

Train Management System - Entity-Relationship Diagram and Database Design

1. Introduction:

The Railway working System is intended to handle a variety of business issues connected to the effective operation of rail services. Data collecting, processing, and reporting will be made easier thanks to this technology, which will increase operational effectiveness and passenger satisfaction.

2. Entities:

The following entities are essential for the MBTA Train Management System:

2.1. Train

Description: Represents a train service running on the MBTA network.

Attributes: TrainID (Primary Key),
TrainName,
DepartureTime,
ArrivalTime.

2.2. Station

Description: Represents a station along the train route.

Attributes: StationID (Primary Key),
StationName,
Location.

2.3. Passenger

Description: Represents a passenger using the train service.

Attributes: PassengerID (Primary Key),
FirstName,
LastName,
ContactInfo.

2.4. Schedule

Description: Represents the schedule of train services.

Attributes: ScheduleID (Primary Key),
TrainID (Foreign Key),
StationID (Foreign Key),
DepartureTime,
ArrivalTime.

2.5. Ticket

Description: Represents a ticket purchased by a passenger for a specific train.

Attributes: TicketID (Primary Key),
PassengerID (Foreign Key),
TrainID (Foreign Key),
DepartureTime,
ArrivalTime,

Price.

2.6. Route

Description: Represents a specific train route between stations.

Attributes: RouteID (Primary Key),
TrainID (Foreign Key),
OriginStationID (Foreign Key),
DestinationStationID (Foreign Key).

2.7. Staff

Description: Represents the staff members working on the trains.

Attributes: StaffID (Primary Key),
FirstName,
LastName,
Position.

2.8. Train Maintenance

Description: Records maintenance activities for trains.

Attributes: MaintenanceID (Primary Key),
TrainID (Foreign Key),
MaintenanceType,
MaintenanceDate,
Details.

2.9. Delays

Description: Records delays in train services.

Attributes: DelayID (Primary Key),
TrainID (Foreign Key),
DelayDuration,
DelayStart.

2.10. Feedback

Description: Stores feedback from passengers regarding their train experience.

Attributes: FeedbackID (Primary Key),
PassengerID (Foreign Key),
Rating.

2.11. Stations Connection

Description: Represents the connection between two stations.

Attributes: ConnectionID (Primary Key),
StationID1 (Foreign Key),
StationID2 (Foreign Key),

2.12. Crew Assignment

Description: Links staff members to their assignments on trains.

Attributes: AssignmentID (Primary Key),
StaffID (Foreign Key),

3. Relationships:

3.1. Train to Route

Type: Identifying

Multiplicity: One-to-Many

Description: A train operates on multiple routes.

3.2. Train to Schedule

Type: Identifying

Multiplicity: One-to-Many

Description: A train can have multiple schedules.

3.3. Train to Ticket

Type: Identifying

Multiplicity: One-to-Many

Description: Passengers can purchase multiple tickets for a single train.

3.4. Train to Maintenance

Type: Identifying

Multiplicity: One-to-Many

Description: A train can undergo multiple maintenance activities.

3.5. Train to Delays

Type: Identifying

Multiplicity: One-to-Many

Description: A train can experience multiple delays.

3.6. Station to Route

Type: Non-Identifying

Multiplicity: One-to-Many

Description: A route include multiple stations

3.7. Station to Schedule

Type: Non-Identifying

Multiplicity: One-to-Many

Description: A stations include multiple schedules.

3.8. Ticket to Passenger

Type: Non-Identifying

Multiplicity: Many-to-One

Description: A ticket belongs to a single passenger.

3.9. Feedback to Passenger

Type: Non-Identifying

Multiplicity: Many-to-One

Description: Feedback is provided by a passenger.

3.10. Stations Connection to Route

Type: Non-Identifying

Multiplicity: One-to-Many

Description: A station connection can be a part of a multiple routes.

3.11. Crew Assignment to Staff

Type: Non-Identifying

Multiplicity: One-to-Many

Description: Staff members are assigned multiple Assignment

3.12. Train to Staff

Type: Non-Identifying

Multiplicity: One-to-Many

Description: a train can have multiple staff members.

4. Business Problems Addressed

The primary business problems addressed by the MBTA Train Management System include:

Efficient Scheduling: Managing train schedules and ensuring timely arrivals and departures.

Rider Information: Providing real-time information to passengers about train arrivals, delays, and other relevant updates.

Maintenance Tracking: Monitoring and scheduling maintenance activities for the train fleet.

Resource Management: Efficient allocation of resources such as train cars, crew members, and maintenance personnel.

Financial Management: Keeping track of budgeting and cost allocation for various train operations.

5. Key Design Decisions:

Third Normal Form (3NF) Normalization: The design of the database complies with 3NF guidelines to reduce data duplication and preserve data integrity.

Relationship Types: Identifying vs. Non-Identifying: Identifying relationships are used when the existence of the child entity depends on the parent entity (for example, Train to Route). When the child entity can exist without the parent entity (as in the case of a ticket to a passenger), non-identifying relationships are employed.

Multiplicity: To ensure appropriate representation of data connections, such as one-to-many and many-to-many.

Entities Connectivity: All entities are connected through appropriate relationships, ensuring data flow and consistency.

6. Conclusion:

The ERD and database design of the MBTA Train Management System is crucial for effectively managing train services, guaranteeing customer happiness, and addressing various business issues relating to train operations, maintenance, and passenger services. The design meets data integrity requirements, normalization principles, and correct depiction of data relationships.

ER-Diagram

