



# DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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## Experiment No: 2

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Branch: BE CSE

Semester: 6<sup>th</sup>

Subject Name: System Design

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Section/Group: 23BCS\_KRG-3\_B

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**1- Aim** - Design an Online shopping platform similar to Amazon / Flipkart that will allow users to purchase mobiles, laptops, cameras, clothes etc.

### 2- Requirements: Functional & Non-Functional

#### A- Functional Requirement

- User should be able to search and find the products based on product title or names.
- User should be able to view the details of the product like description, image, available quantity, review.
- User should be able to select the quantity and move the product/item into the cart.
- User should be able to make the payment and should be able to perform the check out.
- User should be able to check the status of the order.
- System should be able to manage purchase of items having limited stocks.

Race condition happens during a flash sale when inventory has limited stock, and the system must handle multiple transactions occurring at the same time.

#### B- Non-Functional Requirement

- The system is designed for 100 million daily active users with around 10 orders handled per second.
- Consistency & Availability: Based on the target scale, both are required, but at different system levels.
  - i. According to functional requirements, users must search products smoothly, so product search needs high availability.
  - ii. Strong consistency is required for critical components such as payment processing, order placement, and inventory management.
- Expected response time is approximately 200 ms.
- Scaling will be done either Horizontally or Vertically wherever applicable.

### 3- Core-entities of System

- User/Client
- Products
- Cart
- Orders
- Checkout followed by Payment

### 4- API endpoint creation

#### a) GET API Call: Prod\_Search



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Https://Local\_Host/products/search\_item = {Search\_keywords}

HTTP Req  
{  
    GET: <iPhone 16>

}

HTTP Res  
{  
    List<ProductID:iPhone>  
}

Now, on front-end if multiple data of respective product is coming in that case the FE becomes faulty thus ultimately increasing the Latency.

So we will be using Pagination (1,2,3,...next)

## b) GET API Call: View Product Details

Https://Local\_Host/products/{product\_id}

HTTP Req  
{  
    GET: <Product\_id=17>  
}  
HTTP Res  
{  
    Product\_id=17,  
    Name: iPhone17,  
    Color: Navy Blue,  
    Price: \$1009,  
    Image\_URL: URL\_image  
}

## c) POST API Call: Item add in cart

Https://Local\_Host/cart/add\_products

HTTP Req  
{  
    Product\_id:17,  
    Product\_id:16  
}  
HTTP Req Header  
{  
    User\_id: 04



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```
}
```

HTTP Res

```
{
```

Cart\_id: 101

```
}
```

- d) PUT API Call: To update any order in the cart
- e) DELETE API Call: To remove any item from the cart
- f) **POST API Call: for check out & Payment**  
`Https://Local_Host/checkout -> {post body}`

```
HTTP Req
```

```
{
```

All Product Id's,  
Total Quantity,  
Total Price

```
}
```

HTTP Res

```
{
```

Order\_id

```
}
```

`Https://Local_Host/payment -> {post body}`

```
HTTP Req
```

```
{
```

Order\_id,  
Payment Type,  
Payment\_Mode

```
}
```

HTTP Res

```
{
```

Confirmation\_Status: Success / Fail

```
}
```

- g) **GET API Call: Order Status**  
`Https://Local_Host/order_status = {order_id}`

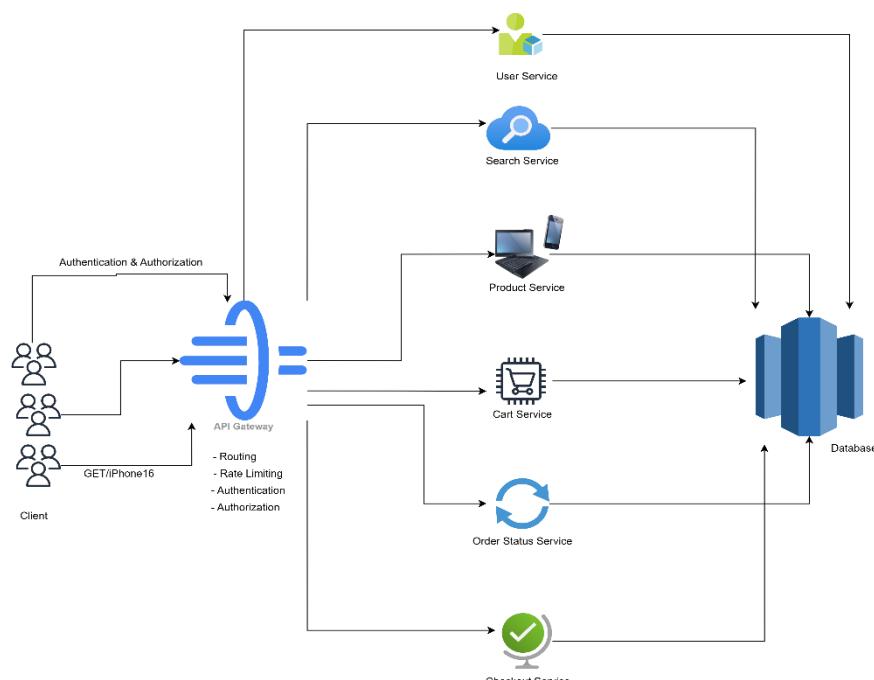
## 5- High-Level Design

Now According to the functional requirement of the system, we can identify that : We have to follow a distributed / micro-services approach not the monolithic one.

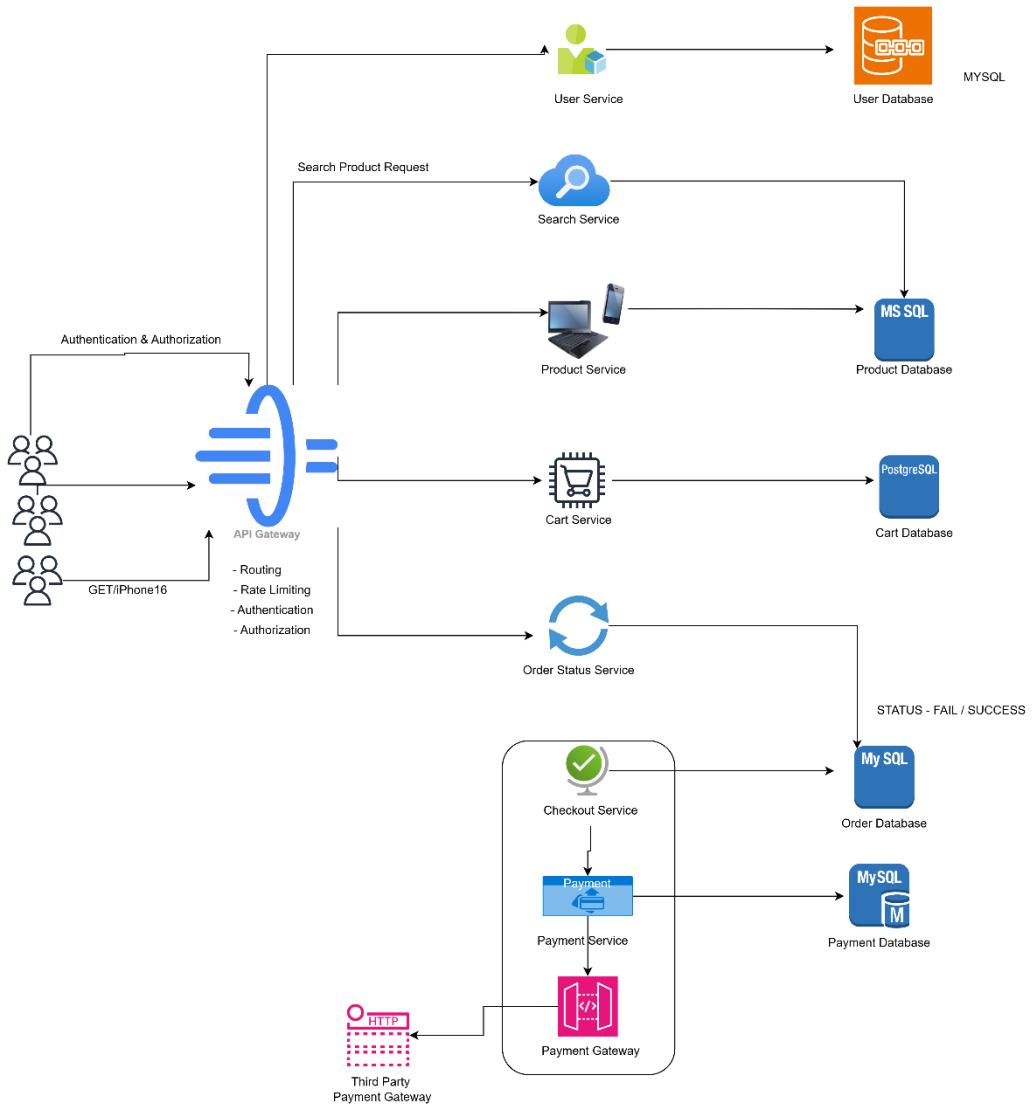


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Drawbacks: Multiple-Database calls are being done and single database is being used to handle every service which increases the latency.





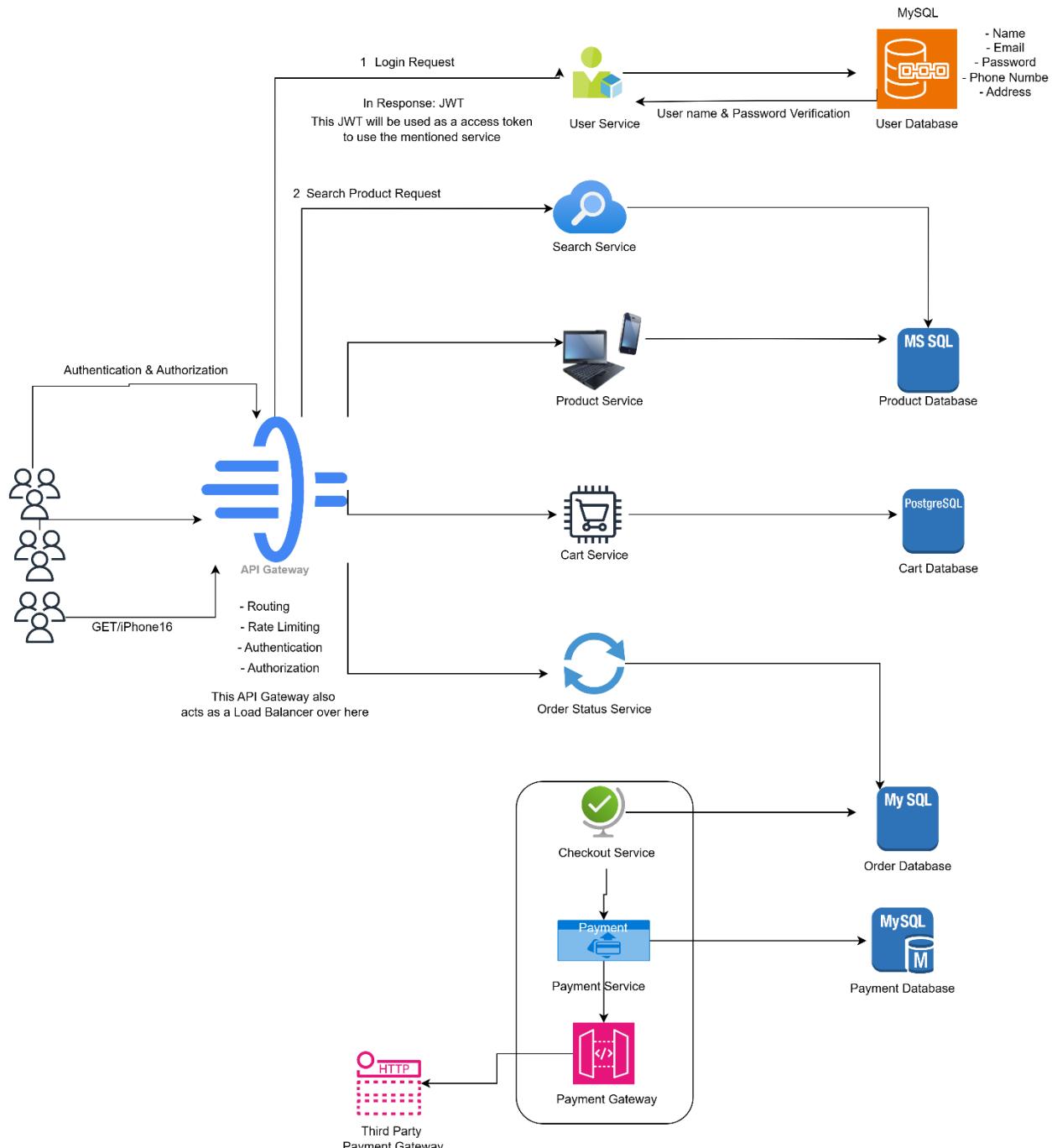
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This will fulfill all the functional requirements that were listed. Now, we will see the internal implementations of each one of these components in LLD.

## 6- Low-Level Design

### 1- User Login and Search Functionality



#### Drawbacks-

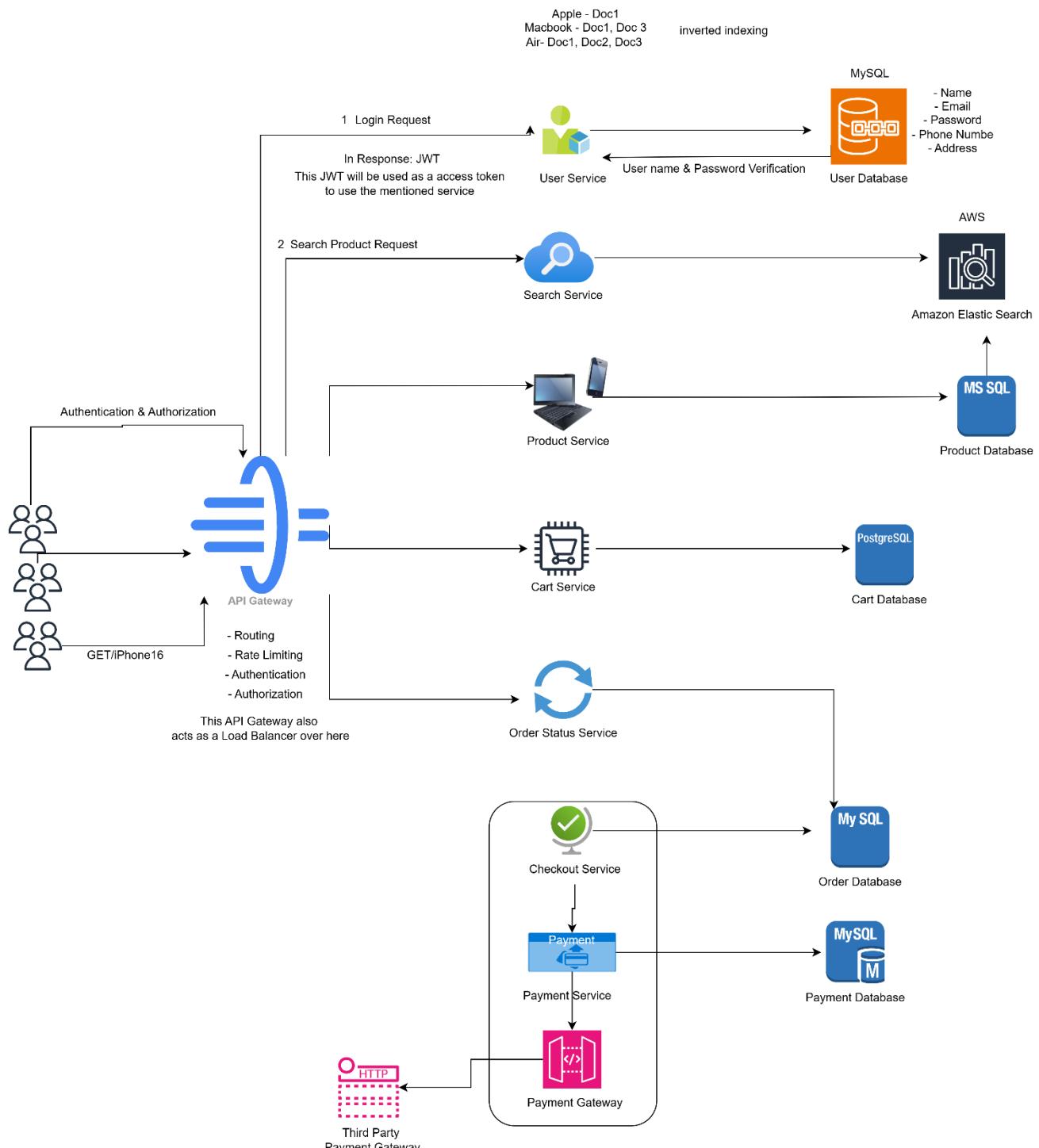
- As per NFR, 10 million DAU, which means searching the entire DB is very non-optimized here
- As a solution we can implement INDEXING here, but still database scanning is not prevented.
- O(n) – time



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## Solution to search functionality problem: ELASTIC SEARCH.





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Elasticsearch is a **Search Engine**, not a traditional database.  
It is built on top of a library called **Apache Lucene**.

Document ID	Content (Stored as a String)
Doc 1	"Apple iPhone 15 Pro"
Doc 2	"Samsung Galaxy S23"
Doc 3	"Apple MacBook Air"

Elastic Search

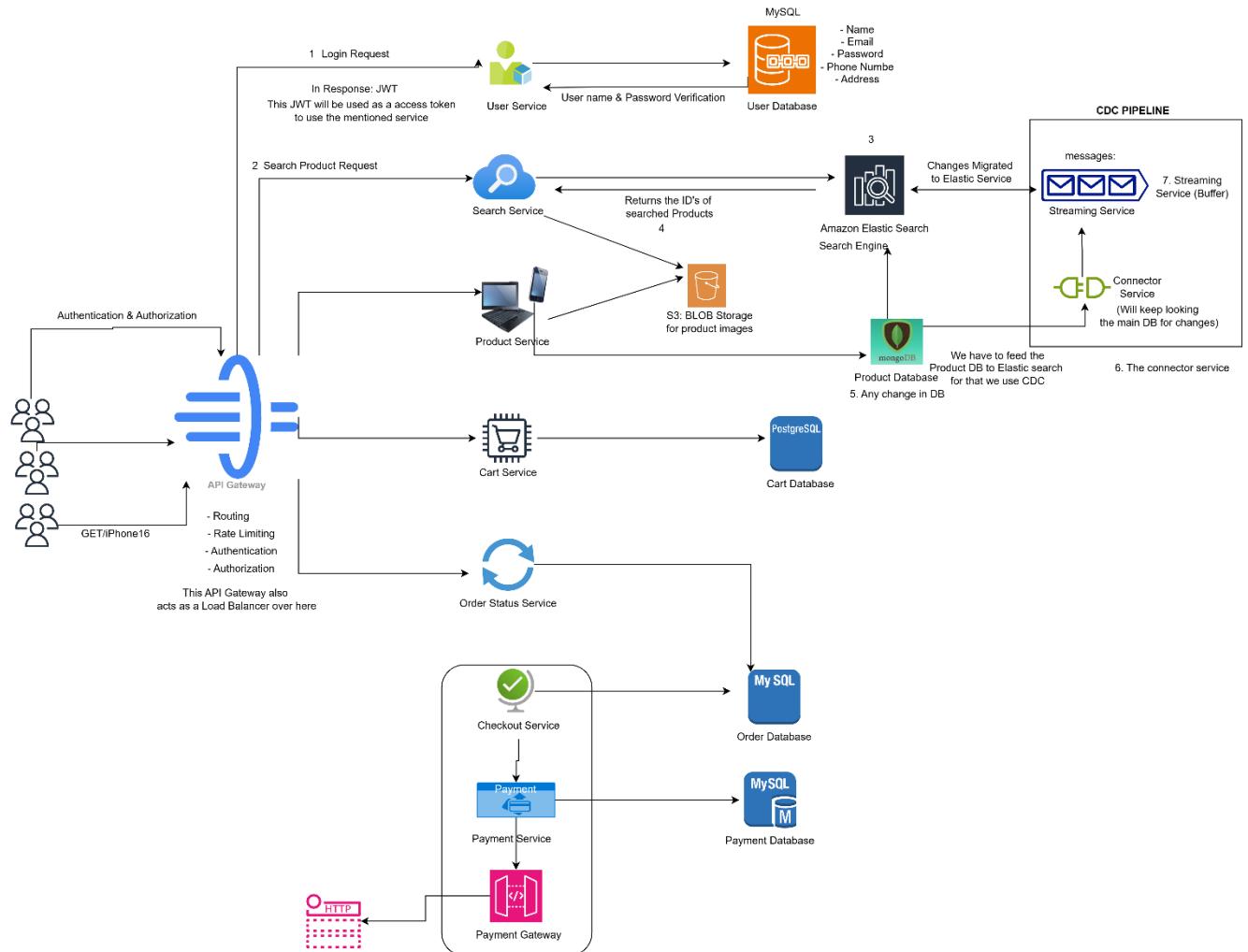
Tokenization		
Word (Token)	Document List (Occurrences)	Frequency (Count)
Apple	Doc 1, Doc 3	2
iPhone	Doc 1	1
15	Doc 1	1
Pro	Doc 1	1
Samsung	Doc 2	1
Galaxy	Doc 2	1
S23	Doc 2	1
MacBook	Doc 3	1
Air	Doc 3	1

Multi-term Logic

Word	Document IDs	
Apple	{Doc 1, Doc 3}	$O(1)$
Macbook	{Doc 3}	

```
search_product_call {
  1. RECEIVE: search_term (e.g., "shoe")
  2. ANALYZE: Break term into lowercase tokens.
  3. QUERY: Ask Elasticsearch Inverted Index for "shoe".
  4. RANK: Get IDs of products containing "shoe" sorted by relevance.
  5. FETCH: Get full product details from the main DB using those IDs.
  6. RETURN: Fast, accurate results to the user.
}
```

We will use CDC (Change Data Capture) to send data from original database to ES in real time.

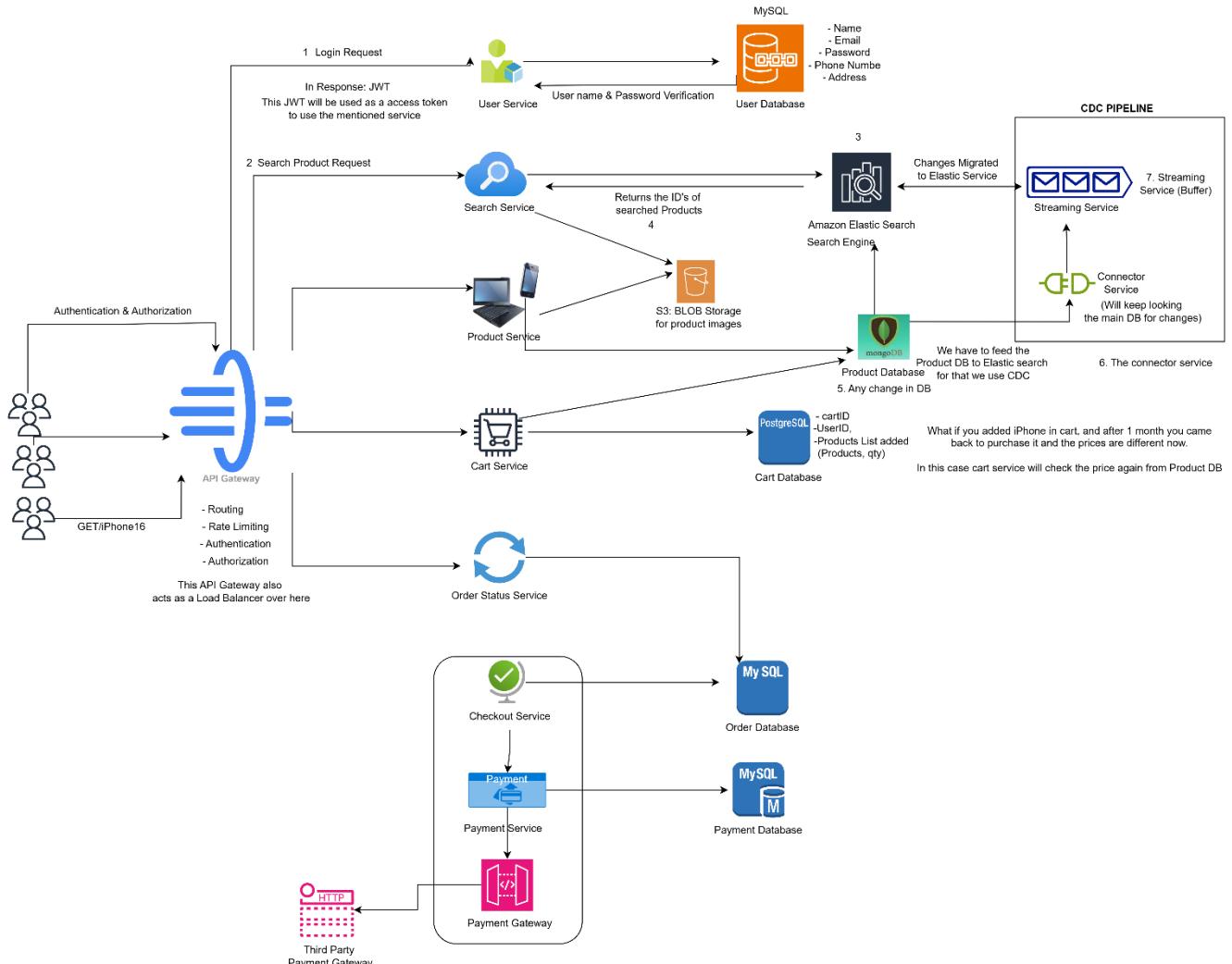




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## 2- Cart Service



## 3- Checkout Service

For a user to do the checkout, the quantities in real-time from the DB should be verified, i.e., whether we have the requested amount of qty available in the inventory or not?

For that we will use a separate service: Inventory Service: For Concurrency

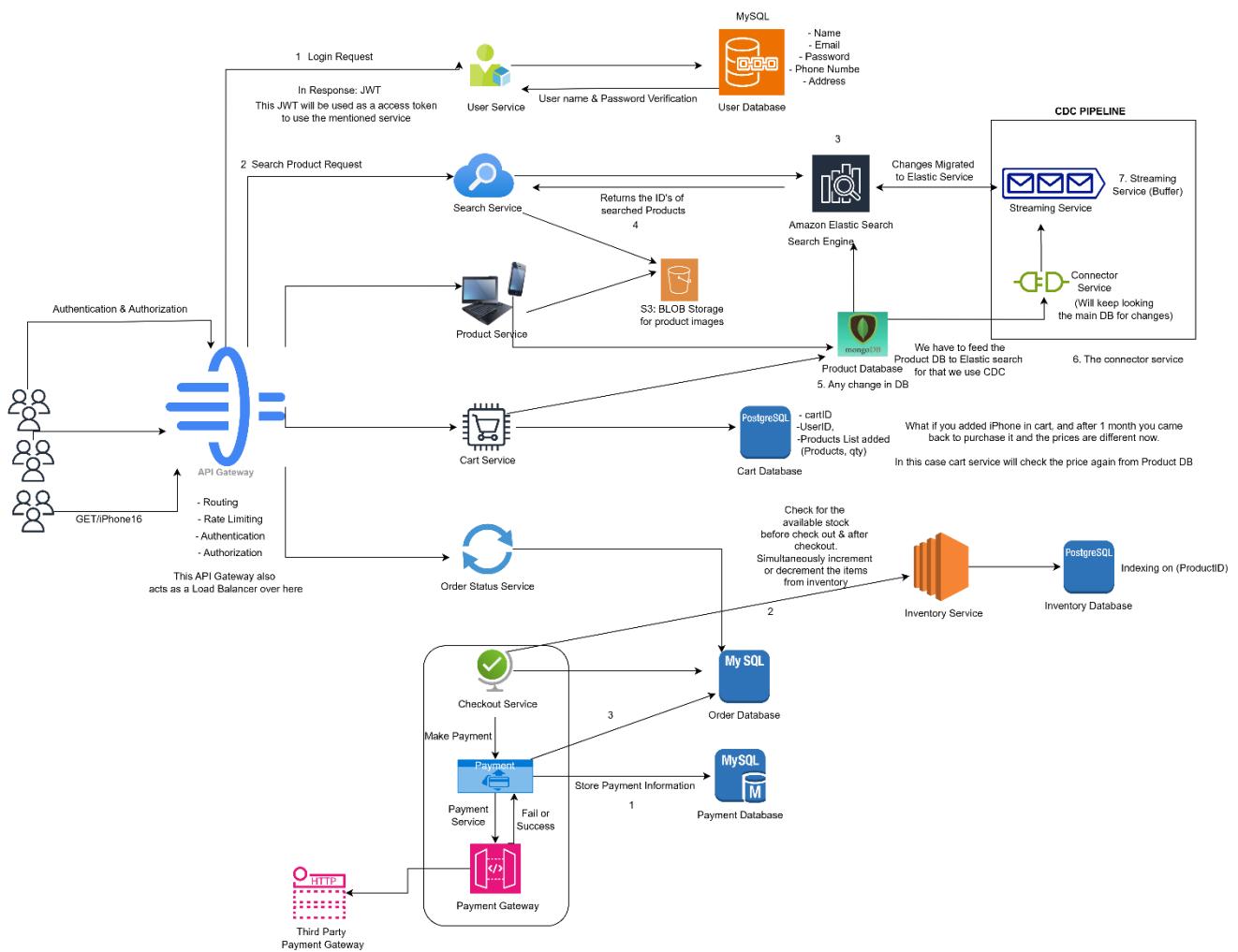
### DRAWBACKS –

- 3 API calls are there to perform a single transaction
- Now For this single transaction, it can happen that payment done successfully, inventory was not updated.  
This is a very critical issue w.r.t consistency
- Rate of failure is very high over here



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Solutions for above drawbacks is to introduce **Producer-Consumer architecture** using KAFKA.



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