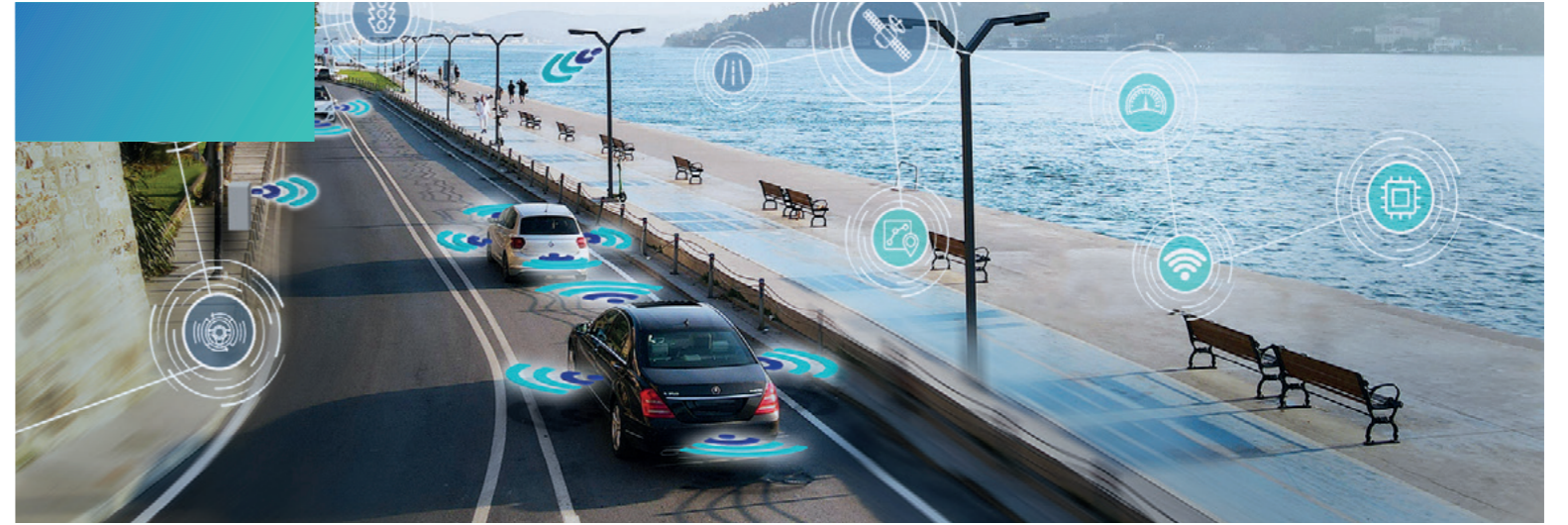




This project is co-financed by the European Union and the Republic of Türkiye.



# INNOVATE. INTEGRATE. TEST!



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## OPEN INNOVATION AUTONOMOUS VEHICLE DEVELOPMENT AND TESTING PLATFORM

### SERVICE CATALOGUE

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**Innovate and Integrate:**

**Anytime, Anywhere!**

# ABOUT OPINA

**OPINA** is an open innovation autonomous vehicle (AV) platform that is committed to accelerating intelligent mobility software development within a comprehensive, dynamic, and agile automotive innovation ecosystem.

**OPINA** is co-financed by the European Union and the Republic of Türkiye. It is implemented by the Ministry of Industry and Technology under the scope of the Competitive Sectors Program and managed by İstanbul OKAN University.

**OPINA** Project partners are TAYSAD (Automotive Suppliers Association), TESİD (Electronics Industrialists Association), YASAD (Software Industrialists Association) and MARKA (Eastern Marmara Development Agency).

**OPINA's** primary objective is to create a collaborative science, technology, and innovation ecosystem. By fostering partnerships between universities, industry, and SMEs, OPINA aims to spur the development of innovative, high-tech, and high-value-added solutions.

## Unlock the Power of Collaboration!

**The OPINA Platform** is the cooperation ecosystem where developers can find technical support for their developments, benchmarking and performance evaluation, software tool chains, compliance checks against automotive standards.



## Online Creativity Hub

### Online Creativity Hub

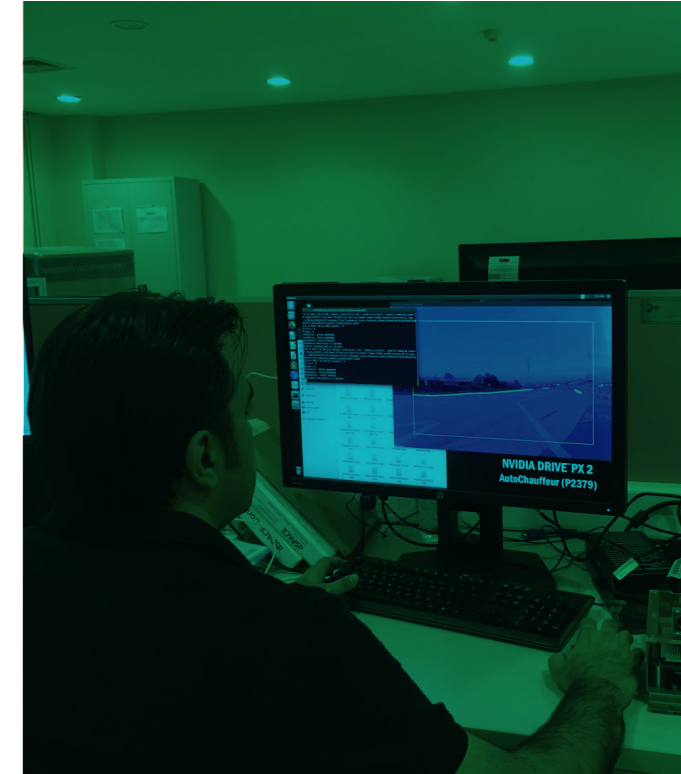
**OPINA's Software Development Platform** is an online hub designed for creating innovative Advanced Driver Assistance Systems (ADAS), Connected and Autonomous Driving (CAD) software modules. It enables developers to test their creations using simulators.

## Realize Your Potential in OPINA's Testbed

Embark on innovation with the OPINA Platform's fully equipped testbed. Developers can put their creations to the test against top-tier MIL/SIL/HIL/DIL systems, bridging the gap between virtual and real-world scenarios. Moreover, within OPINA, there is advisory support available for software methodologies, functional safety, intellectual property rights, and various other issues related to Research and Development (R&D)

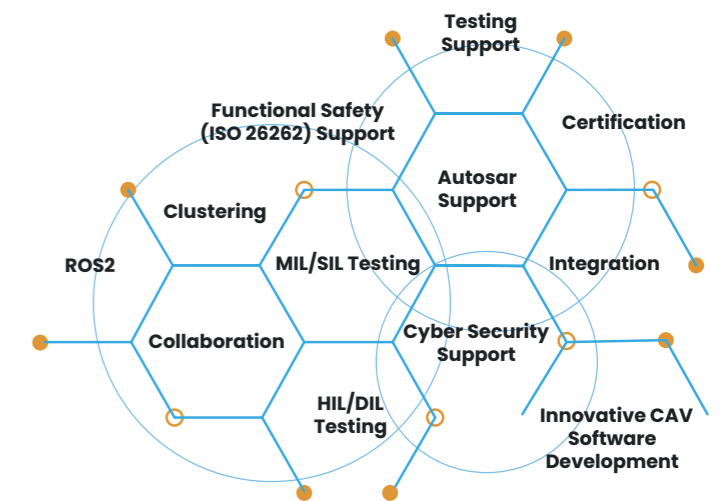
In the realm of **OPINA ecosystem**, services for developing autonomous driving functions are offered through an online platform. This platform operates on UBUNTU 20.04 with ROS2 as middleware, supporting the development of software modules in C++, Python, MATLAB, and AUTOSAR.

The **OPINA ecosystem** also facilitates the generation of scenarios compliant with the ASAM Open SCENARIO standard. These scenarios can be executed on MIL/SIL environments, with two online platforms available: CARLA, an open-source tool, and commercial simulation tool, catering to commercial usage.



## Connect and Collaborate in the OPINA Cluster

**The OPINA Cluster** is where people from all technical disciplines, equally fascinated by this cutting-edge technology, come together! Engage in discussions, stay updated on the latest technical trends and developments, showcase your company and ideas, or connect with specialists to exchange views.



## Who should explore the possibilities within OPINA?



### Engineers from Diverse Industries:

Whether in the automotive sector, (intra-)logistics, precision farming, navigation, rail industry, or any related field, engineers seeking to contribute to cooperative, connected, and automated mobility are welcome.



### Small and Medium-Sized Enterprises (SMEs):

OPINA is designed to be the ecosystem for SMEs, providing a supportive environment for their endeavors.



### Researchers and Scientists:

For those involved in the verification of algorithms and theories related to CCAM, OPINA serves as a key hub.



### Developers of Hardware and Software:

Professionals working on sensors, cameras, deep learning, or AI will find OPINA as the ideal field of application for their innovations.



### OEMs and Automotive Parts Manufacturers:

OPINA welcomes Original Equipment Manufacturers (OEMs) and manufacturers of automotive parts to be part of this transformative journey.

OPINA is more than a platform; it's a collaborative space where diverse talents and industries converge to shape the future of autonomous mobility.

# JOIN US IN DRIVING INNOVATION, SUSTAINABILITY, AND EFFICIENCY IN THE WORLD OF CCAM

# OPINA SERVICES



## Model-in-the-Loop (MIL) Simulation: Carla Open-Source Simulator

The Carla simulator is an open-source MIL simulation tool with a photo-realistic graphics engine that is developed for AD applications simulation.

### The main features of Carla to be used in the OPINA platform are:

#### Dynamic Environments:

Carla brings diverse environments to your fingertips, from urban landscapes to highways. Dive into scenarios defined by the ASAM Open DRIVE standard and customize the time of day and weather conditions. For the creative minds, develop bespoke environments using the Unreal gaming engine.

**Vehicles:** Carla provides different vehicle types, which can be used in simulations. In addition, it is possible to add own vehicles using the Unreal gaming engine.

**Sensors:** Carla supports the most important sensors for AD applications such as Lidar, Radar, RGB camera, depth camera, GNSS, IMU, semantic segmentation camera. Vehicles can be equipped with these sensors by a configuration file.

**Actors:** Carla further allows the addition of pedestrians and bicycles to the simulation to provide a realistic simulation with a variety of traffic participants.

**Scenario Runner:** Carla provides a scenario runner in order to configure and run desired driving scenarios. The scenarios are specified in the important ASAM Open SCENARIO standard.



**ROS2 bridge:** Carla can communicate to external real-time AD applications that are implemented based on the Robot Operating System 2 (ROS2) middleware through a ROS2 bridge. That is, Carla can provide all types of sensor data and receive all necessary actuator commands through this ROS2 bridge.

In the OPINA Platform, it is possible to test real-time AD applications that exchange data with Carla via the ROS2 bridge using different vehicles, sensor configurations, environments and varying weather conditions. In addition, it is possible to create test scenarios with various traffic participants including vehicles, motorcycles, pedestrians and bicycles. These tests can be automated.

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## Commercial MIL/SIL Simulation

**The commercial MIL/SIL simulator** is a proprietary simulation program for high-fidelity vehicle dynamics and manoeuvre model-in-the-loop (MIL) and software-in-the-loop (SIL) simulations.

### Versatile Configuration with Commercial MI/SIL:

Empower your simulation experience with **Commercial MIL/SIL simulator**, enabling the detailed configuration and modification of vehicle component models. From powertrain to suspension, design road layouts, environment models, and introduce diverse traffic elements for a comprehensive driving scenario evaluation.

### Sensory Precision for Autonomous Driving:

**Commercial MIL/SIL simulator** takes simulation to the next level with sensor models tailored for autonomous driving applications. Experience precision with IMU, GNSS, Lidar, Radar, and camera sensors. Benefit from highly accurate Physical Raw Sensor Interfaces (RSI) for Lidar, Radar, and camera sensors, mimicking real-world sensor data.

**Commercial MIL/SIL simulator** seamlessly integrates control algorithm implementation. Whether utilizing model-based design tools like Matlab/Simulink or coding in C/C++, it provides flexibility for a hardware-like microcontroller implementation.

**Commercial MIL/SIL simulator** represents a fusion of cutting-edge simulation technology and sensory precision, offering an immersive environment for the development and testing of advanced vehicle dynamics, control algorithms, and autonomous driving systems.

It's crucial to highlight that the design of **Commercial MIL/SIL simulator** is such that it expects all the developed software to be compiled and executed as part of the **Commercial MIL/SIL simulator** simulation program. That is, **Commercial MIL/SIL simulator** is not designed to support the data exchange with an autonomous driving (AD) stack that is running as an independent application outside the **Commercial MIL/SIL simulator** simulation program.<sup>1</sup>

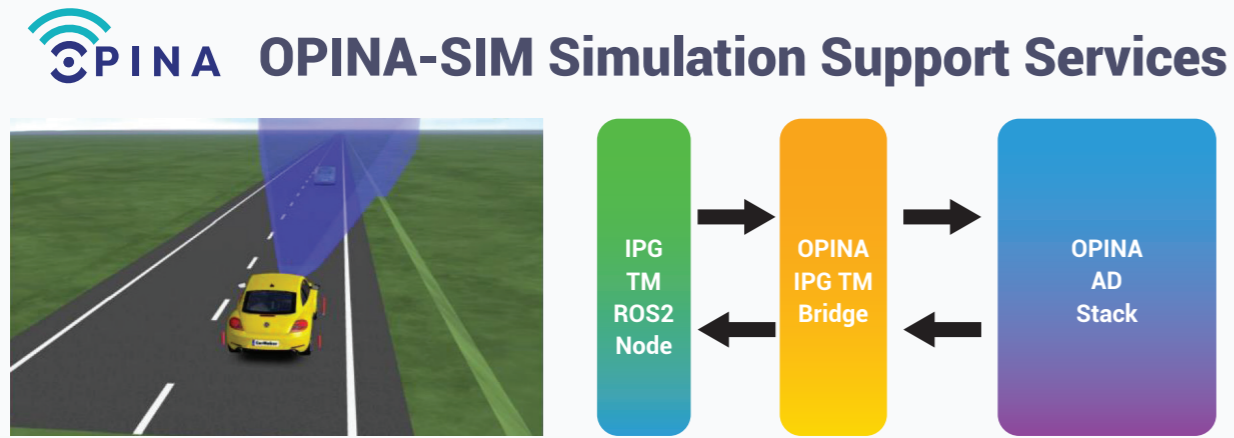
<sup>1</sup> Commercial MIL/SIL simulators and systems can be used by Okan University experts through a service request

## OPINA OPINA-SIM Simulation Support Services



## Bridging the Gap with Commercial MIL/SIL simulator on OPINA Platform

**Commercial MIL/SIL simulator** is extended by an interface to the Robot Operating System 2 (ROS2) in the scope of the OPINA Platform. This integration provides a holistic experience, combining accurate simulation of the driving environment with dynamic maneuvers involving various traffic participants, vehicle dynamics, and sensors. As a further important feature, the AD tests can be automated using the test automation facilities of IPG Truckmaker and dspace ASM. Moreover, IPG TruckMaker allows the import and export of road networks in the ASAM OpenDRIVE standard and provides interfaces to external map generation tools or map providers such as Here HD Live Maps that are also available in the scope of the OPINA Platform. The specification of test scenarios for IPG TruckMaker in the ASAM OpenSCENARIO standard is currently under investigation.



## 3 HIL Simulation: OPINA Commercial Tools

### Diverse Interfaces for Seamless Integration:

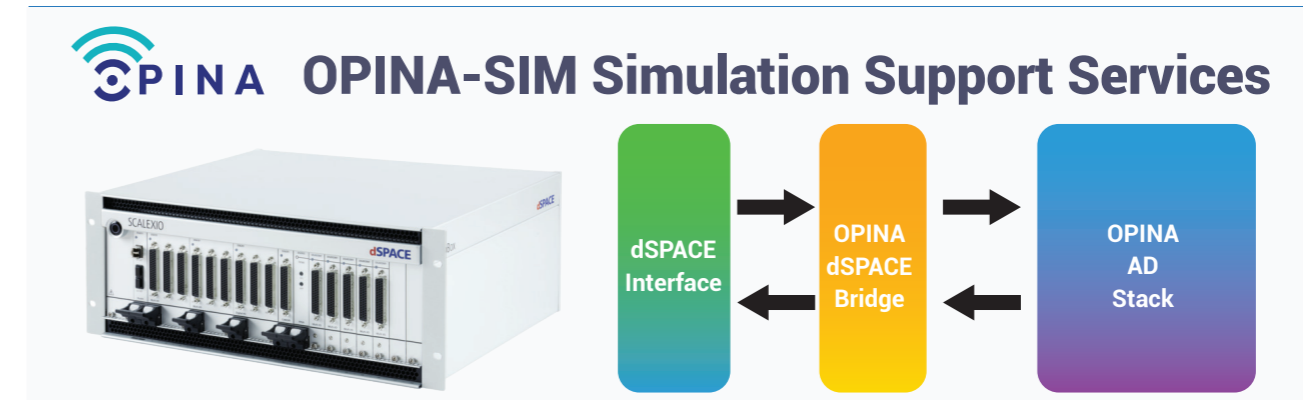
Explore the versatility of OPINA Hardware in the loop (HIL) systems equipped with various interfaces, including Controller Area Network (CAN), Ethernet, FlexRay, and LIN. These interfaces facilitate seamless communication and real-time computations with connected Electronic Control Units (ECUs) and other computing devices. In addition, there are special tools for highly accurate sensor simulation (SENSOR-SIM PCs) and environment sensor interface (ESI) units for providing raw sensor data in real-time.

### Comprehensive set of software tools:

The OPINA HIL hardware is complemented by a comprehensive set of software tools and libraries for highly accurate vehicle, environment, and sensor simulations. These software tools also enable the creation of detailed driving scenarios for autonomous driving (AD) experiments as well as the automation of these experiments.

The OPINA HIL system is not limited to AD applications but can as well be used for HIL tests of ADAS applications and specific vehicle control applications such as powertrain, ABS, ESP, etc. The OPINA HIL system is able to import and export road networks following the ASAM OpenDRIVE standard and is compatible to standards such as ASAM OpenSCENARIO. In order to perform rapid prototyping of developed AD software, proprietary computing hardware can be used together with the OPINA HIL simulation tools and in real prototype vehicles.

Within the OPINA Platform, a synergistic collaboration unfolds as the OPINA HIL system seamlessly integrates with real-time computing devices running the OPINA Autonomous Driving (AD) stack.<sup>2</sup>



<sup>2</sup> HIL System can be used by Okan University experts through a service request.



## DIL Simulation: ODILS<sup>3</sup>

### Immersive Motion Simulation:

Explore the OPINA Driver In the Loop Simulator (ODILS), featuring a cutting-edge motion platform with six degrees of freedom. This platform delivers an immersive experience, replicating realistic movements for users in both manual and Autonomous Driving (AD) modes.

The OPINA Driver In the Loop Simulator (ODILS) is a driver-in-the-loop simulator provides a motion platform with six degrees of freedom that allows simulating movements. The ODILS is configured to provide a realistic driving experience to the user in both manual and autonomous driving (AD) modes. The simulation data can be monitored while driving, recorded, and analyzed after driving experiments using the ODILS management software.

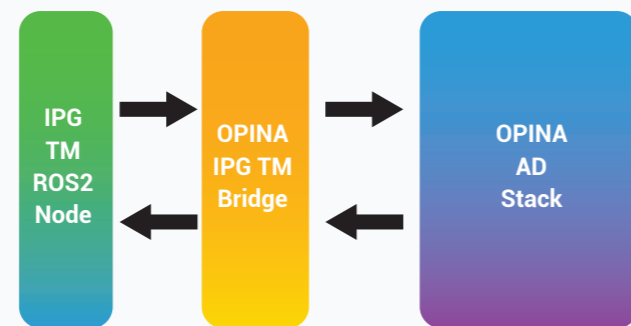
### Integration: ODILS and Commercial MIL/SIL tool Unite

Since the ODILS software is based on **Commercial MIL/SIL simulator**, all functionality provided by the **Commercial MIL/SIL simulator** within the OPINA Platform is as well available for ODILS. In particular, it is possible to use ODILS together with the OPINA AD stack in order to evaluate the driving experience of developed AD functions.

# LIST OF SALEABLE OPINA SERVICES

Functional Area Services	Description
Scenarios generation according to ASAM and ISO standards	MIL/SIL
Scenarios generation according to ASAM and ISO standards	HIL
Bench marking analysis of functionality	DIL
Test procedures preparation according to ISO standards	MIL/SIL/HIL
Fault insertion testing	HIL
Diagnostics functional validation	HIL
Static analysis for ISO 26262 compliance	Unit testing tool (currently we do not have this tool)
Middleware framework development	Software development
Communication software development	Software development
Driver software development	Software development
Algorithm development	Any programming language or MATLAB/SIMULINK <sup>4</sup>
Integration services	Software Integration (SSI), Hardware Software Integration (HIS)
Functional and system testing	HIL
System testing	In-vehicle testing environment
Process certification service	ISO 26262 process; ISO21448
Software certification service	Scenario verification in line with regulations through SIL/HIL/DIL
Training services	Please see OPINA Training Catalogue and/or contact us

## OPINA OPINA-SIM Simulation Support Services



<sup>3</sup> HIL System can be used by Okan University experts through a service request.

<sup>4</sup> MATLAB/SIMULINK can be used by Okan University experts through a service request.