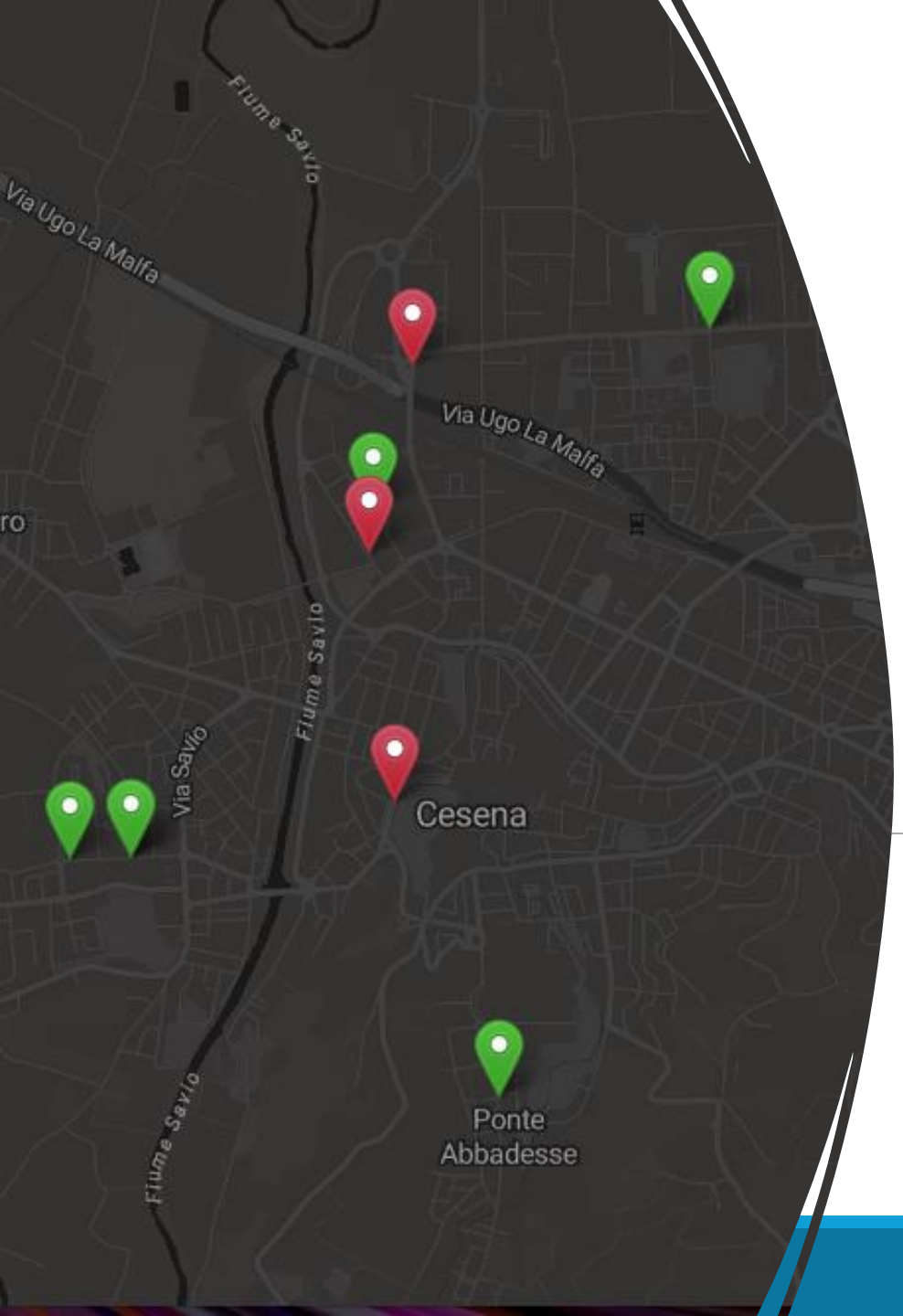


ScooterMonitor

An urban mobility MVP

Ferrarese Nicola – nicola.ferrarese@studio.unibo.it

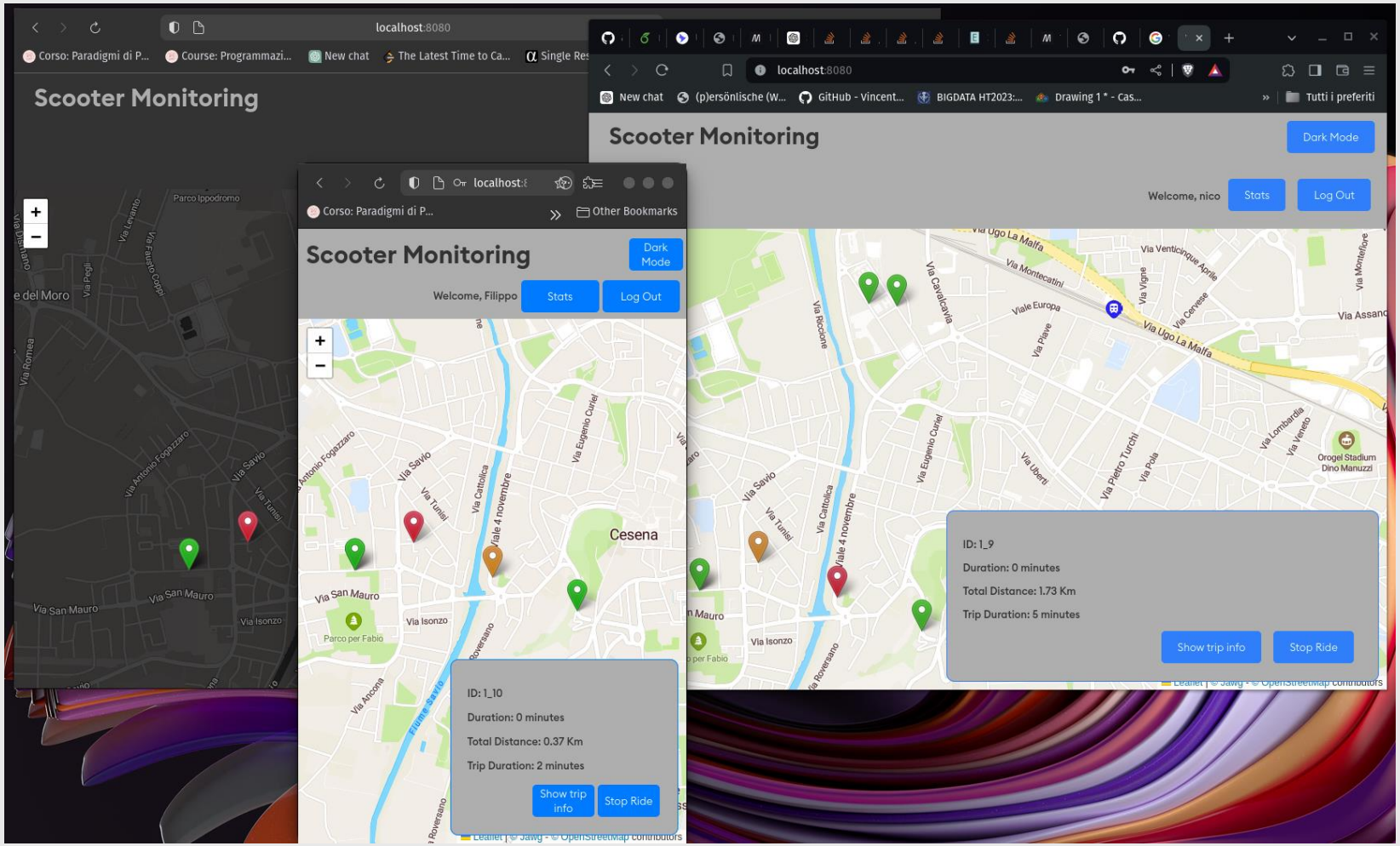
Project presentation – Sistemi Distribuiti

7 agosto 2024

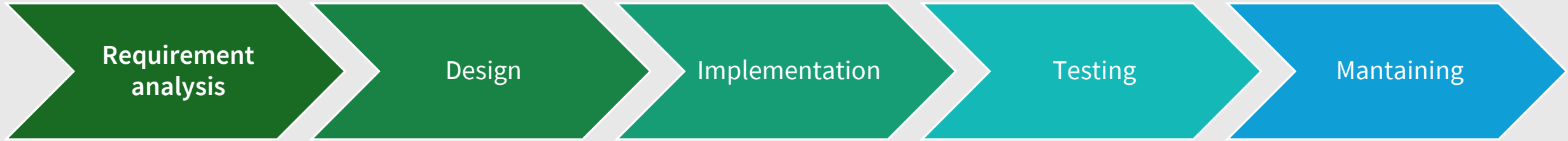
Context

The projects aims to:

- Explore existing tecnologies and assess distributed systems concerns in application design
- Develop a full-stack application
- Ensure proper application monitoring
- Deliver and MVP for an urban mobility solution



Development process



Personas

End Users

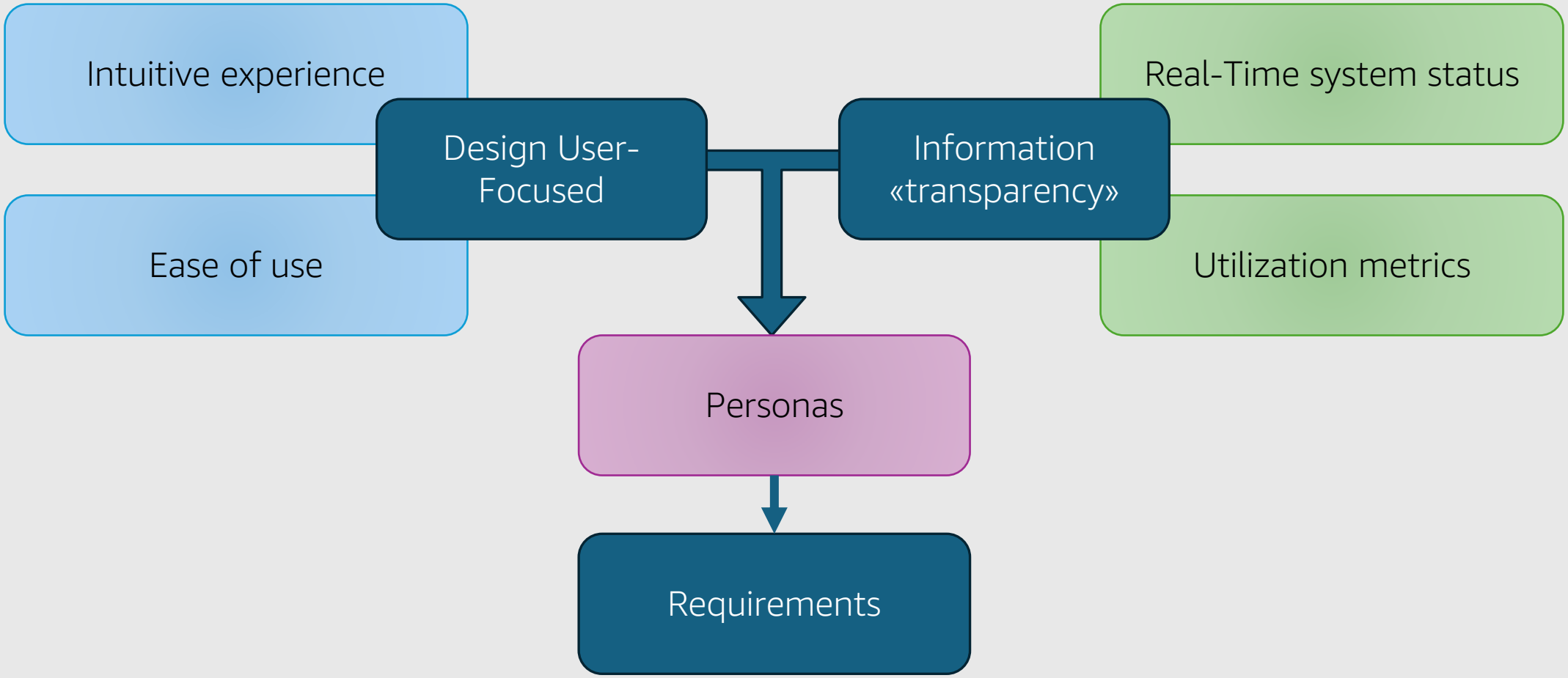
Recharge and maintenance personnel

Business Users & market analysts

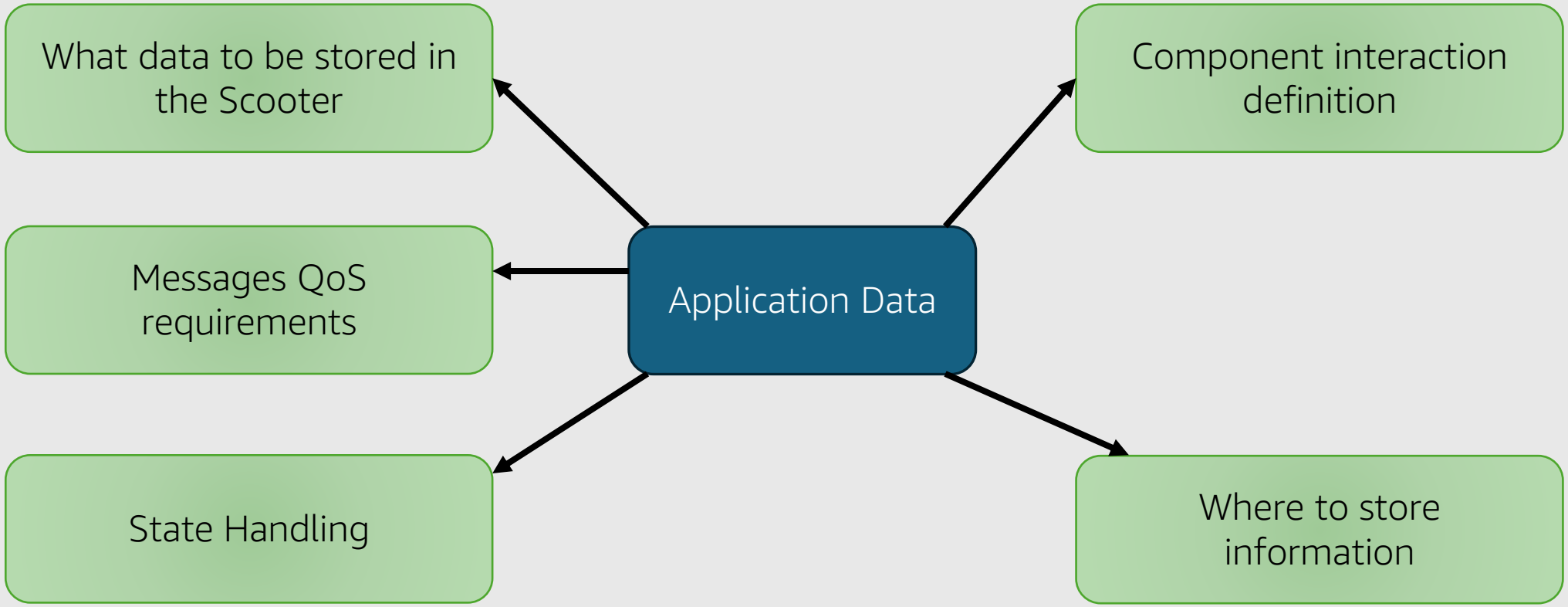
Need for information access

Added value to the platform

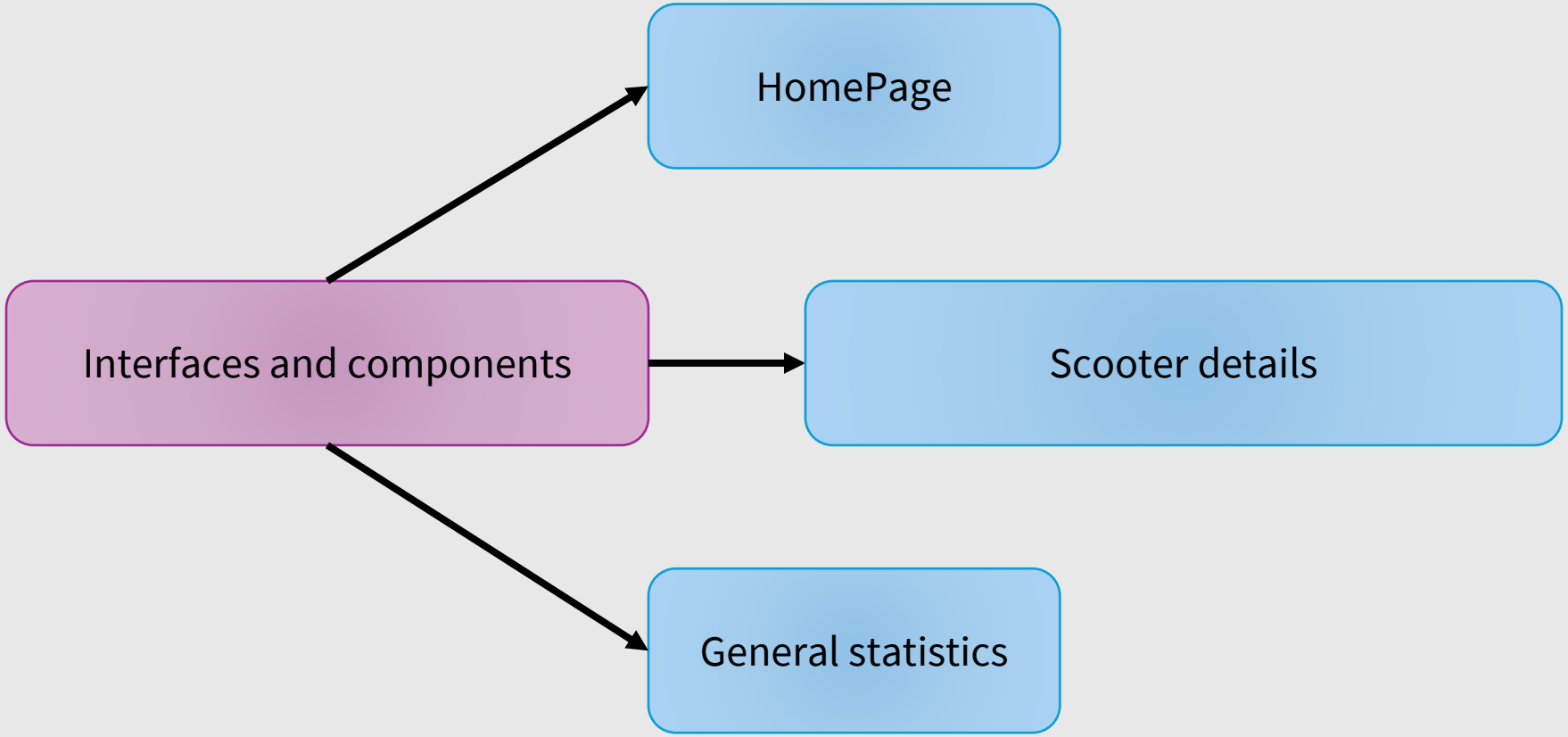
Requirement development



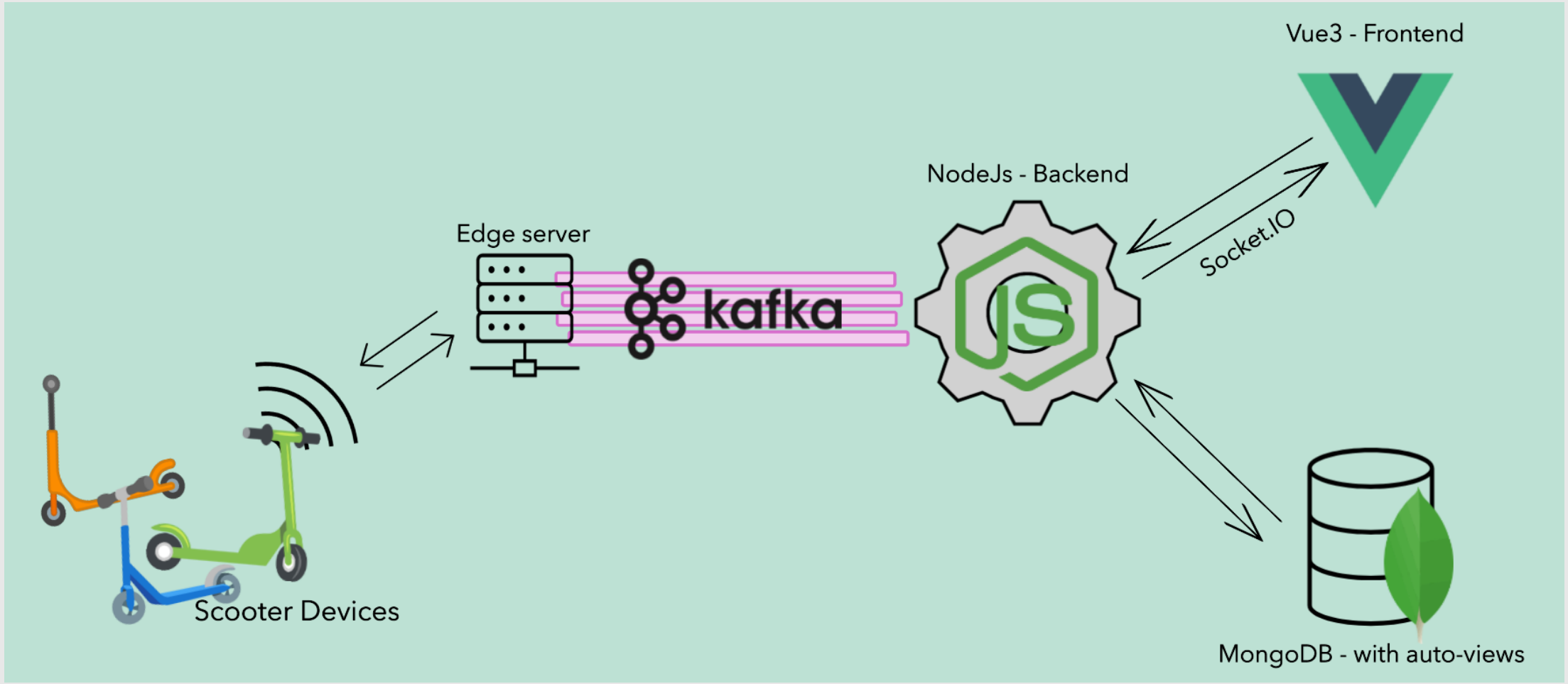
Design – application data



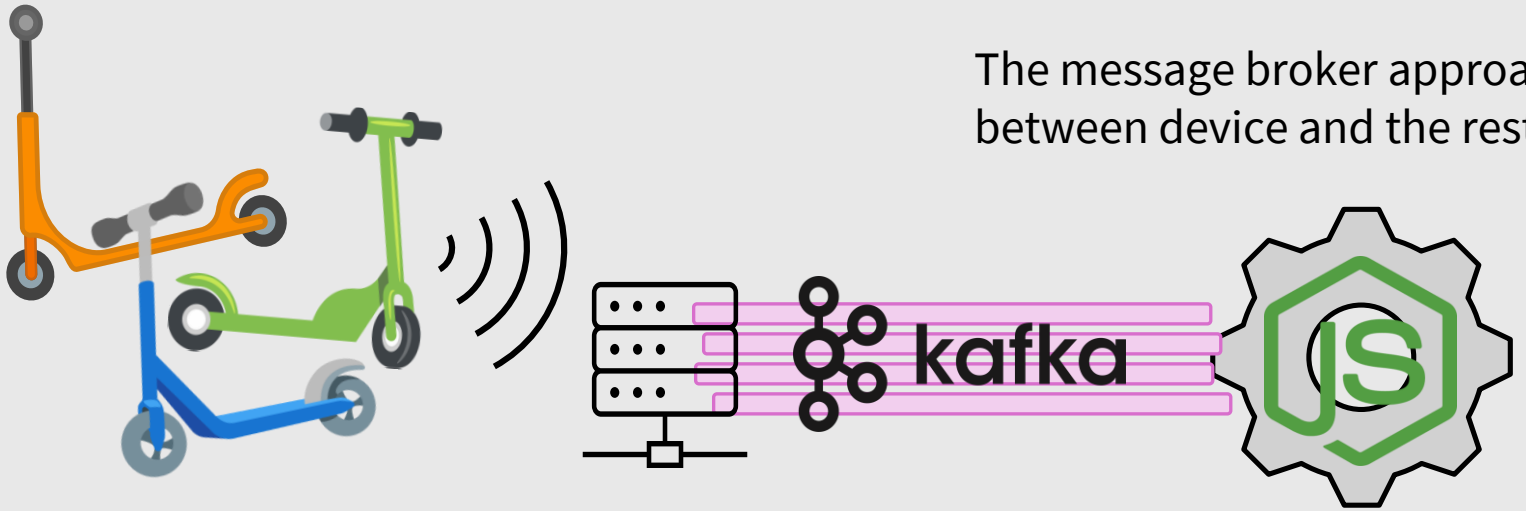
Design – user interfaces



Design - Architecture



Scooter Simulation



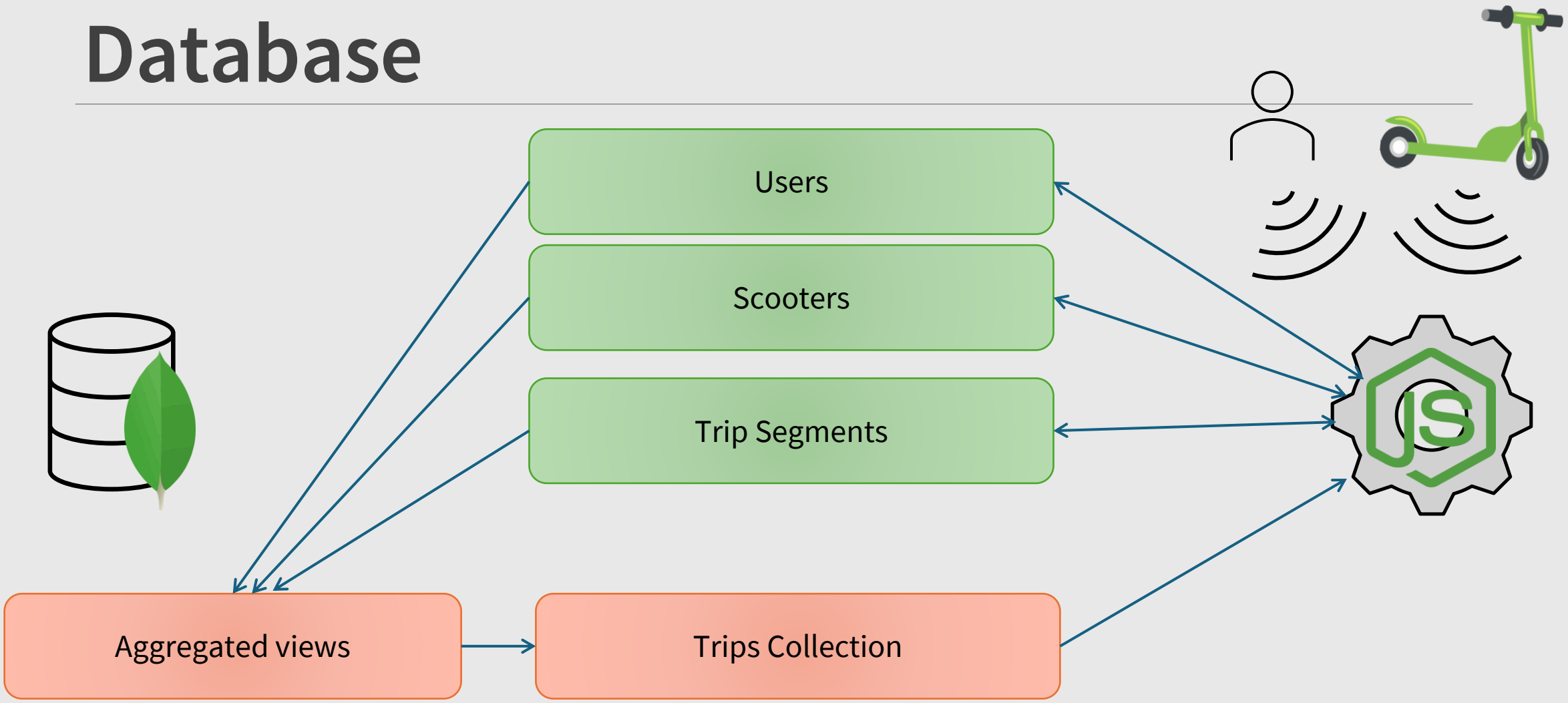
The message broker approach allows for decoupling between device and the rest of the application

Every scooter is modelled as a single, idependent, thread, communicating with the application via a kafka consumer and writer, over three topic to:

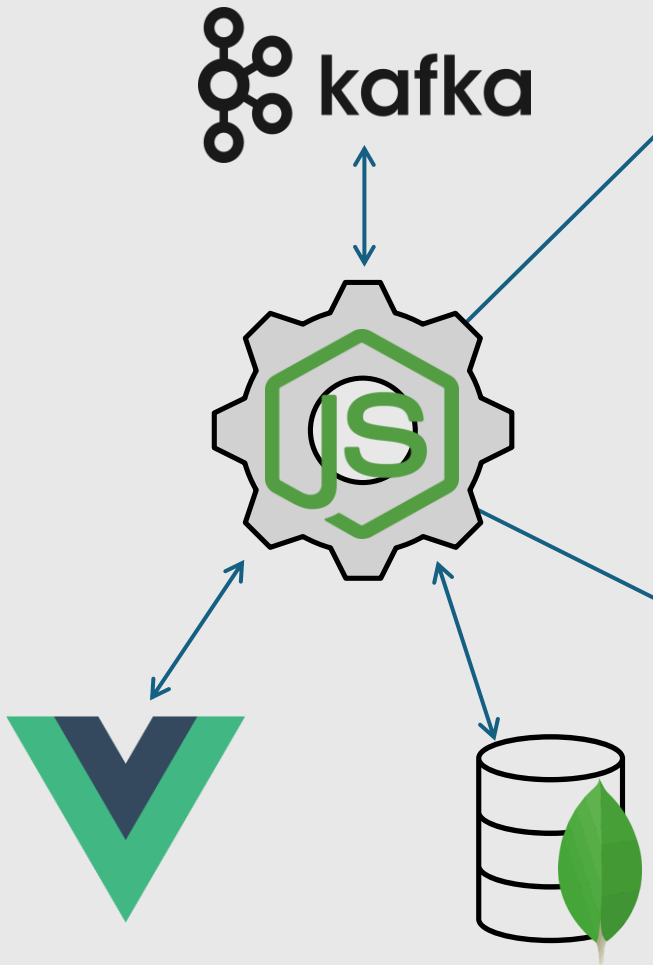
- Send live position (always)
- Send updates and status updates (trip information, event recorded)
- Listen to commands from the application such as block or unblock

Topic Name	Partitions	Number of messages	Size
scooter_commands	1	51	6 KB
scooter_positions	1	1935	219 KB
scooter_updates	1	446	129 KB

Database


Users
Scooters
Trip Segments
Aggregated views
Trips Collection

BackEnd



MiddleWare

Front-End communication
Socket.io

Scooter Communication
Kafka

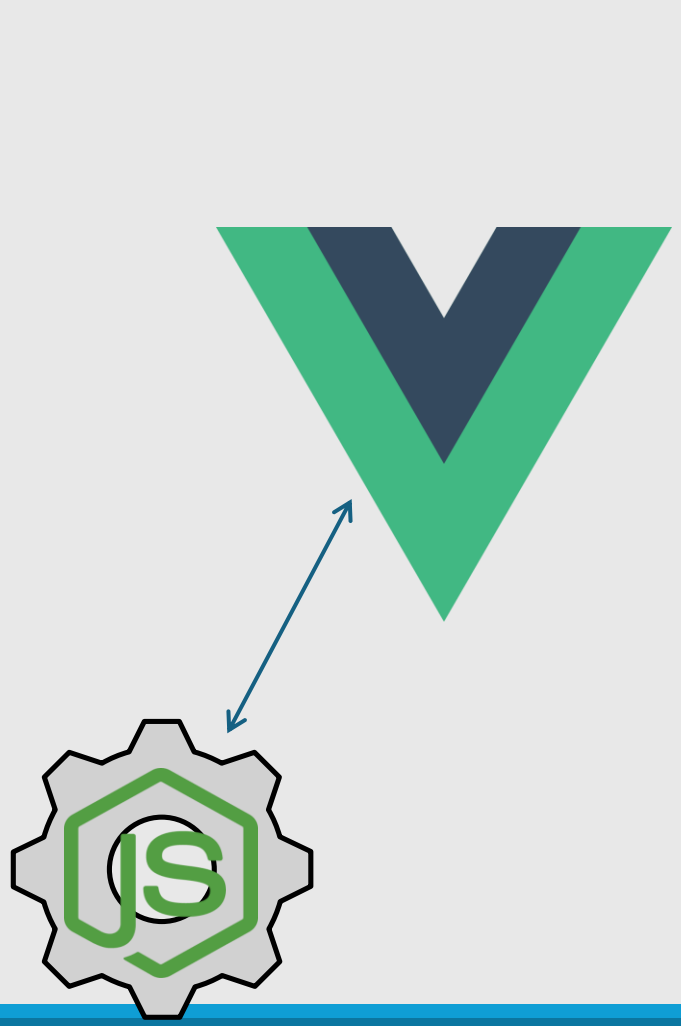
Database communication
MongoDB

Business Logic

Authentication

Management of: Scooters, Users,
Trips and Statistics

FrontEnd



Header

Components subdivision

Map

Login/Logout

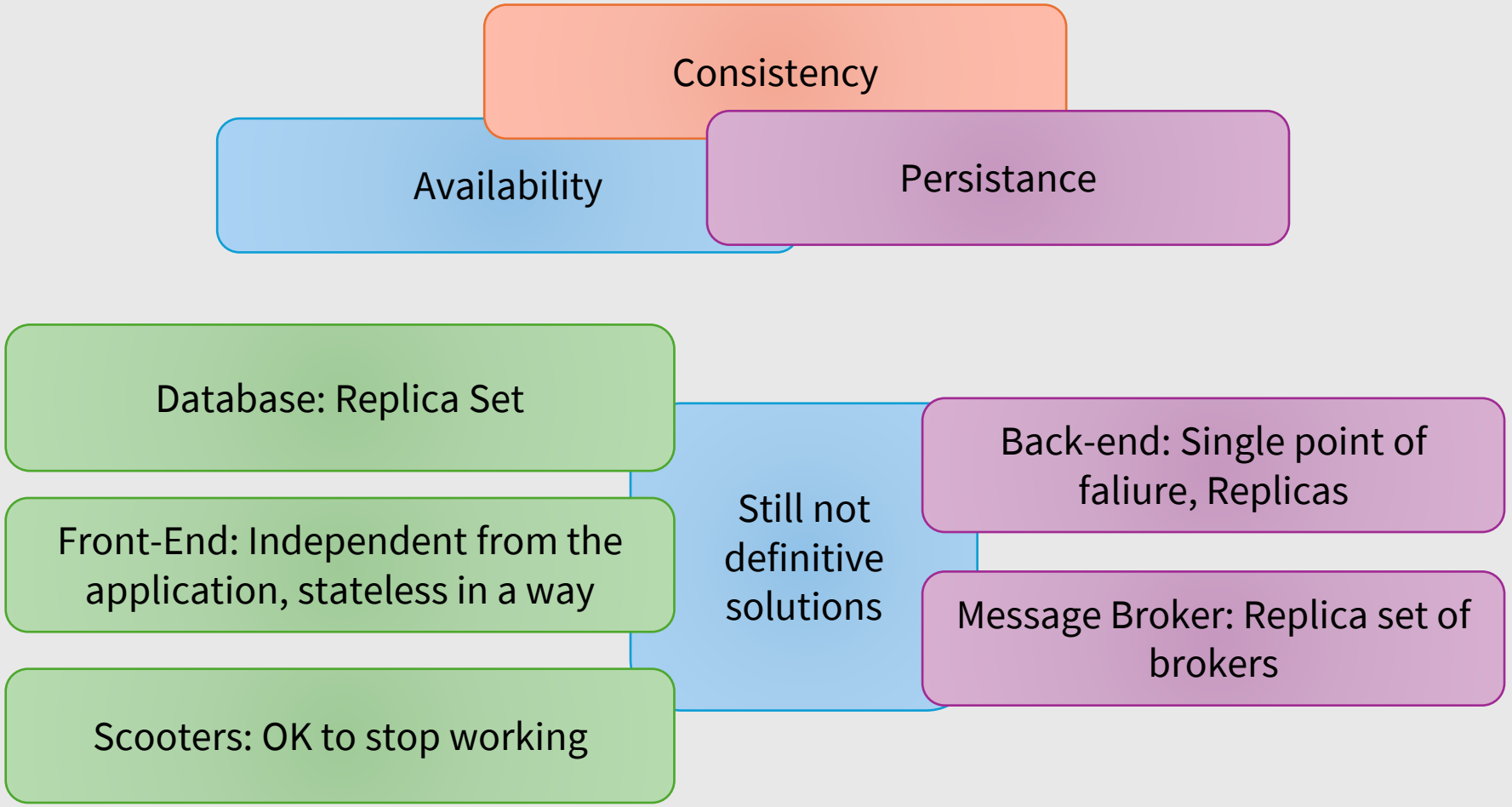
Authentication
JWT

Sign In

Communication
Socket.IO

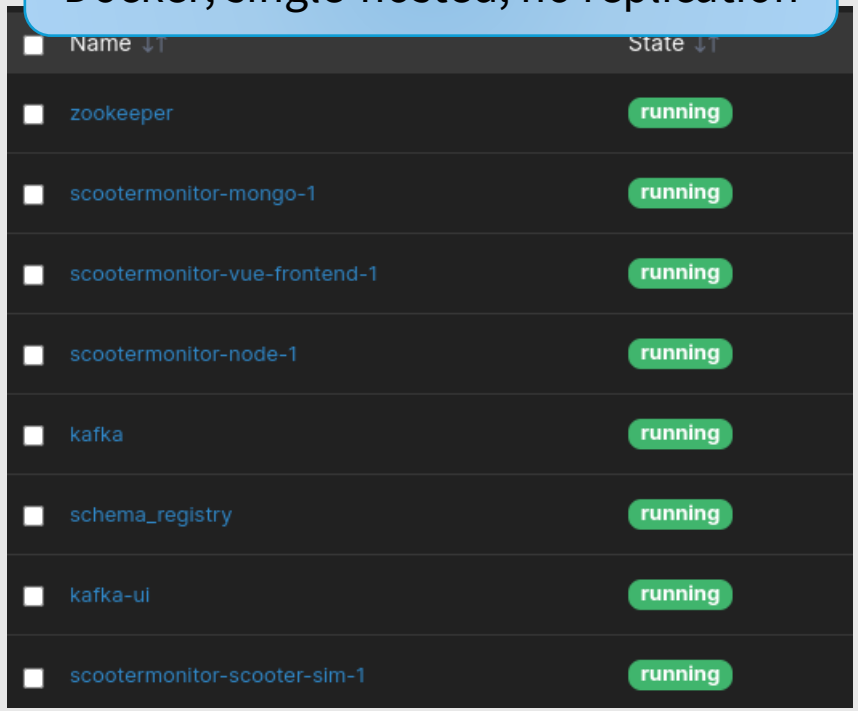
State Handling
Vuex

Architecture analysis



Deployment analysis - are replicas the solution? Introducing orchestrator

Actual project status:
Docker, single-hosted, no replication



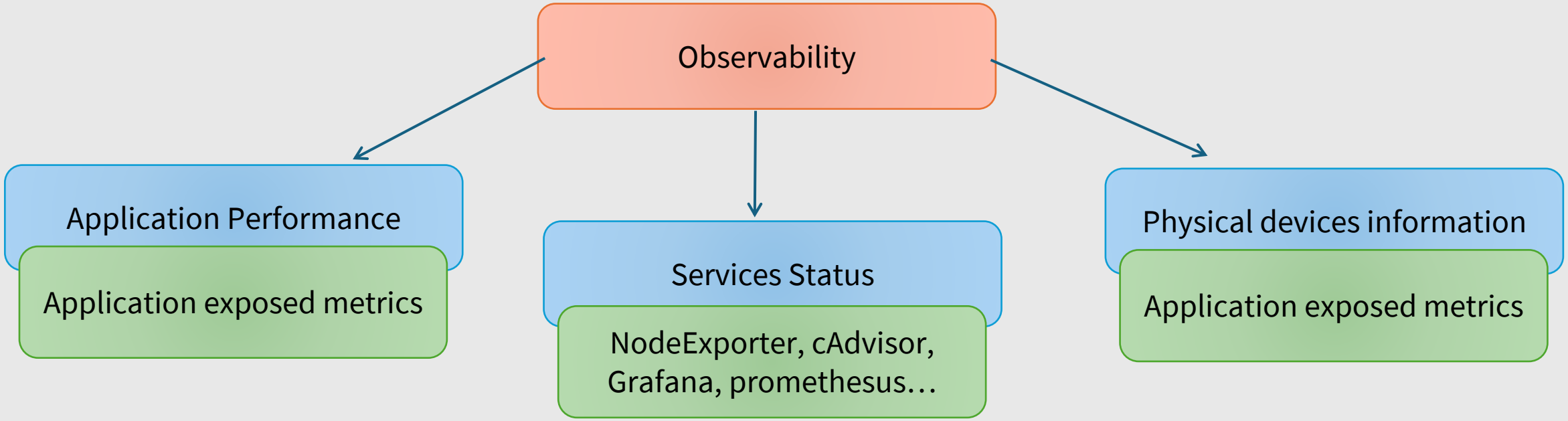
Containerized approach, with replication

Distributing over space (multiple nodes)

Need for:
- Manageability (orchestrator)
- Observability

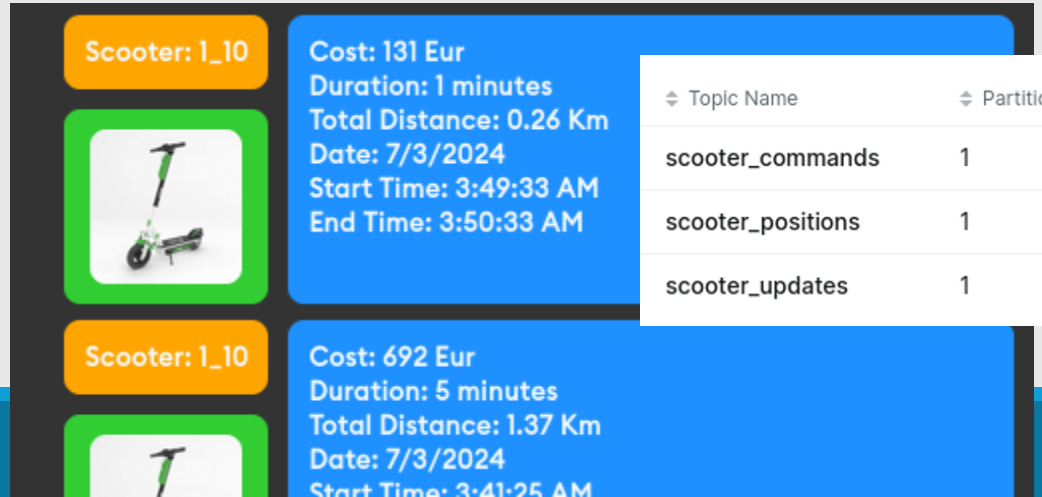
Holistic observability in ScooterMonitor?

Observability is a concept that originated in Control Theory. According to this theory, a system is observable if the current state can be determined in finite time using only the outputs.



Application observability

Name	State	Filter	Quick Actions	Stack	Image
zookeeper	running			scootermonitor	wurstmeister/zookeeper
scootermonitor-mongo-1	running			scootermonitor	mongo:latest
scootermonitor-vue-frontend-1	running			scootermonitor	scootermonitor-vue-frontend
scootermonitor-node-1	running			scootermonitor	scootermonitor-node
kafka	running			scootermonitor	wurstmeister/kafka
schema_registry	running			scootermonitor	confluentinc/cp-schema-regist
kafka-ui	running			scootermonitor	provectuslabs/kafka-ui:latest
scootermonitor-scooter-sim-1	running			scootermonitor	scootermonitor-scooter-sim

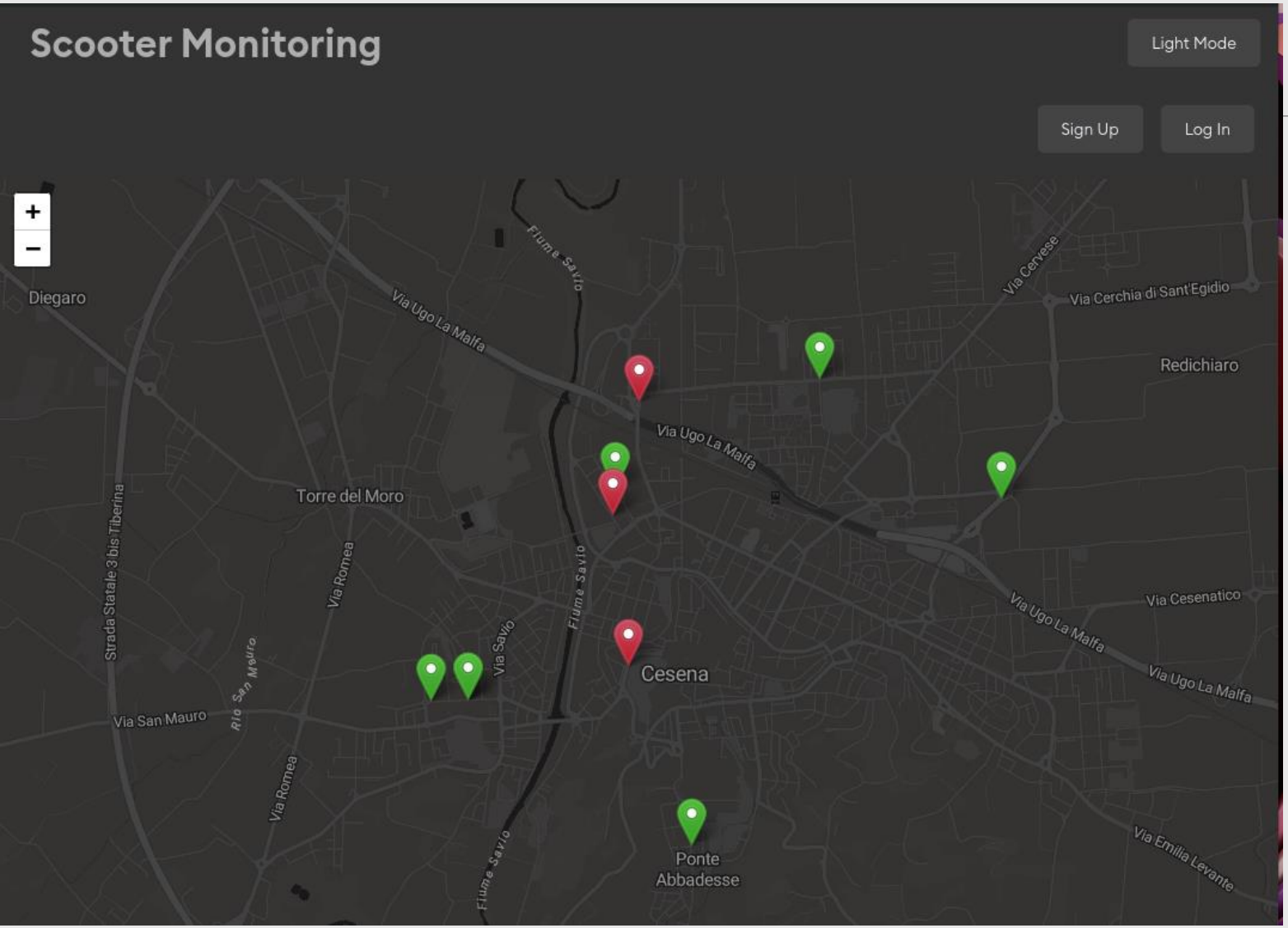


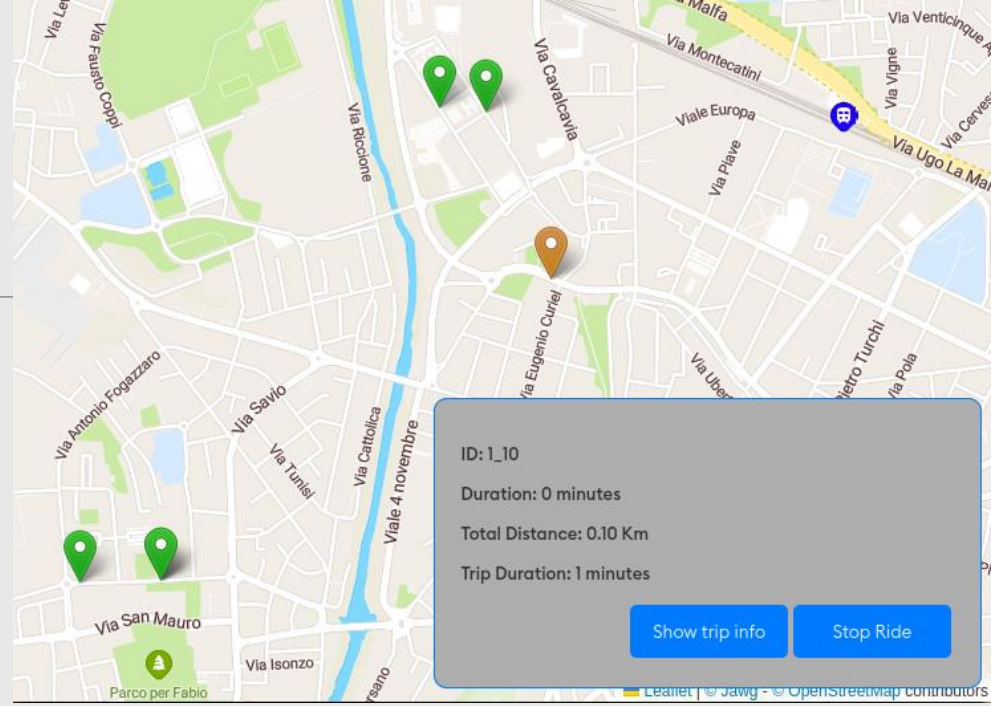
Topic Name	Partitions	Number of messages	Size
scooter_commands	1	51	6 KB
scooter_positions	1	1935	219 KB
scooter_updates	1	446	129 KB

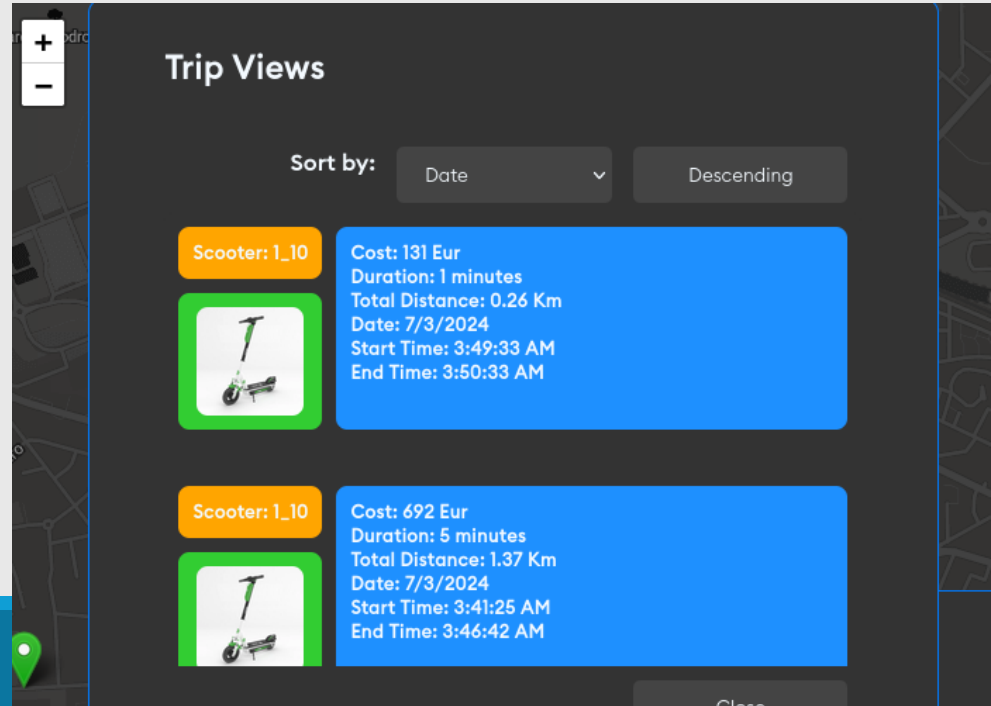
Service monitoring example

Not implemented for the project although envisioned, cAdvisor, NodeExporter, Prometheus and Grafana Stack for application monitoring

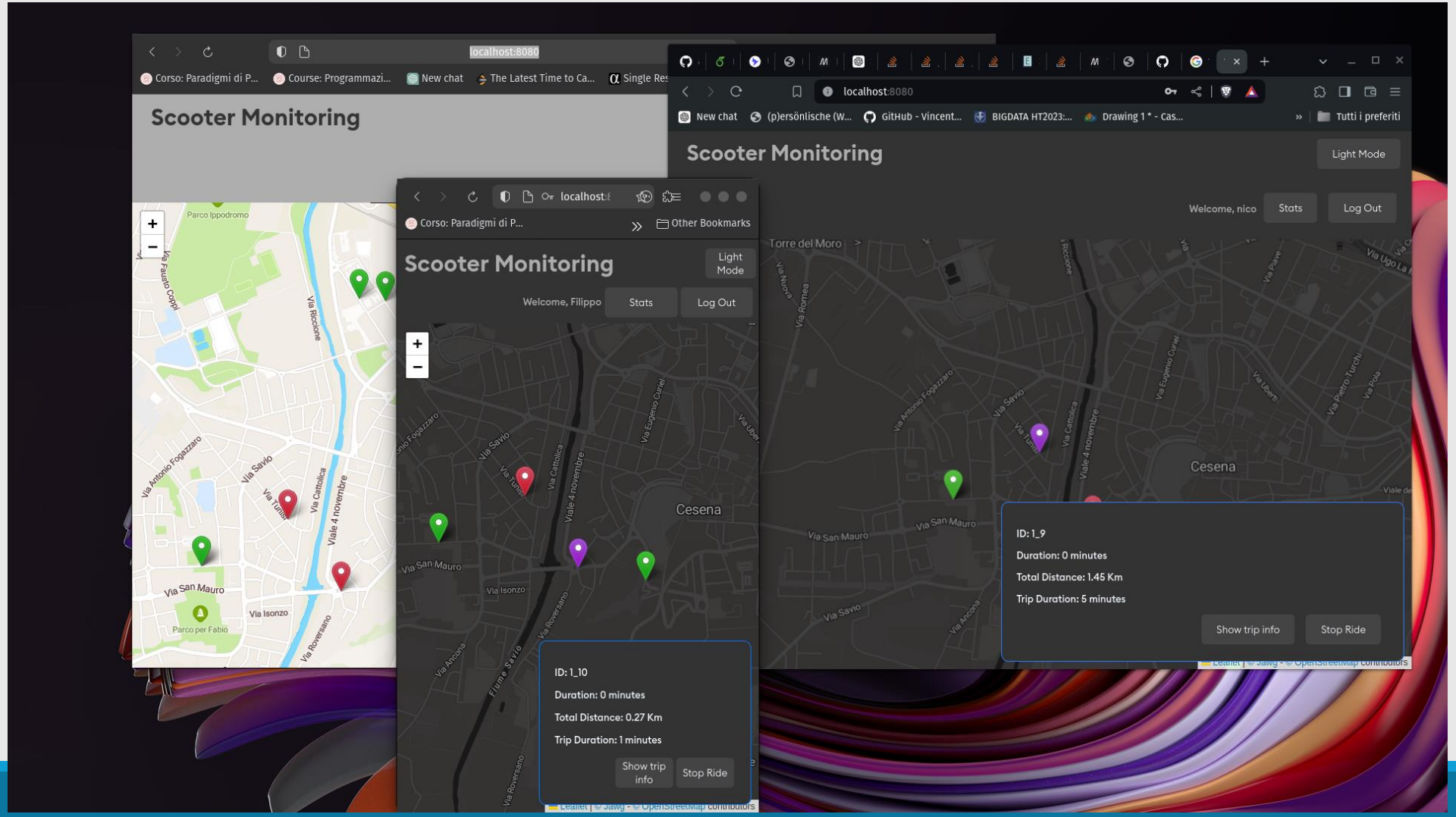
Available at here, from personal project: https://github.com/nicola-ferrarese/rasPi-Home-Lab/


Scooter Monitoring
Light Mode
Sign Up
Log In
Diegaro
Via Ugo La Malfa
Fiume Savio
Via Cervese
Via Cerchia di Sant'Egidio
Redichiaro
Via Ugo La Malfa
Torre del Moro
Strada Statale 3 bis Tiberina
Via Romea
Via Savio
Fiume Savio
Cesena
Via Ugo La Malfa
Via Cesenatico
Via Ugo La Malfa
Via Ugo La Malfa
Via San Mauro
Rio San Mauro
Via Romea
Fiume Savio
Ponte Abbadesse
Via Emilia Levante

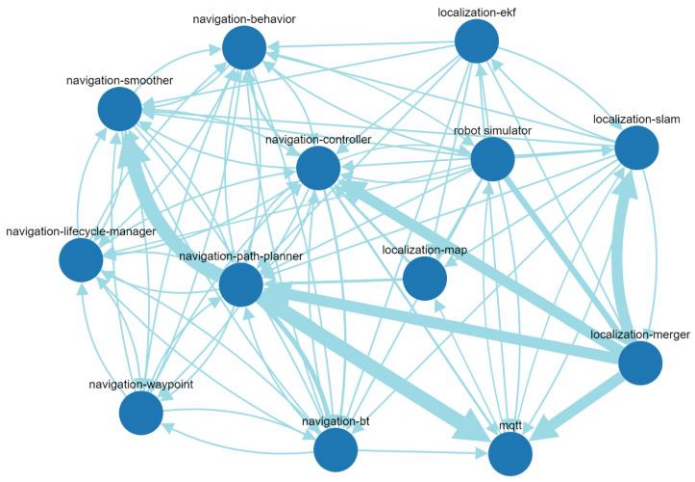

Via Fausto Coppi
Via Riccione
Via Cavalcavia
Via Montecatini
Viale Europa
Via Piave
Via Ugo La Malfa
Via Venticinque A
Via Vigne
Via Antonio Fogazzaro
Via Savio
Via Tunisi
Via Cattolica
Viale 4 novembre
Via Eugenio Curiel
Via Pietro Turchi
Via Pola
Via San Mauro
Via Isonzo
Parco per Fabio
ID: 1_10
Duration: 0 minutes
Total Distance: 0.10 Km
Trip Duration: 1 minutes
Show trip info
Stop Ride
Leaflet | © Jawg - © OpenStreetMap contributors

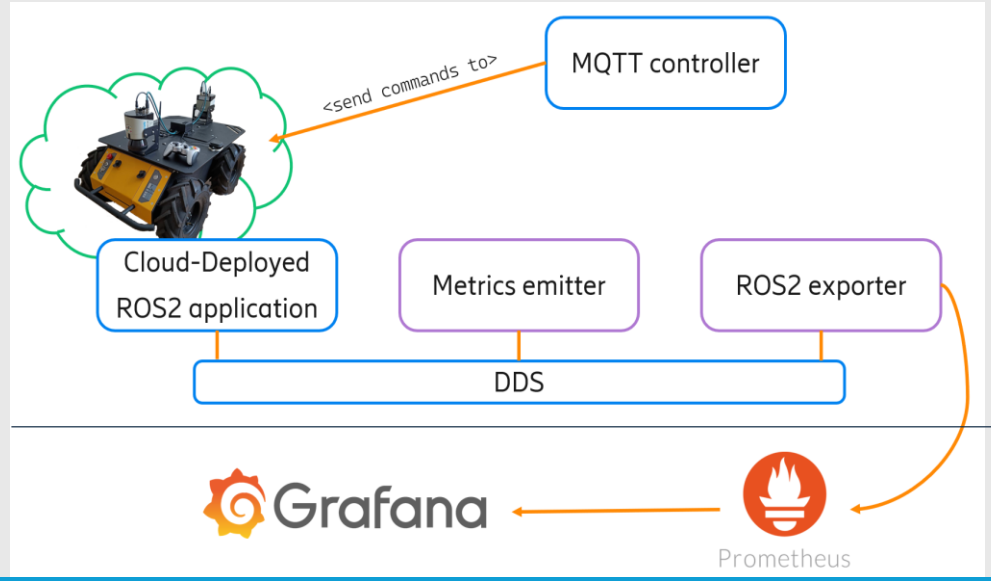

Trip Views
Sort by:
Date
Descending
Scooter: 1_10
Cost: 131 Eur
Duration: 1 minutes
Total Distance: 0.26 Km
Date: 7/3/2024
Start Time: 3:49:33 AM
End Time: 3:50:33 AM
Scooter: 1_10
Cost: 692 Eur
Duration: 5 minutes
Total Distance: 1.37 Km
Date: 7/3/2024
Start Time: 3:41:25 AM
End Time: 3:46:42 AM

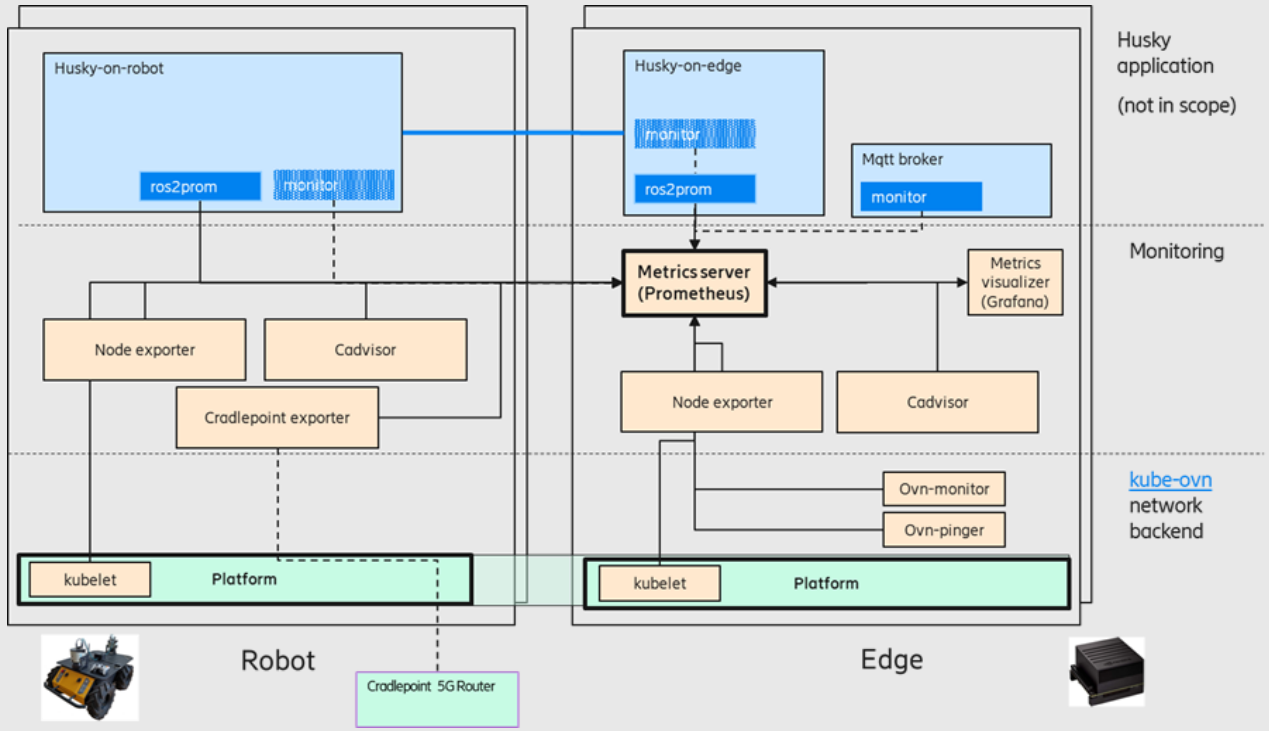
Thanks for the attention



Extra - When do we need CPS observability?







Dealing with CPS, often we speak about Agents.
Proper design and use of these kind of entities is still research topic, given the nature of CP systems themselves, with need for co-design guidelines/ methodologies; still, the first step is to ensure observability in order to start co-design and development/optimization processes