

Towards a Domain-Specific Language for the Virtual Validation of Cloudnative Mobility Services

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EclipseSAAM Mobility 2021
Security | AI | Architecture | Modelling

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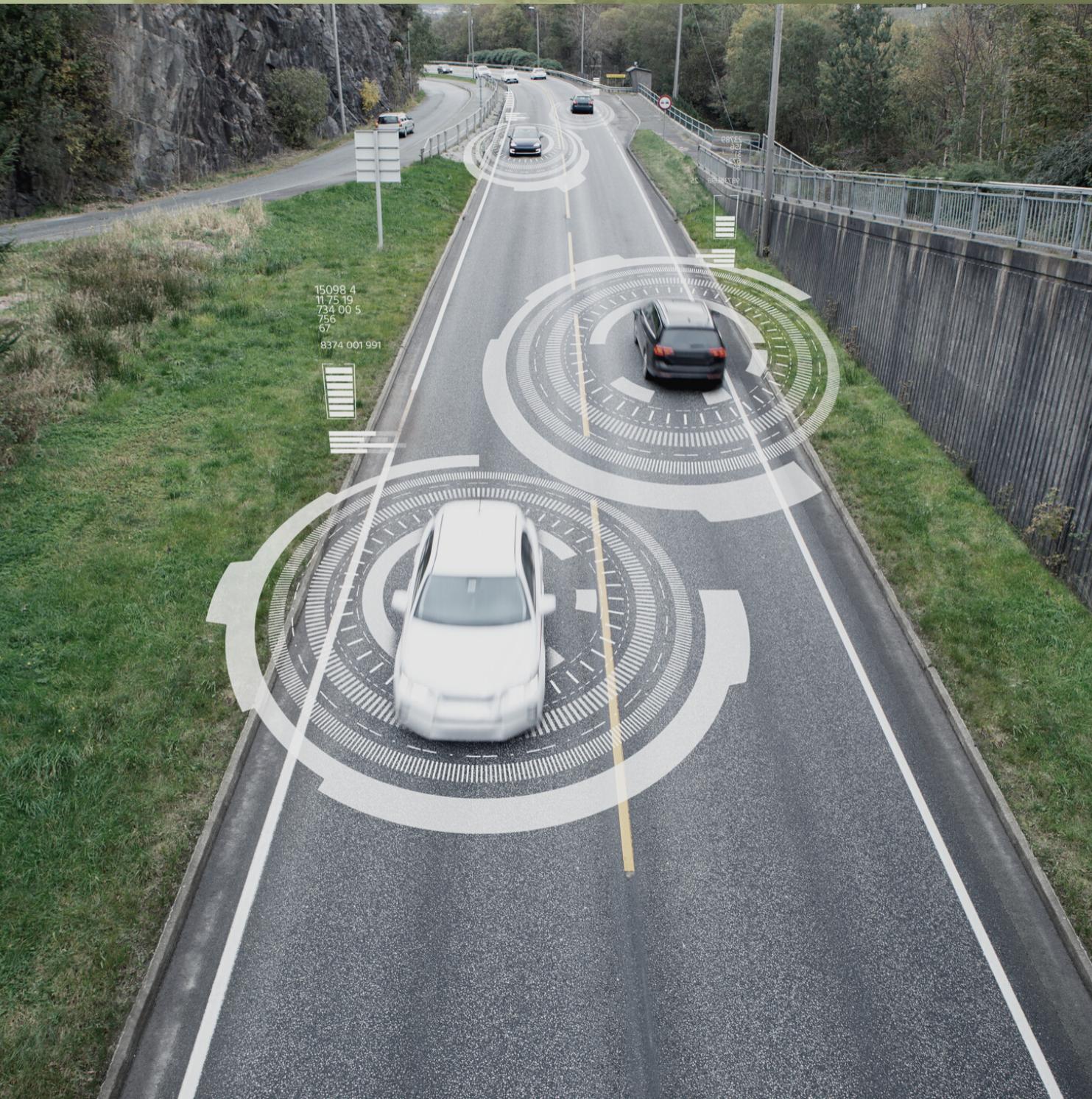
INTRODUCTION



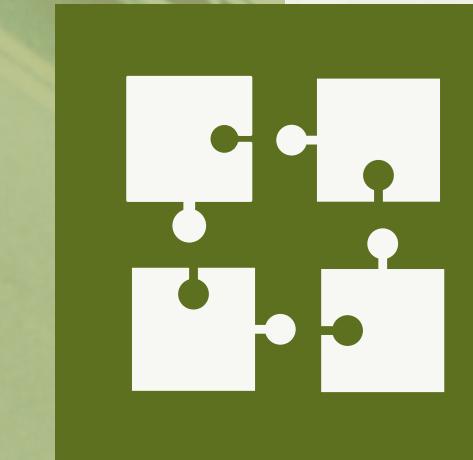
CONNECTED VEHICLES

IoT-Devices on Wheels

- High-performance computation resources
- Various sensing devices
- Data-driven software architecture
- Connectivity



CONNECTED VEHICLE SERVICES



Connectivity, Security, Scalability,
Reliability



Processing multi-modal mass data



Distributed system with various
components



TESTING CONNECTED VEHICLE SERVICES

- Network Conditions (Latency & Bandwidth)
- Network Protocols & Infrastructure
- Security
- Scalability & Reliability
- Vast number of potential traffic situations
-

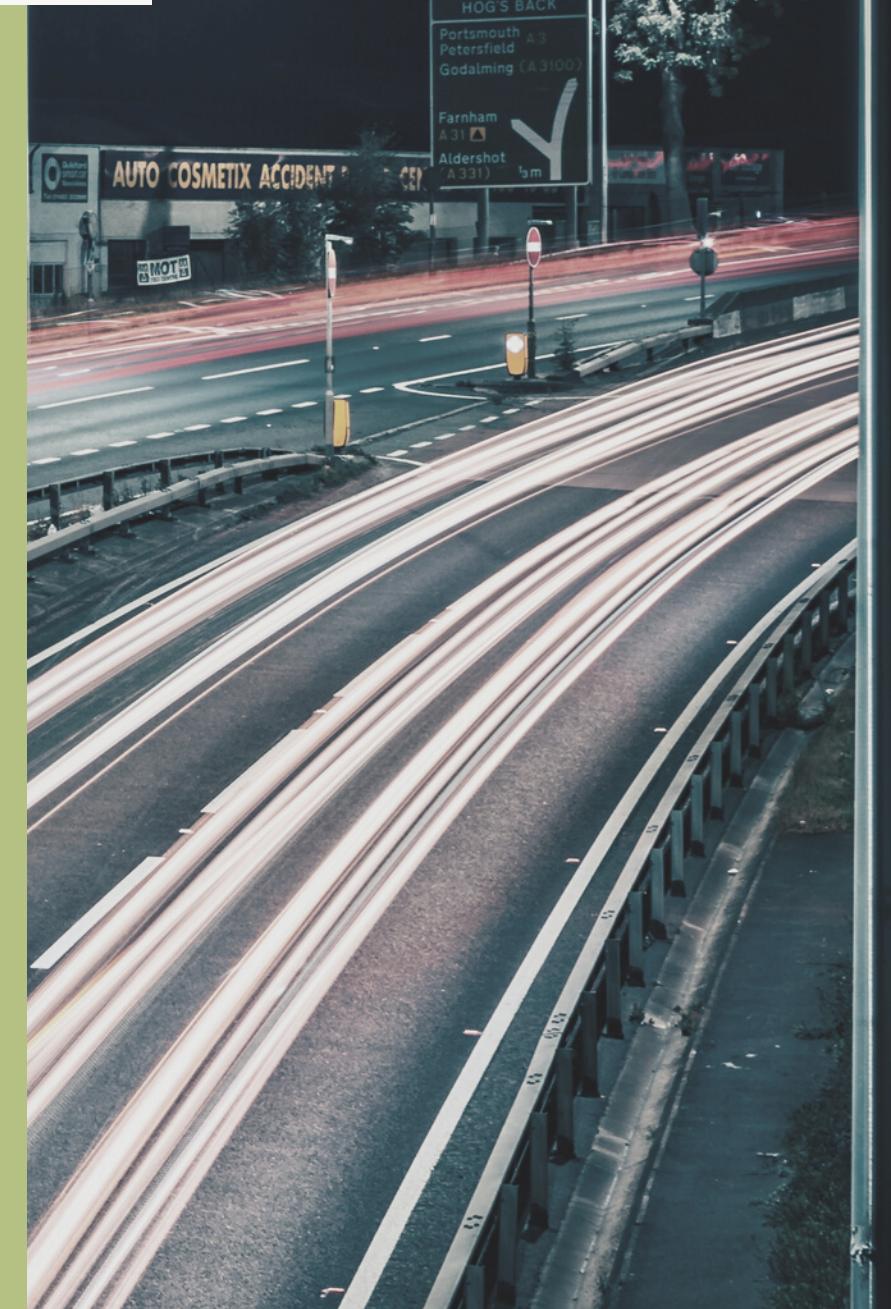


TESTING STRATEGIES

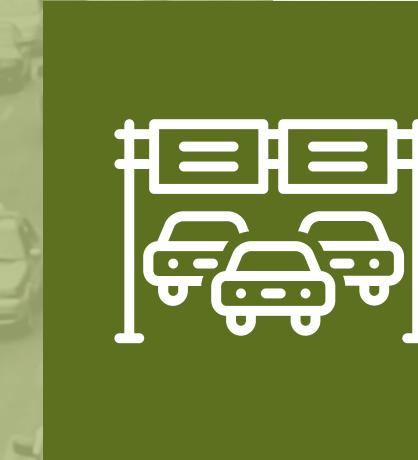
- Dummy data
- On-road testing via a vehicle fleet
- Hardware/Vehicle nodes
- Simulation
 - Creation of multi-modal traffic scenarios
 - Simulations running in the cloud
 - Co-simulation



VIRTUAL TESTING CLOUD-NATIVE MOBILITY SERVICES



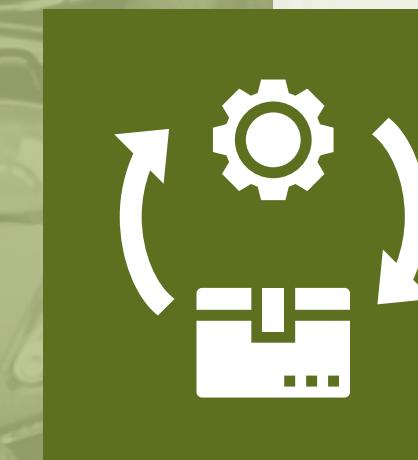
DOMAIN-SPECIFIC LANGUAGE



Model-based description of road networks and traffic demand



Additional properties relevant for testing connected vehicle services

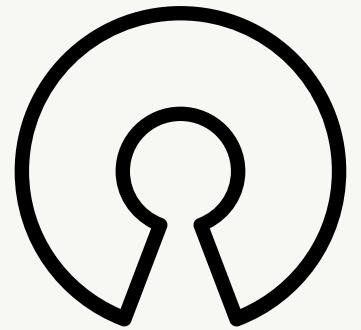


Generate simulation environments for multi-modal traffic scenarios

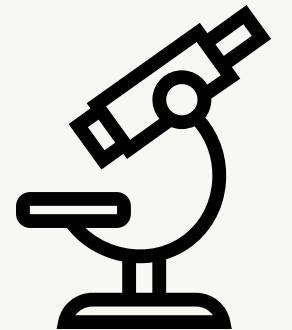


SUMO

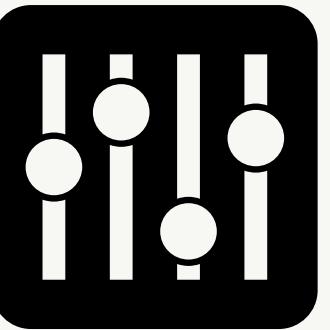
SIMULATION OF URBAN MOBILITY



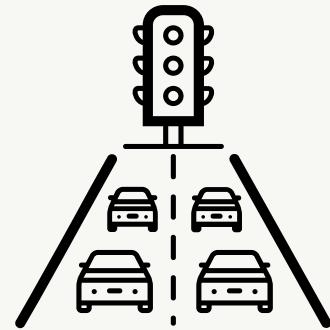
open-source



microscopic
traffic simulation



controllable via
TraCI

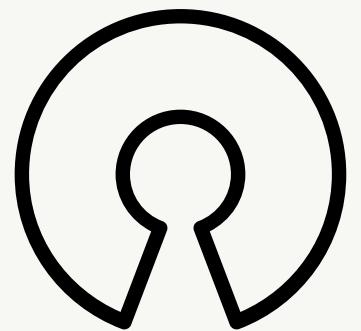


open-source,
real-world
scenarios

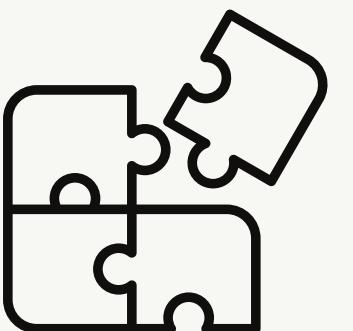




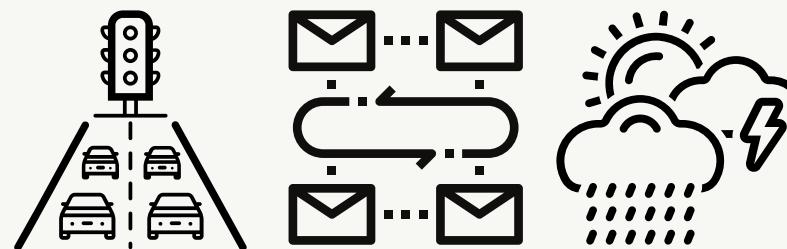
ECLIPSE MOSAIC



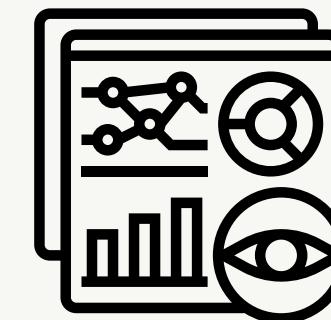
open-source



coupling of
different
simulators



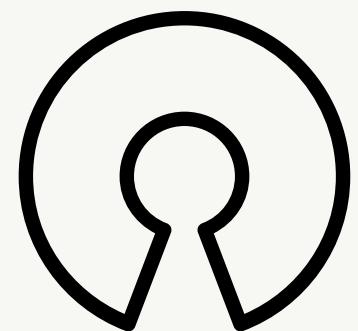
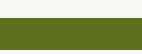
traffic
communication
environment



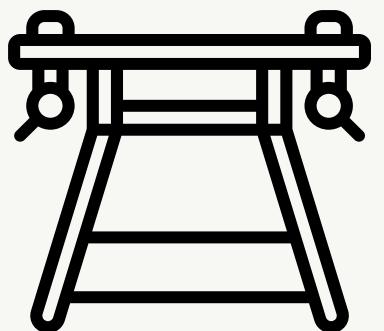
visualization
evaluation



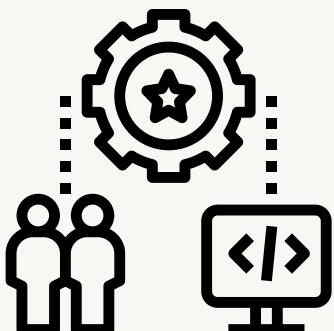
Xtext



open-source



language
workbench



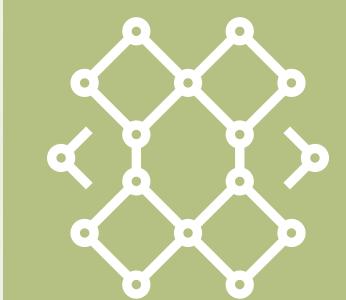
parser
linter
typechecker
compiler



editor support



Structure of the DSL by Example



```
mode MOSAIC

configure SUMO {
    input {
        generate RANDOM size 40
    }

    processing {
        scale 2
    }

    routing {
        algorithm dijkstra
    }
}
```



A wide-angle photograph of a bridge with multiple lanes of traffic moving away from the viewer. In the background, a city skyline with several skyscrapers is visible under a clear sky.

Demo





USE CASE



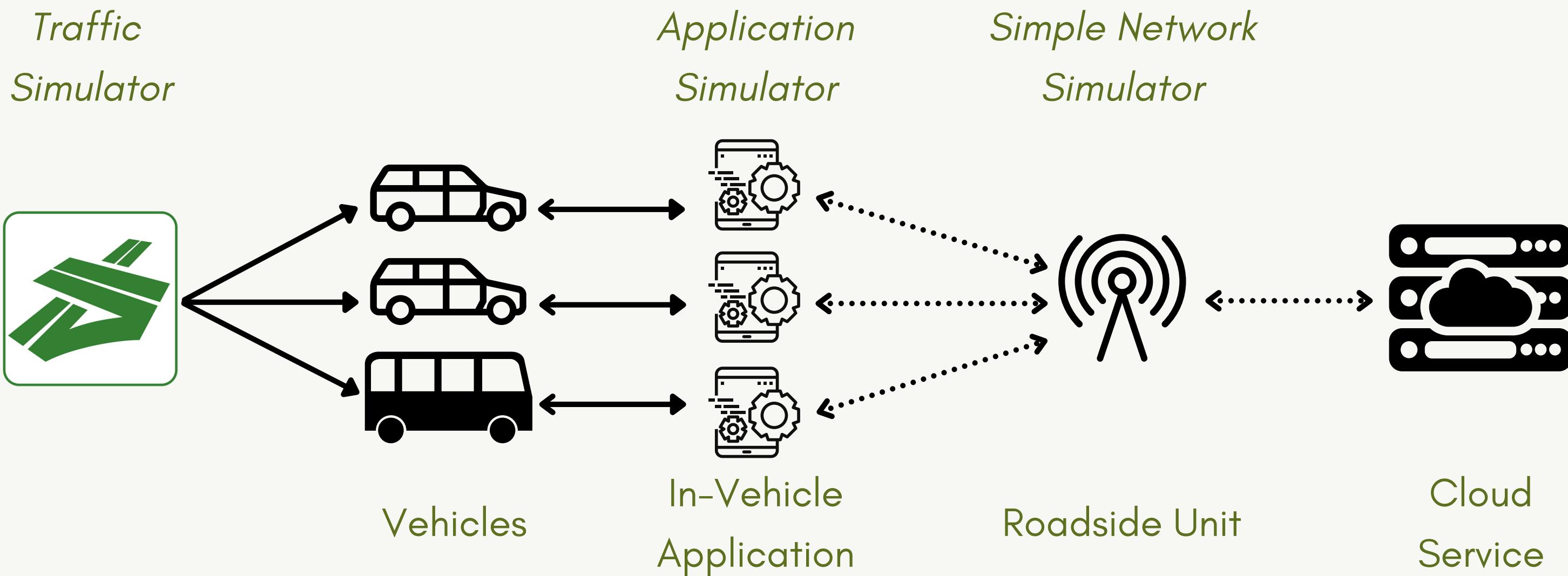
RESTRICTED TRAFFIC ZONE

- Geographical area in which only authorized vehicles are allowed to enter
- Monitored by a local roadside unit
- Cloud service process the data and determine if vehicles are allowed to enter
- Vehicles listening to incoming commands

RESTRICTED TRAFFIC ZONE



MOSAIC Runtime



```
mode MOSAIC
```

```
configure SUMO {  
    input {  
        netFile "highway.net.xml"  
        routeFiles "highway.rou.xml"  
    }  
  
    time {  
        start_at 0 seconds  
        end_at 1000 seconds  
    }  
}
```

The background of the image is a photograph of a bridge, likely the Golden Gate Bridge, with several cars driving on it. In the distance, a city skyline is visible against a clear sky.

Demo



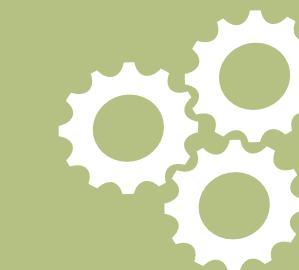
CONCLUSION



DSL PROTOTYPE



Description of minimal traffic scenario for testing connected vehicle services

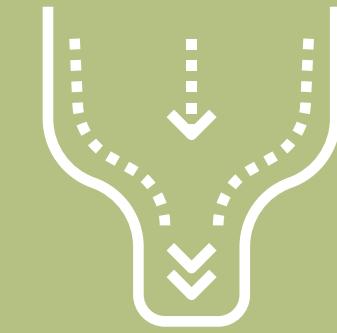


Generation of a Co-simulation environment via MOSAIC



Editor with good usability & Docker support

DSL DRAWBACKS



Strong dependency on SUMO.
How to describe general-purpose
traffic scenarios?



Running SUMO scenarios within
Eclipse MOSAIC has some minor
limitations



Balancing functionality and
complexity.
Cover the whole domain?

FUTURE WORK



Consideration of open standards and formats, e.g. OpenSCENARIO or Vehicle Signal Specification



Web-based user interface and new building blocks

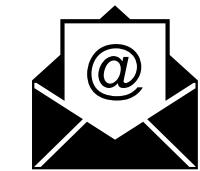


Definition of metrics to asses the architecture against non-functional requirements



THANKS FOR
YOUR ATTENTION

ARE THERE ANY QUESTIONS?



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