

Ticket Booking App

A. Database Design:

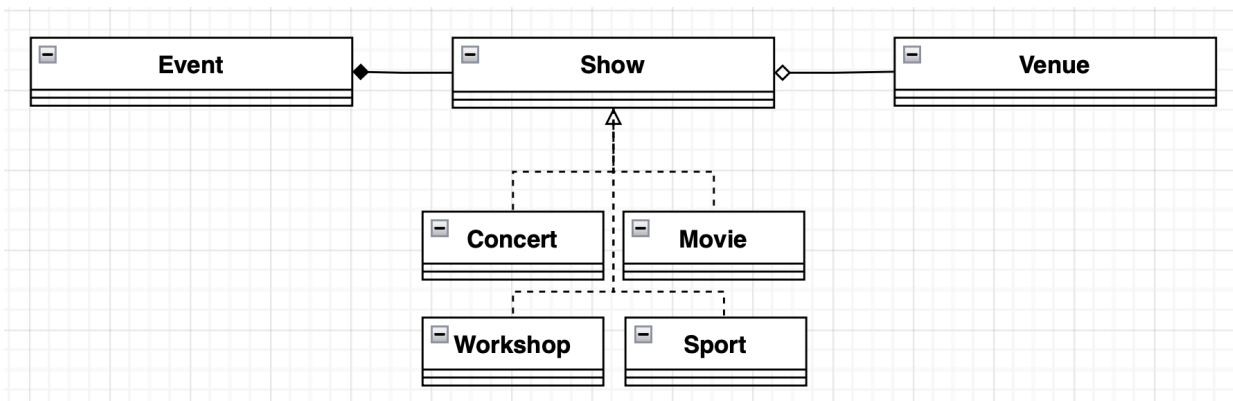
1. Breaking down the whole db design into 4 major components
 - a. Event Management
 - b. Seat Management
 - c. Booking Management
 - d. User Management

2. Relations and Object identifications

- a. Event Management

Events are like bigger plans. Like a movie releasing or a music tour

Now each event is associated with *Shows*. Shows are like a movie show in a particular theatre or a music event in Bangalore on a particular date. Each *Show* will be performed at a *Venue*.



- b. Seat Management

- *Venue Onboarding tables*

Each venue can be onboarded on the platform.

Each venue has a unique seat layout.

The layout is broken into sections, with each section having some priority/ value

These are a part of the venue onboarding process, and will usually remain static

- *Show Launching tables:*

With each new show launching, there will be pricing decided for each section. This will be a part of the launching of a new show.

- c. Booking Management

- *Inventory*

Once you decide to make your show live, there needs to be static data, which will be created to pre-populate all the available tickets.

- *Tickets, Payments*

Once the payment confirmation is received, we add the transaction details to the Payments tables. Booking details are added to the Booking table and the individual tickets are logged in the tickets table

d. User Management

All other tables related to users are managed separately. Visitors, Organisers, Venue Owners

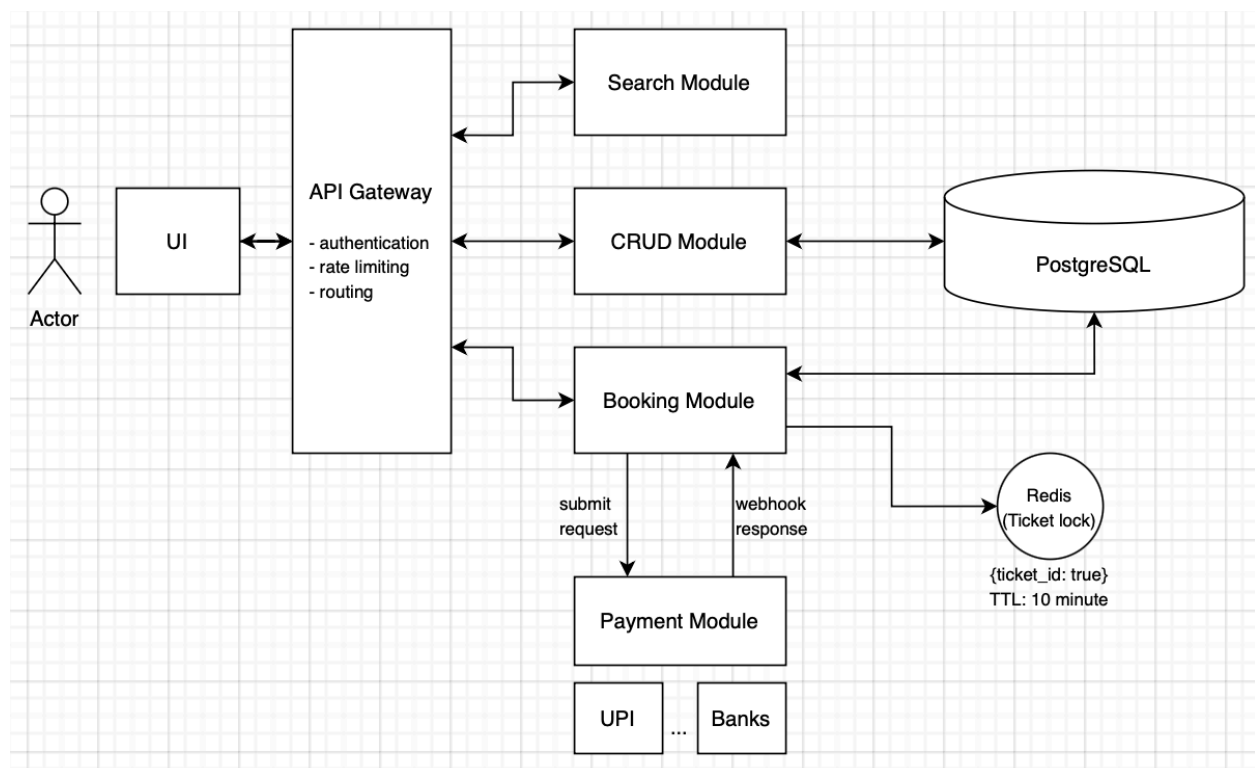
B. System Architecture:

We are planning on creating a system, which should

- a. Booking should be very consistent
- b. CRUD operations should be highly available
- c. The DB is expected to be read heavy sometimes, to fetch available seats

As a part of this assignment I plan to explore on the three modules

- a. CRUD operations: fetching the shows and the available seats
- b. Search Module: searching for ideal results
- c. Booking Module: making sure that system is fault tolerant even during sudden traffic



This architecture diagram could help us implement this product.

User using a mobile app or web app. All the requests reach the API gateway.

API gateway does user authentication, rate limiting and routes the request to the concerned module.

In our backend we can have a search module, basic data fetching module, and a booking module

All our configurations and data stays in the PostgreSQL. Choosing a SQL database because

- a. Our data is very structured
- b. We can use data joins to data efficiently
- c. ACID properties to required to support consistency

While we are booking, once I go to the payment page, there should be a timer, let's say about 10min. We should not allow other users to book the same seats during this time period. There are multiple ways we could achieve this.

- a. We could update the inventory table on the Pg to "reserved". But if the person lets the app, it becomes difficult to undo this
- b. We can create a cron job, which runs every 15 min, and unreserve the seats that we reserved for more than 15 min. But this will result in some stale values and is not real time
- c. Best approach: we could have a separate redis cache. For reservations we update this table with a TTL of 10 min. The cache will just be containing seat_value and true/ false as values

For the search module, I am thinking if we fire a search on the SQL db using LIKE operator, it might be slow since we will need to go through all the rows and fetch the best searches, instead we can have another nosql/ document db, which will be serving for the searches. Eg Elasticsearch.

The next challenge will be to keep it up-to-date/consistent with the information in the Pg.

- a. For this we can add the details there as well when we add a new event. But might result in inconsistencies when one fails and another succeeds.
- b. Best approach: we can configure logstash with a cron job, eg every 10 min. It will fetch the latest data from Pg, process it and add it to the Elastic. Light weight and efficient

This might also help us in building some ML models in future on this text data.

C. API Design:

I have not really used GraphQL, but from my understanding I know it makes more sense to use it when we are trying to create a read-heavy app. Where there are multiple things that need to be shown on the UI, and we do not want to make multiple API calls and then club all the results in the UI.

For us, we have a simple list of events that we need to show on the home, then an info page where we fetch the info about that show and then fetch the available bookings. I'll choose REST API at least for now, and if in future we need to we can think about migrations.

For bookings, we want to make sure that our system is idempotent and transactional in nature. For these properties, REST is the best option.

I have identified these 3 key endpoints.

1. *POST /api/v1/book/reserve*

Request:

Authentication: Required, via Bearer token

Body: { "show_id": 123, "seat_ids": ["A1", "A2"] }

Fields

show_id (*number/int*) (*mandatory*): Show identifier

seat_ids (*array of string*) (*mandatory*): Seat identifiers

Success Response:

- 202 Accepted

Content: { "status": "accepted", "show_id": 123, "seat_ids": ["A1", "A2"] }

Error Response:

- 400 Bad Request

{ "error_code": "INVALID_REQUEST", "message": "seat_ids cannot be empty" }

- 401 Unauthorized

{ "error_code": "UNAUTHORIZED", "message": "Authentication required" }

- 403 Forbidden

{ "error_code": "FORBIDDEN", "message": "Not allowed to reserve seats" }

- 409 Conflict

{ "error_code": "SEAT_LOCKED", "message": "One or more seats are already reserved",
"details": { "show_id": 123, "locked_seats": ["A1"] } }

- 500 Internal Server Error

{ "error_code": "INTERNAL_ERROR", "message": "Something went wrong" }

2. *POST /api/v1/book*

Request:

Authentication: Required, via Bearer token

Idempotency-Key: Required, unique-uuid-key

Body: { "show_id": 123, "seat_ids": ["A1", "A2"] }

Fields:

show_id (*number/int*) (*mandatory*): Show identifier

seat_ids (*array of string*) (*mandatory*): Seat identifiers

Response:

- 201 Created

```
{"status": "seats_booked", "booking_id": 987, "transaction_id":  
"txn_8f3a2c7e-4d2b-4cda-9c62-7d6ad7b1a7d9", "show_id": 123, "seat_ids": ["A1",  
"A2"]}
```

- 200 OK (idempotent replay)

```
{"status": "seats_booked", "booking_id": 987, "transaction_id":  
"txn_8f3a2c7e-4d2b-4cda-9c62-7d6ad7b1a7d9", "show_id": 123, "seat_ids": ["A1",  
"A2"]}
```

Error Response:

- 400 Bad Request

```
{"error_code": "INVALID_REQUEST", "message": "seat_ids cannot be empty", "details":  
{}}
```

- 401 Unauthorized

```
{"error_code": "UNAUTHORIZED", "message": "Authentication required", "details": {}}
```

- 404 Not Found

```
{"error_code": "SHOW_NOT_FOUND", "message": "Show 123 not found", "details": {  
"show_id": 123 }}
```

- 409 Conflict

```
{"error_code": "SEAT_NOT_AVAILABLE", "message": "Some seats are not available",  
"details": {"show_id": 123,"unavailable_seats": ["A1"]}}
```

500 Internal Server Error

```
{"error_code": "INTERNAL_ERROR", "message": "Something went wrong"}
```

3. *GET /api/v1/shows?cat={category}&city={city}*

Request:

Authentication: Required, via Bearer token

Response:

- 200 OK

```
[  
{  
  "show_id": 101,  
  "event_id": 12,  
  "category": "movie",  
  "title": "Pushpa 2: The Rule",  
  "start_time": "2026-01-10T18:30:00+05:30",  
  "end_time": "2026-01-10T21:00:00+05:30",
```

```

    "venue_name": "PVR: Phoenix Marketcity",
    "city": "Bangalore",
    "min_price": 250,
    "currency": "INR"
  },
  {
    "show_id": 102,
    "event_id": 15,
    "category": "concert",
    "title": "Arijit Singh Live",
    "start_time": "2026-01-11T19:30:00+05:30",
    "end_time": "2026-01-11T22:00:00+05:30",
    "venue_name": "INOX: Orion Mall",
    "city": "Bangalore",
    "min_price": 450,
    "currency": "INR"
  }
]

```

Error Response:

- 400 Bad Request

```

{
  "error_code": "INVALID_REQUEST",
  "message": "category must be one of: movie, concert, all",
  "details": {
    "category": "sports"
  }
}

```

- 401 Unauthorized

```

{"error_code": "UNAUTHORIZED", "message": "Authentication required", "details": {}}

```

- 403 Forbidden

```

{"error_code": "FORBIDDEN", "message": "Access to this resource is forbidden",
"details": {}}

```

- 500 Internal Server Error

```

{"error_code": "INTERNAL_ERROR", "message": "Something went wrong", "details": {}}

```

4. GET /show/{show_id}
5. GET /search?q={query}

D. Scalability and Performance:

For handling sudden huge traffic, e.g. for a Diljit concert ticket.

Bottleneck identification:

1. Fetching the real time available seats
2. Making sure that not all tickets gets reserved within few seconds, and then we have to slowly release reserved tickets if payment not done or payment failed

Solutions:

1. Basic solution should be to scale the crud servers, increase read replicas
2. For such cases we can enable some extra components in our design.
 - a. We can add a virtual queue in the system, like a queue we have outside the ticket counter. And allow 10-20 people to enter the system slowly
 - b. This will make sure that not all the users rush to the /booking endpoint at once, and we are able to serve everyone with proper up-to-date information
 - c. This queue will be added after the API gateway and before the booking module
3. We can toggle this queue based on the shows, so that will be configurable and will be show specific.

PS. to keep it fair, we can also put a cap on the number of seats a single user can book at a time.

Caching Strategies:

For improving the performance, we can also add a CDN for the images and maybe the trailers that we plan to show in the info page before the API gateway.

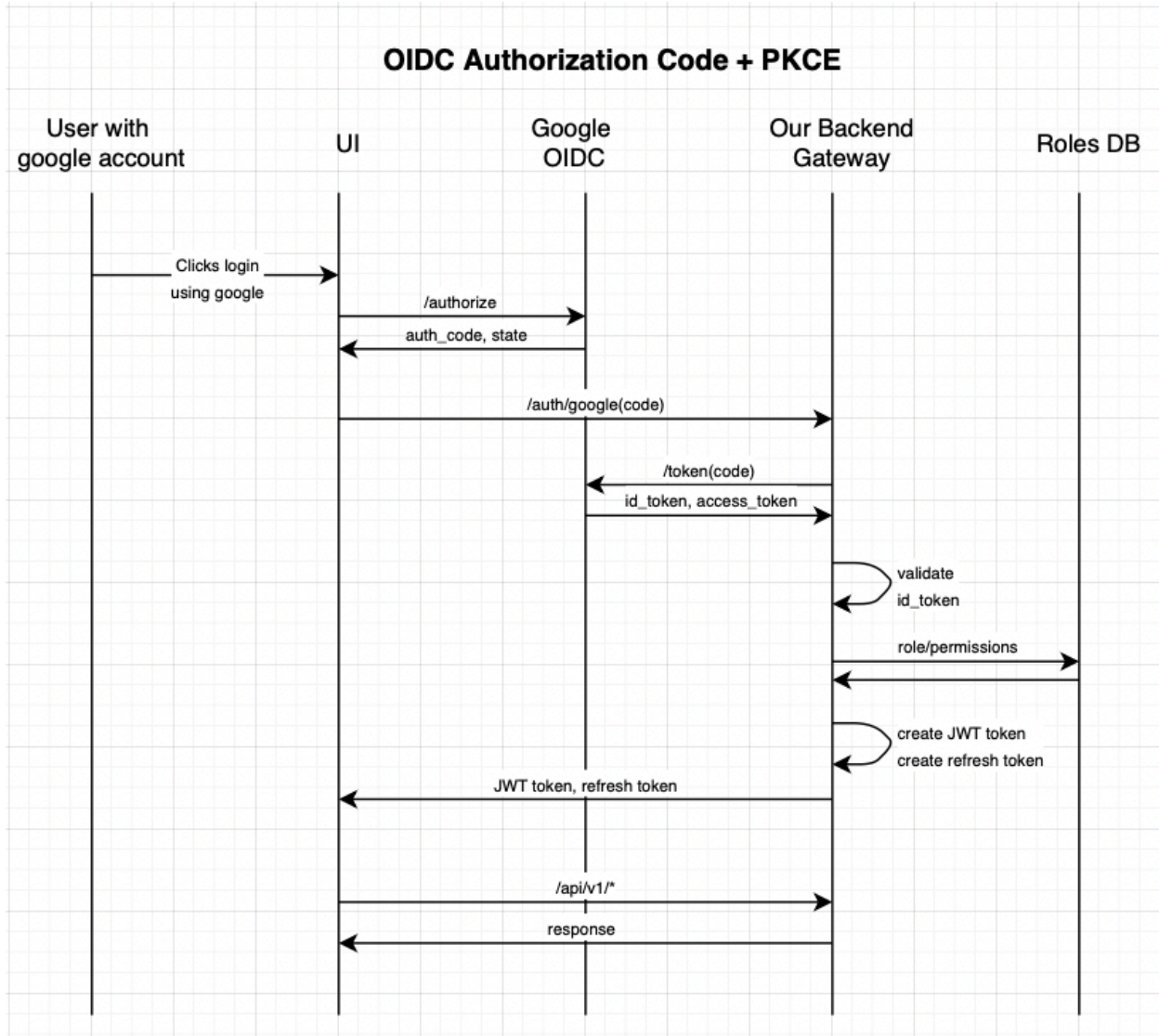
It will cache based on the regions.

Also since its region wise cache, we can also have API responses cached there, for latest region wise events

But we will have to make sure that the seat availability APIs are never from cache, we need to make sure that we provide the latest results to the users for these endpoints

E. User Authentication and Authorization:

We can use Google OIDC with PKCE for user authentication and handle authorization on our own (looking at the unique roles that we need to assign to different people and groups)



Basically once the user logs in, we use google to authenticate, make an entry to our db for the new user, then take the roles from the DB, create 2 tokens (short lived JWT token and long lived refresh token), send it to the UI.

And from the next request, expect the UI to have these tokens as a part of its header. Once we receive them in the gateway, decrypt it, check for the authentication and the role. Make sure that the user has access to call the endpoint. If yes, make the call else respond with 403

F. Real-Time Data Handling:

I am making sure that my seat availability source of truth is the “inventory” table. It pre-pollulates all the seats that are for sale, and as the payment is processed. This table is updated as SOLD for all the seat rows along With this we will also add a row in the “bookings” table with the booking id.

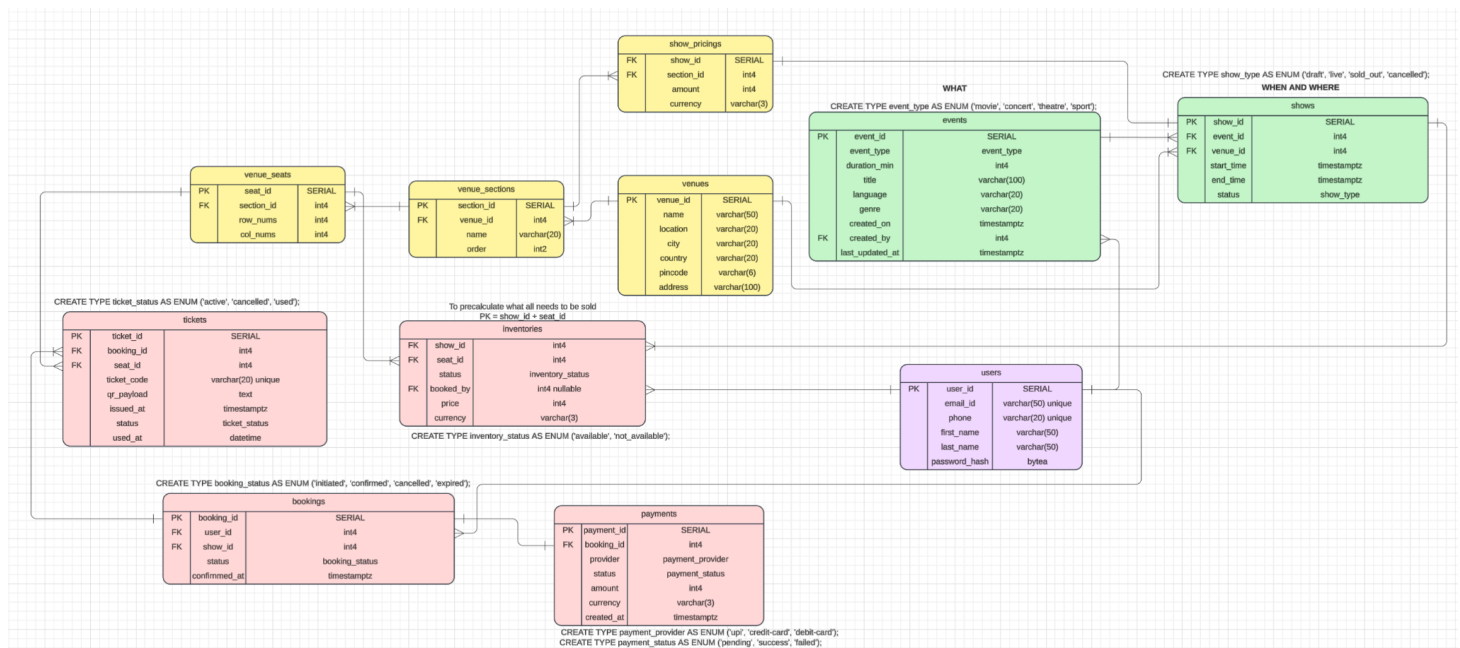
And split this booking into multiple rows per seat in the “tickets” tables, to create a different ticket id for each.

All 3 things are happening as a transaction asynchronously. One fails, everything fails.

Once this succeeds we show the users that the booking is done, and the tickets will be mailed to them

After this we will be maintaining an event queue as well. This booking will be added to the event queue. The subscribers to this queue can be ticket_generation service(taking care of creating a unique QR code), email notification service, mobile notification service, whatsapp notifications service etc

G.Databases:

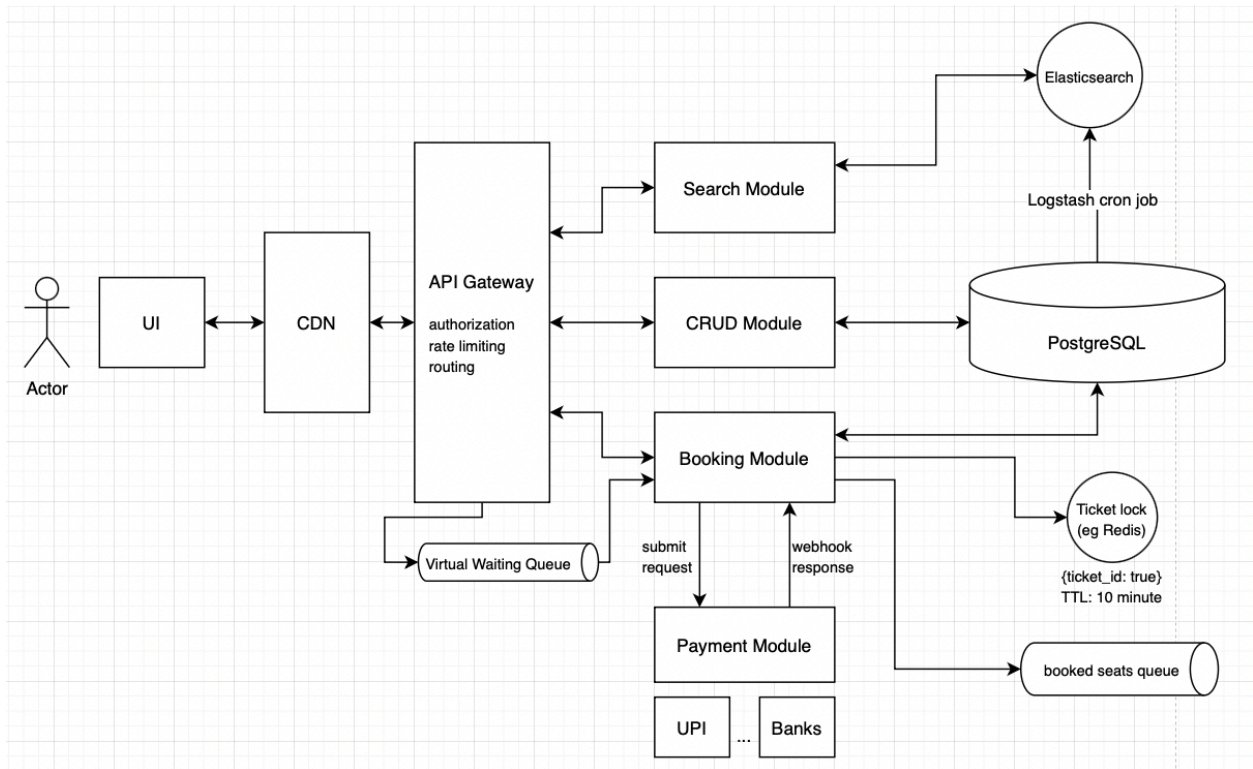


Attaching the [Lucid](#) and the [SQL queries](#) to generate this structure.

Some other DB hosting strategies that we can try are:

- For faster querying we can keep rotating the database. Have a hot and cold version. Where the hot versions are kept in RAM for faster reading. Older events are moved to the cold versions.
- We can shard the DB by the event locations, and host them in those regions.

H. The Final HLD:



Just to press on some key challenges and the solutions:

1. Addition of Elasticsearch, helping us query textual data quickly
2. Addition of Redis for locking seats
3. Addition of a virtual waiting queue for ensuring there is a steady flow of users, and we do not end up blocking all seats together
4. Addition of a CDN, for ensuring caching of local events, for delivering the trailers and images faster
5. Limiting the tasks by booking module, by adding a queue after the rows are successfully entered into the db