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# EV CHARGING SLOT RESERVATION & LOAD MANAGEMENT

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Functional Requirement Document



Business Analyst Project Report  
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## FUNCTIONAL REQUIREMENT DOCUMENT (FRD)

PROJECT NAME: EV CHARGING SLOT RESERVATION & LOAD MANAGEMENT SYSTEM

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### **1. Introduction:**

#### **1.1 Purpose**

This FRD outlines detailed functional requirements for the EV Charging Slot Reservation & Load Management System.

The document describes system behaviour, data processing logic, UI interactions, validations, exception handling, business rules, and integrations.

#### **1.2 Intended Audience**

- Business Analysts
- Developers
- QA/Test Engineers
- Architects
- Product Owners
- EV Station Operations Team

### **2. System Overview:**

The system enables EV users to reserve charging slots, manages charger availability, balances station power load, automates queue management, and provides real-time status updates.

The system consists of:

1. User App / Web Application
2. Charging Station Management System
3. Load Management Engine
4. Slot Reservation System
5. Dynamic Pricing Engine
6. Notification Service
7. Operator Dashboard

### **3. Functional Requirements:**

Below are grouped by modules.

### **3.1 Slot Reservation Module**

#### **FR-01: Search Charging Stations**

- User can search stations by:
  - Location
  - Charger type (Fast/Slow)
  - Connector type
  - Availability
- System must return a list of matching stations with real-time status.

#### **FR-02: View Time Slots**

- System must display available, reserved, and blocked time slots.
- Slot color indicators:
  - Green – Available
  - Yellow – Reserved
  - Red – Unavailable/Faulty

#### **FR-03: Reserve a Slot**

- User selects:
  - Station
  - Charger
  - Date & Time
  - Duration (30–90 minutes)
- System must validate capacity and confirm reservation.

#### **FR-04: Modify/Cancel Slot**

- User can cancel a slot up to 15 minutes before start time.
- System must update queue and availability.

#### **FR-05: Auto Slot Expiry**

- If user doesn't arrive within 10 minutes of slot time, reservation auto-expires.

### **3.2 Real-Time Charger Status Module**

#### **FR-06: Pull Charger Telemetry**

System must fetch charger data every 10 seconds:

- Power consumption

- Charger temperature
- Status (Available / In Use / Faulty / Offline)

#### **FR-07: Update Charger Health**

- System must mark faulty chargers as unavailable.
- Notify operator via dashboard alert.

### **3.3 Load Management Module**

#### **FR-08: Load Calculation**

- System must calculate total station load every 5 seconds:
- Total Load = Sum(charger\_loads)

#### **FR-09: Load Threshold Validation**

- If load > safe threshold, system must:
  - Limit number of parallel sessions
  - Delay new sessions
  - Trigger load alert

#### **FR-10: Intelligent Load Balancing**

- System must allocate charging power dynamically based on:
  - Charger type
  - Number of active sessions
  - Station load
  - Grid constraints

#### **FR-11: Emergency Priority**

- Emergency tagged vehicles bypass queue and load rules.

### **3.4 Queue Management Module**

#### **FR-12: Auto Queue Add**

- If all slots full, system auto-adds user to queue.

#### **FR-13: Queue Priority**

- FIFO model
- Emergency cases override FIFO

#### **FR-14: Queue Notification**

- When slot frees:

- User receives immediate notification
- Must confirm within 5 minutes

### **3.5 Dynamic Pricing Module**

#### **FR-15: Price Calculation**

Price depends on:

- Time of day (peak/off-peak)
- Charger type
- Demand
- Energy units consumed

#### **FR-16: Price Refresh**

- Pricing engine recalculates every 15 minutes.

#### **FR-17: Display Pricing**

- User must see price before booking.
- Operator must see price breakdown.

### **3.6 Charging Session Management Module**

#### **FR-18: Start Session**

- Session begins when:
  - User plugs vehicle
  - Charger detects vehicle
  - System authorizes session

#### **FR-19: Track Session**

System logs:

- Start time
- End time
- Energy consumed
- Charger health during session

#### **FR-20: Stop Session**

- Auto-stop when battery full or session time ends.
- User can manually stop.

### **3.7 Notification Module**

#### **FR-21: Notifications Should Be Sent For**

- Slot booking confirmation
- Slot reminder (30 min before)
- Charging started
- Charging completed
- Queue updates
- Fault alerts

#### **FR-22: Delivery Methods**

- App Push
- SMS
- Email

### **3.8 Operator Dashboard Module**

#### **FR-23: Dashboard Metrics**

Dashboard must display:

- Charger statuses
- Active bookings
- Queue
- Real-time load
- Fault alerts
- Revenue metrics
- Demand forecast

#### **FR-24: Graphs & Reports**

- Load trend graph
- Usage graph
- Peak hour graph
- Booking report

### **4. Data Requirements:**

#### **4.1 Key Entities**

- User
- Vehicle
- Station
- Charger
- Slot
- Booking
- Queue
- Charging Session
- Load History
- Pricing Rules

#### **4.2 Data Validation Rules**

- Phone number must be 10 digits
- Slot duration: 30–90 minutes
- Vehicle connector type must match charger type
- Load must not exceed threshold

### **5. Integration Requirements:**

#### **IR-01: Charger IoT APIs**

For telemetry:

- Power
- Temperature
- Status

#### **IR-02: Payment API (Phase 2)**

#### **IR-03: Notification API**

- SMS gateway
- Email SMTP
- Push notification service

#### **IR-04: Pricing Engine**

### **6. Non-Functional Requirements:**

**NFR-01: Performance**

- System must handle 10,000+ concurrent users
- API response < 2 seconds

**NFR-02: Availability**

- 99.9% uptime required

**NFR-03: Scalability**

- Support 10x increase in stations

**NFR-04: Security**

- Encrypt all user data
- OAuth2 + JWT Authentication

**NFR-05: Reliability**

- Auto recovery for failed processes

**NFR-06: Logging**

- Capture all booking, load, and charging logs

**7. Exception Handling:**

1. Charger offline → system auto-marks unavailable
2. Load spike → deny new sessions
3. User no-show → slot auto-expired
4. Pricing engine failure → fallback to base pricing
5. Notification failure → retry 3 times then log

**8. Assumptions:**

- Chargers support standard APIs
- Real-time station data available
- Users have smartphones
- Stations have stable internet

**9. Approval Sign-off:**

Role	Name	Signature	Date
Product Owner			
Business Analyst			
Technical Lead			
Operations Manager			

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