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# KIOS Testbed: Intelligent Transportation Systems

Christos Makridis

Workshop: Accelerating experimentation in sustainable mobility and transport

KIOS
Research and Innovation Center of Excellence

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# KIOS Center of Excellence at a glance

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- Established as a Research unit in **2008** and upgraded to a Center of Excellence (CoE) in **2017** - Collaborates strategically with Imperial College, London
- Operates within the University of Cyprus (at the level of Faculty)
  - **234** people at KIOS CoE
- Develops **research infrastructures** (Testbeds)
  - Test technologies under realistic operating conditions
- Creates **synergies**
  - National and international industrial and governmental organizations

The name “KIOS” was inspired from the Greek Mythology, where **KIOS was the titan of “Intelligence”**

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# KIOS research and innovation activities address global challenges

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- KIOS research is aligned with the EU/UN priorities.
- Development of technologies and methodologies for making critical infrastructures smarter, more efficient, greener, and more secure.




# Competitive Research and Innovation Projects

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- **40+** active multidisciplinary research & innovation projects, funded by EU and national funding agencies
- **500+** collaborators (Cyprus, EU & Internationally)
- Projects are delivered in collaboration with CIS operators/industry and SMEs
- Contribute to global and regional challenges

URANUS

COCOON
Cooperative Cyber Protection for Modern Power Grids

SPARROW

GuardAi

water futures

TRANSIT

HVDC- WISE

EVORDADS

PROTECDOME

AutoTRUST

TwinEU

Acting
Advanced Cybersecurity Training

IDEATION

CABLEGNOSIS

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# KIOS Innovation Hub Partners

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Deputy Ministry of Research, Innovation and Digital Policy

Number of projects from 2017 – present : **82**


- **90%** of Innovation Hub partners participate in KIOS EU funded projects
- Collaboration with Ministries for the implementation of the Recovery & Resilience Plan of Cyprus

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# KIOS Technical Focus & Specialization

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**Intelligent** monitoring, control, risk management and cyber/physical security of complex, large-scale, dynamical systems

## Application Areas → Critical Infrastructure Systems

Energy & Power Systems

Smart Water & Environmental Systems

Intelligent Transportation Systems

Telecommunication Systems & Networks

Emergency Management Response

Smart Healthcare Systems

*KIOS provides solutions to real-life problems and brings knowhow and tools that make large-scale infrastructures smarter, more efficient, secure, and sustainable*

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# KIOS CoE Research Infrastructure and Testbeds

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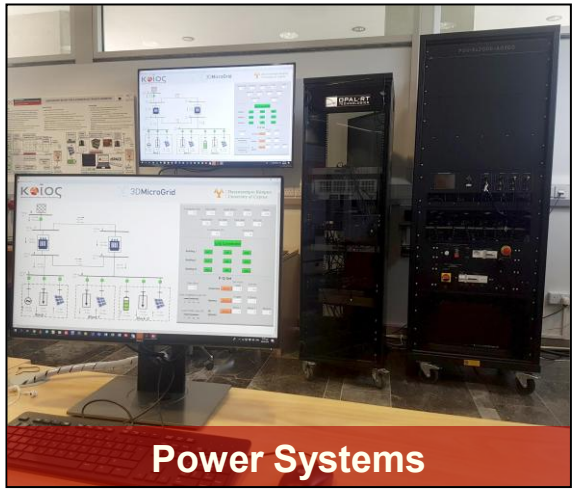



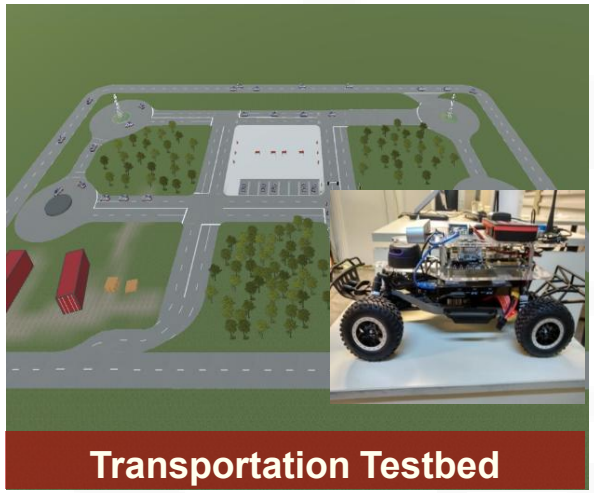


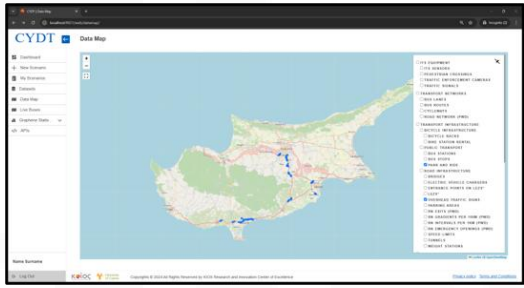


Cyprus Digital Twin

**Telecommunications Systems Testbed**
**CIS Cybersecurity Testbed**
**UAV technologies**

According to the European Institute of Innovation and Technology, "*a testbed is a controlled experimentation platform, in which solutions can be deployed and tested in an environment that replicates real-world conditions*"

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# Cyprus Digital Twin

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Power Networks

Water and waste-water networks

Intelligent Transportation Systems

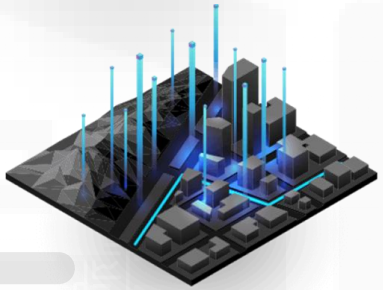
Telecom

Emergency Response

Cyprus Digital Twin

Include simulators for the dynamical behavior of each **individual** infrastructure and simulate the **cascading effects** of an event in **multiple** infrastructures

Decision support



Impact assessment

Risk estimation

'What-if' scenarios

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# Transportation Systems Testbed

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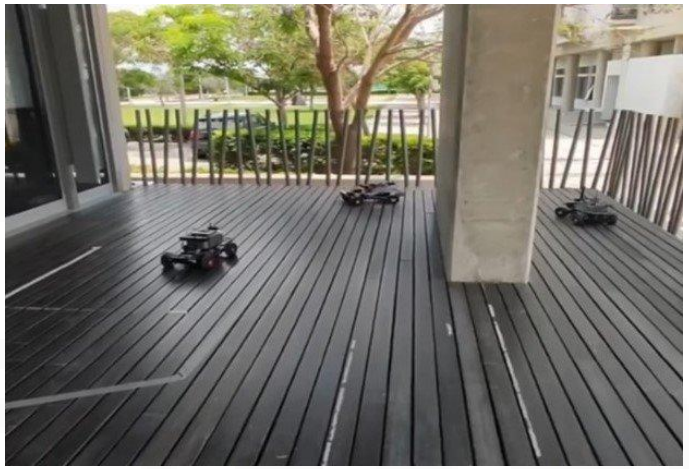
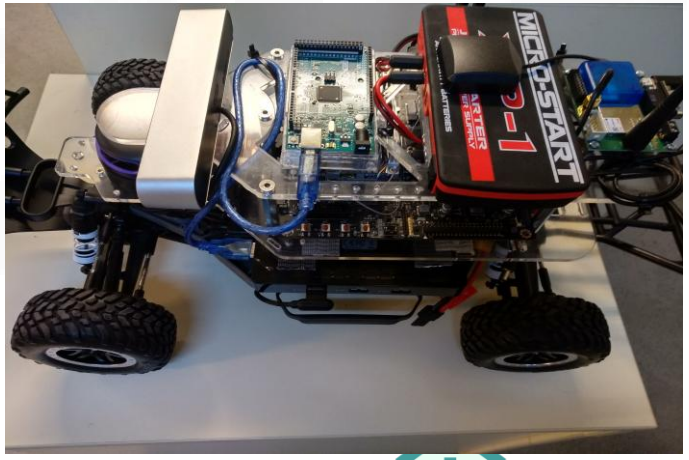
- KIOS physical plant testbed:
  - A live-experimental platform for Connected Autonomous Vehicles (CAVs).
  - Small-scale (1:10) CAV fleet operating in a realistic environment.
- KIOS virtual testbed:
  - High-fidelity digital replica of a real-life urban network.
  - Simulation of realistic traffic conditions using real data and scenarios.
  - Emulation of CAV capabilities.





# Transportation Systems Testbed

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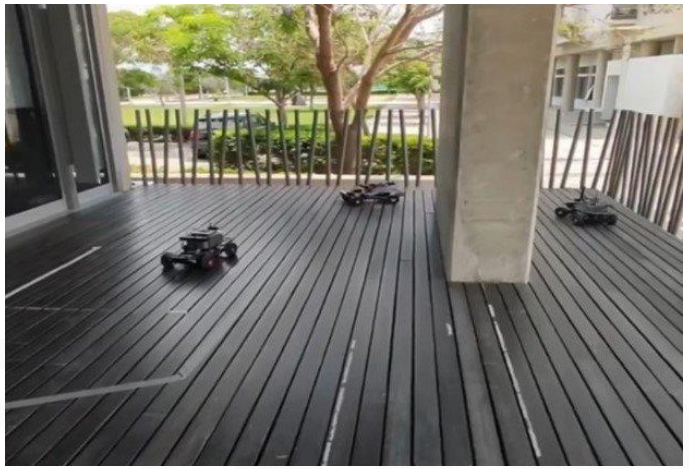
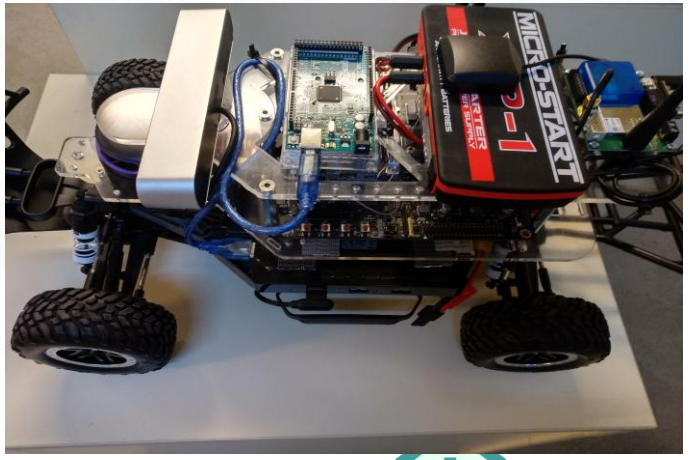
- Research capabilities:
  - Performance evaluation of traffic management and energy saving strategies.
  - Analysis of CAVs operation and the infrastructure under various conditions.
  - Coordination and management of CAVs in future scenarios:
    - Freeway platooning.
    - Merging operations.
    - Intersection crossing.
  - Assessment of V2V and V2I communication gains and limitations.
  - Cybersecurity evaluation of CAVs under malicious attack scenarios.
  - Design, testing, and validation of fault detection algorithms for sensors and actuators.





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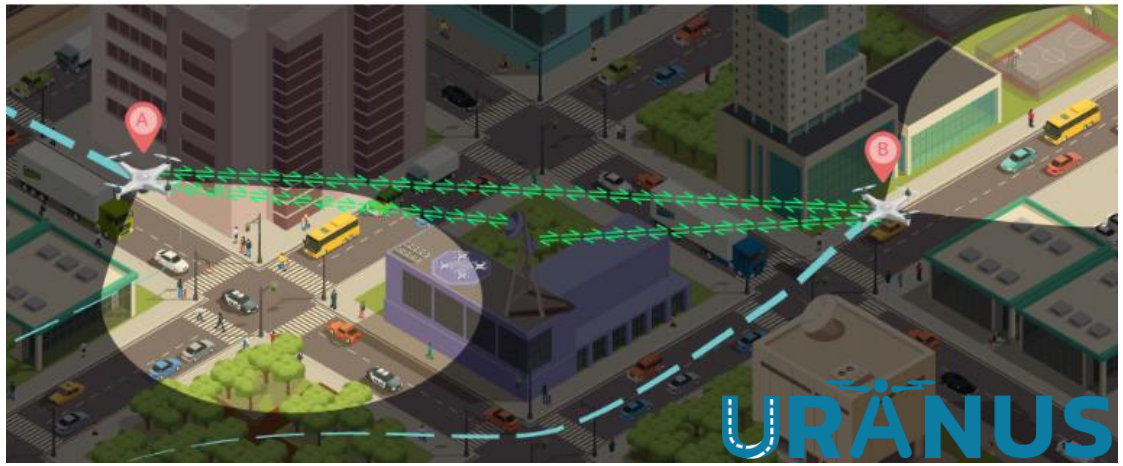
# URANUS: Real-Time Urban Mobility Management via Intelligent UAV-based Sensing




- UAV-based real-time traffic sensing in urban environments.
- Aerial monitoring of traffic flows across critical corridors and intersections.
- Estimation of Origin-Destination patterns and turn ratios.
- Network-wide traffic state reconstruction and congestion detection.
- Data-driven support for dynamic traffic management strategies.

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Funded by the European Union

# URANUS: Real-Time Urban Mobility Management via Intelligent UAV-based Sensing


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# Tangible solutions & tools

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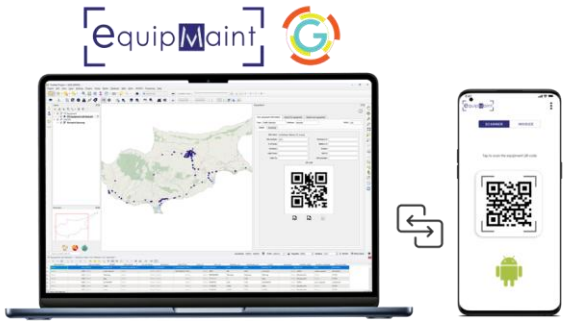
## ITS Equipment Management Tool




A GIS-based asset management tool to assist the **Public Works Department** to digitalize internal procedures (e.g. installation & maintenance of new equipment directly via mobile app, quick access to information in the field), leading to accelerated task execution, improved productivity and reduction of human errors

## PMU-view

A data visualization tool for monitoring the Phasor Measurement Unit (PMU) measurements derived from 18 PMUs. Contributes to the post-disturbance analysis that is performed by the **TSO** after an event, enhancing the situational awareness of the Cyprus power system operator

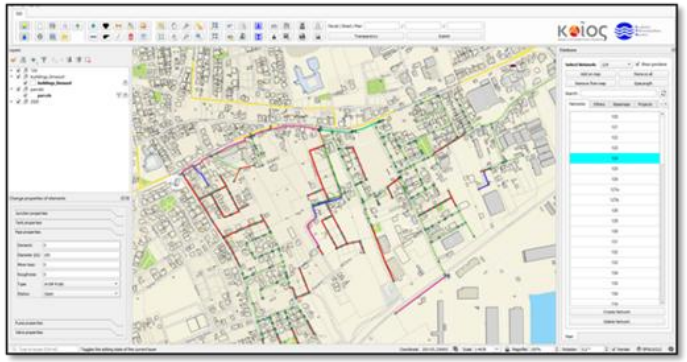
## PT Monitor Toolbox

A Digital toolbox to easily monitor the service quality and performance of public transport providers by public transport inspectors. Developed in collaboration with the **Public Works Department**

# Tangible solutions & tools

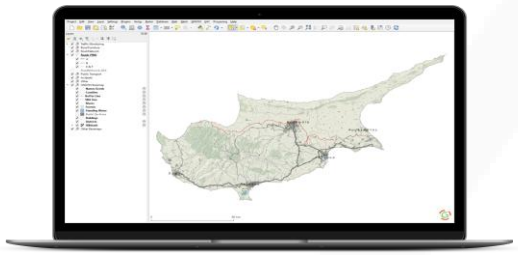
Funded by the European Union

## Oceanos GIS & OCEANOS Digital Twin



An integrated system that gathers, stores, and analyzes data from water networks of Limassol. The early warning system monitors and isolates events. The digital twin supports the decision-making process. Developed in collaboration with **Limassol Water Board**.

## GNOSIS platform



An integrated Geographic Information System that collects, stores, analyses and presents all data related to the Cyprus road network for the optimal management of data and decision making by the **Public Works Department**

## AIDERS AI toolkit

Provides relevant, reliable, and timely information from data collected through sensors onboard drones. It uses real-time data analytics and AI algorithms to enable informed decision-making by incident commanders during emergency response – **Cyprus Police**