Co-simulation of vehicles and crowds for rescue trials

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Knowledge for Tomorrow

Introduction

- Crisis management (CM) is getting more and more attention worldwide.
- Innovation plays an important role in the success of CM.
- Different tools and solutions have been developed, but the interoperability between these applications is still project-specific.
- These tools and solutions need be tested and validated in realistic environments and evaluated to assess their benefits and for their overall suitability, before being adopted by end-users.
- EU-Project Driver+
  - https://www.driver-project.eu/

DRIVING INNOVATION IN CRISIS MANAGEMENT FOR EUROPEAN RESILIENCE

EU-Project Driver+   https://www.driver-project.eu/

To develop a pan-European Test-Bed for Crisis Management capability development enabling practitioners to create a space in which stakeholders can collaborate in testing and evaluating new products, tools, processes or organisational solutions.

To develop a Portfolio of Solutions in the form of a database-driven website that aims at documenting all DRIVER+ solutions. These will be tested via trials during the project lifetime. Ultimately, the Portfolio of Solutions will be opened up to any external organisations willing to share data and experiences of solutions

To foster a shared understanding in Crisis Management across Europe, through the enhancement of the cooperation framework.

https://www.driver-project.eu/driver-project/objectives-and-activities/
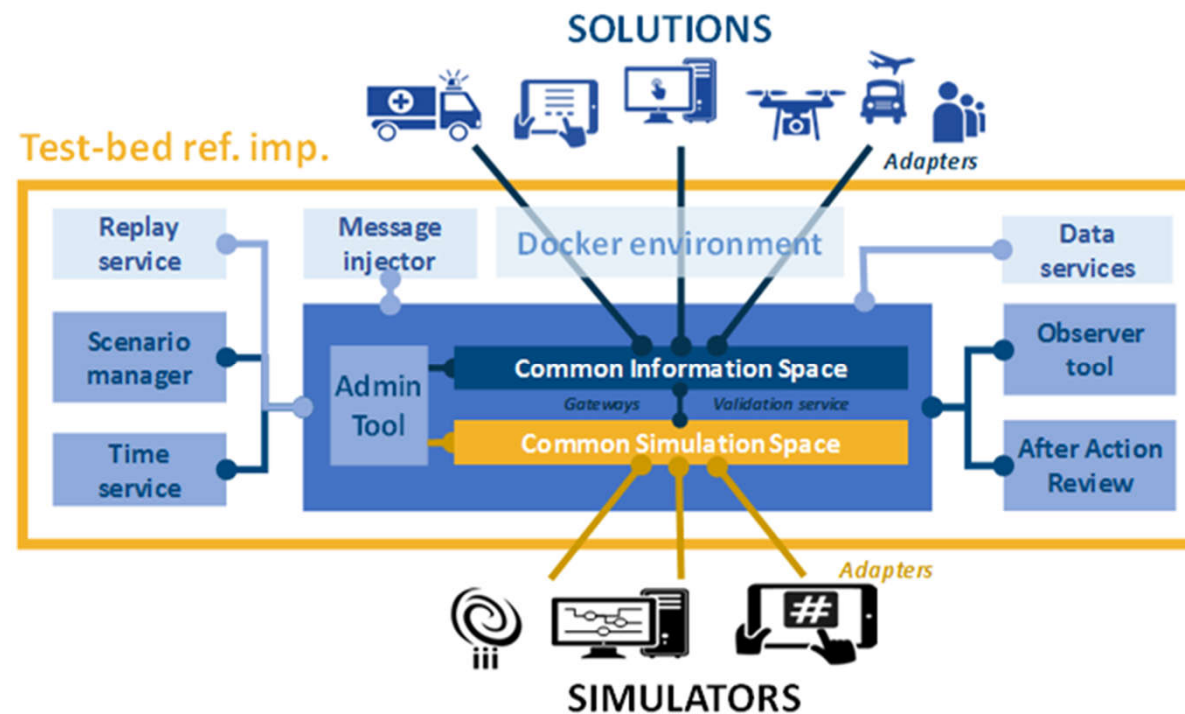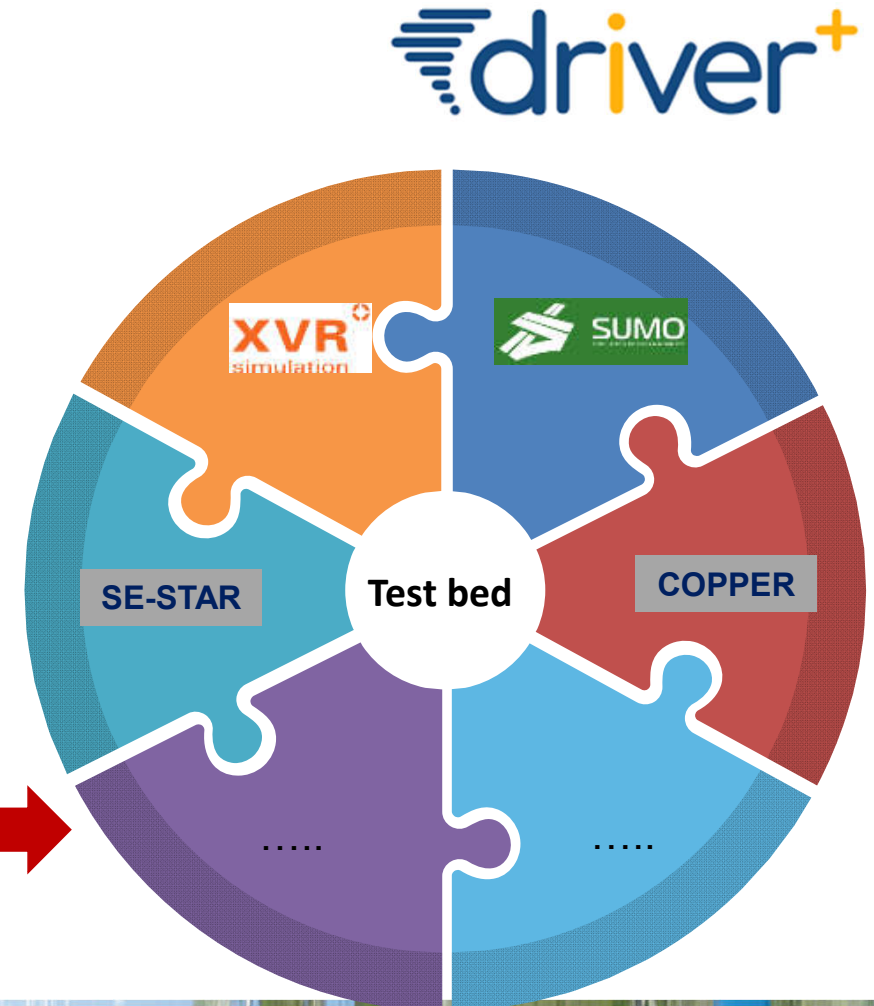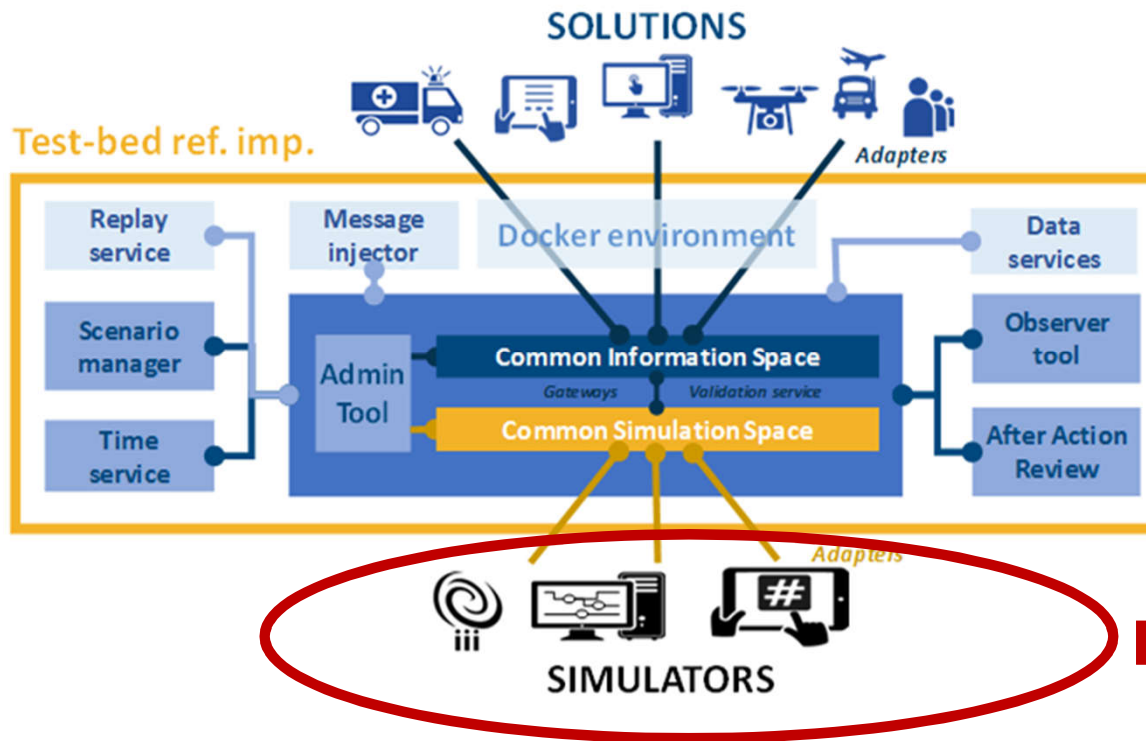
Driver+ Test-bed

- Test-bed:
  - exchange information
  - test solutions with given fictitious incidents created by simulators

- Apache Kafka
  - Open streaming platform for developing CSS and CIS
  - It is set up with use of Docker

- Data schemas: Avro schema

- Available connectors
  - Adapters in Java, C#, TypeScript and Python
 - REST adapter

Focus of this paper

SE-STAR

- It has been developed by THALES since 2008.

- It is a large-scale crowd simulator.

- The C# adapter is used to support SE-STAR network messages
  - Control the simulation: to pause, play and change speed of the SE-STAR simulation

  - Share Entities and Objects: Objects can be entry points for building (shops, restaurants, main entrances …) or security equipment like speakers for evacuation. <u>SE-Star gets objects and entities that can impact the crowd simulation.</u>

XVR OS (XVR On Scene)

driver⁺
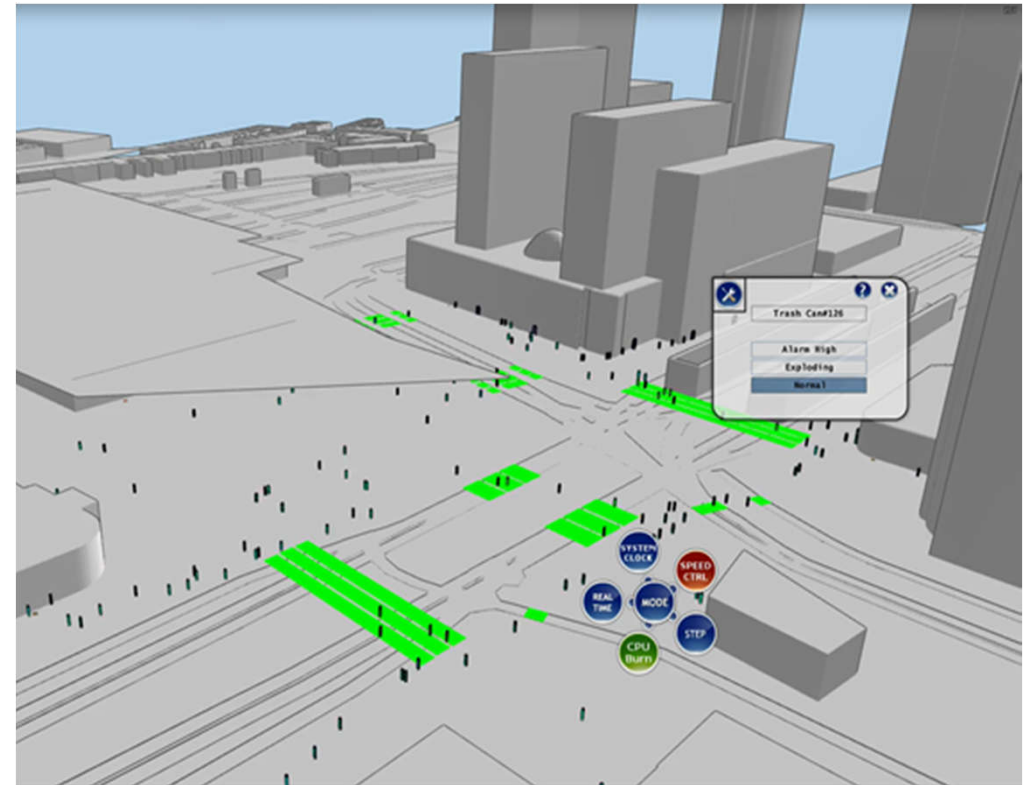
- It is designed as a 3D supporting tool to create virtual scenarios according to the given training objectives.

- It can be used for team training and exercising, classical classroom teaching as well as individual training and assessment.

- It uses the C# adapter to connect to the Driver+ test-bed.

XVR RM (XVR Resource Management)

- It is a training & education tool that allows users to train and assess incident management.
  - to see how participants set-up the command structure together

  - deal with the resource deployment

- It is a map-based visualization tool

- It uses the C# adapter to connect to the Driver+ test-bed
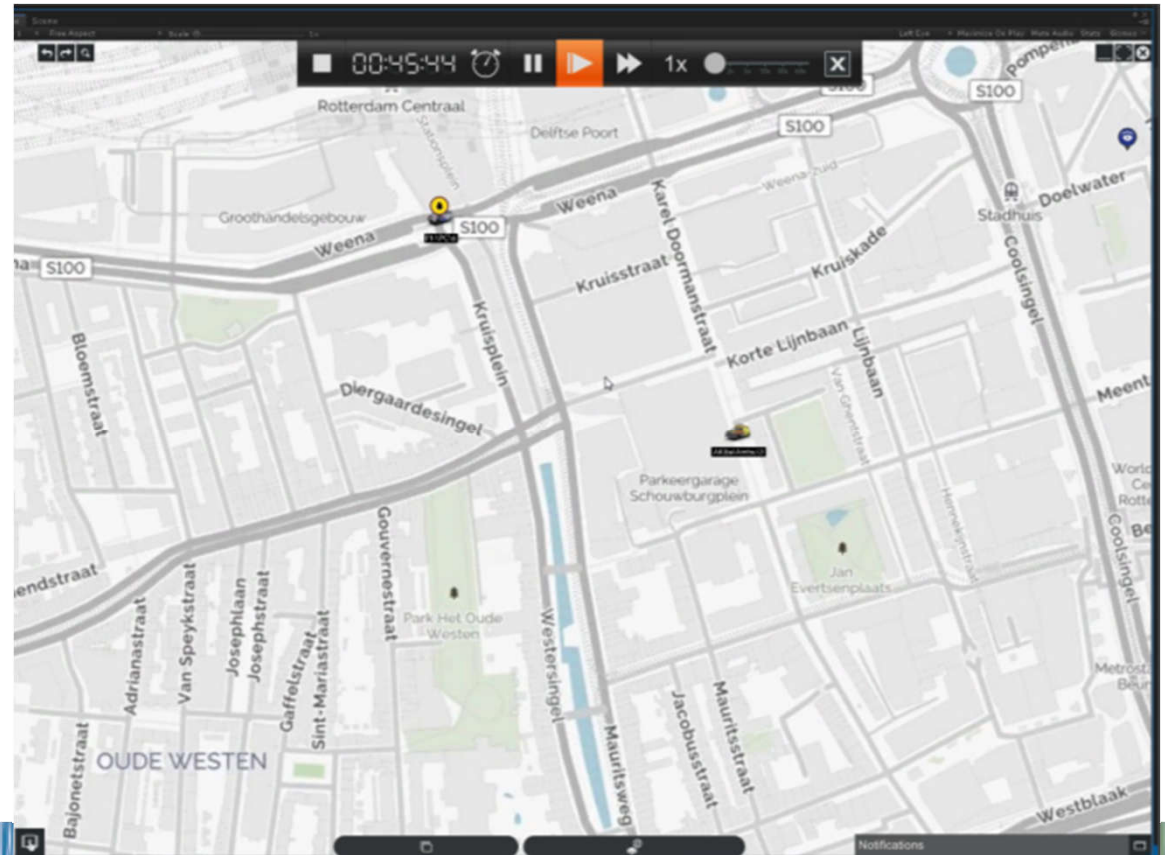
SUMO Connector

- It is written in Python and the Python-Adapter is used to connect SUMO with the Driver+ test bed.

- TraCI is used to interact with other simulators during a simulation.

- Three message categories are defined:
    - Configuration
        - Start/end times, sumo configuration file name and data aggregation intervals (optional)

    - Affected area
        - Begin/end times, polygon information, status of broken traffic lights, affected vehicle types

    - Requests:
        - to insert rescue vehicles in the simulation with the given start and end geo-coordinates
        - to find the corresponding fastest routes and send them back to the test-bed
        - to send the respective vehicle positions back to the test-bed at each time stamp

COPPER (Common Operational Picture-Tool)

- It is a client – server dashboarding application connected with the Driver+ test-bed via the TypeScript adapter
- It gives the overview of a simulation
- It listens and displays the messages published by other tools.
- Current functions are to process and display:
  - Trial time
  - Route request
 - Rescue vehicle positions
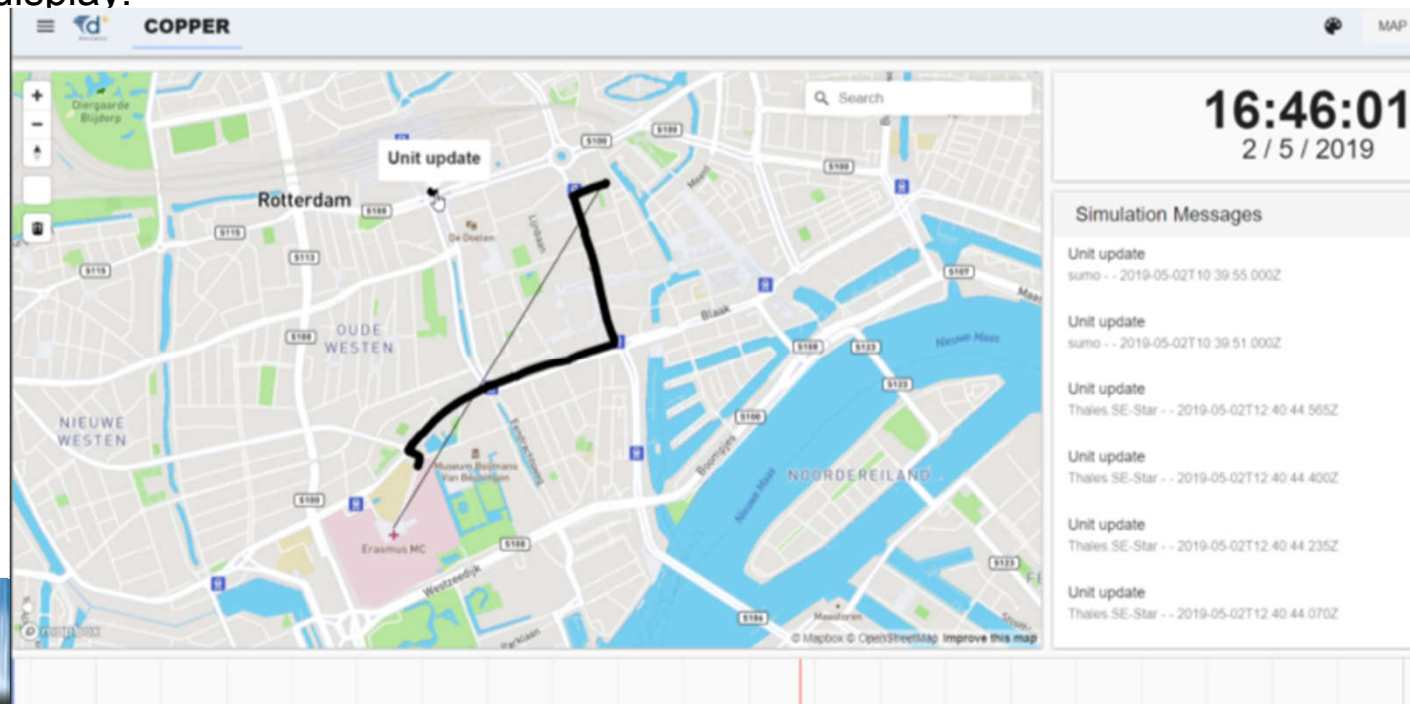
Overview of the Coupling Work

- To carry out a common traffic-based simulation environment
  - Vehicles,
  - Pedestrians,
  - real-time vehicle dispatching, routing and positioning
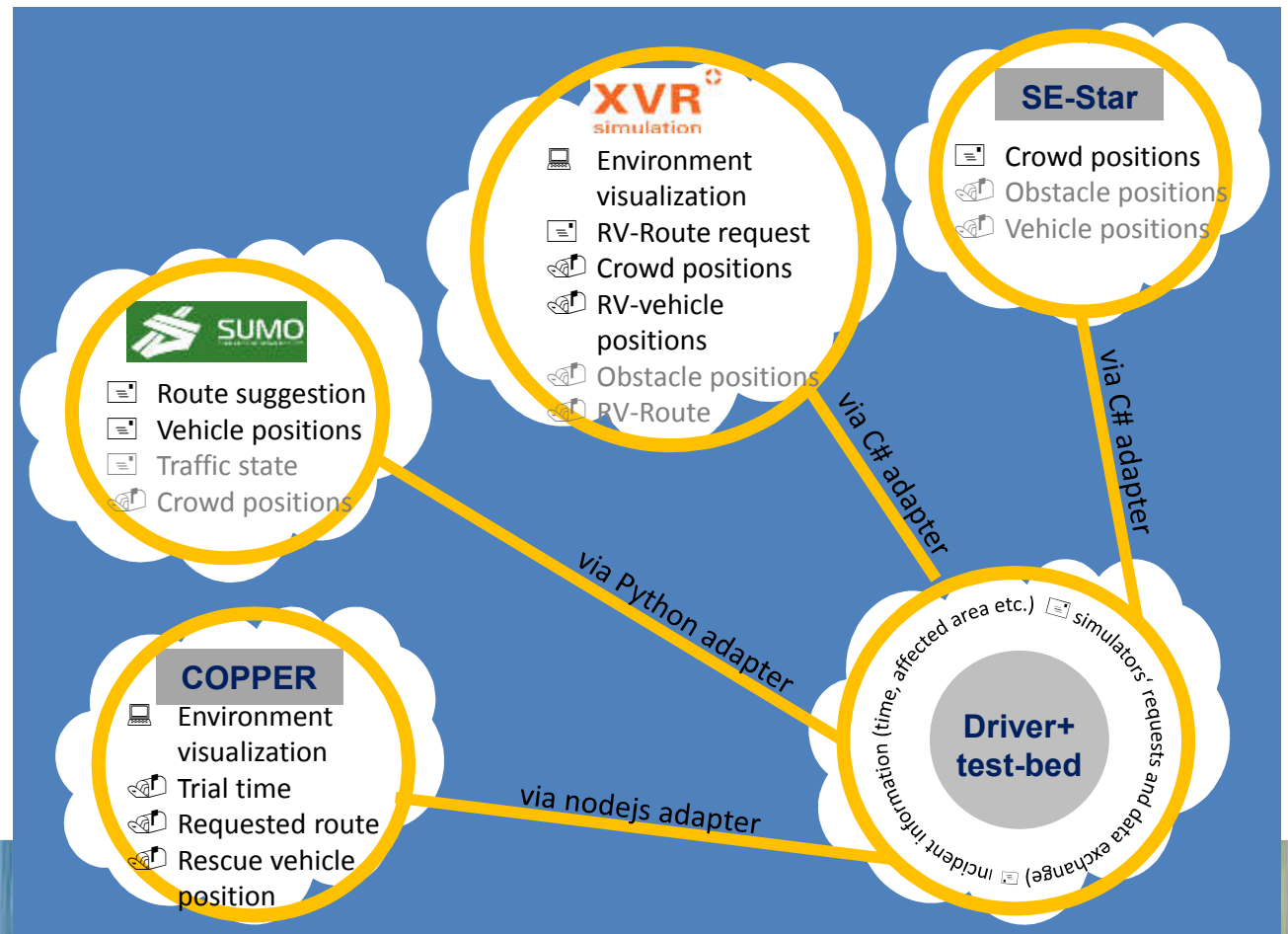
Scenario

- An oil tanker was exploded in the front of the main entrance of the Rotterdam railway station.
- The neighbouring roads are closed (the area in yellow).
- People were evacuated.
- Vehicle dispatching was requested.
- Based on the OSM a synthetic traffic simulation was set up with SUMO.
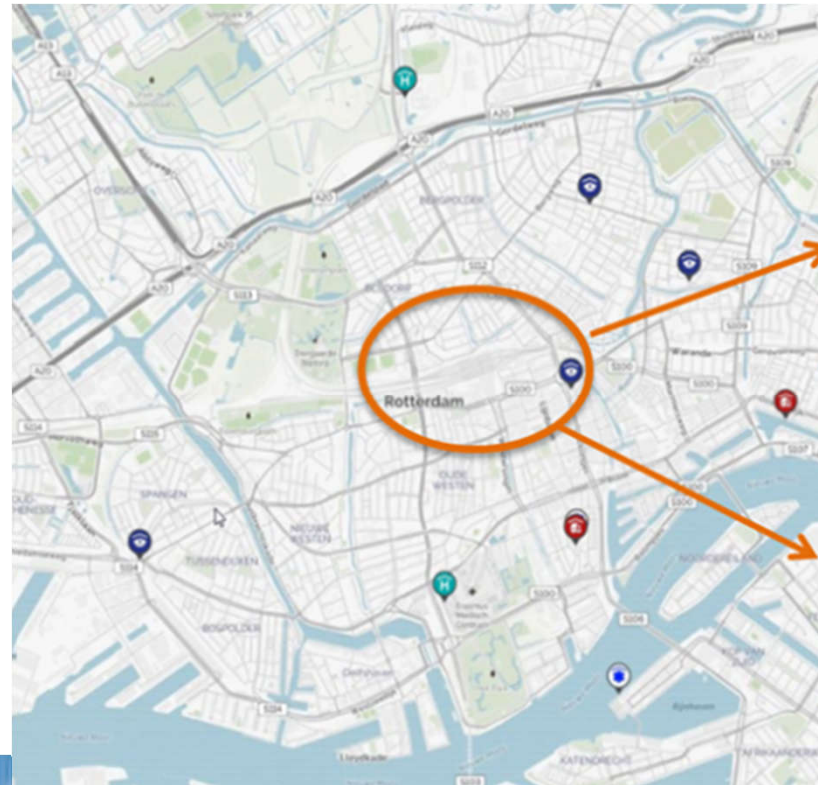
Illustration

Conclusion

- The first results show that the positions of simulated vehicles/routes/pedestrians are with high accuracy.

- The coupled simulation can be conducted in real-time in the proposed scenario.→ The timing issue needs to be considered when simulating a large area with high travel demand.

- Except XVR and SE-STAR all the related codes, schemas and tools are open-source and can be found in the GitHub platform.

- A Docker compose file with a local test-bed is available and a step-by-step tutorial can be found under
  https://github.com/DRIVER-EU/sumo-connector/tree/master/Rotterdam

- Next step:
  - Include SUMO and SE-STAR in the Docker compose file
  - Integrate the coupled simulations with the Trial Management Tool (TMT), which is used to control the trial, such as start a session, control the time, inject messages and more.
  - Extend functions upon the request.