Detailed Design Document for Online Delivery Application

1. Introduction

Project Name: Online Delivery Application
Objective:
To design and implement a scalable and user-friendly online delivery application that allows users to order products from various vendors, track their orders, and manage deliveries efficiently. The application will cater to different user roles with specific permissions and access rights, including Admins, Vendors, Delivery Personnel, and Customers.

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2. System Overview

The Online Delivery Application will consist of several interconnected components, including a web-based frontend, a mobile app, a backend API, and a database. The system will provide features for product management, order processing, delivery management, payment integration, notifications, and user management.

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3. Functional Requirements

3.1 User Roles and Authentication

- **User Roles:**
    - **Admin:** Full access to manage users, products, orders, and deliveries.
    - **Vendor:** Manage products, view orders, and update order status.
    - **Delivery Personnel:** View assigned deliveries and update delivery status.
    - **Customer:** Browse products, place orders, track orders, and leave reviews.
- **Authentication:**
    - Secure login and registration using JWT (JSON Web Tokens).
    - Role-based access control (RBAC) ensuring users can only access features relevant to their role.
    - Password management features including password reset and two-factor authentication (2FA).

3.2 Product Management

- **Vendor Portal:**
    - **Add/Update/Delete Products:** Vendors can manage their product listings, including adding new products, updating existing ones, and removing obsolete products.
    - **Categories and Subcategories:** Products will be organized into categories and subcategories for easy browsing.

- **Product Attributes:** Each product will have attributes such as name, description, price, images, availability status, and SKU (Stock Keeping Unit).

3.3 Order Management

- **Customer Experience:**
  - **Product Browsing:** Customers can browse products with search and filter capabilities.
  - **Shopping Cart:** Customers can add products to a cart, view the cart, and proceed to checkout.
  - **Order Status:** Customers can track their order status from placement to delivery.
  - **Order History:** Customers can view their past orders and reorder products.
- **Order Lifecycle:**
  - Order statuses include: Order Placed, Processing, Shipped, Out for Delivery, Delivered, and Canceled.
  - The system will support order cancellation and returns based on predefined conditions.

3.4 Delivery Management

- **Assignment:**
  - **Auto Assignment:** Orders will be automatically assigned to delivery personnel based on proximity and availability.
  - **Manual Assignment:** Admins can manually assign orders if needed.
- **Tracking:**
  - **Real-Time Tracking:** Integration with GPS for real-time delivery tracking.
  - **Delivery Updates:** Delivery personnel can update the status of deliveries in real time.

3.5 Payment Integration

- **Payment Gateways:**
  - Integration with Stripe, PayPal, and Razorpay to handle various payment methods, including credit/debit cards and digital wallets.
  - **Secure Transactions:** Payments will be processed securely, adhering to PCI DSS standards.
- **Invoices:**
  - Automatic invoice generation and emailing to customers upon successful payment.

3.6 Notifications

- **Types of Notifications:**
  - **Email:** For order confirmations, status updates, and other important communications.

- **SMS:** For critical updates like delivery status.
- **Push Notifications:** For mobile app users to receive real-time alerts.

3.7 Admin Dashboard

- **User Management:**
  - View, add, update, and remove users.
  - Role management and assignment.
- **Product and Order Management:**
  - Overview of all products and orders with the ability to manage them.
  - Reporting on sales, user activity, and delivery performance.

3.8 Search and Filters

- **Search Functionality:**
  - Full-text search using Elasticsearch to provide fast and accurate search results.
  - Autocomplete and search suggestions based on user input.
- **Filters:**
  - Customers can filter products by category, price range, ratings, and other attributes.

3.9 Reviews and Ratings

- **Customer Feedback:**
  - Customers can leave reviews and rate products post-purchase.
  - Vendors can respond to customer reviews.
- **Display:**
  - Product pages will display average ratings and top reviews to aid purchasing decisions.

3.10 Scalability and Performance

- **Scalability:**
  - The system will be designed to handle high traffic volumes using microservices architecture and cloud infrastructure.
  - Horizontal scaling to accommodate growth in user base and transactions.
- **Performance:**
  - Caching using Redis for frequently accessed data.
  - Load balancing with NGINX to distribute traffic across multiple servers.

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4. Non-Functional Requirements

4.1 Security

- **Data Encryption:** Sensitive data, including user credentials and payment information, will be encrypted using AES-256.
- **Authentication and Authorization:** JWT tokens will be used for secure authentication. Role-based access control will ensure users have appropriate access.
- **Compliance:** The system will comply with GDPR and PCI DSS regulations for data protection and payment processing.

4.2 Reliability

- **High Availability:** The application will be hosted on AWS with multiple availability zones to ensure uptime.
- **Backup and Recovery:** Automated backups will be scheduled, and a disaster recovery plan will be in place.

4.3 Maintainability

- **Code Quality:** The codebase will follow best practices in software engineering, with documentation and comments for clarity.
- **Testing:** Comprehensive unit, integration, and load testing will be conducted to ensure the application is robust.

4.4 Usability

- **User Experience:** The application will be designed with a focus on intuitive navigation and a responsive interface.
- **Accessibility:** The application will adhere to accessibility standards (WCAG) to ensure it is usable by people with disabilities.

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5. System Architecture

The system will follow a microservices architecture with the following components:

- **Frontend:** React.js for web applications, React Native for mobile apps.
- **Backend:** Spring Boot microservices communicating via RESTful APIs.
- **Database:** PostgreSQL for transactional data, Redis for caching.
- **Authentication:** Spring Security with JWT for token-based authentication.
- **Payment Integration:** Stripe, PayPal, and Razorpay for payment processing.
- **Deployment:** AWS with auto-scaling groups, RDS for database management, and S3 for storing static assets.

Architecture Diagram:

- **Frontend:** React.js + Redux → REST API (Spring Boot) → PostgreSQL / Redis.
- **Backend:** Spring Boot Microservices → AWS Services (EC2, S3, RDS) → External APIs (Stripe, Twilio).
- **Communication:** API Gateway for routing, authentication, and load balancing.

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6. Database Design

Tables:

- **Users:** Stores user information (ID, name, email, role, password hash).
- **Products:** Stores product details (ID, name, description, price, vendor ID, category ID, stock).
- **Categories:** Hierarchical structure of product categories.
- **Orders:** Stores order details (ID, customer ID, order date, total amount, status).
- **OrderItems:** Stores individual items within an order.
- **Deliveries:** Tracks delivery details (ID, order ID, delivery personnel ID, status, delivery date).
- **Payments:** Stores payment information (ID, order ID, amount, payment method, status).
- **Reviews:** Stores customer reviews and ratings for products.

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7. API Design

- **User Authentication:**
    - POST /api/auth/login: Authenticate user and return JWT.
    - POST /api/auth/register: Register a new user.
- **Product Management:**
    - GET /api/products: Retrieve a list of products.
    - POST /api/products: Add a new product (Vendor only).
    - PUT /api/products/{id}: Update product details (Vendor only).
    - DELETE /api/products/{id}: Delete a product (Vendor only).
- **Order Management:**
    - POST /api/orders: Create a new order.
    - GET /api/orders: Retrieve a list of customer orders.
    - GET /api/orders/{id}: Retrieve details of a specific order.

- **Delivery Management:**
    - GET /api/deliveries: Retrieve a list of deliveries (Admin/Delivery Personnel).
    - PUT /api/deliveries/{id}: Update delivery status (Delivery Personnel).
- **Payment Processing:**
    - POST /api/payments: Process a payment for an order.
    - GET /api/payments/{id}: Retrieve payment details.

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8. Testing Strategy

- **Unit Tests:** Use JUnit and Mockito for testing individual components in the backend.
- **Integration Tests:** Use Postman for API testing and Selenium for UI testing.
- **Load Testing:** Use JMeter or Locust to simulate high traffic and assess system performance under load.
- **End-to-End Tests:** Automated tests to verify the entire user journey from product selection to order delivery.

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9. Deployment and CI/CD

- **CI/CD Pipeline:**
    - Automated builds and tests using Jenkins or GitHub Actions.
    - Deployment to AWS using Docker containers and Kubernetes for orchestration.
    - Staging and production environments with blue-green deployment strategy.
- **Monitoring:**
    - Use AWS CloudWatch for real-time monitoring and alerts.
    - Set up logging with ELK stack (Elasticsearch, Logstash, Kibana) for log aggregation and analysis.

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10. Future Enhancements

- **AI-Powered Recommendations:** Implement machine learning algorithms for personalized product recommendations.
- **Multi-Language Support:** Add support for multiple languages to cater to a global audience.
- **Advanced Analytics:** Integrate with analytics tools like Tableau for deeper insights into user behavior and sales trends.

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11. Conclusion

This design document provides a comprehensive blueprint for developing a robust, scalable, and user-friendly online delivery application. By adhering to the outlined architecture, technology stack, and best practices, the application will meet the needs of users while ensuring security, performance, and maintainability.