality assurance.

4. Pricing Model

* Dynamic Cost Estimation: The system calculates estimated delivery costs based on various factors:
  + Distance between pickup and drop-off locations
  + Type of vehicle selected
  + Vehicle capacity
  + Time of delivery

5. Admin Management

* Fleet Management: Admins can manage the entire fleet, including adding and removing vehicles and drivers.
* Booking Oversight: Admins have access to view all drivers' bookings and ratings, ensuring operational oversight.
* Availability Management: Admins can mark vehicles and drivers unavailable, managing resources effectively during peak times or maintenance.

6. Real-Time Tracking Service

* Live Location Storage: Redis is utilized for storing live location data, allowing for rapid updates and retrieval of current location information. This is particularly beneficial for frequently changing data.

7. Database Structure

* The system maintains five core tables:
  + Admins: For administrative user management.
  + Bookings: To track all delivery requests and statuses.
  + Drivers: Information and management of all drivers in the fleet.
  + Users: To manage end-user information and profiles.
  + Vehicles: Details and specifications of all vehicles in the fleet.

8. User Interface

* Polished and Elegant UI: The user interface is designed to be intuitive and visually appealing, enhancing the overall user experience.

A screenshot of a computer screen

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