Testing mobility scenarios with the Open-Source simulation environment Eclipse MOSAIC

On the occasion of EclipseCon 2020, Fraunhofer FOKUS launches its simulation environment Eclipse MOSAIC. This solution is based on VSimRTI (Vehicle-2-X Simulation Runtime Infrastructure), which has been developed over the last 12 years in close cooperation with the DCAITI of the TU Berlin and has already been used by more than 600 partners to test mobility services and traffic scenarios. Eclipse MOSAIC is now partially available as open-source.
Our view of mobility scenarios

- Roads & Infrastructure
- Connected Vehicles
- Automated Vehicles
- Cloud Applications

Ad-hoc communication (ITS-G5)
Cellular communication LTE/5G
additional mobility solutions
Eclipse MOSAIC
A Multi-Domain and Multi-Scale Simulation Framework for Connected and Automated Mobility.

MOSAIC as Co-Simulation Framework
- All management tasks for simulation, synchronization and interactions are done by the RTI

MOSAIC as collection of models / modelling approaches
- Application logic
- Traffic pattern (vehicles, bicycles, pedestrians)
- Vehicle models (dynamics, sensors and controllers)
- Communication technologies
- Electric mobility aspects

Additional tools for
- scenario generation and evaluation
PHABMACS Scope

Prototyping of Cooperative ADAS, e.g. for

- Solving hazardous situations by a coordinated safety intervention

Mapping physics realistically

- Below the limits of driving dynamics, no highly detailed models of body, chassis, powertrain
- Calibration and Validation of vehicle dynamics against real world vehicles
The Multi-Scale Approach

Use different simulators according to your needs and required level of detail

**Vehicles:** Use traffic simulation or vehicle dynamic simulation, or both!

**Communication:** Simple heuristics, or detailed communication/network simulation (all layers in ETSI / 3GPP stacks)

Exchange simulators easily without touching the simulation scenarios
Facts and Figures

Current Release of MOSAIC
- Eclipse MOSAIC 20.0 (October 2020)

Duration of development
- More than 12 years

Scientific input
- 2 PhDs, 22 Masters, 8 Bachelors
- About 40 papers, articles and book chapters

Number of users / partners
- More than 600 (ca. 250 from Germany)

Projects and success stories
- PRE-DRIVE-C2X, DRIVE-C2X
  simTD (support of V2X field trials)
- STREETLIFE (bicycle mobility)
- eMERGE, eMERGE2, eBaseCamp (electric mobility)
- TEAM (holistic mobility solutions)
- IMAGinE (collaborative driving maneuvers)
- SENDATE-TANDEM (Internet and cloud)
- INFRAMIX (automated driving on highways)
- Several projects for industry partners
Selected Success Story
Traffic Management on Highway Scenario

Digital map with e.g. roadwork zones

Traffic with different vehicle types and behavior

Road infrastructure with sensors and signs

Communication infrastructure with C-ITS and 5G links and additional nodes (RSUs)

Management Applications with
- Dynamic speed limits
- Lane closures (Roadworks)
- Dedicated lanes for automated vehicles
### Eclipse MOSAIC Versions

<table>
<thead>
<tr>
<th>3D Visualization</th>
<th>Statistics Output</th>
<th>ITEF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery / Charging</td>
<td>Variable Message Signs</td>
<td>PHABMACS</td>
</tr>
<tr>
<td>Browser Visualization</td>
<td>File Output</td>
<td>CMD Starter</td>
</tr>
<tr>
<td>Application</td>
<td>Eclipse SUMO</td>
<td>Environment</td>
</tr>
<tr>
<td>Cellular</td>
<td>ns-3</td>
<td>OMNeT++</td>
</tr>
<tr>
<td>Runtime Infrastructure</td>
<td>Interactions Library</td>
<td>Tutorials</td>
</tr>
</tbody>
</table>
MOSAIC @ Eclipse

openMobility

Strategic development as an associated project

Part of the OpenADx demonstrator
Thank you!

Eclipse MOSAIC Website
https://www.eclipse.org/mosaic/

Eclipse MOSAIC GitHub
https://github.com/eclipse/mosaic

Contact
mosaic@fokus.fraunhofer.de

Robert Protzmann
robert.protzmann@fokus.fraunhofer.de