



EV CHARING SLOT RESERVATION & LOAD MANAGEMENT

Functional Requirement Document



Business Analyst Project Report
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Date: October 2025
Version: 1.0

FUNCTIONAL REQUIREMENT DOCUMENT (FRD)

PROJECT NAME: EV CHARGING SLOT RESERVATION & LOAD MANAGEMENT SYSTEM

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			
