Mastering System Design

Design a Ticketing System (BookMyShow)

What is a Ticketing System?

- A ticketing system is an online platform that allows users to browse, book, and manage tickets for events such as concerts, sports, and travel.
- It must handle real-time seat availability, secure transactions, and high concurrency.

Functional Requirements

- Users should be able to:
  - Browse events and view available seats
  - Book/reserve tickets
  - Get real-time seat availability
  - Pay for tickets securely
  - Receive email/SMS confirmations
- Admins should be able to:
  - Create/manage events and venues
  - Define seat layouts and pricing

Non-Functional Requirements

- High Availability (No downtime during peak sales)
- Low Latency (Booking response in milliseconds)
- Scalability (Handle flash sales, global traffic)
- Data Consistency (Avoid double booking of the same seat)
- Audit Logs (For tracking transactions and fraud prevention)

Constraints & Challenges

- 5M total users, 100K concurrent users at peak
- Global event organizers (multi-region support)
- Handling payment failures (release locked seats quickly)

Estimating Scale & Identifying Bottlenecks

- User Load Assumptions
  - 📈 1M Daily Active Users (DAU)
  - 👥 100K Concurrent Users during peak events
  - 🔎 Each user browses ~10 events/day → 10M read requests/day
- Booking Traffic Estimations
  - 🧾 ~500K bookings/day
  - ⏱️ Average: ~6 bookings/sec
  - 🚀 Peak Load: up to 2000 bookings/sec (e.g., big concert ticket release)

Identifying System Bottlenecks

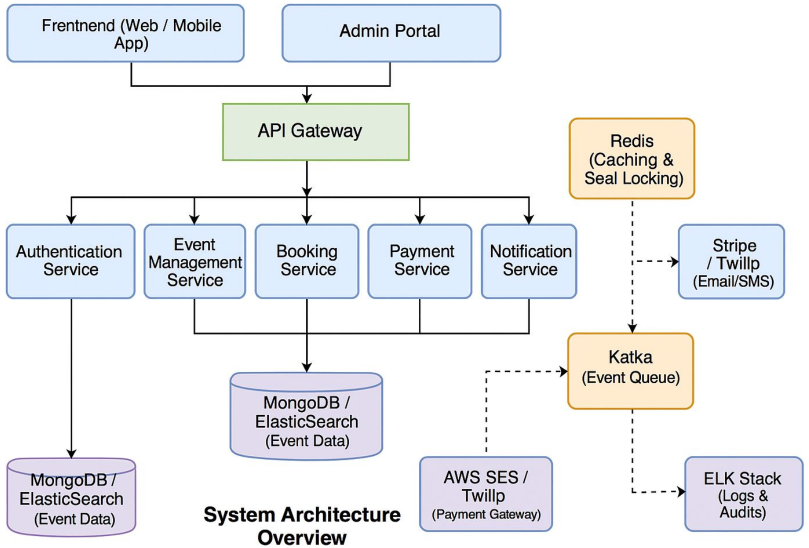
- 🔁 Concurrency in Seat Allocation:
  - Race conditions while multiple users book the same seat
- 🛢️ Database Write Pressure
  - Sudden spike in bookings can overwhelm the write DB
- 🌐 Payment and External API Latency
  - Delays or failures in third-party APIs can block seat availability
- 📩 Notification Backlogs
  - Email/SMS confirmation systems can queue up during spikes

Core Components Overview

- 🧱 The system consists of the following major components:
  - **Frontend Clients**: Web & Mobile App
  - **API Gateway**: Unified entry point for routing and authentication
  - **Authentication** Service
  - **Admin Portal**: Event creation, venue setup, pricing

Backend Services

- **Event Management Service**: Manage events, venues, and seat layouts
- **Seat Inventory Service**: Track available/locked/booked seats
- **Booking Service**: Handles bookings, locking seats, confirming payments
- **Payment Service**: Integrates with payment gateway, handles retries
- **Notification Service**: Sends booking confirmations via Email/SMS


Frentnend (Web / Mobile App)
Admin Portal
API Gateway
Redis (Caching & Seal Locking)
Authentication Service
Event Management Service
Booking Service
Payment Service
Notification Service
Stripe / Twillp (Email/SMS)
Katka (Event Queue)
MongoDB / ElasticSearch (Event Data)
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AWS SES / Twillp (Payment Gateway)
ELK Stack (Logs & Audits)

System Architecture Overview

Data & Caching Architecture

- **Relational DB** (e.g., PostgreSQL/MySQL): For transactions, bookings, users
- **NoSQL DB** (e.g., MongoDB/DocumentDB): For events and seat layouts
- **Caching Layer** (Redis/Memcached): Real-time seat availability
- **Queue System** (Kafka/RabbitMQ): Async handling for:
    - Emails
    - Payment retries
    - Audit logs

Notable Design Decisions

- 💡 **Concurrency Control**: Use Optimistic Locking (version check) or Pessimistic Locking (seat-level lock)
- ⏱️ **Seat Hold Timeout Logic**: Redis-backed TTL-based lock → auto-releases after 5 minutes
- 📚 **CQRS Pattern**: Split reads (seat availability, listings) from writes (bookings)
- 🔁 **Idempotency Keys for Payments**: Prevents duplicate charges and ensures safe retries

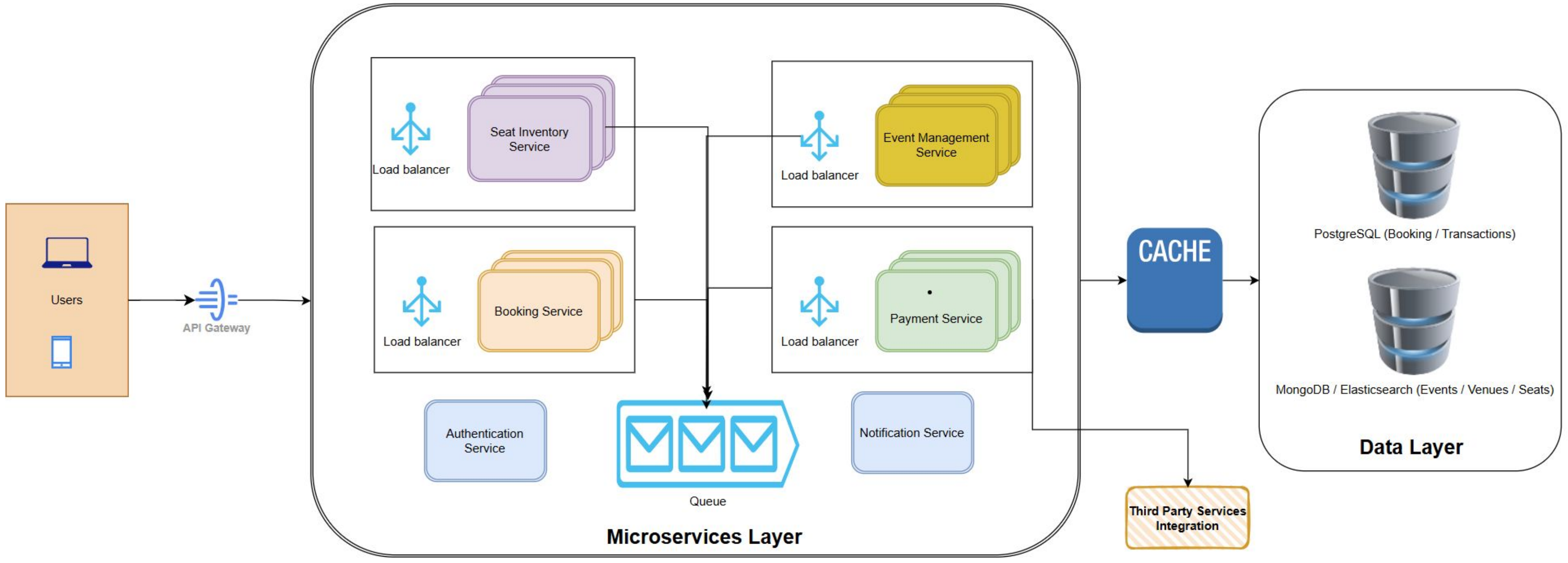
API Design (Only few key ones)

- Event Management Service:
    - Resource: /events
    - POST /events: Create a new event.
        - Request Body: (Details of the event: name, description, date, time, location, etc.)
        - Response Body (Success - 201 Created): (Details of the created event, including its ID)
    - GET /events: Get a list of all events (potentially with filtering, sorting, and pagination via query parameters).
        - Response Body (Success - 200 OK): [{"id": "...", "name": "...", ...}, ...]
    - GET /events/{eventId}: Get details of a specific event.
        - Response Body (Success - 200 OK): {"id": "...", "name": "...", ...}
        - Response Body (Failure - 404 Not Found): {"error": "Event not found"}
- Booking Service:
    - Resource: /bookings
    - POST /bookings: Create a new booking for an event.
        - Request Body: {"eventId": "...", "userId": "...", "numberOfTickets": ...} (and potentially other booking details)
        - Response Body (Success - 201 Created): (Details of the created booking, including its ID)
        - Response Body (Failure - 400 Bad Request): (e.g., "Not enough tickets available")
    - GET /bookings: Get a list of all bookings (potentially filtered by user or event via query parameters).
        - Response Body (Success - 200 OK): [{"id": "...", "eventId": "...", "userId": "...", ...}, ...]
    - GET /bookings/{bookingId}: Get details of a specific booking.
        - Response Body (Success - 200 OK): {"id": "...", "eventId": "...", "userId": "...", ...}
        - Response Body (Failure - 404 Not Found): {"error": "Booking not found"}

Strategic Tech & Infra Decisions

- **API Gateway**: Use NGINX for self-managed or AWS API Gateway for serverless routing and rate-limiting
- **Authentication**: Implement OAuth 2.0 with JWT tokens for secure, stateless auth
- **Booking Database**: Choose PostgreSQL for strong consistency and transactional support
- **Event & Venue Data**: Use MongoDB or Elasticsearch for flexible, schema-less search and filtering
- **Caching Layer**: Integrate Redis for fast access to seat availability and temporary locks
- **Async Messaging**: Adopt Kafka for high-throughput event streaming and async workflows (notifications, logging)
- **Payment Gateway**: Integrate with Stripe or Razorpay, ensuring support for retries and webhooks
- **Notifications**: Use AWS SES for emails and Twilio for SMS confirmations
- **Infrastructure**: Deploy on Kubernetes with Auto-Scaling Groups for elasticity and resilience
- **Monitoring**: Leverage Prometheus and Grafana for metrics and real-time dashboards
- **Logging**: Use the ELK Stack (Elasticsearch, Logstash, Kibana) for centralized log aggregation and search

The Final Design - Ticketing System (BookMyShow)


Users
API Gateway
Load balancer
Seat Inventory Service
Load balancer
Event Management Service
Load balancer
Booking Service
Load balancer
Payment Service
Authentication Service
Queue
Notification Service
Microservices Layer
CACHE
Third Party Services Integration
PostgreSQL (Booking / Transactions)
MongoDB / Elasticsearch (Events / Venues / Seats)
Data Layer