Status OpenMCx

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At **AVL** we believe that:…

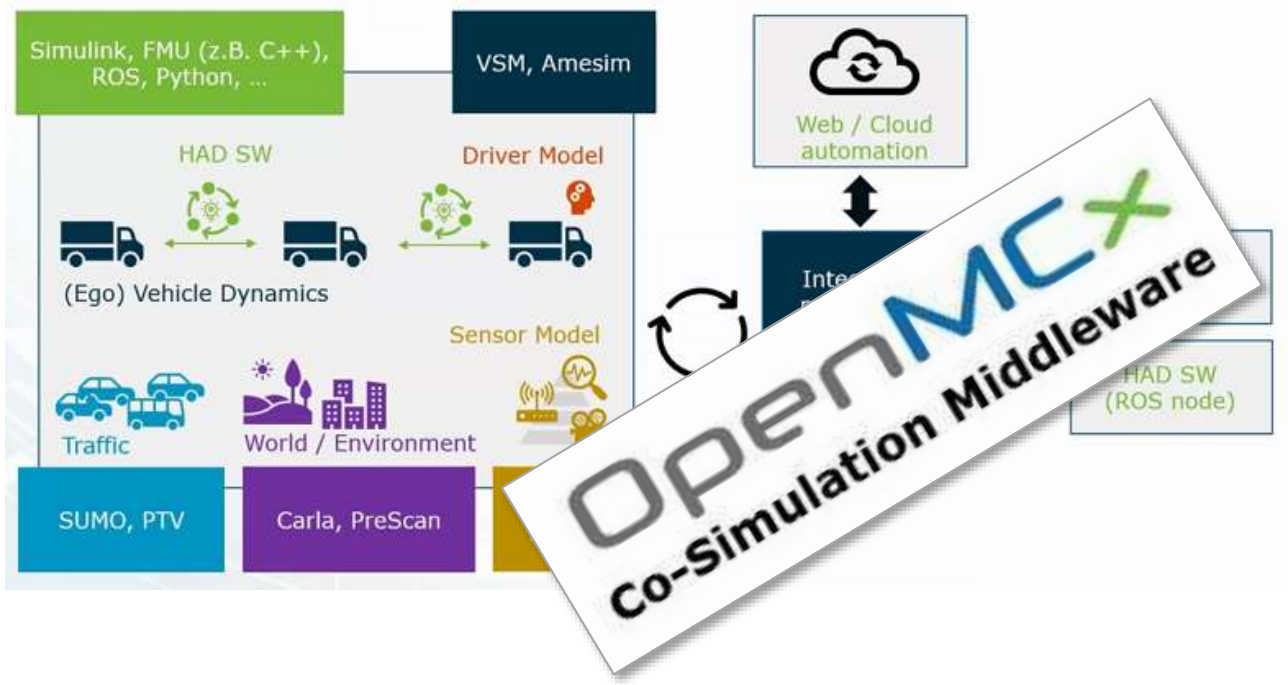
A. **<u>ADAS/AD virtual validation</u>** is one of the hottest topics out there (automotive-SW-wise☺)

B. Setting up a virtual system is a **<u>complex task</u>** (environment, sensors, controls, vehicle, analytics,…)

C. Validation efficiency can be increased by a standard-based **<u>open co-simulation</u>** middleware (mix-and-match)

D. **<u>There is no one-size-fits-all</u>** toolchain (use-case specific: perception and fusion, planning and controls, system validation, driver experience, security and safety,…)

E. The add-ons to the middleware should be **<u>application driven</u>** (democratize plug-ins development: environment, HiL, cloud, sensor integration,…)



Intro

01/2018

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06/2019

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09/2021

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The OpenADx Working Group wants to serve in the field of **software tools for** the realization of **autonomous driving** by defining **open interfacing standards** for software for use **in-vehicle based systems and in testing environments**, under the governance of the **Eclipse Foundation**.

"Eclipse OpenMCx" is an open, tool-neutral **co-simulation middleware** based upon simulation standards and formats, such as **FMI, SSP, DCP, OSc, OSI, etc.** aiming to support **advanced simulation applications** with a heterogenous toolchain in a distributed **collaborative development process**.

https://github.com/eclipse/openmcx
https://projects.eclipse.org/proposals/eclipse-openmcx

Our goal:

- Providing a referent implementation for promoting standards-based co-simulation methodology and enable the end-users to concentrate on their innovation process using use-case specific, best-in-class models and tool-chains.
- **Making the world a better place! At least a bit.☺**

Use Case Specific ADAS/AD Validation Cascade

Simulation (MiL/SiL)

Scale Testing of Variants
(Vehicle Configurations and Scenarios)

Use case: Software function testing

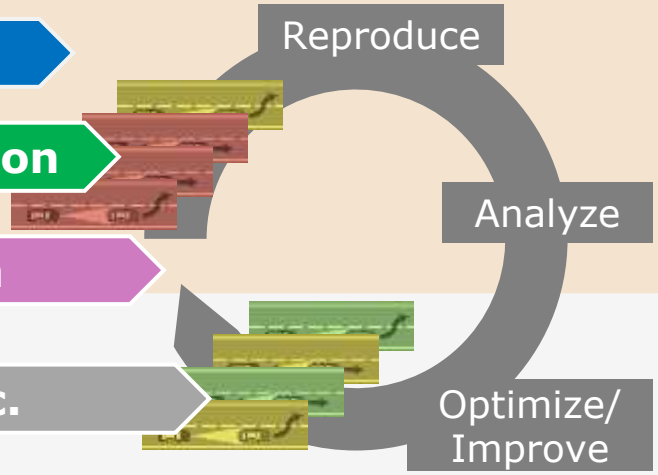
Use case: Control function validation

Use case: Corner case extraction

Use case: Perceived safety, etc.

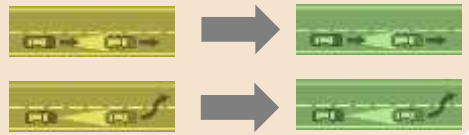
Virtual Testing (HiL/ViL)

Integrate, Analyze and Improve



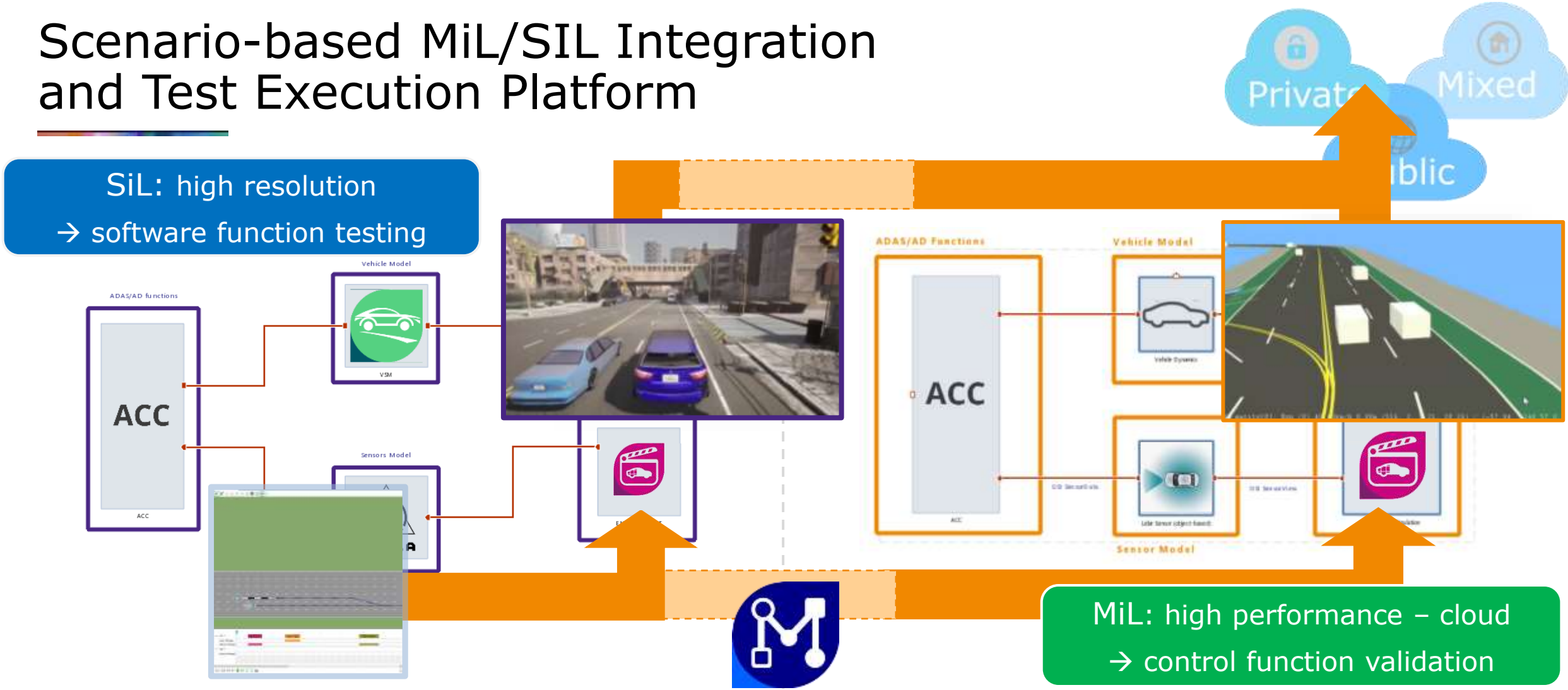
Proving Ground / Real World

Finalize and Confirm



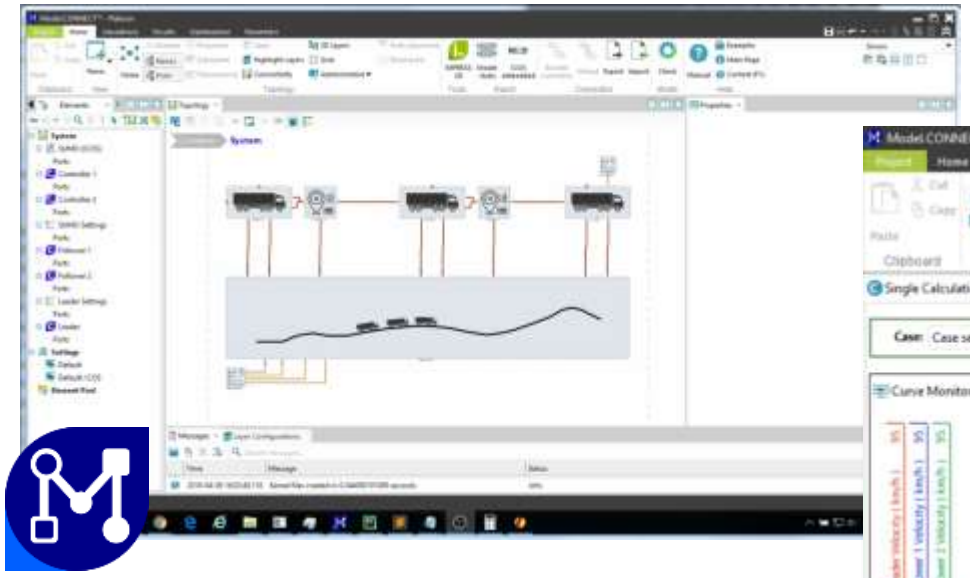
ADAS/AD function verification and validation starts in a fast and scalable virtual environment. For the higher accuracy and specific corner cases, the tests are performed in HiL and ViL environment and end up in the road tests. Validation workflow must be optimized for specific use cases in order to improve test coverage and reduce road testing.

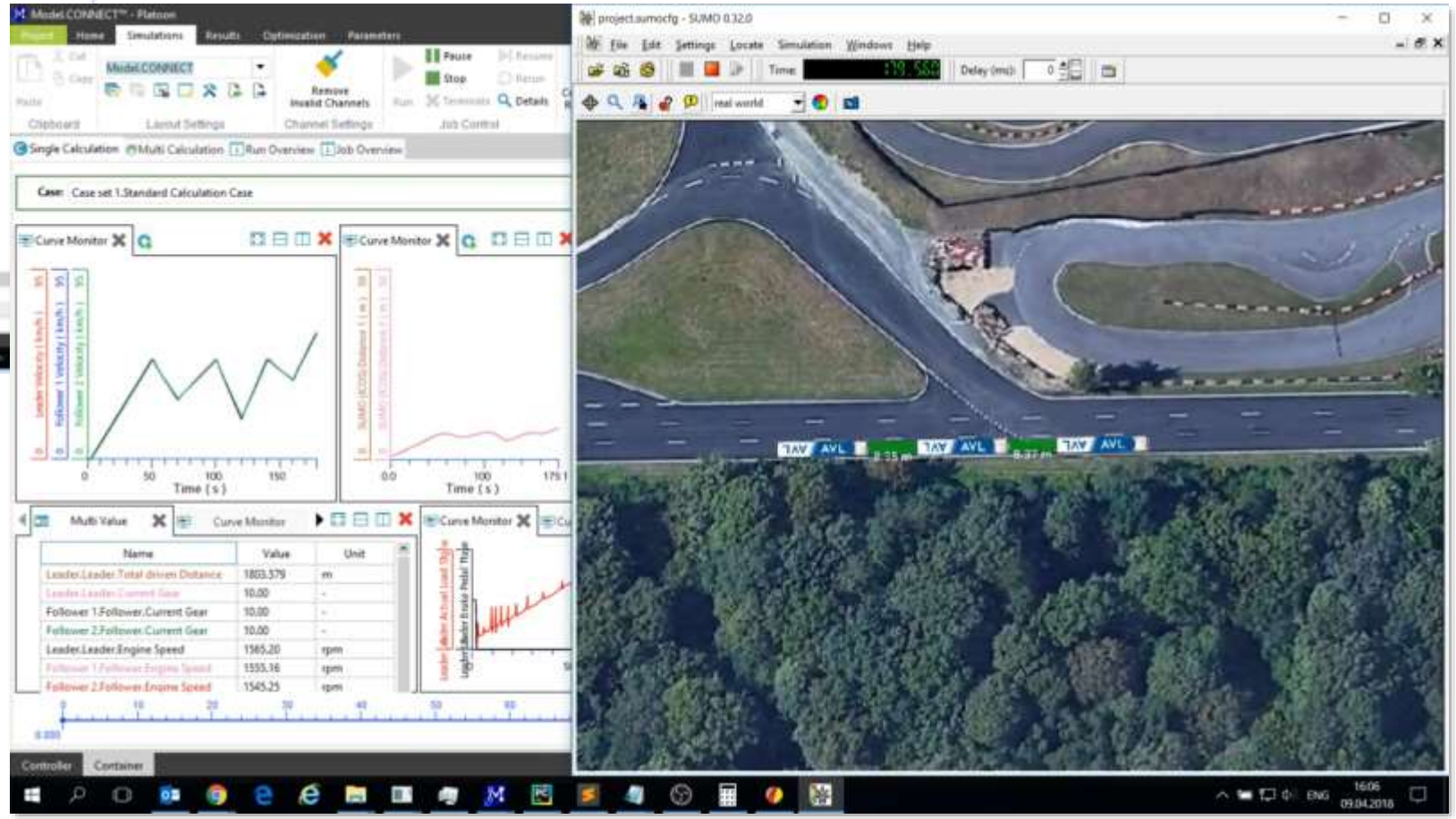
Scenario-based MiL/SIL Integration and Test Execution Platform



AVL provides standardized scenario management and an open virtual integration and simulation platform. Depending on the use case, an ideal combination of environment, vehicle, sensor and control models is provided for optimal execution performance and KPI-based data analytics.

Platooning (Eclipse SUMO, AVL CRUISE, Matlab/Simulink)

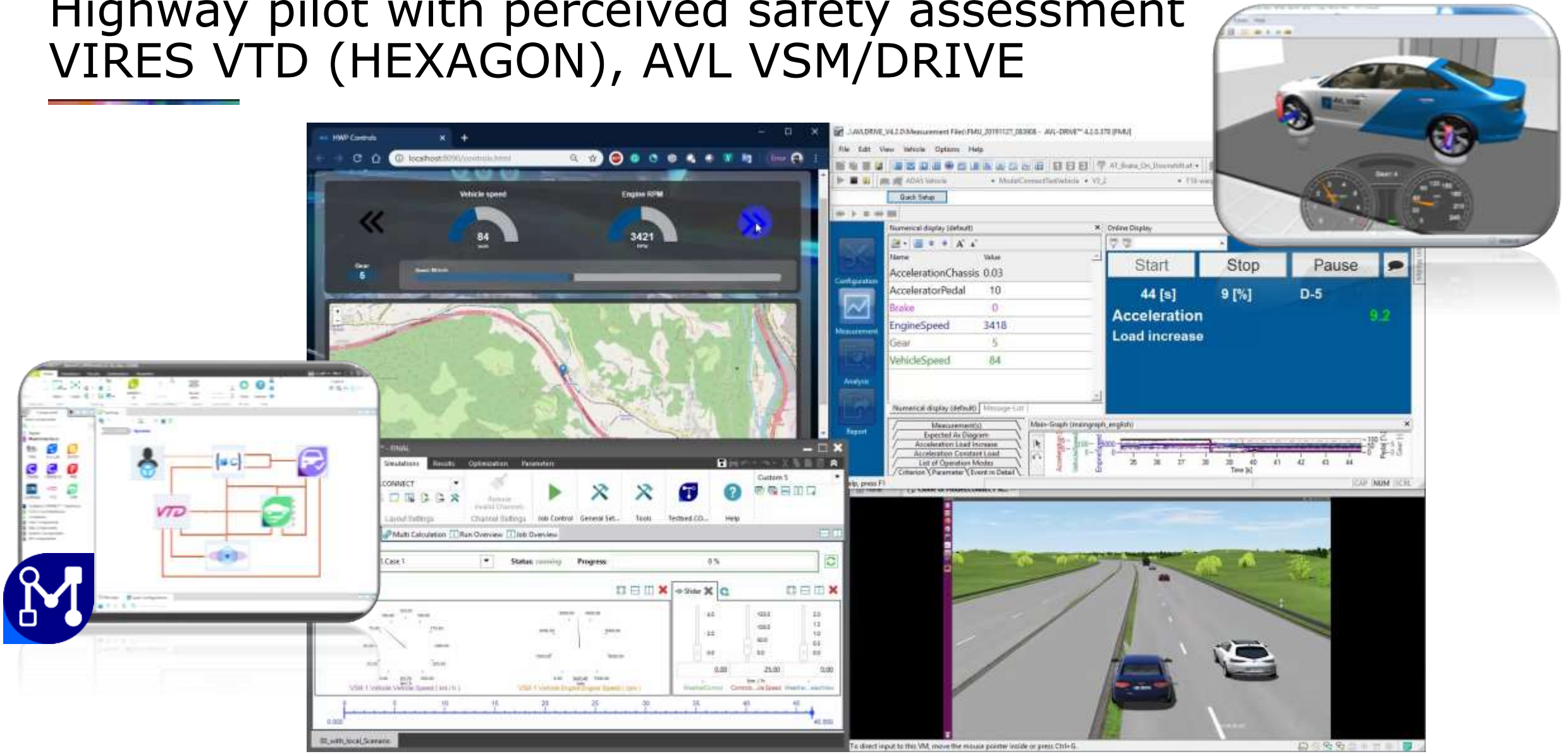




Design objectives:

- Fuel consumption reduction with variable safety distance under different following strategies

Highway pilot with perceived safety assessment VIRES VTD (HEXAGON), AVL VSM/DRIVE



Business models behind open-source

- Donations
- Hosted Version
- Support/Courses
- Add-ons
- Dual Licensing
- Selling Commercial Version

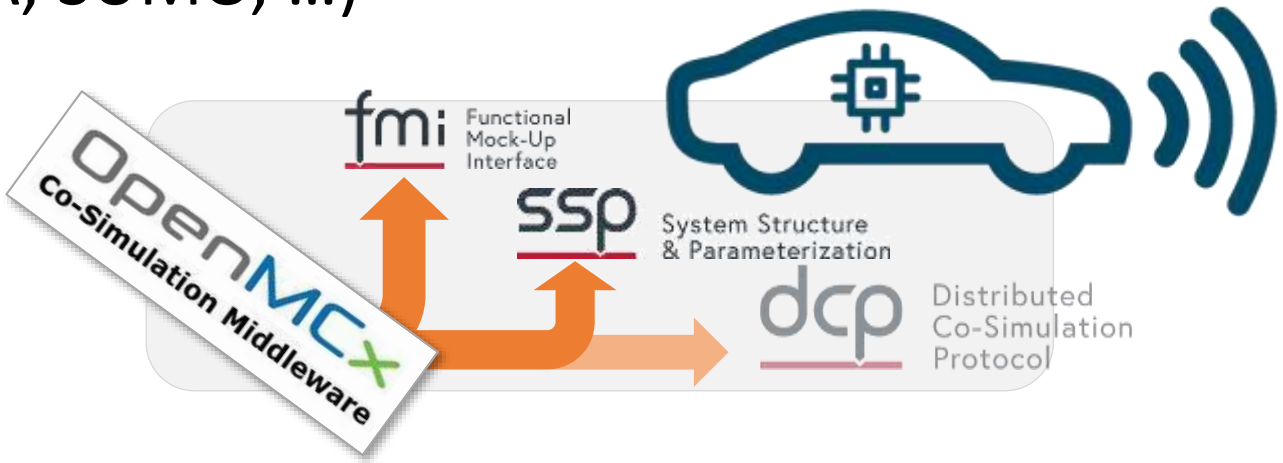
https://www.karllhughes.com/posts/open-source-companies

- Promoting technology
- Learning effect

OpenMCx
Co-Simulation Middleware

- Co-simulation Framework based on (Modelica Association) standards: FMI, SSP, DCP, etc.

- Open for interfacing with other (quasi) standards and tools (python, OSI, ROS2, CARLA, SUMO, …)



OpenMCx

Co-Simulation Middleware

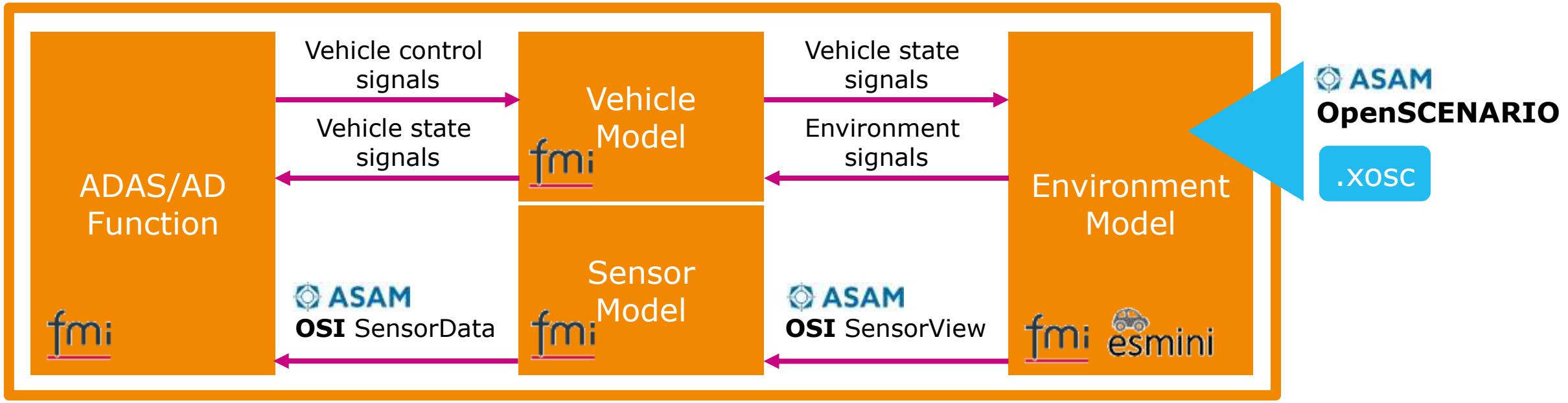
- System Structure Definition (*.ssd) input file (www.ssp-standard.org)
  - annotations for run-time config (default values if undefined)
- Features:
  - Parallel (Multi-Threading) or sequential execution
  - Unit-conversion
  - Parameter support
  - Result writing
  - binary port support (FMI2.0 with OSI Sensor Model Packaging)
  - …
- How to use (build, run, debug) OpenMCx?

https://github.com/eclipse/openmcx

Scenario-based testing of cyber-physical systems
powered by OpenMCx

Modelica Association ssp

System Structure Definition (SSD)



.ssd

Simulation

OpenMCx
Co-Simulation Middleware

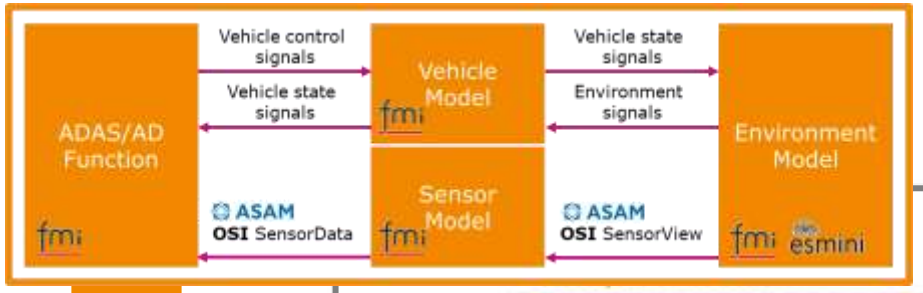
Results

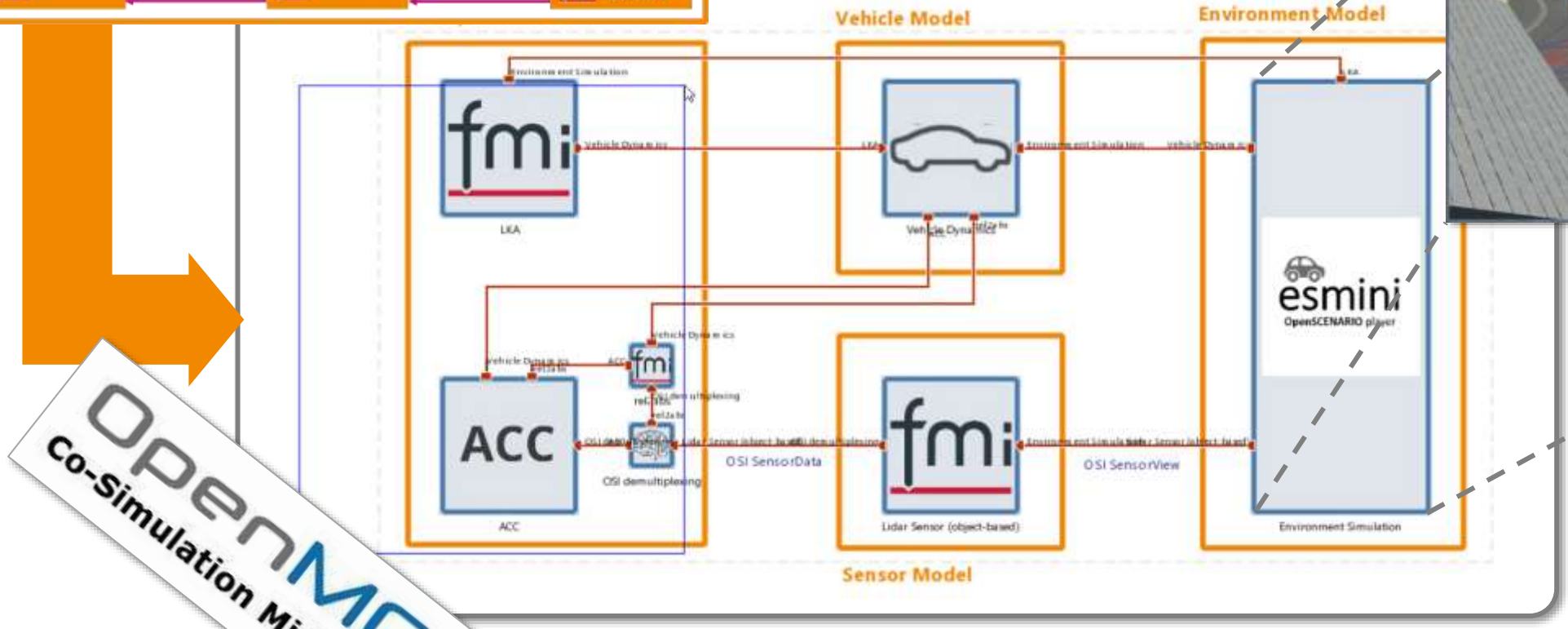
.csv

OSI trace

Analysis

Calculate KPIs
- Time to collision
- Perceived safety
- …



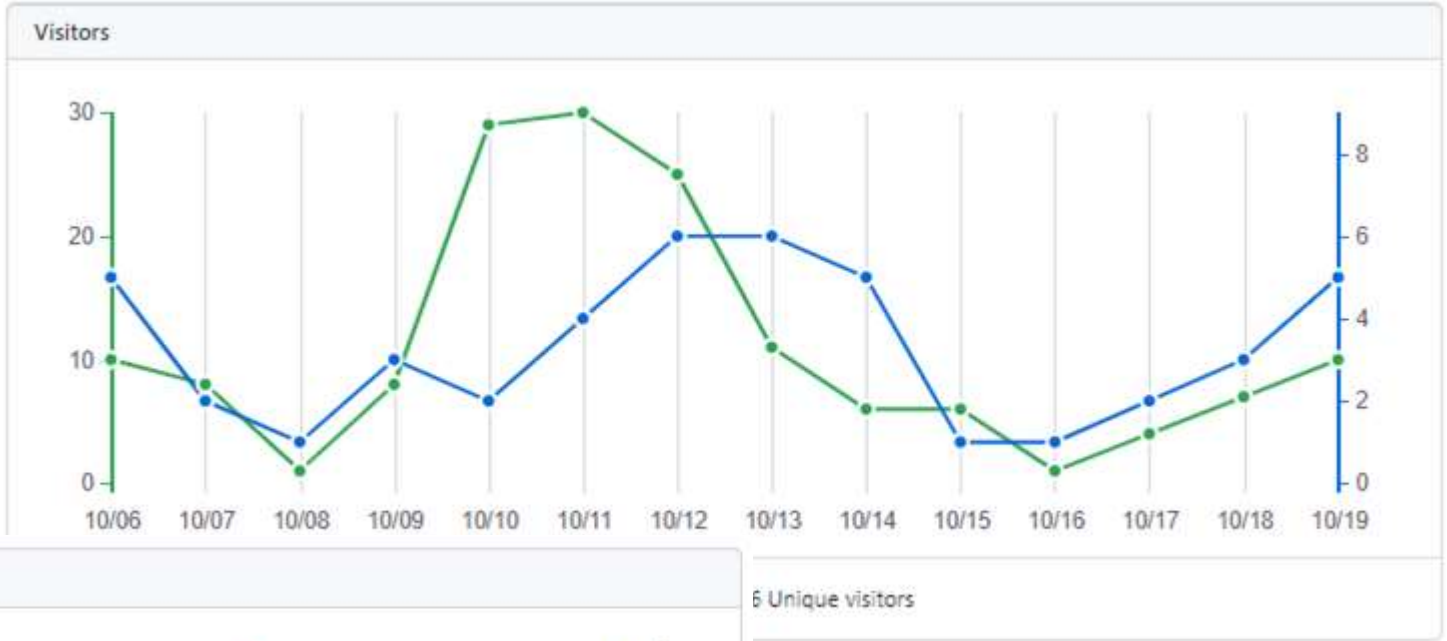


OpenMCx Co-Simulation Middleware

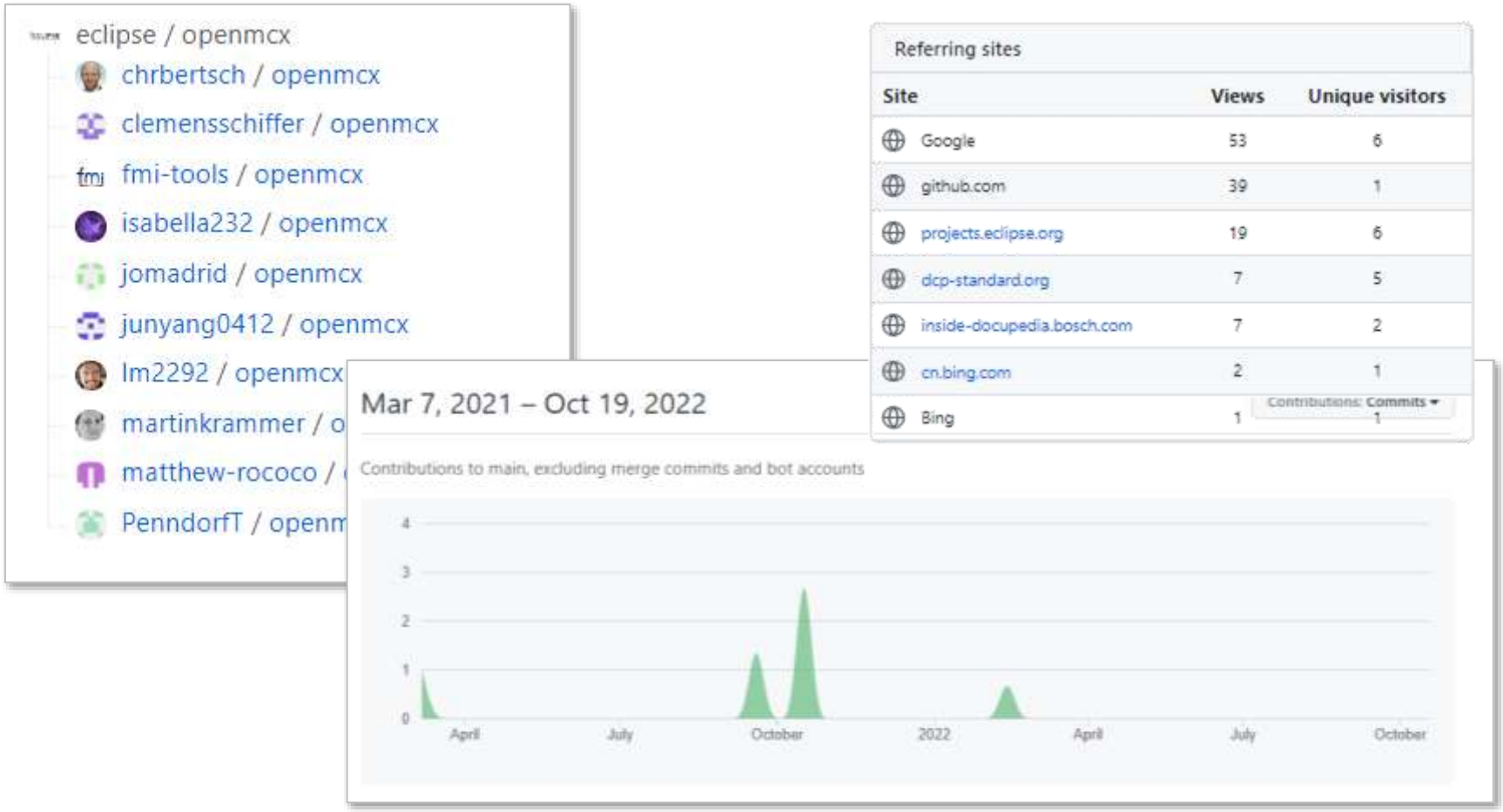
https://github.com/eclipse/openmcx

Stats

- Visitors and cloners



Forks, contributions, referring sites…



Outlook

Did it pay off?

- Clear answer: yes and no!

Further steps:

- New momentum under OpenMobility and SDV?
- Steam beyond ADAS.
- Scalable middleware.

Thank you

www.avl.com

Contact us:

klaus.schuch@avl.com

Come and contribute!

https://github.com/eclipse/openmcx