PROJECT KESSLER

ORBITAL DEFENSE INITIATIVE

CLASSIFICATION: PUBLIC RELEASE
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SUBJECT: TECHNICAL REFERENCE MANUAL

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1. Mission Overview

The Space Debris Collision Risk Analyser (SDCRA) is a next-generation
visualization tool designed to monitor the growing threat of the
Kessler Syndrome|a theoretical scenario where the density of objects
in Low Earth Orbit (LEO) becomes high enough that collisions between
objects could cause a cascade in which each collision generates
space debris that increases the likelihood of further collisions.

2. System Architecture

SDCRA operates as a high-performance web application leveraging GPU acceleration for real-time orbital propagation.

Frontend Core: React.js (Vite) + TypeScript

Visualization Engine: Three.js / React Three Fiber

Physics Engine: SGP4 (Simplified General Perturbations) Propagator

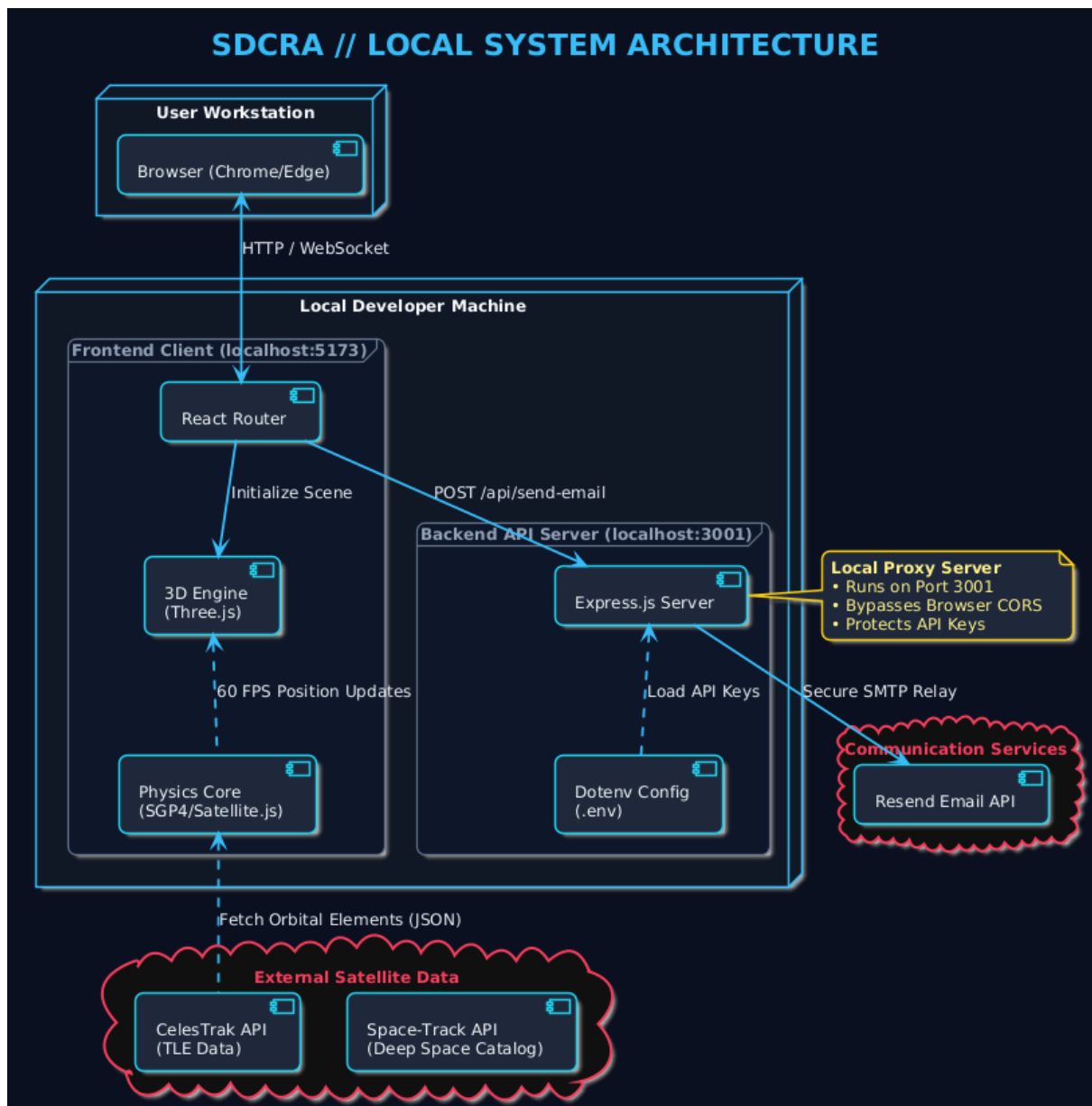**Data Stream:** CelesTrak (NORAD GP Elements) & Space-Track.org

Figure 1: System Architecture Diagram

3. Operational Modules

3.1 Orbit Risk (3D Visualizer)

A WebGL-powered digital twin of Earth's orbital environment. It renders 15,000+ active satellites and debris fragments in real-time (60 FPS).

Color Coding: Cyan (Active Payloads) vs. Orange/Red (Debris/Rocket Bodies).

Features: Interactive zoom, rotation, and click-to-identify functional

3.2 Reentry Watch (VLEO Monitor)

A tactical dashboard focused on objects in Very Low Earth Orbit (<300km altitude).

decay_algorithm: Monitors Mean Motion (Revs/Day) and B* Drag Term to predict imminent atmospheric reentry.

Purpose: To track large uncontrolled bodies (e.g., spent rocket stages) posing ground risk.

3.3 SATCAT (Global Registry)

A searchable, paginated database of the unclassified space object catalog.

Capacity: Indexes 26,000+ objects.

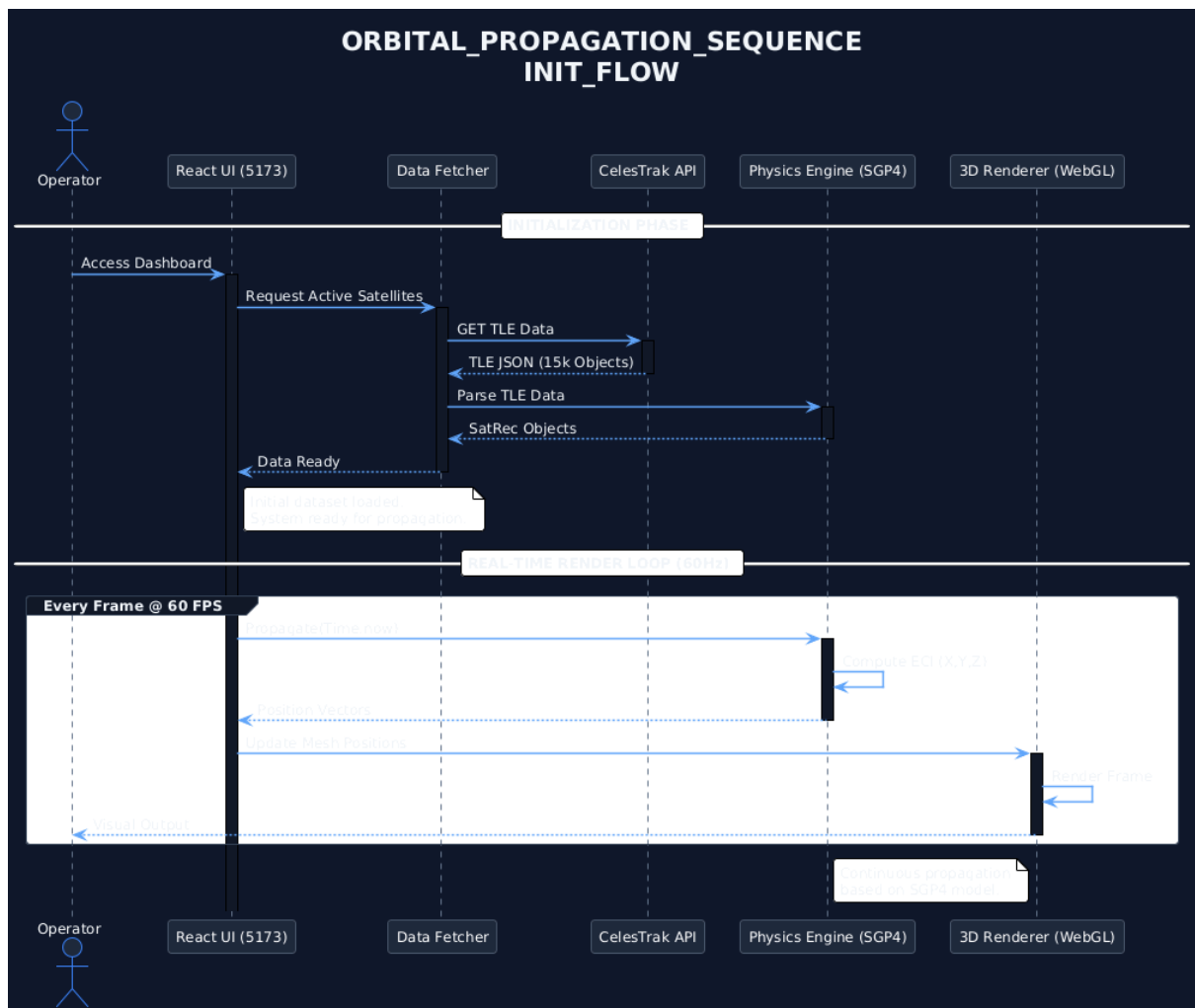**Search Protocol:** Filter by International Designator or NORAD Catalog ID (e.g., ISS #25544).

Figure 2: Orbital Propagation Sequence Diagram

4. Data Integrity

Tracking data is sourced from the USSTRATCOM Two-Line Element (TLE) sets. While suitable for situational awareness and educational visualization, SDCRA data should not be used for mission-critical collision avoidance maneuvers without corroborating radar telemetry.
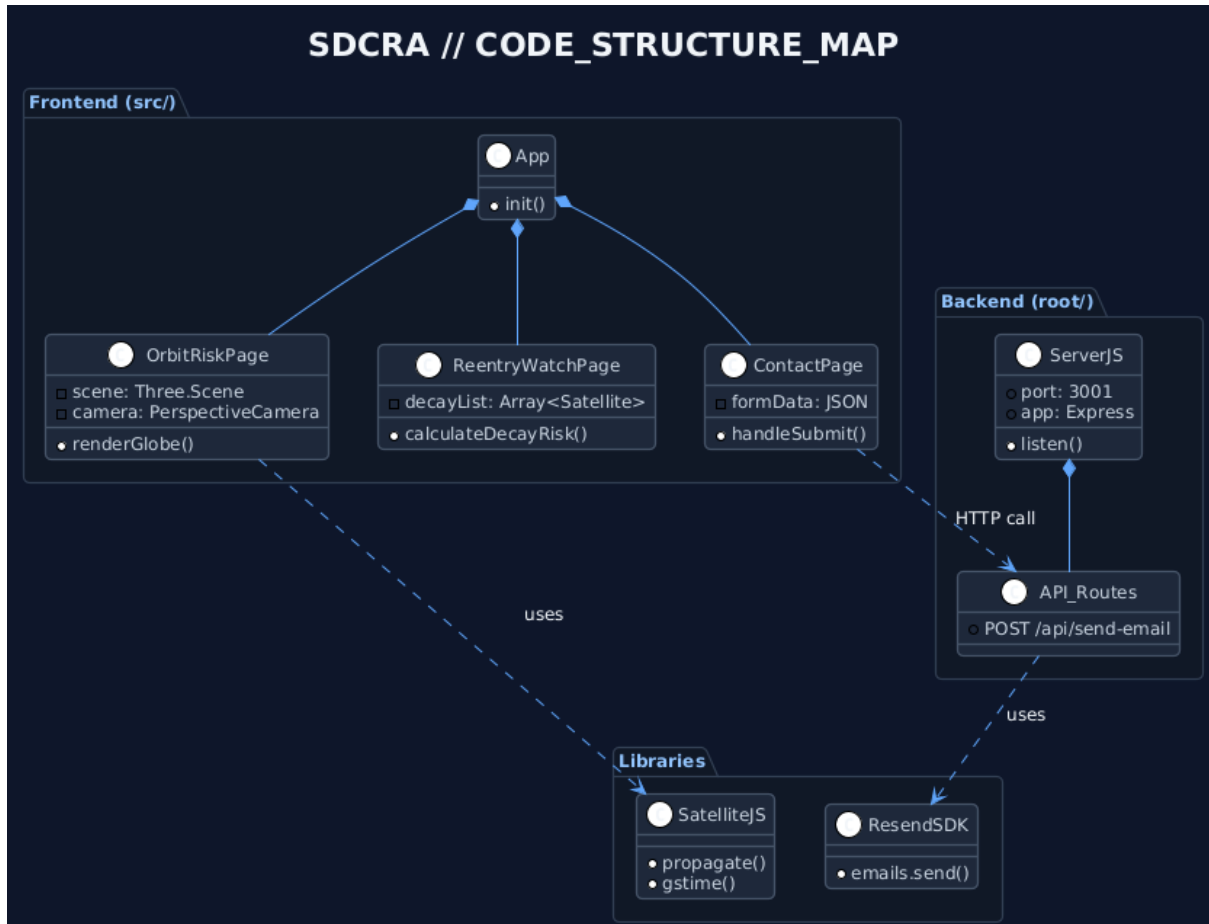

Figure 3: Code Structure (Class) Diagram

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