

Decentralized Vehicle Identification System

A primitive supply chain solution for automotive vehicles on the Ethereum blockchain.

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Context

The automotive supply chain is one of the most complex supply chain systems on the planet. On average a vehicle is composed of about 30,000 different parts. These parts are manufactured by many different companies. Each of the parts use source raw materials from many different sources.

Manufacturers typically source components from Tier 1 suppliers who purchase components from Tier 2 suppliers and package it into automotive-grade systems. Tier 2 suppliers source their raw materials from Tier 3 suppliers.

Once manufactured, vehicle manufacturers sell their products to consumers via dealerships. These dealerships are mostly independent from the OEM manufacturer with a few exceptions.

Vehicles are then often sold from consumers to other consumers, and sometimes back to the dealership, then sold back to a consumer.

For the purposes of this project, the solution will focus on tracking vehicles starting from the OEM (original equipment manufacturer).

Advantages

- Recording vehicle ownership on a blockchain has the following advantages:
- Open access to ownership data means that vehicles are easier to track by the OEM, dealerships, & consumers
- Vehicle transactions can occur without the need of a middleman (like the DMV)
- Easier international transfer of vehicle ownership
- Valuable information for OEMs and dealerships regarding the lifecycle of their vehicles

Rinkeby Deployment

The application is deployed on the **Rinkeby test network**.

Contract Address	0xcd33A42A23650E737D21B119E90DB8bbFa1DC48E
Transaction ID	0x7eb26030745384b7df2f1534150eba8c3fbef16d88712ea4765925cb0ca2f066
UI Frontend	https://maz.ninja/international-vehicle-tokens

Architecture

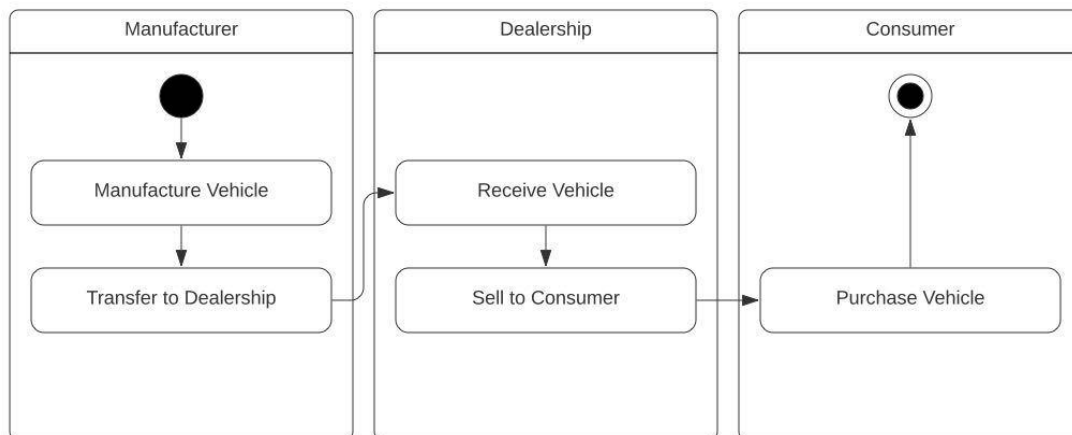
In this primitive system, the lifecycle of the vehicle begins at the manufacturer. Registered manufacturers can mint an ERC-721 non-fungible token that is tied to the Vehicle Identification Number (VIN) that they produce.

Since the system follows the ERC-721 Non-Fungible Token Standard, the tokens (or digital deed for a vehicle), can be transferred to any appropriate owner.

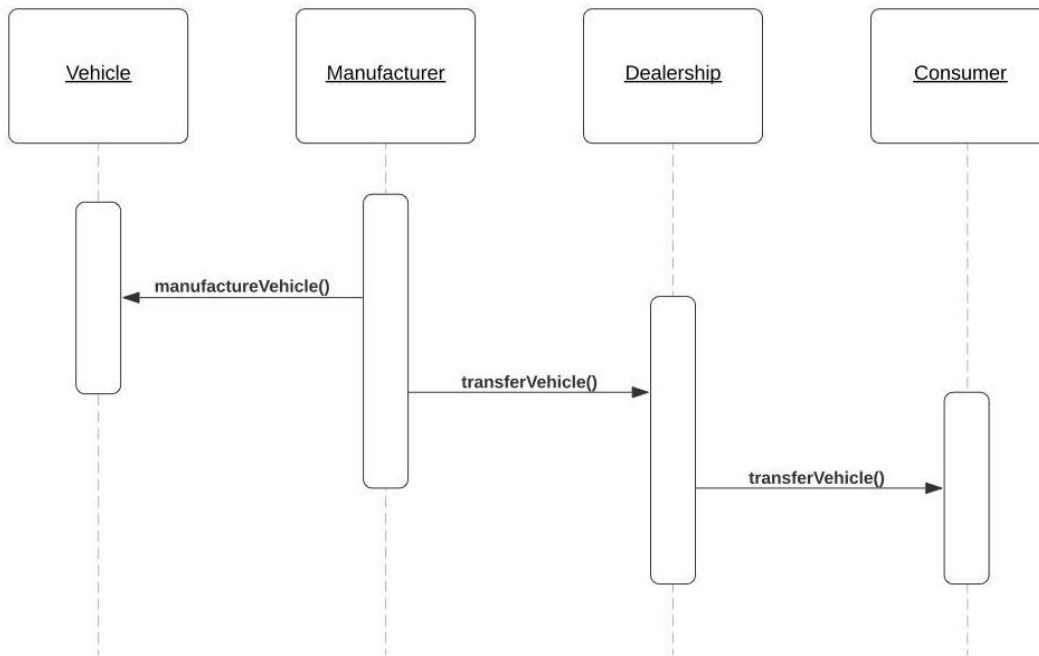
Dealerships are given a special role in the system so that manufacturers can follow local regulations which in some places state that the manufacturer must sell their vehicles to a dealership.

Dealerships are then free to transfer (or sell) the digital token to any consumer or to another dealership, and even back to the manufacturer.

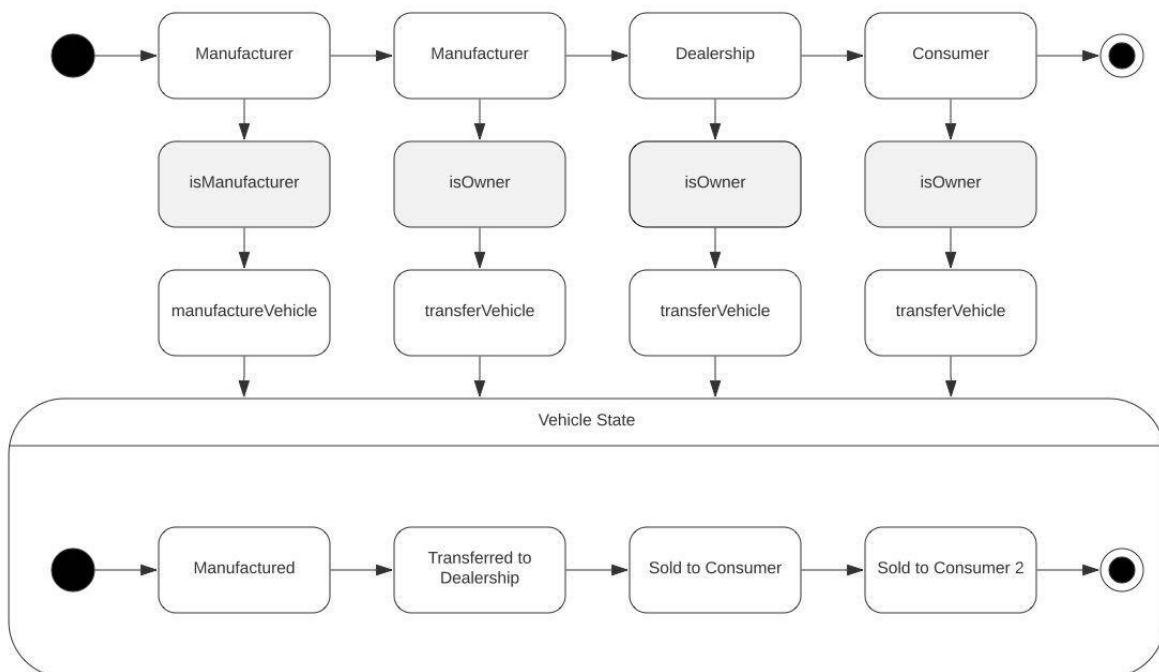
Activity Diagram



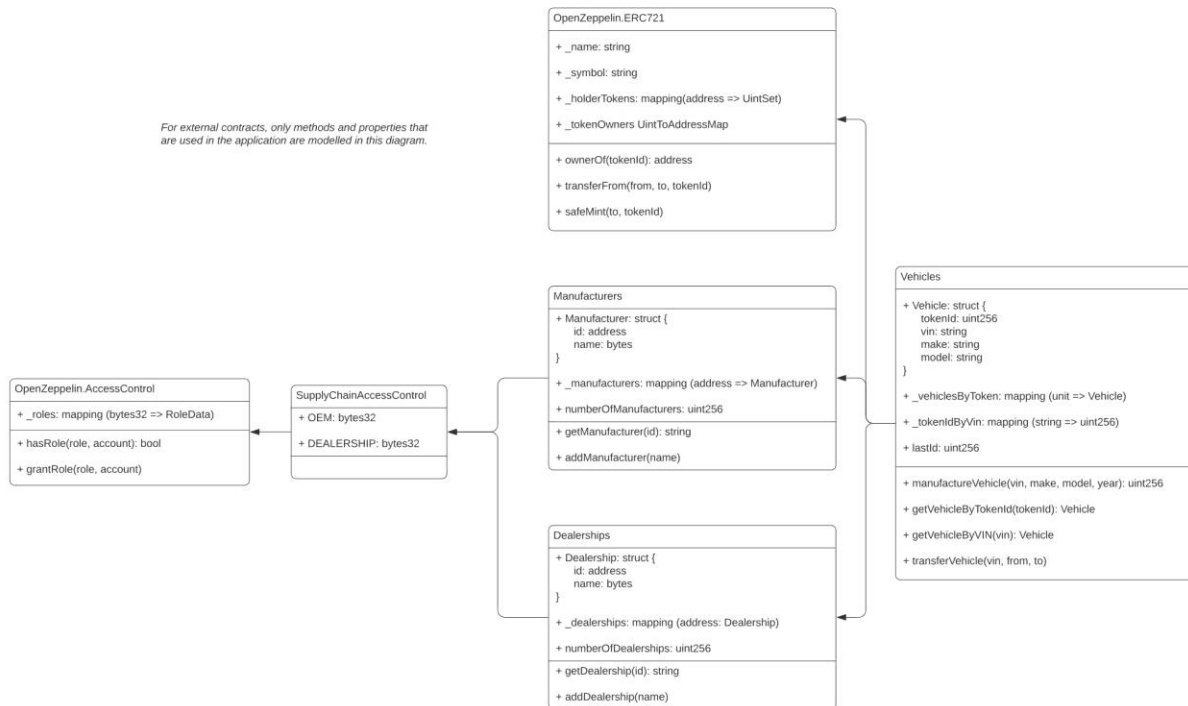
Sequence Diagram



State Diagram



Data Model



Libraries

The application takes advantage of many open source libraries. *OpenZeppelin* is used in the decentralized backend for the ERC721 token functionality which greatly simplified implementation.

OpenZeppelin's access control contract is also being used to simplify role-based access control in the system.

The backend takes advantage of *Truffle*'s toolchain to simplify deployment and compilation.

On the frontend, the application uses the following libraries to assist speed up UI development:

- **React** – UI library
- **Redux** – State management library
- **Drizzle** – React components and helper libraries for smart contracts
- **IBM Carbon Components** – Styled React UI components that follow IBM's design system
- **Fortmatic** – Cloud-based web3 provider
- **Moment** – Time manipulation library
- **Node SASS** – Used for SCSS compiling
- **React Router** – Used for JavaScript routing and history manipulation