Smart India Hackathon 2025 – Ministry of Railways Problem Statement

Problem Statement:

Maximizing Section Throughput Using AI-Powered Precise Train Traffic Control Software (SIH25022).

Problem Explanation:

Indian Railways faces congestion in busy sections where multiple trains compete for limited tracks. Efficient traffic control is required to increase throughput (number of trains that can pass safely through a section in given time) while reducing delays and conflicts. Current systems rely heavily on fixed timetables and human operators, which lack real-time adaptability.

Proposed Solution:

We propose an AI-powered software system (Web + Backend + Simulator + Future ML Integration) that tracks real-time train positions, simulates train movements, and provides intelligent scheduling. Initially, a rule-based system will be implemented, later extended to machine learning models for adaptive and predictive traffic management.

Tech Stack:

1 Frontend: React + Leaflet.js for map-based live dashboard
2 Backend: Node.js + Express
3 Database: MongoDB (Telemetry + Scheduling data)
4 Simulation: Python (train movement generator)
5 Real-time updates: WebSockets (Socket.IO)
6 AI/ML (future): Scikit-learn, Google OR-Tools, Reinforcement Learning (PyTorch)

Development Phases:

1 Phase 1: Backend APIs + Database setup (trains, sections, telemetry)
2 Phase 2: Frontend dashboard with map and live updates
3 Phase 3: Train movement simulation using Python
4 Phase 4: Rule-based scheduling (priority handling, avoiding conflicts)
5 Phase 5: AI/ML integration for optimization (future enhancement)

Micro-Phases (Example: Phase 2 - Dashboard):

1 Design UI layout with React components
2 Integrate Leaflet.js map
3 Show train markers with live updates
4 Add status indicators (delayed, on-time, priority)
5 Enable operator to view and approve scheduling suggestions

Approach Summary:

1. Start with core MERN stack to build backend and frontend. 2. Add a Python simulator for train movement. 3. Implement simple rule-based scheduling to show concept. 4. Present dashboard and simulation at SIH as proof-of-concept. 5. Keep AI/ML as future upgrade, showing scalability of solution.