



# [Hard]Mock - Stock Exchange like NASDAQ - Jan 2

Design a stock exchange system that should support buying and selling of stocks at a very high rate.

## System Requirements

### Clarifications

1. Is it a broker like Zerodha or Robinhood or an exchange like BSE or NSE or Nasdaq, NYSE?
  - a. This is exchange - BSE, NSE, NASDAQ, NYSE.
2. Limit vs Market order
  - a. Market price order fine for now. Limit order would be more of algo deep dive, skip for now.
3. Do we have enough funds to buy?
  - a. Simple - we always have money to transact
    - i. cred system
    - ii. credit bound to succeed
    - iii. funds are always available



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### 3. How do we do the funds processing?

- Simple - do we have enough funds?
  - credit system
  - credit bound to succeed
  - funds are always available
- Hard - make payment and then complete the buying.

### 4. Do we partial order processing or full order?

- Full would be simpler
- Partial order process support needed, algo

### 5. How much time do we want to get the order fulfillment done?

- As soon we get the order process has done EOD?
- Can we asap?
- Can we target microseconds?

### 6. Scale

- 10K unique stocks(3K in NASDAQ)
- 100M DAU
- 100 transactions per day per person including retail, brokers, robotic, high-frequency traders(contract) - Morgan.
- 10 billion transactions per day

### 7. Do we need a recommendation

- More relevant to brokers rather than exchange

## Functional Requirements

3. How do we do the funds processing?
  - a. Simple - do we have enough funds?
    - i. credit system
    - ii. credit bound to succeed
    - iii. funds are always available
  - b. Hard - make payment and then complete the buying.
4. Do we partial order processing or full order?
  - a. Full would be simpler
  - b. Partial order process support needed, algo
5. How much time do we want to get the order fulfillment done?
  - a. As soon we get the order process has done EOD?
  - b. Can we asap?
  - c. Can we target microseconds?
6. Is it for 24x7 or certain business  
a. List
7. Scale
  - a. 10K unique stocks(3K in NASDAQ)
  - b. 100M DAU
  - c. 100 transactions per day per person including retail, brokers, robotic, high-frequency traders(contract) - Morgan.
  - d. 10 billion transactions per day with top stock GOOG - 100 million transactions per day?
8. Do we need a recommendation
  - a. More relevant to brokers rather than exchange

Serializable data structure.

Persist

## Data model

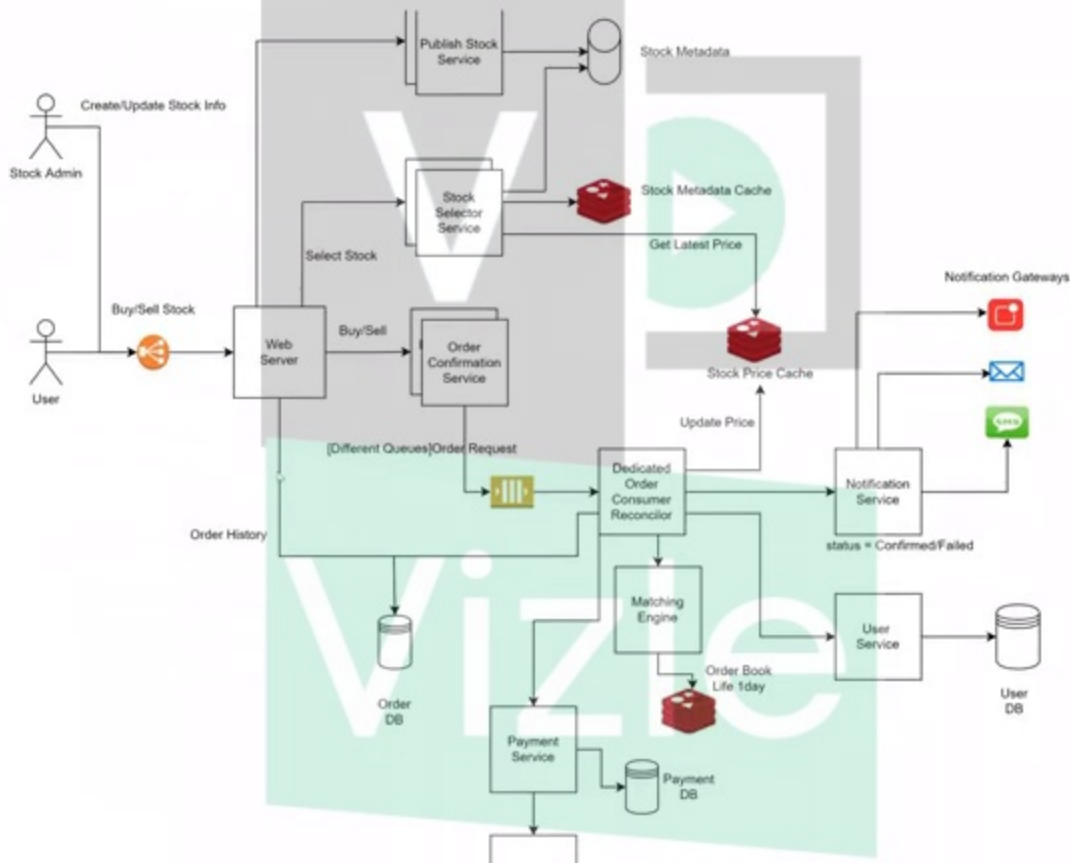
Deal with base currency

JSON

buy/sell order event

```
{
  ticker_id: 1, // GooG
  order_intent: buy,
  order_type: limit or market,
  target_price: 3000,
  quantity: 100,
  status: executed
  meta: {
    customer_type: HNI or retail, broker, HFT
  }
}

{
  ticker_id: 1, // GooG
  order_intent: sell,
  order_type: limit or market,
  target_price: 2900,
  quantity: 100,
  status: cancelled.
  meta: {
    customer_type: HNI or retail, broker, HFT
  }
}
```



- a. Pull - REST
- b. Push - event-driven notification, webhooks.

## Algorithm

Matching algorithm for the limit order.

Based on price ordering:

Sell price list sorted by increasing

first - 8(10 quantity), 9, 10, 11, 1000(expire)

Buy price list sorted by decreasing -

Higher bids will have preferences.

+ first - 12, 11, 10, 7(unmatched), 1(expire)

match 1 to 1, and the buyer will get the stock at the selling price.

Data structure:

1. List or Array -  $O(N)$
2. LinkedList
3. Heap or PQ - min and max PQ -  $O(1)$ ,  $\log N$  new orders.





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