Trash bins – The ideal route

CAS Machine Intelligence

January 2021

Bruno Hunkeler

Content

Overview and Structure

Trash bins – The ideal route

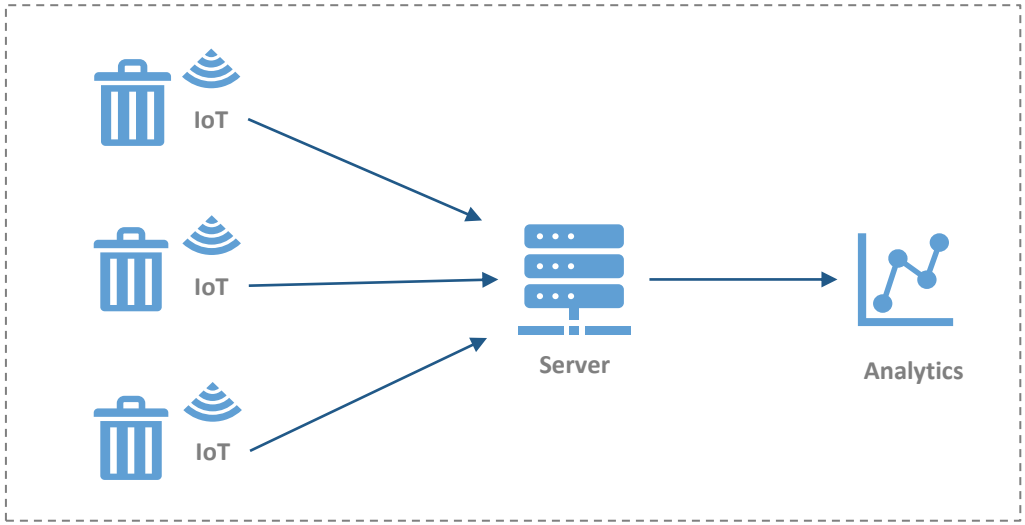
Introduction / Motivation

Motivation

- Every morning 5:15am a garbageman passes by and empties Trash bins (if full or empty)
- Create a product if a trash bin requires maintenance (filling level, HW Issue)
- Find an optimal route for a garbage man
- Situation is applicable to any city in the world

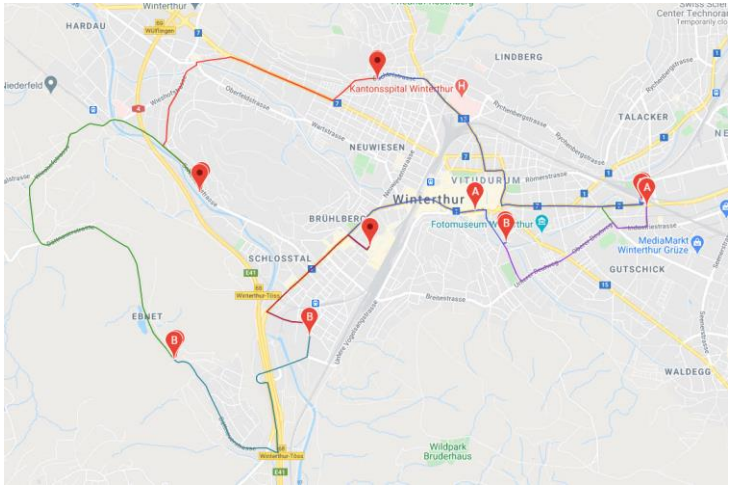
Challenge

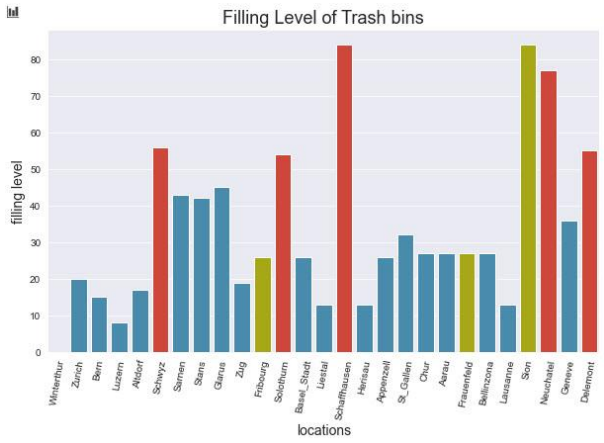
- No data source available (simulation of interactive data exchange required)
- Equip IoT Component with every trash bin which indicates filling level and IoT Component state
- Approach should work for every city in the world

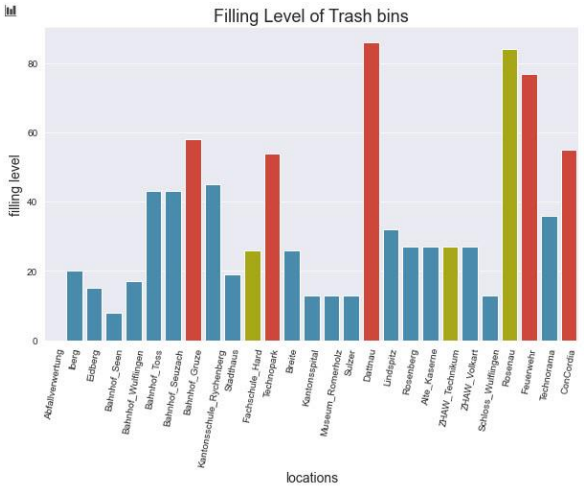


Trash bins – The ideal route

Result for Switzerland and Winterthur





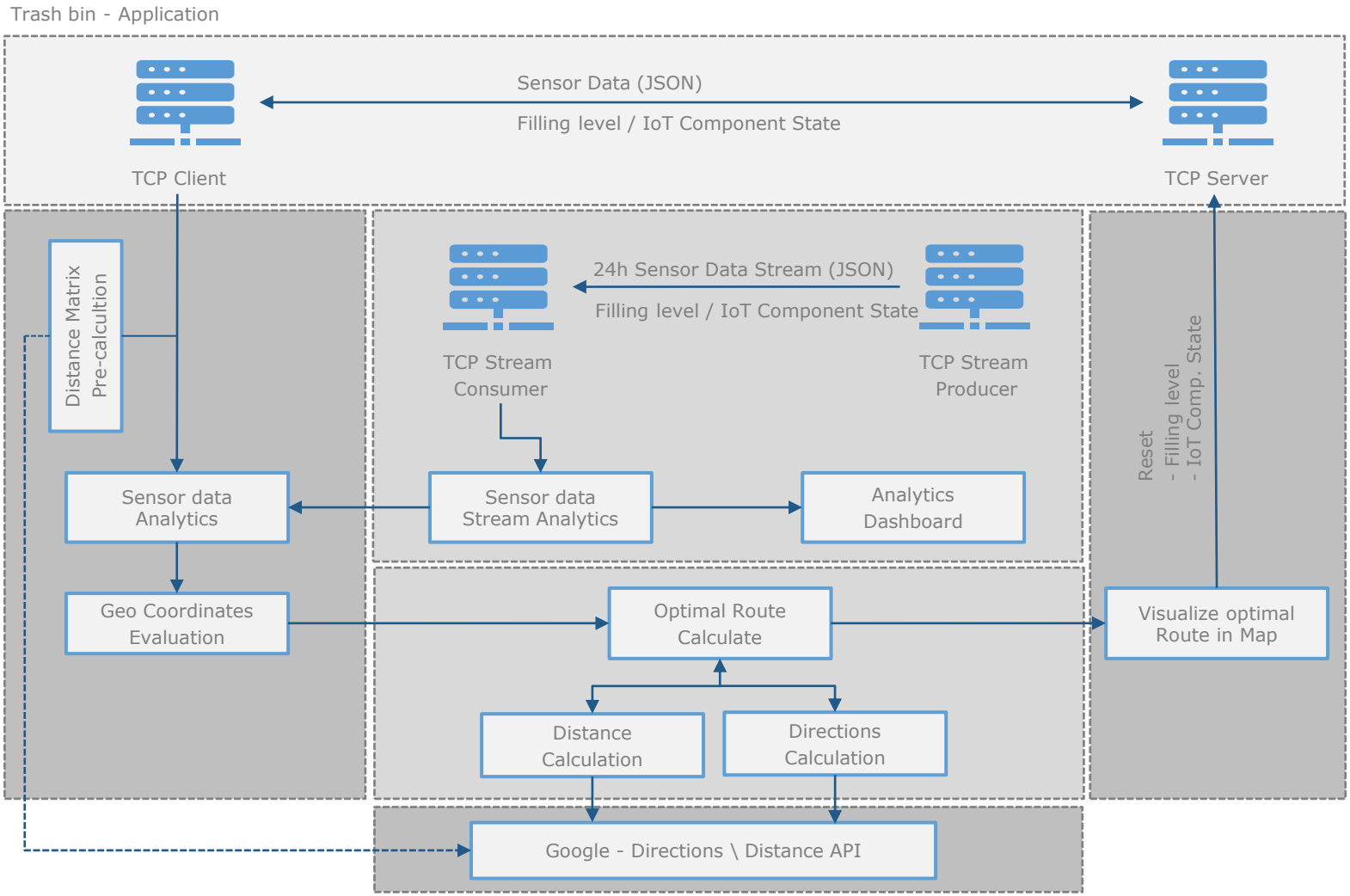


Origin: Winterthur
Trash bins: Capital Cities

Origin: Verbrennungsanlage
Trash bins: Random locations

Trash bins – The ideal route

Context diagram



Application Demo

Trash bins – The ideal route

Project Insights / Issues

- **Local infrastructure setup**
  - Spark / Hadoop
- **Data source**
  - 26 locations + Origin (Switzerland / Winterthur)
  - Manual creation of data source 24h
- **Optimizer algorithms**
  - Optimal Route Algorithm
  - Simulated Annealing Algorithm
- **Google map integration**
  - Directions-, Distance Matrix API Connection
  - Map Integration
- **TCP Client / Server**
  - For Data exchange and simulation of real behaviour
- **Streaming**
  - Dashboard
  - Producer / Consumer

- **Issues**
  - Databricks migration not possible due to Infrastructure unavailability) -> Community Edition a wreck
  - Code bundling (building Python package)
  - Installation of **Geospatial Data Abstraction Library (GDAL)**
  - None I couldn’t manage (just lots of effort)

Trash bins – The ideal route

Conclusion

- The final Big Data Project has been a challenge overall.
- Since no streaming service exists, all data needed to be created synthetically.
- Creating synthetic data to simulate a data stream is tedious and time consuming.
- But creating the foundations for a new Product and finding out that it generally works, was a delight.

There are now various additional aspects, which could be considered when continuing with the given project as follows:

- Apply Machine learning to analyze historic data and predict the future
- Estimating the time consumption for a route considering the traffic by using further google API's
- Consider the use of multiple routes and therefore additional Vehicles
- Prepare a decent interactive Web Front End

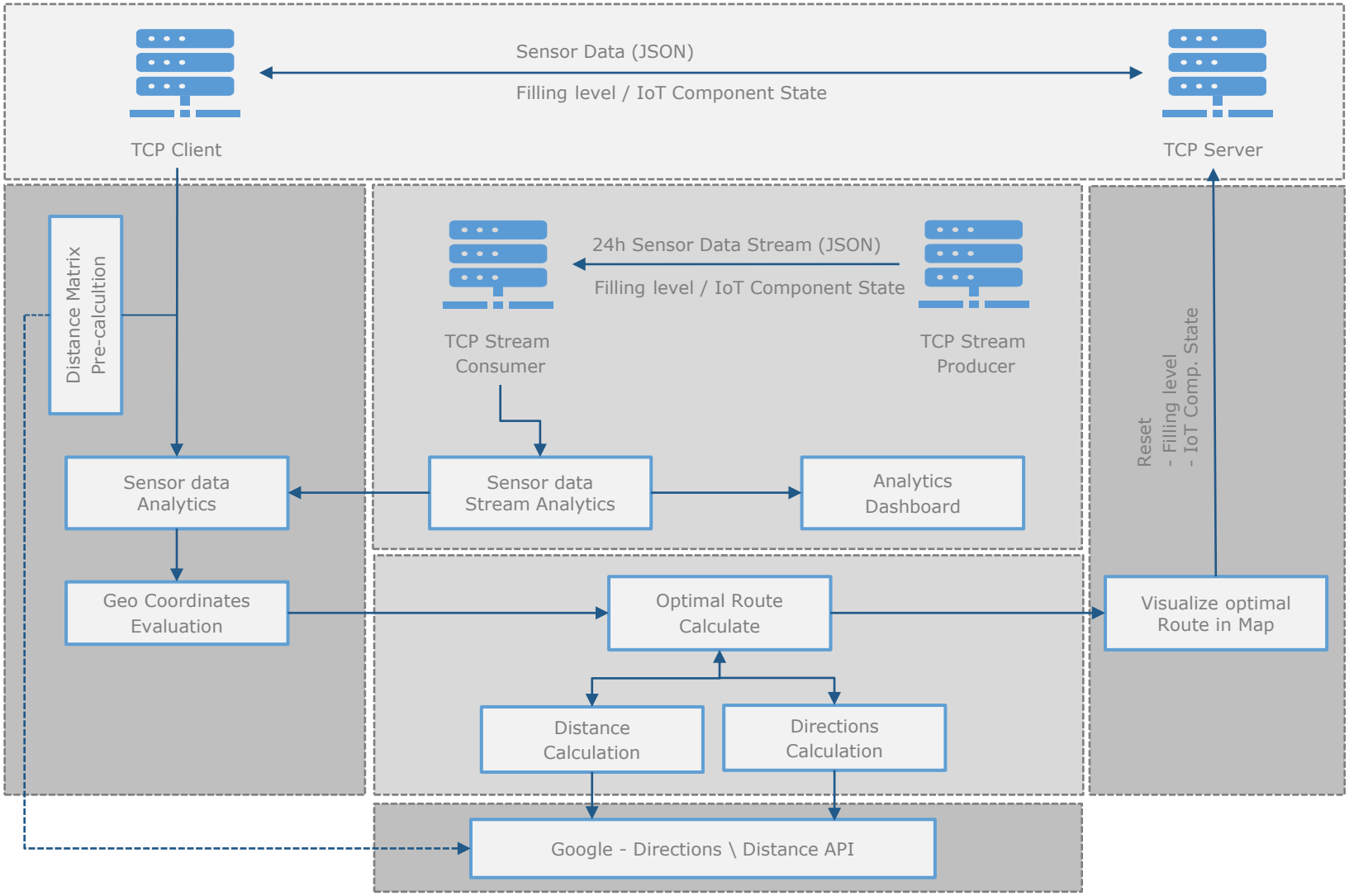
Trash bins – The ideal route

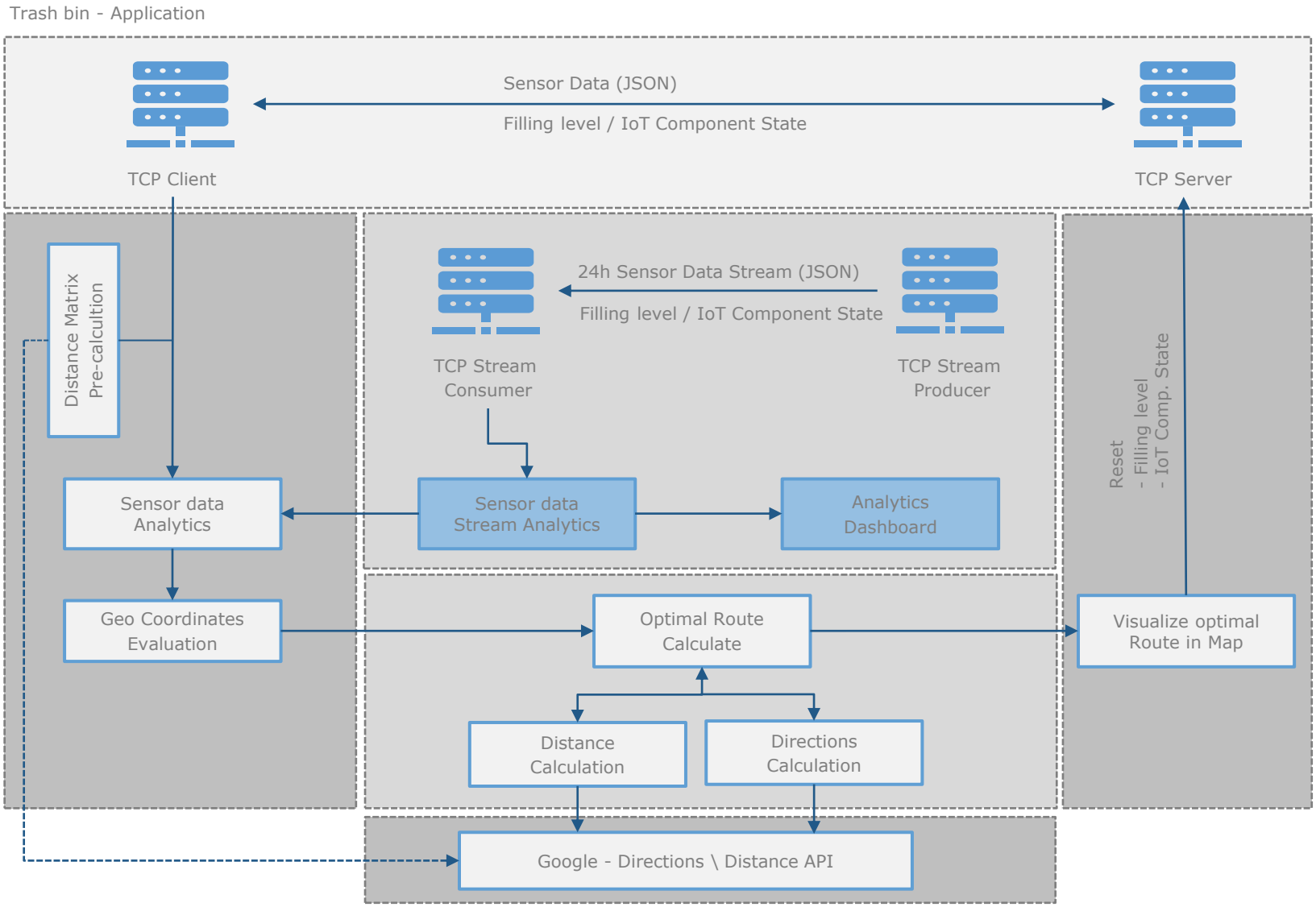
Questions

Archive

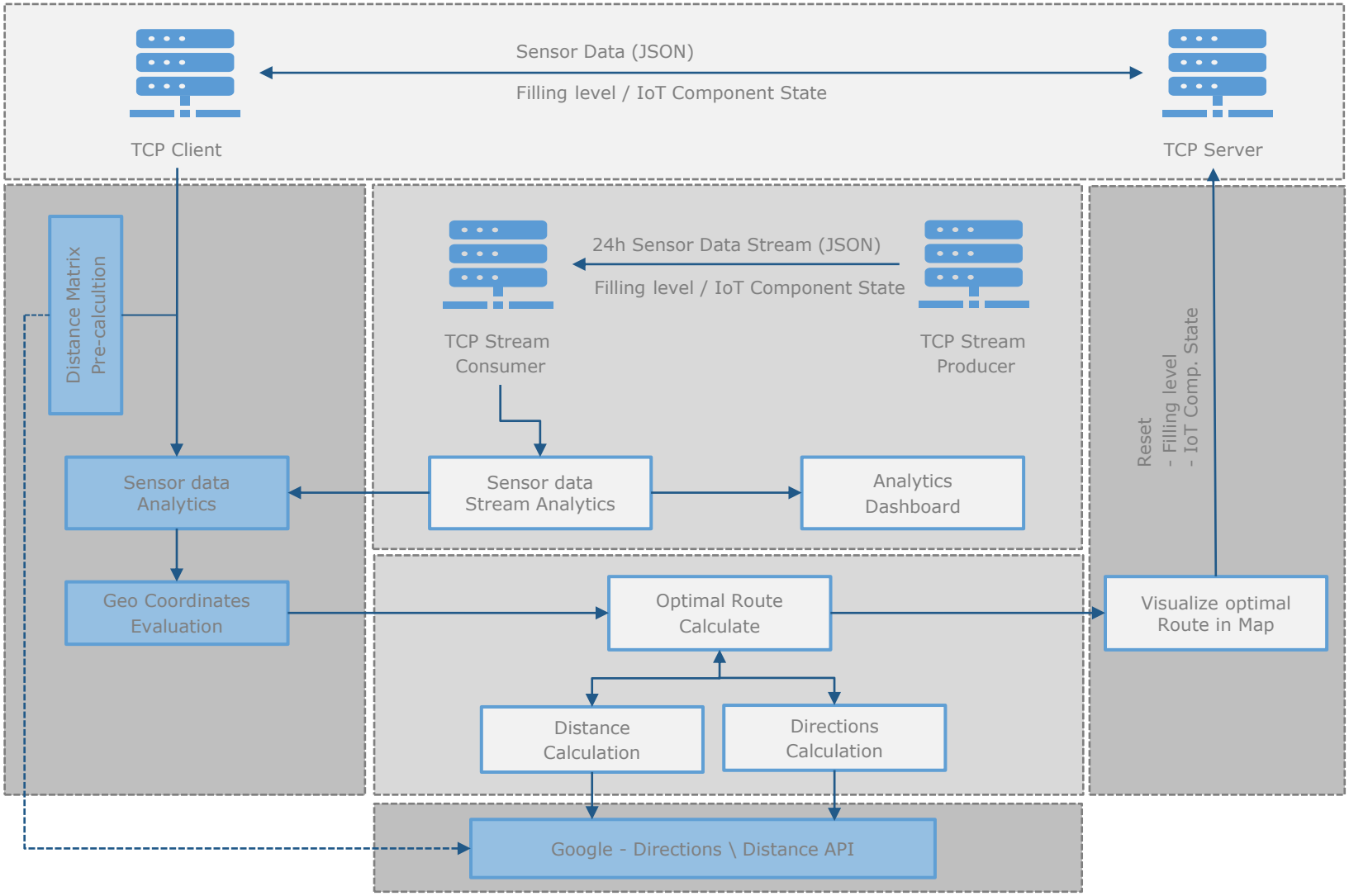
Further Information and Screenshots

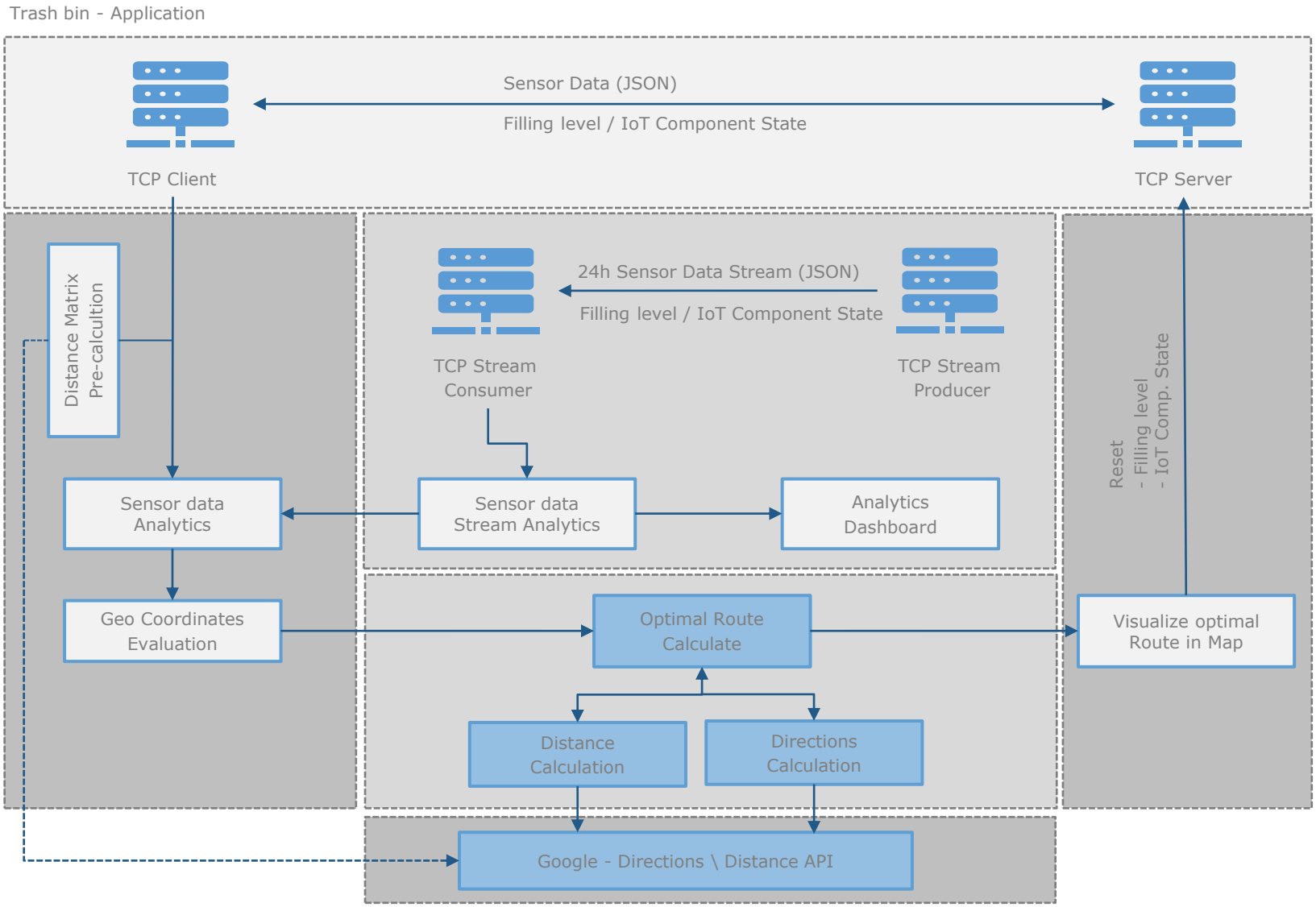
Trash bin - Application

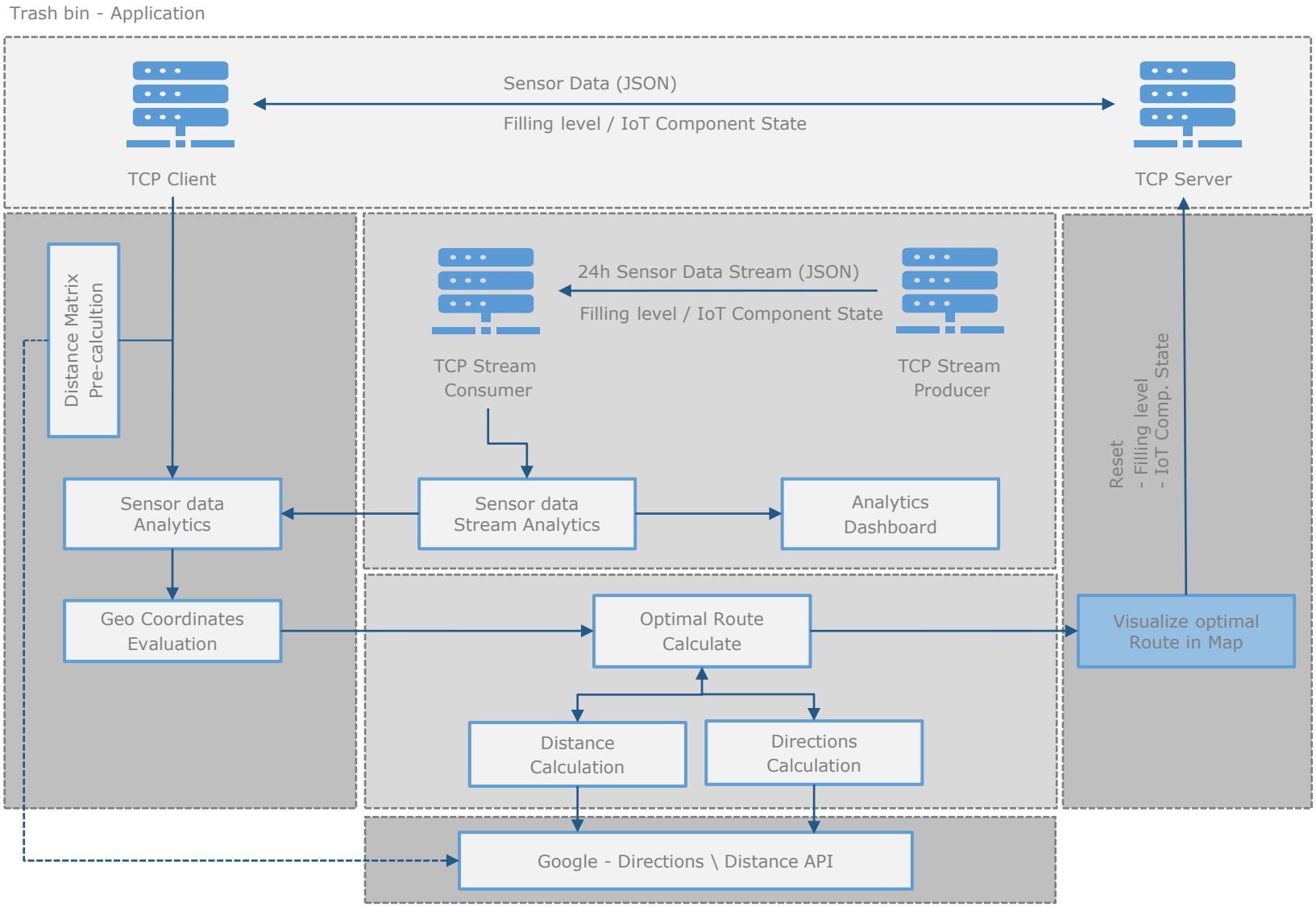



Trash bin - Application
Sensor Data (JSON)
Filling level / IoT Component State
TCP Client
TCP Server
Distance Matrix Pre-calculation
24h Sensor Data Stream (JSON)
Filling level / IoT Component State
TCP Stream Consumer
TCP Stream Producer
Reset
- Filling level
- IoT Comp. State
Sensor data Analytics
Sensor data Stream Analytics
Analytics Dashboard
Geo Coordinates Evaluation
Optimal Route Calculate
Visualize optimal Route in Map
Distance Calculation
Directions Calculation
Google - Directions \ Distance API

Trash bin - Application




Trash bin - Application
Sensor Data (JSON)
Filling level / IoT Component State
TCP Client
TCP Server
Distance Matrix Pre-calculation
24h Sensor Data Stream (JSON)
Filling level / IoT Component State
TCP Stream Consumer
TCP Stream Producer
Reset
- Filling level
- IoT Comp. State
Sensor data Analytics
Sensor data Stream Analytics
Analytics Dashboard
Geo Coordinates Evaluation
Optimal Route Calculate
Visualize optimal Route in Map
Distance Calculation
Directions Calculation
Google - Directions \ Distance API


Trash bin - Application
Sensor Data (JSON)
Filling level / IoT Component State
TCP Client
TCP Server
Distance Matrix Pre-calculation
24h Sensor Data Stream (JSON)
Filling level / IoT Component State
TCP Stream Consumer
TCP Stream Producer
Reset
- Filling level
- IoT Comp. State
Sensor data Analytics
Sensor data Stream Analytics
Analytics Dashboard
Geo Coordinates Evaluation
Optimal Route Calculate
Visualize optimal Route in Map
Distance Calculation
Directions Calculation
Google - Directions \ Distance API