CCAM

CONNECTED, COOPERATIVE
& AUTOMATED MOBILITY

Breakout Session
Cluster 1 „Large-scale demonstrations”

ccam.eu

Reminder:
ERTRAC WG CAD & CCAM Partnership - a complementary approach.

The SRIA is the reference document of the partnership aiming at identifying research and innovation priorities, detailing the expected impacts as well as the Key Performance Indicators.

→ **Update focus on Large Scale Demonstration**

The ERTRAC Roadmap is the position of the independent technology platform aiming at drawing the overall longterm picture as well as the concrete next steps referring to ambitious and realistic use cases.

→ **Agenda 2030 update focus on Innovation Use Cases**

Preparation of LARGE SCALE DEMOS: Research / Development / Innovation

Connected and cooperative services

Innovation:	Safety and Traffic Management related Services **Fleet & Transport management** Carsharing schemes

Confined areas

Innovation:	Bus depot / **Truck terminal**
Research:	**L4 Truck hub-to-hub operation**

Highways

Innovation:	L3 Traffic Jam, L3 Commute
Development:	**L4 Truck safe auto-follow**
Research:	L3/L4 Full Highway

Urban/peri-urban transport for people and goods

Innovation:	**Last mile goods and services**
Development:	Fixed route shuttles / shared vehicles Bus auto-follow
Research:	**Flexible route** people and **goods**

Parking

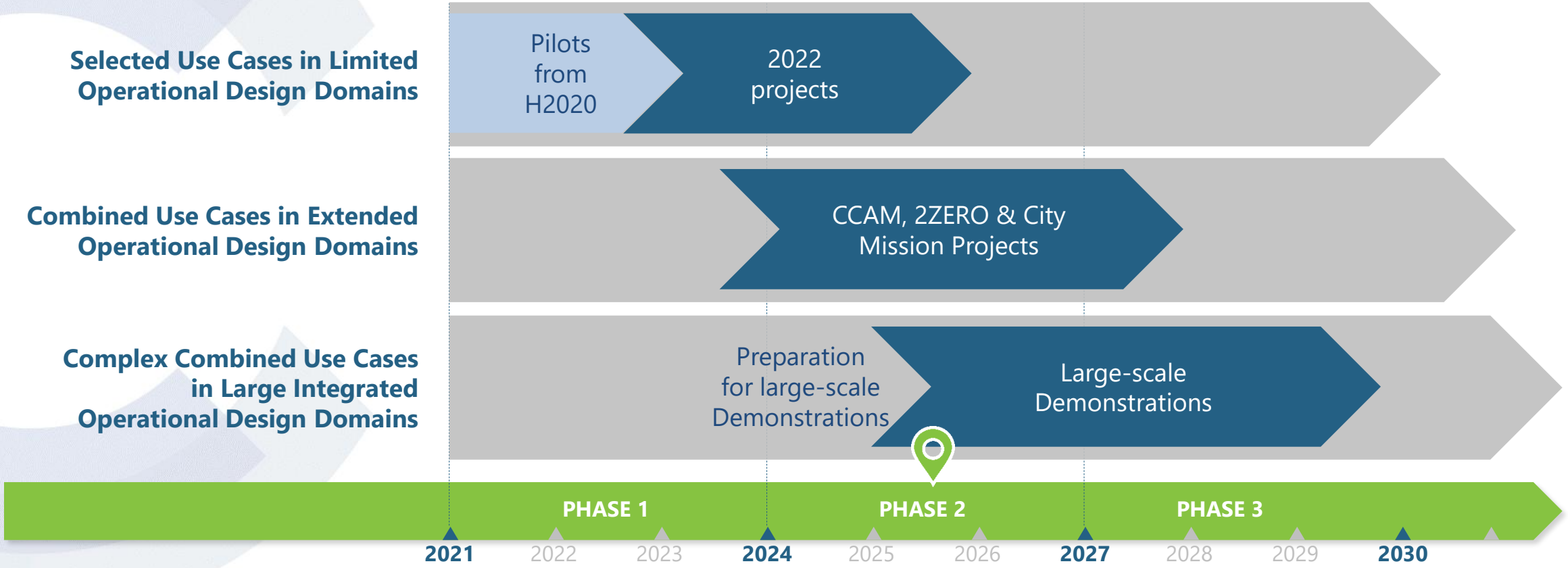
Innovation:	AVP Infrastructure focus
Development:	AVP Vehicle tech focus

Rural and secondary road network

Research:	Fixed route shuttles / shared vehicles, municipal services

CCAM SRIA: Focus

Cluster 1: Large-scale Demonstrations



Preparatory action (WP2025)

Proposed actions for this topic are expected to address all the following aspects:

- Define the prerequisites for performing large-scale demonstration projects, considering vehicle technology maturity and other technical enablers, physical and digital infrastructures, as well as approval frameworks for public road testing.
- Prepare and refine methodologies, test procedures and tools for the execution of field tests and efficient data management.
- Identify test and demonstration sites across Europe for CCAM functions, considering the extension of Operational Design Domains (ODDs), using vehicular communication technologies (V2X) that enables Traffic Management Systems (TMS) for improved traffic flow and operational efficiency.
- Initiate a cross-sector stakeholder forum for the definition of use case relevant projects in different domains and their consequent implementation.

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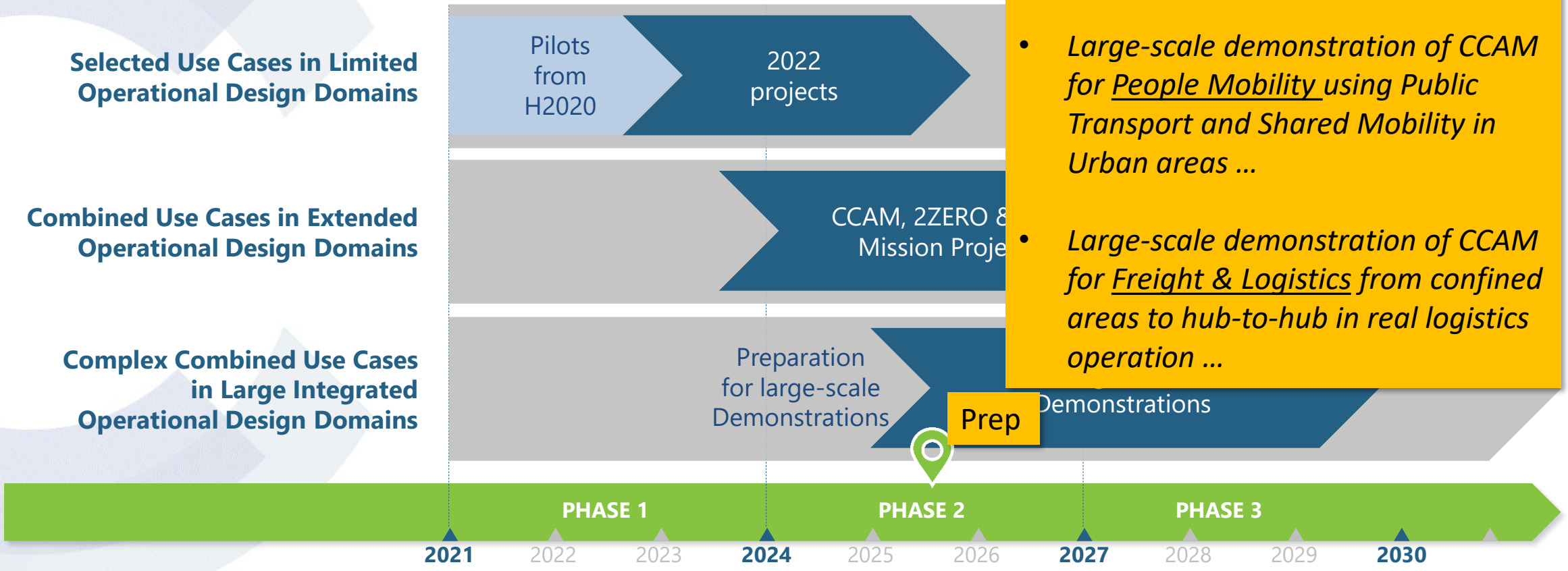

Scope

- *Large-scale demonstration of CCAM for Vehicles in Mixed Traffic on public/open roads and in parking/confined …*
- *Large-scale demonstration of CCAM for People Mobility using Public Transport and Shared Mobility in Urban areas …*
- *Large-scale demonstration of CCAM for Freight & Logistics from confined areas to hub-to-hub in real logistics operation …*

CLUSTER 2: Vehicle Technologies

PROJECT	Results with potential for implementation in LSDemos	Lessons learned (both positive and negative)	What is hindering / what still needs to be done?
EVENTS (ICCS)	• Collective perception • 4D bad weather radar • VRU prediction	• Degradation of sensors • Independence of cost • AD system evaluation	• Time-consuming approach • Lack of personnel
ROADVIEW (Högskola i Halmstad)	• Snow removal in LiDAR • Slipperiness estimation • All-weather navigation	• AI is vehicle-specific, challenging domain shift • Data logging challange	• Switch to any new sensor requires additional data
AWARE2ALL (Vicomtech)	• Occupant Monitoring • Driver Monitoring • External HMI	n/a	n/a
OptiPEx (VTT)	• Passenger perspective • Data-use optimization • Data privacy/security	• Representative pax • Incentives needed • Co-creation commitment	• Lack of real-life data • Representative data • Long way to AI
AutoTRUST (CERTH)	• Pax behaviour sensing • Pax experience analysis • Pax-vehicle interaction	n/a	n/a

Recommendations for LSD
derived from Cluster 2 projects and scope

- make **safety** the top priority, and take **security** seriously
- make the **ODD large** scale
- adapt to vehicle systems to **mixed traffic** and **cross border** traffic
- provide **redundancy of sensors** to cover edge cases
- understand the interplay of **sensors and processors**
- assess **energy usage** of CAD systems comprehensively
- benchmark **cost vs. performance** of sensors
- build **trust** of users in-vehicle and on the road
- involve users in **human-centric developments**
- co-design AI/software and electronics for **Software-Defined Vehicle**

Results from Cluster 3 Breakout on 10/10/2024

PROJECT	Results with potential for implementation in LSDemos	Lessons learned	What is hindering / what still needs to be done?
SUNRISE	• Safety Assurance Framework feeding into exemption processes for LSDs (FAME: harmonisation of exemption procedures) • Large scale: not only large number of vehicles, but also large number of Member States involved in demo. • SUNRISE learnings to be applied for commercial vehicle LSDs as well	R&I on validation should be continued in parallel to LSDs as a direct track towards deployment; data acquired in LSDs can feed back into federated database of validation scenarios. SUNRISE results can be applied by a larger group of organisations and to additional vehicle types. LSDs could support the validation of human behavioural models.	To be done: - Data sharing - Effective data collection - Coordination of lessons learned country to country w.r.t. exemptions of vehicles for LSDs
BERTHA	• KPIs for the acceptance of the behaviour of CCAM systems • Delivering a wide variation in human driver models, creating a versatile, acceptable model for L4 behaviour in LSDs		Hindering: Human complexity: huge variation, including cultural aspects in different Member States
i4Driving	• Realistic representation of CCAM systems in multi-agent traffic simulations (macro-scale) considering both safety and traffic flow		To be done: Data sharing again
National projects	• Efficient data collection technologies • Semi automated, objective exemption process • EU LSD sites with digital twin already available (ground truth for validation)		

Cluster 4 Breakout results

- General comments:
  - Physical Digital Infrastructure (PDI) needs to be included in LargeScaleDemos in any case (inclusive, not only focusing on automated driving! Also Vulnerable Road Users (with and without mobile phones, standard vehicles, etc.))
  - Definition of “Large Scale” should include
    - Several geographical areas/ Operational Design Domains (ODD)/ cross-border/…,
    - Several types of users,
    - Multi-modality,
    - Impacting several people (careful: avoid focus on metropolitan areas)
  - Business models to include PDI need to be addressed, large investments on PDI will need to be justified
  - Multi-modality has been rated important
  - Trusting external data sources is very relevant (cyber-security, safety of the intended functionality (SOTIF)…)
  - LSDemos need to prove benefits in terms of safety, decarbonization, inclusivity, accessibility, …

- Specific results requiring scaling-up:
  - Augmented CCAM has 80+ PDI elements identified and prioritized. → potential to scale-up need to be identified and prioritized as well.
  - CONDUCTOR emphasized that urban and regional components are already at TRL6/7, including business models, as good candidates for LSDemos
  - IN2CCAM has identified promising cases of multi-modality related to public transport, demand-responsive transport and the last-mile part of the journey

CLUSTER 5 Key Enabling Technologies

PROJECTS and Main KET	Results with potential for implementation in LSDemos	Lessons learned	What is hindering / what still needs to be done?
Cybersecurity • **CONNECT** • **SELFY**	• Trust Assessment Framework • Data Transfer, information exchange approaches • Cybersecure Situational awareness and collective perception, resilience tooling	• Cybersecurity should be addressed from design in any CCAM approach • Trusted systems (communications) are a must • Scaling is challenging – should be included from the beginning	• Validation scenarios with growing complexity – projects cover limited number of actors • Standardization to facilitate interoperability • Common definition of trust (cybersecurity)
Trustworthy AI • **AITHENA** • **AI4CCAM**	• Methodology for Trustworthy AI in CCAM (guide from AI act to CCAM applications) • Trustworthy AI modules (perception, decision making) • Trustworthy AI incl ethics, qualitative scene understanding • Semantic description for explainability	• Scalability of TAI in real-world applications (Data & AI require-ments and specifications) - ODD • Fairness, diversity, inclusivity are difficult to specifically address • Data/Model characterization (semantically – human understandability) • Importance of AI EU sovereignty -> TAI with explanation for different type of users	• TRL advancements needed • Policy, standards certification • AI in type approval • Scaling of ethics & scenarios library - spoofing scenarios • Trust in AI by end users • AI from engineering benefits to societal benefits
Data • **(SYNERGIES)**	• (tools for) scenarios (extraction, generation, management) • Data for LSD preparation and validation (edge case, complex scenarios, etc)	• Data ≠ just data ≠ info • Difficulty Edge cases and representativity • Assess Trustworthiness or AI training data	• Framework for data sharing • Extending data & scenarios • Data sharing approaches

CL5 KET recommendations for European LSD:

- Address **trustworthiness from design** (CCAM cyber-resilience & regarding AI used)
- Show the **scalability** of Trustworthy AI modules for driving functions
- Steps **towards AI certification and type approval** in selected driving functions and UC
- **Enrich the data sharing approach** -> the data generated during the demonstrators should feed the Federated Data sharing approach

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CLUSTER 6: Societal Aspects & People Needs

Results with potential for implementation in LSDemos	Lessons learned (both positive and negative)	Needs
Impact evaluation tool **Experiencing CCAM increases intention to use and alleviate safety concerns, but Security, speed and oboard space challenges remain** **High potential for onboard entertainment or engagement activities** **Methodology for inclusiveness & Taxonomy has been established**	**Large scale *service* demo** **Involvement of developers and cities should happen early on!** **Diverse use-cases** Appropriate business models are needed to capture future CCAM services/Vehicles Participants believed cyber attacks as a real threat - Consider overcommunicating onboard security aspects for users Plan for “life after the demo” Early involvement of (committed) users! (incentives) Speed! (comparable to cars) Usage also without smartphone • Select an area with a need for mobility. • What is the “large scale” component? • Geographical: well defined area: small/big, time of the year, rural &/ urban, type of land etc. • Cultural: Target groups: adapt the operation to a clear target group or make sure it fits all? • Level of service: Provide a high qualitive service. • Duration of operation: it takes time to get users on board; several months or demonstration? Don’t focus on technology at the expense of the service / human considerations. Avoid over-prioritizing the technical aspects of CCAM solutions at the expense of real-world applicability and societal impact.	Use toolkits!

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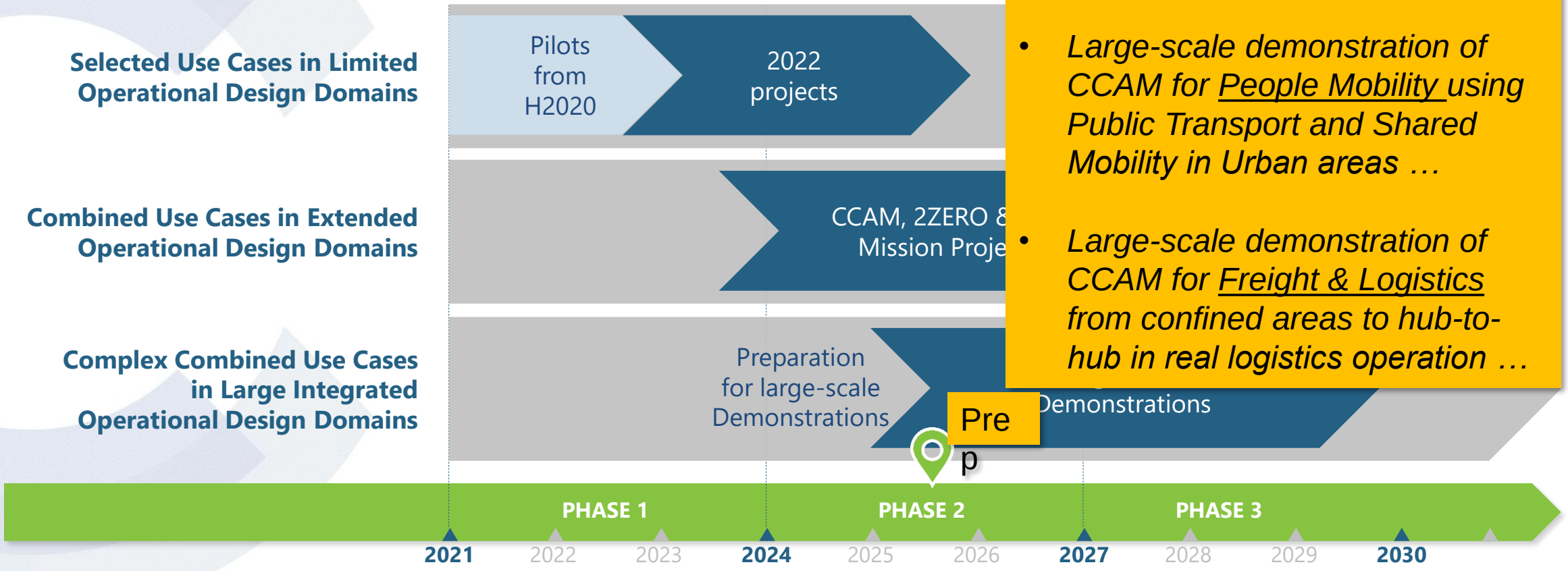

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Recommendations received for the topic “Vehicles in Mixed Traffic”:

Use-Cases:

- Focus and limit the number of use cases addressed, finalize harmonized exchange of corner cases for further development,
- Cover the edge cases by collecting scenarios to great extent, address mixed traffic in restricted areas with up to 20-30 vehicles,
- Drive autonomously through Europe - be truly cross-border: same vehicle operated within different countries, not just crossing the border,
- Corridor for AD across Europe
- Don’t forget the “mix” with VRUs, emergency vehicles, non-connected users, the unexpected
- Interaction between various traffic participants with various levels of automated vehicles, different users vs. VRUs but also as drivers
- Monitor behaviour of other human driven vehicles
- Focus on transport of people, both shared and private
- Complexity increases when including both technology and societal topics. Challenging to address in a single project
- ODD should be large enough, or cover a large variety of ODD
- Speed limit 130km/h on motorway, 50km/h in city

Vehicles & Fleets:

- Don’t need necessarily large fleets of the same vehicle but rather fleets of different type of vehicles.
- Need common safety & security, technology, functionality and data sharing platforms for a variety of vehicles
- Integrate/harmonise a small number of automated vehicles with a larger number of connected and cooperative vehicles
- Emphasize uniqueness compared to US/China FOTs: multi-brand, interoperability,
- Ensure link with “Software Defined Vehicles”
- Minimum “viable product” of L4 fit for all EU
- Co-design SW/AI and HW/electronics
- Keep in mind that L4 technology is not yet fully mature

Safety, Data, Trust, Cyber-security and Privacy,:

- Include cyber-security resilience, V2X C-ITS trustworthy and cyber-secure (messages and channels), to exercise connected & cooperative,
- Data collection aligned with the federated data platform, Safety: Address split in responsibility for safety: vehicle vs. infra vs. operator,
- Emphasize safety (and security/privacy), Safety assurance to enable trustworthiness, therefore supporting adoption
- Demonstrate trustworthy and safe AI approaches in real roads & conditions. Require regulatory framework
- Prepare for the large amount of data (from CAVs, VRUs & others) that will generate questions of trust, GDPR, cybersecurity,
- Allocation of responsibilities of owners of data major disturbances of existing traffic because of the LSD must not occur, to not risk a loss of trust
- Address trusting external data sources

Physical & Digital Infrastructure, Regulations & Homologations:

- PDI support for all road users, PDI designed for CAVs, Secured and reliable data exchange V2V/V2I/I2V
- How to ensure that the potentially conflicting needs of logistics/citizens/society are taken into account across these 3 projects?
- Exemption procedure for EU, learning fast from exemption in one EU country towards acceptance in another one
- (digital) law enforcement method
- Allow driving without driver (need safety values)
- Regulation of (or engagement for) the circulation of CAVs at large scale (and assure many vehicles will be involved).
- Prepare framework for homologation based on use cases and scenarios up to digital twin and vehicle testing
- Simplified regulation for mixed traffic CCAM
- As close to sustaining deployment as possible. What’s missing for deployment (at scale)?

and…

- Don’t forget the research perspective. It’s not only deployment!

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Recommendations received for the topic “People mobility”: shared and public transport

Use-Cases, Cities, Regions & Rural

- Involve cities: public transport and mobility operators
- Focus on a few regions
- Focus also on rural areas
- Urban to urban connection (end-to-end journeys)
- It is not important to connect a point A to a point B: need to create a departure to destination service for users
- Public transport, bus rapid transit (BRT) on dedicated roads. (Currently half of the price of the service is the salary of the driver)
- Public transport, tools to manage mixed service with automated buses and classic buses on the same line
- MaaS applications in urban areas
- Development of carpooling (ride sharing) approach with CCAV in urban areas
- Demonstrate solutions which allow a mobility almost as flexible and convenient as owning a car -> advanced carsharing
- Testing of services/systems rather than vehicles
- What are the most important issues can AD/C-ITS/CCAM solve in urban areas?
- Keep and increase the share of active modes in urban areas
- Achieve huge effects on society, traffic, business case

Vehicles, Fleets & Services

- Must be sustainable over time, after the project ends => validate the service
- Improve traffic management with the help of CCAM (rerouting, optimizing the use of network, …)
- “large-scale” should be understood as reaching out to a large number of persons (not to a number of vehicles)
- don’t stick to urban only => user point of view from start to destination is not limited to city boundaries
- High volume of vehicles, with different vehicle types
- Not only vehicle automation capability but focus on service.
- Trustworthy public transport use case
- Provision of completely integrated services for users (integrated tickets, information systems, adequate mobility hubs)
- Explore and develop choices for people (including multimodal?)
- Combination of freight & people mobility using multi-purpose vehicles
- SDV vehicle with flexible E/E architecture possible to be customized by user with communication on board

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Recommendations received for the topic “Freight & Logistics”

Use-Cases

- Duration of demonstrations must be expanded. Operations must be repeated during a long period to gain evidence of impacts and reveal operational challenges
- Evaluate an end-to-end logistic solution for hub-to-hub on public road, preferably in daily operation for 1 full year (addressing the 4 seasons)
- Use case: ask logistic operators themselves something simple, generating money, tested for 1 year. Edge cases can be tested at a shorter duration (minimum 3 months)
- Follow the logistics chain: last mile, transition, confined areas, public, long and short distance, highway-urban roads. All parts of the chain should be assessed in the process
- Connect confined operations use cases with TEN-T freight flows (corridors)
- Do not approach too many concrete use cases, but these should be either complementary or “replicas”
- Platooning for trucks on dedicated hub-to-hub relations
- Also include delivery services with vehicles of different size and concept
- Keep use case simple but follow type approval process
- Enhance multi-modal transportation (end to end)
- Parking areas at the edge of urban areas (semi-urban)

Vehicles, Fleets & Services

- Large scale logistics defined by mileage and time. Diesel truck = 120k km/year => +30 vehicles are already a lot. 2Zero project 10-20 vehicles. H2 accelerate 150 vehicles: too much. Time: at least 1 year. Why: data, acceptance, safety, seasonal weather, logistic peak operation, reliability. Logistic operator will only trust if it is proven (with references).
- Use of robot vehicle in last-mile logistics with district-hub spread in the cities
- Combination of passenger & freight?
- Testing of services/systems rather than vehicles
- Limit amount of vehicles to approx. 20 and from different OEMs (reason is cost, and trucks make more miles than passenger cars)
- Include multiple OEMs to demonstrate interoperability
- Increase number of OEMs
- Create an atmosphere for start-ups to deploy supporting solutions like planning and dispatching platforms
- Data trust, data exchange