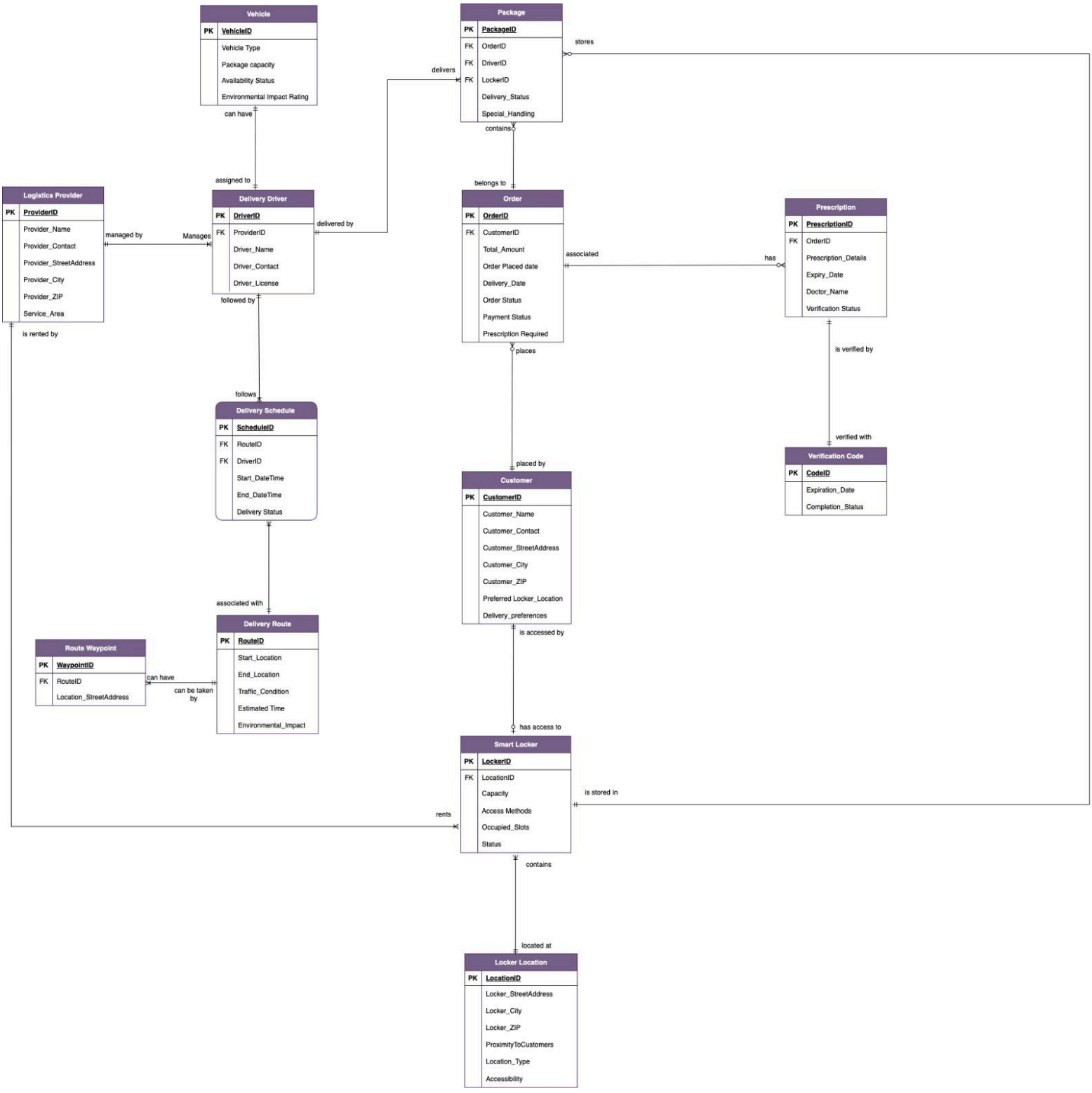
Urban Smart Logistics and Delivery System

Logical ERD Design



Changes Made in the model:

1. Removed Relationship Between Verification Code, Customer, and Order:
    - Conceptual ERD: The initial design connected the Verification Code entity directly to both Customer and Order, creating a direct link between these entities.
    - Logical ERD: In the revised model, the relationships between Verification Code, Customer, and Order have been removed. Instead, the Verification Code is now associated solely through the Prescription entity, which is linked to Order and subsequently related to Customer.

    Reason for Change:
    This change simplifies the model and removes redundant relationships, as the same connection can be achieved through the *Order -> Prescription -> Verification Code* path. This reduction in direct links reduces complexity in data management and reflects a normalized approach by avoiding duplicate relationships.

2. Removed Relationship Between Logistics Provider and Vehicle:
    - Conceptual ERD: The original model directly linked the Logistics Provider entity to Vehicle.
    - Logical ERD: This direct link was removed, as the Vehicle entity is now indirectly associated with Logistics Provider through Delivery Driver.

    Reason for Change:
    This relationship was deemed unnecessary because the *Logistics Provider* is already connected to *Delivery Driver*, who in turn is assigned to a *Vehicle*. By linking only Logistics Provider to Delivery Driver and Delivery Driver to Vehicle, the model avoids redundancy, making it cleaner and more efficient. This change also aligns with the normalization principle by eliminating unnecessary direct associations.

3. Addition of Waypoint Entity:
    - Conceptual ERD: The initial model lacked a Waypoint entity, which would allow tracking of specific locations along a delivery route.
    - Logical ERD: In the revised model, the Waypoint entity has been introduced and associated with Delivery Route. Each Waypoint represents a specific stop along the route, allowing for more detailed tracking. Waypoint in Conceptual was a multi valued attribute, which is here converted into a new entity.

    Reason for Change: Converting *Waypoint* from a multi-valued attribute to an independent entity enhances the model's normalization by treating each waypoint as a distinct entity. This approach allows for precise route tracking and route optimization through recorded checkpoints along a route, leading to improved delivery accuracy, real-time monitoring, and better ETA predictions for customers.

Summary of Changes and Their Benefits

These modifications contribute to a more efficient and normalized database design. By removing redundant relationships, the logical model:

- Improves Clarity: Removing redundant relationships makes the data model easier to understand and reduces complexity for both users and developers.
- Reduces Redundancy: By structuring connections through intermediary entities (e.g., using Order -> Prescription -> Verification Code), the model follows a streamlined approach, preventing duplication of data and minimizing the risk of anomalies.
- Enhances Tracking and Optimization: The Waypoint entity addition allows for precise route tracking and optimization, leading to improved delivery accuracy and better customer satisfaction.

These changes reflect feedback from the professor and align with best practices for database design, resulting in a more structured, implementable, and optimized model.