

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

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Security | AI | Architecture | Modelling

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AUTOMOTIVE
CLUSTER**

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INTRODUCTION

—

american golf
CAR PARK
←
Europe's #1
golf retailer

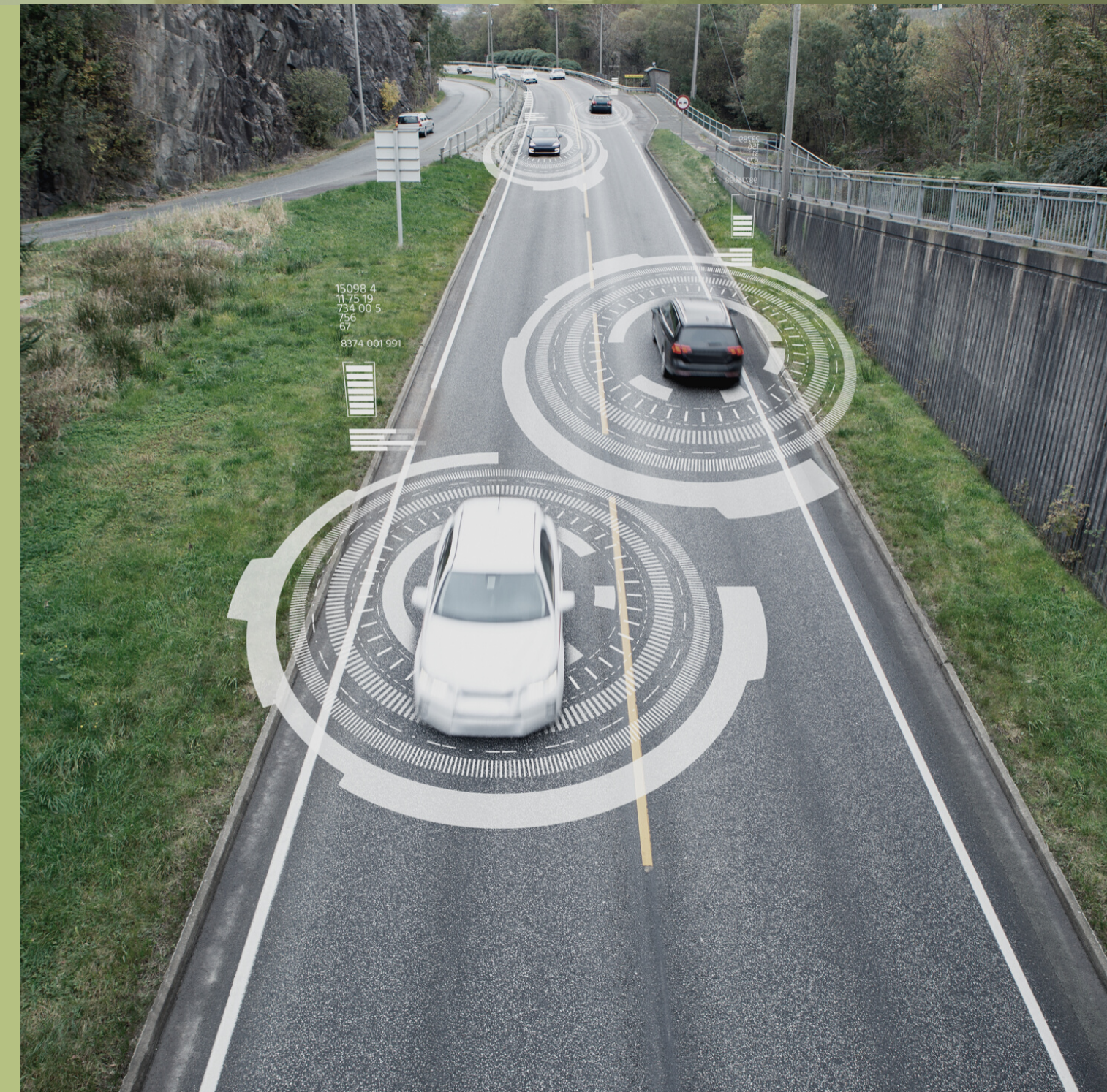
HOG'S BACK
Portsmouth A3
Petersfield
Godalming (A3100)
Farnham
A31
Aldershot
A331 5m

AUTO COSMETIX ACCIDENT

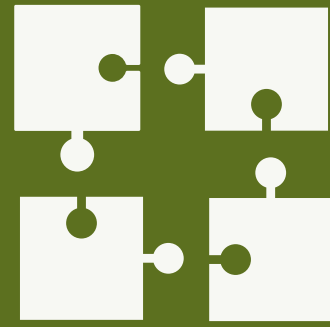
CONNECTED VEHICLES

IoT-Devices on Wheels

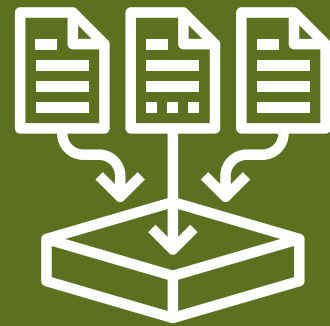
- High-performance computation resources
- Various sensing devices
- Data-driven software architecture
- Connectivity



CONNECTED VEHICLE SERVICES



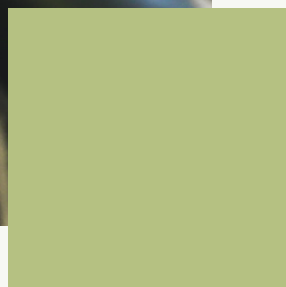
Connectivity, Security, Scalability,
Reliability



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
-

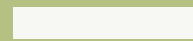
TESTING STRATEGIES

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



A nighttime photograph of a multi-lane highway with light trails from cars. A large green rectangular overlay is positioned in the center, containing white text. A white square is located in the top right corner of the green overlay. A white horizontal line is positioned below the text in the green overlay. In the background, a sign for 'american golf' is visible on the left, and a road sign for 'HOG'S BACK' is visible on the right.

VIRTUAL TESTING CLOUD-NATIVE MOBILITY SERVICES



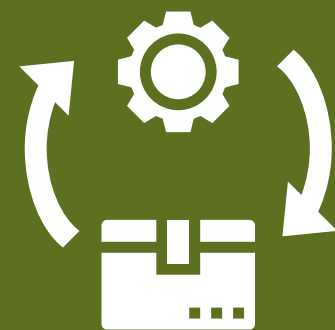
DOMAIN-SPECIFIC LANGUAGE



Model-based description of road networks and traffic demand



Additional properties relevant for testing connected vehicle services

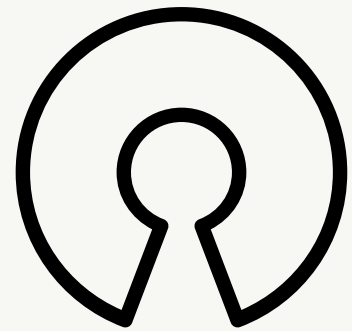


Generate simulation environments for multi-modal traffic scenarios

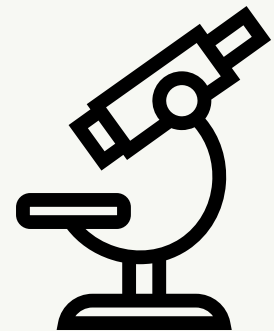


SUMO

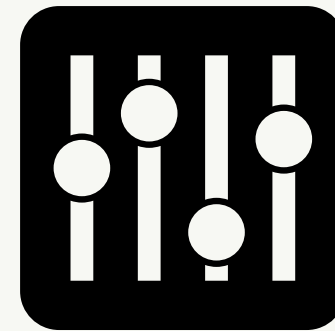
SIMULATION OF URBAN MOBILITY



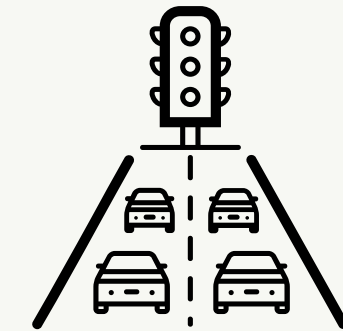
open-source



microscopic
traffic simulation



controllable via
TraCI

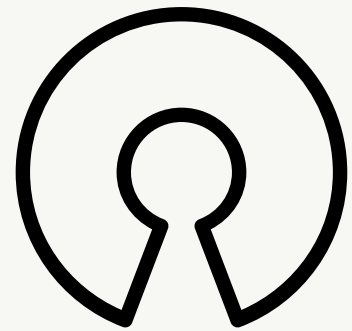
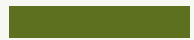


open-source,
real-world
scenarios

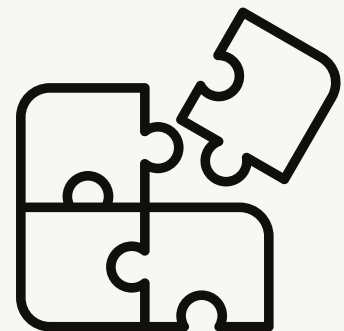




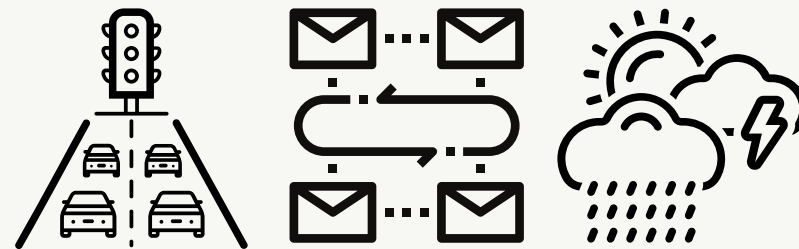
ECLIPSE MOSAIC



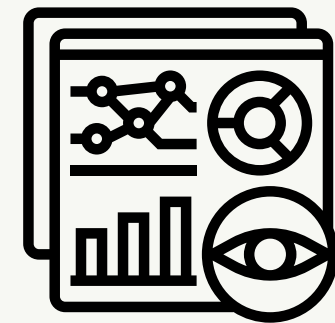
open-source



couping of
different
simulators



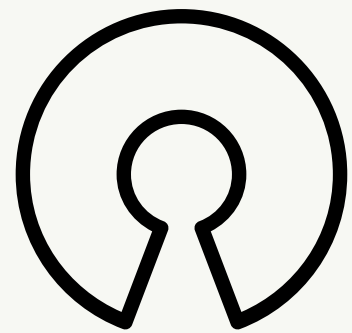
traffic
communication
environment



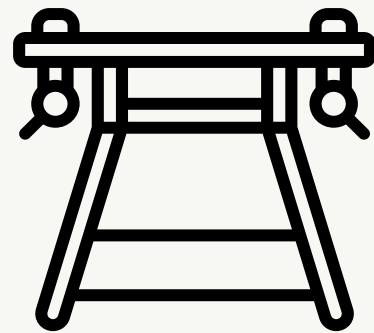
visualization
evaluation



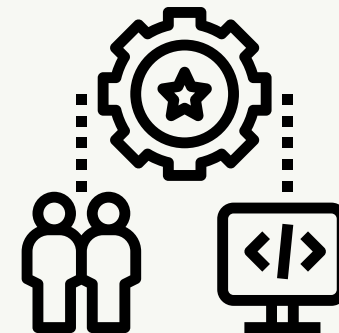
Xtext



open-source



language
workbench



parser
linter
typechecker
compiler

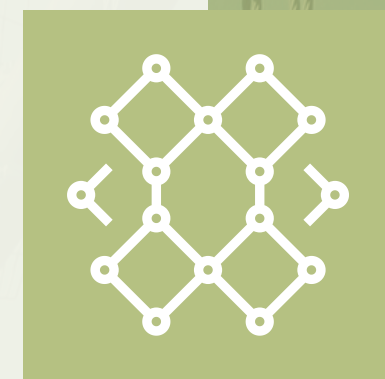


editor support



Structure of the DSL

by Example



```
mode MOSAIC
```

```
configure SUMO {
```

```
  input {
```

```
    generate RANDOM size 40
```

```
  }
```

```
  processing {
```

```
    scale 2
```

```
  }
```

```
  routing {
```

```
    algorithm dijkstra
```

```
  }
```

```
}
```

Demo





USE CASE

—

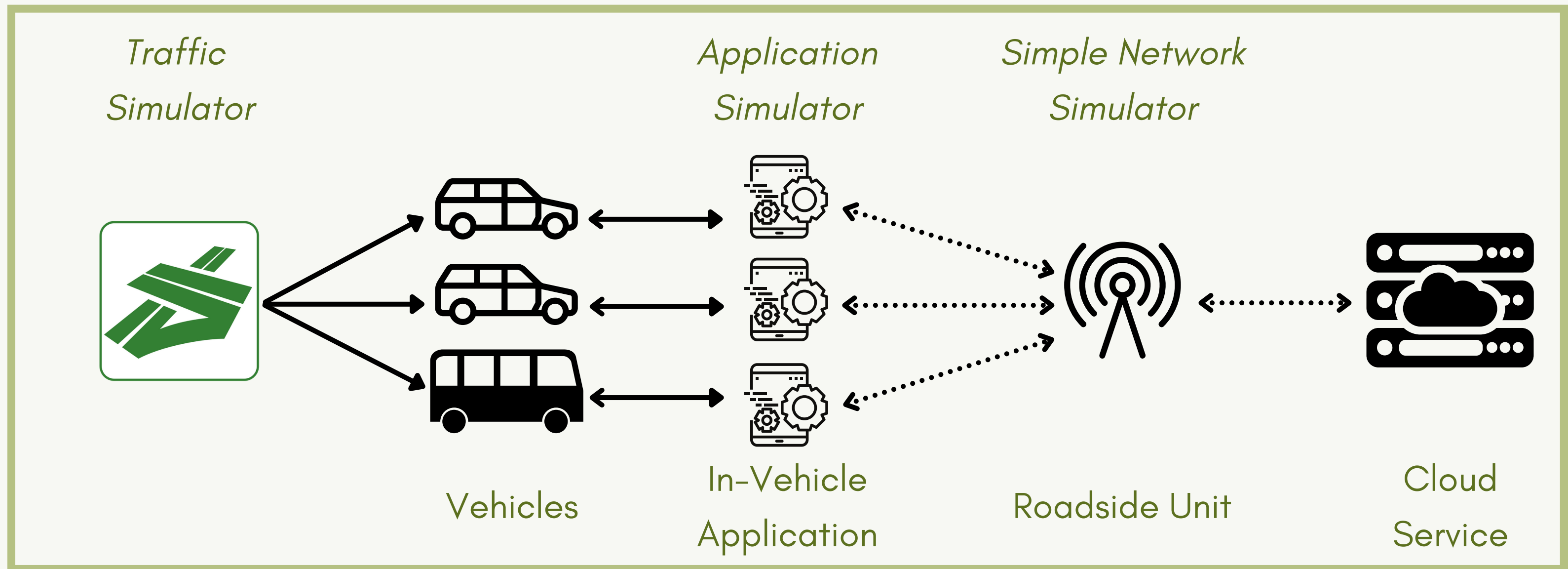


**RESTRICTED
ACCESS
AUTHORIZED
VEHICLES
ONLY**

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



```
mode MOSAIC
```

```
configure SUMO {
```

```
  input {
```

```
    netFile "highway.net.xml"
```

```
    routeFiles "highway.rou.xml"
```

```
  }
```

```
  time {
```

```
    start_at 0 seconds
```

```
    end_at 1000 seconds
```

```
  }
```

```
}
```

Demo





CONCLUSION

american golf
CAR PARK
←
Europe's #1
golf retailer

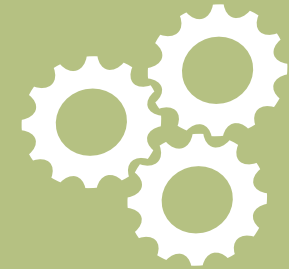
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A31
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A331 5m

AUTO COSMETIX ACCIDENT

DSL PROTOTYPE



Description of minimal traffic scenario for testing connected vehicle services

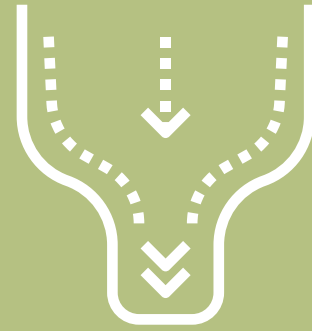


Generation of a Co-simulation environment via MOSAIC

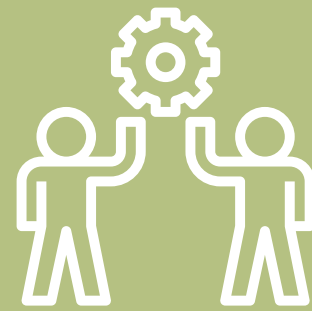


Editor with good usability & Docker support

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?

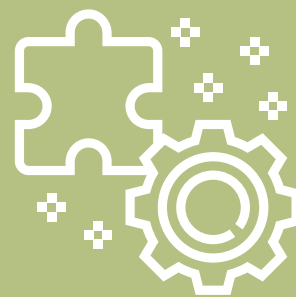
FUTURE WORK



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 assess the architecture against non-functional requirements



THANKS FOR YOUR ATTENTION



ARE THERE ANY QUESTIONS?



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