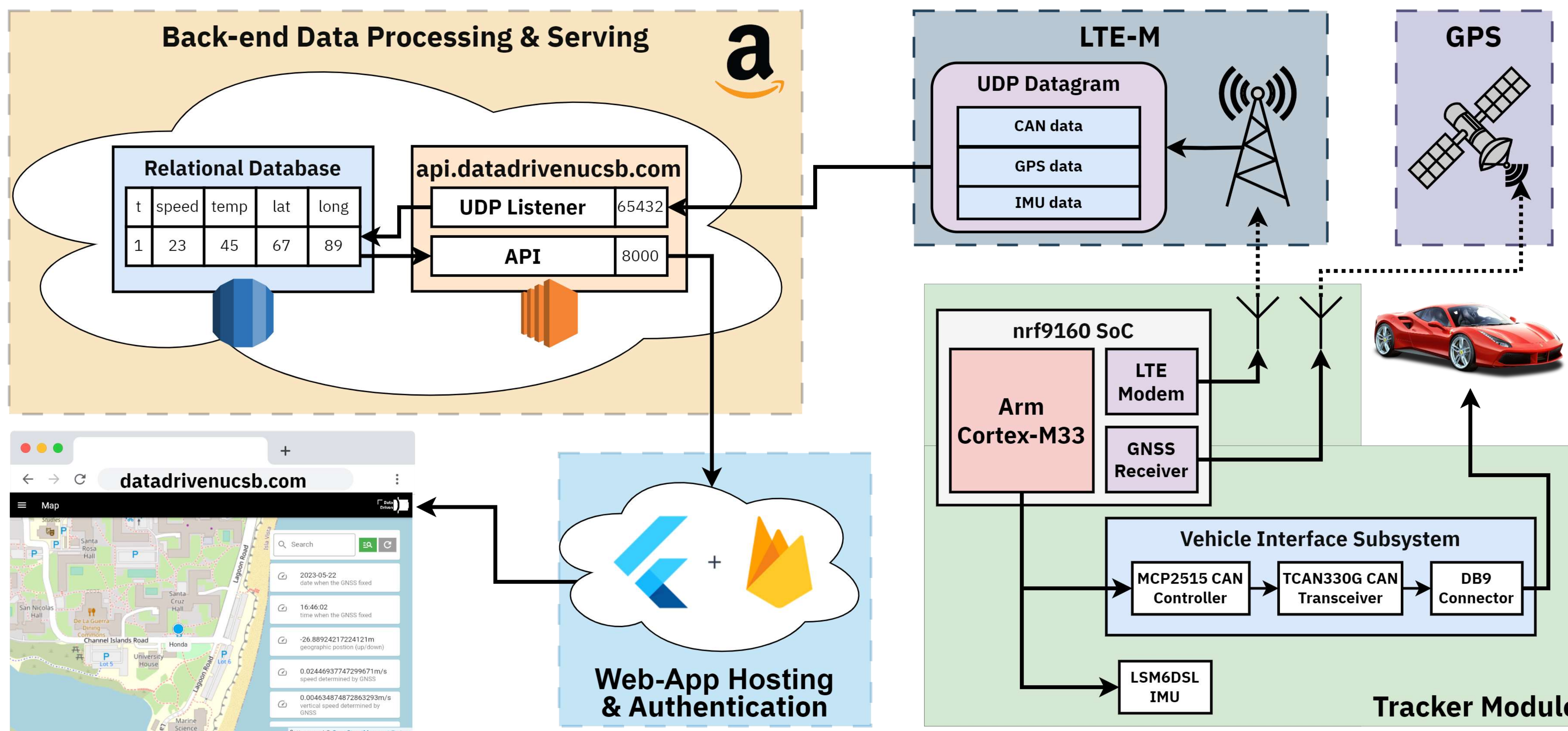## Background

🚗 Vehicles are **expensive** investments – they need routine maintenance and constant upkeep to avoid costly repairs. At scale, this becomes a **complex logistical challenge**. Failures can be costly to the fleet owner in vehicle downtime for unexpected maintenance and repairs.

💡 By **tracking** the routes these vehicles take and cross-referencing it with **vehicle diagnostic data**, users can find **correlations** and **develop insights**.
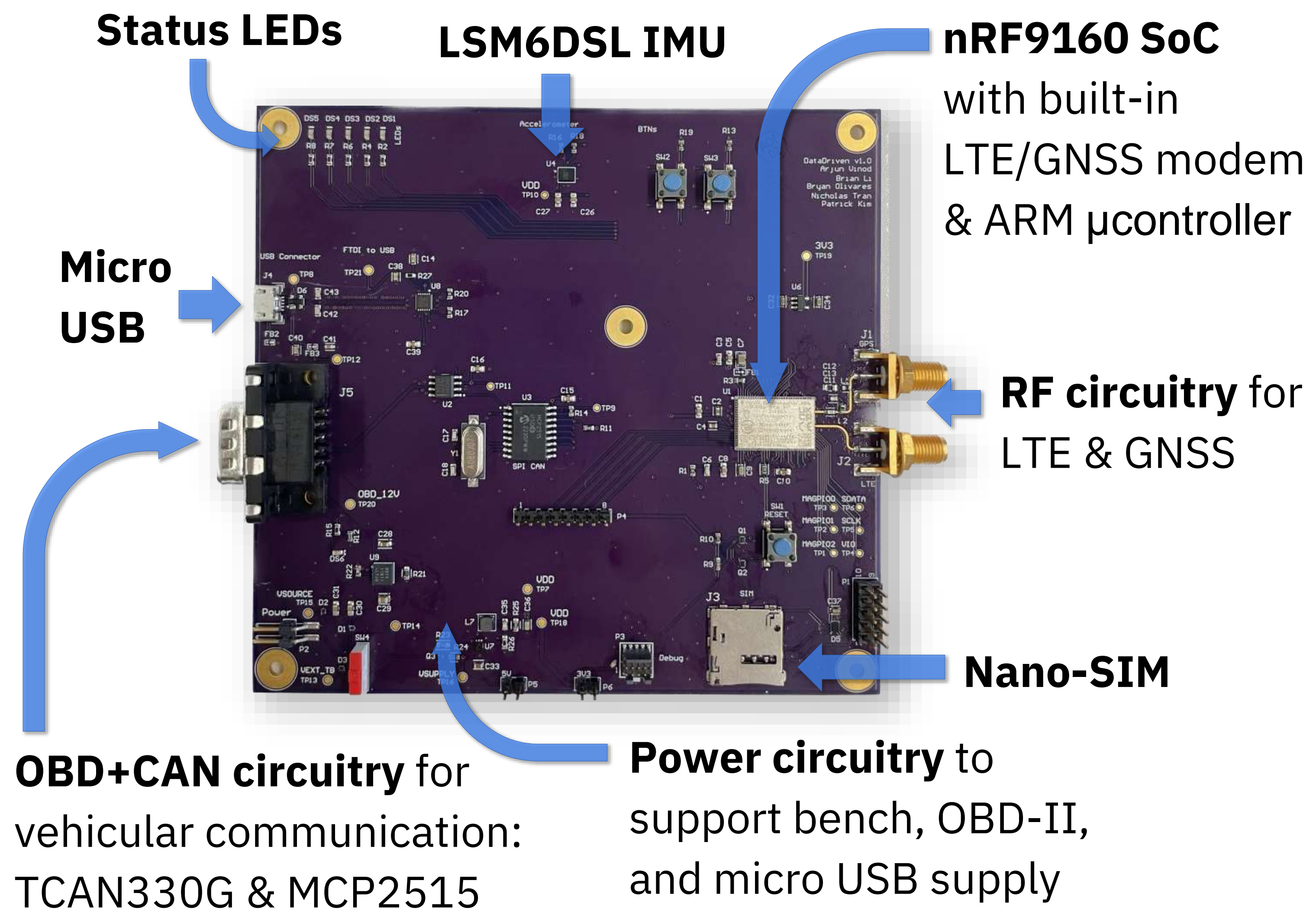
📝 Design Spec

📍 **Tracker**: sits on the dashboard of the vehicle with a cable connected to the OBD-II port, extracting vehicle diagnostic data and collecting GPS, accelerometer, and gyroscope data via onboard sensors.

🗺️ **Web App**: an interactive map to track the vehicle location along with a statistics page with a dashboard of KPIs and calculations over historical data.
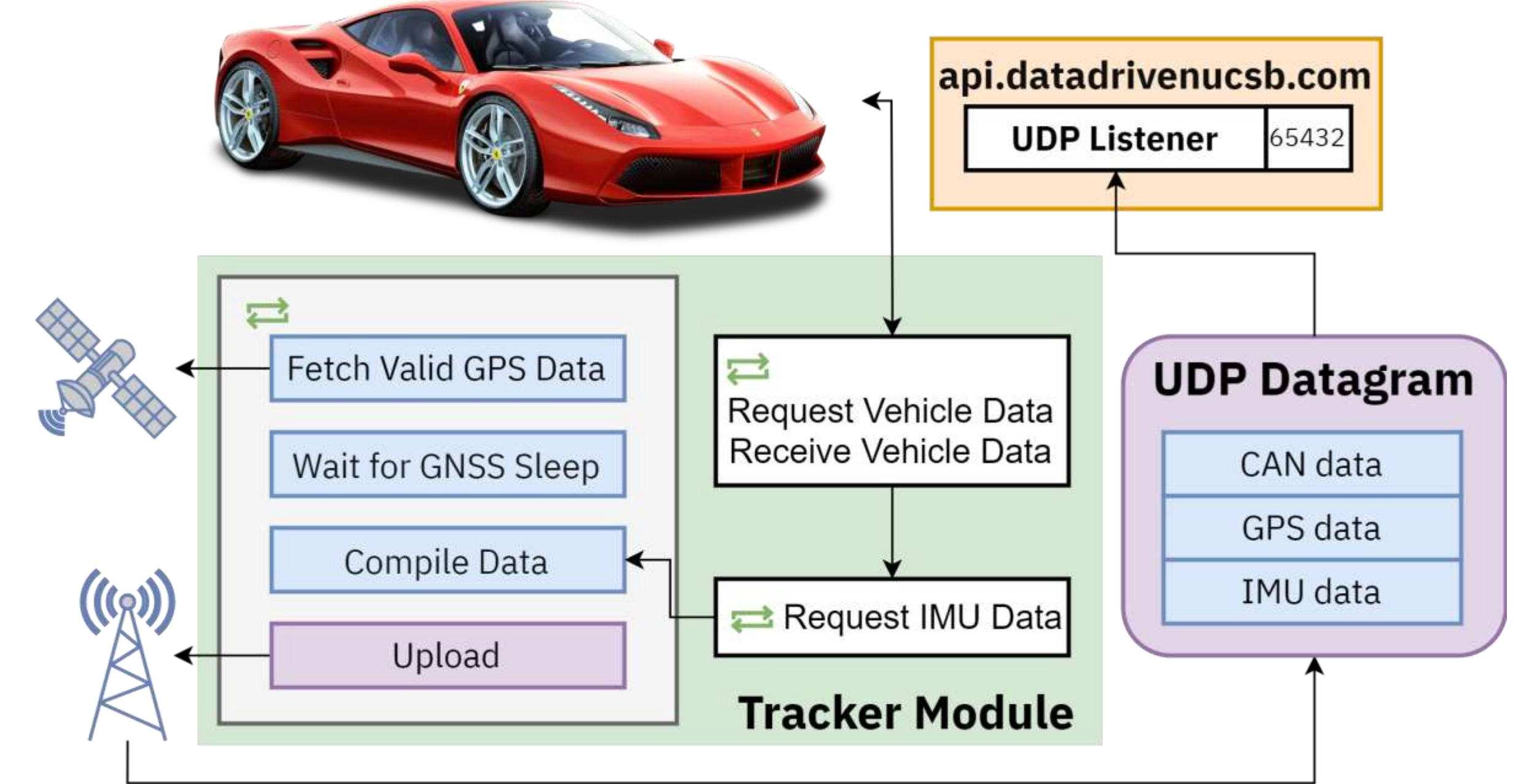
📍 Tracker (Custom PCB)

Status LEDs

LSM6DSL IMU

nRF9160 SoC with built-in LTE/GNSS modem & ARM µcontroller

Micro USB

RF circuitry for LTE & GNSS

Nano-SIM

OBD+CAN circuitry for vehicular communication: TCAN330G & MCP2515

Power circuitry to support bench, OBD-II, and micro USB supply

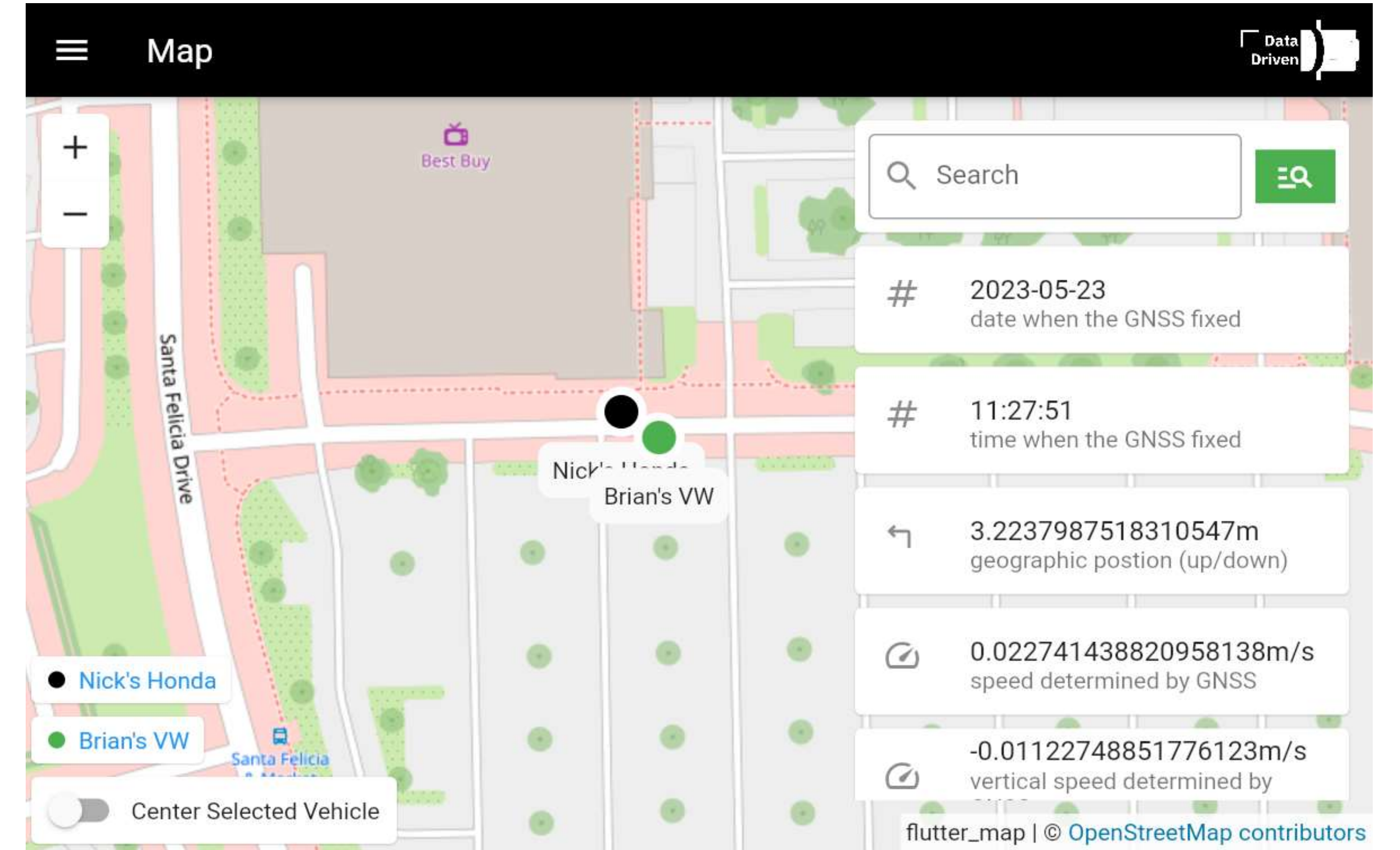### 🚀 Available Vehicle Parameters

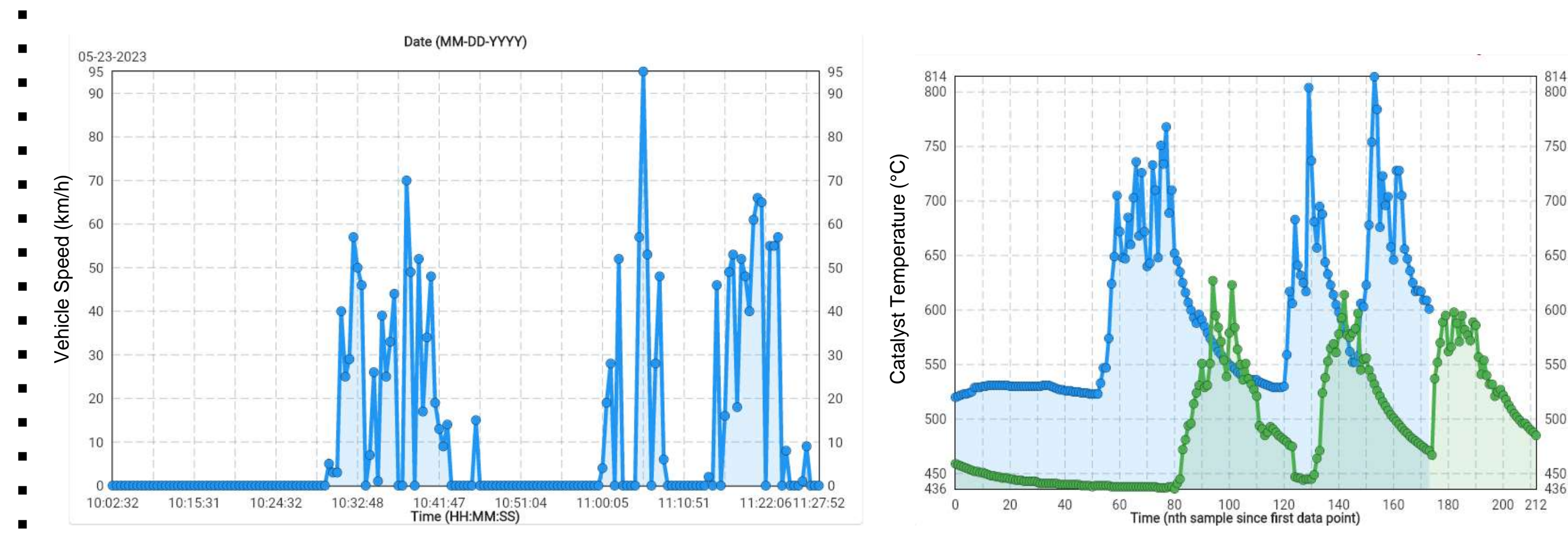|		
Vehicle Speed	Throttle Pos.	Abs. Load Value
Engine Rot. Speed	O2 Sensor Voltage	Latitude
Gyro.(X/Y/Z)	O2 Sensor Fuel Trim	Longitude
Accel. (X/Y/Z)	Barometric Pressure	... and more!

📶 Networking

With a single on-chip LTE/GNSS modem, our firmware uses **time-division multiplexing** for concurrent LTE and GNSS functionality.

api.datadrivenucsb.com — UDP Listener 65432

Fetch Valid GPS Data / Wait for GNSS Sleep / Compile Data / Upload

Request Vehicle Data / Receive Vehicle Data / Request IMU Data

Tracker Module

UDP Datagram — CAN data / GPS data / IMU data

🗺️ Live Tracking

Map

Search

2023-05-23 — date when the GNSS fixed

11:27:51 — time when the GNSS fixed

3.2237987518310547m — geographic postion (up/down)

0.0227414388220958138m/s — speed determined by GNSS

-0.01122748851776123m/s — vertical speed determined by

● Nick's Honda
● Brian's VW

Center Selected Vehicle

flutter_map | © OpenStreetMap contributors

Block Diagram

Back-end Data Processing & Serving

Relational Database

t	speed	temp	lat	long
1	23	45	67	89

api.datadrivenucsb.com — UDP Listener 65432 / API 8000

datadrivenucsb.com — Map

Web-App Hosting & Authentication

LTE-M

UDP Datagram — CAN data / GPS data / IMU data

GPS

nrf9160 SoC

Arm Cortex-M33

LTE Modem

GNSS Receiver

Vehicle Interface Subsystem

MCP2515 CAN Controller → TCAN330G CAN Transceiver → DB9 Connector

LSM6DSL IMU

Tracker Module

📊 Data Visualization

Date (MM-DD-YYYY)

Time (HH:MM:SS)

❏ Visualize vehicle parameters in **time series charts**.

❏ **Compare** vehicle data across multiple vehicles.

John Buckley, Brian Canty, Stefan Crigler, Martin Fay, Duane Gardner, Austin Hwang, David McCarthy, Eric Nystrom

CACI EVER VIGILANT

Dr. Yogananda Isukapalli, Alex Lai, Jimmy Kraemer, Venkat Krishnan

UC SANTA BARBARA engineering