

Urban Smart Logistics and Delivery System

1. Introduction

This document describes the database design for an Urban Smart Logistics and Delivery System, which aims to provide comprehensive data management solutions for logistics operations, including customer and package management, delivery scheduling, vehicle routing, smart locker utilization, and prescription handling capabilities.

2. Business Problems Addressed

The increasing volume of urban deliveries, combined with the limitations posed by traffic congestion, environmental regulations, and consumer expectations for speed and reliability, presents significant logistical challenges. Traditional delivery models often struggle with inefficiencies in route planning, delayed deliveries, and poor environmental sustainability.

The business problem addressed by this Urban Smart Logistics and Delivery System is the need for a more efficient and scalable solution to manage last-mile deliveries in congested urban environments. The system solves the following issues:

- **Inefficient route planning:** By using optimized delivery routes and schedules, the system minimizes traffic delays and reduces fuel consumption.
- **Environmental sustainability:** The system considers the environmental impact of vehicle usage, with an emphasis on reducing carbon emissions through efficient vehicle management and route optimization.
- **Package security and accessibility:** The inclusion of smart lockers provides secure, flexible delivery options for customers, enabling contactless pickup at their convenience.
- **Prescription and special deliveries:** The system allows the management of special handling requirements, particularly for sensitive items such as prescriptions, ensuring compliance and timely delivery.

3. Entities Description

3.1 Logistics Provider

- ProviderID: Unique identifier for each logistics provider
- Name: Name of the logistics provider
- ContactInfo: Contact information (phone number, email, etc.)
- Address: Headquarters or primary business location
- ServiceAreas: Areas or cities serviced by the provider

3.2 Delivery Driver

- DriverID: Unique identifier for each driver
- Name: Full name of the driver
- ContactInfo: Contact information (phone number, email, etc.)
- LicenseNumber: Driver's license number
- VehicleAssigned: The vehicle assigned to the driver
- ProviderID: ID linking the driver to a logistics provider
- AvailabilityStatus: Status indicating if the driver is available, on route, or off-duty

3.3 Customer

- CustomerID: Unique identifier for each customer
- Name: Full name of the customer
- ContactInfo: Contact information (phone number, email, etc.)
- Address: Residential or preferred delivery address
- PreferredLockerLocation: Default locker location for package retrieval
- DeliveryPreferences: Preferences for delivery times, notification method, etc.
- PaymentDetails: Payment methods and transaction history
- AuthenticationCode: Security code used for locker access

3.4 Package

- PackageID: Unique identifier for each package
- OrderID: Order ID associated with the package
- ContentsDescription: Brief description of the package contents
- DeliveryStatus: Status of the package (pending, in-transit, delivered, etc.)
- SpecialHandling: Indicator for items requiring special handling (e.g., fragile, medicine)
- LockerLocationID: ID of the smart locker location, if applicable

3.5 Delivery Route

- RouteID: Unique identifier for the delivery route
- StartLocation: Starting point of the route
- EndLocation: Final destination of the route
- Waypoints: Key points along the route (optimized for deliveries)
- EstimatedTime: Estimated time of completion
- TrafficConditions: Real-time traffic conditions for the route

- EnvironmentalImpact: Estimate of the carbon footprint for the route

3.6 Smart Locker

- LockerID: Unique identifier for each smart locker
- LocationID: Identifier for the locker's location
- Capacity: Number of compartments within the locker
- OccupiedSlots: Number of slots currently occupied
- AccessMethod: Method to open the locker (PIN)
- Status: Availability status of the locker (available, full, under maintenance)

3.7 Locker Location

- LocationID: Unique identifier for each locker location
- Address: Physical address of the location
- ProximityToCustomers: Distance from high-density customer areas
- Accessibility: Information on location accessibility (24/7, etc.)
- LocationType: Type of location (mall, transit station, etc.)

3.8 Prescription

- PrescriptionID: Unique identifier for each prescription
- OrderID: ID linking to the order requiring the prescription
- CustomerID: ID linking to the customer for prescription verification
- PrescriptionDetails: Details of the prescription (medication, dosage, etc.)
- ExpiryDate: Expiration date of the prescription
- DoctorInfo: Information about the prescribing doctor
- VerificationStatus: Status of the prescription verification (pending, verified)

3.9 Order

- OrderID: Unique identifier for each order
- CustomerID: ID linking to the customer who placed the order
- TotalAmount: Total cost of the order
- OrderDate: Date when the order was placed
- DeliveryDate: Scheduled delivery date
- OrderStatus: Current status of the order (pending, shipped, delivered)
- PaymentStatus: Status of the payment (paid, pending, refunded)
- PrescriptionRequired: Indicator for orders requiring prescription verification

3.10 Verification Code

- CodeID: Unique identifier for the verification code
- OrderID: ID of the associated order requiring verification
- CustomerID: ID linking to the customer for verification
- CodeValue: The actual code (OTP)
- Expiration: Expiration time or date of the code
- Status: Status of the code (valid, expired, used)

3.11 Vehicle

- VehicleID: Unique identifier for each vehicle
- ProviderID: ID linking the vehicle to a logistics provider
- Type: Type of vehicle (bike, van, truck, etc.)
- Capacity: Maximum capacity for packages
- FuelType: Fuel type used by the vehicle (electric, diesel, etc.)
- CurrentLocation: Real-time GPS location
- AvailabilityStatus: Vehicle status (available, in-use, maintenance)
- EnvironmentalImpactRating: Rating based on emissions

3.12 Delivery Schedule

- ScheduleID: Unique identifier for each delivery schedule
- RouteID: ID of the associated route
- DriverID: ID of the assigned delivery driver
- VehicleID: ID of the assigned vehicle
- StartDateTime: Start date and time of the delivery schedule
- EndDateTime: Expected end date and time
- StopCount: Number of stops planned along the route
- Status: Status of the schedule (planned, in-progress, completed)

4. Entity Relationships

4.1 Logistics Provider

- **Manages → Delivery Drivers:** Each logistics provider manages multiple drivers who carry out deliveries.
- **Contracts → Smart Lockers:** Providers contract or lease smart lockers for package storage and customer retrieval.
- **Provides → Vehicles :** each logistics provider provides vehicles for deliveries

4.2 Delivery Driver

- **Managed by → Logistics Provider:** Each delivery driver is employed by a specific logistics provider.
- **Assigned to → Vehicle:** Drivers are assigned specific vehicles to use for deliveries.
- **Executes → Delivery Route:** Drivers follow assigned delivery route optimized by the system.
- **Delivers → Package:** Drivers are responsible for delivering packages to customers or smart lockers.
- **Follows → Delivery Schedule:** Each driver follows a schedule that outlines the timing of each route and delivery.

4.3 Customer

- **Places → Order:** Customers place orders through the system, which then organizes deliveries.
- **Receives → Package:** Customers receive packages from delivery drivers or pick them up from smart lockers.
- **Accesses → Smart Locker:** Customers retrieve packages from smart lockers using authentication methods.
- **Verifies Prescription with → Verification Code:** For prescription-based deliveries, customers verify their identity using a secure code.

4.4 Package

- **Belongs to → Order:** Each package is associated with a customer's order, which dictates the delivery process.
- **Delivered by → Delivery Driver:** Packages are physically handled and delivered by drivers.

4.5 Delivery Route

- **Assigned to → Delivery Driver:** Drivers are assigned delivery routes that optimize package delivery.
- **Contains → Waypoints:** The route is composed of waypoints, marking key delivery points (e.g., customers, lockers).
- **Related to → Delivery Schedule:** Routes are outlined within delivery schedules that specify timing and stops.

4.6 Smart Locker

- **Stores → Package:** Lockers hold packages temporarily for customers to pick up.
- **Located at → Locker Location:** Smart lockers are installed at specific locations for customer convenience.

- Accessed by → Customer: Customers access smart lockers using authentication codes.
- Rented by → Logistics Provider: Logistics providers may lease smart lockers to facilitate the package retrieval process.

4.7 Locker Location

- Contains → Smart Lockers: Each location houses one or more smart lockers for customer package pickup.

4.8 Prescription

- Associated with → Order: Prescriptions are linked to specific orders requiring medication delivery.
- Verified with → Verification Code: Prescription verification involves secure codes to validate the order before delivery.

4.9 Order

- Placed by → Customer: Customers create orders through the system for delivery.
- Contains → Package: Each order consists of one or more packages that need delivery.
- May Require → Prescription: Orders involving medicine require prescription verification.

4.10 Verification code

- Generated for → Prescription or Customer Verification: Codes are generated for secure authentication, especially for medicine deliveries.
- Linked to → Customer: Each verification code is linked to a customer for a specific order or package.
- Associated with → Order: Each code is tied to a specific order that may involve secure or prescription-based deliveries.

4.11 Vehicle

- Assigned to → Delivery Driver: Each vehicle is assigned to a driver for daily delivery routes.
- Follows → Delivery Route: Vehicles follow specific delivery routes that are optimized for efficiency.
- Operated by → Logistics Provider: Vehicles are owned or leased by the provider for transporting packages.
- Scheduled for → Maintenance: Vehicles have maintenance schedules to ensure they remain operational and meet environmental standards.

4.12 Delivery Schedule

- Linked to → Delivery Route: The delivery schedule outlines the timing for each route, optimizing the driver's itinerary.
- Includes → StopCount: Schedules include a count of stops that align with delivery points (customers or lockers).
- Assigned to → Delivery Driver and Vehicle: Each schedule is allocated to a driver and a specific vehicle, organizing the delivery workload.
- Organized by → Logistics Provider: The provider organizes and assigns schedules to optimize deliveries and reduce congestion.

5. ER Diagram

