Task 1.04 Knowledge Building
Digital Infrastructure Workshop
Artificial Intelligence in Mobility

October 7th, 2024

Co-financed by the Connecting Europe Facility of the European Union

MERIDIAN Workshop Recording Disclaimer

- This workshop will be recorded and may be published on our MERIDIAN webpage
  By participating in this workshop, you consent to be recorded
- The recording will include voice recordings, on-screen footage, and video of participants captured through their device cameras if on

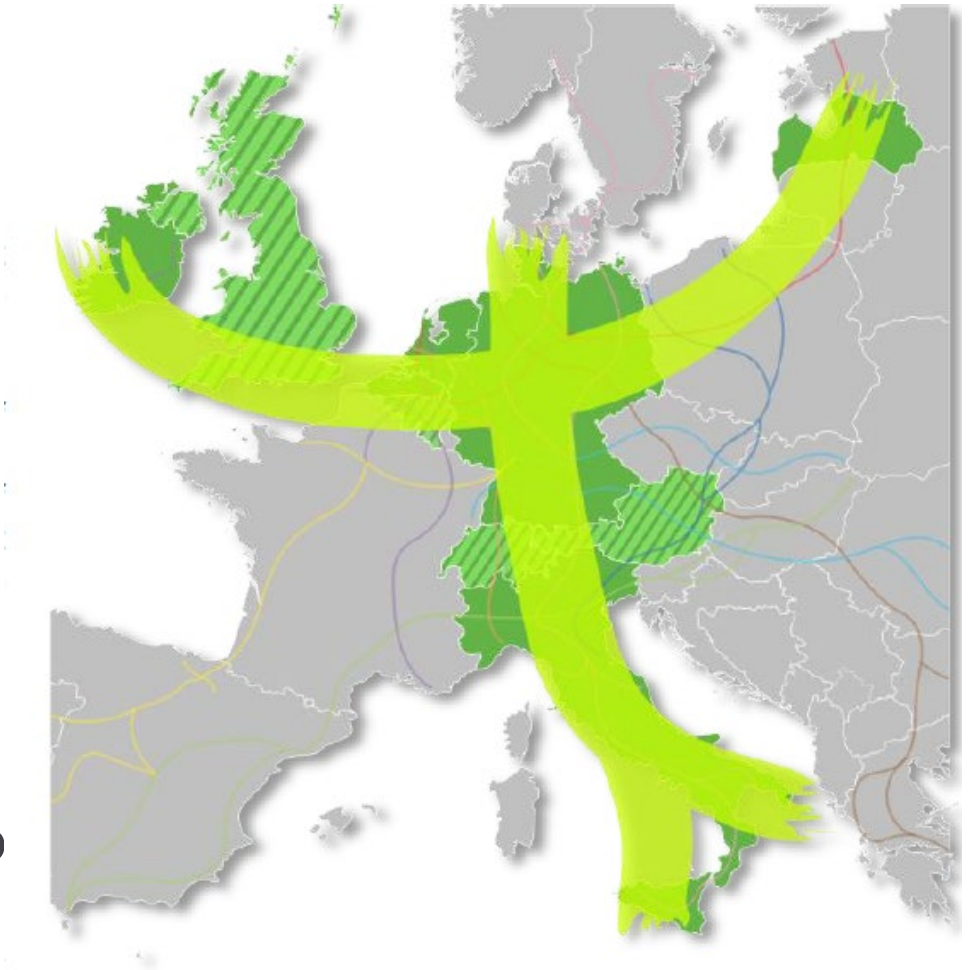
Practicalities & Questions

- Please mute your microphone
- Please switch of your camera

- Raise questions using the chat function
- Raise your hand at the Q&A session after all presentations

Welcome & Introduction

- The MERIDIAN project fosters digitalisation of the mobility system focusing mainly on the Scandinavian-Mediterranean and North Sea-Baltic Core Network Corridors
- Implementing digital systems and services along the busiest European freight corridors. The project targets expansion of digital infrastructure, roll-out of C-ITS, implementation of ITS for bottlenecks on open road and tunnels, digital corridor management and multimodal services
- Its implementations support common objectives to increase traffic safety and reduce congestion



Partners

Bundesministerium für Digitales und Verkehr

Die Autobahn

Rijkswaterstaat
Ministerie van Verkeer en Waterstaat

Gemeente Amsterdam

SINA
ASTM GROUP

LATVIJAS VALSTS CEĻI

Autorità di Sistema Portale del Mar Ligure Orientale
Porti di La Spezia e Marina di Carrara

Autorità di Sistema Portale del Mare Adriatico centro settentrionale
PORT OF RAVENNA

bast
Federal Highway Research Institute

Vlaanderen
is wegen en verkeer

Baden-Württemberg
MINISTERIUM FÜR VERKEHR

An Roinn Iompair
Department of Transport

Ministerium für Umwelt, Naturschutz und Verkehr des Landes Nordrhein-Westfalen

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Bonneagar Iompair Éireann
Transport Infrastructure Ireland

CONSORZIOZAI
VERONA DEVELOPMENT AGENCY

A4autostrada
Brescia Verona Vicenza Padova

Autorità di Sistema Portale del Mar Tirreno Settentrionale

anas
GRUPPO FS ITALIANE

A22 Autostrada del Brennero SpA
Brennerautobahn AG

CONCESSIONI AUTOSTRADALI VENETE

COMUNE DI TRENTO

AUTONOME PROVINZ BOZEN SÜDTIROL
PROVINCIA AUTONOMA DI BOLZANO ALTO ADIGE
PROVINZIA AUTONOMA DE BULSAN SÜDTIROL

Port Network Authority of the Eastern Adriatic Sea
Ports of Trieste and Monfalcone

PROVINCIA AUTONOMA DI TRENTO

Co-financed by the Connecting Europe Facility of the European Union

Knowledge Building

WP1 Project Management & Knowledge Building – DE

- T1.01 Project Management – DE
- T1.02 Communication – NL
- T1.03 Cross Corridor Cooperation – DE
- **T1.04 Knowledge Building – BE** → **Digital Infrastructure**
  → **C-ITS**
  → **Bottleneck and Digital Corridor Mgt**
  → **Multi-modal Services**
- T1.05 Evaluation – IT

MERIDIAN DNA

- Please visit our website: www.meridian-corridors.eu

Workshop Agenda
Artificial Intelligence in Mobility

Time	Agenda Item	Lead/Speaker
14h00	Welcome & Introduction	Kristof Rombaut (AWV)
14h10	AI for mobility, a smart move!	Laure De Cock & Ynte Vanderhoydonc (imec)
14h40	European AI Act and impact on NRA	Joost Vantomme, Emil Berlin (Ertico) & Coen Bresser (TM2.0)
15h00	Artificial intelligence software for automatic traffic and incident detection in tunnels (Concessioni del Tirreno)	Paola Mainardi (SINA)
15h15	Break (15 min)	
15h30	Data Turbo Pipeline; digital incident management	Fred van der Zeeuw (Rijkswaterstaat)
15h50	AI experimentation in the radar-based traffic counting and classification system along the A4 motorway (Autostrada Brescia-Padova)	Matteo Gironi (A4 Mobility)
16h20	How AI can help road asset experts in a smart way	Jānis Vilciņš (Latvian State Roads)
16h40	Q & A	Kristof Rombaut (AWV)
17h00	*End*	

MERIDIAN

AI for Mobility, a smart move!

Laure De Cock & special guest
(imec)

Co-financed by the Connecting Europe Facility of the European Union

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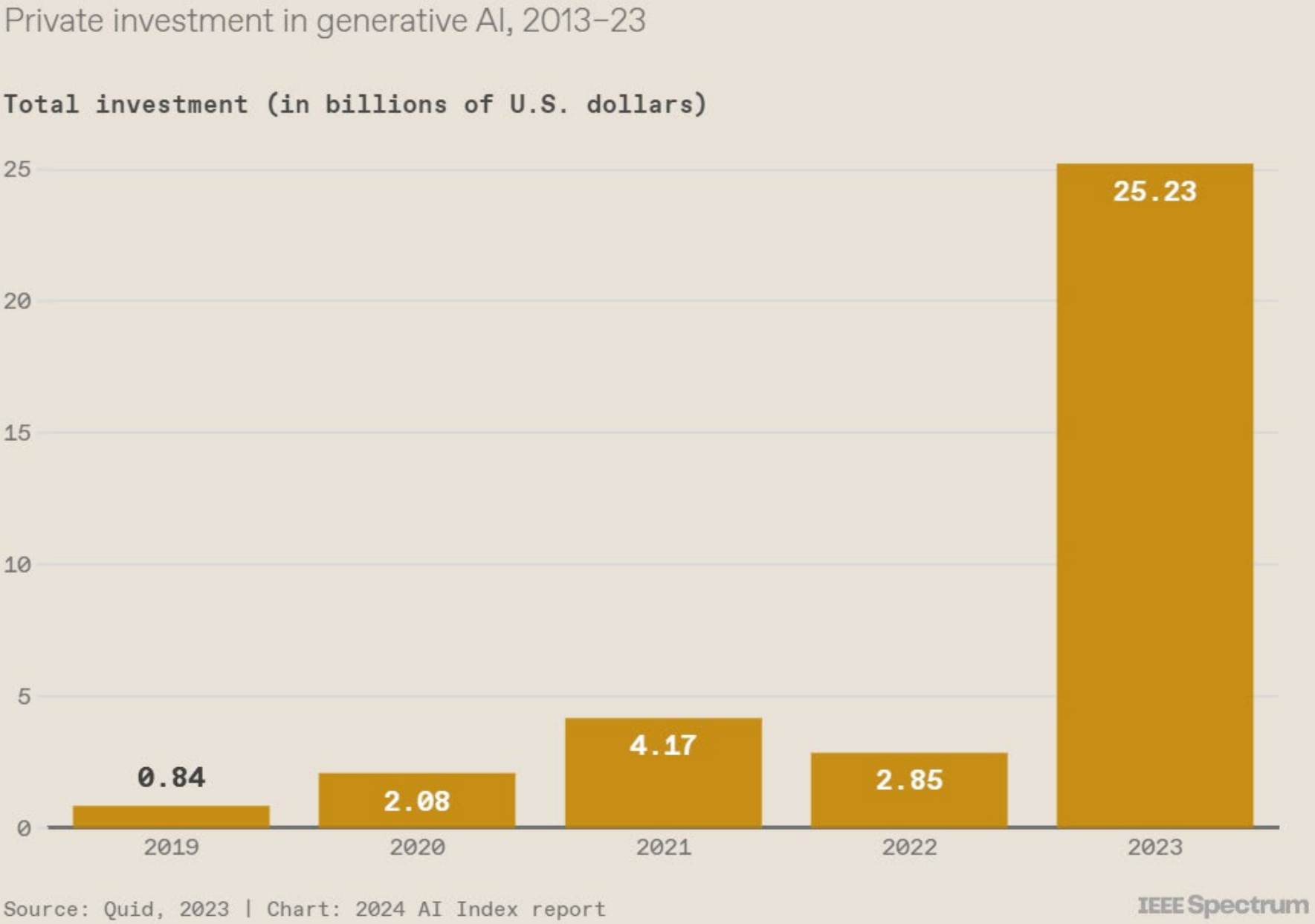
AI for mobility, a smart move?

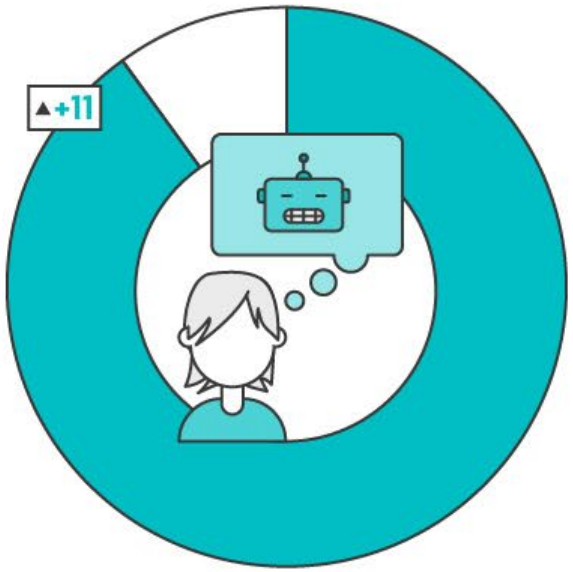
Dr. Laure De Cock and special guest


imec



https://spectrum.ieee.org/ai-index-2024

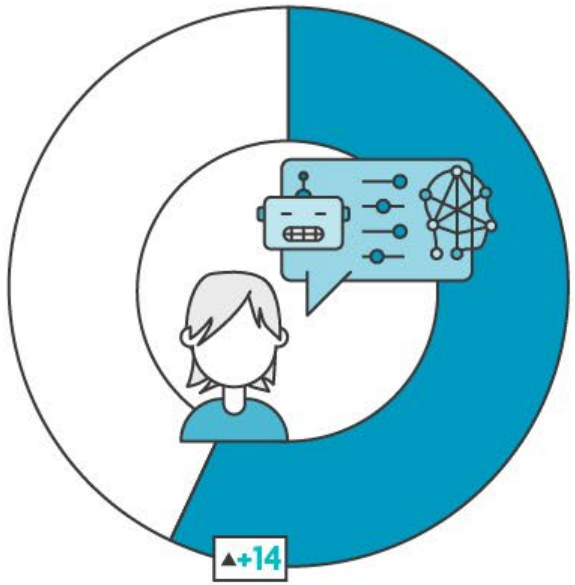
Kennis en begrip van AI



90%

kent

het begrip AI



57%

kan uitleggen

wat het begrip AI betekent

https://www.imec.be/nl/press/vlaming-had-ai-erlebnis-2023

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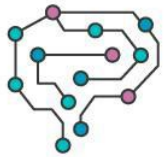
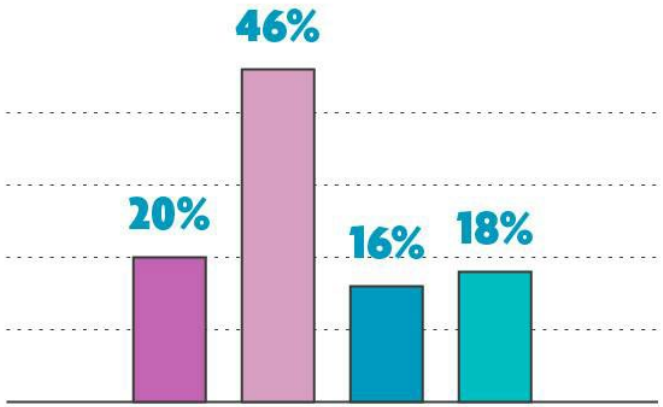
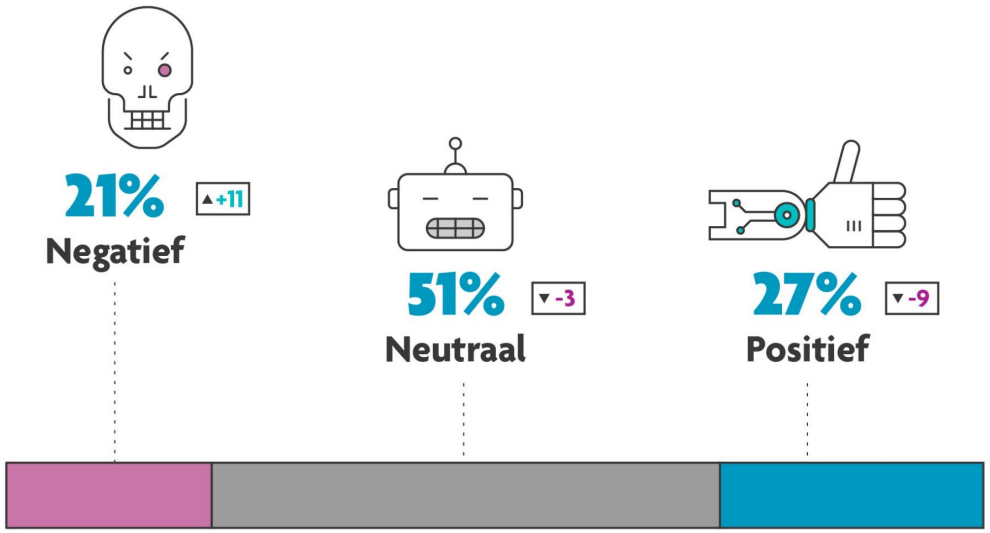
Kennis en **gebruik** van **AI-toepassingen**



Hoe vaak gebruik je AI-dienst die **tekst, beeld, muziek** of **spraak** opstelt?



- Niet kennen, niet gebruiken
- Kennen, nooit gebruikt
- Kennen, zelden gebruikt
- Kennen, minstens maandelijks gebruiken



- 18- to 24-year-olds: 42%.
- Those who use it report efficiency gains.
- In the history of the imec.digimeter, there are no technologies or platforms that have recorded such a rapid and widespread adoption.

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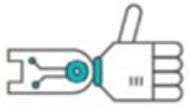
The AI paradox



"Ik ben **nieuwsgierig** over de **toepassingen** en **mogelijkheden** van AI" — **61%**

"Ik wil **graag meer** over AI te **weten** komen" — **57%**

"Ik ben ervan overtuigd dat AI ervoor zal zorgen dat we **sneller** en **efficiënter kunnen werken**" — **48%**

"Ik ben ervan overtuigd dat AI **meer voordelen dan nadelen** heeft" — **31%**

"Ik ben onder de indruk van wat AI **allemaal kan**" — **69%**

"Ik ben geïnteresseerd om AI **meer** te gaan **gebruiken** in mijn **dagelijks leven**" — **32%**

"Ik maak me zorgen over de **impact** van AI **op mijn privacy**" — **56%**

"Ik ben bezorgd over de **negatieve impact** die AI kan hebben" — **64%**

"Ik ben bezorgd dat ik **geen verschil** zal kunnen merken tussen een **mens** en een **chatbot**" — **51%**

"Ik ben bezorgd dat ik het **verschil niet meer** zal zien tussen wat door een **mens en** wat door **AI** is gemaakt" — **64%**

"Ik ben bezorgd over de taken die AI in de toekomst mogelijk kan **overnemen** van **mijn job***" — **35%**

"Ik ben bezorgd dat AI **foutieve informatie** kan **helpen verspreiden**" — **71%**

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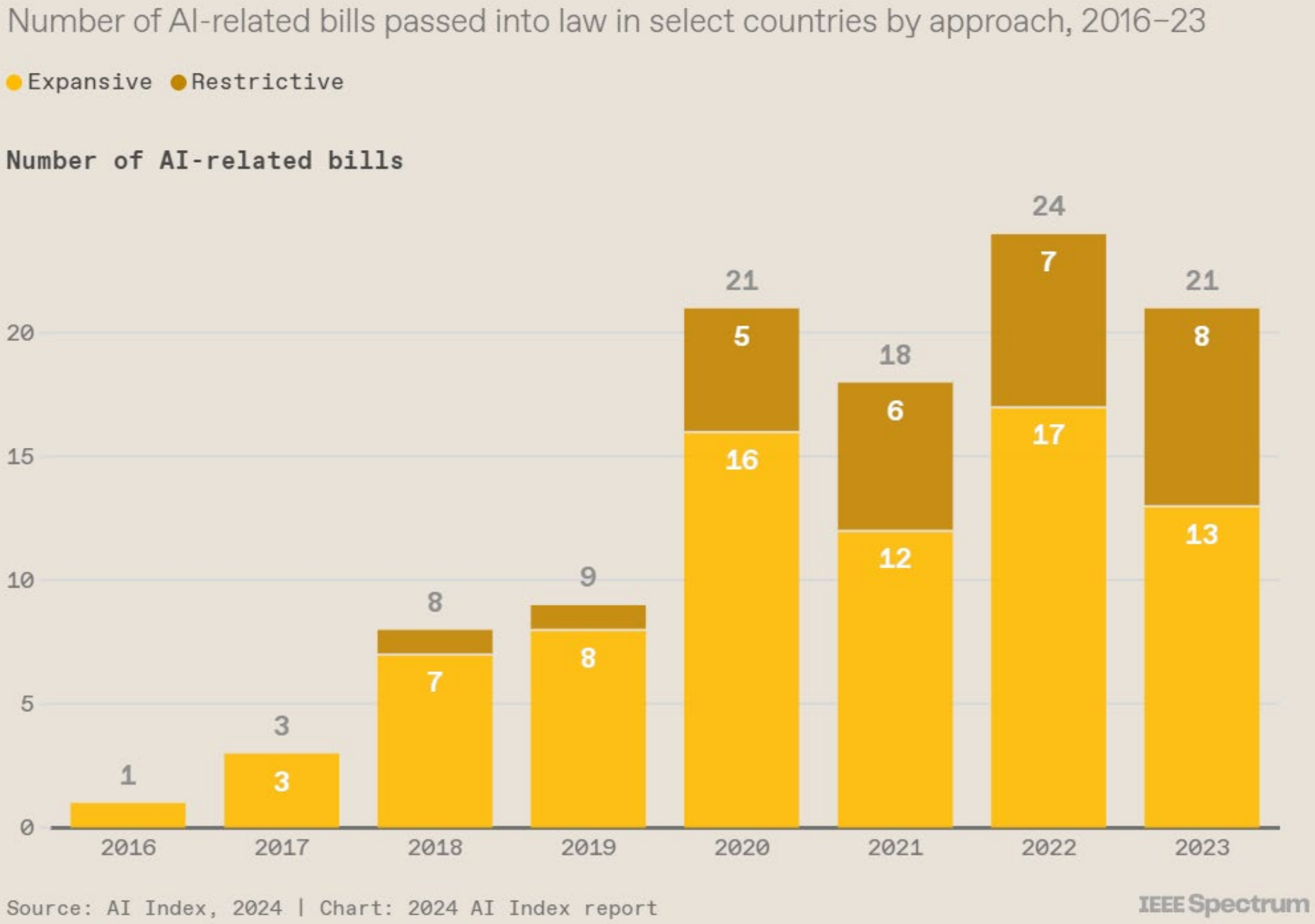
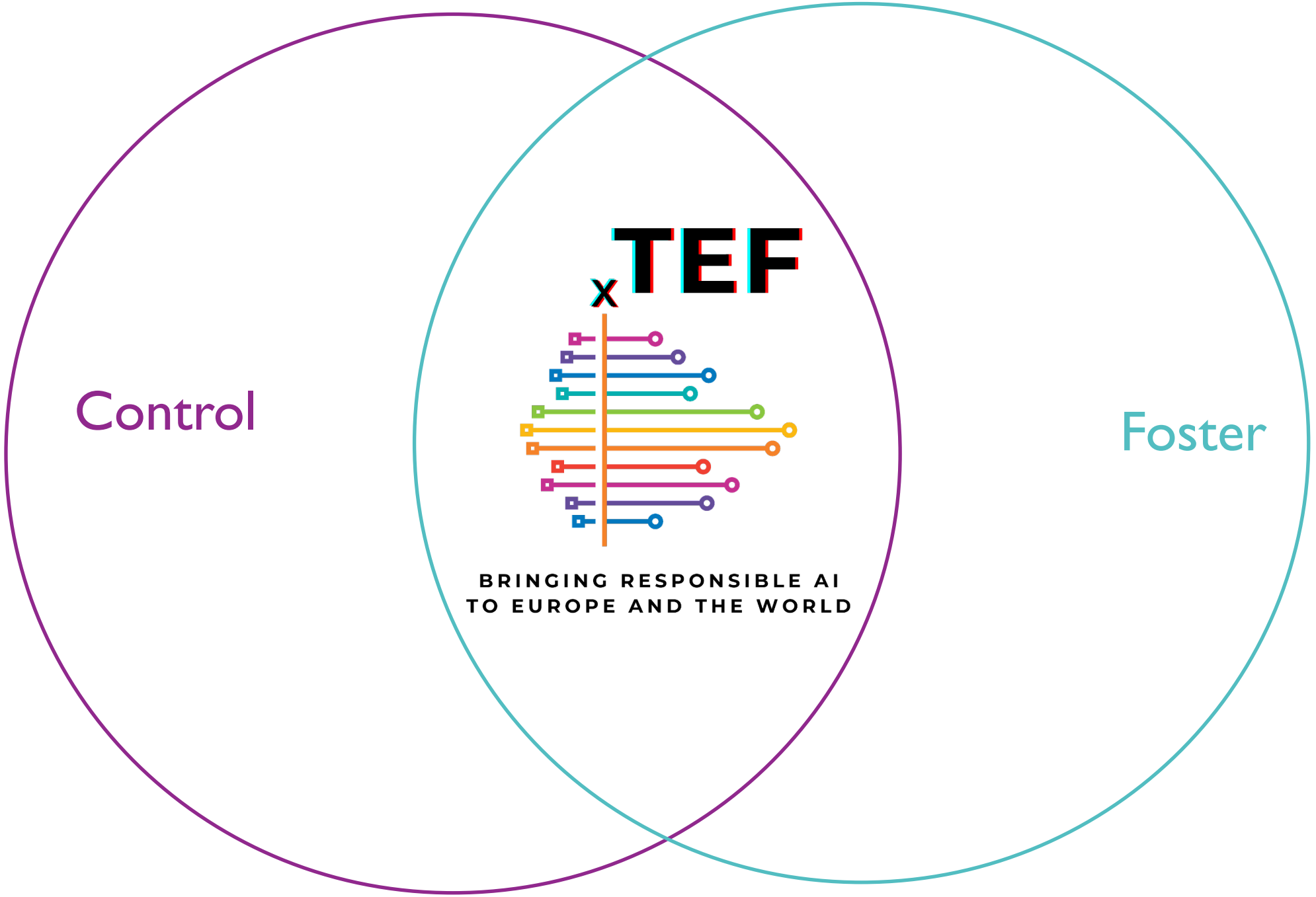


https://spectrum.ieee.org/ai-index-2024


EU
Artificial
Intelligence Act
“The AI Act will guarantee the safety and fundamental rights of people and businesses when it comes to AI, and strengthen uptake, investment and innovation in AI across the EU”


Control
xTEF
BRINGING RESPONSIBLE AI
TO EUROPE AND THE WORLD
Foster

CitCom AI

European AI TEF for Smart and Sustainable Cities and Communities

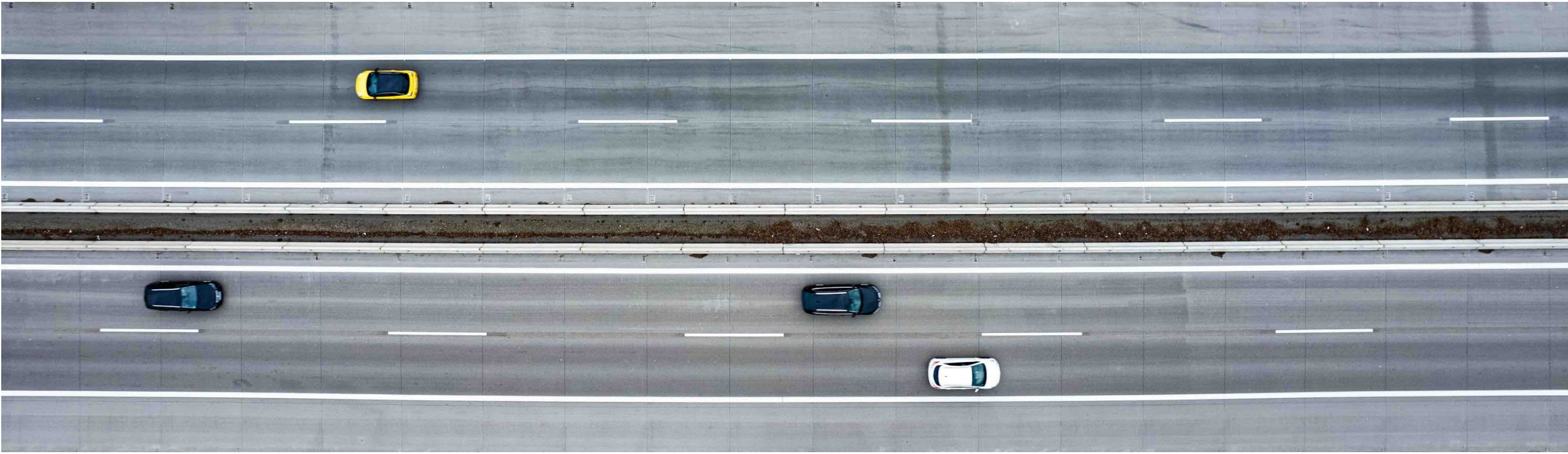
Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

https://citcom.ai/

Road safety

'Mandatory drivers assistance systems expected to help save over 25 000 lives by 2038.'



https://single-market-economy.ec.europa.eu/news/mandatory-drivers-assistance-systems-expected-help-save-over-25000-lives-2038-2024-07-05_en#:~:text=New%20rules%20on%20general%20vehicle,systems%20for%20all%20new%20vehicles.

NEW SAFETY FEATURES IN YOUR CAR

FOR ALL ROAD VEHICLES

FOR CARS AND VANS

FOR BUSES AND TRUCKS

New Safety Features required in all new cars from 7 July 2024

** these measures apply to all new vehicle types since 6 July 2022*

- Intelligent speed assistance
- Reversing detection with camera or sensors
- Attention warning in case of driver drowsiness
- Emergency stop signal
- Cybersecurity measures

- Lane keeping assistance
- Advanced emergency braking detecting cars, pedestrians and bicycles
- Event data recorders

- Detection and warnings to prevent collisions with pedestrians or cyclists
- Tyre pressure monitoring systems.

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Brigade

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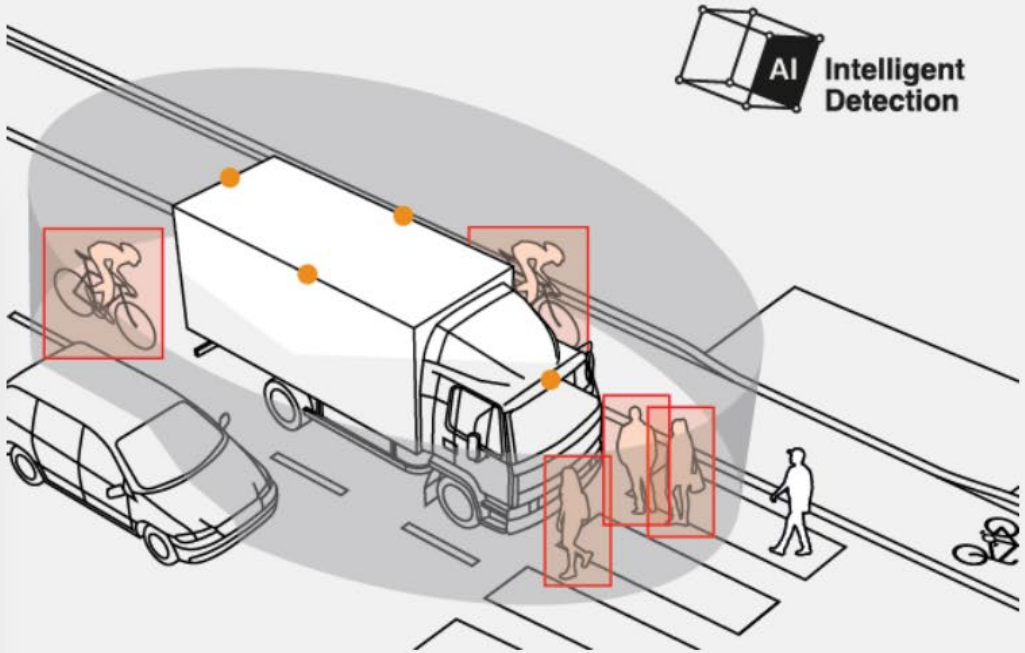
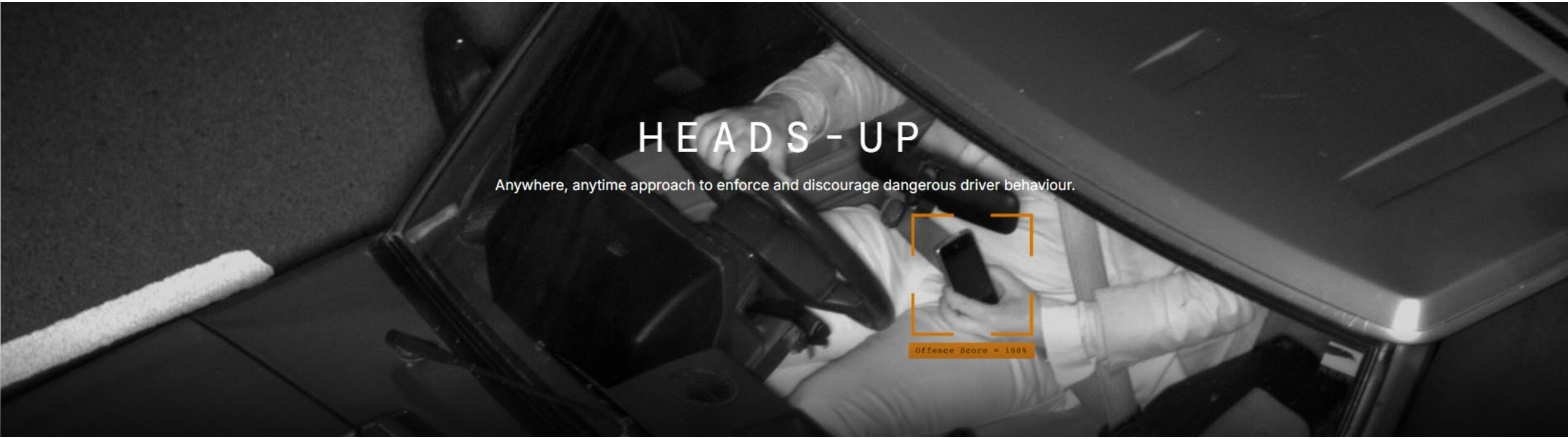
How does Brigade's Backeye®360 AI Vehicle Camera System Work?



imec

Road safety

'In New South Wales (Australia) it contributed to a 22% decline in road fatalities and an 80% decline in use of mobile phones behind the wheel.'



https://www.deeplearning.ai/the-batch/the-view-through-the-windshield/

Road safety

'Up to 14 offenses per lane per hour during peak times on the Antwerp ringroad.'

https://vias.be/nl/newsroom/succesvolle-test-met-camerasysteem-om-gsm-gebruik-achter-het-stuur-te-detecteren-/#:~:text=De%20voorbije%20weken%20is%20Vias,handelingen%20stelt%20met%20zijn%20gsm

https://www.vrt.be/vrtnws/nl/2023/09/20/politieke-onenigheid-en-juridische-vragen-camera-s-tegen-gsm-en/

Road safety

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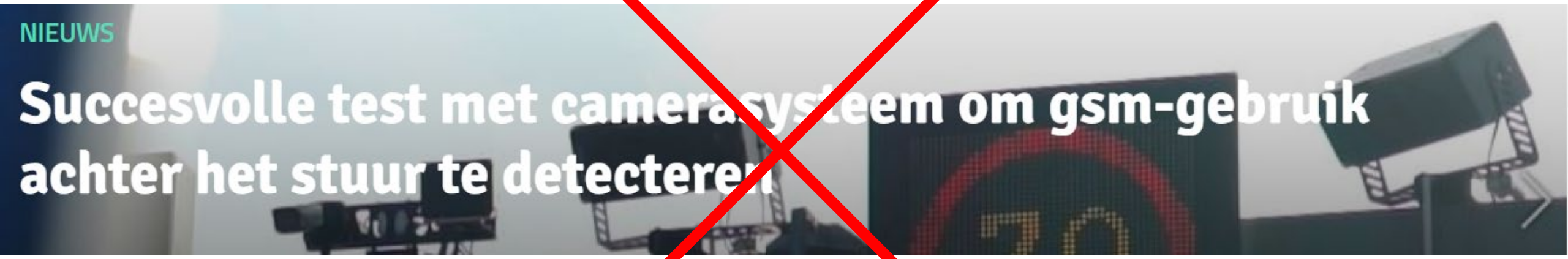


https://vias.be/nl/newsroom/succesvolle-test-met-camerasysteem-om-gsm-gebruik-achter-het-stuur-te-detecteren-/#:~:text=De%20voorbije%20weken%20is%20Vias,handelingen%20stelt%20met%20zijn%20gsm

https://www.vrt.be/vrtnws/nl/2023/09/20/politieke-onenigheid-en-juridische-vragen-camera-s-tegen-gsm-en/

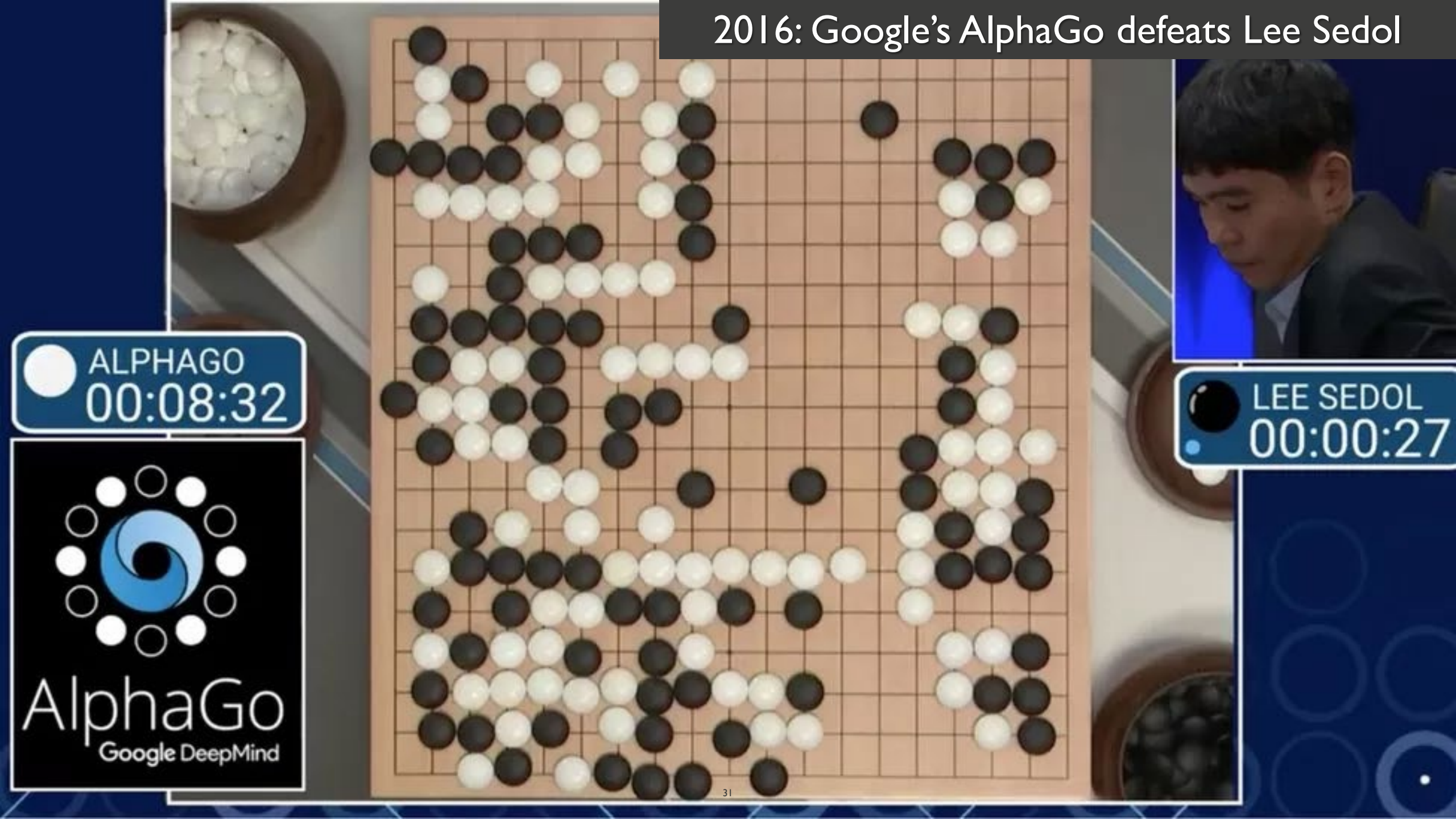
Moravec's paradox

"Human skills that appear effortless are difficult to reverse-engineer, but skills that require effort may not necessarily be difficult to engineer at all"

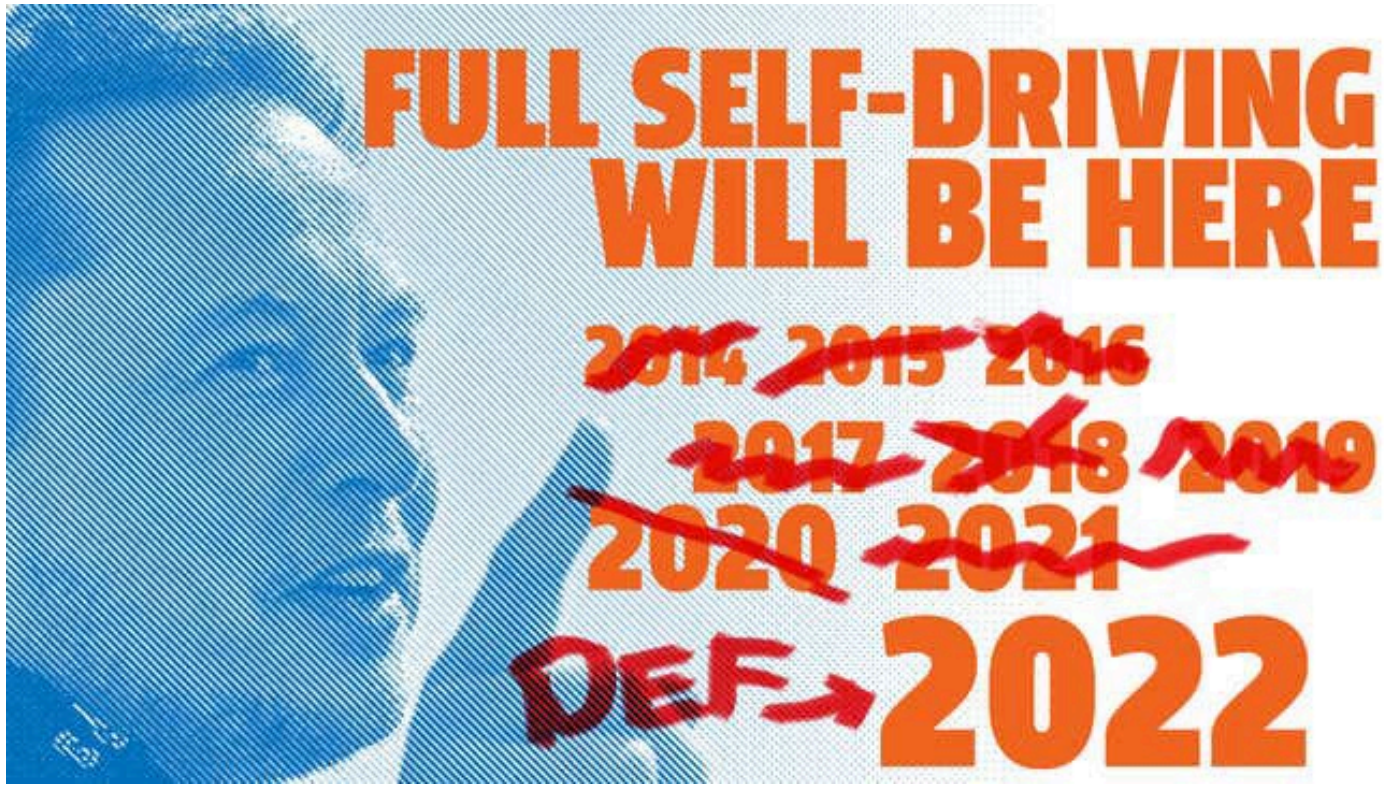
Moravec's paradox

1997: IBM's Deep Blue defeats Garry Kasparov

2016: Google's AlphaGo defeats Lee Sedol



Meanwhile in mobility…



Meanwhile in mobility…

The Batch > AI & Society > Article

Cruise Control

Cruise shuts down self-driving cars due to California safety concerns.

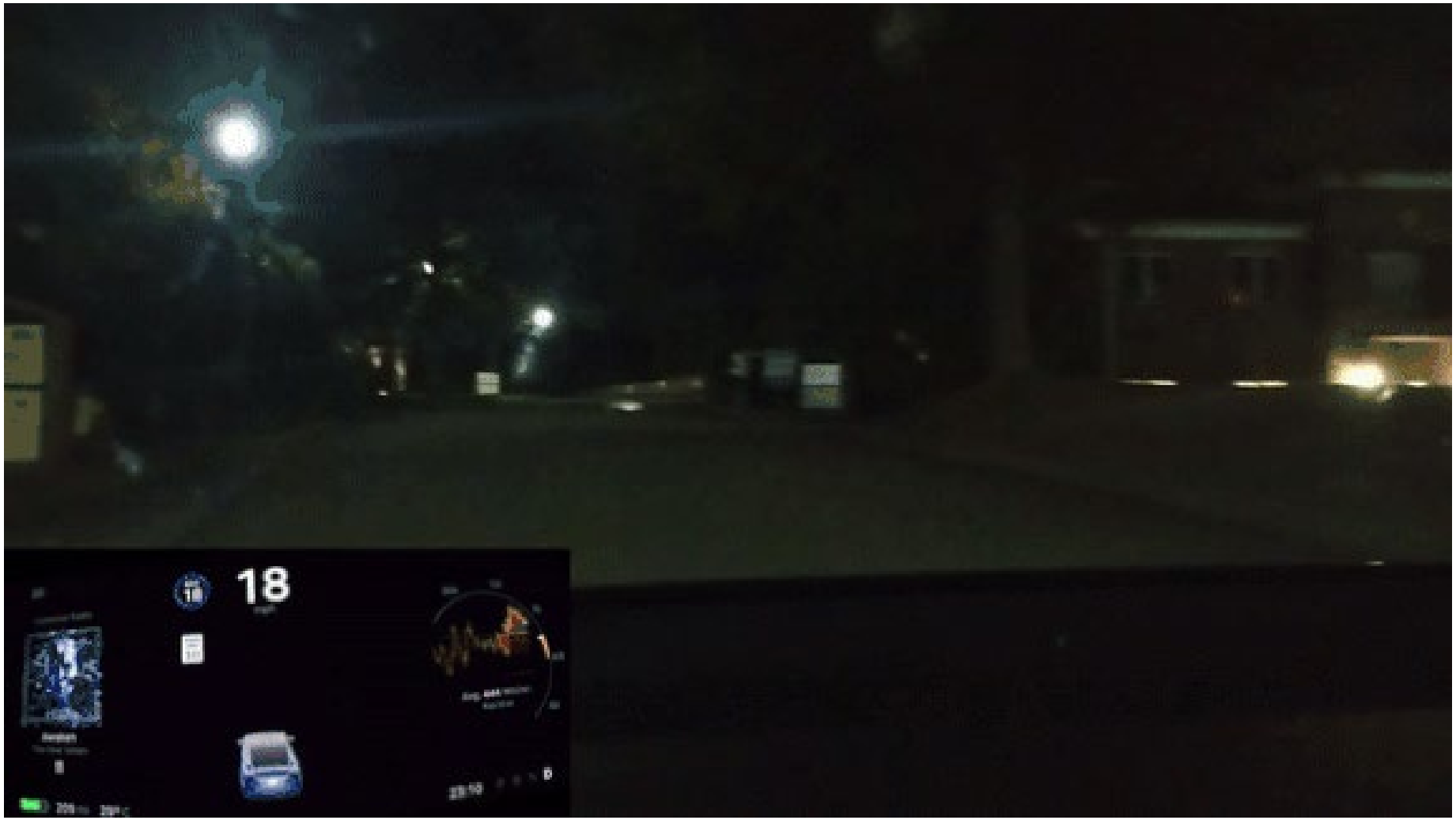
AI & Society | Hardware | Autonomous Driving | Autonomous Vehicles | Full Self-Driving | Regulations

Published: Nov 01, 2023

Reading time: 2 min read

https://www.deeplearning.ai/the-batch/cruise-shuts-down-self-driving-cars-due-to-california-safety-concerns/

Meanwhile in mobility…

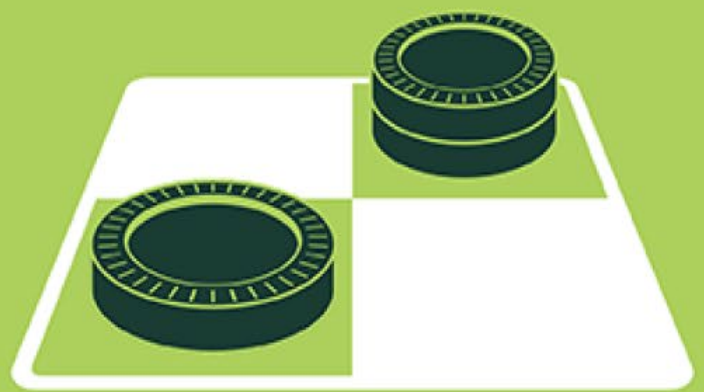


https://www.deeplearning.ai/the-batch/phantom-menace/

Can recent developments drive AI in mobility forward?

ARTIFICIAL INTELLIGENCE

Early artificial intelligence stirs excitement.



MACHINE LEARNING

Machine learning begins to flourish.

DEEP LEARNING

Deep learning breakthroughs drive AI boom.

1950's 1960's 1970's 1980's 1990's 2000's 2010's

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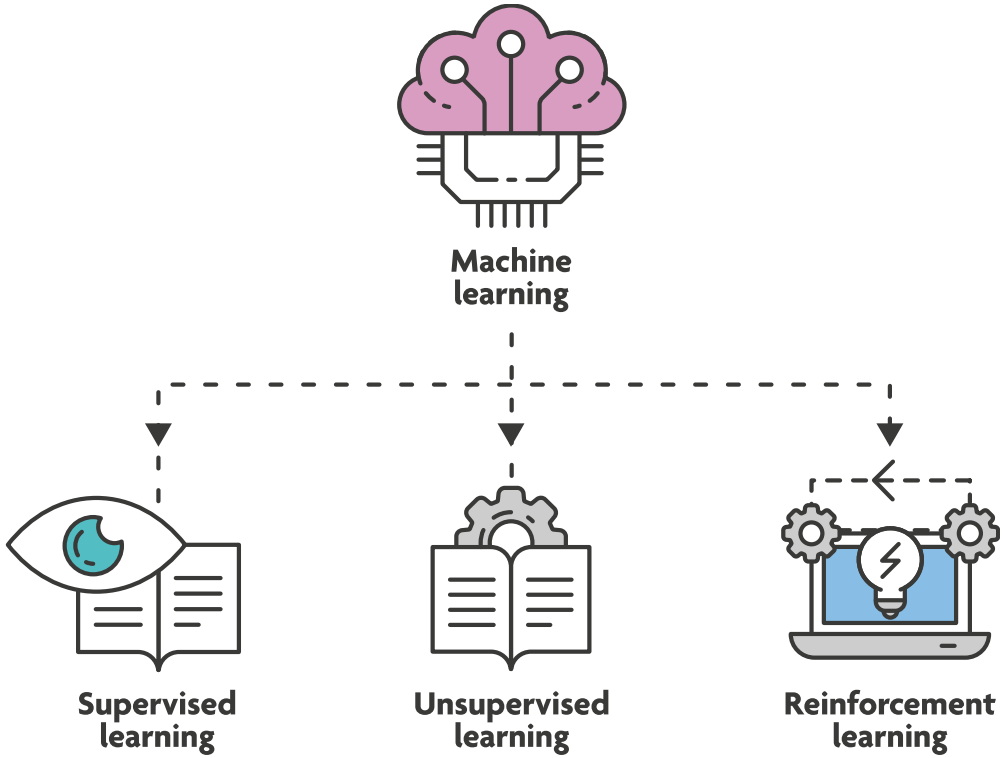
How do they learn?



What can they do?

Generative AI

Classification

Natural Language Processing

Predictive analysis

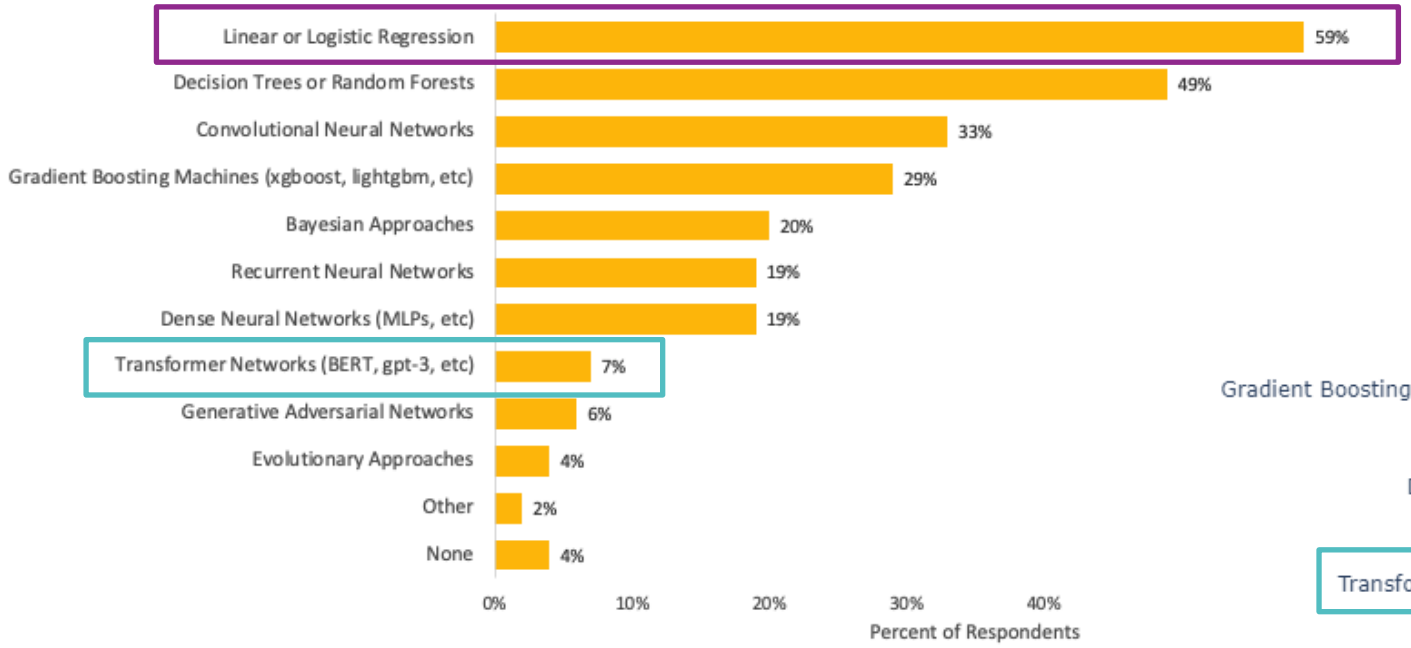
Speech recognition

Computer vision

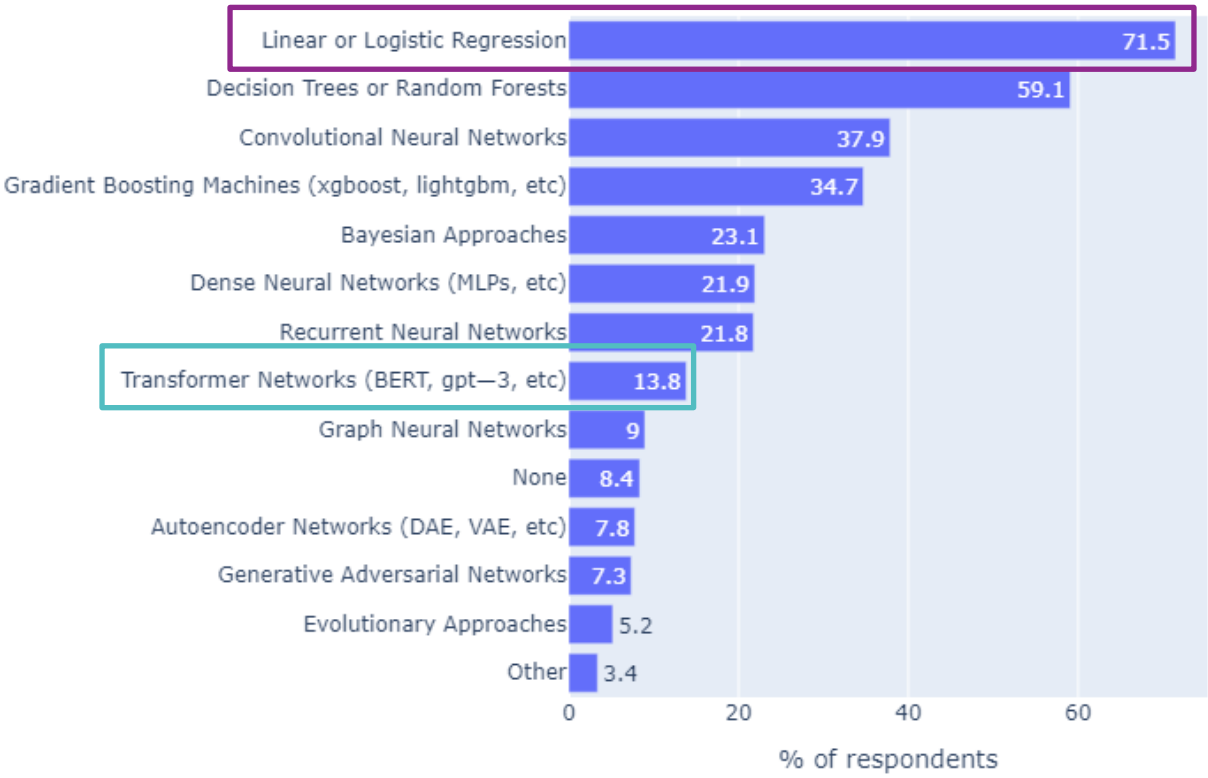
Object detection

Which algorithms do they use?

2019



2022



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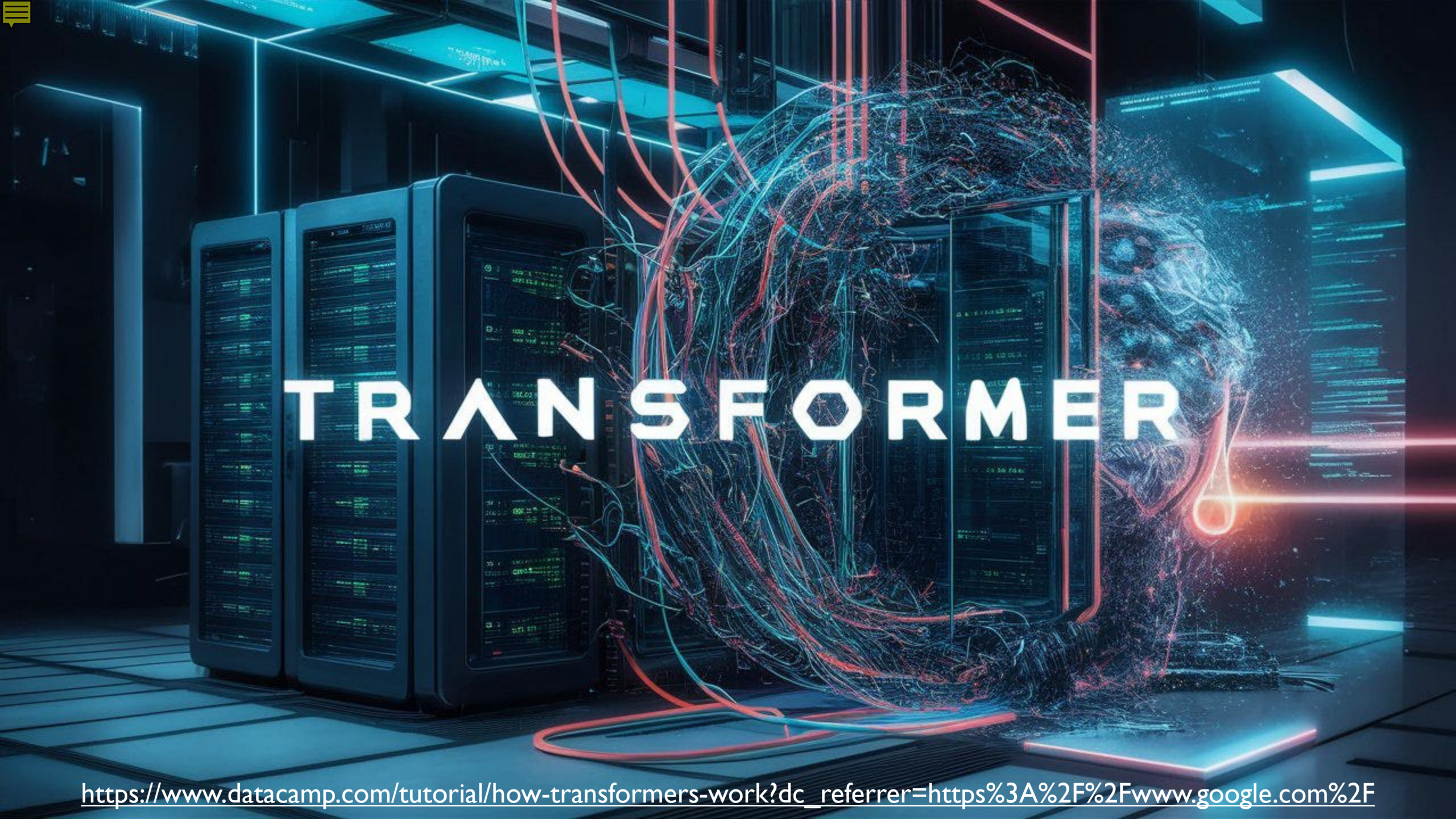
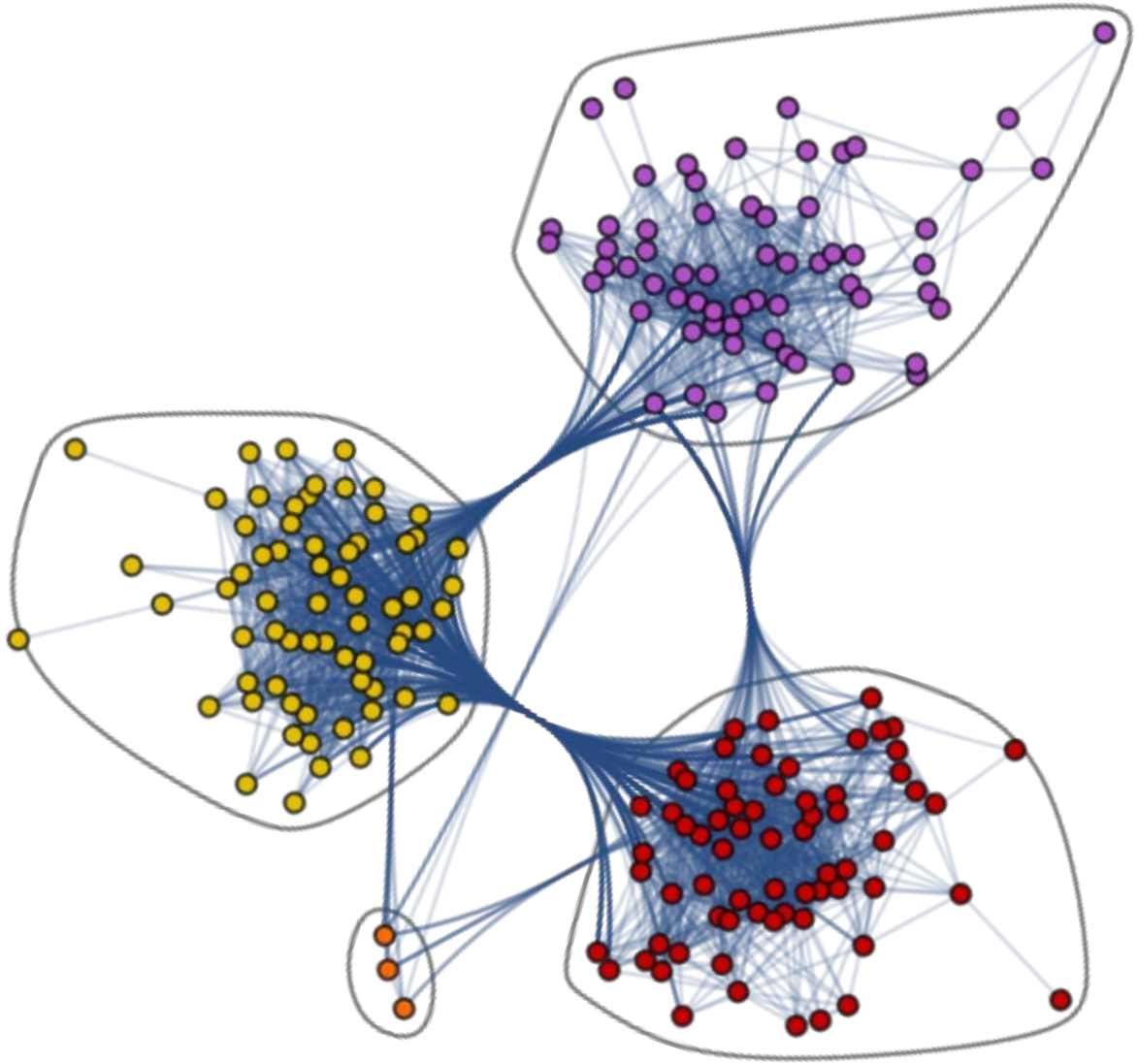


https://www.datacamp.com/tutorial/how-transformers-work?dc_referrer=https%3A%2F%2Fwww.google.com%2F

Graph Neural Networks



Graph Neural Networks

The Batch > Machine Learning Research > Article

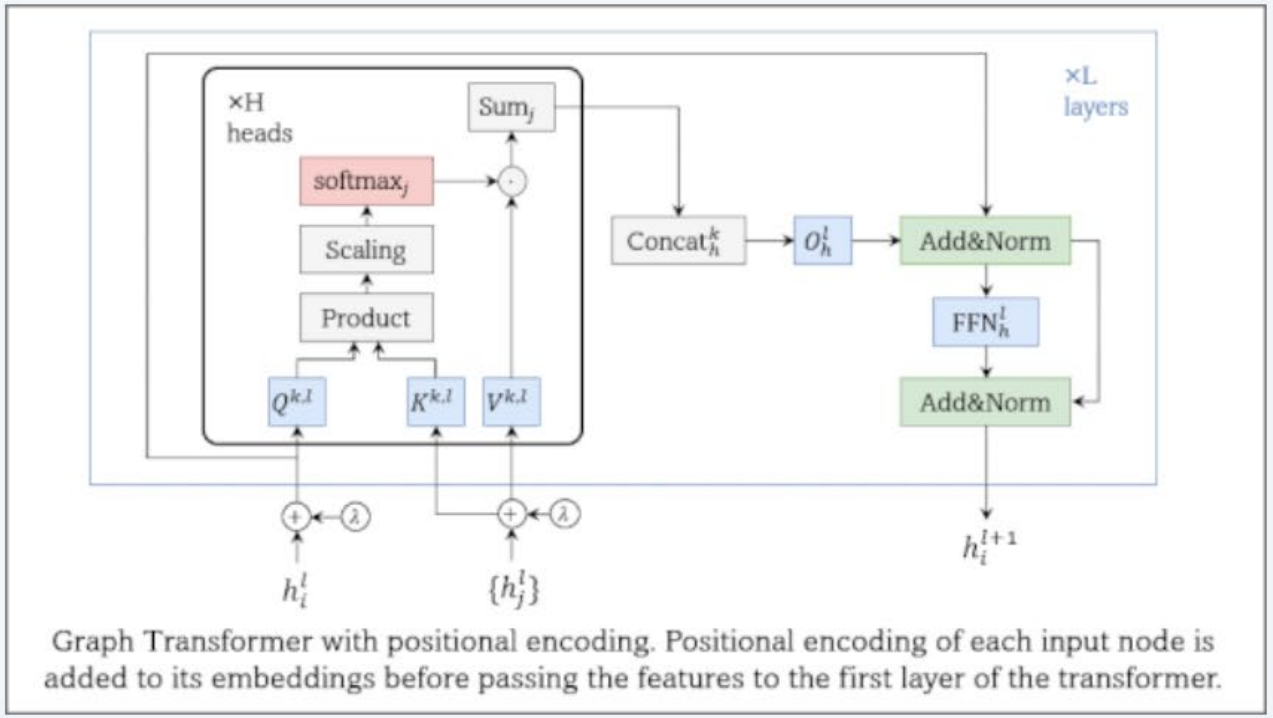
A Transformer for Graphs

New Method for Processing Graph Data with Transformers

Machine Learning Research | Structured Data | Transformer | Graph Neural Networks (GNN) | Graph Transformers (GT) | Nanyang Technological University

Published: Jun 29, 2022

Reading time: 2 min read

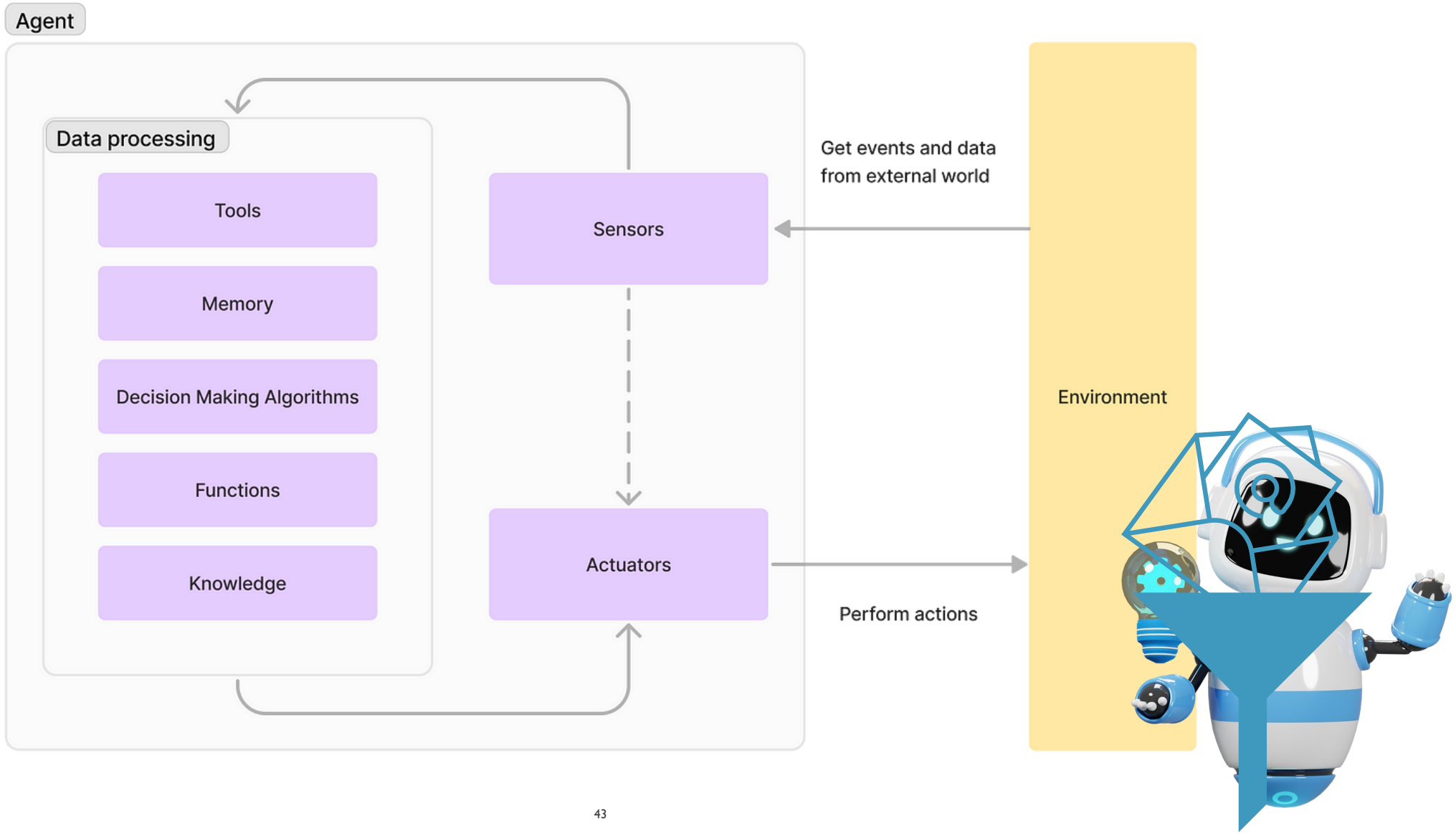


Graph Transformer with positional encoding. Positional encoding of each input node is added to its embeddings before passing the features to the first layer of the transformer.

https://www.deeplearning.ai/the-batch/a-transformer-for-graphs/


MAPGPT
OPENAI

AI Agents


Agent
Data processing
Tools
Memory
Decision Making Algorithms
Functions
Knowledge
Sensors
Actuators
Get events and data from external world
Perform actions
Environment

https://www.deeplearning.ai/the-batch/the-dawning-age-of-agents/

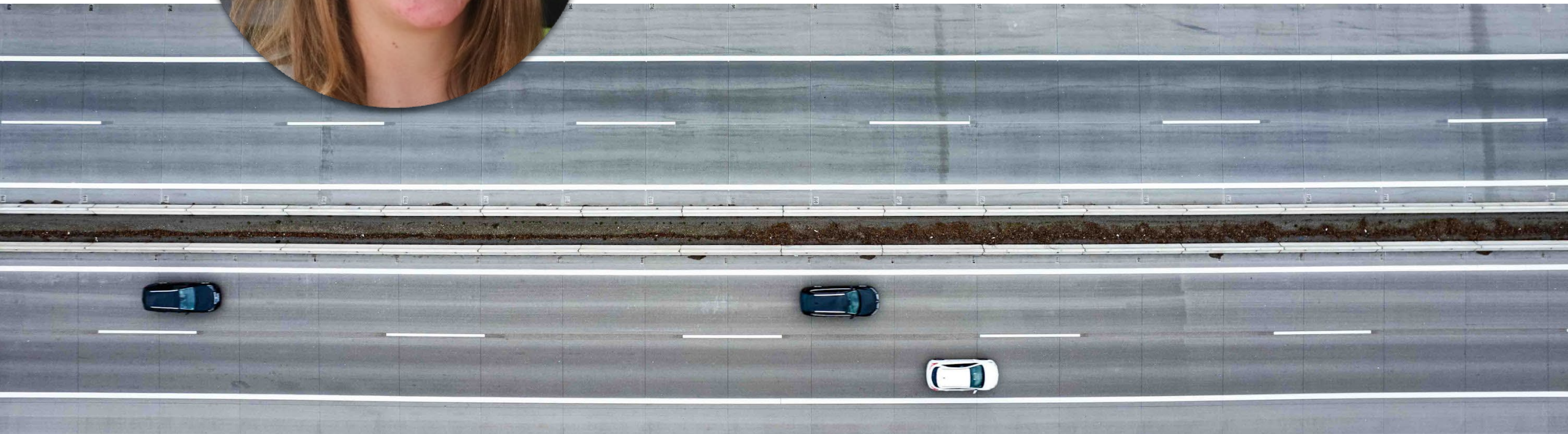
Image generated using ideogram.ai

AI for mobility, a smart move?

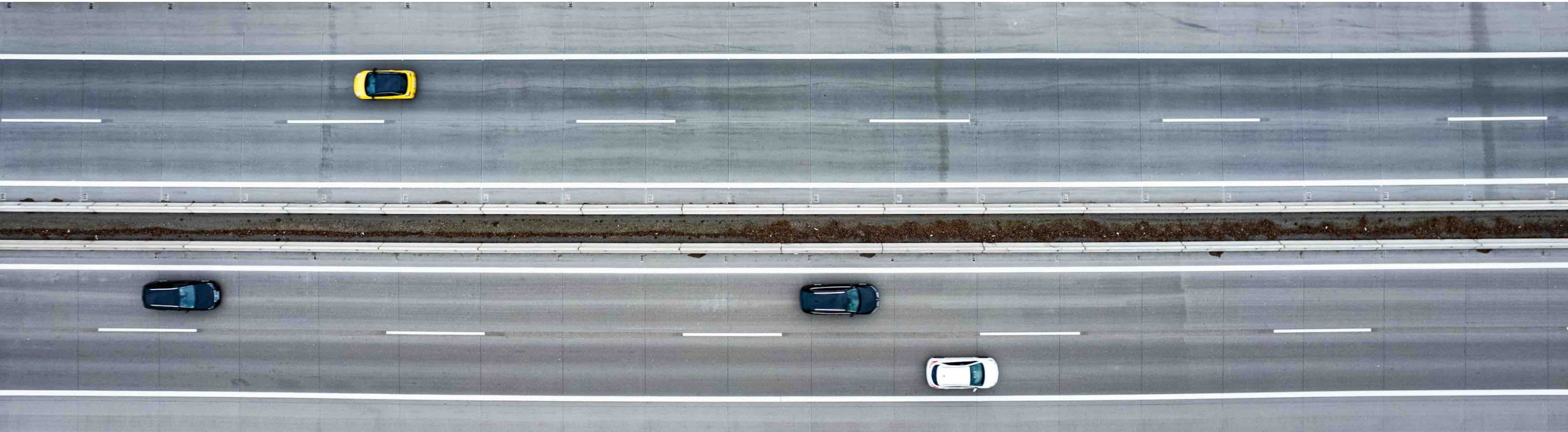
https://botpress.com/blog/real-world-applications-of-ai-agents

Dr. Ynte Vanderhoydonc

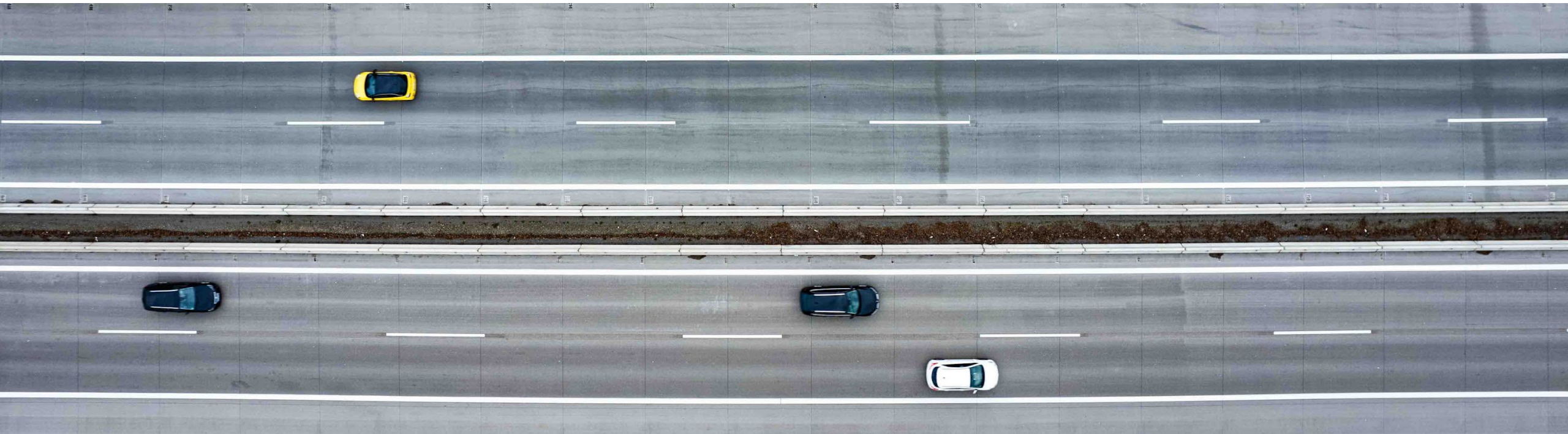
IDLab – UAntwerpen-imec

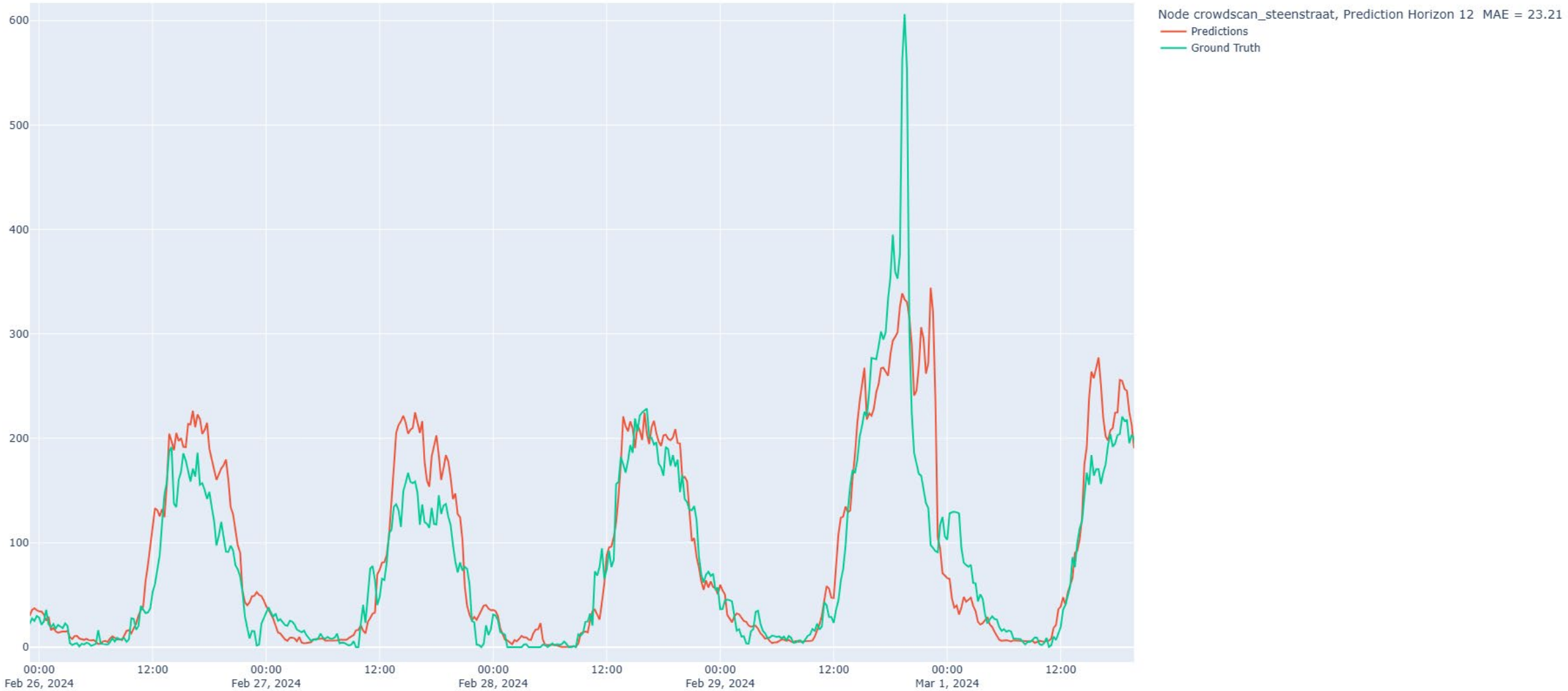


How is your research affected by the current trend of balancing the stimulation of AI advancements with the need for regulatory control?

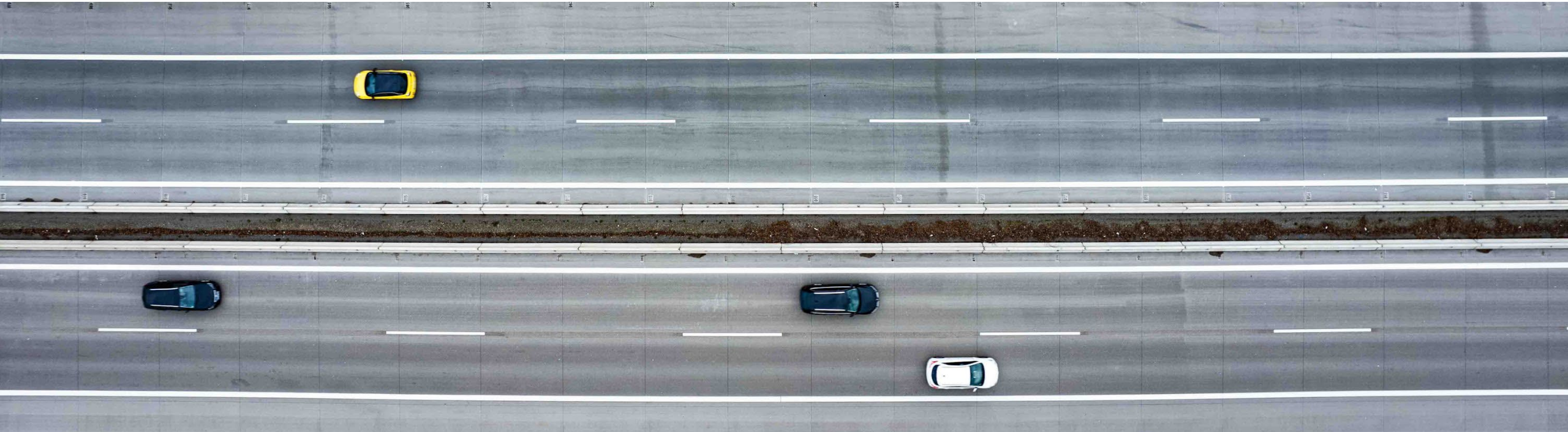


Moravec's Paradox suggests that tasks that are easy for humans, like perception and movement, are challenging for AI, while complex problem-solving is easier for machines. How does this paradox manifest in your research on AI for mobility? Are there specific tasks in traffic modeling that are easier to solve with ML than others?

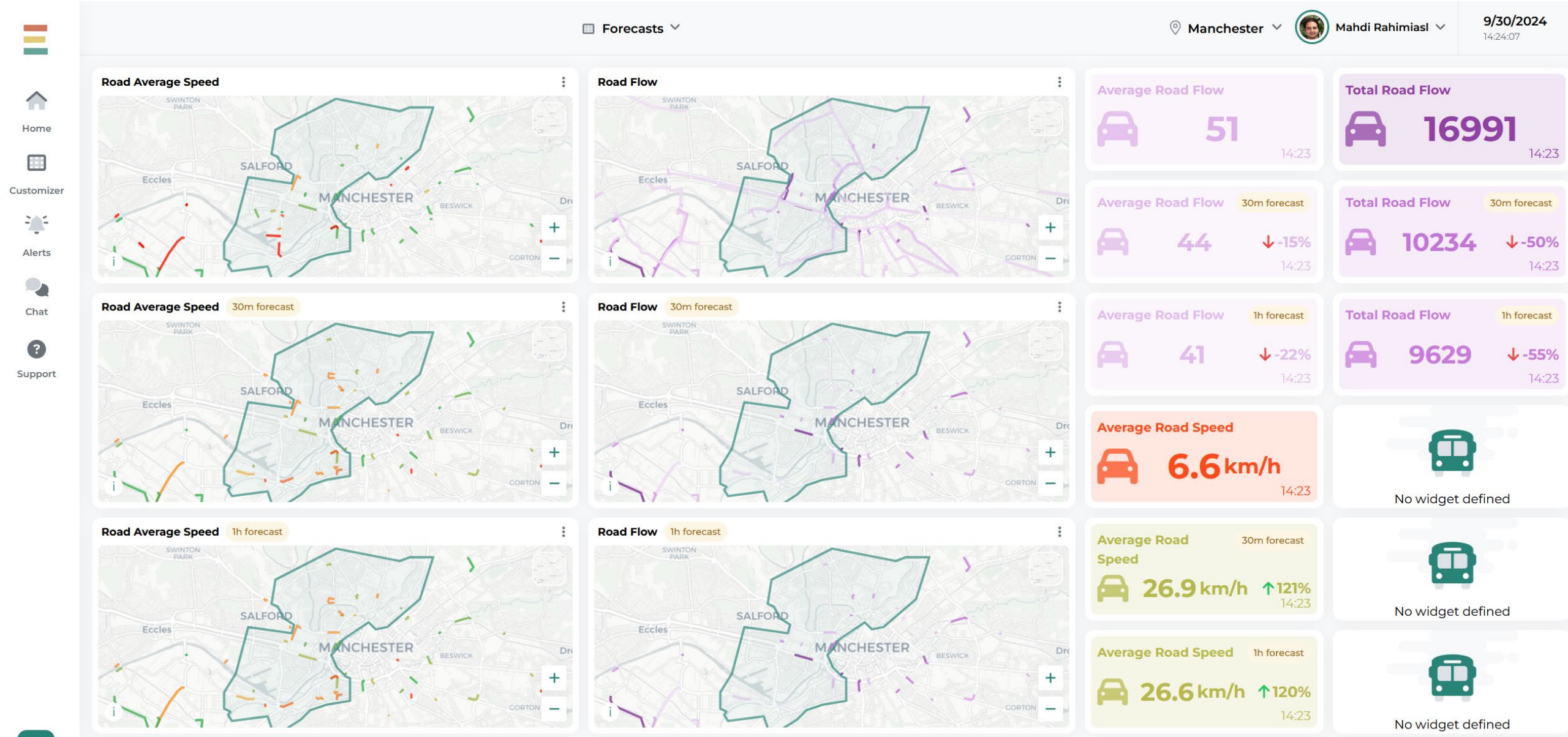



Node crowdscan_steenstraat, Prediction Horizon 12 MAE = 23.21
Predictions
Ground Truth
600
500
400
300
200
100
0
00:00
Feb 26, 2024
12:00
00:00
Feb 27, 2024
12:00
00:00
Feb 28, 2024
12:00
00:00
Feb 29, 2024
12:00
00:00
Mar 1, 2024
12:00

Could you tell us about the specific projects or research initiative you are currently working on? How does your research support mobility authorities and traffic managers in making more informed decisions?



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 955273



OptiRoutS

BEMOBILE a revolution in traffic

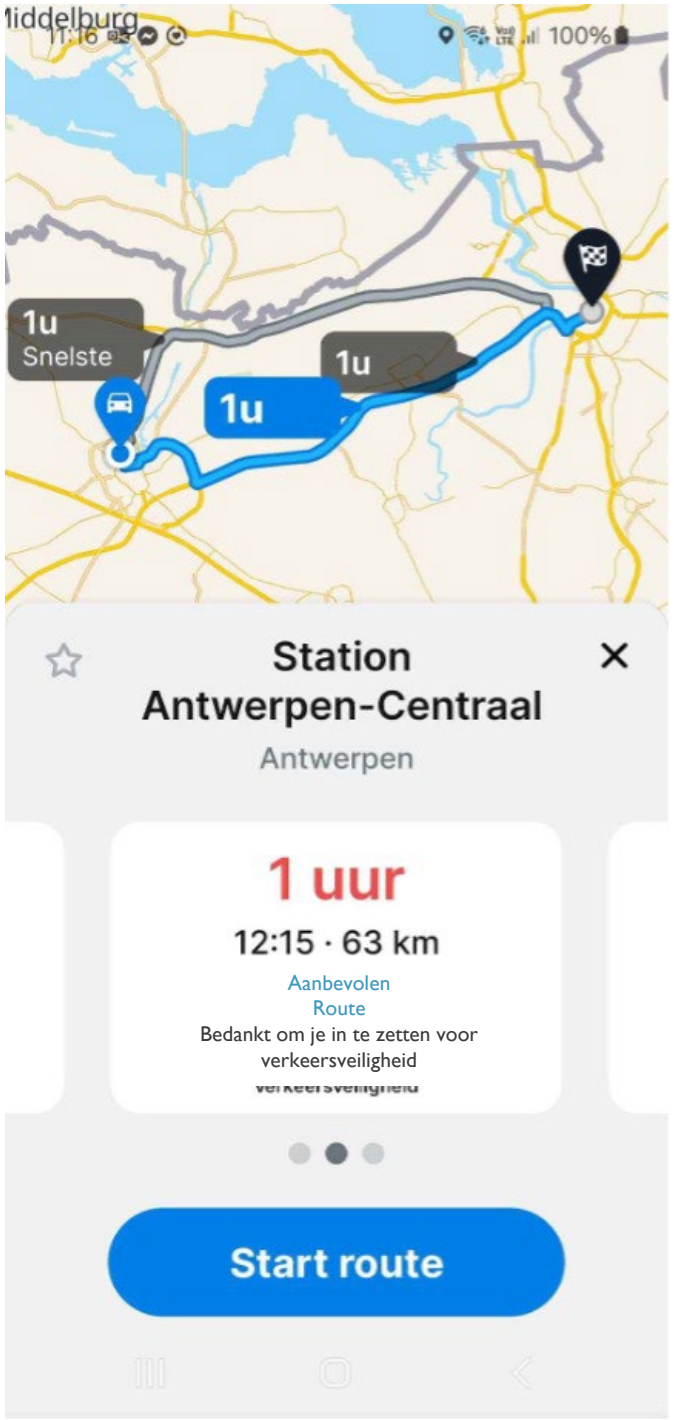
MOVIAS smart mobility

AGENTSCHAP WEGEN & VERKEER

IDLab INTERNET & DATA LAB

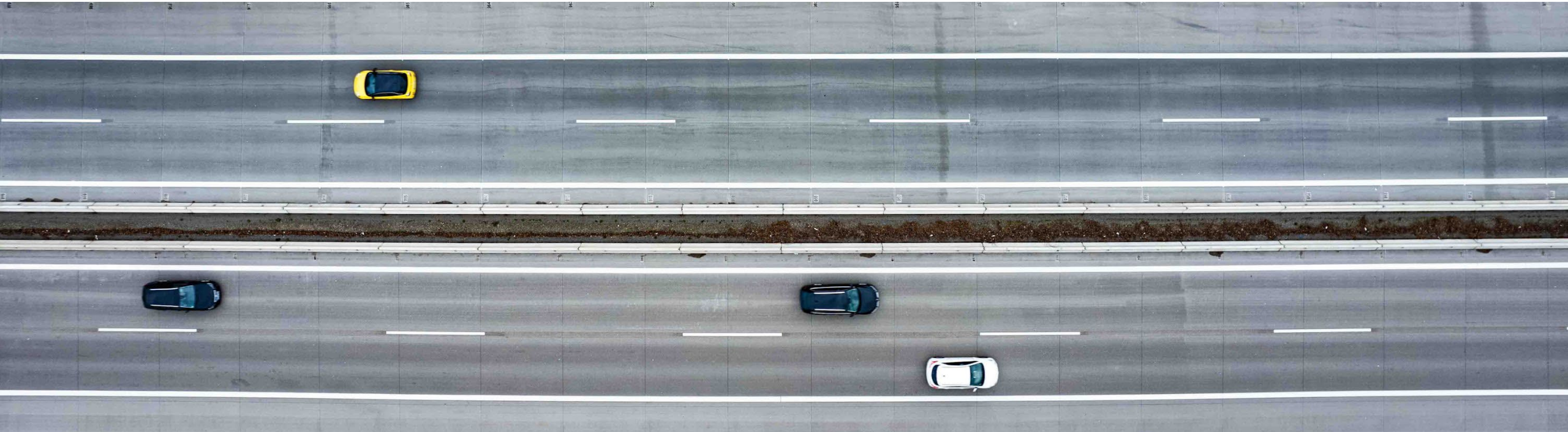
KU LEUVEN

SMIT



imec

Based on your research, what are the most promising future directions for AI in the mobility sector? Are there any emerging technologies, methodologies or use case that you believe are promising?




MOBILITY
MOBILITY PREDICTION MOLL
TRAFFIC
TRAFFIC
PREDICTION
TRAFFIC
PREDICTION

embracing a better life

The EU AI Act and impact on NRAs

Joost Vantomme, Emil Berlin (Ertico) &
Coen Bresser (TM2.0)

Presenting the speakers

Joost Vantomme
CEO

Emil Berlin
Partnership &
Governance Officer

Coen Bresser
Senior Manager &
TM2.0 Co-chair

ERTICO

ITS EUROPE

A unique public-private partnership

Bringing together over **120 Partners** from **all ITS sectors** to make mobility **smarter**, **cleaner**, **safer** and **more efficient.**

- ✓ **Established in 1991 by the European Commission and industry leaders**
- ✓ **Focus on innovation in the transport and mobility system**
- ✓ **European projects on research, innovation -> deployment**
- ✓ **Building bridges with the ITS community worldwide & thought leadership**
- ✓ **Organiser of ITS congresses**

Innovation through ITS

Intelligent Transport Systems

Automated driving

Drones

Data exchange

Traffic management

Artificial Intelligence

Mobility Apps

Mobility as a Service

Transport and Logistics

Navigation

Intelligent Infrastructure

Safety

Micromobility

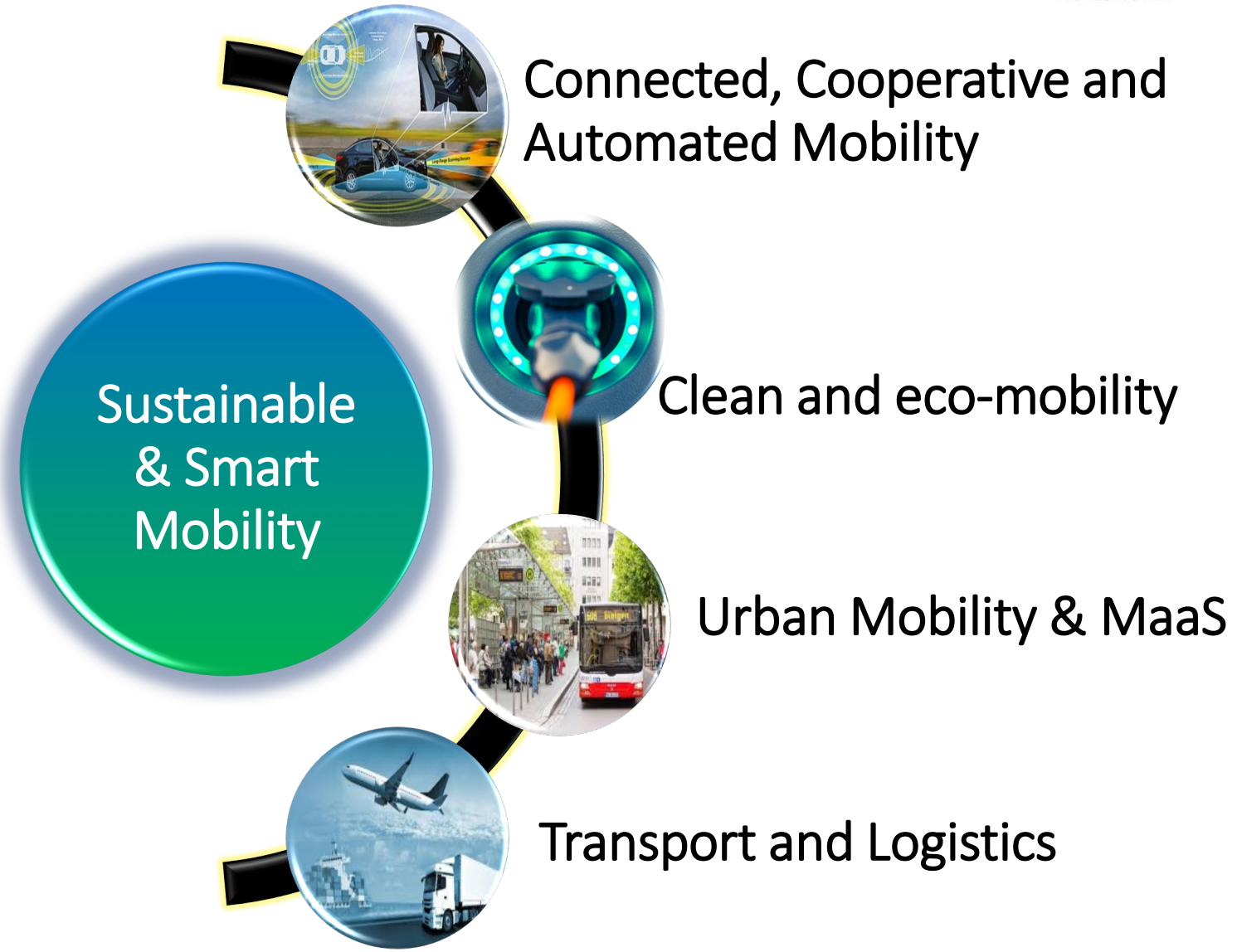
Payment Systems

V2X Communication

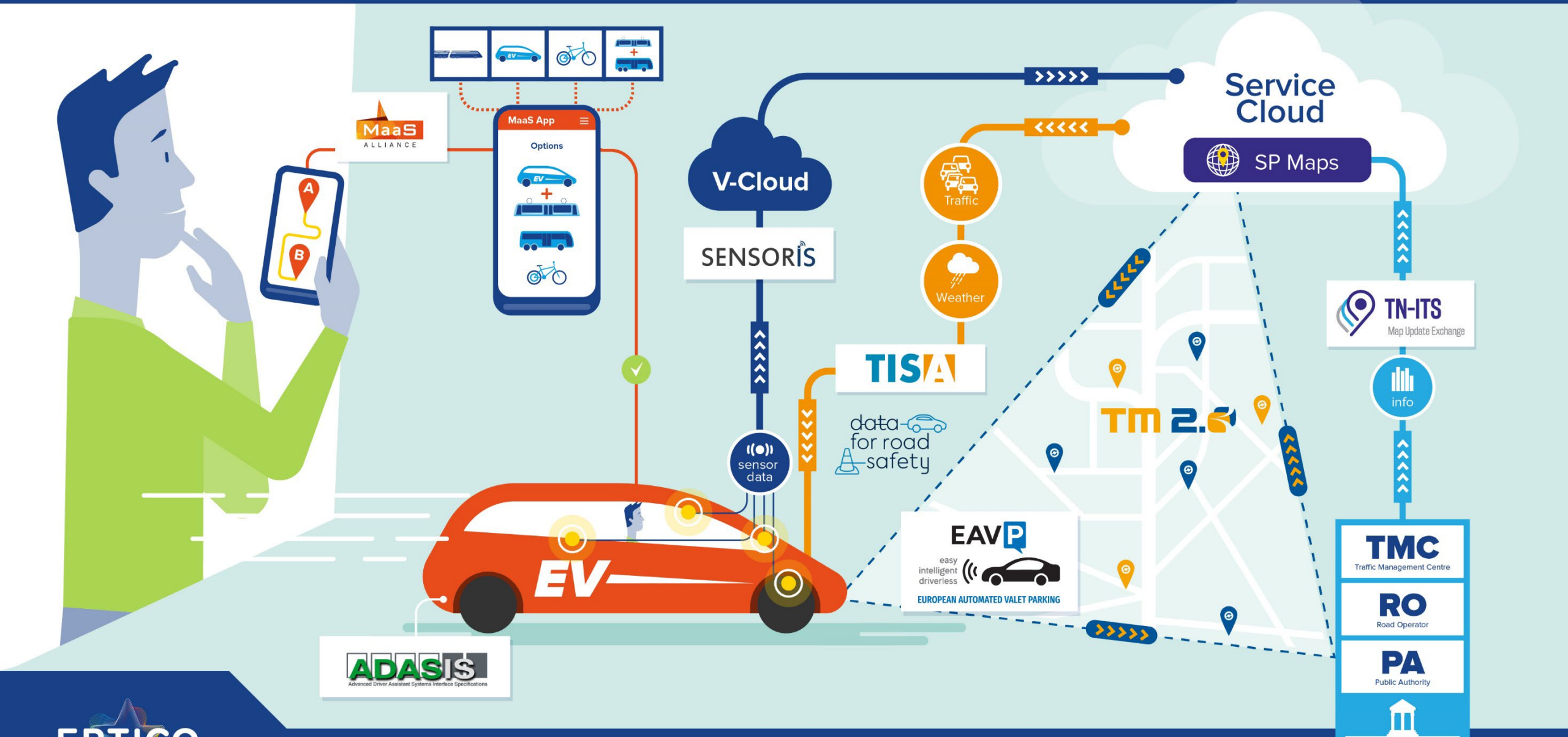
eMobility

Focus Areas


Vision
Safe, smart, sustainable — ERTICO brings intelligence into mobility towards:
SUSTAINABLE MOBILITY
contribute towards
zero impact
on the environment
EFFIECIENT MOBILITY
contribute towards
zero delays
and fully informed users
SAFE MOBILITY
contribute towards
zero accidents
Mission
ERTICO develops, promotes and deploys intelligent transport services by providing a multi-stakeholder platform for action.
6


Sustainable & Smart Mobility
Connected, Cooperative and Automated Mobility
Clean and eco-mobility
Urban Mobility & MaaS
Transport and Logistics

SMART MOBILITY DEPLOYMENT BY ERTICO PARTNERSHIP



ERTICO
ITS EUROPE

AI in the labyrinth of EU policies

- Increasing the uptake of **zero-emission vehicles**
- Making **sustainable alternative solutions** available to the public & businesses
- Supporting **digitalisation & automation**
- Improving **connectivity** & access

- Establishment of EU-wide common, interoperable data spaces including a **Common European mobility data space**
- **Framework for cybersecurity and artificial intelligence**
- Review of the ITS Directive and its Delegated Regulations
- Stronger coordination mechanism **federating National Access Points**

- Making the EU transport system **sustainable**, **smart** and **resilient**
- **Automated mobility** deployed at large scale by **2030**
- **82 initiatives** in 10 key areas
- Deployment and management of ITS and connected and automated mobility, facilitate cross border AV, recharging infrastructure, 5G

- Deliver at least **100 climate-neutral and smart European cities** by 2030
- Ensure these cities are **experimentation** and **innovation hubs** to support all European cities to become climate-neutral by 2050.
- **112 Mission** Cities selected

AI act: adopted by European Parliament 13 March 2024

- From EC proposal in April 2021 until final adoption
- https://www.europarl.europa.eu/news/en/press-room/20240308IPR19015/artificial-intelligence-act-meps-adopt-landmark-law
- New European AI Office : within EC DG CNECT
  - Coherent application of the AI Act across the Member States
  - Tools, methodologies and benchmarks for evaluating capabilities and classifying models with systemic risks
  - State-of-the-art codes of practice
  - Investigating possible infringements
  - Guidance and guidelines, implementing and delegated acts, and other tools to support effective implementation of the AI Act and monitor compliance with the regulation
  - Fostering international cooperation

European approach to trustworthy AI

What the new rules do:

- ❑ address risks specifically created by AI applications;
- ❑ propose a list of high-risk applications;
- ❑ set clear requirements for AI systems for high-risk applications;
- ❑ define specific obligations for AI users and providers of high-risk applications;
- ❑ propose a conformity assessment before the AI system is put into service or placed on the market;
- ❑ propose enforcement after such an AI system is placed in the market;
- ❑ propose a governance structure at European (European AI Board) and national level.

+ AI liability Directive is proposed by the Commission on 28 September 2022

Applicable to whom?

- **Providers** of AI systems established within the EU
- **Users** of AI systems located in the EU
- Providers and users of AI systems located in a **third country** where the output produced by those systems is **used in the EU**
- Not applicable to AI systems developed or used exclusively for military purposes, to public authorities in a third country, nor to international organisations, or authorities using AI systems in the framework of international agreements for law enforcement and judicial cooperation

Examples of use cases in Transport and Mobility

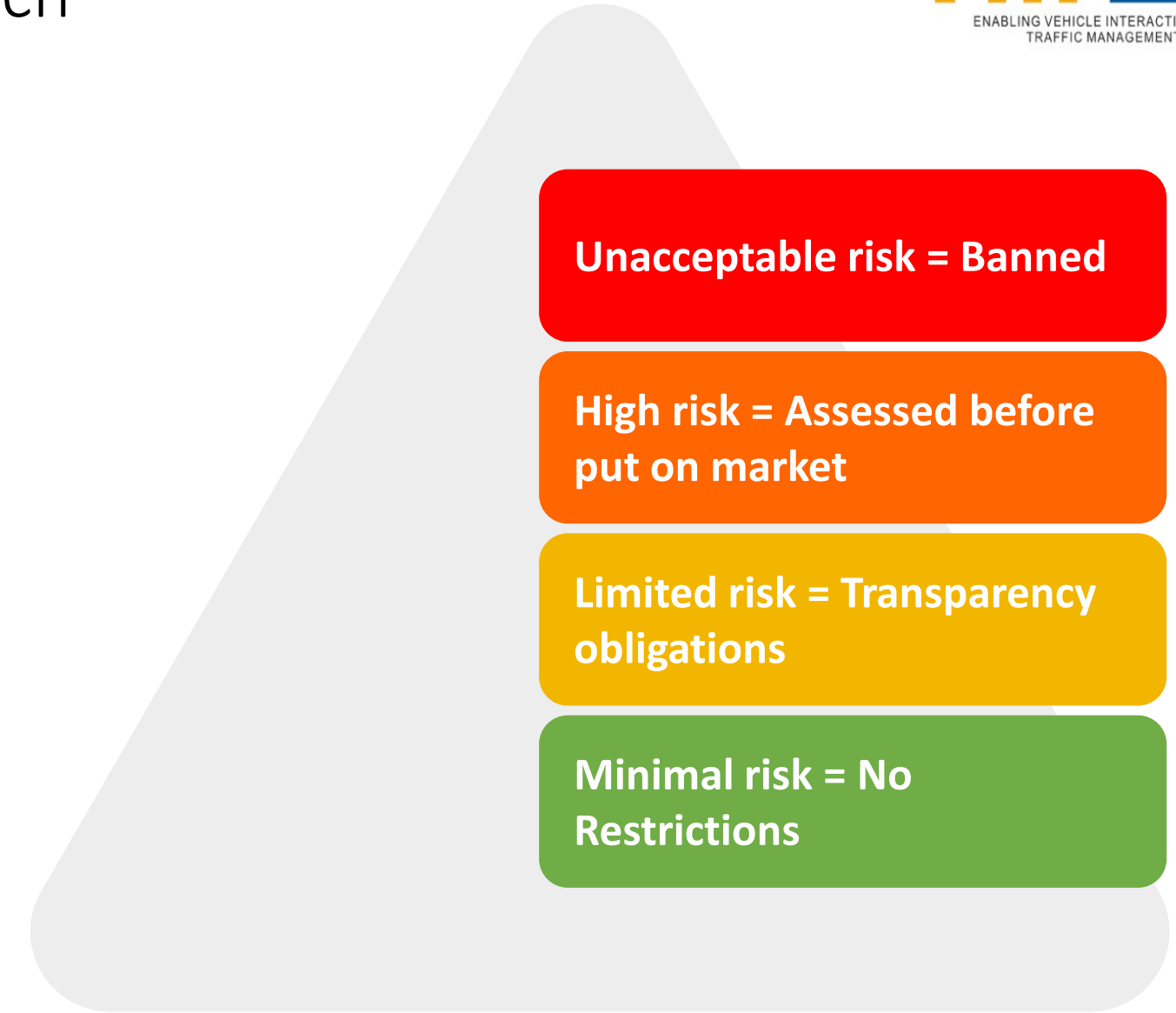
- Safety (smart intersections, dangerous driving, …)
- Efficiency and sustainability (EV charging, remote sensing, environmental impact assessments, predictive maintenance, traffic signal optimisation , …)
- Multimodality (group behaviour, traffic signalling, …)
- Equity (accessibility, optimisation, …)

Essential:

- Quality of data and real-time/up-to-date data
- Increased computing power/upgrade digital networks

AI Act – Risk Based Approach

Regulatory requirements tailored to the level of risk to health, safety or fundamental rights



AI Act – Risk Based Approach

Unacceptable risk = Banned

High risk = Assessed before put on market

Limited risk = Transparency obligations

Minimal risk = No Restrictions

Requirements for Providers of High-Risk AI systems

Conformity assessment:

- Data & Data Governance Transparency
- Accuracy, Robustness & Cybersecurity
- Human Oversight
- Risk & QMS
- Technical Documentation
- Record keeping
- Declaration of conformity /CE marking
- Post-market monitoring system & incident reporting

Requirements for Deployers of High-Risk AI systems

- Fundamental rights assessment & Data Protection Impact Assessment (DPIA)
- Ensure proper use according to providers' instructions
- Human oversight, training and authority
- Ensure relevant & representative input data
- Fulfill monitoring, record-keeping, incident reporting

“AI systems intended to be used as safety components in the management and operation of road traffic” are

The EU Commission shall provide **Implementation Guidelines** for high-risk AI systems incl. **practical examples of high risk and non-high risk use cases**

TM2.0 – Position Paper

ENABLING VEHICLE INTERACTION WITH TRAFFIC MANAGEMENT

ERTICO

TM 2.0

Artificial Intelligence (AI) Act – TM2.0 Platform Position Paper

The TM2.0 Innovation Platform (an initiative under the ERTICO umbrella of activities) wishes to provide feedback regarding the AI Act and in particular the inclusion of the management and operation of road traffic in the list of High-Risk systems in Annex III of this proposed piece of legislation. TM2.0 is in a unique position to assess developments in the road traffic sector, as it brings together all relevant stakeholders from the public and private sector with the aim to promote and deploy interactive Traffic Management.

TM2.0 acknowledges the European Commission's endeavor to regulate how AI is used and developed within the EU to ensure the use of AI does not jeopardize citizens' safety, security, and fundamental rights. The adoption of the EP's negotiating position on the AI Act on 14 June this year and the commencement of the inter-institutional discussion with the European Council on the final form of the law makes it necessary to provide some clarifications on the categorization of Traffic Management as a 'high risk' area. The elaboration of guidelines regarding the AI Act's High-Risk Use Cases by the European Commission once the law is adopted, requires that the TM2.0 traffic management community contributes to this effort by offering clarifications on some important points to be taken into account during the implementation phase.

In our view, the future High-Risk sector specific guidelines for the road traffic sector should **i) include a risk-assessment approach based on criticalities ii) be developed together with all sector stakeholders, and iii) not hinder innovation that benefits road safety**.

---

i. **Defining High-Risk AI applications in Traffic Management should be based on a proper risk assessment based on criticality.**

The risk the use of AI in the road traffic sector bears, should always be related to the place of the AI application along the so-called 'traffic management data decision chain' i.e., a sequential or interconnected series of decisio

Ensure Implementation Guidelines for High-Risk AI-systems in Traffic Management are in line with the Risk-Based Approach

TM 2.6

ENABLING VEHICLE INTERACTION WITH TRAFFIC MANAGEMENT

Enabling interaction between travellers and traffic and mobility management

ERTICO

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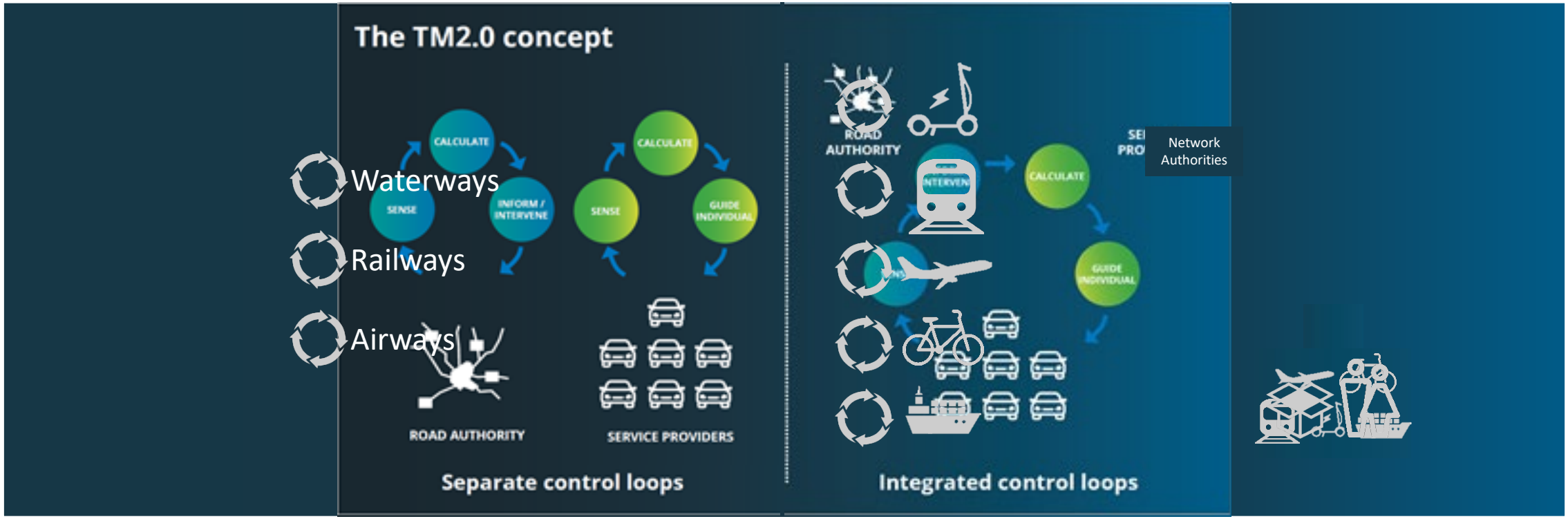
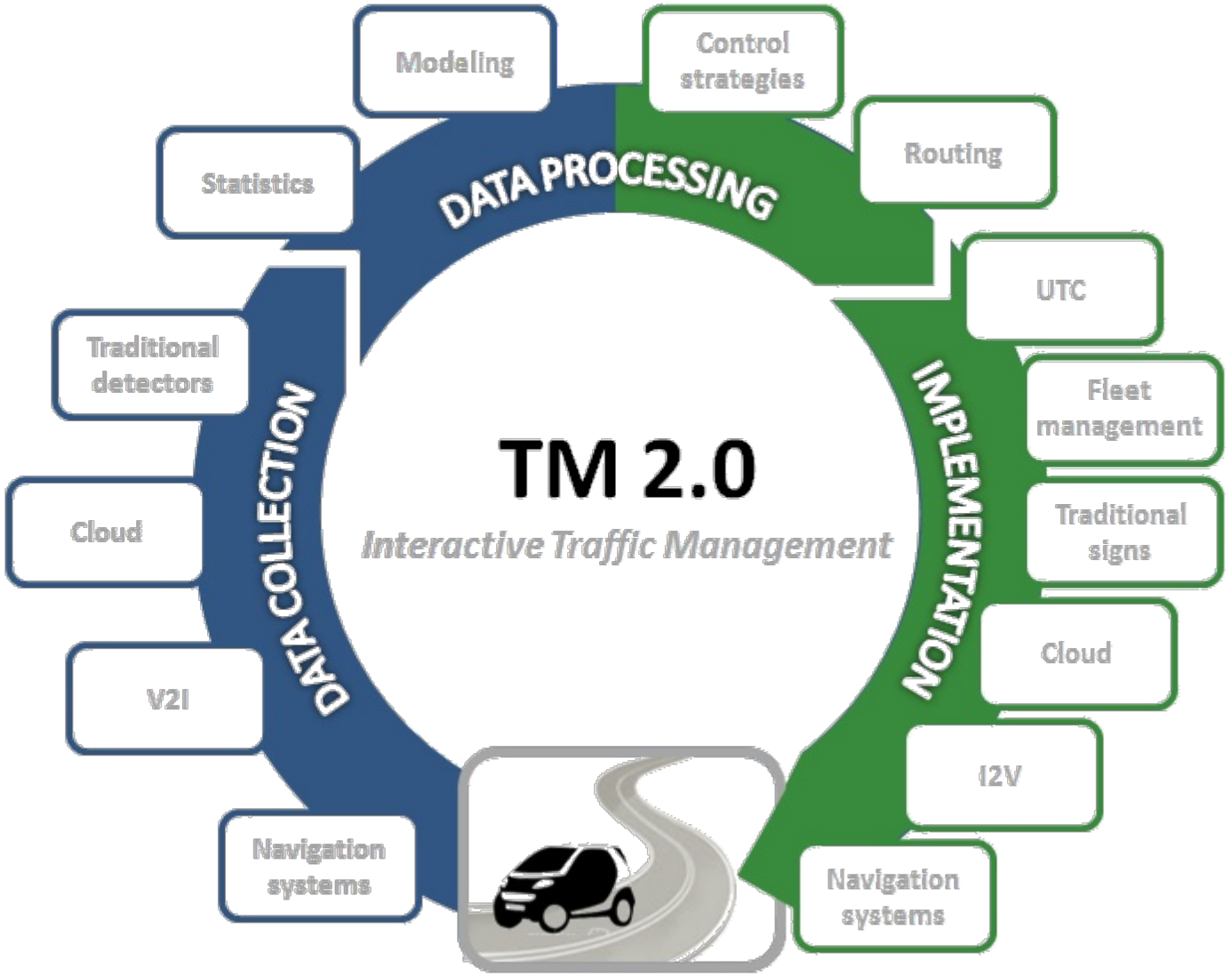
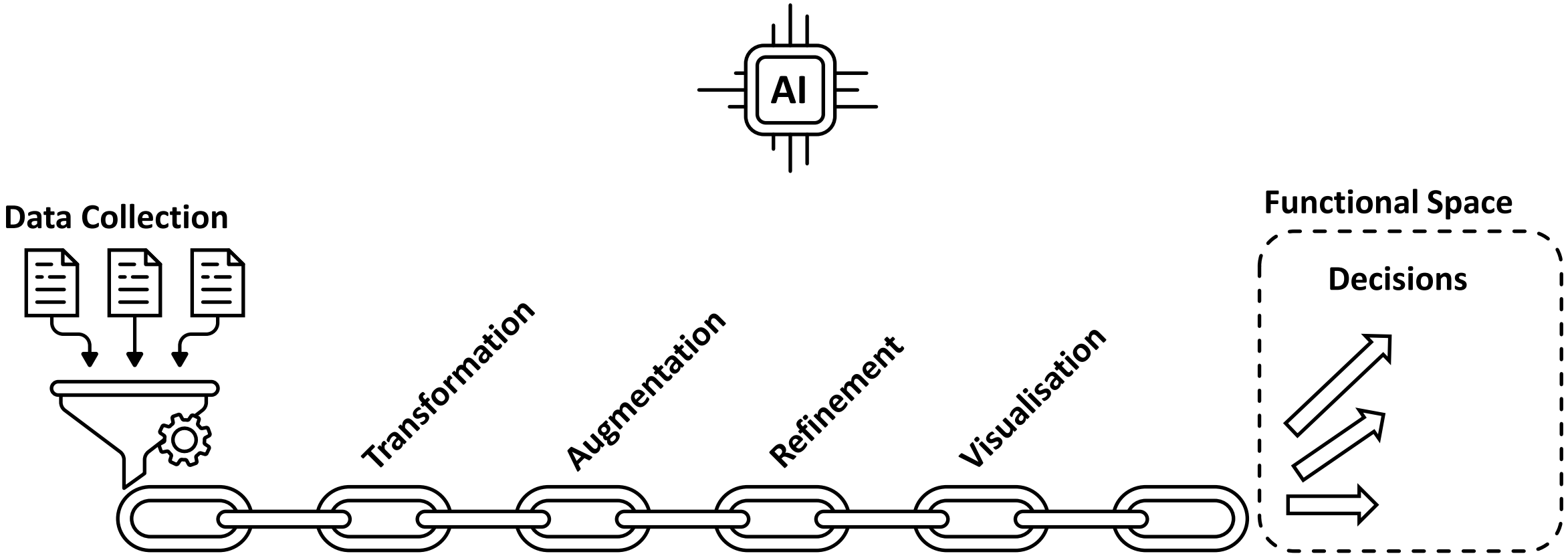
Traffic Management moving from traditional situations to combined cycles of control



The TM 2.0 Process Data needs & Data feeds



ERTICO / TM2.0 – Position Paper



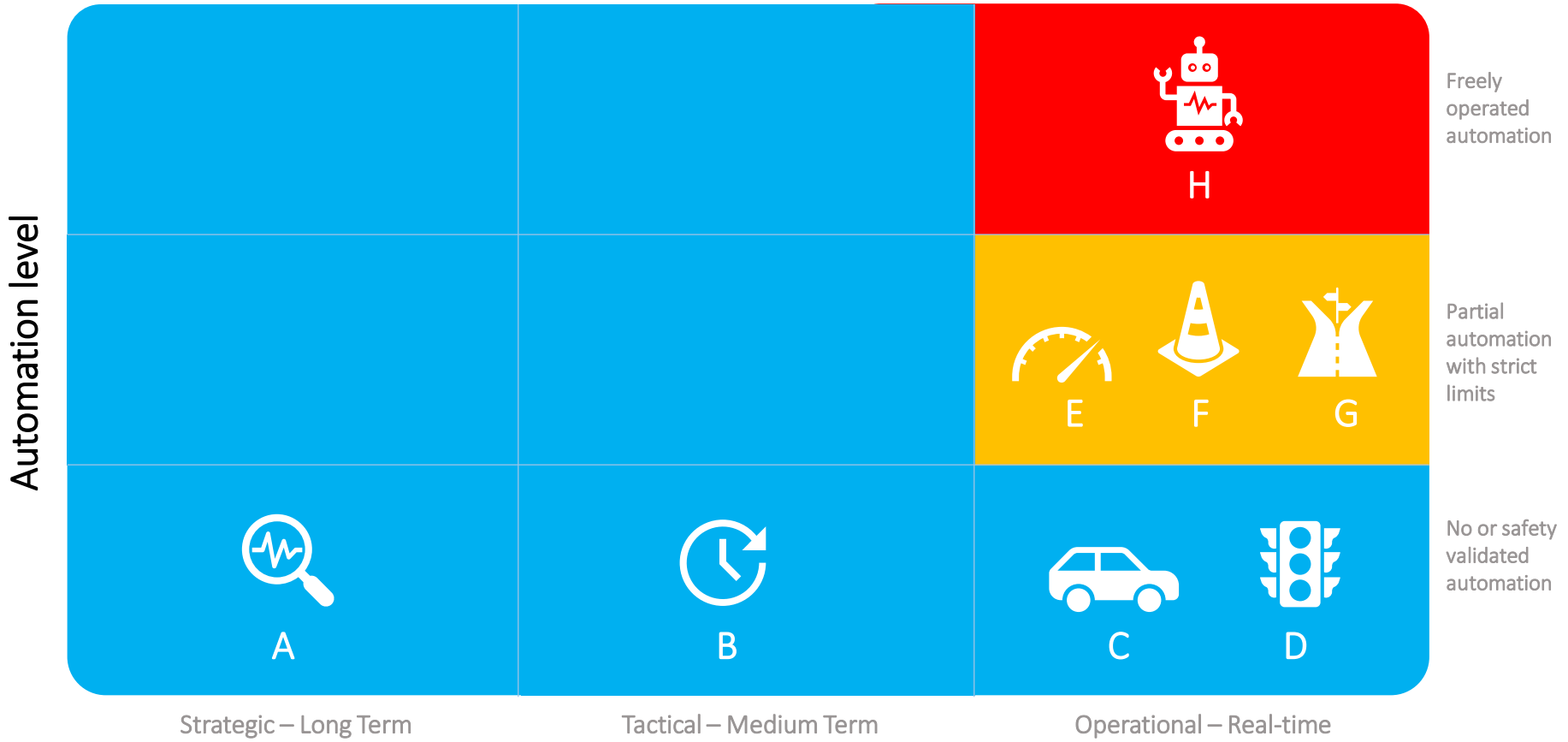
AI in Traffic Management

Use Case Based Risk Assessment

TM 2.0
ENABLING VEHICLE INTERACTION WITH TRAFFIC MANAGEMENT

- A. Data Driven Traffic Analytics
- B. Traffic Prediction and Flow Optimization
- C. Real-Time Traffic Management
- D. Non-critical phase management
- E. Adaptive speed limits
- F. Hard shoulder Management
- G. Dynamic Lane Management
- H. Responsive & Adaptive Control *

* Not know to be in operation yet

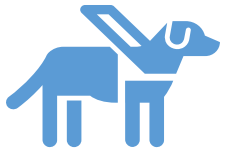


LOW SAFETY CRITICALITY
No automated changes triggered or limited to safety validated functional space outcome (no conflicts possible)

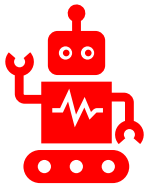
MEDIUM SAFETY CRITICALITY
Automated changes are triggered in real-time but within strictly set limits for functional space outcome

HIGH SAFETY CRITICALITY
Full dependency on AI chain outcome, no limits set for functional space outcome

ERTICO / TM2.0 – Position Paper Key Messages



AI in Traffic Management today still mainly plays an **advisory**, **supporting role** by **improving monitoring capacities** and **planning** to avoid traffic disruptions



Only AI systems triggering **automated changes** to the road infrastructure **in real-time without human intervention** and with an **unlimited set of possible outcomes in the functional space** should be labelled **High-Risk**

AI Act High-Risk Implementation Guidelines for the **traffic management sector** should be **developed** together with **all sector stakeholders**

Get in touch

Coen Bresser c.bresser@mail.ertico.com

Milica Žižić m.zizic@mail.ertico.com

Céline Lefort c.lefort@mail.ertico.com

www.tm20.org

ENABLING VEHICLE INTERACTION WITH TRAFFIC MANAGEMENT

Thank you

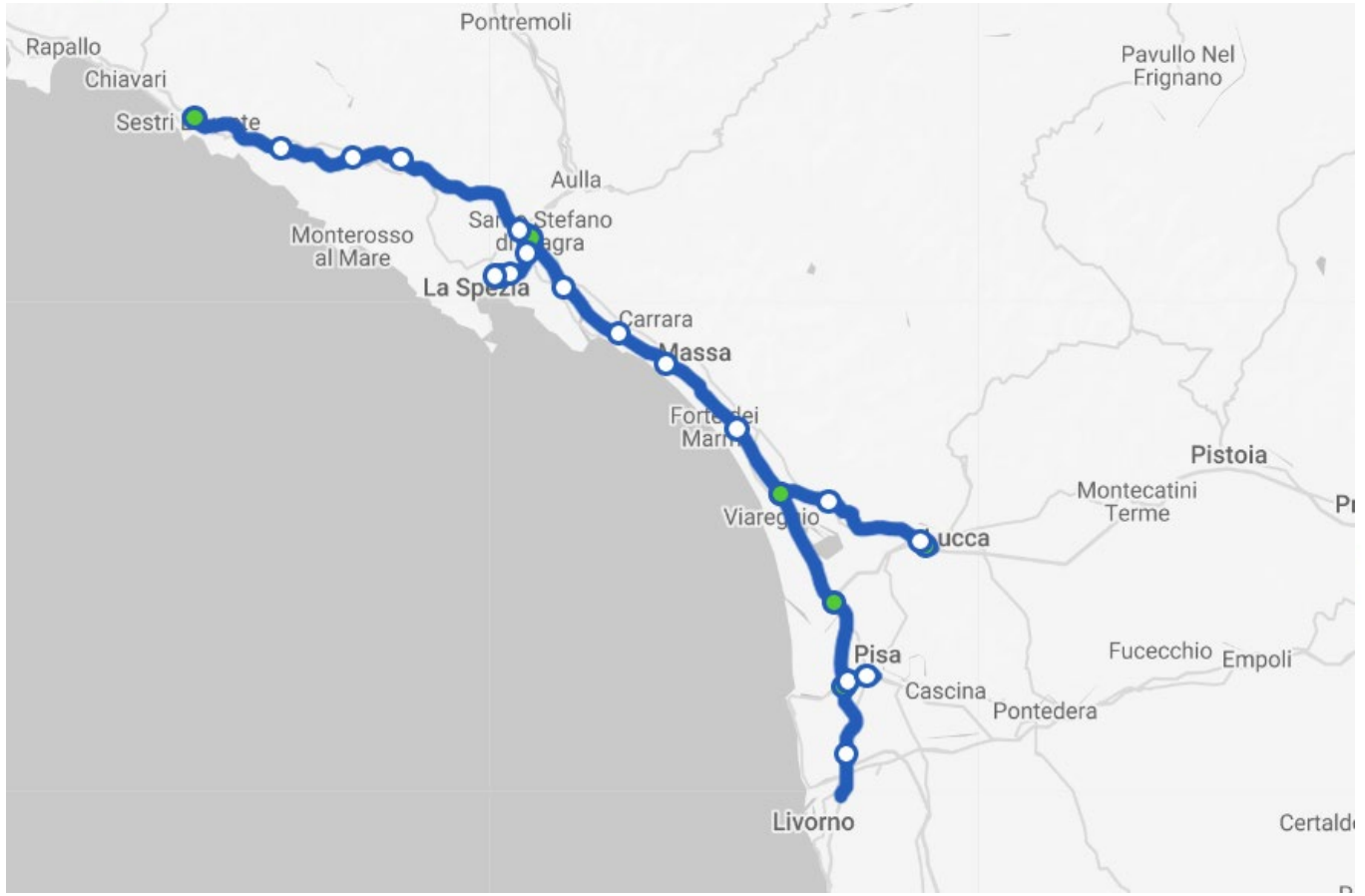
ERTICO ITS EUROPE

AI software for automatic traffic and incident detection in tunnels

Paola Mainardi (SINA)

Project title: *Artificial intelligence software for automatic traffic and incident detection in tunnels > 500m*

- **Implementer:** Concessioni del Tirreno S.p.A.
- **Localization:** A12 Sestri Levante – Livorno, A15 Urban Penetration of La Spezia – only tunnels > 500 m (Core network): 30KM
- **Start / End date:** 15/06/2023 – 31/12/2023
- **Description:** Development and installation of an innovative software using artificial intelligence for automatic traffic and incident detection in order to reduce the number of false alarms inside tunnels
- **Co-funding**: MATIS project



Concessioni del Tirreno

➢ Technical description:

traffix.ai software, developed by Sprinx, is a solution dedicated to critical infrastructures such as roads, highways, tunnels, bridges, and viaducts, capable of analyzing video streams in real time to classify vehicles and quickly identify abnormal situations in traffic.

The use of sophisticated 3D object tracking algorithms combined with the Deep-Learning module, has made it possible to achieve extremely interesting detection performances in the field, indoor but also outdoor, introducing a completely new approach to video analysis (AID).

The software allows to quickly alert operators in case of accidents and / or traffic slowdowns, sending notifications of events as well as to the management platform, to third-party systems (e.g. VMS, ITS or SCADA software platforms) able to trigger visualization and intervention scenarios.

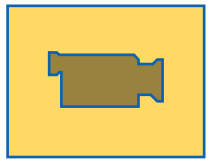
The software also allows to collect statistical data relating to traffic, integrating functions typically delegated to other technologies / sensors.

Co-financed by the Connecting Europe Facility of the European Union

➢ How it works:

The traffix.ai software platform is available both server-side and onboard standard CCTV cameras. Sprinx, as an Independent Software Vendor (ISV), is focused on developing software platforms that can be installed on market hardware and belonging to different brands, both server-side and at the edge.

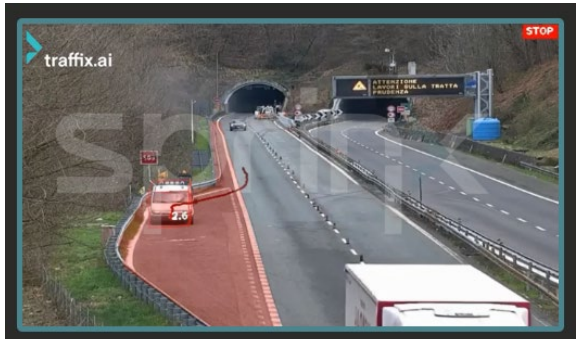
In the case of server-side solutions, the Sprinx solution is entirely agnostic to the camera brand, requiring a standard Onvif-RTSP stream for analysis. The traffix.ai can be installed on a standard PC platform, using just the CPUs, thanks to the AI inference engine based on the Intel® OpenVINO™ toolkit, or **Nvidia GPUs**, according to the system requirements.



Co-financed by the Connecting Europe Facility of the European Union

➢ Artificial Intelligence (AI – Deep Learning) & 3D Object Tracking

traffix.ai is able to recognize objects in real time from models using neural networks already trained (*Deep Learning*), and then reconstruct the trajectory within a three-dimensional model calculated on the entire image (*3D Object Tracking*). This combination allows to combine an extremely high detection capability with a drastic reduction of false alarms.



Stop Vehicle

For example, the following events can be detected:

- Stop vehicles;
- Slowdown, congested traffic, queue;
- Pedestrians;
- Wrong-way driver;
- Smoke or loss of visibility (for indoor applications and with visible cameras);
- Spilled cargo in the roadway (for indoor applications and with visible cameras).

Slowdown & Queue

Co-financed by the Connecting Europe Facility of the European Union

➢ Traffic data collection

traffix.ai can collect traffic data for statistical purposes, allowing cameras to be used for predictive and mobility analysis purposes.

In detail:
- Counting of vehicles in transit;
- Classification of vehicles in transit (4 classes: motorcycle, car, van, truck/bus);
- Average vehicle transit speed divided by vehicle class (km/h per class);
- Traffic density.

➢ Centralized management platform

The platform ensures a unified and centralized management and visualization of traffix.ai analysis systems.

The platform allows to graphically represent the connected video analysis systems in a unified way. Through the interactive interface it is also possible to manually filter and qualify the detected alarms, true or false, and display them on the relative graph.

https://youtu.be/Tuhhxkpmsj0

Co-financed by the Connecting Europe Facility of the European Union

Concessioni del Tirreno

➢ **Implementation:**

The project is **finished**, and the equipment was installed in every tunnel over 500 meters. The interested tunnels are 26 as planned: A12 Bordigona north and south, A12 Croce dei Tozzi north and south, A12 Giovannella north and south, A12 Ramello north and south, A12 Schiena di Sciona north and south, A12 Soggio north and south, A12 Costa di Roverano north and south, A12 Madonna del Poggiolo north and south, A12 Foce north and south, A12 Pian del Lupo north and south, A12 Pian della Madonna north and south, A15 Fresonara east and west, A12 Nocentini north and south.

+ LA15 Saturnia Tunnel (about 1900 m) – no TEN-T network, but tunnel with a single arch and with two-way traffic

➢ **Expected impacts:**

The new software with dedicated hardware will improve tunnel event detections by drastically reducing false alarms and identifying events that could not be detected by the previous software.

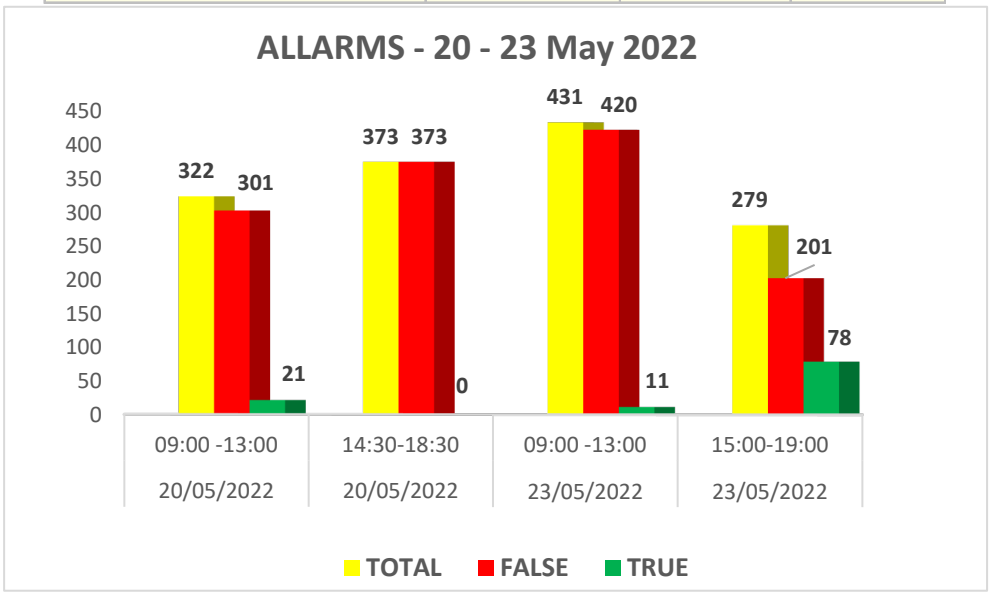
The use of this approach allows to considerably increase the performance of analysis and detection (AID) thanks to the reduction of false alarms typical of an analysis based on Computer Vision and to drastically reduce the tuning of the system.

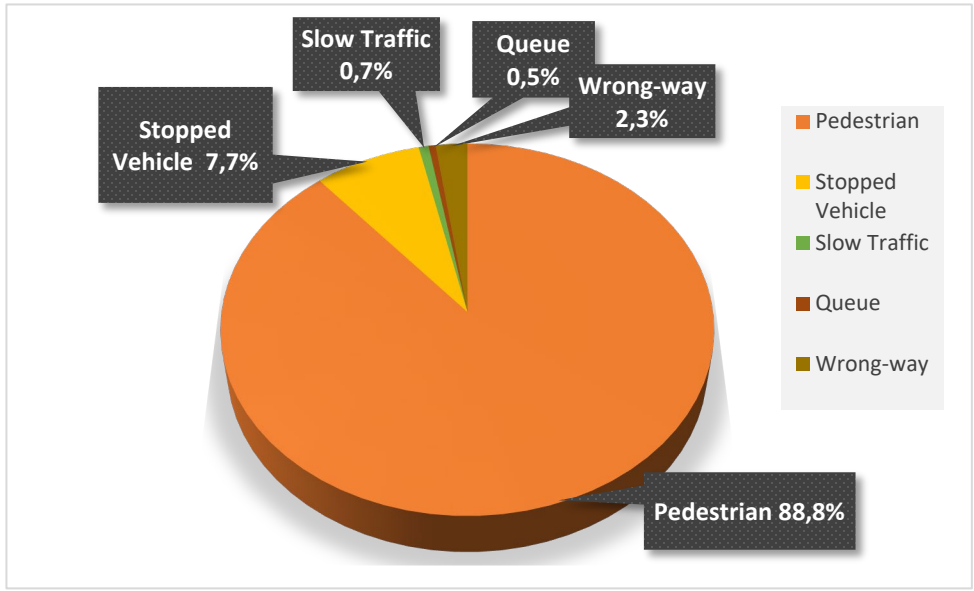
Co-financed by the Connecting Europe Facility of the European Union

1) Pre-AID Test

CASE STUDY N°1
Time: 20/05/22 --> 26/05/22 -Several time slots
OBSERVATION OF TOTAL TUNNEL ALARMS - Identification of RELEVANT false alarms

TEST		COLLECTED DATA - ALLARMS		
DATE	Time slot	TOTAL	FALSE	TRUE
20/05/2022	09:00 -13:00	322	301	21
20/05/2022	14:30-18:30	373	373	0
23/05/2022	09:00 -13:00	431	420	11
23/05/2022	15:00-19:00	279	201	78
	∑	**1405**	**1295**	**110**
*24/05/2022	09:00 -13:00	59	45	14
*24/05/2022	15:00-19:00	33	23	10
*25/05/2022	09:00 -13:00	13	13	0
*25/05/2022	15:00-19:00	24	24	0
*26/05/2022	09:00 -13:00	41	27	14
*26/05/2022	15:00-19:00	47	32	15
	∑	217	164	53





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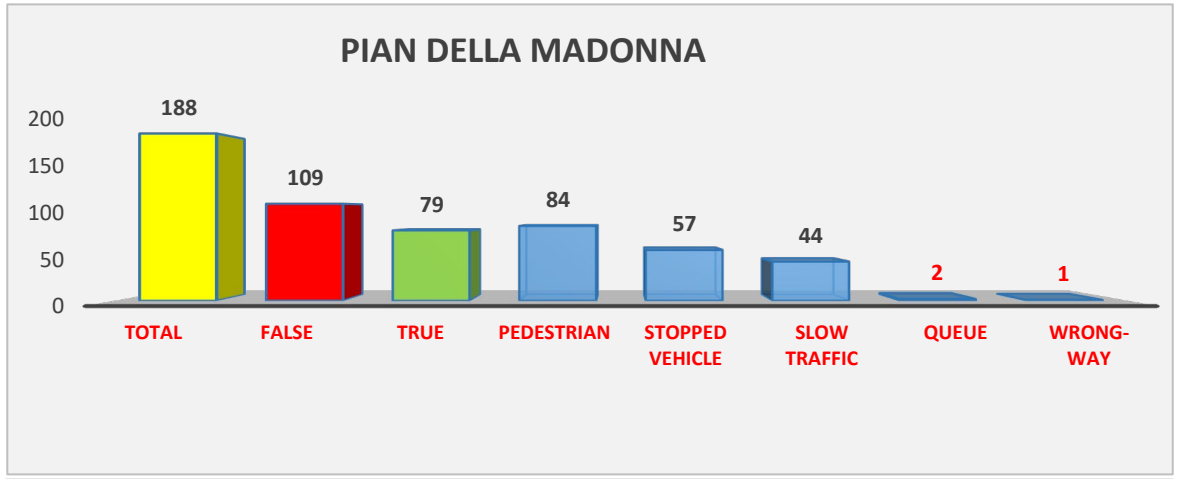
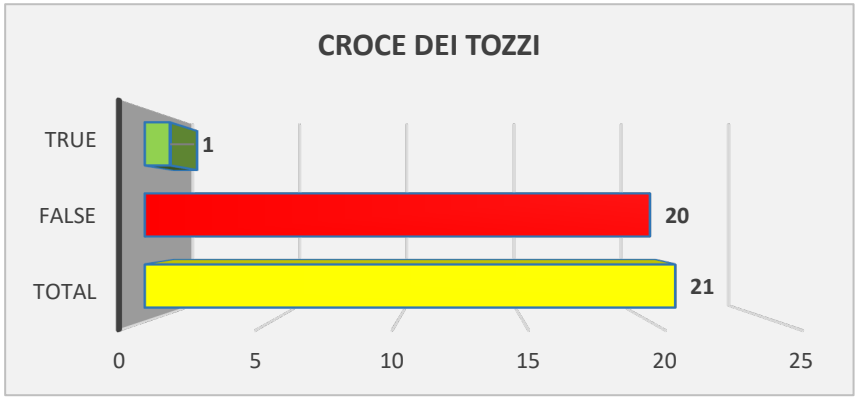
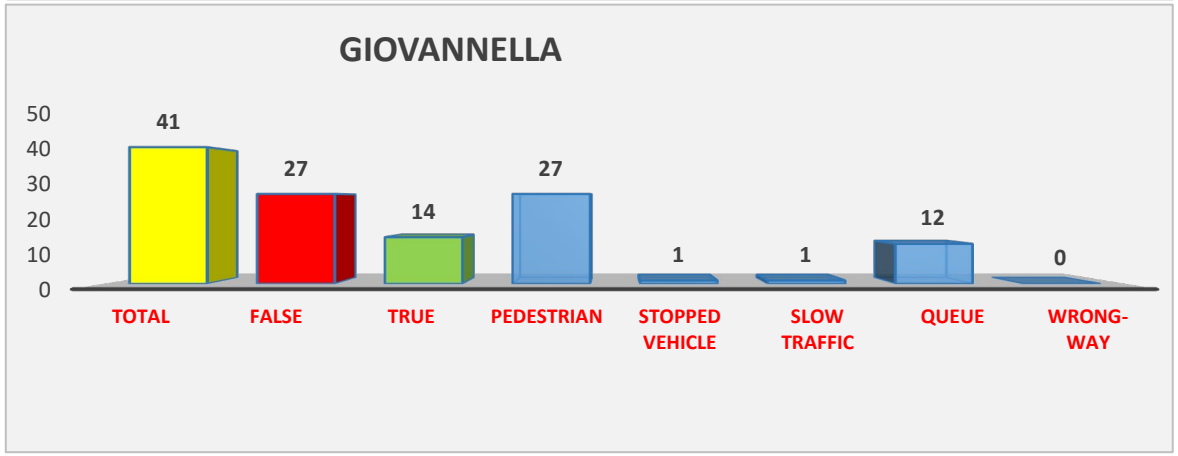
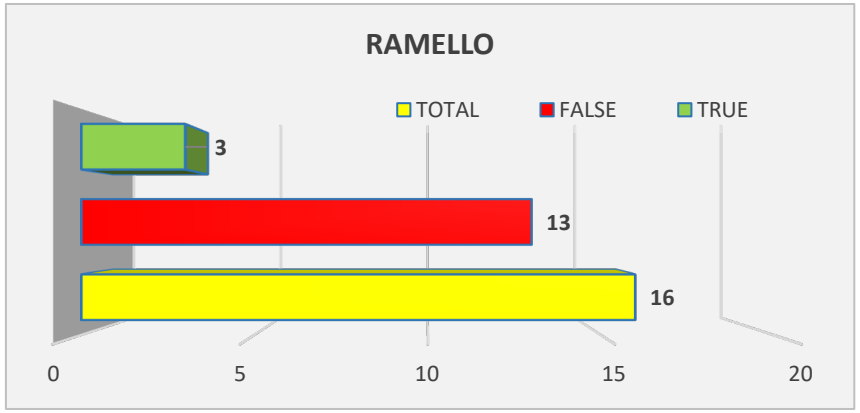
2) Introduction of AID

CASE STUDY N°2
Time: 16/06/22 --> 08/08/22
OBSERVATION OF TOTAL TUNNEL ALARMS - Identification of RELEVANT false alarms









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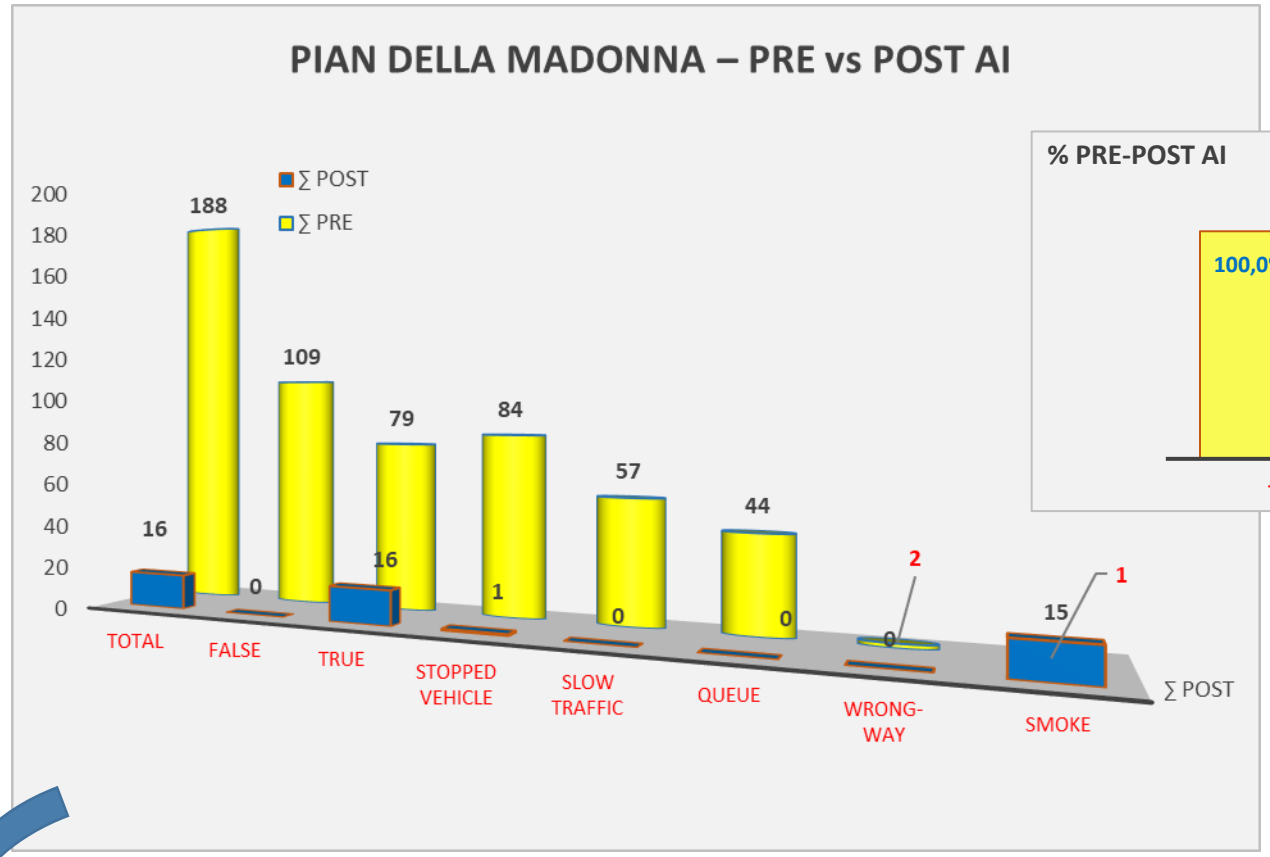
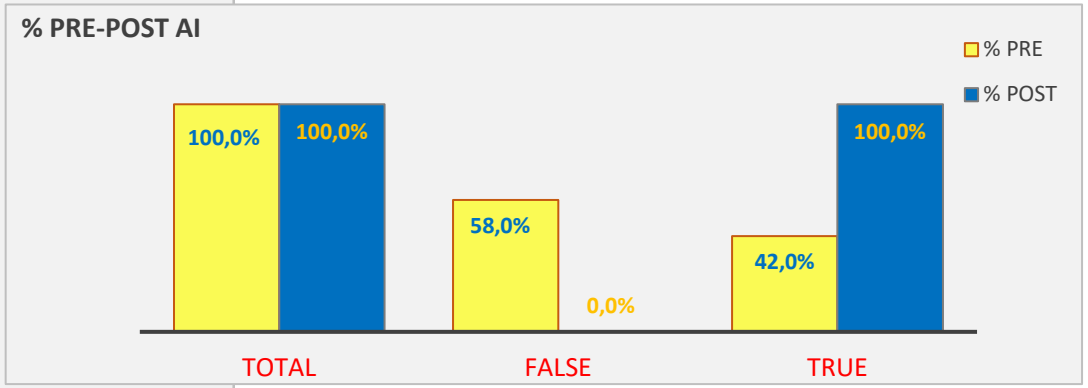
3) Post AI

CASE STUDY N°3
Time: 18/06/23 --> 01/07/23
AID vs AI (after 14 days from the installation of traffix.AI)





PARAMETERIZATION of the total alarm value on the evolution of traffic data (Pre vs Post AI)

Co-financed by the Connecting Europe Facility of the European Union

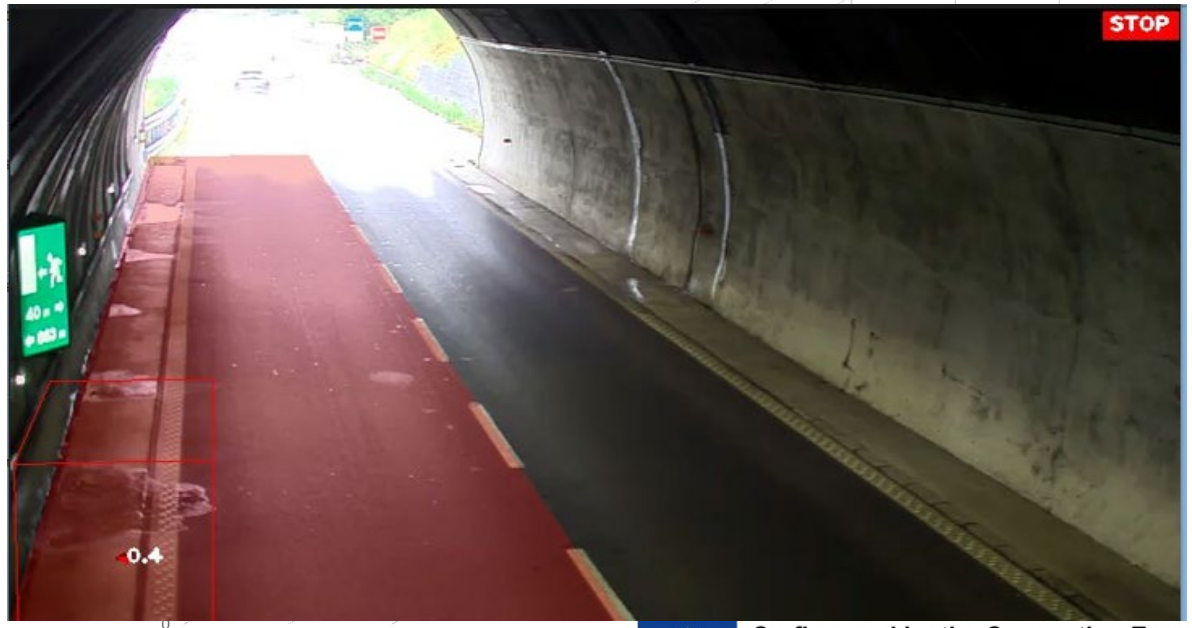
4) Current situation

CASE STUDY N° 4
Time: 07/05/24 --> 30/09/24
% False alarms on Total, investigation about the cause

	7 → 13 May	14 → 20 May	21 → 27 May	28 May→ 3 June	4 → 10 June	11 → 17 June	1 → 8 September	9 → 16 September	17 → 24 September	25 → 30 September
TOTAL ALLARMS	162	228	150	66	169	257	213	403	373	220
FALSE	9	4	4	0	1	7	8	8	10	18
% false	5,6%	1,70%	2,6%	0%	0,6%	2,7%	3,8%	2,0%	2,7%	8,2%
		Average:	3,0%				Latest data			

- **Some causes for the false allarms:**
  - ✓ Shadow projection
  - ✓ Green exodus sign
  - ✓ Water stagnation
  - ✓ Reverb
  - ✓ Bright light exiting tunnel

GALLERIA FRESONARA EST - WATER STAGNATION



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➢ **Feedback and lessons learnt:**

1. Artificial Intelligence (based on the inference engine) vs Computer Vision (based on pixel blobs): comparison of the two different systems in a situation with the presence of a vehicle with flashing lights that create intermittent glare effects > **AI vs ComputerVision_1.mkv**

2. Artificial Intelligence (based on the inference engine) vs Computer Vision (based on pixel blobs): comparison of the two different systems in a situation with the presence of traffic inside a tunnel and continuous glare effects through the headlights of oncoming vehicles > **AI vs ComputerVision_2.mkv**

Co-financed by the Connecting Europe Facility of the European Union

Concessioni del Tirreno

Thank you for the attention!

paola.mainardi@sina.it

Co-financed by the Connecting Europe Facility of the European Union

Break

Reconvene at 15h45 7 min break

Data Turbo Pipeline; digital incident management

Fred van der Zeeuw (Rijkswaterstaat)

Co-financed by the Connecting Europe Facility of the European Union

Rijkswaterstaat
Ministry of Infrastructure and Water Management

Co-funded by the European Union

MERIDIAN

Incident Management

A transformative journey from data utilization to machine learning.

Fred van der Zeeuw

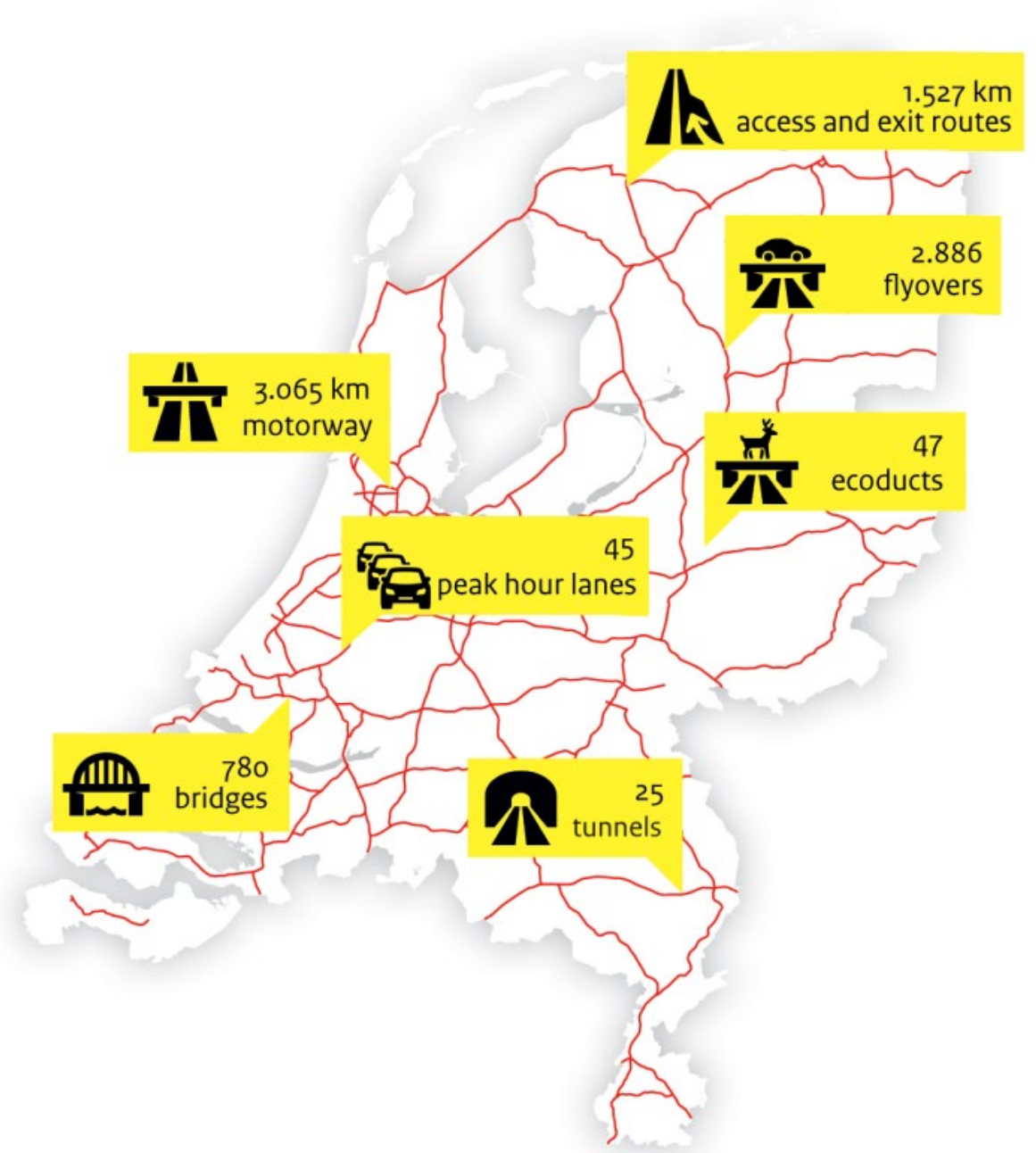
October 2024

Highways Network

- 68 billion vehicle kilometres annual
- 3 million road users daily
- High intensity

RWS agency:

- Builds road infrastructure
- Maintains road infrastructure
- Manages traffic



Traffic Management Operations

25,000
Dynamic lane operations

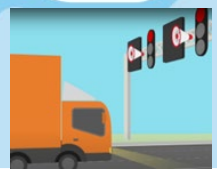
240,000
Incidents handled

29,000,000
Automatic que detection

>100,000
Manual lane closures

>100,000
Road Works measures

>100,000
Notifications to service providers



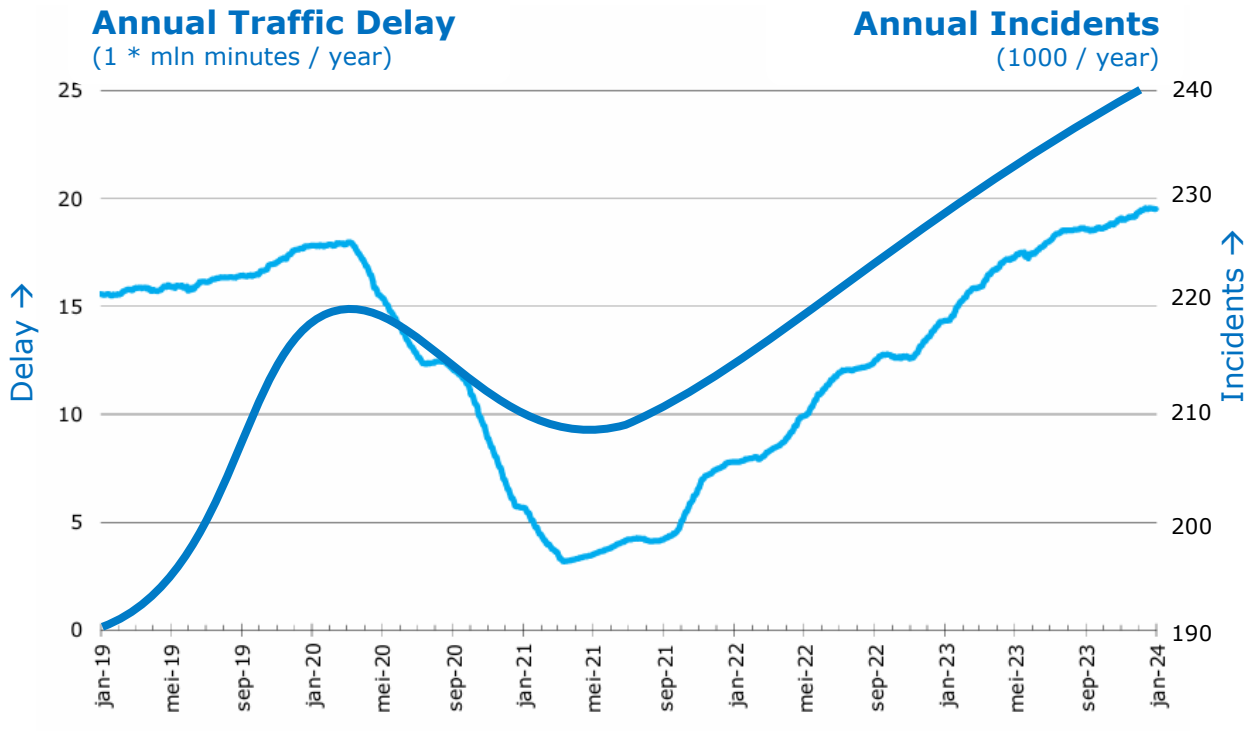
>100,000
Tunnel height alarm handling

13,000
De-Icing trips
471,000 km

Challenges

Incidentmanagement

Challenge



Incident Management Goal

-25% handling time

Incidentmanagement Process

Incident Source

Detection Sources	#
0800	16.000
Traffic Officers	55.000
112	73.000
Road side assist	33.000
Road operators	17.000
Loop data	20.000
WAZE	27.000

Traffic Man. Center

Traffic Officer

Tow Truck

Road Clear

Detect 0-? min

Average throughput 40 min

Response 19 min

Handling 21 min

Approach

Goal: -25% Handling

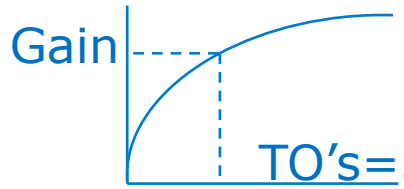
Constraint 1: Detection

Constraint 2: Response

Constraint 3: Handling

Constraint: Conflict

< Response = >TO



Conflict: Innovation

Predict Incidents/Coverage

Auto-deployment TO's

Digitized Transactions

Innovation: Deploy

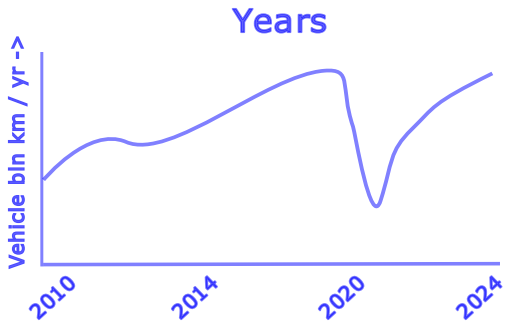
Small experiment 2020

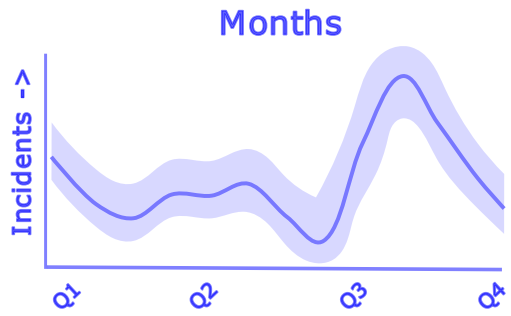
National Roll Out 2022

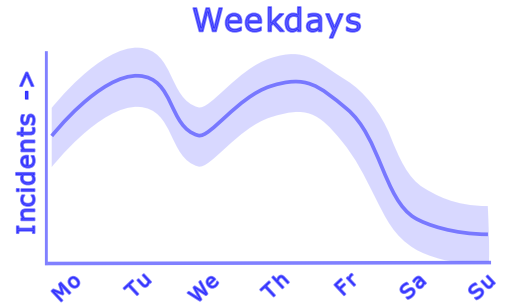
Result 11% & 11%

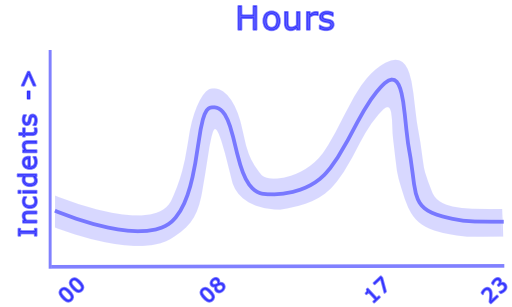
Approach

Patterns
Historical Data









Predictions
Lat-long-incident probability

Real Time Data
TO- Status, GPS, Speed, Direction

Real Time Redistribution
Optimizing Response Times

25 digit ->10.000 options simulated

Options ranking / selection

Traffic Operator Screen

Computed Risk Coverage

Within 15 minutes

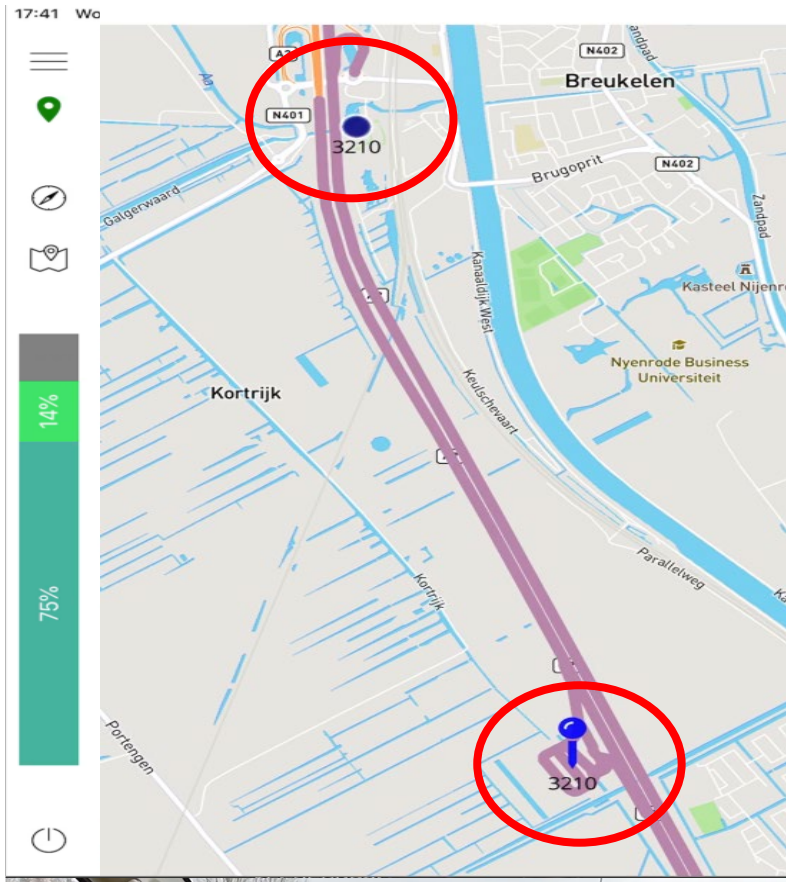
82% 6%

Within 10 minutes

62%

Laren
Hilversum
Baarn
3220 AVAILABLE
Soest
Bilthoven
3231 AVAILABLE
Maarssen
3227 UNMAPPABLE
Alphen aan den Rijn
Bodegraven
Woerden
Boskoop
3219 AVAILABLE
3218 ON_SCENE
Driebergen-Rijsenburg
Montfoort
Zeist
IJsselstein
1264 AVAILABLE
Gouda
Wijk bij Duurstede
Culemborg
3209 AVAILABLE
3204 AVAILABLE
Leerdam

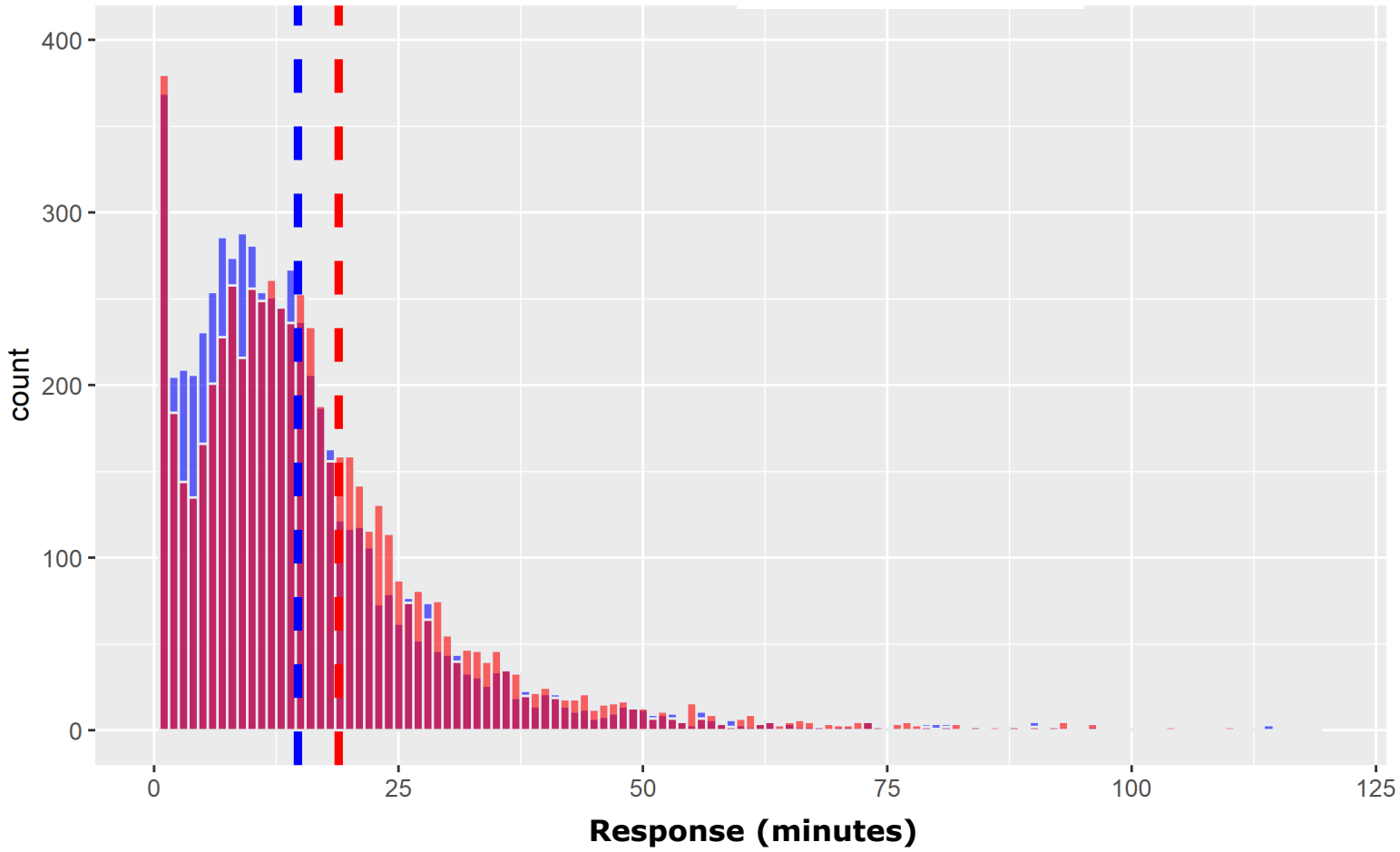
Traffic Officer Screen



Results

Response Time

DTP versus Legacy = -4.19 minuten, t-test 95% CI= -6.37/-2.00 minutes



Region	Legacy(m)	DTP(m)	Gain (%)
NL	18.88	14.69	22.19

- 11% on the road
- 11% in the data
- 6.8% throughput
- 4.3 mlnE/yr Traffic loss hrs

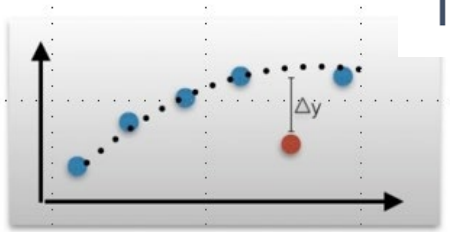
Journey

Fuzzy boundaries

Rule-based Decision making

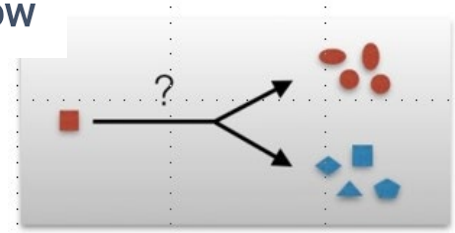
if condition fulfilled *then*
activity 1
else
activity 2

Statistical reasoning



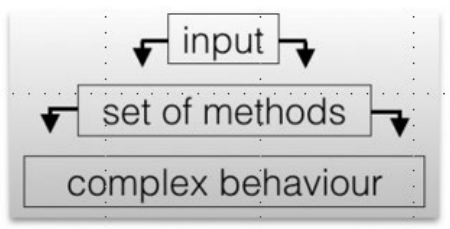
TensorFlow

Machine learning



Narrow Broad

Generative AI



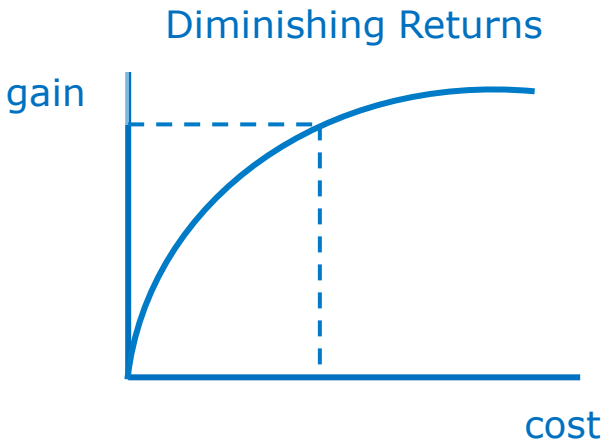
2000 2010 2020 2030?

Lessons Learned

- It’s the people (autonomy / explainability) not the tech.
- Small increments → failure = cheap & success = scalable.
- Doing is a part of thinking.

Looking Forward

People	Tech
Manual process operator	Statistics
Hybrid process operator	Machine learning narrow
Process supervisor	Machine learning broad
Process manager	Artificial generative intelligence



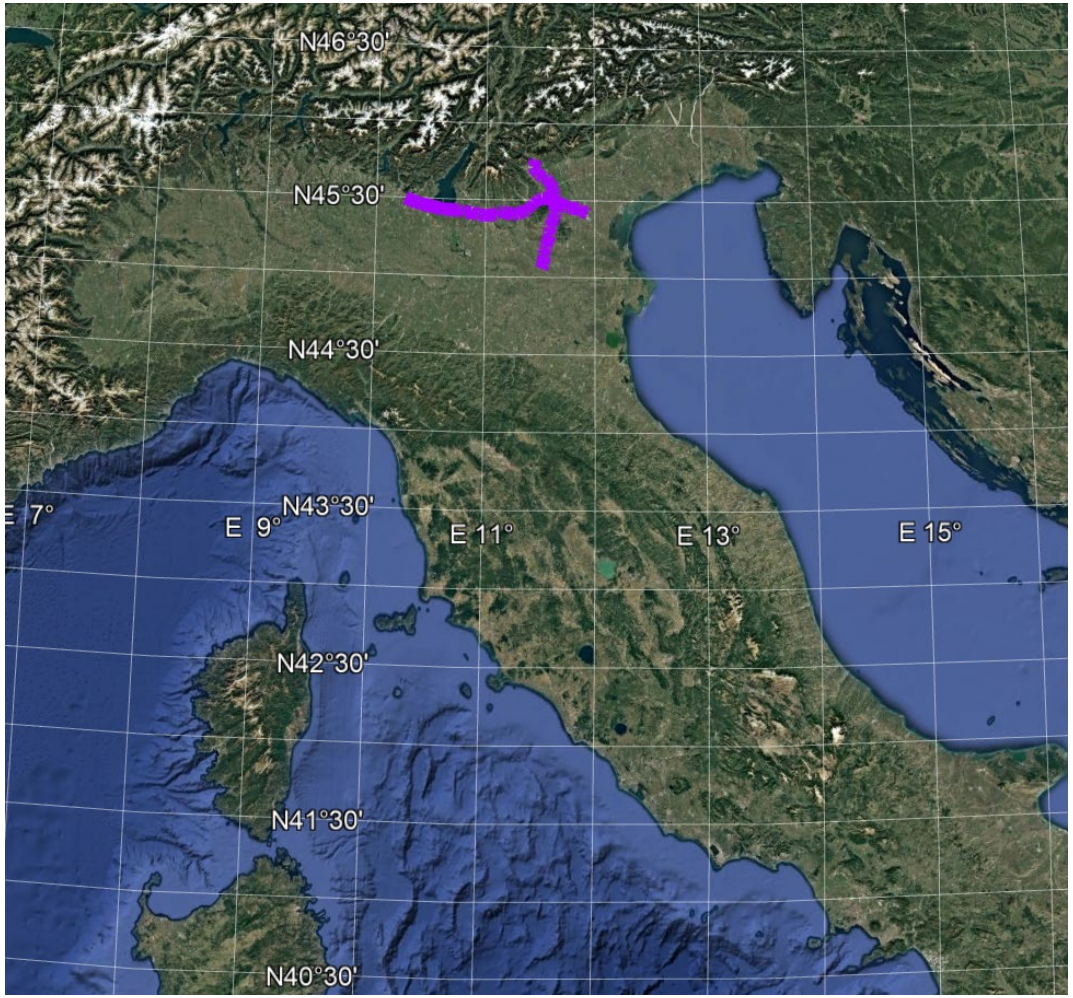
Questions

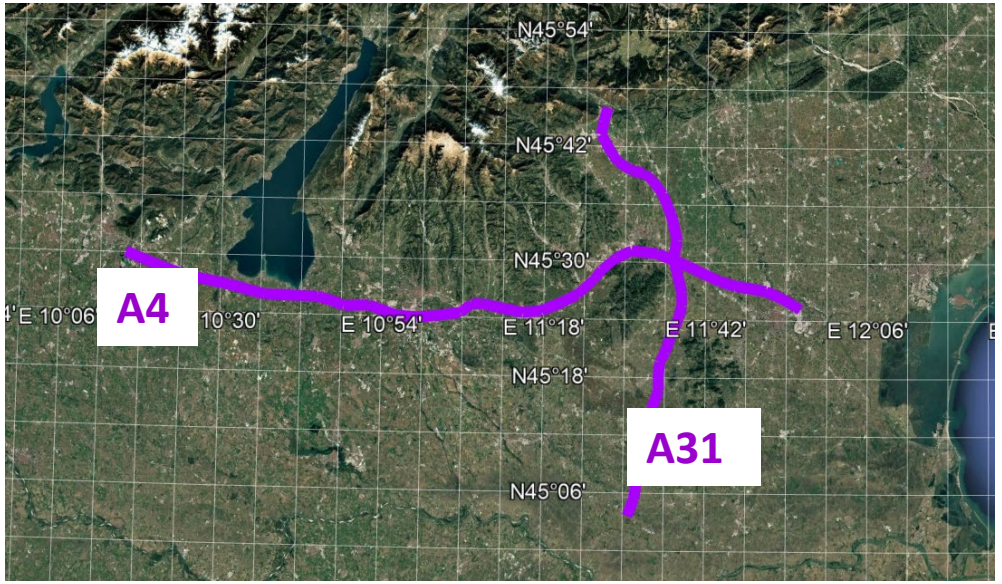
AI experimentation in the radar-based traffic counting and classification system along the A4 motorway

Matteo Gironi (A4 Mobility)

Autostrada BS-VR-VI-PD

Geographical position and extensions





Extensions:

260 km of tolling road managed

60 km of non tolling road managed

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AI experience in Traffic counting and classification

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A4mobility

<u>Needs that suggested to Auto BS-PD the experiment with Video Analysis based on Artificial Intelligence:</u>

In 2018 the Italian legislator emitted a decree about “Smart Roads”. Attached to that law, a technical sheet collects requirements about technological aspects.

For the traffic counting and classification aspect, it has been set a specific requirement that consist in the classification of 8 vehicle classes, distinguishing for example trucks from buses.

The radar technology that Auto BS-PD normally adopt, is able to perform classification exclusively based on length.

In order to search a way to satisfy the decree, classifying vehicles from the shape and the aspect, Auto BS-PD decided to experiment the adoption of a visual AI classification engine.

Autostrada BS-VR-VI-PD

AI experience in Traffic counting and classification

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Classes required by the Smart Road decree:

Dati da rilevare	a. Classificazione del veicolo (conteggi classificati, almeno 8 classi + 1) **: 1. Classe 1 (moto) 2. Classe 2 (auto) 3. Classe 3 (auto con rimorchio) 4. Classe 4 (furgone) 5. Classe 5 (camion) 6. Classe 6 (autotreno) 7. Classe 7 (autoarticolato) 8. Classe 8 (autobus) 9. Altro (non classificato) b. Velocità di transito (es.: Km/h) ** c. Istante di rilevamento (es.: gg/mm/aa, hh:mm:ss:mmm) d. Lunghezza veicolo (es.: cm) e. Headway temporale (testa-testa o coda-coda) rispetto a veicolo precedente (es.: millisecondi) f. Presenza di coda in corrispondenza del sensore*

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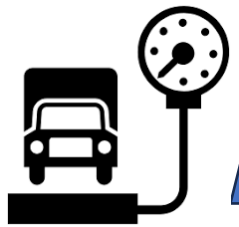
Logical flowchart of the plant



1x

WIM

5%

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80%

Radar sensor

30x radars

15%

Dedicated camera

4x FLIR dual

VA-AI classification engine

Auto BS-PD IOT environment

Central software ingestion layer

Sensor management console

Central software data storage layer

Power-BI data visualization

Co-financed by the Connecting Europe Facility of the European Union

Autostrada BS-VR-VI-PD

Examples of radars physical deployment

Auto BS-PD installed about 30 transversal multi lane radar sensors

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Examples of dedicate cameras physical deployment

Auto BS-PD installed 4 FLIR dual cameras to supply with streaming the AI engine

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Examples of dedicate cameras point of view

The VA-AI analysis is made both on the visual and the thermal images

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Logical flowchart of the VA-AI subsystem

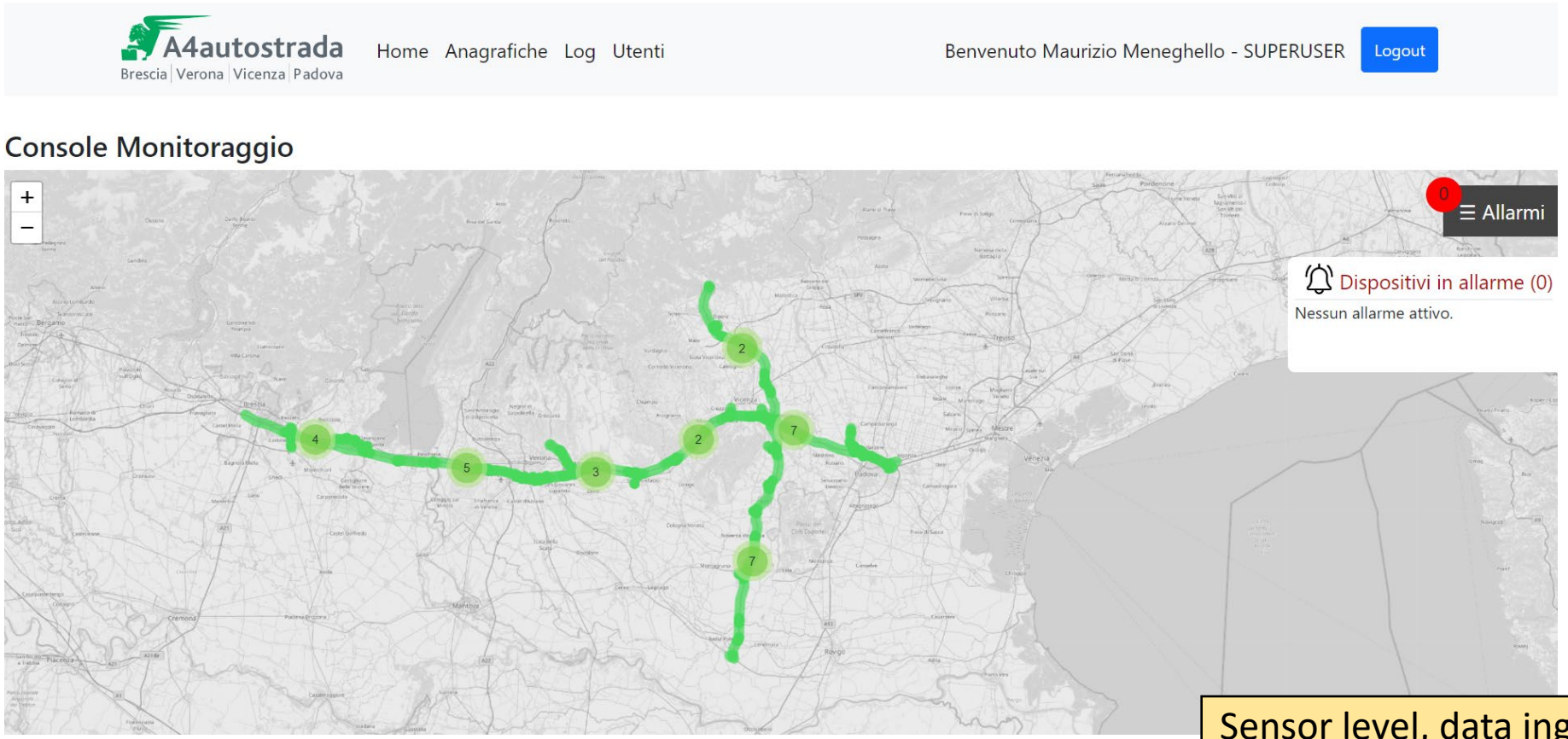
2x physical GPU powered server for the AI classification engine

External AI specialists from a specialized enterprise

fabbricadigitale

Autostrada BS-VR-VI-PD

Sensors management console



Sensor level, data ingestion software

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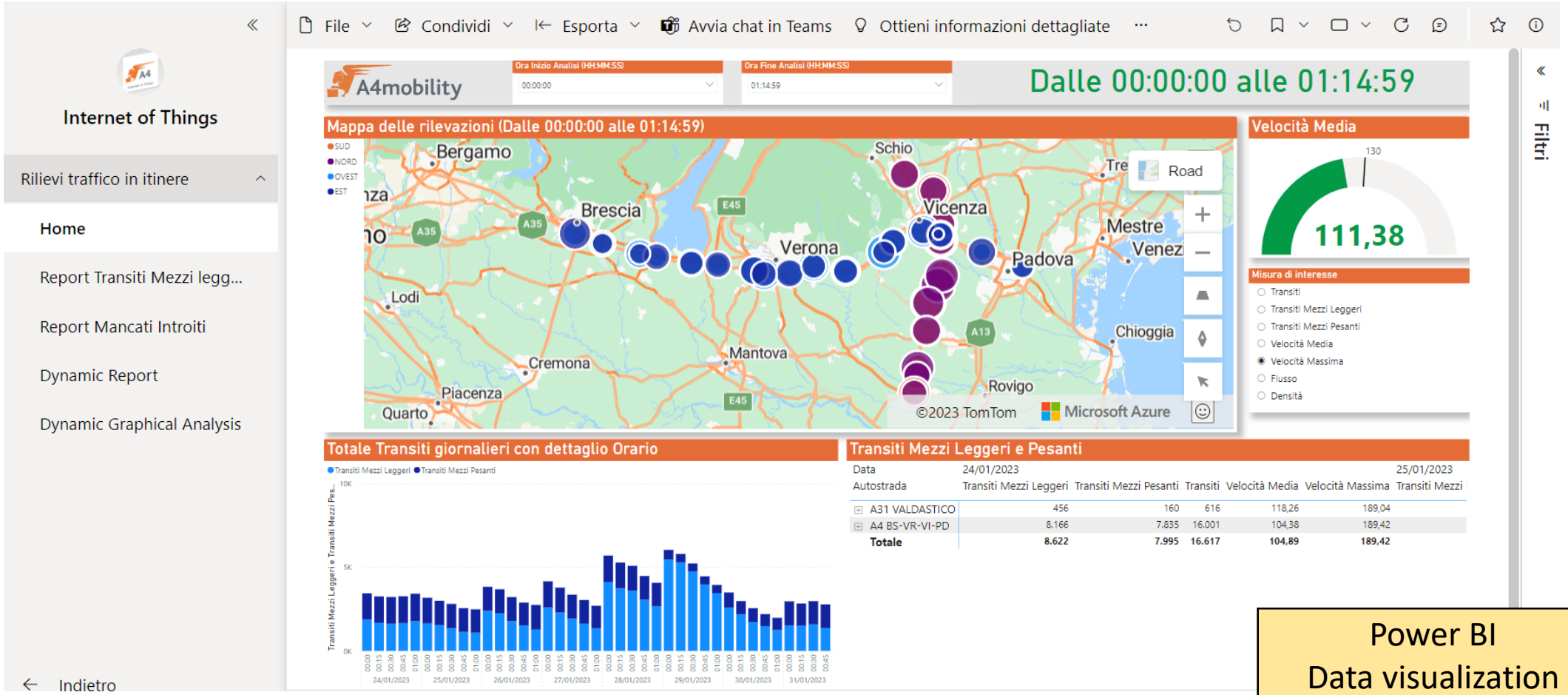
Data visualization via Power BI



Power BI
Data visualization

Autostrada BS-VR-VI-PD

Technical results and performance of the VA-AI component and of the entire system

Parameter	Results achieved from our VA-AI setup		Comparison to the entire plant
Traffic counting Video Analytic AI	Depending on the density of the traffic, up to 10% **less accurate** when compared to radars in the same situation	→	↑
Traffic classification	Not reliable due to an important decrease of accuracy when vehicles are overlapped	↓	→
Traffic mean speed estimation	Good	↑	↑
Vehicle punctual speed estimation	Not reliable for vehicle punctual values	↓	↑
Usage of the AI component	Data produced can be used only for statistical confrontation purposes. Not usable for punctual, real-time information.	→	n.a.

The **entire plant**, composed from all the kinds of sensors, give **optimums performance** in terms of statistical accuracy in data collected. The **Video Analysis based on Artificial Intelligence component** of the system is up and running but the quality of data is **less effective than the expectations**.

In order to improve the performance of the VA-AI subsystem, Autostrada BS-PD is planning a mid-term change of the technological approach, moving from a centre-based solution to a specialized, distributed, solution that uses traffic-specific on edge processing, applying updated and latest algorithms.

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How AI can help road asset experts in a smart way

Jānis Vilciņš (Latvian State Roads)

MERIDIAN

Hṅǖ Al ắƵļ ĝdǰǿ ễṅƵč Ƶř ř dș dľvǿdȫșř ħļ Ƶ ř ļ Ƶȫș ǖ Ƶwǿ

Jäļ ħĭ Ǘĥắħmî

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Ķƶşūħƶļ Rşƶşď Qṅƶč ř ļ ƶļ ƶẽdř

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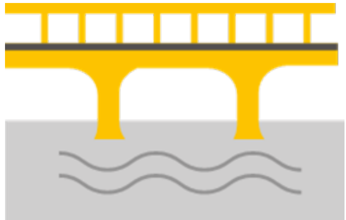

Bȃħč ẽ dř

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Cĝžjjdļ ēdř

MERIDIAN

Aååť öžåwṅęžååť ļ ťjžşdč čžşž ṅļ ä̈ṅžč jdļ ēşĝř6

- ¡Ĵ Ł ¡┼ žą̈ 7 ž┼ žą̈ dö̈şĝžş ĝdjøř şṅ┼žūłẽžşd'şĝd'ä̈ṅžč ļ dşü ṅą̈ 4Aļ č ṅļ jw4—

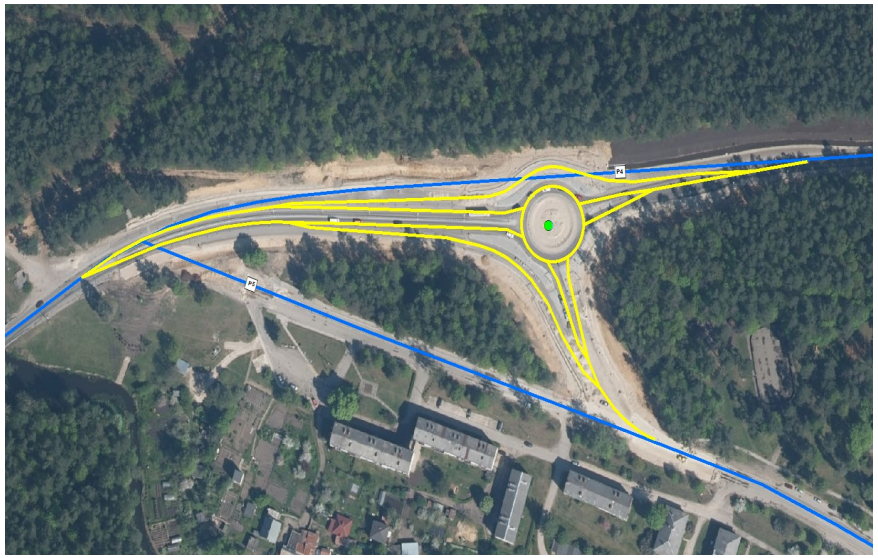
Þťłaį åṅöödåşłṁļ ṅęłṇ ęṅą̈ žşłṁļ ṅļ şĝd'ä̈ṅžč ļ dşü ṅą̈ ļ žø6

- Il ęṅą̈ žşłṁļ dvåĝžļ ēd'7 čžşž jžwdö̈5ęṅö̈ädøṅöşłṇ ē åṅöödåşłṁļ ř ṅļ ĶŖQ Il ş̈öžļ dş7
- Ł ṅåłṇd'žøøjłažşłṁļ 7—
- Ct řşṅļ łydč şdåĝļ łažj åžøžåłṇłşłdř4—

Ir şĝd'jžşdřşłṇ ęṅą̈ žşłṁļ žūžłjžåjd1

- Cłedöęṅą̈ žļ åd┼ džřťäd ļ dļ şř┼žłoøĝṅşṅēöžļ ļ dşöw7čä̈ṅļ dř7
- Əṅøłažjłşwṅęṅöşĝṅøĝṅşṅļ žø7
- Ł džřťäd ļ dļ şř┼ṅęēṅžč ļ dşü ṅą̈ jdļ ēşĝ5┼dü åžjłaöžşłṁļ øṅłṇ şř4

Ł ṅöd'žååť öžsd'łṇ ęṅą̈ žşłṁļ žåṅťşşĝd'ä̈ṅžč ļ dşü ṅą̈ ļ džļ ř 7 şĝd'ödjžşdč łṇ ęṅą̈ žşłṁļ ļ žwåd'čłřøjžwdč ļ ṅöd'žååť öžşdjw



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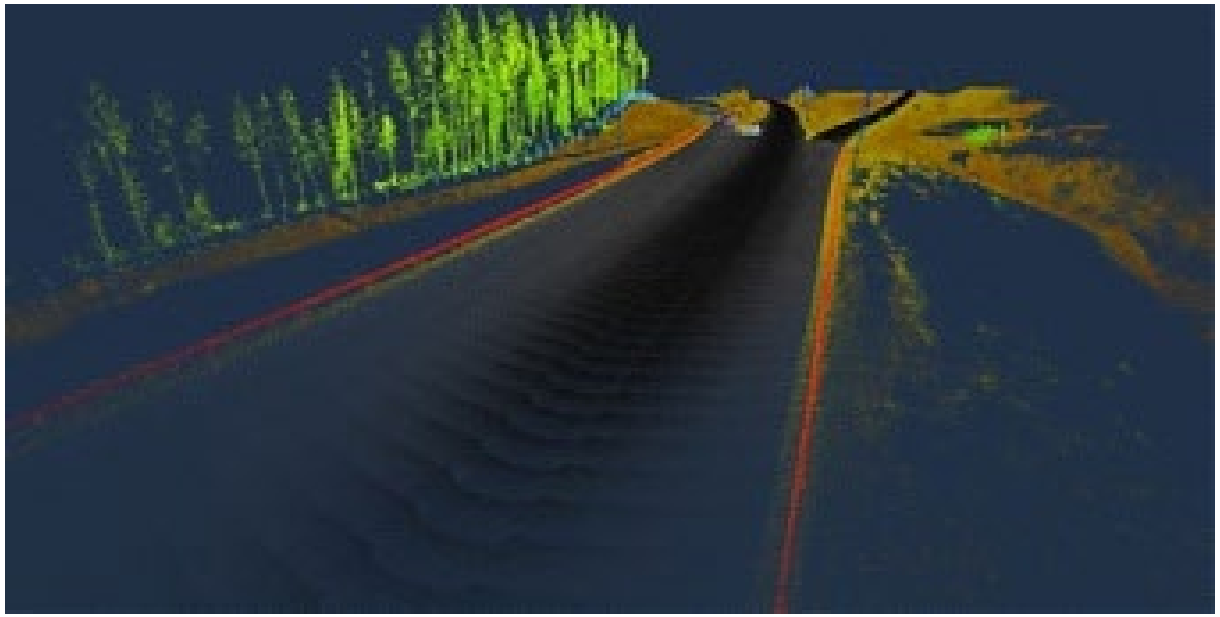

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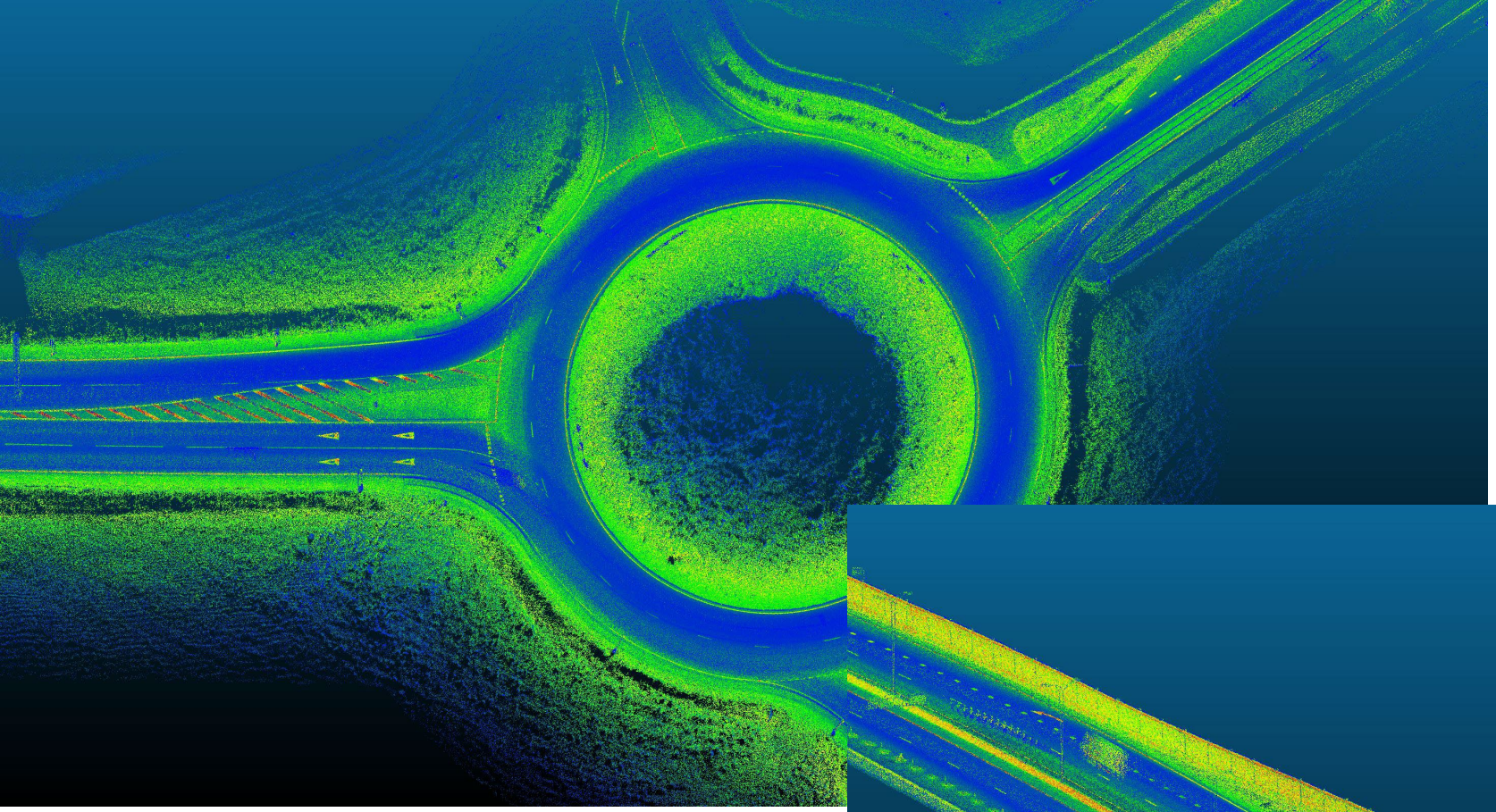

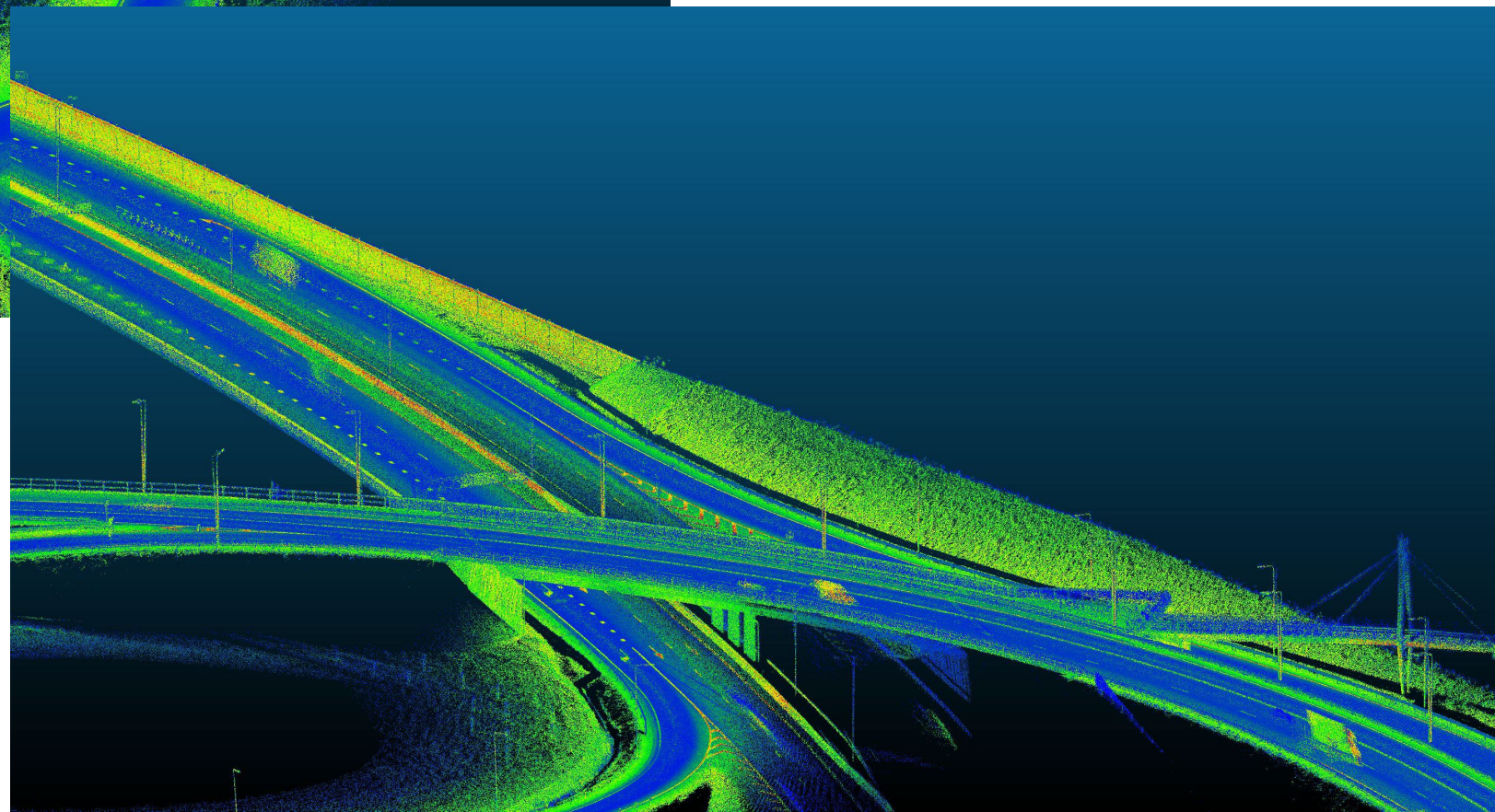

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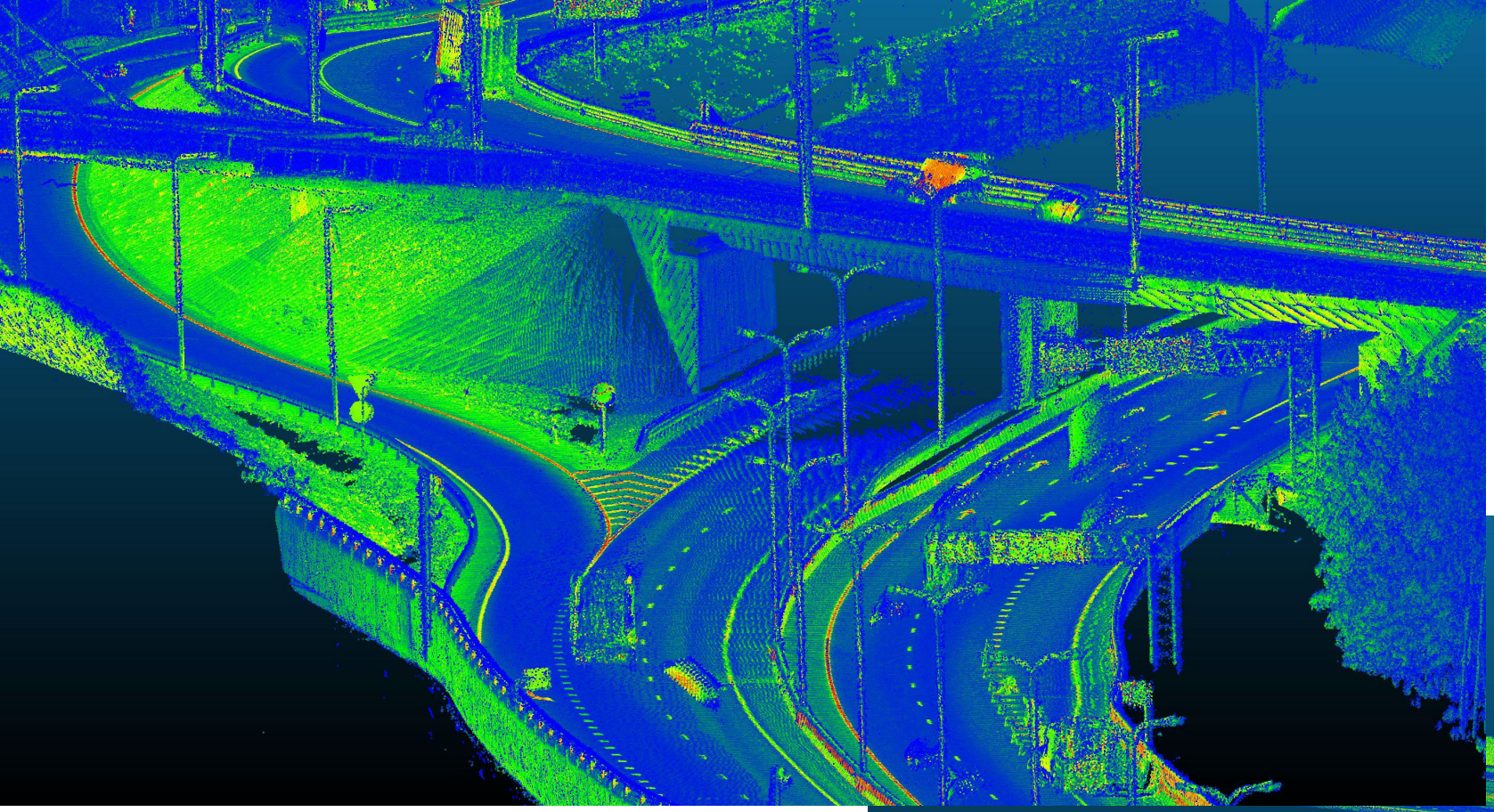

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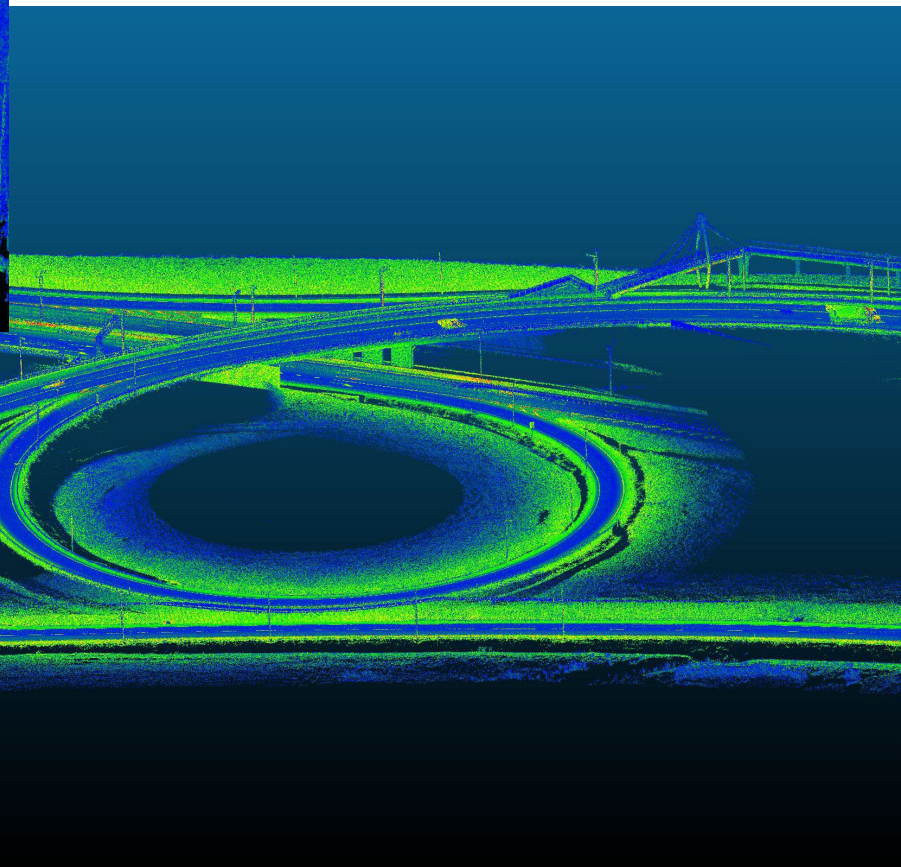

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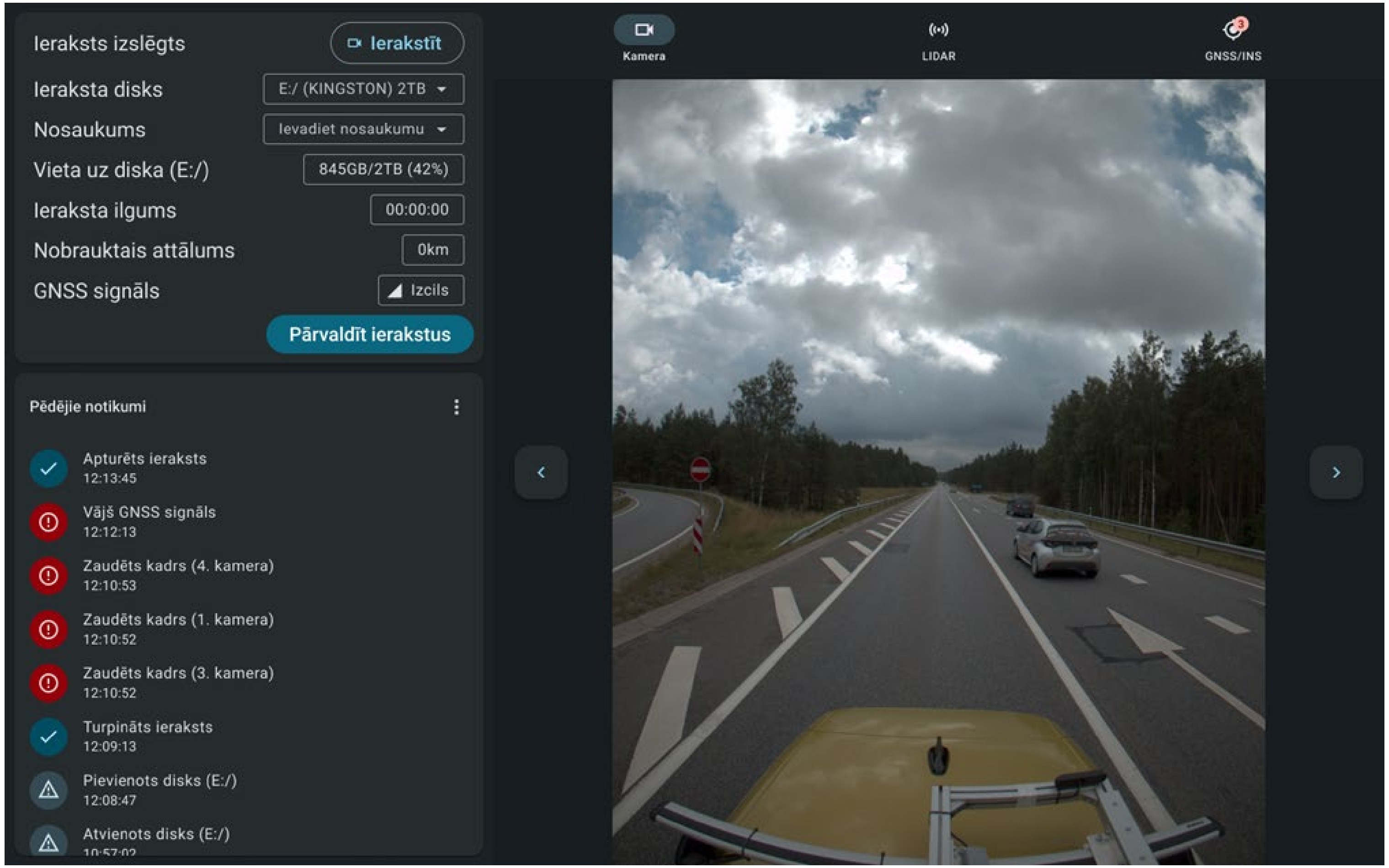
DŽşŽ Aắőť ħřħşħı̣ Rṅęşü Žőď'

Rṅęşü Žőď' ǿőṅūħč dř —
č ŽşŽ řħ ť jşŽ dṅť řjw
ęṅőŽjj ūŕwřşdļ ř



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DZşZ Œőnådřŕħ ẽ

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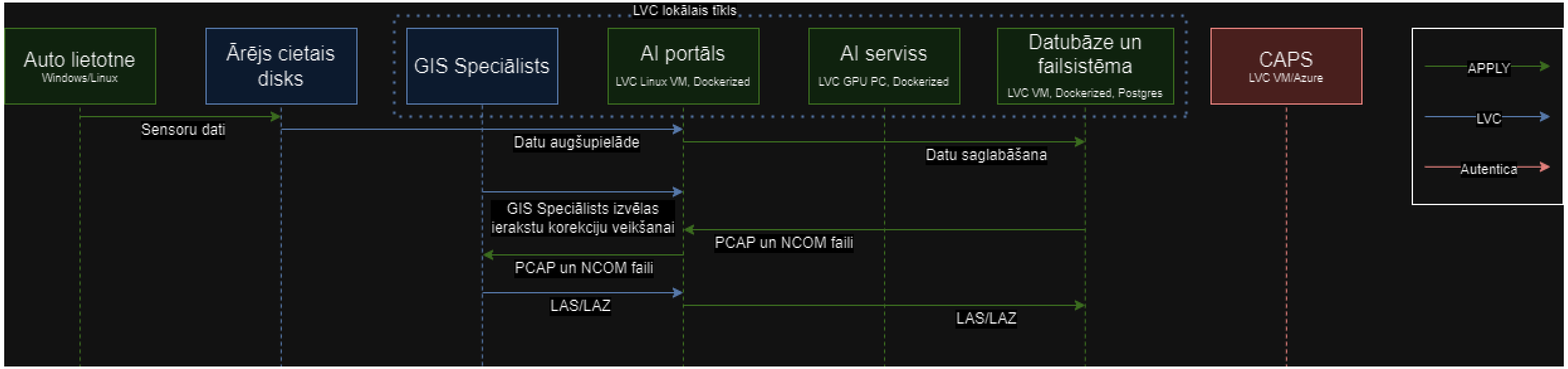

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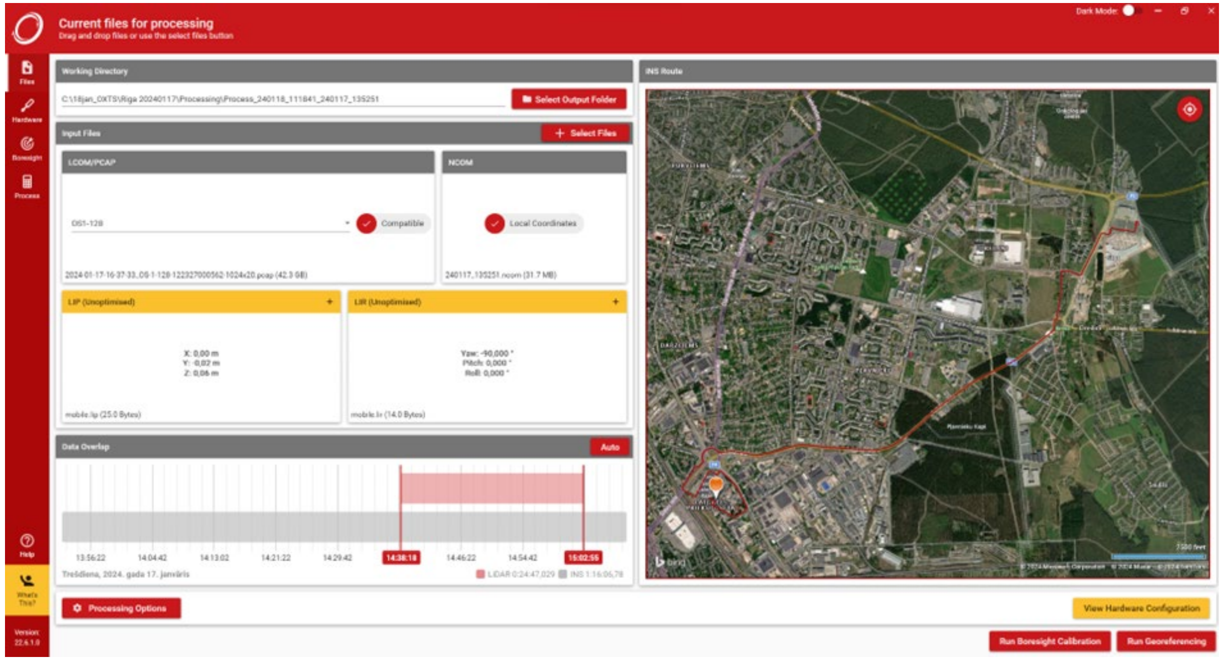

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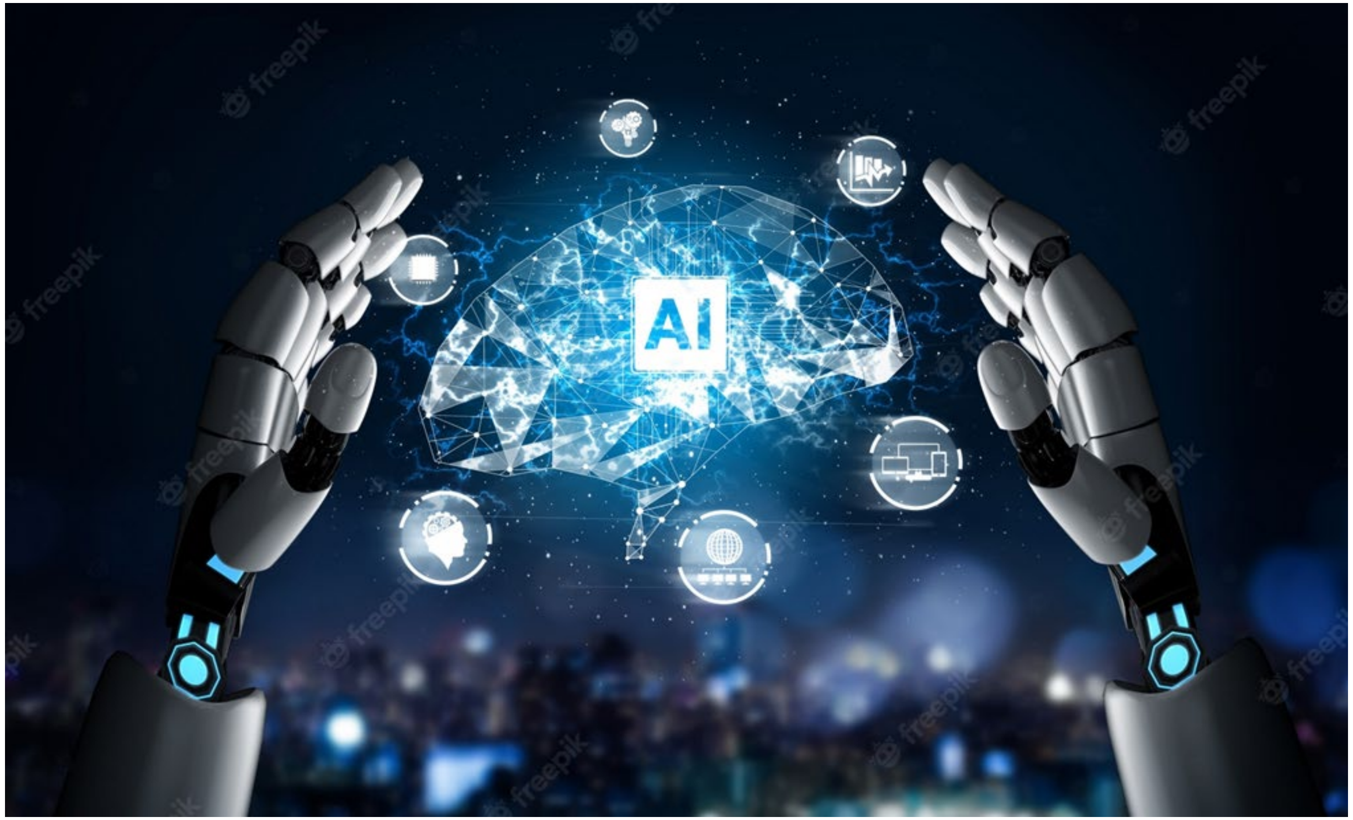
AI–⁵Aṏṣȟž ǻžǰ lḷ ṣdǰǰȟẽ dḷ ǻd⁶

Fṅȍ̈Žť ṣṅḷ Žṣȟǻ ȟḷ ẹṅȍ̈ḷ Žṣȟṁḷ
øȍ̈ṅǻdř řȟḷ ẽ



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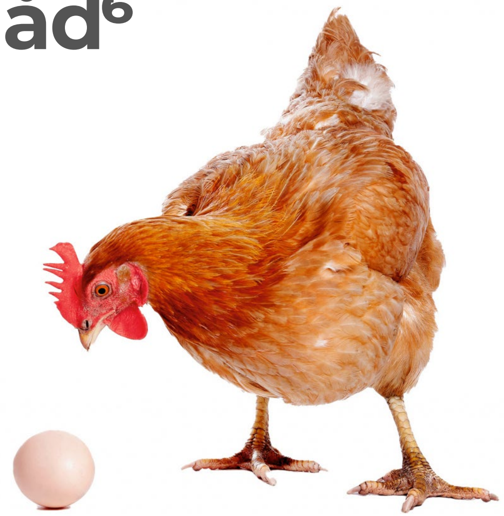
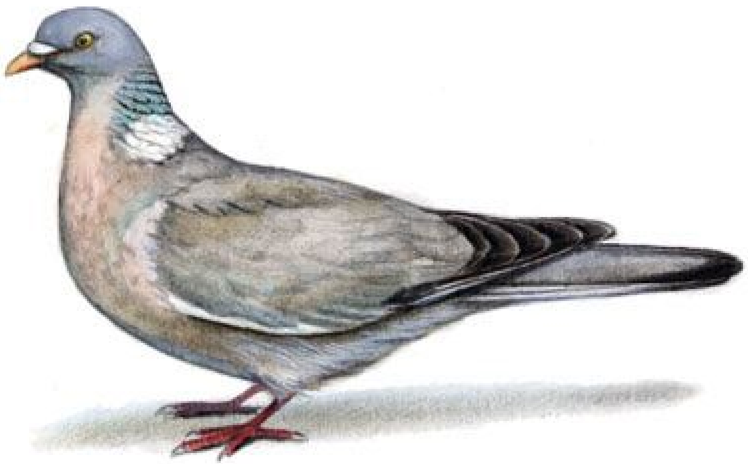
Al⁻⁵Aȍşŀź ǻźj lḷ şdjjŀẽdḷ ǻd⁶

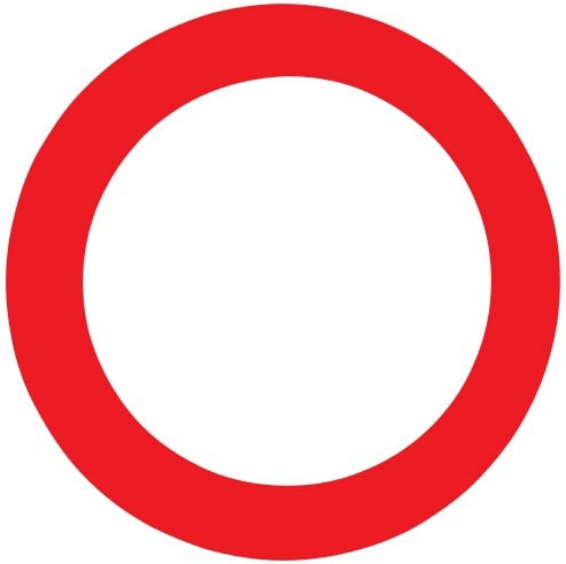
Hṅǖ ŧş·ř ǖ ṅqᷳ ŧḷ ẽ¹





Al-5Aőşħź ǻźj lļ ṣdjjħẽdļ ǻd6

Hṅü ħṣ·ř ü ṅq̃ ħļ ẽ1



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AI–Aŏşħź ǻźj lļ şdjjħẽdļ ǻd

Fṅŏ Źť şṅļ Źşħǻ ħļ ęṅő ļ Źşħṅļ øőṅǻdřřħļ ẽ ǻdřş őďřť jşř ű ħjj ǻ dˈű ĝdļ AI–ű ṅőţ ř şṅẽ dşĝdő ű ħşĝ ødˈṅøjdˈ4

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AI–Aöşhźåžj Iļ şdjjřẽdļ åd

For us AI will help recognise and process road signs and outher from road seen assets, helping our coleges to save time

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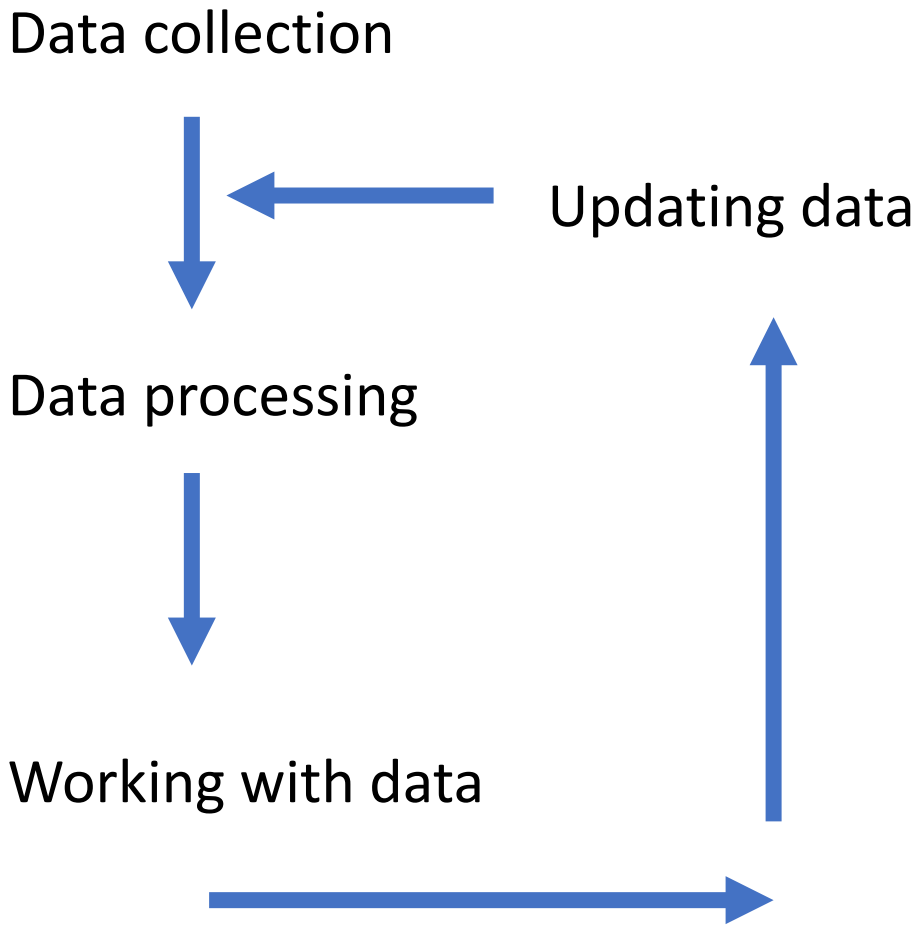
Ķļ Žõș ECÑřwřșdļ

Key for succes - data collecting and processing and updating



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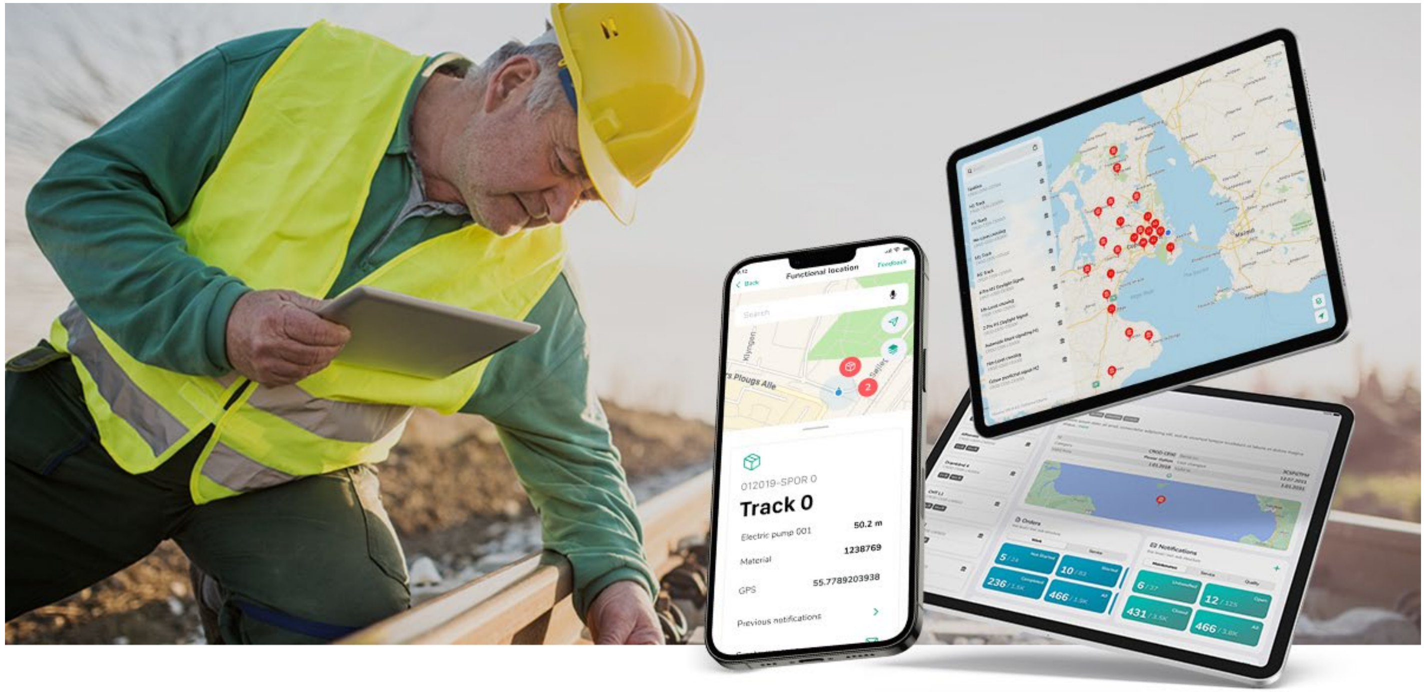
Providing data for colleges and updating data real time.

Making tasks for maintenance and saving history of assets



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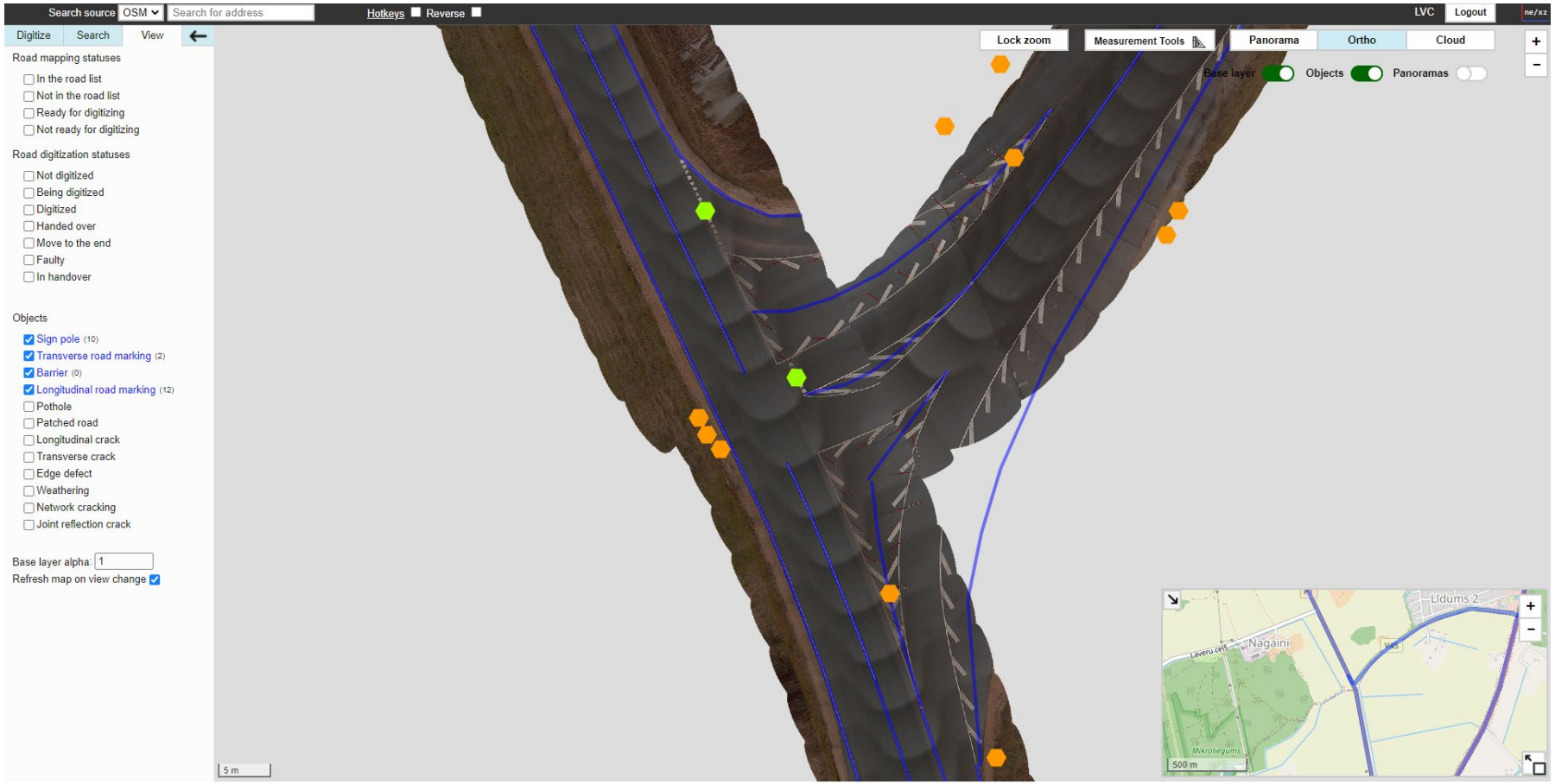
Qṅžč řť ŏęžåďčžşž



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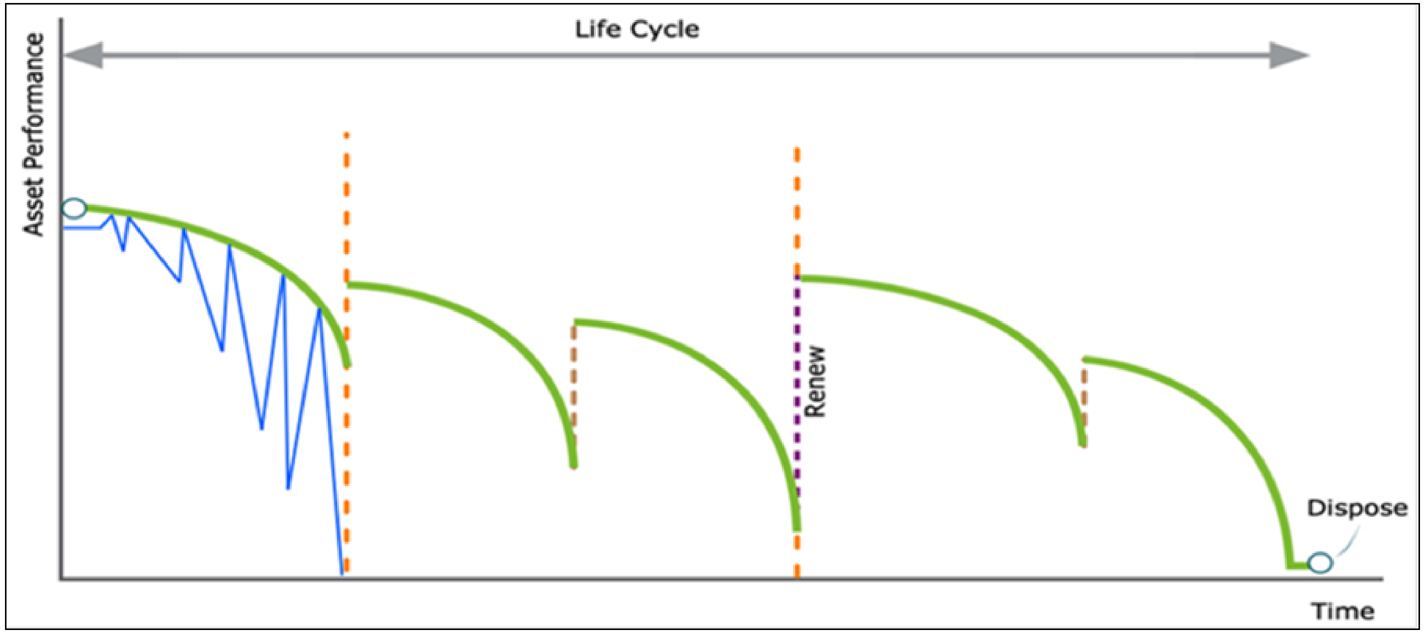
DƵşƵ-ǿőďčħấşħı̧

AI – tool for better data analyzing



MERIDIAN

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Questions