4TH INTERNATIONAL CONFERENCE FOR SUSTAINABLE MOBILITY

& IRF ANNUAL CONFERENCE

6 OCT. 2022 MARRAKECH

DECARBONISE, FINANCE AND DIGITALISE THE ROAD SECTOR FOR A SUSTAINABLE MOBILITY & GROWTH

The AUGMENTED CCAM project

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The Need

- **Key enablers** to resolve the Vision 2050 challenges: **Infrastructure**, **Artificial Intelligence (AI)** and **Validation** (ERTRAC Roadmap, Strategic Research and Innovation Agenda – SRIA of CCAM)

- **Vision**: **100% real time connectivity for all vehicles** (Year 2050), **sharing and actuation enabling service framework** and **novel AI** allowing: *Transport network situational awareness; AVs ODD extension; maximum benefits for all connected vehicles, automated or not; granular TM strategies for different road users; increase of functional and traffic safety, traffic efficiency, security and trustworthiness*

What is missing/ Open questions

- Which are the priority PDI requirements and adaptations for different mixed traffic application contexts, transport modes and CCAM readiness?
- Which are the most cost-efficient technological paths to exploit existing and emerging PDI to support near future CCAM ensuring the safety and efficiency of the transport network as a whole?
- Which are the concerned adopters in each case and how can we reflect the varying governance and operational models in a service operational framework to be beneficial for all actors on technological and economic grounds?
- How can we put in place a "no-regret" process for decision making before proceeding to investments?
  - Physical infrastructure investments roadmap: 30-50 years
  - Digital infrastructure investments roadmap: 8-15 years

The Aim of AUGMENTED CCAM project

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To **understand, harmonise** and **evaluate** in an **augmented manner, adapted and novel support concepts of Physical, Digital and Communication infrastructure**, to **advance** its **readiness** for **large scale deployment of CCAM solutions for all.**

Factsheet

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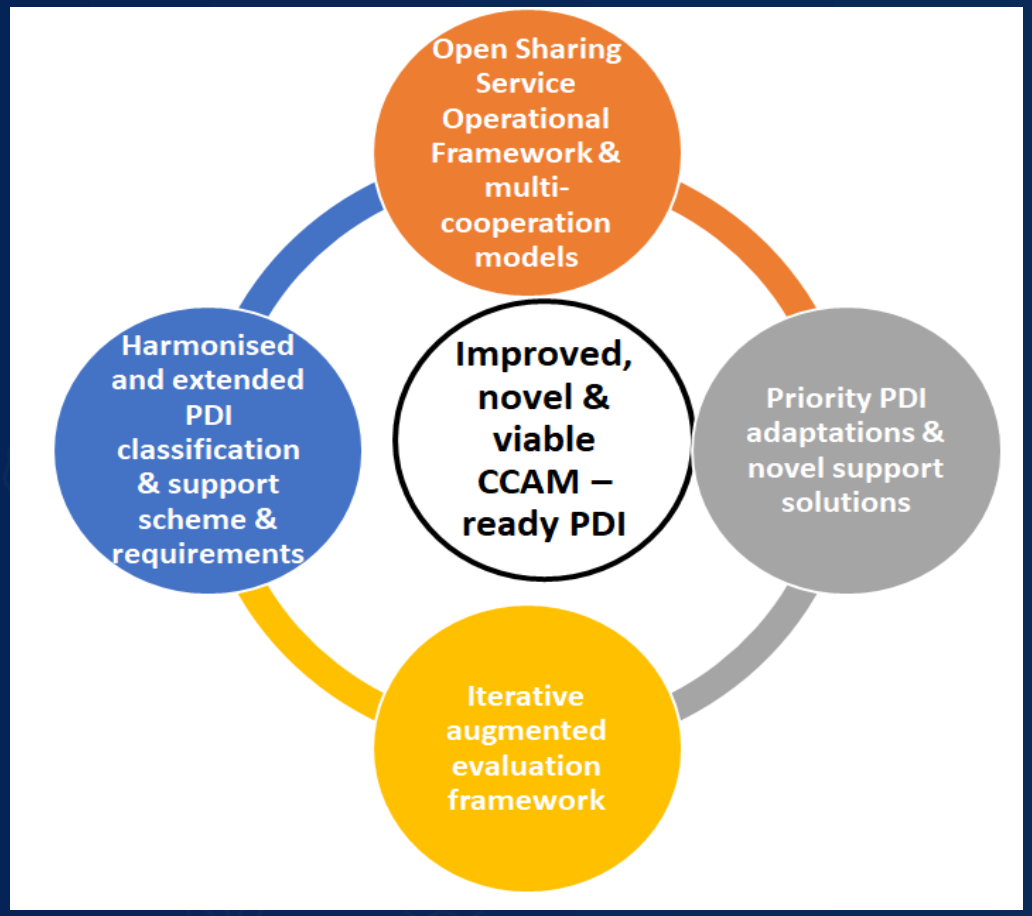
- **AUGMENTED CCAM** - Augmenting and Evaluating the Physical and Digital Infrastructure for CCAM deployment
- Under HORIZON-CL5-2021-D6-01-03 - Physical and Digital Infrastructure (PDI), connectivity and cooperation enabling and supporting CCAM (CCAM Partnership)
- **Research and Innovation Action**
- Estimated Project Cost: €11,134,645.2 - Requested EU Contribution: **€8,999,808.13**
- Duration: 40 months// Start date: 1st Sep 2022 - End date: 31st Dec 2025
- **27 beneficiaries from 13 European countries**, coordinated by **FEHRL** (Forum of European National Highway Research Laboratories) & technically managed by **CERTH/HIT**

4 Key Blocks Approach



A. New PDI Classification & Support Scheme for CCAM
B. Technology agnostic "We Share What we See" Service Operational Framework and Architecture
C. Priority adaptations & new/optimised PDI support solutions for CCAM services
D. Augmented (in physical and virtual world) iterative implementation and validation plan to feed impact assessment

New PDI Classification & Support Scheme for CCAM

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- **Extended, Multidimensional & Harmonized PDI classification schema**, to be **automatically updated**, considering varying:
  - Automation levels
  - Traffic contexts & ODD
  - C-ITS services
  - PDI elements and ways to use them
  - Environmental conditions
  - Road users synthesis
  - Driving manoeuvres
  - Critical infrastructures (i.e. bridges, tunnels)

- **Translating clearly defined contextual needs to priority adaptations per key actor (different levels of detail)**

- **Building upon past work**: ISAD, CRCS, PIARC, CCAM, MANTRA, SHOW & SLAIN projects.
- **Considering standardization** (CCAM, US-NHA standards, Australian Austroads)
- **Upgrade of SHOW segmentation tool** to feature also digital infra.

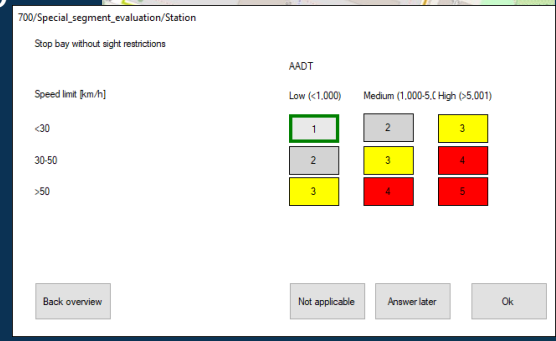
Infrastructure Approach	What it is	CRCS Levels: Needs Upgrade & Maintenance	Meets Current Best Practices	Meets Emerging Market (1–5 years)	Meets Next Decade Market (10 years)
Talking	Electronic communications between vehicles & roadway	• Limited or no fiber installed • Limited or no cellular coverage • Limited or no roadside devices with communication • Signal equipment outdated with no connections • Temporary TCD deployed with no communication	• Fiber along roadway with access points • Good cellular coverage • Updated signal controller, meets MUTCD, connected as part of system • Infrastructure has no V2I capability • TCDs connected	• DSRC or C-V2X nodes tied into fiber • Signal is equipped with V2I communication capability • Infrastructure has V2I capability • TCDs able to connect to cellular or fiber	• Small cells deployed along roadway with 5G coverage • Signal transmits SPaT messages • Infrastructure transmits information on conditions with local processing capability

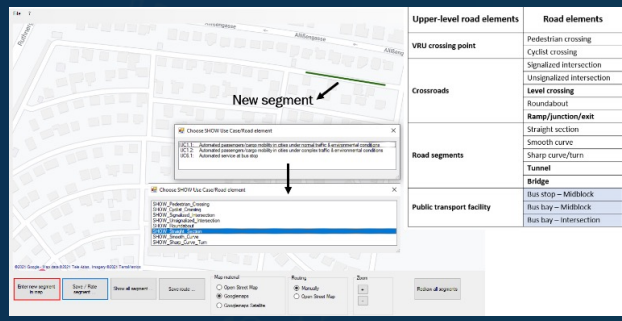
CRCS for the infrastructure approach “Talking”

	Level	Name	Description	Digital information provided to AVs: Digital map with static road signs	VMS, warnings, incidents, weather	Microscopic traffic situation	Guidance: speed, gap, lane advice
Digital infrastructure	A	Cooperative driving	Based on the real-time information on vehicles movements, he infrastructure is able to guide AVs (groups of vehicles or single vehicles) in order to optimize the overall traffic flow	X	X	X	X
	B	Cooperative perception	Infrastructure is capable of perceiving microscopic traffic situations and providing this data to AVs in real-time	X	X	X	
	C	Dynamic digital information	All dynamic and static infrastructure information is available in digital form and can be provided to AVs	X	X		
Conventional infrastructure	D	Static digital information / Map support	Digital map data is available with static road signs. Map data could be complemented by physical reference points (landmarks signs). Traffic lights, short term road works and VMS need to be recognized by AVs	X			
	E	Conventional infrastructure / no AV support	Conventional infrastructure without digital information. AVs need to recognise road geometry and road signs				

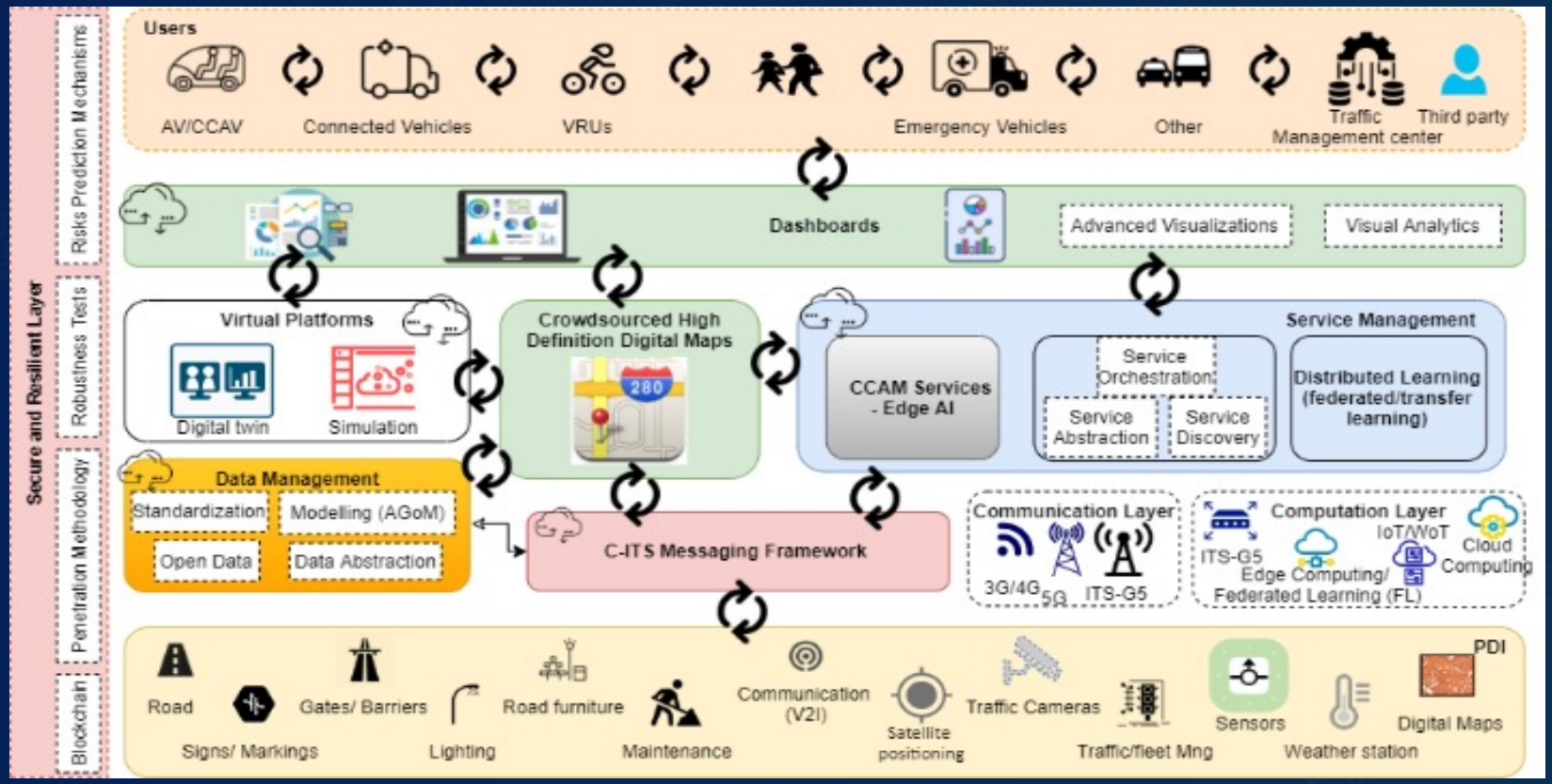
ISAD levels (INFRAMIX)

Segmentation Tool





Technology agnostic Service Operational Framework



- Reflecting **existing and emerging PDI & varying ways of its deployment**
- Capable to support all **Day 1 & 1,5 C-ITS services and their evolution in Day 2 & Day 3+ CCAM services**
- Enabling **granular TM strategies** to road users' cohorts in mixed traffic environments.
- **Supporting multi-actor cooperation models**

Novel PDI supported solutions for CCAM

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- **11 Novel PDI Solutions** will be implemented and validated

- Assuming **mixed fleets penetration**
- Aiming to **leverage the safety and cooperativeness of all CCAM users by sharing intentions of each other making them context-aware at any time given.**

- **Deploying existing and emerging PDI, V2X/ I2X technologies & AI & Big Data advanced learning and prediction techniques**

- **Addressing passenger & logistics transport** both
- **Varying traffic contexts** (different AV types & readiness, network synthesis), **road users, connected and not connected, focus levels,** extending from network traffic management to critical safety driving maneuvers, aiming at **ODD extension**, **advanced functionality for the rest connected vehicles** and **cooperation with non-connected vehicles/users**

PDI to adapt/improve/add: road zones, entrance and exit ramps, (camera-based) RSUs, road pavement markings, road work stations, adapted traffic controllers, IoT, V2X & 5G connectivity, TCC upgrade, OBUs, detection & surveillance upgraded equipment, crowdsourced HD maps, UAVs, ….

11 Novel PDI Solutions to implement & validate

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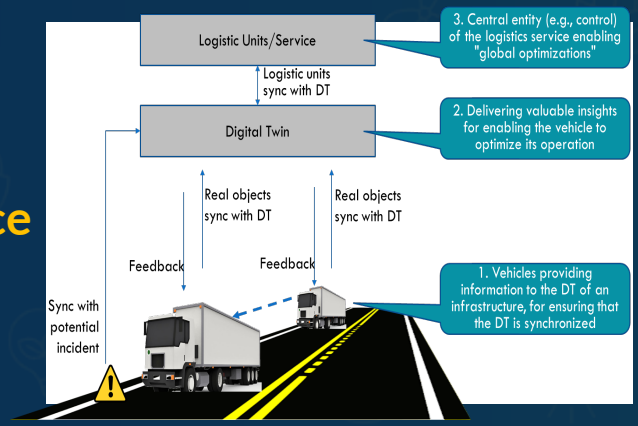
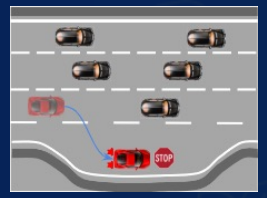
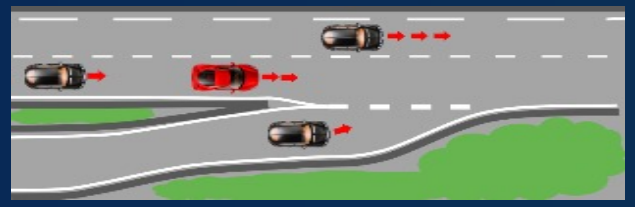
1. Equipped VRUs protection to increase the protection of VRUs by using information from connected road users and AVs
2. Non-equipped VRUs protection
3. UAV based VRU protection for closed environments
4. Road workers in the field
5. Temporary road works
6. Traffic Management optimization based on Vehicle Probe Data from CCAM (and vice versa
7. Emergency vehicle approaching
8. Insertion/merging of CAV/Other on highway
9. Minimum risk manoeuvres (MRM)
10. Localisation of assets and CCAM vehicles
11. Optimised logistic operation of AVs leveraging on advanced digital technologies and DT

! TRL6-7 at the end of the project





MRM performed by a CAV (in red) on highway



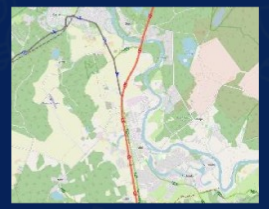
Management of the insertion of a vehicle on a highway where a CAV (in red) is approaching

Insertion on highway of a CAV (in red) from the entry slip road

Multilayered & iterative validation in physical & virtual test beds

- ✓ From 20km/h (in confined areas) to 130km/h in highways
- ✓ 9 CAV demonstrators
- ✓ 10 more connected vehicles
- ✓ Under all weather conditions (sunny to icy)

Open traffic rural/sub-urban site (A1 & local roads)



Closed racing track Biķernieki, Riga city

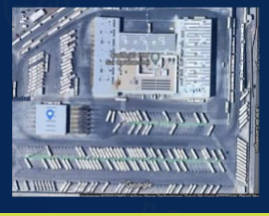
Transpolis (Living Lab)

Zehns A63 – open traffic highway (A63)

Vinci open traffic highway (A10-A11)

Open traffic urban area, Madrid

Autonomous bus docking, Madrid-EMT depot



- •7 physical test sites in 3 European Cities
- •7 validation rounds
- •Interconnecting field trials & validation in AV and driving simulators, Digital Twins, microscopic and macroscopic traffic simulation
- •In confined areas and living labs, urban, rural and highway open traffic contexts, operated by different national operators;
- •With events triggering;
- •With AV safety & remote drivers, drivers of connected vehicles, road operators & all open traffic types of users (road workers, VRUs (pedestrians, PtW, wheelchair users, elderly), etc.)

Key Expected Outcomes & Impacts - Economical/Business

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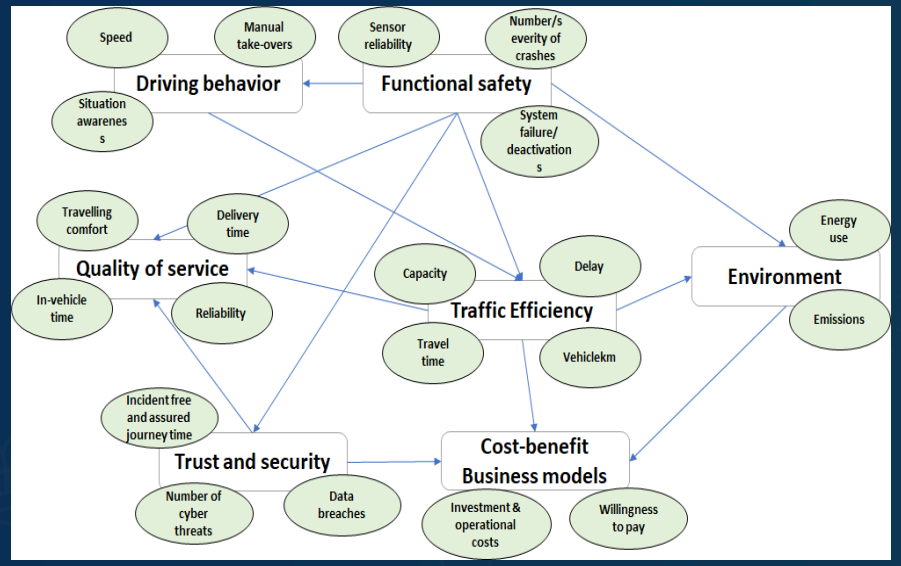
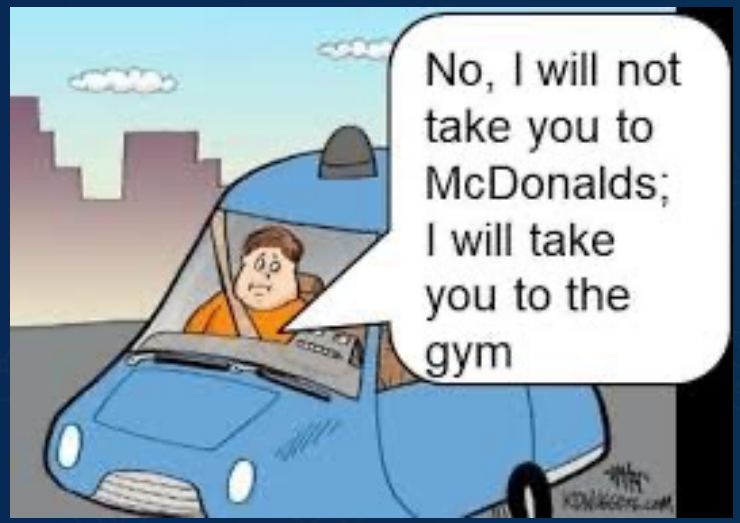
- At least **5 new CCAM services deployed** in the project test contexts
- **At least 1 new business model** emerging in each project test context
- **Endorsement of new classification schema** by at least **5 road operators /constructors/owners** and **10 Cities in the project** - *multiplied by 10 within 3 years after the end of the project.*
- **Adoption/application of the new service framework** by at least **15 implementers** (road operators, Cities)
- At least **2 new corridors created in the project**

- **Proactive decisions on CCAM planning and PDI investments towards 'no-regret' measures** in alignment with local policy goals, to the benefit of the society
  - Outcomes endorsed in the R&D agendas (CCAM SRIA), **the CAD.eu Knowledge Base** & **CCAM SUMP Topic Guide**
- **≈ 50% increase of probability for PDI investments**
- **≈ 10% saving for investors**

Key Expected Outcomes & Impacts - Societal

- **0 cyberthreats and data breaches** proved in validation
- **Increase of Traffic Safety, Traffic Efficiency** and **Environmental friendliness**:
  - **≈ 50% reduction of accidents in merging scenarios in highways equalling to 2% traffic safety increase** (assuming 30% penetration of AVs)]
  - **≈ 50% fewer accidents in specific road zones**
  - **≈ 40-50% fewer accidents with VRUs**
  - **≈ 15% reduction of emergency vehicles response time**
  - **≈ 10% reduction of speed for vehicles approaching an accident/traffic jam/obstacle**
  - **≈ 20% reduction of the time needed for a road hazard to be communicated** to the road users
  - ≈ 20% **traffic efficiency increase overall**
  - **≈ 20% reduction of delay time in delivering** in logistics operations
  - **≈ 5% reduction of energy use & emissions**





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