



“AI-Enabled Data Lifecycles Optimization & Data Spaces Integration for Increased Efficiency & Interoperability”

WS 56 – Data Spaces Beyond the Basics: Toward Operational AI and Robotics

Dr. Dimitrios Giakoumis, PLIADES Coordinator, CERTH/ITI

European Robotics Forum (ERF) 2026, 25 March 2026, Stavanger, Norway

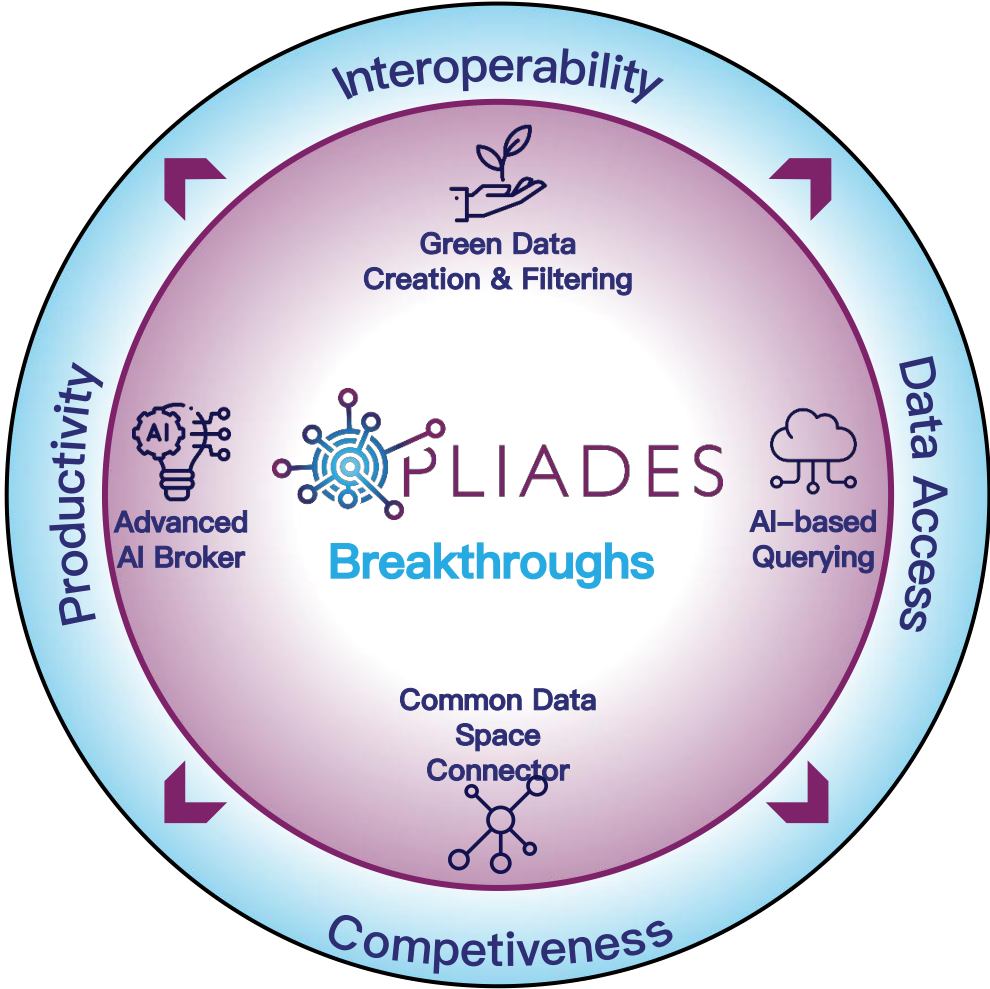


This project has received funding from the European Union’s Horizon Europe research and innovation programme under Grant Agreement No. 101135988

PLIADES – Mission

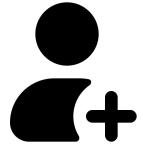
Develop an Advanced AI-enabled Data Integration Framework

Enhancing Lifecycle Optimisation & Data Spaces



1. Cooperative, Connected & Automated Mobility, 2. Advanced Driver Assistance & Autonomous Driving, 3. Human-Robot Interaction

The Users & their Expectations for PLIADES



Users

Data Engineers, Data Scientists, AI Developers

IT Departments, System Integrators

Researchers, Domain Experts, Engineers

Technical Managers, R&D Leads



Needs:

Tools to design and manage AI pipelines

Integration with legacy systems and heterogeneous data sources

Semantic enrichment and annotation of industrial data

Validation of AI outputs with human expertise (human-in-the-loop)

Automation across the data lifecycle (discovery, processing, sharing)

Secure and compliant data sharing across domains

Cross-domain discoverability and reuse of data assets



Expectations for PLIADES:

Explainable and trustworthy AI integrated into workflows

Interoperability with European Data Spaces and standards (e.g., DSSC, IDSA)

Simplified access to diverse and distributed data

Enhanced collaboration across departments, domains, and organizations

Support for data sovereignty, compliance, and value creation

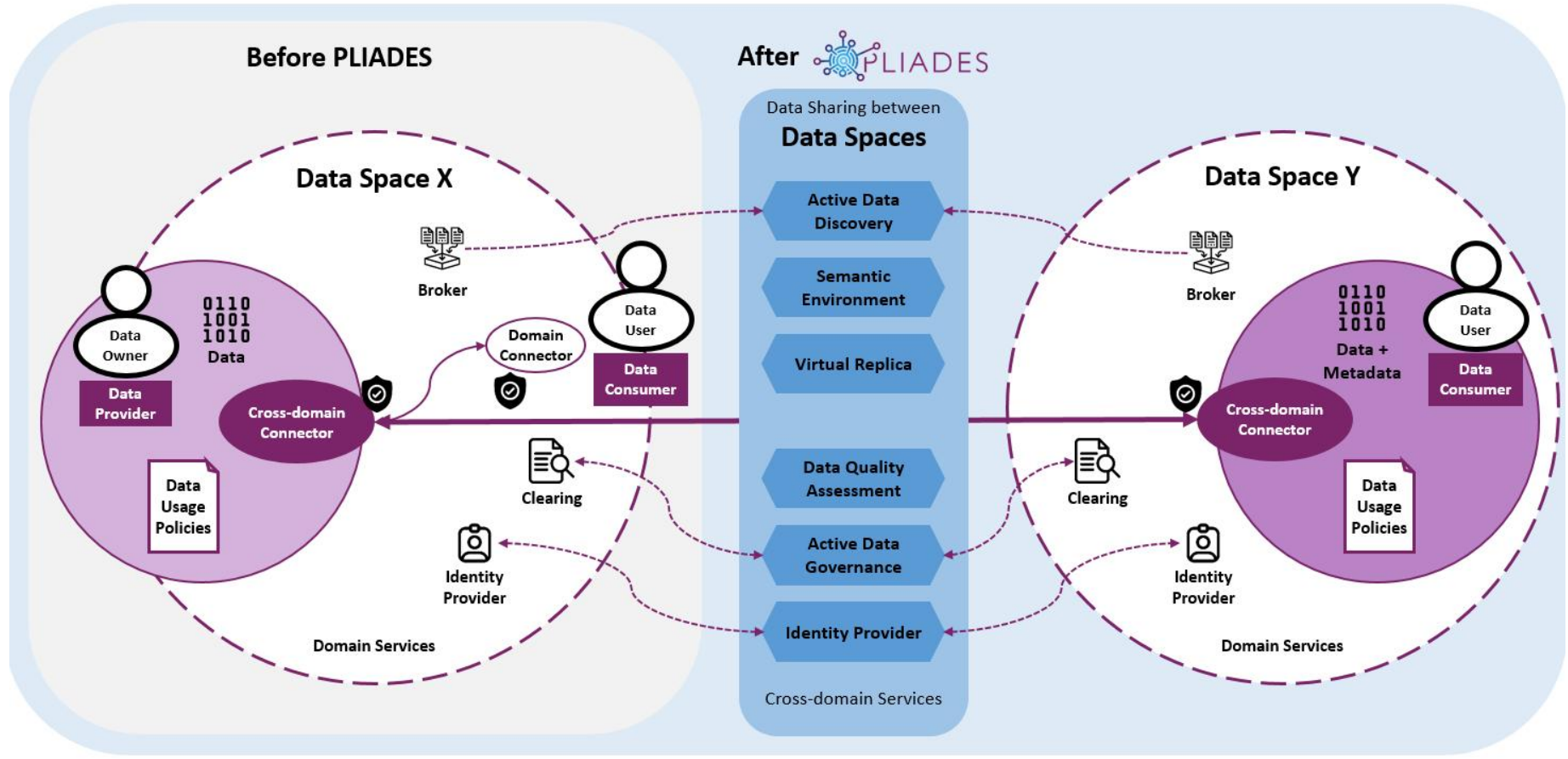


PLIADES – Approach

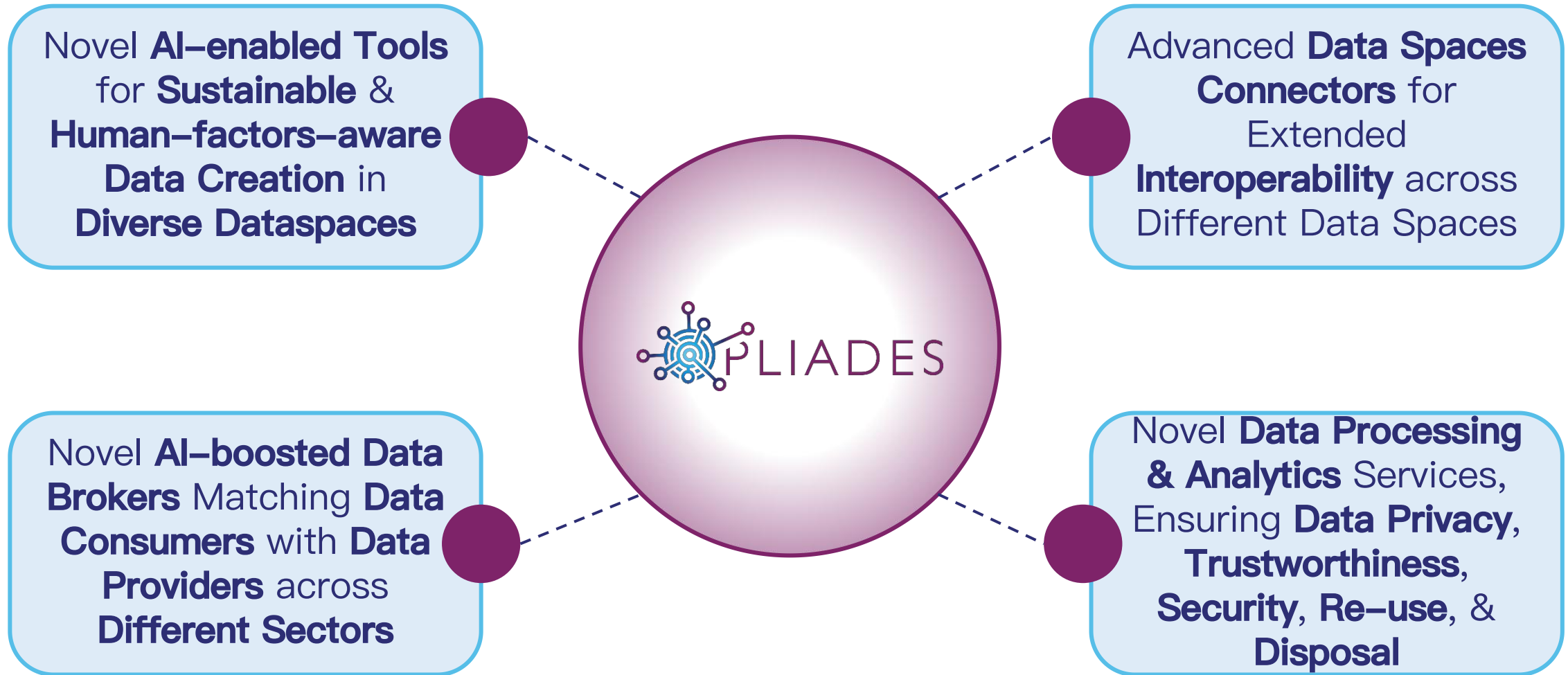
PLIADES establishes a secure & seamless **Data Exchange Ecosystem** by integrating **Diverse Data Spaces**

Key components

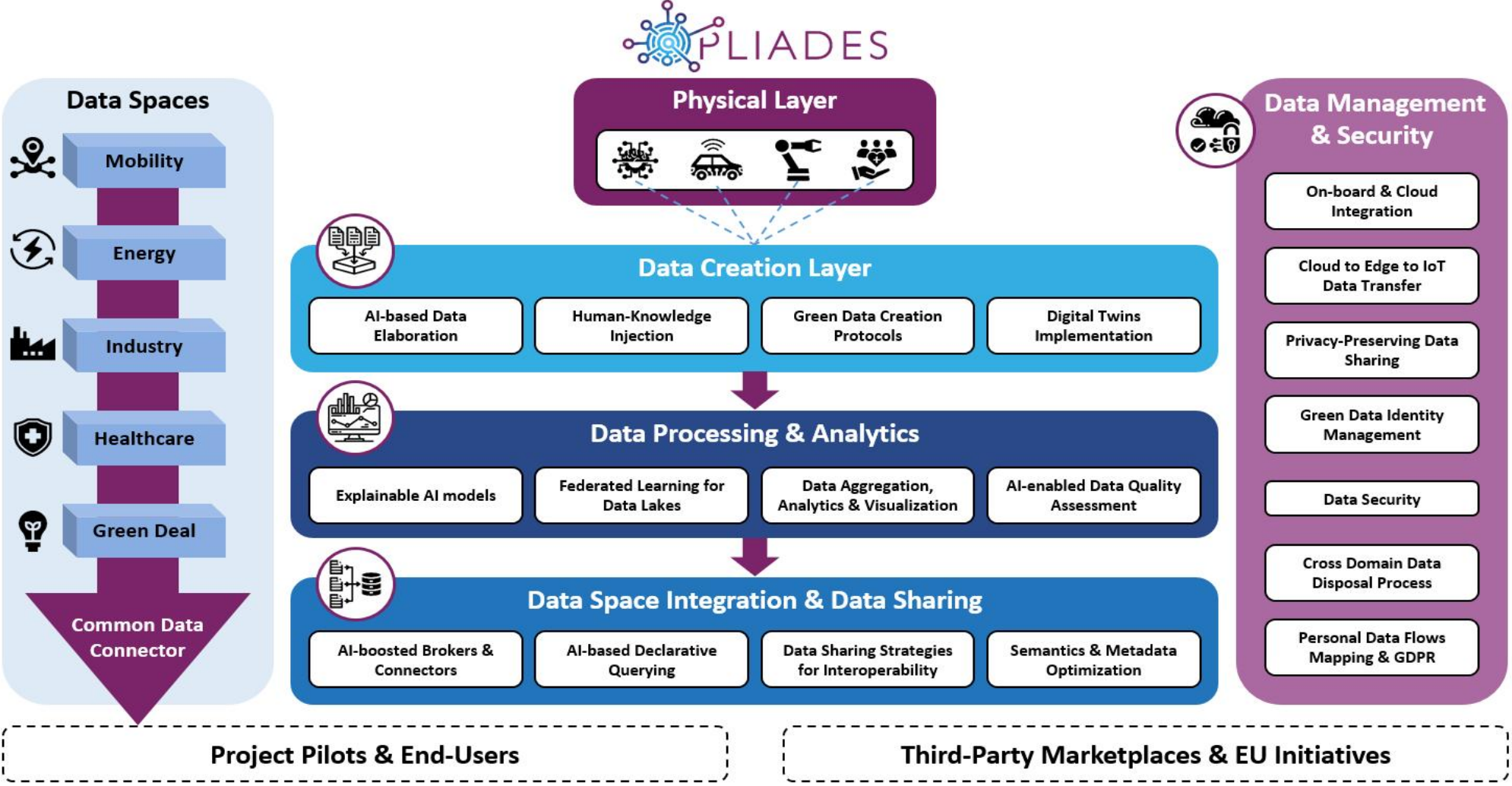
- Data Discovery & Governance
- Secure Data Exchange
- Cross-Domain Integration



PLIADES – Objectives

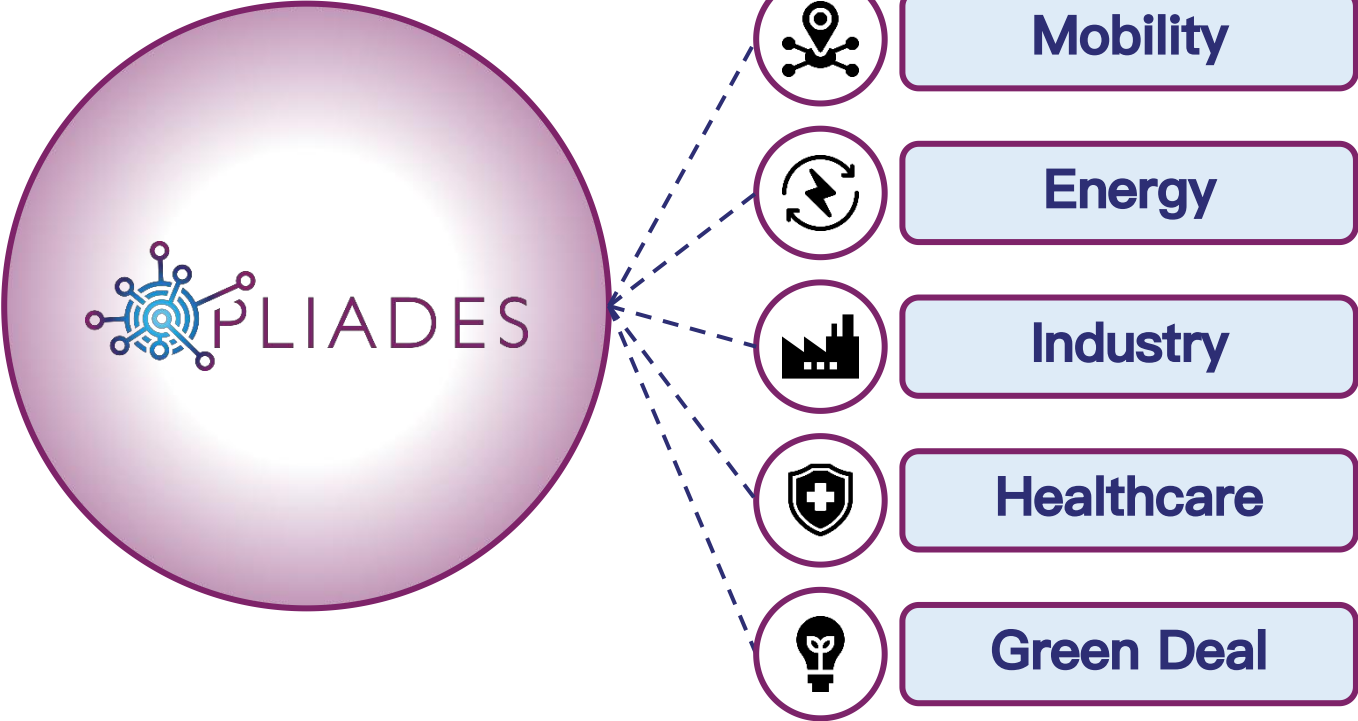


PLIADES – Concept Overview



PLIADES – Use Cases

PLIADES Outcomes will be Evaluated in **Six Use Cases**, Focusing on **Key AI & Robotics Technologies**, oriented around **Five Diverse Data Spaces**



PLIADES – Six (6) Use Cases – Five (5) Diverse Data Spaces

Integrating Data Life Cycles of Sustainability, Operations & Process **Industry Manufacturing Operations**



1



4



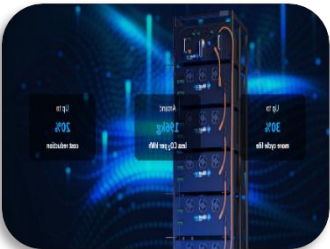
Integrating Data Life Cycles of **Smart Vehicles for CCAM Operations & ADAS/AD Functions**



Integrating Data Life Cycles of **Service Robot to Improve HRI with End Users**



2



5



Integrating Data Life Cycles of **WEEE1/Batteries Management & Car Parts Manufacturing Operations**



Integrating Data Life Cycles of **Personalized Medicine Services to Improve Diagnostic & Prognostic Clinical Prediction Models**



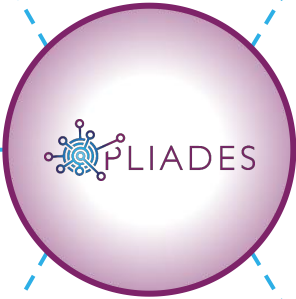
3



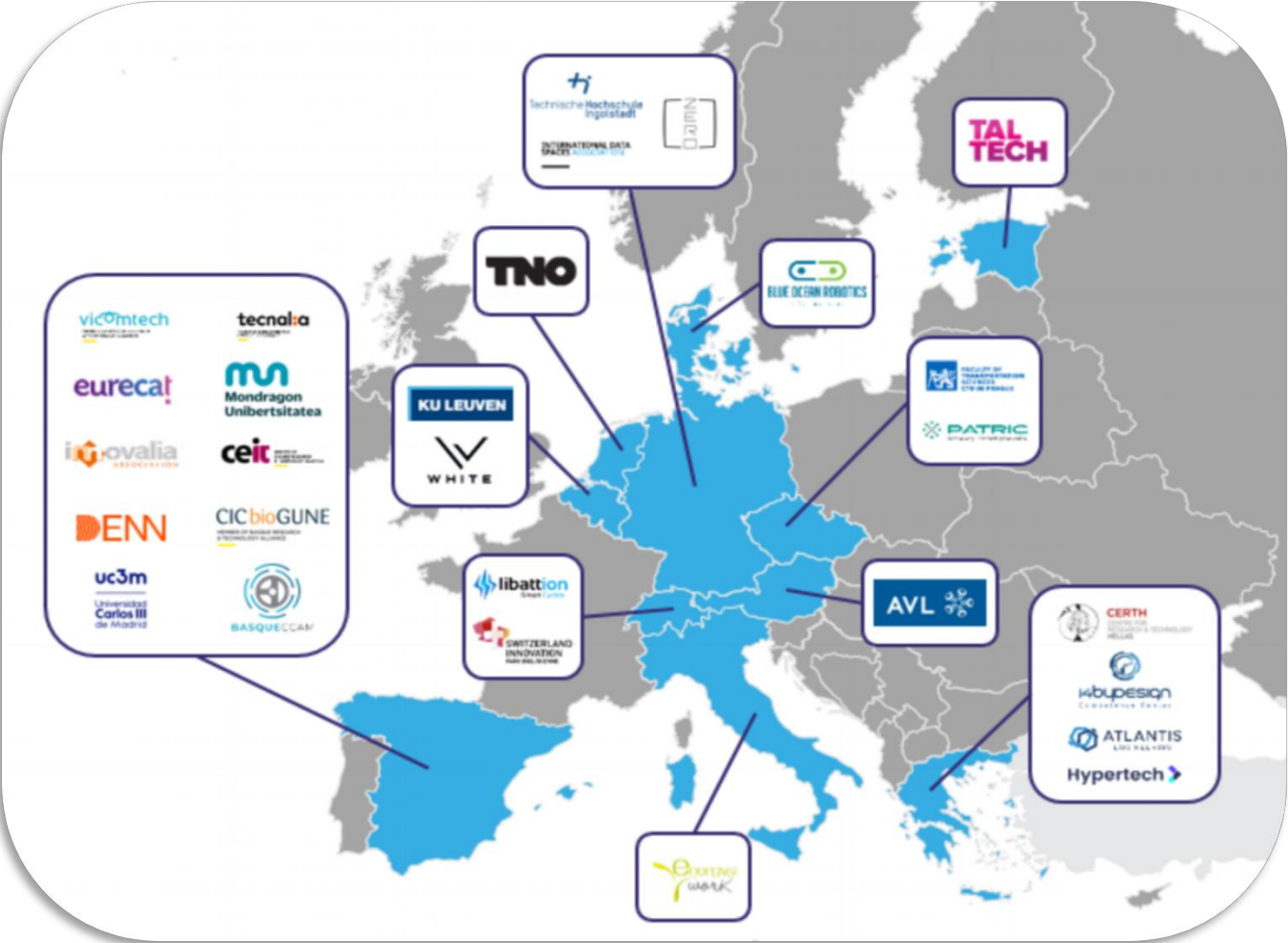
6



Integrating **Professional Service Robot Data Life Cycles to Improve HRI with Robot Operators**



PLIADES – Consortium



PLIADES Consortium

- 28 Partners
- 10 EU Member States + Switzerland

Consortium Breakdown

- 13 RTOs
- 10 SMEs
- 5 NPOs


 Duration 42 Months	 Budget EU funding 8.999.820 €	 Partners from 11 Countries
--	--	--



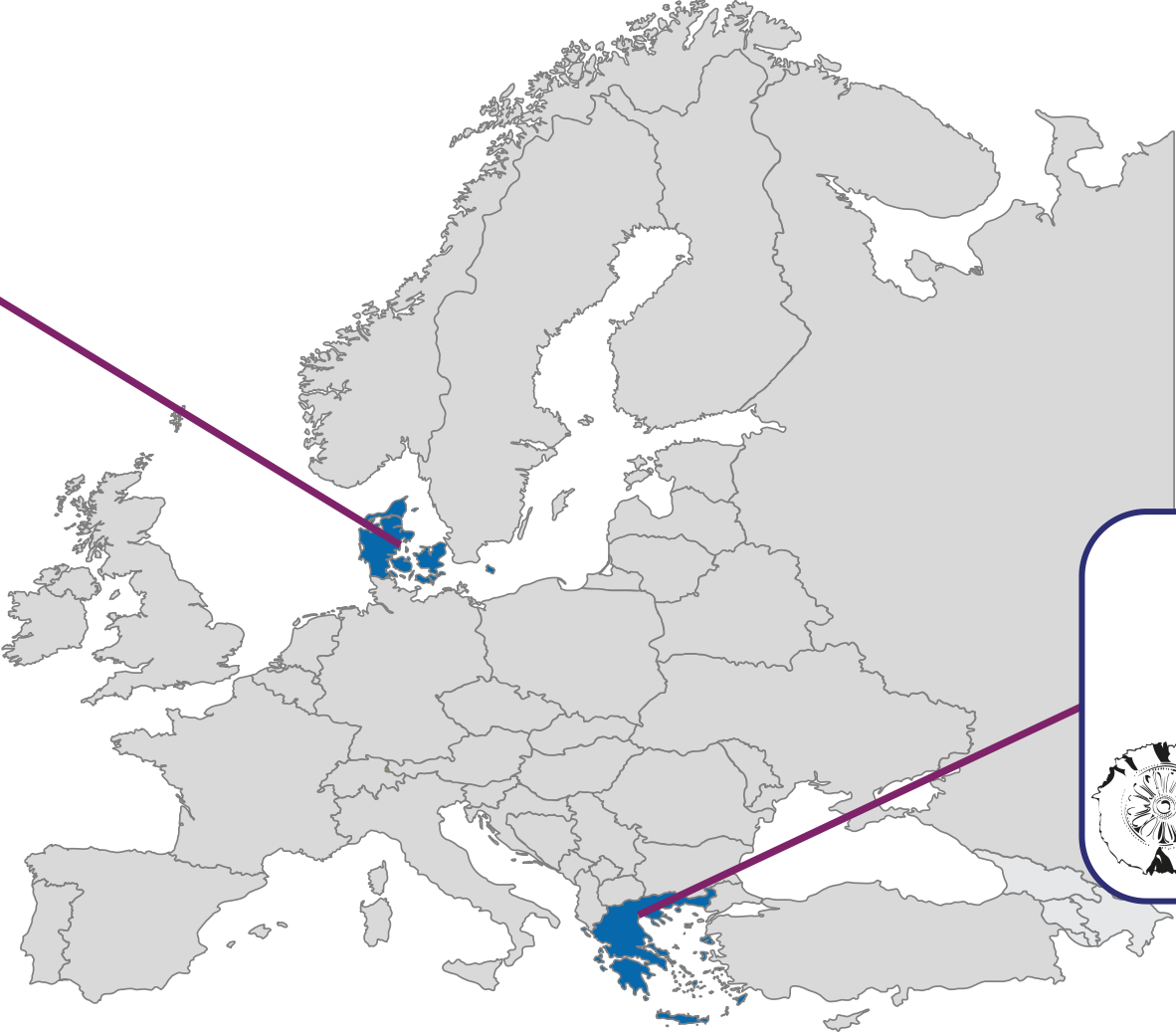
**UC2.
Integrating Data Life
Cycles of Service Robot
to Improve HRI with End
Users**



PLIADES – Pilot End-Users (UC2 & UC6)



BLUE OCEAN ROBOTICS
- for humans



14bydesign
Competence Center



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS



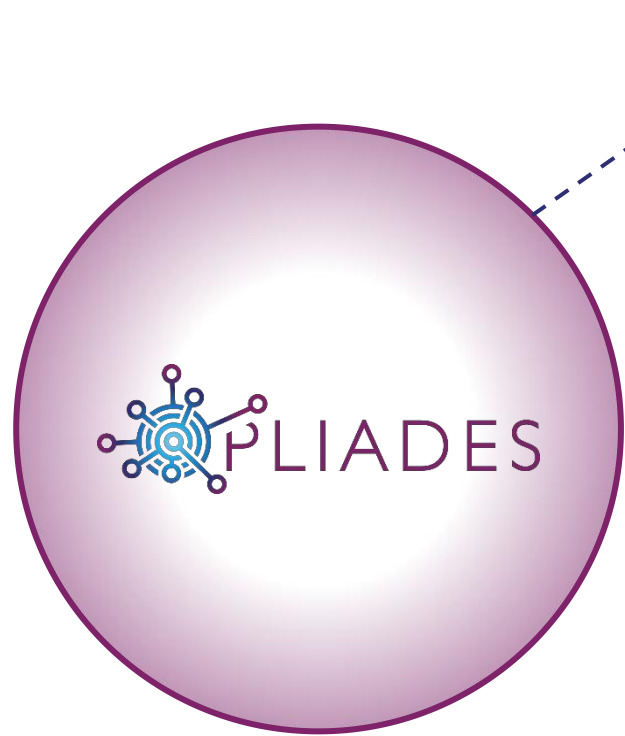
PLIADES – Use Case 2 – Healthcare Data Space

UC2. Integrating Data Life Cycles of Service Robot to Improve HRI with End Users

- HRI in Rehabilitation
- HRI in Patient Monitoring



Current Robots from CERTH Performing Human Action Recognition & Receptionist Tasks



Healthcare

Impact for AI & Robotics in Healthcare:

- Human-Centric AI for Personalized Robotic Assistance
- Secure, Scalable Data Spaces for AI-Driven HRI Training
- Improved Robot Autonomy & Adaptability in Healthcare
- Privacy-Preserving AI Development for Ethical & Reliable Robotics

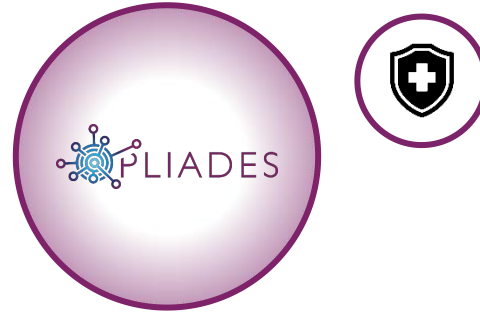


CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

PLIADES – Use Case 2 – Healthcare Data Space

UC2. Integrating Data Life Cycles of Service Robot to Improve HRI with End Users

- HRI in Rehabilitation
- HRI in Patient Monitoring



Data collection preparation

- **Robot Hardware:** surrounding RGB-D cameras, 2D & 3D LiDAR, microphones, touch screen, IMU, wheel odometers
- **Onboard Software:** Object detection, gesture recognition, activity recognition, speech recognition, speech-to-text models, autonomous navigation & obstacle avoidance
- Some robots involve **touch screen interaction** through specifically designed **UI** that enables seamless HRI synchronized with sensor data
- Data are **synchronized** through **ROS/ROS2**

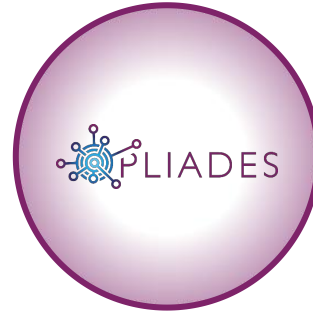


CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

PLIADES – Use Case 2 – Healthcare Data Space

UC2. Integrating Data Life Cycles of Service Robot to Improve HRI with End Users

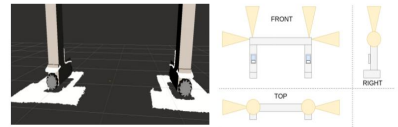
- HRI in Rehabilitation
- HRI in Patient Monitoring



UC2a HRI in patient rehabilitation



UC2b HRI in patient monitoring



- **Current robotic systems from BOR** were designed for real-world applications, commercial scenarios
- Operated by humans, with partial navigation autonomy
- **Limitations at the start of the project:**
 - No built-in features for smooth Human-Robot Interaction (HRI) or data collection.
 - Robots did not collect any valuable data
- **Improvements after PLIADES:** modified hardware and software on the robots to enable HRI and continuous data collection
- Efficient data exchange with other ROS-based systems in similar environments



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS



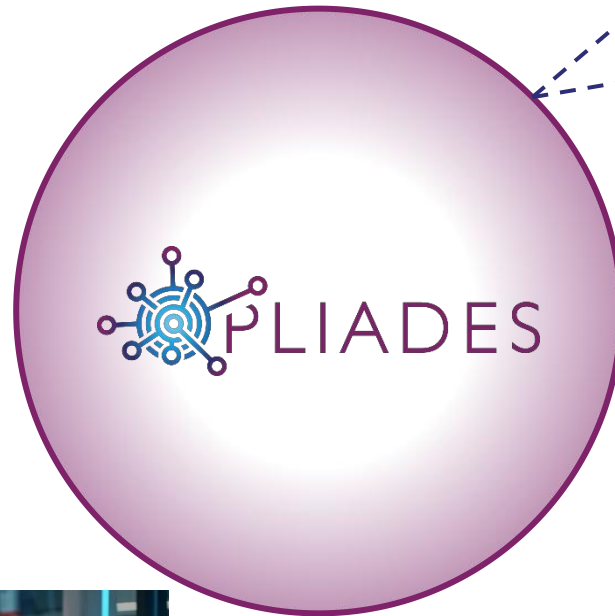
**UC6.
Integrating Professional
Service Robot Data Life
Cycles to Improve HRI
with Robot Operators**



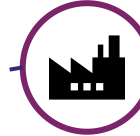
PLIADES – Use Case 6 – Healthcare & Industrial Data Spaces

UC6. Integrating Professional Service Robot Data Life Cycles to Improve HRI with Robot Operators

- HRI in telepresence robot operation
- HRI in rehabilitation robot operation
- HRI in nursing personnel support
- HRI in manufacturing inspection robot operation



Healthcare



Industry

Impact for AI & Robotics in Healthcare:

- AI-powered HRI Enhancement through Multimodal Data Fusion (Speech, Gestures, and Commands)
- Adaptive Robotic Systems for Healthcare Environments with Personalized Interaction.
- Secure and Scalable AI-driven Data Spaces for Continuous Robot Learning and Human-robot Collaboration.

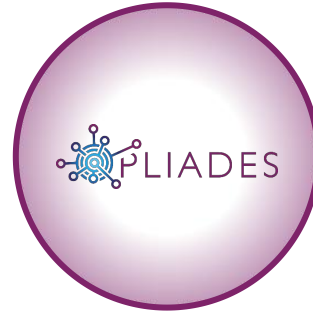


CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

PLIADES – Use Case 6 – Healthcare & Industrial Data Spaces

UC6. Integrating Professional Service Robot Data Life Cycles to Improve HRI with Robot Operators

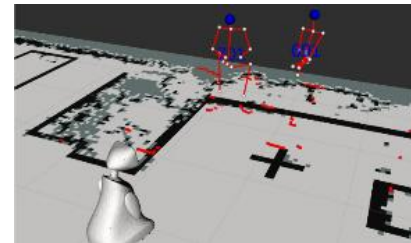
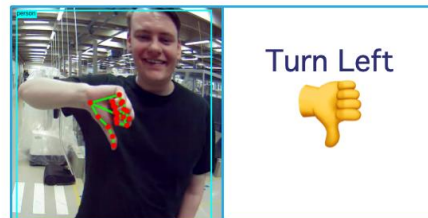
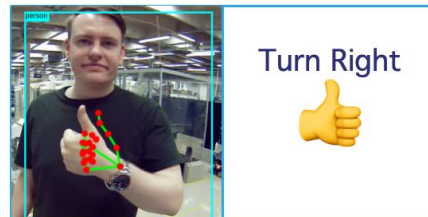
- HRI in telepresence robot operation
- HRI in rehabilitation robot operation
- HRI in nursing personnel support
- HRI in manufacturing inspection robot operation



UC6a HRI in telepresence operation



UC6b HRI in rehabilitation operation



UC6c HRI in nursing personnel support



UC6d HRI in manufacturing inspection operation



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

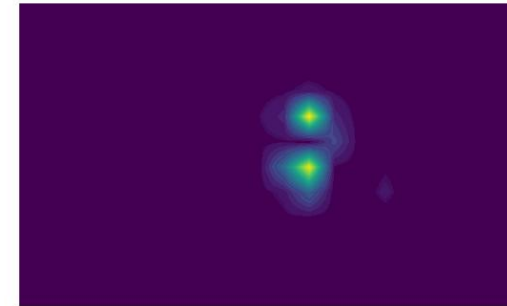
PLIADES UC2 & UC6

Per-box explanations (layer 19) for the same detection

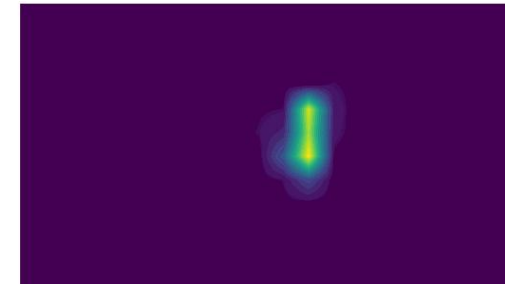
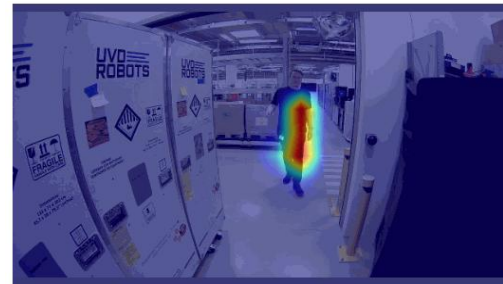
overlays

heatmaps

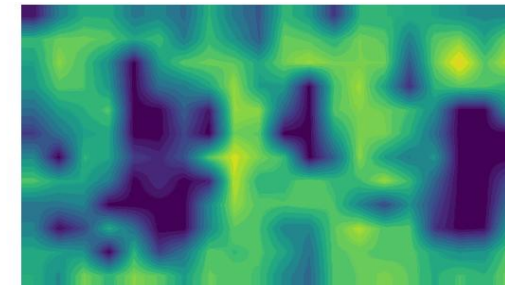
raw



HiResCAM



LayerCAM



GradCAM+
+

Explainability for human detection CNN:

- Helps **validate** model **decisions**
- Areas near **arms** and **torso mostly** affect detections
- **XAI** will be provided as a **dataspace service** through the **connector**

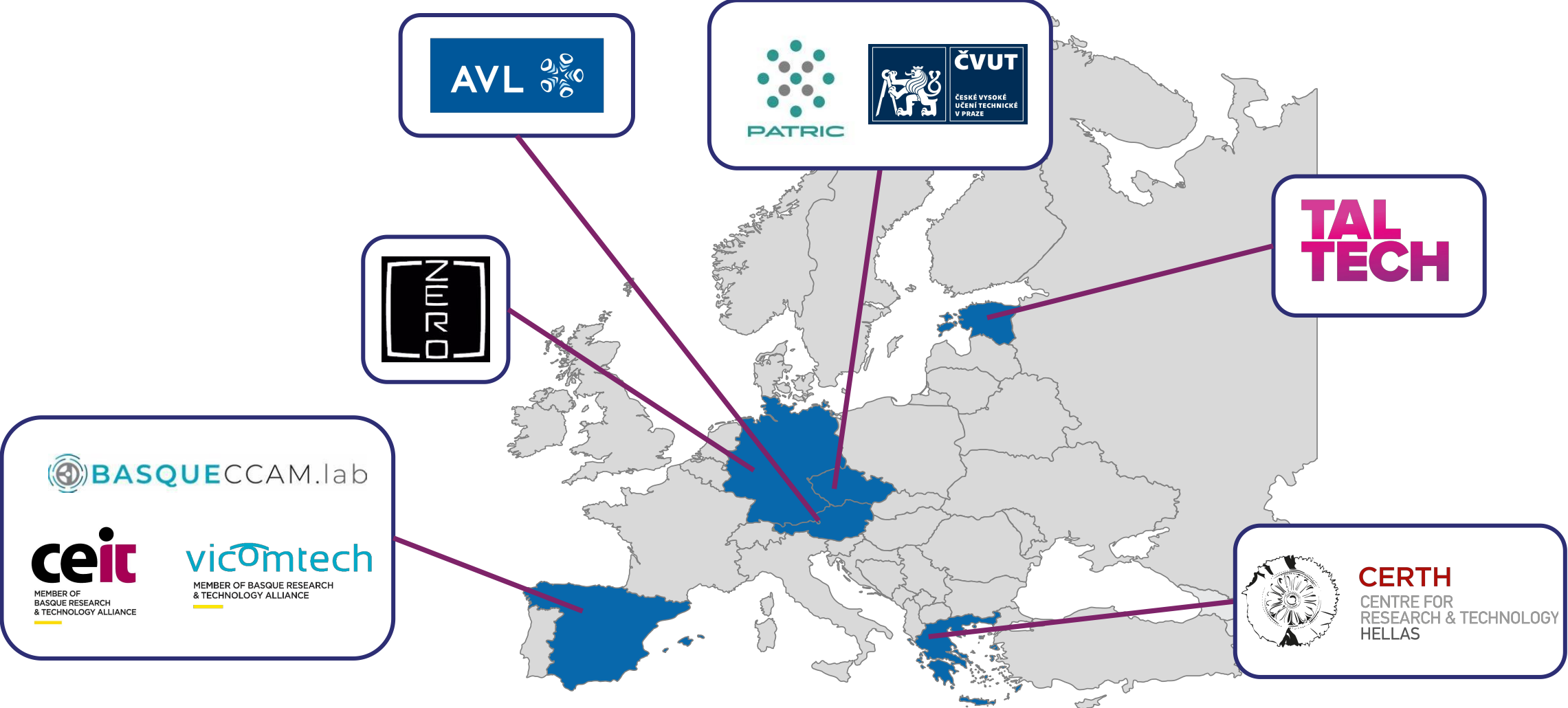




UC4. Integrating Data Life Cycles of Smart Vehicles for CCAM Operations & ADAS/AD Functions



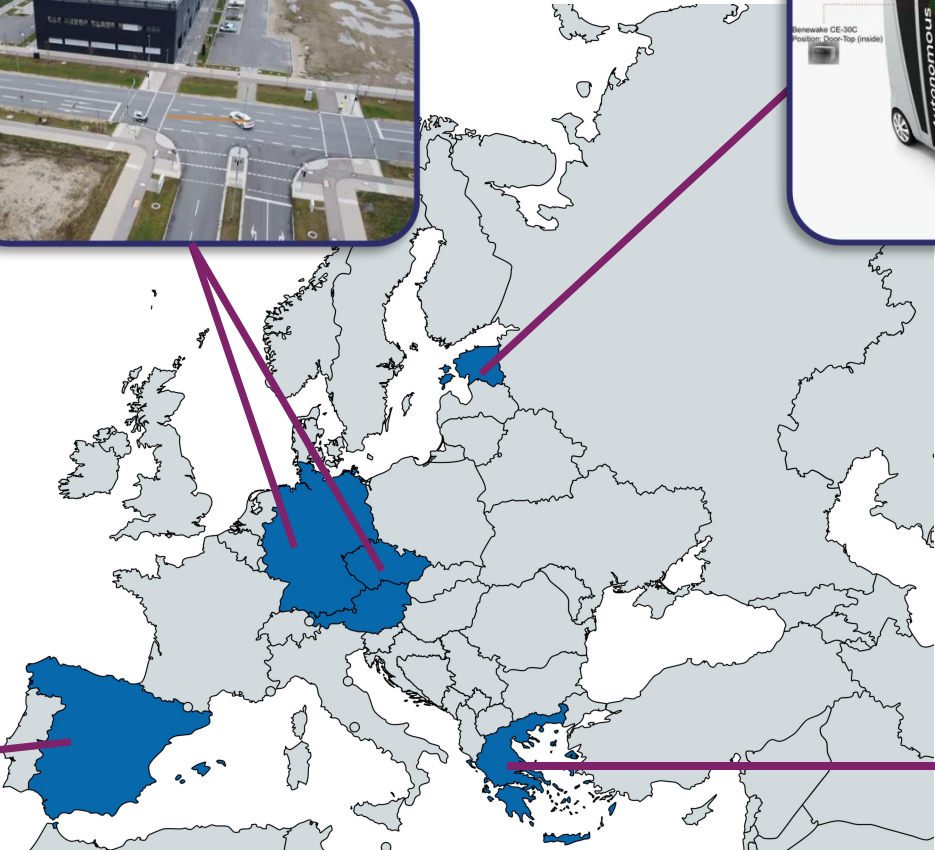
PLIADES – Pilot End-Users (UC4)



PLIADES – Data & Pilot End-Users & Infrastructure

Data Types involved:

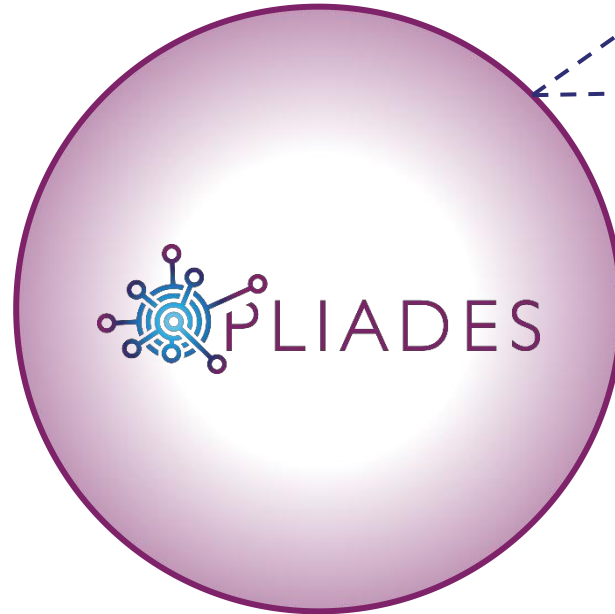
- Images
- LiDAR
- Radar
- IMU
- GNSS trajectories
- ETSI V2X messages
- CAN bus data



PLIADES – Use Case 4 – Mobility & Industrial Data Spaces

UC4. Integrating Data Life Cycles of Smart Vehicles for CCAM Operations & ADAS/AD Functions

- AI-based ADAS Development
- AI-based Traffic Management



Mobility



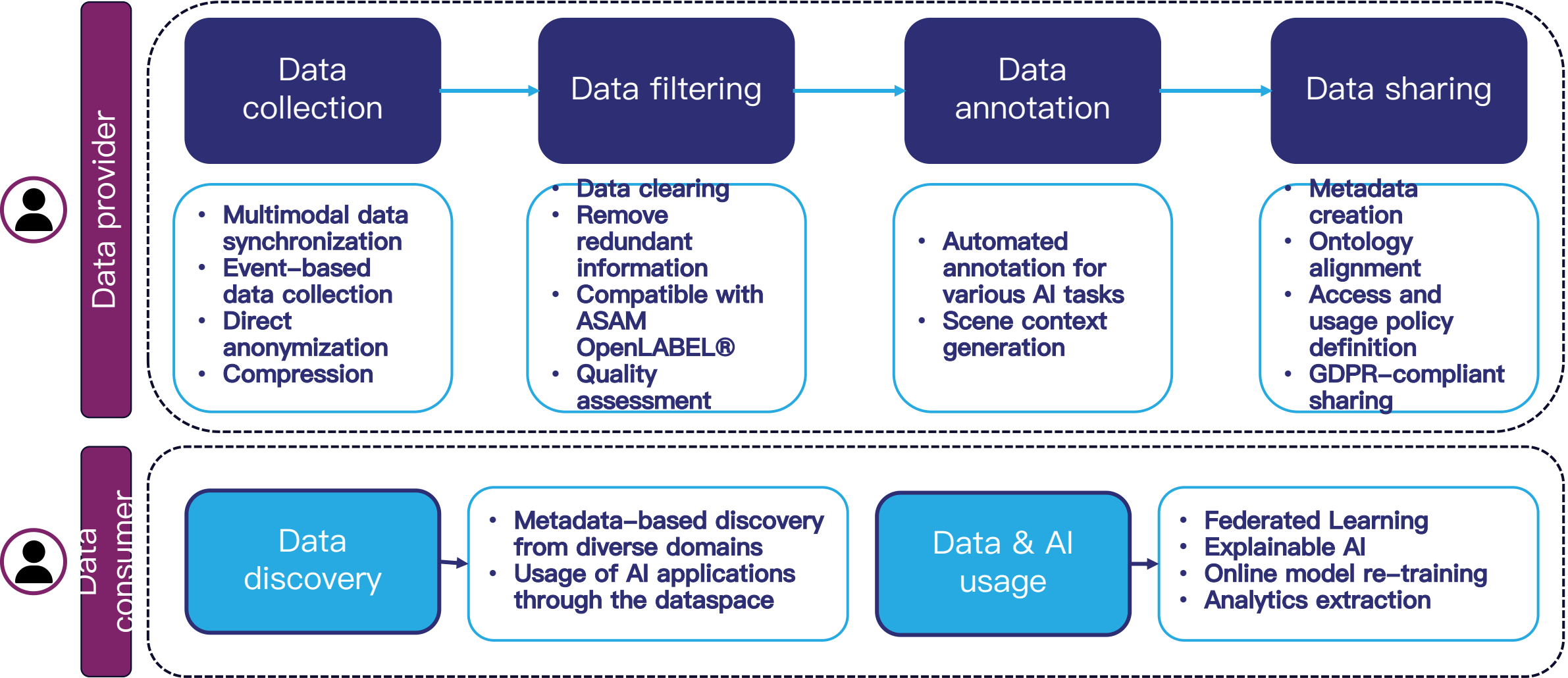
Industry

Impact for AI & Robotics in Mobility:

- AI-Driven Autonomous Vehicle Perception & Decision-Making
- Enhanced Real-Time Scene Understanding & Traffic Safety
- Integration of Vehicle, Roadside & Floating Vehicle Data for AI Training
- Human-AI Collaboration for Data Labeling & Autonomous Driving Optimization



PLIADES – Data Lifecycle



PLIADES – Data Collection & Sustainability

➤ Reduce storage & transmission requirements **prior to data sharing**

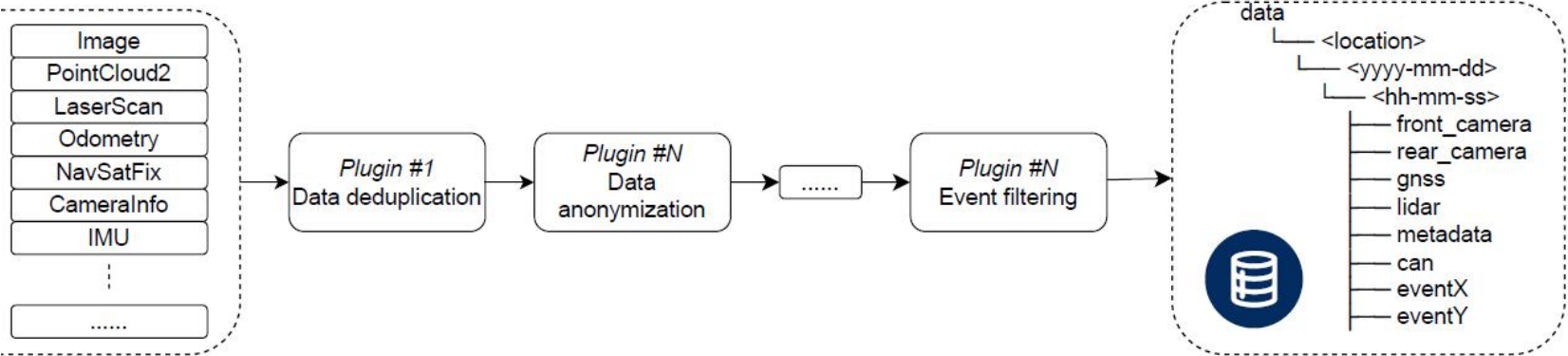
➤ **Embedded plugins** in the **dataspace connectors** that:

Automatically **remove** redundant frames

Anonymize images (faces & plate blurring)

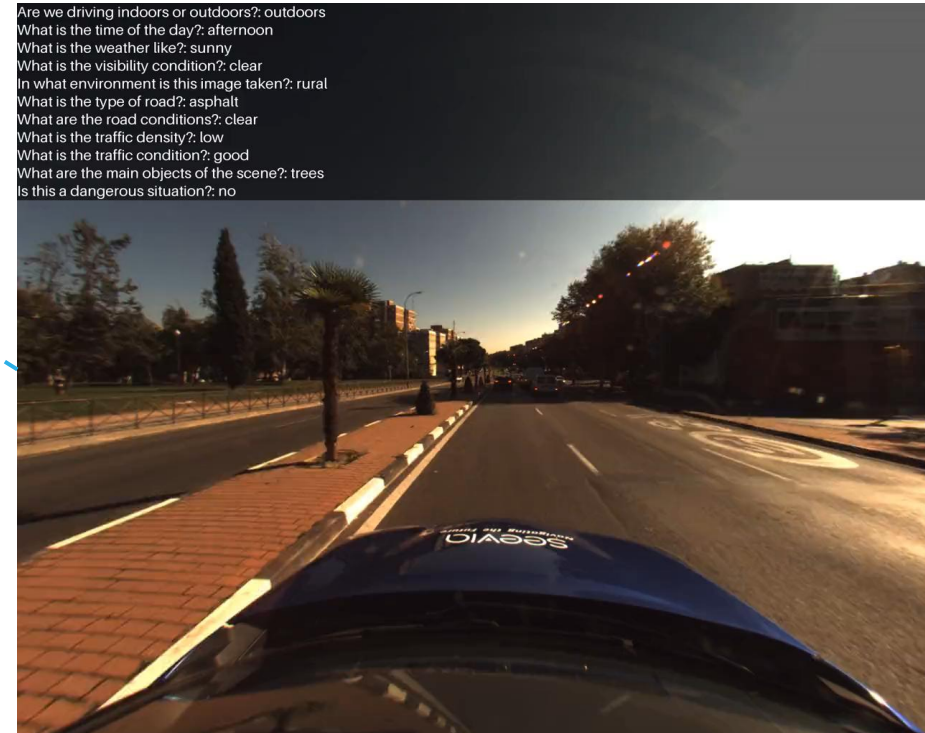
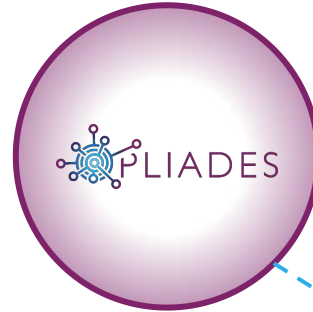
Store only **event-specific** events (e.g., during sudden braking)

Structure data according to **ASAM OpenLABEL standard**



PLIADES – Data Annotation & Context Capturing

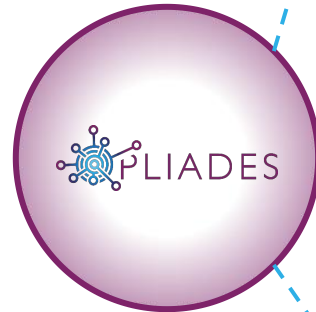
- Automated capturing of **context** using VLMs
- Generate relevant metadata **prior to data sharing** to support **data discoverability** prior
- Context refers to:
 - Traffic situation
 - Weather conditions
 - Visibility levels
 - Road layout
 - Surrounding objects



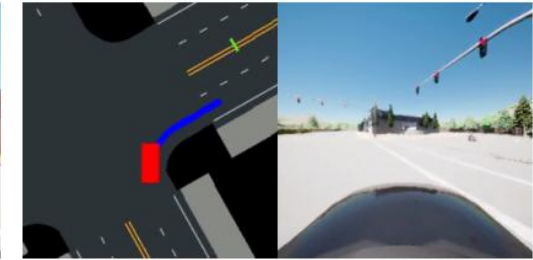
PLIADES – Synthetic Data Generation

➤ Usage of **Generative AI** methods to:

- Create more **diverse conditions** in existing datasets
- **Simulate edge-cases**
- **Share synthetic data** to avoid **privacy-sensitive** information
- **Provided either prior to data sharing**, as a **connector plugin**, or as a **service** through the **dataspace**

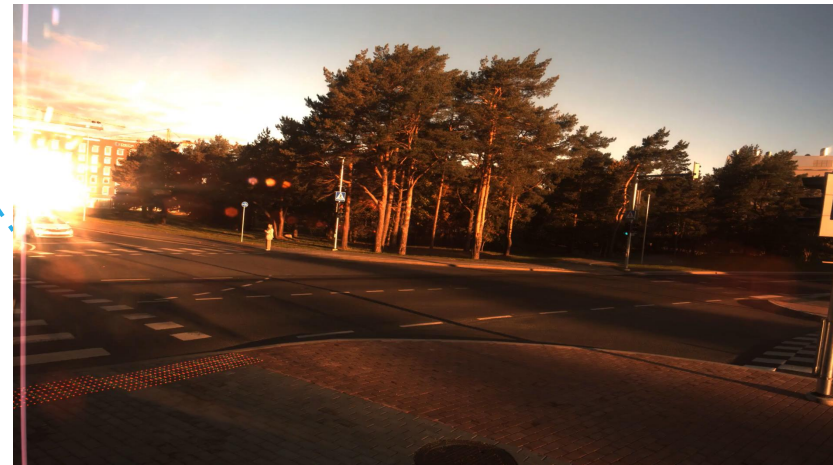


The pedestrian appears from a driveway on the left and suddenly stop and walk diagonally.



The cyclist on the left front suddenly stops in the middle of the intersection and dismounts.

Edge case generation in CARLA simulator



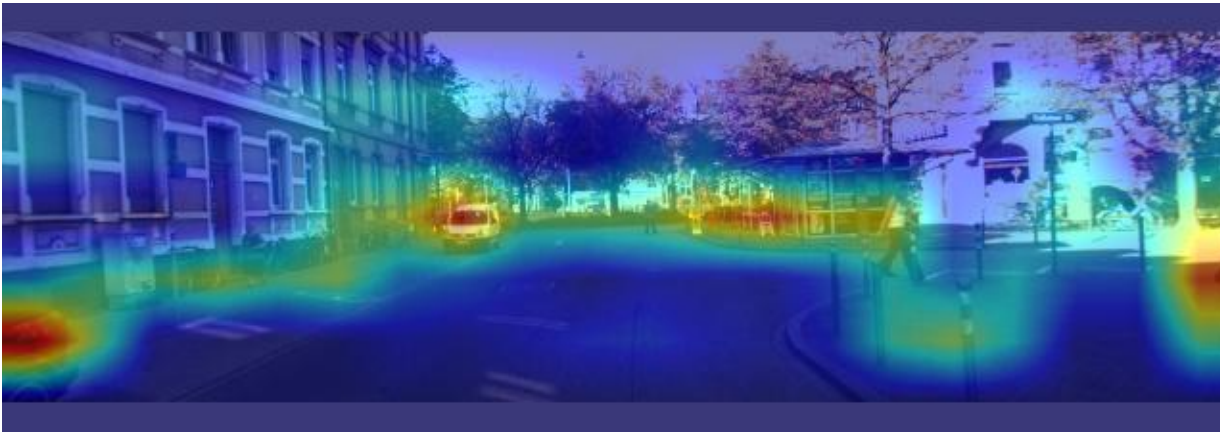
Synthetic video with cloudy/rainy weather



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

PLIADES – Explainable AI services for AVs

Mask image patches



Saliency map from the explainer

Explainability for vehicle detection using a CNN:

- Enable better **communication** of model **decision-making** to non-technical stakeholders
- Improve **transparency** in safety-critical AI models
- Provide **explainability** as a **service** through the **dataspace** infrastructure



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

PLIADES – Data Discoverability via AI-based Querying

- Provide NL prompts to the **agentic system**
- Uses dataset structures, relationships & field mappings for **accurate query generation**
- Recommendation & ranking capabilities

Pliades Agentic System

Home Examples New Session

PAS - Ask Questions About Your DataSpaces

Use natural language to query and analyze your DataSpaces. Our AI agent will understand your question and provide detailed answers.

Ask Your Question

Your Question:

Which dataset is more suitable for behaviour analysis?

Ask questions about datasets, data assets, and relationships in your dataspace.

Examples Ask Question

Pliades Agentic System - Natural Language Interface for DataSpaces