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**High Level Document [HLD]**

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**1. Introduction**

1.1. Why this High-Level Design Document?

The purpose of this High-Level Design (HLD) Document is to add the necessary detail to

the current project description to represent a suitable model for coding. This document is

also intended to help detect contradictions prior to coding, and can be used as a reference

manual for how the modules interact at a high level.

1.2. Scope

The HLD documentation presents the structure of the system, such as the database

architecture, application architecture (layers), application flow (Navigation), and

technology architecture. The HLD uses non-technical to mildly technical terms which

should be understandable to the administrators of the system.

1.3 Overview

The HLD will:

* Present the design aspects.
* Describe the Criteria for database.
* Describe the design architecture.
* Describe some of the technical/non-technical points related to this project.

**2. General Description**

2.1 Product Prespective

The Project will be comprised of several different components. Some of these components will be programmed, while others will be implementations of open-source programs. The language and technology implemented will be dictated by its purpose. It will also be set up using two user levels. First is the basic user, which can only view their orders, product catalogue, reviews, their personal data including address, reviews and their order history. The second type of user is the Administrator. They have the ability to change information in the database such as settings and user history. This user level can only be attained by logging into the system.

2.2 Technical/Non-technical Attributes

**E-commerce Platform:**

Amazon's e-commerce platform serves as the foundation for its business, facilitating millions of transactions daily. The platform consists of various interconnected components:

Product Catalogue:

Amazon maintains a vast catalogue of products spanning multiple categories. This catalogue is continuously updated and optimized for efficient search and discovery.

Search Engine:

The search engine enables users to find products quickly and accurately. It employs advanced algorithms for keyword matching, relevance ranking, and personalized search results. The search engine is a critical component of Amazon's platform, enabling users to find products efficiently. It employs a combination of technologies and techniques:

* Keyword Matching: The search engine analyzes user queries and matches them to relevant products in the catalog. It considers factors such as product titles, descriptions, and attributes.
* Relevance Ranking: Products are ranked based on their relevance to the user's query. Machine learning models continuously learn from user interactions to improve ranking algorithms.
* Product Filtering: Users can filter search results based on various criteria such as price, brand, ratings, and availability. Dynamic filtering options enhance the user experience.
* Autocomplete: As users type their queries, the search engine provides real-time suggestions to expedite the search process. Autocomplete is powered by predictive algorithms and user search history.
* Personalized Search: Amazon personalizes search results based on user preferences, browsing history, and purchase behavior. Machine learning models tailor search results to individual users, improving relevance and conversion rates.
* Data sources for the search engine include product information, user data, clickstream data, and customer reviews. Machine learning algorithms analyze this data to extract insights and improve search relevance over time.

Shopping Cart:

The shopping cart feature allows users to add items for purchase and proceed to checkout seamlessly. It integrates with the inventory management system to ensure product availability.

Payment Processing:

Amazon supports various payment methods, including credit/debit cards, digital wallets, and Amazon Pay. Payment processing is secured using encryption and tokenization techniques to protect sensitive information.

Order Management:

The order management system handles the entire lifecycle of an order, from placement to fulfillment. It coordinates with inventory, logistics, and payment systems to ensure timely delivery.

Inventory Management:

Amazon's vast network of fulfillment centers requires sophisticated inventory management systems to track stock levels, replenish inventory, and optimize storage space.

User Accounts:

User accounts are central to personalization and order history tracking. Amazon securely manages user authentication and authorization to protect customer data.

Recommendations:

Amazon leverages machine learning algorithms to provide personalized product recommendations based on user behavior, purchase history, and preferences.

Scalability is achieved through a microservices architecture, where each component is decoupled and independently scalable. Load balancers distribute traffic across multiple instances to handle fluctuations in demand. Caching mechanisms reduce latency by storing frequently accessed data closer to the user. Distributed databases, including NoSQL (e.g., Amazon DynamoDB) and relational databases (e.g., Amazon RDS), provide scalability and reliability.

Recommendation System:

Amazon's recommendation system plays a crucial role in driving sales and enhancing the user experience. It utilizes a combination of techniques to suggest relevant products to users:

* Collaborative Filtering: The recommendation system analyzes user behavior and preferences to identify similar users and recommend products based on their interests. Collaborative filtering algorithms, such as item-item and user-item collaborative filtering, are employed.
* Content-Based Filtering: Product attributes such as category, brand, and features are used to recommend similar items to those previously viewed or purchased by the user. Content-based filtering is particularly effective for new or niche products.
* Hybrid Approaches: Amazon combines collaborative and content-based filtering techniques to provide more accurate and diverse recommendations. Hybrid models leverage the strengths of both approaches to improve recommendation quality.
* Data sources for the recommendation system include user purchase history, browsing behavior, ratings, reviews, and product attributes. Machine learning algorithms analyze this data to generate personalized recommendations tailored to each user's preferences.
* Benefits of Amazon's recommendation system include increased sales conversions, higher customer engagement, and enhanced user satisfaction.

Fulfillment and Delivery:

Amazon's fulfillment and delivery network is a complex ecosystem designed to ensure fast and reliable order fulfillment:

* Warehouses and Distribution Centers: Amazon operates a vast network of warehouses and distribution centers strategically located near major population centers. These facilities store and process inventory, enabling quick order fulfillment.
* Transportation Network: Amazon utilizes a combination of transportation modes, including trucks, airplanes, and drones, to move products between warehouses and delivery stations.
* Last-Mile Delivery: The last mile of delivery, from the delivery station to the customer's doorstep, is often the most challenging and expensive. Amazon employs various strategies, including route optimization, delivery drones, and partnerships with third-party logistics providers, to expedite last-mile delivery.
* Inventory Management: Amazon's inventory management system ensures optimal stock levels across its fulfillment network. Machine learning algorithms forecast demand, optimize inventory allocation, and prevent stockouts.
* Route Planning: Efficient route planning is critical to reducing delivery times and costs. Amazon's logistics algorithms optimize delivery routes based on factors such as traffic conditions, package size, and delivery windows.
* Warehouse Automation: Amazon invests heavily in automation technologies such as robotics, conveyor systems, and warehouse management software to streamline operations and improve efficiency.
* Scalability is a key consideration in fulfillment and delivery operations, with Amazon dynamically adjusting resources to meet demand fluctuations. Real-time monitoring and analytics enable proactive decision-making and continuous optimization of the supply chain.

Cloud Infrastructure:

Amazon's cloud infrastructure, powered by Amazon Web Services (AWS), provides the foundation for its e-commerce platform and supporting systems:

* Compute: AWS offers a wide range of compute services, including virtual servers (EC2), serverless computing (Lambda), and container orchestration (ECS, EKS). These services provide scalability, flexibility, and cost-efficiency for running applications and services.
* Storage: AWS provides scalable and durable storage solutions such as Amazon S3 (object storage), Amazon EBS (block storage), and Amazon Glacier (cold storage). These services enable efficient storage and retrieval of data at any scale.
* Database: AWS offers a variety of database services, including Amazon RDS (relational databases), Amazon DynamoDB (NoSQL databases), and Amazon Redshift (data warehousing). These services provide high performance, availability, and scalability for storing and querying structured and unstructured data.
* Networking: AWS provides networking services such as Amazon VPC (Virtual Private Cloud), AWS Direct Connect (dedicated network connection), and Amazon Route 53 (DNS service). These services enable secure and reliable communication between resources and users.
* Security Services: AWS offers a comprehensive suite of security services, including identity and access management (IAM), encryption (KMS), and threat detection (GuardDuty). These services help protect applications and data from unauthorized access, data breaches, and other security threats.
* Benefits of AWS include scalability, elasticity, cost-efficiency, and reliability. Automated deployments, monitoring, patching, and disaster recovery mechanisms help ensure the availability and performance of Amazon's e-commerce platform.

In conclusion, Amazon's high-level system design encompasses various components and technologies, including its e-commerce platform, search engine, recommendation system, fulfillment and delivery network, and cloud infrastructure. These components work together seamlessly to provide a scalable, reliable, and personalized shopping experience for millions of customers worldwide.

**3. Design Details**

3.1 Design Criteria

3.1.1 Functional Requirements

User:

* View Inventory.
* View Recommended Item.
* Search.
* Compose a Cart.
* Place an Order.
* Track an Order.
* Cancel an Order.
* Reviews.
* View Profiles, Orders & Invoices.

Seller:

* Add or Remove items to his inventory.

Delivery Person:

* View the Pending deliveries.
* View the Completed deliveries.
* Amount earned.

Admin:

* KYC
* Add delivery guys & sellers.

3.1.2 Non-functional Requirements

* Low Latency (in recommendation & search).
* Availability.
* Scalability.
* Consistency.

3.2 Application Architecture

