CONFERENCE

Results from road transport research

Summary Report
#RTR2024 Conference

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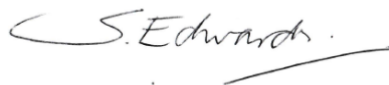Co-organised by

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INTRODUCTION

The 7th edition of the European Conference on the Results from Road Transport Research (#RTR2024) took place from 5th to 7th February 2024 in Brussels. A total of 76 EU-funded projects were presented during 26 parallel sessions.

The presentations gave the final outcomes from numerous Horizon 2020 projects, providing a glimpse into a promising future for road mobility. Further, attendees were introduced to new results for the recent Horizon Europe funded projects.

In addition to the standard programme, featuring activities related to infrastructure, safety, urban mobility, logistics, projects from new partnerships were invited to present in 2024. These partnerships were the Towards Zero Emission Road Transport Partnership (2Zero), the Connected, Cooperative and Automated Mobility Partnership (CCAM), the Batteries for Europe Partnership. For the first time, some projects from the Clean Hydrogen Europe, the Chips-JU (former ECSEL-JU) and the 5G partnership were presented. Hence, this edition of the RTR Conference embraced the system approach promoted by the road transport research community for many years.

In this Summary Report, the moderators of each session briefly tell of what was presented by each project's representative and provide a summary of the discussions and conclusions from their session. For more information, the recording of each session can be accessed by clicking on the YouTube logo next to the session title.

We wish you a good read and hope to see you at the next edition from 11th to 13th February 2025.

S. Edwards

Simon Edwards
Ricardo
ERTRAC Vice-Chairman & RTR Conference Chair

PARALLEL SESSION 1:

NETWORK AND TRAFFIC MANAGEMENT FOR FUTURE MOBILITY

DIT4TraM   FRONTIER   Orchestra   TANGENT

Summary from **Serge van Dam** (Rijkswaterstaat)

DIT4TraM (Distributed Intelligence and Technology for Traffic and Mobility Management) aims to identify the potential for (horizontal and vertical) decentralization of managing multi-modal demand and supply, to reach contemporary objectives. The project has developed a digital twin for intersections, to be able to auction intersection control for prioritization. Also, the project has developed a decentralized control scheme for Utrecht freeways, and control strategy integration for inflow metering. A concept of tradable mobility credits was developed and simulated. A fair service provider competition model for ride hailing services was tested.

FRONTIER (Next generation traffic management for empowering CAVs' integration, cross-stakeholders collaboration and proactive multi-modal network optimization) researches AI models for the optimisation and efficient management of transport networks. The project also develops simulation models for evaluation of traffic management response plans. This should contribute to finding solutions for the cooperative implementation of traffic management strategies. For road user, these solutions should eventually land in web-based and smartphone applications for collaborative traffic management. Eventually, the level of sophistication of parts of the road network could be registered in a smart infrastructure classification index.

ORCHESTRA (Coordinating and synchronising multimodal transport improving road, rail, water and air transport through increased automation and user involvement)

showcases how we can evolve from today's Traffic Management, which is done in silos, towards future Traffic Orchestration that facilitates the coordination of multimodal transport across modes and governance areas. ORCHESTRA's result supports new and improved transport services, both of people and goods, and provides individualised support to transport providers. ORCHESTRA delivers policy papers, a polycentric multimodal architecture and lessons learned from simulations and trials.

TANGENT (ENHANCED DATA PROCESSING TECHNIQUES FOR DYNAMIC MANAGEMENT OF MULTIMODAL TRAFFIC) focuses on the need to move to multimodal and integrated NTM systems. The project develops concepts for enhanced information service for multimodal transport management, Real time Traffic Management Services and Transport network optimization for Transport Authorities. The TANGENT tool offers a better coordination of multiple modes, therefore supporting multimodality and innovation. TANGENT has held many workshops with demonstrations for co-creation and multi-stakeholder engagement in designing new NTM systems. The consortium created novel transport modelling, prediction, simulation and data harmonization and fusion techniques. A key result was the transport network optimization module for transport authorities.

Discussions after the presentations were lively and focused on the future role of road authorities in traffic management, taking into account the limited budgets and capabilities of road authorities. The concept of mobility credits was debated. Connectivity and, especially, trust and security in the context of these services was seen as a key topic.

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Summary from **Michael Weissner** (Volkswagen)

Session 2 addressed understanding and mitigation of the topic of particle and noise emissions, in a wide range from low to high TRL, with a focus on their impacts on human health. The results shown from recently finished or currently running projects from Horizon2020 and Horizon Europe, including those on BEVs, will contribute to a cleaner mobility with reduced health impacts. The projects covered topics from health effects to technical solutions, new testing methods and fundamental data as a basis for future regulations.

The first presentation was given by Ulf Olofsson (KTH) about the project **nPETS** "nano Particle Emissions from the Transport Sector". The project started in 2021 and had a duration of 3½ years. The aim was to gain comprehensive knowledge about the creation, fate and health effects of nanoparticles (<100nm) from all transport modes (road, rail, air and sea). A key method is the use of ALIs (air-liquid-interfaces) to perform cell-exposure studies in real-world conditions. Systemic processes, protocols and databases, have been elaborated as preparation for the next steps in this topic. A key learning so far is that all particle sources studied (exhaust and non-exhaust) contribute to UFP (ultra fine particles).

In the second presentation Juan J. Garcia (Applus IDIADA) described the results of the **LEON-T** project. "Low particle Emissions and lOw Noise Tyres", which started in 2021 with a duration of 3½ years. The project aims at increasing the knowledge and evidence

about particle and noise emissions from tyres and their associated effect on public health. Outcomes at a low TRL about the cardiovascular effects of exposure to tyre generated noise up to higher TRL mitigation proposals, such as an airless tire-concept for reduced particle and noise emission, have been presented. Finally, recommendations for legislation have been made and the numerous links to other projects for an increased impact have been described.

Johan Øvrevik (NIPH) has presented the third project of the session: **ULTRHAS**. The project has a scheduled duration of 4 years, until August 2025. The scope is to investigate the toxicity of particles from different types and sources, including cell models and tests with jet and maritime engines. A key question to be answered is, which factor drives toxicity of particles: particle number, surface area, mass or chemical composition? Besides still existing uncertainties one outcome is that regulation targeting 0.1-1.0 µm and volatile/semi-volatile (VOC/SVOC) emissions may be more important than regulating extremely fine particles (UFPs).

AeroSolfd ("Fast track to cleaner, healthier urban Aerosols by market ready Solutions of retrofit Filtration Devices for tailpipe, brake systems and closed environments") has been presented by Martin J. Lehmann (MANN+HUMMEL GmbH). The project is conducted under Horizon Europe for 3 years until April 2025. The aim is to develop and demonstrate filtration solutions in order to improve air quality in urban areas. Technologies are addressing tailpipe and brake emissions as well as the pollution at metro stations. The potential of the elaborated systems has been tested and validated in real use cases, a positive impact on air quality could be demonstrated.

The final presentation about the **TUBE** project: "Transport Derived Ultrafines and the Brain Effects" was given by Pasi Javal (UEF). The project, with a duration of 4 years, looks at the effects on the brain and lungs in combination, using, for example, biomarkers for the early detection of brain disease as a result of air pollution, e.g., ultrafine particles from road transport. With methods like ALI exposures or in vivo/ in vitro experiments, valuable knowledge has been created about emission related parameters, such as fuel composition or ICE-operating mode, together with their impact on health risks, including differentiation between male and female. TUBE was able to suggest which traffic related pollutants are the most important to protect human health via the regulations.

The session has shown remarkable improvements of knowledge on the health aspect of emissions coming from transport in general. Useful recommendations have been made to both, regulation and further research needs. One example for necessary research is the understanding of secondary effects, the fate of the emissions, for example the chemical effects under sunlight. A lively discussion beyond the end of the session showed the relevance of this topic as well as the numerous knowledge gaps, which need to be addressed by further research activities.

PARALLEL SESSION 3:
ADVANCEMENTS IN LITHIUM-ION BATTERIES GENERATION 3B

Summary from **Burak Dermenci** (VUB)

Session 3. Advancements in Li-ion batteries Generation 3b was opened with the welcoming speech from Monica Giannini (CINEA). Four project presentations were held during the session.

3beliEVe: This project is the first presentation during the session and covers the supply chain from material development towards recycling. Cobalt-free LNMO based cathodes in combination with Si-based anodes are used in the 3beliEVe project. Electrolyte tailoring to improve the high voltage capabilities are also being discussed. 450 W.h/litre volumetric energy density has been achieved. Loss of cyclable Li and significant gas generation are the governing mechanism affecting the energy density.

Sense: This project covers the supply chain from material development towards sensor and BMS integration. While cobalt-free and nickel-rich NMC cathodes are the focus of the project, important progress on chemical pre-lithiation of Si-C anodes is achieved. The project achieved its volumetric energy density targets of 750 W.h/litre. The electrolyte used in this project contains flame retardants to improve the safety.

COBRA: This project covers the supply chain from material development towards recycling. Here, the selected Cathode Active Material (CAM) is Li-rich NMC in combination with Si composite Anode Active Material (AAM) made from recycled Si.

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Differently to other projects, the potential of ionic liquids as electrolytes is being studied. The project stands below its target with 400 W.h/litre.

Intelligent: The project focuses on 20 A.h pouch cells for automotive applications, with an ambitious 850 W.h/litre volumetric energy density target. To meet the ambitious targets, tailored binder engineering, electrolyte engineering with the support of modelling and digitalization tools is going to be realized within the project. The project is currently midway and extensive research is going on for the time being.

The four projects clearly serve the ambition to reduce the critical raw materials in the battery components. As they are complementary, they are able to bring valuable know-how on all important challenges linked with Si anode use. The success of the projects is being rewarded with the follow-up projects maintaining the know-how to be built-up within the EU on the upcoming challenges. The projects are able to contribute the whole value chain since they showed clear vision on battery recycling and recyclability of the components.

PARALLEL SESSION 4:
DIGITALISATION OF LOGISTICS

Summary from **Fernando Liesa** (ALICE)

Introduction

The session was framed in the context of the Sustainable and Smart Mobility Strategy[1] and the developments of the Digital Transport and Logistics Forum[2], supporting the creation of interoperability for data sharing in logistics and the implementation of the electronic Freight Transport Information regulation (eFTI) and the European Mobility Data Spaces.

Four projects and their main results were shown. The projects highlighted core innovations, including autonomous freight vehicles, IoT sensors, 5G coverage linked to the CCAM partnership (**e-PICenter**) and the electrification adoption including mapping of charging infrastructure linked to 2ZERO (**STORM**). These technologies aim to increase the efficiency of logistics processes, hence reducing carbon emissions and improving environmental sustainability. The importance lies in the ability to mitigate the negative impact of transportation on the environment, while driving innovation and competitiveness in the logistics industry.

The European Commission underlined the continued support to digital innovation in logistics to harness the power of new technologies and reminded the 2024 call on

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[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789
[2] Digital Transport and Logistics Forum, DTLF (*www.dtlf.eu*). Commission Expert Group (E03280).

scaling-up logistics innovations, supporting freight transport decarbonisation in an affordable way through the Physical Internet with a focus not only on digital but also physical technologies.

Summary of projects presentations

PLANET (*Progress Towards Federated Logistics through the Integration of TEN-T into a Global Trade Network*) was presented by Dr. Tomas Ambra, technical director of INLECOM. The project developed simulation capabilities, open ICT infrastructure concepts and use cases to move from monolithic platforms to federated networks tested in Living Labs. Through Living Labs, AI and Blockchain technologies, the use of dynamic synchromodal management on the TEN-T and IoT integration on the Silk Road and Digital Twins were demonstrated to optimize transportation on key corridors. These approaches have resulted in potentially reduced costs, increased operational visibility, improved customer experience, increased transport volumes management, and reduced emissions and impact from disruptions in the supply chains.

ePICenter (*Enhanced Physical Internet-Compatible Earth-frieNdly freight Transportation*) was presented by Dimitri Laureys, from the Port of Antwerp-Brugges. The project is demonstrating technologies and solutions through three demonstrators, ePI-Link that is about data sharing in digitalization focus, how to apply the ePI-Node, to know what the knock-on effects on global freight transport are, and Arctic that seeks the growing interest in transport through the arctic region. ePI-Node stands out because it has implemented a 'connectainer' which is a case of an automotive plant, where there is a remote-control truck in operation.

STORM (*Smart freight Transport and logistics Research Methodologies*) was presented by Dr. Yancho Todorov, VTT. The results of a design of EU heavy trucks charging network were presented, highlighting the large number of charging points of different capacities required in the network, with a proposed average ratio of 4.5 CCS points for each MCS point, and that the energy required could reach 110 GW.h per day to charge the vehicles. The methodology carried out involves identifying long-haul trucks trips by projecting 2030 trucking demand and assigning routes to electric trucks, as well as identifying the necessary charging infrastructure based on energy consumption and load constraints. STORM made an analysis of likely scenarios for logistics development

and moving towards Physical Internet was reported as the most likely development scenario.

FOR-FREIGHT (*Flexible, multi-mOdal and Robust FREIGHT Transport)* was presented by Dr. Georgia Ayfantopoulou, CERTH. FOR-FREIGHT objectives include developing multimodal logistics case studies, implementing interoperable solutions to improve efficiency and sustainability, and promoting new business models and collaborative approaches in transportation and logistics. In addition, it seeks to improve logistics management through the use of real data, validate the business maturity of solutions, and ensure compatibility with logistics rules and standards.

A significant improvement in the physical and digital infrastructure for clean, connected and automated mobility is expected, with 25% reduction in greenhouse gas emissions and more than 30% of connected and automated vehicles in the EU. In addition, it seeks to improve operational efficiency by 30% and optimize the supply chain by more than 50% through the use of decision support system and real-time data.

Concluding Summary

The implementation of digitalization in logistics, including autonomous vehicles, electric trucks, IoT sensors, and 5G coverage, is revolutionizing transportation toward cleaner and more efficient systems. Through initiatives such as **PLANET**, **EPICENTER**, **STORM** and **FOR-FREIGHT**, innovative technologies, such as AI, Blockchain, digital twins and transport automation, are being leveraged to optimize processes and reduce carbon footprint.

These projects aim to enhance operational visibility, reduce emissions and improve sustainability in the logistics sector. Overall, they demonstrate a significant effort towards a greener and more competitive industry landscape, with tangible benefits including improved efficiency, reduced greenhouse gas emissions and enhanced supply chain optimization.

As per the session Q&A session, the following aspects came in as research and innovation needs:

- Addressing cyber-security aspects and risk assessment linked to digitalization of logistics from a system perspective.
- Resilience implications of digitalization adoption: positives, negatives and trade-offs

- The need to involve the innovation ecosystem in living labs and large-scale demonstrations, to address interdependencies between stakeholders for logistics innovation.

Additionally, the consensus of the session discussion raised that technology readiness is not the key barrier for innovation but other aspects, such as framework conditions, interdependencies across stakeholders, are. Those aspects are still not in the "competitive" domain and still need to be addressed through collaboration projects focussed on organizational and transition management innovations to achieve the desired impacts, as none of the individual stakeholders has the power and/or capacity to create the market conditions for adoption.

PARALLEL SESSION 5:
USER-CENTRIC CHARGING SOLUTIONS

Summary from **Christof Schernus** (FEV)

The three presentations of this session dealt with user-centric charging solutions applying different technologies: fast, slow, smart, bi-directional, wireless static and dynamic, as well as conductive charging, in different use-cases. The integration of the EV with the electricity grid is the second pillar of the Strategic Research and Innovation Agenda (SRIA) of the Towards Zero Emission Road Transport (2Zero) co-programmed EU public-private partnership. It aims to mitigate effects on the power grid by charging of EVs and turn their connection to the grid into benefits for public power supply.

INCIT-EV is a Horizon 2020 project funded under the 2019 call of the European Green Vehicles Initiative LC-GV-03-2019 - User centric charging infrastructure and coordinated by Fundación Centro de Investigación de Recursos y Consumos Energeticos (CIRCE). The project included the following seven different use cases employed in seven different cities in Europe. The presentation focused on several examples, of which the first enabled conductive bi-directional slow-charging at 25 kW and fast-charging of up to 200 kW, achieving 95% efficiency in V2G operation with very fast SiC power electronics. Then, three demonstration sites dealt with wireless charging, the interoperability of which was ensured by the project partners, so that each of the four vehicles could be wirelessly charged at each of the three sites. This included a static oil-cooled wireless opportunity charging at a taxi stand with 50 kW reaching up to 90% of the efficiency of conductive charging at the same power. Further, a second wireless charging demonstration in Paris implemented a series of 1

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m long coils in the ground that supply the vehicle on that lane with power as it rolls over the coils. With some realistic misalignment of vehicle and ground installation, the efficiency reaches approximately 85%. A third technology with a 10 m long coil in the ground is being tested in Zaragoza and shall, thereafter, be upscaled in Paris to an 80 m long demonstration with such coils. The benefit of these long coils is their possible communication with up to three coils in the vehicle, increasing the power transfer to about 90 kW and less installation of power electronics along a motorway. This is estimated to drop the investment from € 6-10 m per km to about one third or one fifth. The project contributes to the international standards for 85 kHz wireless charging and to interoperability of vehicle and infrastructure. It further delivers a tool for urban planning of low medium and high-power charging installations. The researchers noticed some reluctance of car makers to implement V2G charging, assumingly related to concerns about premature ageing of batteries. There seem to be considerations to limit the cumulated energy cycling in supply to the grid in a battery lifetime to avoid warranty problems, which would have a detrimental effect on the V2G business model. INCIT-EV collaborates in a cluster of projects with five other projects, among them SCALE that also participates in this session.

EV4EU is funded by the EU under the 2021 call of the 2Zero PPP [HORIZON-CL5-2021-D5-01-03 - System approach to achieve optimised Smart EV Charging and V2G flexibility in mass-deployment conditions](). At the time of the presentation, the project recently completed its first reporting period. According to the topic, the 16 partners, including the Distribution Service Operator (DSO) ELES from Slovenia, deal with different business models and use cases. In order to provide a V2G service to the system, connected vehicles must become organised in Virtual Power Plants (VPP). Therefore, EVs must be modelled in the context of DSOs and Charging Point Operators (CPO). The implementation of V2G services across Europe still suffers from inhomogeneous regulations across member states, some of which prohibit charging in energy communities, others do not allow feeding energy back to the grid. Hence, most of the V2G strategies investigated in EV4EU cannot be implemented across all of Europe before DSOs are allowed to activate the possible services by connected EVs. Like the other projects in this session, EV4EU is challenged by the incomplete definition of ISO 15188-20. The further work will include user surveys related to, e.g., vehicle-to-home (V2H) and other beneficial applications.

SCALE established seven demonstration-sites, each in a different EU country, for smart charging and applications of Vehicle-to-Home (V2H), Vehicle-to-Public (V2P), Vehicle-to-Business (V2B) and Vehicle-to-Depot (V2D). It further conducted a customer survey with about 3000 participants across the seven countries that revealed a high willingness to employ smart charging: however, not all customers were satisfied that the technology works. Besides an easy, user-friendly smart charging application, users want to have control, transparency and participate in the financial benefit the technology brings to the system.

The willingness to participate in V2X is limited unless financial benefits are offered. Also, V2H is of interest in conjunction with own solar power generation and smart home installation to integrate the car's battery in their home use. Most concerns among the interviewed people about V2X relate to premature battery ageing, except for The Netherlands, where a lot of positive news is heard from the demonstration area in Utrecht. Accordingly, a study by the Drivers Association in the NL, with 100k participants, showed a high appreciation of smart charging with dynamic pricing that can reduce their power demand during expensive hours by 19% and increase use of cheap electricity by 31% compared to average Dutch households, and saved the participants up to 63% of the costs. On the other hand, in extreme cases, a community of 100k vehicles could challenge the grid operators, with a combined power of 1 GW contributed to the grid (at 11 kW each).

Distribution Service Operators (DSO) see chances in smart charging and V2X to mitigate grid congestions from EV charging, which starts being noticed and is expected to grow in the next 5-10 years. However, regulations and technical conservativeness are seen among the obstacles for roll-out.

SCALE further created a planning tool for urban EV charging infrastructure that helped the city of Utrecht launching a tender for about 800 bidirectional charging stations which became augmented to 1700 recently. It is necessary that municipalities specify modern communication protocols when they tender charging stations, because the specification of, e.g., the old OCPP 1.6 would prevent users doing bidirectional charging at these charging points for their foreseeable lifetime of 10-15 years.

Among the demonstration sites is one smart charging car park of Renault in Toulouse that combines 12 MWp PV with a large number of 22 kW DC chargers. The Goteborg demonstration sites combines 11 kW AC bidirectional charging stations with 22 kW DC compliance investigations, and the demonstration site in Oslo will shift the 150 V1G chargers to V2G in the second half of the project. VDL in Valkenswaard demonstrates vehicle-to-depot charging of trucks and buses. In the city of Rotterdam, the company

Stedin applies smart charging of their electric light vehicles vehicle-to-load (V2L) to supply tools of workers with power in off-grid situations.

The vivid **Q&A session** gave further information about 3-phase AC connection being the preferred power level feedback from cars into the grid, from the DSO point of view, which is better to adopt than 1-phase. The 11 kW connection splits the 22 kW 3-phase connection for two vehicles, which is still a modest C-rate for typical battery sizes of full battery electric vehicles, unlikely to cause significant reduction of battery life. On the other hand, overloading the grid could be avoided by having a 22 kW connection in a building that combines six cars of 3.7 kW 1-phase each to 3-phase. DSOs do not need the flexibility of V2G connected vehicle battery storage 24 hours a day, but just for a few hours of congestion. It was noted that the efficiency of delivering electricity back to the grid is often higher than for charging the battery. However, throttling the feedback power can reduce the efficiency of the power electronics to a level where the value of charging and discharging becomes questionable. The current pricing models, including blocking fees after some time, prohibits using the battery capacity for smart charging or even V2G. Smart charging, in turn, is incentivised by dynamic pricing only in a few countries, e.g. in Denmark. Still, many cities do not include smart and/or bidirectional charging in their tenders for charging infrastructure but stick to the legacy infrastructure. Questions about better going to DC bidirectional charging were argued against, as all public tenders for roadside chargers ask for AC for space and cost reasons. Therefore, AC V2G chargers in cars are inevitable. The losses from AC/DC conversion are comparable to DC/DC inverter, whose efficiency drops when operating in partial load.

The discussion about inductive electric road systems (ERS) agreed on the use case being mainly commercial vehicles that would make use of such roads intensively. There is a cost trade-off between battery capacity to install and the cost for charging in motion that must return the investment in the expensive infrastructure.

PARALLEL SESSION 6:
CCAM COORDINATION FRAMEWORKS, INCLUSIVENESS AND SOCIETAL IMPACT

Summary from **Anna Larsson** (RISE)

The CCAM Coordination framework is derived from Cluster 7 of the CCAM partnership and currently implemented by the **FAME** project and, in terms of Safety and Security, by the **SUNRISE** project. The outcome of these projects aim to set a backbone for further implementations and for projects to build upon within the programme. The session also included the important aspects of inclusiveness and societal impact, where **SINFONICA** and **Move2CCAM** are working in close cooperation to assess the integration in society but also to look at ways of lowering the threshold for acceptance for CCAM technologies and systems.

FAME (Framework for coordination of Automated Mobility in Europe) started in July 2022 and will continue until June 2025. IT includes 23 members from 12 states and has a budget of 12MEuro.

FAME is building on acquired knowledge from earlier projects such as VRA (2013-2016), CARTRE (2016-2018) and ARCADE (2018-2022) and envisions further deepening and articulation of the framework in a possible consequential project in the coming work programme.

The main objective of the project is to establish a European framework for CCAM testing, which includes setting a common taxonomy, understanding the need from different states based on valid legislation and to investigate technical solutions that enables trusted data sharing in a responsive and available manner.

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Within FAME, the site www.connectedautomateddriving.eu has successfully been developed to create a one-stop-shop for all CCAM related activities in Europe. The site draws knowledge from not less than 410 projects and 286 test sites but also from different policies, regulations and standards, strategies and action plans, news and events, evaluation methodologies and data sharing framework etc.

The project will lead to better coordination of public and private R&I actions as well as to support the creation, dissemination and capitalization of knowledge to accelerate the development and improvement of CCAM enabled solutions.

SUNRISE (Safety Assurance Framework for Connected and Automated Mobility Systems) started in September 2022 and will continue until August 2025. It includes 21 members from 12 states and has a budget of almost 13.5 MEuro.

SUNRISE is working at TRL 6-7, building on the earlier project HEADSTART (2019-2022) that considered a TRL level 3-4. It aims to push this framework further into TRL 8-9 in a possible follow-on project 2025-2028.

The main objective is to develop a harmonized, scalable, CCAM Safety Assurance Framework (SAF) through identified methods, toolchain, data frameworks and validation in relevant and realistic test cases.

An initial SAF has been created based on six existing approaches, including a mapping of use case requirements implemented in a Scenario Database (SCDB) and the Data Framework (DF) as well as definition of the V&V simulation framework enabling the toolchain. The project is encouraging people from the CCAM community to join their expert platform www.ccam-sunrise-project.eu/register to further enrich their knowledge base.

The main impact of the project is to find common methodologies to validate the safe system function of CCAM use cases and, in the long run, achieve a validated safety and security, and improved robustness for CCAM Technologies and Systems.

SINFONICA (Social INnovation to FOster iNclusIve cooperative, Connected and Automated Mobility) started in 2022 and will continue until 2025. It includes 14 members from 7 states and has a budget of almost 4 MEuro.

The project has established a large selection of different interest groups, created methodologies for qualitative data collection and engagement strategies and is planning for three rounds of Interviews and Focus groups: the first round is completed.

After the first round it seems "availability", security and safety are important parameters, that there is a high trust in technology, and that a noted frequent impression of autonomous vehicles is very positive but also that they are "slow".

The main impact of SINFONICA is to increase the knowledge base for how CCAM solutions affect different interest groups in society, to be able to set the right requirements for future solutions and to increase acceptance and awareness in an inclusive, equitable, efficient and accessible way.

Move2CCAM (MethOds and tools for comprehensiVE impact Assessment of the CCAM solutions for passengers and goods) started in September 2022 and will continue until 2025. It includes 8 partners and 3 prototypical regions and has a budget of 2.5 MEuro.

By establishing a network of CCAM stakeholders in so called satellites, developing scenarios, business models and KPIs through co-creation and then exploring stakeholders' requirements, goals and perception, the project aims to fulfil their main objective: to develop an assessment tool to evaluate societal impacts.

So far, they have grown a large network, held 7 co-creation activities that has resulted in 52 use cases in passenger and freight transport and business models for 15 of these, as well as AV Demo and VR development, and games in the prototypical regions.

The Impact Assessment Tool is expected to be launched at the end of March 2024, including Creation, Evaluation and Comparison of CCAM scenarios. Through the tool, the project will also provide training and material to the satellites going forward.

The main impact of the project, in the long run, is facilitation of the introduction of CCAM solutions in society.

The projects of this session set a valuable baseline for further development in the CCAM area and it is clear that there is still work that needs to be carried out during the coming years. The session was well attended, with an attentive audience despite being late in the day. The timing of the session is well set in the first afternoon of the conference, since it relates so closely to the next coming sessions and projects of the CCAM portfolio.

PARALLEL SESSION 7 A+B:

NEXT GENERATION ELECTRIFIED VEHICLES FOR URBAN AND SUBURBAN USE

Summary from **Ian Faye** (Bosch)

The session included presentations from projects that addressed the Horizon 2020 call for "Next generation electrified vehicles for urban and suburban use" in 2020, as well as the call for an InCo-flagship (International Cooperation) project on "Urban mobility and sustainable electrification in large urban areas in developing and emerging economies" a year earlier. Projects in the 2020 call address new vehicle architectures that lead to flexibility and modularity in order to ensure urban-readiness (appropriate range, compatibility with charging infrastructures, ease of parking and operations) in all kind of urban and sub-urban areas, most likely with different implementation levels of infrastructure and smart technologies. The InCo-flagship call tackles strategies and demonstration activities towards a more efficient private and public urban electric mobility on a global scale, as well as concepts and means to scale these up. In the future, urban areas are expected to be rethinking needs and expectations for individual mobility and, in some cases, even taking dramatic measures to restrict access to urban spaces, such as the recent decision to significantly increase the cost parking SUVs in Paris.

LEONARDO (MicrovehicLE fOr staNd-Alone and shaReD mObility) has been presented by Michelangelo-Santo Gulino (UNIFI) and plans to be finalized in August of 2024. The project has taken on the challenge to develop a new micro-vehicle that takes in the best features of monowheels and scooters, especially considering user's needs and safety regulations. The development phase of platform and charging stations for

the battery-sharing service was also highlighted, and the ability to park the vertically park the vehicles is a benefit for use in urban spaces. The current status of the demonstration activities was shown, with the first results from the on-field analyses in Rome. Further testing will involve up to 150 vehicles in Rome and Palermo as well as other partner sites. Commercial exploitation and business plans will focus on a ramp-up starting with 4000 vehicles in 2025, and continuing over the next 5 years, to ensure an initial impact of the project.

REFLECTIVE (Reconfigurable Light Electric Vehicle) has been presented by Jenni Pippuri-Mäkeläinen (VTT) and should be completed after 45 months in October 2024. This project has taken on the challenge to develop and test an innovative, modular vehicle concept, scalable and tailored for urban usage needs, and with reconfigurable interiors to enable the transportation of both goods and people. A two-step simulation approach has been used to analyse and better understand urban use cases and missions of light EVs for the vehicle specification. Both simulation and initial crash tests are being used to confirm the ability to meet Euro NCAP ≥ 4-star requirements for the targeted L-Category vehicle. Both conductive and wireless charging to recharge the vehicles are being investigated, and the effective use of smaller batteries will lead to a better overall utilization of resources. Field testing for post and parcel delivery are being planned as well as further options for exploitation after the conclusion of the project.

SolutionsPlus (Integrated Urban Electric Mobility Solutions in the Context of the Paris Agreement, the Sustainable Development Goals and the New Urban Agenda) has been presented by Oliver Lah (UEMI) and had a duration of four years until December 2023, but will be finalized in June of 2024. The project aimed to set up a global platform for shared, public and commercial e-mobility solutions that will help to kick start the transition towards low-carbon urban mobility especially in regions with very low penetration of electrification. This encompasses city level demonstrations to test different types of innovative and integrated e-mobility solutions, vehicle and user-level demonstrations complemented by scaling-up and replication activities. The project has reported that more than 15 e-mobility business models have been developed as well as more than 20 replication actions initiated. Proposed long-term outlook based on 10 demonstration action implemented is potential international cooperation as well as strengthening local implementation activities.

The two final presentations following the coffee break complement each other quite nicely since one starts with improvements to the e-drivetrain and moves up to the vehicle level for last-mile delivery and the other project aimed at achieving a multi-purpose vehicle capable of demonstrating crash capabilities including a mock-up battery pack and fulfilling the NCAP 4 star rating.

URBANIZED (modUlaR and flexible solutions for urBAN-sIzed Zero-Emissions last-mile Delivery and services vehicles) has been presented by Salvador Ruiz (IDIADA) and Victor Desmots (IDIADA) and is planned to have a duration of three and half years, ending in June of 2024. The project aims at demonstrating a cost-effective solution, with substantially reduced vehicle energy consumption and operational costs thanks by a self-adapted and predictive multi-level, multi-layer Energy Management System (EMS) integrating 4 ECO functionalities at different system levels. A high-performance traction inverter, based on GaN-technology, as well a scalable e-axle drive along with the EMS supports demonstrating these achievements. Following the project URBANIZED more sustainable urban logistics will result from these improvements. Final evidence will be collected with the user application bpost in the remaining months of the project.

Multi-Moby (Safe, Secure, High Performing Multi-Passenger and Multi-Commercial Uses Affordable EVs) has been presented by Javier Romo (CIDAUT) and was completed in November of 2023. The project aimed to design a fleet of multi-passenger and multi-purpose commercial vans with enhanced safety features that will serve to enhance autonomous capabilities. The vehicles also featured a low-voltage drive as well as a robust battery pack based on hybrid cells. The structural solution is based on the use of High Strength Steel due to its recyclability, low cost and simplicity of assembly. Safety is integrally covered from an active and passive point of view considering not only the occupants but also the vulnerable road users. The project proposes a rapid implementation especially due to affordability and achieving a 4-star NCAP rating. A cost breakdown has been published and can serve nicely as a reference for future projects.

PARALLEL SESSION 8 A+B:
CCAM AND CONNECTIVITY

Summary from **Hamid Zarghampour** (Trafikverket)

The first part of the session was focused on Connected, Cooperative Mobility (CCAM) and showcased the state-of-play and findings of three projects. These projects emphasized the significance of physical infrastructure, supporting digital infrastructure and cloud solutions for safe and secure mobility data sharing among diverse stakeholders, which are deemed necessary prerequisites for the deployment of CCAM.

The **PoDIUM** project aims to explore the necessary conditions for connected and cooperative automated mobility in real traffic across Germany, Spain and Italy. It establishes living labs equipped with connected LTE and 5G infrastructure, multi-access edge computing facilities, Road Side Units (RSU, ITS-G5) and mobile devices for vulnerable road users. These labs serve as testbeds for investigating five distinct use cases. In Germany, connected and automated vehicles (CAVs) interact with each other and vulnerable road users (VRUs) at an urban T-junction. In Spain, the project examines the importance of PDI for User-Centric, CCAM-enabled Traffic Management in Urban Corridors with High Priority Vehicles and VRUs, as well as Real-time responsive PDI for CCAM-enabled Traffic Management in a Cross-Border Corridor. In Italy, testing includes a VRU-aware intersection movement assistant where appropriate PDI indicates safe passage for CAVs at a crossroad, along with risk management in a highway tunnel. PoDIUm endeavours to enhance understanding and facilitate the implementation of connected and automated mobility across diverse traffic environments.

Augmented CCAM is a pioneering project dedicated to exploring the possibilities and significance of Physical and Digital Infrastructure (PDI) as essential supporting solutions for the deployment of CCAM. Its primary aim is to pinpoint the priority PDI requirements and suggest no-regret measures necessary to support CCAM deployment across diverse mixed traffic environments. Central to the project is the establishment of effective governance among stakeholders to invest in cost-effective, no-regret measures for the large-scale deployment of CCAM solutions. This project expects to accelerate the large-scale deployment through testing of eleven PDI support solutions across several test sites in France, Latvia and Spain, which encompass a variety of physical environments including closed areas, open traffic highways, urban, peri-urban and rural areas. Among its anticipated outcomes, the project aims to deploy at least 5 new CCAM services along with their associated business models. It also seeks to introduce a universally accepted PDI classification framework among stakeholders and develop decision-making tools for no-regret PDI investments to be implemented in at least two corridors.

The **MobiDataLab** project pioneers future solutions for mobility data sharing across Europe, addressing key challenges in interoperability and accessibility. It aims to foster collaboration among transport authorities, operators and stakeholders, enhancing cooperation and collective problem-solving. Through a platform for sharing insights and resources, MobiDataLab is anticipating facilitating informed decision-making and innovation in the mobility sector. The project expects to establish a well-functioning cloud-based service platform, providing stakeholders with easier access to valuable datasets and tools. Promoting a culture of continuous co-development, it encourages innovation in data sharing practices. By collecting and analysing expert advice and recommendations, MobiDataLab expect to identify the best practices and emerging trends, driving forward the evolution of mobility solutions. Emphasizing a cross-thematic knowledge base, the project compiles insights from experts and stakeholders to create a comprehensive repository of actionable recommendations.

In reflecting on the presentations and discussions across the projects, several key lessons emerge:

- Physical and digital infrastructure (PDI) serve as foundational elements enabling safe and secure deployment of connected, cooperative and automated mobility (CCAM) solutions across diverse traffic environments.

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- Establishing living labs equipped with connected LTE and 5G infrastructure, multi-access edge computing facilities and mobile devices facilitates essential investigations, testing, and verification of innovative CCAM solutions tailored to complex traffic environments.
- The projects collectively address major challenges surrounding interoperability, data accessibility and governance, crucial for the successful implementation of CCAM solutions.
- Innovation and continuous knowledge sharing are underscored as imperative drivers for advancing the evolution of mobility solutions, fostering adaptation and improvement in response to evolving needs and technologies.
- Trustworthy collaboration among mobility and infrastructure stakeholders emerges as a linchpin for the effective development and deployment of CCAM solutions, emphasizing the importance of cohesive partnerships and shared objectives.

These insights highlight the multifaceted nature of the challenges and opportunities inherent in advancing CCAM mobility solutions, underscoring the importance of holistic approaches and collaborative endeavours in shaping the future of mobility.

The second part of the session was focused on connectivity with particular focus on 5G capabilities, enabling various uses cases of Connected, Cooperative, Automated Mobility and the importance of seamless connectivity (low latency) cross border.

The **5GCroCo** project addressed a critical challenge: when vehicles cross country borders, calls and data connections often face lengthy interruptions, leaving vast stretches of European border regions without connectivity. This highlights the urgent need for reliable cross-border connectivity to enable advanced Connected, Cooperative and Autonomous Mobility (CCAM) services. The presentation underscores the pivotal role of 5G technology in facilitating CCAM applications such as Tele-operated Driving (ToD), High-Definition Map generation and distribution (HD-mapping), and Anticipated Cooperative Collision (ACCA) avoidance across international borders. Emphasizing the technical challenges involved, particularly in the Luxembourg corridor spanning France, Germany and Luxembourg, the 5GCroCo project, has conducted large-scale trials demonstrating the technical feasibility of ensuring seamless service continuity at border crossings. The insights gained from

5GCroCo offer valuable input for ongoing and future EU-funded initiatives, particularly those under the Connecting Europe Facility (CEF) deployment framework.

The **5G Carmen** project has demonstrated important advancements in cross-border connectivity, improving CCAM services. By establishing a full 5G cross-border corridor spanning Germany, Austria and Italy, the project utilized 5G Non-Standalone (NSA) technology to enhance existing infrastructure, enabling capabilities such as Precise Positioning and Predictive Quality of Service (QoS) for automated manoeuvres. The implementation of improved network reselection reduced latency to nearly 2-4 seconds, complemented by Mobile Edge Computing (MEC) for low-latency data routing. Through orchestrated MEC/edge cloud systems, the project validated low-latency CCAM services, showcasing SAE level 3/4 capabilities in real traffic trials. Additionally, the project conducted comprehensive research, informing market analysis and deployment strategies for CCAM services, emphasizing societal benefits and financial sustainability. Looking ahead, the project is expected to contribute to ongoing 5G for CAM deployment studies and standards organizations, influencing strategic deployment agendas and refining the European CAM/CCAM ecosystem, ultimately shaping deployment strategies and establishing common standards across Europe.

The **5G-MOBIX** project, aims to ensure seamless cross-border 5G connectivity for autonomous vehicles. Its overarching objective is to develop and test automated vehicle functionalities across multiple cross-border corridors and urban trial sites, considering various traffic, network coverage and legal aspects. By conducting trials in EU countries, China and Korea, the project evaluates 5G's value for connected and automated mobility services, identifies deployment scenarios, addresses standardization gaps and contributes to the advancement of 5G-enabled CCAM systems. The project has focused on five use case categories, aligned with 3GPP TS 22.186 standards, emphasizing cross-border operations including Advanced Driving, Vehicles Platooning, Extended Sensors, Remote Driving and Vehicle Quality of Service (QoS) Support. The project has demonstrated the possibility of maintaining uninterrupted mobility across borders with minimal disruption, as indicated by the 0.2 second service disruption. This project underscores the critical role of 5G in augmenting vehicle operations, ensuring speed compliance of CCAM, facilitating seamless V2X interactions, enhancing driving quality by reducing instances of hard braking and improving the overall quality of travel through enhanced reliability.

Upon reviewing the presentations and discussions across the projects, several key lessons come to light:

- Reliable Cross-Border Connectivity: all three projects underscore the critical importance of reliable cross-border connectivity for advancing CCAM services. They highlight the urgent need to address interruptions in calls and data connections when vehicles cross country borders, emphasizing the pivotal role of advanced technologies like 5G in ensuring seamless service continuity.
- Technical Feasibility and Implementation Challenges: The projects reveal the technical challenges involved in implementing cross-border corridors and deploying advanced CCAM functionalities. They emphasize the need for innovative solutions, such as 5G Non-Standalone (NSA) technology and Mobile Edge Computing (MEC), to overcome these challenges and enable low-latency data routing and high-quality services.
- Value of Large-Scale Trials and Research: The projects demonstrate the value of conducting large-scale trials and comprehensive research to validate the technical feasibility of CCAM services and inform deployment strategies. Insights gained from real traffic trials contribute valuable input for ongoing and future initiatives, shaping the deployment agendas and refining the European CCAM ecosystem.
- Contributions to Standardization and Deployment Studies: each project contributes to advancing standardization efforts and deployment studies for CCAM systems. By aligning with industry standards and addressing standardization gaps, they play a crucial role in establishing common standards and shaping deployment strategies across Europe and beyond.
- Societal Benefits and Financial Sustainability: the projects emphasize the societal benefits and financial sustainability of CCAM services. They highlight the potential to improve driving quality, enhance safety and reduce instances of hard braking, ultimately enhancing the overall quality of travel and contributing to a more sustainable transportation ecosystem.

Overall, these projects highlight the multifaceted challenges and opportunities in advancing cross-border connectivity and CCAM services, emphasizing collaboration, innovation, and a commitment to enhancing mobility and safety on European roads.

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PARALLEL SESSION 9 A+B:

FUEL CELLS APPLICATIONS IN HDV (FCH)

Summary from **Roland Uerlich** (RWTH Ika)

Parallel Session 9A

Fuel cell drives can be one of the core components on the way to sustainable, emission-neutral mobility. Yet some key questions need to be answered to bring them to market maturity, some of which the projects presented in this session are contributing to answering. The Fuel Cell Applications Session was introduced by Pietro Caloprisco (Clean Hydrogen Partnership) and Georgios Tzamalis (DG MOVE).

MORELife focuses on improving fuel cell materials and developing viable application-orientated operating strategies. The aim is to optimize the durability and reliability of individual cells and cell stacks for use in heavy commercial vehicles. The project aims to achieve a power density of > 1.2 W/cm² at 0.675 V/cell and a Platinum Group Metal (PGM) load of ≤0.3 g/kW, with a power loss of only <10% over the system lifetime. Selected progress of this work presented at the RTR Conference included the model-based simulation of the degradation mechanisms and the derivation of accelerated stress tests based on driving profiles from the VECTO tool. Further results presented included the model extension by new Accelerated Stress Test as well as the experimental validation of the catalyst material. Likewise featured were the results of dissemination in the form of an exchange with the AEVETO project cluster and the expansion of production capacities.

IMMORTAL also addresses the need for a better understanding of degradation mechanisms within fuel cell applications for heavy-duty commercial vehicles. Achieving the target service life of 30,000 hours and the target output of 1.2 W/cm^2 at 0.675 V is also addressed by optimizing the Membrane Electrode Assemblies (MEAs). The project aims to improve the current MEAs for automotive applications to achieve higher performance, while at the same time developing measures to reduce degradation within the materials. Their primary goal is to significantly reduce the rate of performance degradation thus increase the durability of the fuel cells. This material optimization is evaluated using accelerated stress tests. Within the project, these tests are based on simulated driving cycles using initial driving data. A representative use case derived by clustering these driving profiles is based on this data.

StasHH is developing an open standard for fuel cell modules for heavy-duty commercial vehicles in terms of size, interfaces, control and test protocols. The aim is to promote the use of fuel cells and hydrogen in the field of heavy commercial vehicles where electrification with batteries is not feasible. The introduction of a uniform standard is intended to lower the barrier to entry and boost competition, as original equipment manufacturers will be able to choose and switch suppliers. As part of this project, prototypes from eight leading manufacturers of fuel cells will be produced following this standard and tested by two independent institutes for compliance with the open standards developed by the project itself.

Following the presentations, an extensive and lively discussion ensued, moderated by Roland Uerlich (RWTH Aachen). In this session, questions regarding the further requirements of material development for fuel cells and the transferability of the results from the operation of fuel cells in the laboratory to operation under conditions in the commercial vehicle segment were discussed. The importance of a better understanding of commercial vehicle applications was also addressed, as their diverse use cases impose different requirements on fuel cells. Concerning standardization, the clear definition of interfaces has been confirmed, but also the need to define a uniform communication strategy between fuel cell and vehicle to ensure real interoperability.

Parallel Session 9B

PRHYDE addresses the need for a standardized refuelling protocol for the fuel cell operation of heavy commercial vehicles. The aim is to enable this protocol to be used

in other areas of application, such as trains and ships. Therefore, various protocols for operating pressures of 35, 50 and 70 MPa are designed. These are validated within the project through both simulative and experimental investigations. The results presented in the project show that a significant increase in performance can be achieved through extended communication between the vehicle and the refuelling station. Various concepts and extended data exchange have been defined within the project. Based on these findings, the project aims to initiate an overarching standard thus pave the way for the provision of a standardized, cost-efficient hydrogen infrastructure.

H2Haul aims to develop and deploy 16 zero-emission fuel cell trucks at four sites. In addition, new high-capacity hydrogen refuelling stations will be installed to provide reliable, low-carbon hydrogen supplies to the trucks. The project began in 2019 and will run for seven years. The project includes the development and operation of trucks for long-distance transport and the associated fulfilment of a wide range of customer requirements. Three types of fuel cells are also being tested for safe use on Europe's roads. This is accompanied by the setup of refuelling infrastructure for the initial supply of the vehicles. The aim is to demonstrate the operational capability of the hydrogen-powered vehicles within the project based on the driving performance of more than one million kilometres of the project vehicles.

During this Q&A session, there was a lively discussion about the framework condition of bidirectional communication between infrastructure and vehicles, as this is the only way to utilize the full potential of the refuelling process. The remaining hurdles to implementation were also addressed. The need for further action even after the introduction of the SAE standard, which is currently being developed, was also discussed. It was furthermore pointed out that the general usability of fuel vehicles in the heavy commercial vehicle segment can be demonstrated based on the deployment scenarios realized within the project. However, there is still a need for further research concerning the evaluation of this operational capability in terms of competitiveness with diesel vehicles and the durability of fuel cell vehicles under real operating scenarios.

PARALLEL SESSION 10:
VIRTUAL MODELLING OF BATTERIES

Summary from **Paul Schiffbaenker** (AVL List)

The session "Virtual modelling of batteries" covered the development of models, to speed-up battery cell development. The topic relates to the current research landscape and greatly contributes to both: the introduction of new products (cell technologies) as well as new methodologies (modelling).

The virtual modelling of batteries fully reflects the BATT4EU's vision of establishing an innovation ecosystem boosting a competitive, sustainable and circular European battery value chain, and driving the transformation towards a carbon-neutral society. Particularly, it supports cell design and manufacturing, and fosters the development and deployment of sustainable and affordable battery solutions for clean mobility. The virtual modelling of batteries contributes to the achievement of all operational objectives of the Partnership, in particular regarding increased energy density, power density and charging rate, cycle lifetime and reduced battery costs.

The topic is fully in line with the Commission's priorities of digitalisation and greening of the economy, as it helps replace costly and time-consuming trial and errors methods for battery design and manufacturing, and it enables the design of batteries that last longer, have an improved capacity and performance.

The two presented projects both started in January 2020 and were completed at the end of December 2023. Both are funded by the European Commission within the framework of the Horizon 2020 programme and are within the H2020 LC-BAT-06-2019 call.

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The **DEFACTO** project (Battery DEsign and manuFACTuring Optimization through multi-physic modelling) aimed to develop an open-source modelling tool for multi-physic and multi-scale modelling of battery materials, the manufacturing process and cell behaviour. By using the experimental data from two existing NMC cells to optimise algorithms, the platform promises to reduce development time and cost while enhancing performance and durability. The following results were achieved:

- 12 modelling tools had been developed covering the electrode fabrication steps, electrolyte filling as well as cell ageing (based on two cell chemistries).
- An advanced optimization tool has been developed and released.
- 130 cells have been manufactured and Detailed multiscale post-mortem analysis, from macro (visual inspection) to nanoscale (FE-SEM, TEM) and from bulk (XRD) to surface (XPS) have been done.

The expected impact varies from technological improvement of the accuracy in cell modelling to reduce development time and cost for battery cells by 30%. Further, skill development is facilitated by a developed e-learning platform to engage stakeholder towards the modelling field.

The **MODALIS2** (Modelling of Advanced LI Storage) project targeted to develop a new simulation toolchain for new and future Li battery technologies (Gen 3b and Gen 4). The main results of the project can be summarized as follows.

- The development of 12 modelling tools to reduce the costly and time-consuming trial and error process by, for instance, allowing faster integration of new and innovative materials within next-generation Li-ion battery cells, resulting in cost-effective, efficient and reliable electric vehicles.
- A validated multiscape modelling of Gen 3b cells and a newly developed and validated Gen 4 modelling toolchain were developed.

Future industry needs are covered by the implementation of the models into industrial tools (commercially available). The impact is rated as a potential development time reduction from material development to cell implementation in system by 35%.

Discussions arrived regarding the utilization of the developed models both in commercial tools (**MODALIS2**) and as open-source code (**DEFACTO**). Both presenters stressed that the target, to be quicker in (cell) development by the implementation of modelling was achieved (by the projects, as well as the surrounding activities of research and industry partners). Next steps could be the improvement in accuracy of models, as well as the application to new cell technologies.

PARALLEL SESSION 11:

MEDIUM AND HEAVY-DUTY VEHICLE DEVELOPMENTS

Summary from **Mats Rosenquist** (Volvo Group)

This session focused on two projects focusing on medium and heavy-duty vehicles developments included the projects **LONGRUN** and **NextETRUCK**. These projects relate to the 2ZERO SRIA pillar regarding "Innovative concepts, solutions and services for the zero-tailpipe emission mobility of people and goods".

The volume of the commercial freight sector is expected to increase towards 2050, especially in the medium to heavy truck modes. Road freight is the backbone of trade and commerce on the European continent. Trucks carry 77% of all freight transported over land in the European Union. The heavy-duty sector is responsible for just over a quarter of the greenhouse gas (GHG) emissions from road transport, and for about 6% of the EU's total GHG emissions. Hence it is of key importance to continue to lower the impact from Medium and Heavy-duty Trucks. New powertrain solutions will further improve energy efficiency and reducing emissions. Innovative digital concepts to manage vehicle fleets will further optimize freight logistics. A system perspective and user needs focus are necessary. The two projects in this session presented results on what can be achieved further addressing energy efficiency improvements for heavy-duty long-haul powertrain solutions and new electrified medium duty distribution vehicles. The focus was on the complete system and user needs.

LONGRUN was concluded in 2023 and presented results meeting the objectives of lowering emissions and increased energy efficiency. This was achieved by developing different engines, drivelines and demonstrator vehicles with 10% energy saving (TtW)

and related CO_2, 30% lower emission exhaust (NOx, CO and others), and 50% Peak Thermal Efficiency. A second achievement was the multiscale simulation framework to support the design and development of efficient powertrains, including hybrids for both trucks and coaches. With these initiatives the potential of hybrid powertrain technology and Internal Combustion Engine operating on renewable fuels in Europe was demonstrated. Simulation also showed that a single solution will not be enough to achieve the emission and energy targets. A diversity of solutions will be required. The LONGRUN project also showed the importance of cooperation between leading OEMs of trucks and coaches, their suppliers and research partners, to develop a set of innovations and applications. The project has published roadmaps for technology and fuels for to support decision making with validated results and to make recommendations for future policies.

NextETRUCK is an ongoing project started in July 2022. The overarching objective is to provide zero-emission electric medium freight haulage, to play a pioneering role in the decarbonization of the vehicle fleets. The main objectives include 10% energy efficiency increase compared to existing highest-end benchmark EVs of the same size, efficient fast charging concept and infrastructure and development of business models to increase the end user acceptance and foster market uptake. Results will be demonstrated in three different unique real-world cases where the concept will be validated for a range of at least 200 km daily operation over a period of at least 6 months. Three use-cases will be developed in Turkey, Spain and the UK, with three different truck providers. The project will address different optimization challenges regarding tomorrow's urban and suburban logistics for medium duty vehicles into a systems-approach that is reliable, strongly integrated, affordable and flexible enough to be re-used in different applications via dedicated tools and methods. The project presented the ongoing activities regarding a co-simulation model, a digital twin for cloud and virtual vehicle and a fleet management tool. We look forward to revisit the project to learn about the results in a future RTR conference.

In conclusion, this session presented the importance of.
- The importance of **cooperation** between all involved stakeholders for medium and heavy freight transport for a continued **systemic approach.**
- Considering the need of a **diversity of powertrain** solutions depending in the user needs and available energy carriers and infrastructure.

- The session also demonstrated results from models and simulations to aggregate and estimate the impact of various solutions for emission reduction and energy efficiency.
- Further actions for innovative concepts, solutions and services for the zero-tailpipe emission mobility will be needed, as highlighted in the 2Zero SRIA.
- It will be important to address the area of medium and heavy-duty freight transport at future RTR conferences to discuss results and share learnings.

Summary from **Horst Pflügl** (AVL List)

This session was based on presentations from two ECSEL projects (later called KDT (Key Digital Technologies) and now Chips-JU projects). Both projects dealt with the verification and validation of complex electronic and software-based systems (ESBS). These projects are now managed by the Chips-JU PPP, an institutionalised public-private partnership funded by the EU and the Member States. The Chips-JU partnership focuses on digital technologies, as one of the former names suggests.

Both projects worked on validation frameworks from a more generic point of view in the first phase of the project, but later had to focus and apply the methods to specific industrial use cases.

VALU3S, presented by Peter Folkesson from RISE in SWE, is an application agnostic project, which means that the methods can be applied in different application domains, such as automotive, aerospace, healthcare etc.

The main objectives are new methods and tools for verification and validation (V&V) of automated systems with respect to safety requirements. This should lead to reduced time and cost. A multi-dimensional framework that can be applied to different use cases is the expected outcome and should be validated within the project.

The (8th) multi-dimensionality of the V&V framework is related to the type of validation (e.g. experimental versus analytical) or the type of component (e.g. software versus hardware) or the stage of development (e.g. system design versus component testing) etc. As the project had 41 partners and a total project budget of ~25 MEuro, the

consortium found a lot of improvements (41), produced several publications (94+) and created 16 public open-source deliverables (see homepage [VALU3S | Verification and Validation of Automated Systems' Safety and Security](#)). It is expected that the V&V framework and methods will contribute to a more common understanding and processes across the different industries and stakeholders involved in this process.

The **ArchitectECA2030** project was presented by Georg Stettinger of Infineon GER and dealt with a V&V framework for automated (and connected) electric vehicles. Although the project duration was extended, the project ended after 42 months, just two weeks before the conference. Georg explained the hierarchical monitoring concept across all layers and how to monitor, assess and mitigate risks at the system level (across layers). There were also several use cases in the project to evaluate the improvements. A key theme of the project was the Reference Homologation Process (RHP), which provides a consistent way of describing the technology building blocks, methods, processes and tools required for safety assurance and homologation of SAE Level 3+ automated vehicles.

What was also shown in this project is the commonalities between the Commission's AI Act and the V&V safety and security relevance when compared to each other and where a lot of similarities were found. For example, there is a need for a standardised deployment and homologation process, the metrics and KPIs are similar, and the V&V process is always based on high quality datasets and scenarios. Finally, the role of ethics and residual risks is essential in both cases.

To summarise the projects session, the more automation we introduce into our systems, which are often involved in the day-to-day activities of us humans, the more important the verification and validation process becomes. The more AI is involved in decision making and understanding the environment, the more critical we need to look at this process, because we are talking about safety critical systems and failures in such a system could put not only machines at risk but also human lives. Therefore, research must continue to develop improved tools and methods to reduce the residual risk.

PARALLEL SESSION 13:
SOLID STATE BATTERIES

ASTRABAT   **SAFE Li MOVE**   **SOLiDIFY**

Summary from **Silvia Bodoardo** (POLITO)

The session was focused on the Horizon 2020 projects based on solid-state batteries for automotive applications. The updates of the projects already presented during the previous RTR edition.

The projects presented were: **ASTRABAT,** coordinated by Sophie Mailley of CEA, **SAFELIMOVE,** coordinated by María Martínez-Ibañez of CIC EnergiGUNE, and **SOLIDIFY,** presented by Daniele Di Lecce of IMEC.

ASTRABAT aims to find a better architecture with an all-solid-state electrolyte, containing ionic liquids, are tailored for cells with silicon-based anodes and NMC-based cathodes. The solution proposed is a new bipolar cell.

SAFELIMOVE aims to produce hybrid polymer-ceramic solid electrolytes for high-energy cells using lithium metal anode and a NMC 811 cathode. The optimization of the interfaces was carried out together with the project of a new BMS.

SOLIDIFY focuses on bringing the liquid-processed solid-state cell fabrication concept from laboratory scale to pilot line at TRL6, using lithium metal at the anode protected with a 3D artificial interlayer and NMC811 at the cathode.

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The presented results are very interesting and many questions from the audience have highlighted many promising aspects, for example related to high energy densities, safety but also aspects on critical materials and recyclability.

Some issues still need to be overcome. These issues are mainly related to the need to obtain high power densities and greater cyclability of these cells, in particular focusing on automotive applications. An additional point to be highlighted is that the call for proposals request was too ambitious and too difficult to be reached.

PARALLEL SESSION 14:

CRASH PROTECTION AND COLLISION AVOIDANCE

SALIENT
Safer, Lighter, Circular, Smarter

V4SAFETY

SAFE-UP

Summary from **Peter Urban** (RWTH Ika)

The session on "Crash protection and collision avoidance" focussed on road safety as an important field of action in the Clean and Digital Transport Transition, also constituting the first expected societal impact of the CCAM Partnership. Consequently, Anca Paşca, as the moderator of this session on behalf of the EC, reminded the participants of the still enormous number of about 20,000 EU road fatalities per year, about half of them being occupants of motor vehicles. Three projects were presented in this session following the ambition of providing new solutions to avoid road crashes, mitigate their consequences and assess the effectiveness of safety measures.

The **SALIENT** project presented by Raquel Ledo from CTAG is to develop novel concepts for lighter, circular and adaptable vehicle structures for enhanced crashworthiness and higher crash compatibility. Having started in September 2022, SALIENT is at its midterm and could show the results of its simulation-based material selection process: The car front structure that the project is focussing on will follow a multi-material design approach making use of aluminium, hybrid structures and thermoplastic carbon-fibre reinforced tapes, including shape memory alloys. Cross-project cooperation with seven other EU-funded projects has been established. Moreover, Raquel Ledo quantified the expected impacts of SALIENT at a high level of detail. These are in line with the ambitions of the corresponding Horizon Europe call in terms of road safety and with the expected outcomes of the specific call topic in terms of lightweight design. During the Q&A part of the session, the importance of including

production engineering already in the concept development of new vehicle structures was emphasised as well as the growing relevance of crash compatibility between very light and very heavy vehicles. In addition, the conflict between lightweight design making use of many different materials and challenges in recycling such structures was highlighted.

Sytze Kalisvaart from TNO presented the midterm status of the **V4SAFETY** project, which he is coordinating. The project, which started in October 2022, is developing a predictive and, therefore, virtual assessment framework for road safety measures. As a key result from the first year of the project, Sytze Kalisvaart explained the basic V4SAFETY assessment framework and elaborated, in particular, on the definition of the evaluation scope and the selection of a baseline approach preparing the execution of numerical simulations of safety measures in various scenarios. In addition, V4SAFETY has already developed guidelines for the development, quality assurance and use of models representing the human in such assessment scenarios. V4SAFETY is aiming at increasing the coverage of safety measures which can be assessed virtually, as well as the comparability of results, reducing uncertainty and bias, and finally at the standardisation of the assessment framework to be developed. This is likely to contribute to the expected impact of improving the reliability and performance of safety systems from the respective Work Programme. The already established cooperation with the SUNRISE project under the CCAM Partnership, which was mentioned as beneficial during the Q&A, shows the potential to broaden the expected impact to CCAM technologies and systems.

The last project presented in this session was the already completed **SAFE-UP** project. In line with the original objectives, the project coordinator Núria Parera from Applus IDIADA explained that SAFE-UP had developed the prototype of an adaptable restraint system for new seating positions in automated vehicles. In addition, the project had delivered three system prototypes improving the safety of pedestrians and bicyclists by better detection in bad weather conditions, by advanced interventions avoiding critical events and by the provision of timely warnings based on V2X communication. While the functions of all systems were shown in physical demonstrations, the project also worked on advanced virtual assessment methods and supported training as well as awareness raising. Regarding expected impacts, Núria Parera quoted a reduction of up to 60% in road fatalities for vehicles fully equipped with all safety systems from

SAFE-UP in the Q&A part of the session, which clearly exceeds the expected impacts of the respective 2019 call topic.

The session, as a whole, gave a fine insight into the broad thematic spectrum of current EU road safety research, ranging from collision avoidance to the crashworthiness of vehicle structures, novel restraint systems and the predictive performance assessment of road safety measures. Expected impacts show the potential of road safety research results to support the intended transition from the current stagnation in EU road fatality and injury figures to their significant, continuous reduction and finally towards Vision Zero, the EC's long-term vision of a road transport system in which no-one will be killed or severely injured anymore. While a multitude of lessons learned and future research needs was pointed out in the presentations, the discussion with the audience moderated by Peter Urban highlighted in particular the need for further research on human behaviour in the context of road safety and for advances in modelling such behaviour. Speakers also put emphasis on the need for future research actions on the safety of pedestrians and bicyclists.

PARALLEL SESSION 15:

TRUSTWORTHY CCAM

Summary from **Oihana Otaegui** (Vicomtech)

Connected Cooperative and Automated Mobility (CCAM) plays a pivotal role in shaping the future of transportation. As our cities become more congested and our roads busier, CCAM offers a promising solution to enhance safety, efficiency and comfort. But what makes CCAM truly transformative is its commitment to trustworthiness. Trustworthy CCAM ensures that the integration of Communication technology and Artificial Intelligence (AI) into our mobility systems is not only efficient but also reliable and secure. By adhering to guidelines set forth by the European Commission and leveraging methodologies we can build a mobility ecosystem that prioritizes safety, respects ethical boundaries, and fosters public confidence.

During this session, three projects were presented addressing the challenges of trustworthy communications as an enabler to deploy connected and cooperative systems.

CONNECT (Continuous and efficient cooperative trust management for resilient CCAM) aims to tackle the intersection of security and safety within Cooperative Connected Automated Mobility (CCAM). The primary objective is to facilitate trust establishment among entities involved in executing safety-critical functions within CCAM systems. The focal point of CONNECT is the development of a trust management framework geared towards enhancing the quality and efficiency of decision-making in CCAM operations.

At its core, CONNECT endeavours to assess dynamic trust relationships, leveraging the knowledge and processing capabilities residing in the cloud backend to expedite and fortify decision-making processes. Introducing a pioneering trust modelling framework tailored specifically for CCAM, CONNECT captures and conceptualizes trust relationships, empowering entities such as vehicles, cloud services and edge computing to collaboratively establish trust.

Embracing a zero-trust approach, CONNECT broadens the scope of trust assessment beyond predefined assumptions. By evaluating trust based on the source of information, it ensures a more precise and adaptable trust model. The project's key focus areas include:

- Safety and Security Convergence, addressing the intricate interplay between safety and security aspects in CCAM;
- Trust Assessment, dynamically evaluating trust relationships;
- Trust Reasoning Framework, providing a fundamental basis for trust establishment;
- Resilience Enhancement, ensuring the robustness and reliability of CCAM operations.

Through these endeavours, CONNECT seeks to foster a secure and dependable ecosystem for cooperative decision-making in CCAM, laying the groundwork for safer and more efficient mobility solutions.

The **SELFY** (SELF assessment, protection & healing tools for a trustworthy and resilient CCAM) project is dedicated to bolstering the resilience of the Cooperative Connected Automated Mobility (CCAM) sector. Its primary goals encompass advancing the safety and security of CCAM operations, developing collaborative tools, and aligning with European requirements. With a focus on practical applications, the project involves a diverse team of experts. SELFY aims to emerge as a leading provider of CCAM security and resilience solutions in Europe.

To achieve its objectives, SELFY is developing a comprehensive toolbox tailored to address critical challenges within the CCAM domain. These collaborative tools are designed to fortify CCAM resilience, enhance data security and safeguard privacy. Through the integration of these tools, SELFY is creating a robust environment capable of effectively mitigating emerging threats.

SELFY's solutions undergo validation in three real and controlled environments:

- Resilient Cooperative Mechanisms for Vulnerable Road Users (VRUs) Safety addressing safety challenges related to pedestrians, cyclists, and other vulnerable road users.
- Secure Empowerment of Backend Systems for Traffic Management enhancing the security and reliability of traffic management systems
- Robust Platooning Ensuring safe and efficient platooning of automated vehicles.

EVENTS (Reliable in vehicle perception and decision making in complex environmental conditions) endeavours to develop a dependable in-vehicle perception and decision-making system tailored for Connected and Automated Vehicles (CAVs) navigating through intricate road environments and challenging conditions. The project tackles the issue of how CAVs can effectively handle unforeseen circumstances, termed "events," which may disrupt their normal operations. These events encompass various scenarios like sudden traffic changes, adverse weather or lighting conditions, data imperfections, sensor failures, communication glitches and more.

EVENTS introduces an innovative approach that amalgamates advanced sensing, artificial intelligence and human factors to augment the capabilities of CAVs in detecting, categorizing, and responding to these events in a safe and efficient manner. In instances where the system or its subsystems fail to operate at the expected level of quality and reliability, an enhanced minimum risk manoeuvre is initiated.

The project endeavours to contribute to the advancement of more resilient and robust CAVs capable of navigating through a broader spectrum of scenarios and conditions. By doing so, it aims to bolster user acceptance, trust and market adoption of automated driving technologies.

Q&A Panel Discussion

In conclusion, the discussion panel highlighted the paramount importance of cybersecurity as the primary enabler for the successful deployment of connected and cooperative services within the mobility landscape. Delving into cybersecurity and trustworthiness from various angles, the panel shed light on both in-vehicle perspectives and communication aspects. Throughout the discussion, key questions emerged, emphasizing the critical need to prioritize source reliability and data fusion to effectively address cybersecurity and trustworthiness issues in CCAM.

Furthermore, while acknowledging the current scarcity of tools and solutions available in the market to tackle these challenges, the panel recognized the collaborative efforts

of the projects involved. These projects aim to pool their resources, sharing valuable data, tools and methodologies at the conclusion of their endeavours. By doing so, they aspire to pave the way for the development of more trustworthy, cyber-secured and resilient CCAM solutions. Through continued collaboration and knowledge sharing, the panellists expressed optimism for the advancement of cybersecurity practices in the CCAM domain, ultimately enhancing safety, security and reliability in future mobility systems.

PARALLEL SESSION 16:

URBAN MOBILITY – CITIES AS URBAN HUBS AND URBAN LOGISTICS

Summary from **Ivo Cré** (POLIS)

The session combined three levels of interventions in urban areas, with focus on the movement of goods. The **MOVE21** and **SCALE-UP** projects research the role of urban areas as nodes in the TEN-T. The **U-LAADS** project studies and demonstrates measures in the field of Urban Freight Logistics, and the **LEAD** project tested the use of digital twins for the management of urban goods flows.

Although the projects count on further decarbonisation of the fleet and the projects exert a 'digital-by-default' approach, there are no direct links with the 2ZERO nor the CCAM partnership. The topics treated in the projects relate closely to the ERTRAC-ALICE-ERRAC Urban Mobility Roadmap and the activities of the respective working group.

The policy relevance of the projects is apparent: the Urban Nodes concept has been recently fully recognised in the revision of the TEN-T regulation (expanding the number of 88 designated urban nodes to 431 hotspots for digital and green transition). The urban nodes are identified in AFIR and in the ITS Directive as locations for charging infrastructure and data creation respectively. Urban logistics accounts for 10 to 15% of vehicle equivalent miles and for 25% of urban transport related CO_2 emissions and 30 to 50% of other transport related pollutants (Particulate matter and Nitrogen Oxide) and is in that sense a crucial sector to reach zero pollution and climate neutrality ambitions.

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Projects presentation

MOVE21 was presented by Tiina Ruohonen of the city of Oslo. MOVE21 is an Innovation Action funded by the European Commission. It aims at transforming European cities and their surroundings into smart zero emission nodes for mobility and logistics. The project helps participating cities achieve a 30% reduction of transport-related emissions by 2030 via the implementation of 15 transport-related innovations. The project is entering its final year-and-a-half of activities. The project has set objectives in three areas:

- Impact Area 1: Long term decarbonisation in the Living Lab Cities (e.g. 3-18% CO_2 reductions from local road transport, 1-5% CO_2 reductions from local freight transport, 3-15% NO_x reductions from local road transport, 1-5% NO_x reductions from local freight transport);
- Impact Area 2: Sustainable, inclusive, safe and secure mobility systems (1-9% reduction in passenger transport related noise, 1% reduction in freight transport related noise);
- Impact Area 3: Improvements of the efficiency and accessibility (12 (micro)hubs, 52 improvements in existing hubs, 2-15% increase in public transport use, 2-27% modal shift to more sustainable modes).

The results are simulated using digital twins and measures are demonstrated in real world conditions. These are in line with the KPIs of the 2ZERO Partnership, with the overall EU transport objectives, as well as the Mission for climate neutral and smart cities objective. The project is establishing a learning community (SCAN-MED Observatory) that looks at urban nodal performance and progress in the SCAN-MED corridor.

The **SCALE-UP** project was presented by Michiel Penne and Katia Kishchenko, City of Antwerp. SCALE-UP was selected under the same call topic as MOVE21, and as Innovation Action focuses on three European urban nodes (Madrid, Antwerp and Turku) and explores options to render them better connected and climate resilient while further developing complex multi-modal transport systems. SCALE-UP stands for "Scale up user-Centric and dAta driven soLutions for connEcted Urban Poles". The project is entering its final year-and-a-half of activities. The main outcome of the Research & Innovation Project are at least 28 newly developed innovative mobility measures to ensure the vertical (governmental) and horizontal (dimensional) upscaling of urban mobility. The speakers presented three applied measures: the Antwerp rout

planner, the Turku inclusive cycling scheme and shared e-mobility services in Madrid. Impact is expected in three areas:

1. Governance: SCALE-UP addresses the importance of Urban Nodes, and the need to better integrate all levels of governance. The project also exemplifies the Urban Nodes as frontrunners: a variety of measures helps Urban Nodes to realise climate and clean transport goals.
2. Economy: public-private cooperation, strengthening the economy; congestion reduction and passengers/freight transport efficiency generates growth across all areas of the city and FUA; improved safety conditions for freight flows and active modes, contributing to the reduction of the economic losses caused by a lack transport safety.
3. Health: positive health impacts of a shift towards active mobility.

As next steps, the project is working with fellow cities, will issue an Urban Nodes Handbook, and will develop exploitation plans for the above mentioned 28 measures.

The **LEAD** project was presented by EMT Madrid's Sergio Fernandez Balaguer. LEAD: "Low-Emission Adaptive last mile logistics supporting on demand economy through Digital Twins" was a RIA that ended in September 2023. LEAD created Digital Twins of urban logistics networks in six TEN-T urban nodes (Madrid, The Hague, Lyon, Budapest, Oslo and Porto), to support experimentation and decision making with on-demand logistics operations in a public-private urban setting. Each local demonstrator combined a number of measures, coined as LEAD Strategies, to cover the complete dynamics and complexity of a city's logistics challenges. The project established an open Digital Twinning platform that standardises the execution of model workflows, comprising several interdependent models, where the output of one is the input of another. In this sense, the project is reusing models in order to establish new city-wide digital twins. LEAD supported the integration of models developed in third-party tools with diverse programming languages, frameworks and technologies. It ensures scalability, supporting the simulation of local to city-wide complex scenarios and provided flexibility in the ingestion, use, and sharing of data sources used in the simulations. The project tracked 20 KPIs for the duration of the project in the demonstration sites. In most cases the set targets were reached. The project was granted a patent in Belgium and Greece for an EV Charging Scheduling algorithm (by project partner Inlecom) designed to optimise the charging schedule for an EV during a trip. The patent is pending in Germany, France and the USA.

U-LAADS was presented by Howard Weir of TOI. ULaaDs – Urban Logistics as an on-Demand Service is a RIA that will end in February 2024. It offers a new approach to system innovation in urban logistics by re-localisation of logistics activities and re-configuration of freight flows at different scales. The project uses a combination of innovative technology solutions (vehicles, equipment and infrastructure), new schemes for horizontal collaboration (driven by the sharing economy) and policy measures and interventions as catalysers of a systemic change in urban and peri-urban service infrastructure. The project findings will be translated into open decision support tools and guidelines. The project is active in 7 cities: Bremen, Groningen, Mechelen, Alba Iulia, Bergen, Edinburgh and Rome. ULAADS combined demonstrations for collaborative and shared urban logistics with measures for integrated passenger and urban freight networks. Pilots included (Bremen) containerized last-mile delivery, cargo bike sharing, and cargo hitching simulation, (Groningen) shared vehicles for shopkeepers, urban logistics as a service for commuters at P+R zones, and (Mechelen) combined parcel pick-ups at local shopkeepers and cargo-hitching with autonomous vehicles. Impact was measures tracking the number of SUMPs that incorporate the ULAADS guidelines, the number of stakeholders locally engaged and the share of on-demand UF trips performed with ZE solutions. Final outputs of the project include the application and implementation of selected ULaaDS solutions, stakeholder involvement methodology (local fora and collective target systems) enables broadly accepted and supported solutions, as well as turning SULPs into actionable frameworks. The experience with the automated freight shuttles links to the CCAM partnership objectives, the reliance on EVs for freight delivery relates to 2ZERO objectives.

Session summary

Urban Freight has to innovate in all the OECD-recognised innovation categories: social innovation, governance, business and technology. The presented projects cover all these issues. This is a strength. The session made the different levels of intervention explicit: the urban nodal level (where the TEN-T interfaces with the local and regional road networks), the strategy and measures level, as well as the enabling tools and methods.

The urban freight sector has to deal with two challenges: market fragmentation (multiple clients, multiple shippers and multiple service providers) as well as market segmentation (different purposes, e.g. e-commerce, construction logistics etc.). An

integrated planning approach (SULP or Urban Freight as part of the SUMP) can bring the policy framework to coordinate better on these two aspects. Digital tools (such as digital twins) can support the needed coordination and integration.

The session raised the issue of understanding the magnitude of the problem: what qualifies as urban freight, when does the last mile start, what are the logistics generators of importance? Urban Freight is a sector that needs more and better data in order to come to evidence based innovation in planning and operations. Projects such as presented above deliver this much-needed understanding.

In view of future research, an improved understanding of the use of public space for urban freight delivery, and the establishment of a common space syntax (to be used by other public space dependent sectors) is of essential importance. Digital twins are a reoccurring tool in the projects, but show that the definition of this method needs re-adjustment. In a multi-stakeholder public-private constellation, such as the urban freight logistics ecosystem entails, the digital twin is unlikely to be a single integrated 3D virtual representation of the city, but rather an interlinked, interactive combination of tools. This requires further research.

Given the fact that all demonstrators focus on full-electric operations, and there is openness with regard to CCAM, urban freight can be a very interesting use case for future combined R&I across partnerships.

PARALLEL SESSION 17:

CCAM ON THE ROADS

Summary from **Margriet van Schijndel** (TUe Eindhoven)

Introduction

The session explored strategies and challenges related to bringing CCAM solutions to the daily transport system. Use cases for both passenger mobility and goods transport were discussed, as well as the interaction with the users. The insights presented clearly relate to the ambition of the CCAM Partnership to accelerate the implementation of innovative CCAM technologies and services in Europe. The contributions addressed two Problem Drivers identified in the CCAM SRIA:

- Insufficient demand as society does not yet understand the potential benefits of CCAM enabled mobility. The long-term implications, benefits and impacts of integrating CCAM solutions into the mobility system are not sufficiently examined. (PD1)
- Current R&I efforts are fragmented and lack a coherent, longer-term vision and strategy for targeting systemic solutions. (PD3)

The session discussed the importance of testing in real life conditions and environments, public acceptability, harmonised methodologies, transferability and practicality of use-cases. The session also looked at recommendations for future R&I activities, with specific focus on commonalities between the 3 projects.

SHOW (SHared automation Operating models for Worldwide adoption): the main objective is *Deployment of shared, connected and electrified automated vehicles to advance sustainable urban mobility*. The eight underlying project objectives were briefly discussed. Results so far included a range of demonstrations, including the use of eighty autonomous vehicles for different types of use cases. Highlights given included demonstrations in Frankfurt (first and last-mile services), Madrid (bus depot management) and Les Mureaux & Escrennes (fully driverless; remote supervision). Further results included replication guidelines, with three levels of replication, as well as regulatory recommendations. Project impacts were presented using 87 KPIs. A more generic impact description focussed on strengthening public transport, best practices and cost-efficiency. Furthermore, the international collaboration was presented, showing fruitful exchanges with other countries on technological challenges, regulatory issues, and business models.

During the Q&A, points raised included topics such as monitoring the KPIs, which the project makes available via a common database to disseminate knowledge and results as the project evolves. Another discussion point touched upon international collaboration, especially with Japan and the United States. Interestingly, Japan has similar concerns regarding the public acceptability of automated solutions as in Europe. Importantly, demonstration projects like SHOW must ensure continuous dialogue with local authorities and operators to meet their mobility implementation plans with innovative solutions, including public acceptability. In this respect, policy recommendations and guidelines will be published. Further R&I activities on integrating CCAM into public transport remains a key priority.

AWARD (All Weather Autonomous Real logistics operations and Demonstrations): the main objective is *Develop and deploy a safe autonomous transportation system applicable to a wide range of real-life occurrences and scenarios*. This is done by developing solutions for four real conditions demonstrations including port trailer autonomous transfer operations, hub to hub autonomous logistics on public roads, airport autonomous ground support equipment, and autonomous loading and unloading operations. For each demonstration, the status and results were presented. Furthermore, the approach and scenarios used in the testing were discussed and detailed. Impacts presented include, e.g., a better understanding of customer use-cases and constraints, a roadmap for the improvement of autonomous missions under very harsh weather conditions and recommendations for AV use on airports.

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During the Q&A, points raised included topics such as the relevance of teleoperations and the growing importance of logistics as a business use-case. Due to the diversity of the consortium the project managed to receive feedback from industry partners on the pros and cons of the four use-cases explored in the project, which will improve future research activities.

Hi-Drive (Addressing challenges toward the deployment of higher automation): has the goal *to make driving automation robust and reliable by taking intelligent vehicle technologies to conditions and scenarios neither extensively tested nor demonstrated earlier in European and overseas traffic*. The key project challenge discussed in the session was the development of a firm understanding of the user when interacting with automated vehicles. The needs of different user groups, the factors influencing user acceptance, user monitoring and intervention tools were discussed, as well as information needed by vulnerable road users, as well as other road users, when interacting with CAVs. Initial findings were presented on the external communication, making a clear distinction between explicit and implicit communication. Furthermore, driver response times as well as the quality of the take overs were discussed. Research facilities and approaches used were presented and include, e.g., driving simulators, on road vehicles, driver monitoring and remote assistance. Impacts of the presented work can be in increased user understanding, leading to CCAM solutions with higher uses acceptance and more reliable vehicle-user interactions.

During the Q&A, points raised included topics such as the difference between explicit and implicit communication with external road users, and why it is important to distinguish both types of communication. Human behaviour, in particular taking place outside of the vehicle remains a crucial research topic, in order to better understand the transition to automated mobility, especially in mixed and multimodal traffic. In addition, the project shared relevant insights in terms of handover of control between the driver and the vehicle. Public acceptability was also explored in the Hi-Drive project: public authorities have an important role to play therein and should continue to better understand the challenges and concerns of users and non-users alike.

Summary

The projects presented showed a broad range of applications and approaches. They all gave specific indications and results aiming to improve uptake and usefulness of new CCAM technologies, both for people and goods mobility.

Large scale demonstrations of connected and automated mobility thus remain a priority, as shown through projects SHOW, AWARD and Hi-Drive: testing innovative mobility concepts in real life conditions is crucial to make sure they cater to real needs and challenges. As we move towards deployment, future research should include larger vehicle fleets and interoperable solutions that can complement different modes of transportation, for both the mobility of people and goods.

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PARALLEL SESSION 18 A+B:
NEXT GENERATION OF POWER ELECTRONICS

Summary from **Roland Uerlich** (RWTH Ika)

Parallel Session 18A

Power electronics are the central interface of the electric drivetrain. Only through their efficient and stable operation is it possible to guarantee the performance of the powertrain. In this context, Joao Carrilho (CINEA) introduced the session on the next generation of power electronics.

PowerDrive comprises the development of advanced power electronics components and their integration into the electric drivetrain. Here, in addition to peak efficiency, the importance of overall system efficiency is taken into account, considering various system states of the vehicle. The central focus is the development of components with a high degree of integration to enable a particularly compact design of the drive system, both for the battery as well as for the electric motor. Suitable simulation models are being developed to assess the designed systems, such as passive components like magnets, cooling systems, connections, and the integration of sensors and circuits in semiconductor components. These form a simulative evaluation basis and are supported by specific experimental validations.

RHODaS is developing an innovative power converter topology that utilizes digital technologies and novel semiconductor materials to reduce overall costs and improve durability and sustainability. Within the project, a multidisciplinary process for the

development of modular power electronics has been used to enable integrated motor drives that can also be used in heavy commercial vehicles and improve their overall sustainability. The project results were presented concerning the achievable high performance and density of the e-axle that was constructed and the high operating efficiency of the SiC/GaN power hybrid switching technology that was developed.

HiPE develops energy-efficient, cost-effective, modular, compact and integrated power electronics with a wide bandgap for next-generation battery-powered electric vehicles. The aim is to enable greater market penetration of these electronics in the automotive sector. The project results include a scalable and modular family of WBG-based traction inverters and DC/DC converters with significantly improved specific cooling performance. These are suitable for use with 400V, 800V and 1200V and with outputs from 50 to 250 kW. Their integration into electric drives offers great potential in terms of size and weight reductions. A family of integrated WBG-based onboard chargers and DC/DC converters with optimized innovative topologies has also been designed, which includes the use of GaN. This technology is also being applied in the area of high-voltage auxiliary devices and chassis actuators to develop an integrated, fault-tolerant, and cost-efficient solution.

Following the presentations, an extensive and lively discussion ensued moderated by Roland Uerlich (RWTH Aachen). In this session, questions regarding the influence of different states of charge on the resulting overall efficiency of the charging process. Furthermore, the importance of this efficiency for bidirectional grid integration was emphasized, as these losses occur several times. In addition, the potentials that can be tapped by hybrid system solutions made of GaN and SiC elements and the thermal challenges that arise from this hybridization, in particular, were discussed. Concerning the high degree of integration, it was also suggested that aspects of reusability and reproducibility should also be considered, as these often contradict with the idea of integration.

Parallel Session 18B

HighScape is testing the viability of a group of highly efficient power electronics components and systems, including integrated traction inverters, on-board chargers, DC/DC converters, and electric drives for auxiliary power units and actuators. To pave the way for emission-free road transport, the proposed solutions will be tested on two

prototypes of battery-powered electric vehicles of different sizes. In this way, the project will present new solutions for auxiliary units and chassis actuators as well as higher power density, specific power and energy efficiency. The proposed solutions will be evaluated on test benches and two BEV prototypes of different sizes. The project will lead to the following results: Component integration with the installation of the WBG traction inverters in the wheel machines to achieve a zero footprint of the electric powertrain on the sprung mass; The functional integration of the traction inverter with the on-board charger and the installation of the latter and the DC/DC converter in the battery pack and the implementation of multi-motor and fault-tolerant inverter solutions for the auxiliary units and chassis actuators. The aim is to achieve a significantly higher power density, specific power, and energy efficiency for the resulting power electronics systems and the associated drives. This ultimately leads to a significant reduction in costs thanks to the dual use of parts and the modularity of subsystems.

PROGRESSUS aimed to introduce a next-generation smart grid, demonstrated using the application example of an intelligent charging infrastructure that fits seamlessly into the current concepts of smart grid architecture. For this purpose, new efficient high-performance converters that support bidirectional current flow have been investigated. New DC microgrid management strategies for energy efficiency and service provision that take into account renewable energy sources, storage, and flexible loads were also considered. New sensor types have also been used to ensure cost-effective, high-bandwidth communication technologies and security measures. On this basis of hardware security modules and blockchain technology, various concepts for the protection of communication and services could be considered. The results of the project show potential for promoting a more environmentally friendly and efficient next-generation energy supply infrastructure. In particular, research into new efficient high-performance voltage converters that support a bidirectional flow of electricity and enable a new type of highly economic charging station with connected storage and a measurement platform for local monitoring of the grid status shows great potential for cost savings.

During this Q&A session, the topics of the operating strategy and its influence on the efficiency of the system electronics and the overall system were discussed. There was also a lively panel dialogue on the topics of upgradeability and reproducibility as well

as the reusability of components. Concerning network integration, the need to design a standardized communication protocol was also debated.

PARALLEL SESSION 19 A+B:
HUMAN FACTORS IN TRANSPORT SAFETY

HEIDI   Mediator   FitDrive   HADRIAN Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs   NEXT PERCEPTION

Summary from **Magnus Granström** (SAFER)

The topic of this session was human factors in transport safety, an area of continuous and growing relevance, not least taking into account new types of vehicles in our transport system, manual, semiautomated and automated. We need to understand a multitude of aspects, such as the optimal way to communicate between a driver and a semi or fully automated vehicle, the need for external communication to other road users, not least unprotected such as pedestrians, how to ensure the fitness of a driver or rider etc.

Five projects were presented in the session, three finalized and two ongoing.

Projects

The main target of the ongoing **HEIDI** project is to enable safe, efficient, acceptable interactions between vulnerable road users and vehicles of different automation capabilities. Halfway through the projects, the following milestones have been accomplished:

- fluid Internal and External Human-Machine Interfaces, used to communicate with drivers and pedestrians at crossing situations;
- methodologies to develop coordination logics to optimize safety and efficiency of interaction between driver and pedestrians while tracking the evolution of the situation, especially when the complexity is increasing;

- and a model to predict the intentions of both drivers and pedestrians in potential conflict situations.

The **MEDIATOR** project was finalized in May 2023 and has, among other things, provided a fitness plan model, assisting in assessing both the human driver and automated system capabilities, allowing for improved determination of which (if any) type of driver is the best to handle the current situation. Also, different HMI concepts have been evaluated both in simulators and in real vehicles. One specific impact from the project is the definition of both corrective and proactive actions and another is the clear understanding that the SAE levels do not constitute a relevant basis for communication to the driver.

In the ongoing project **FitDrive**, techniques are being developed for continuous monitoring of fitness to drive of professional drivers, primarily truck drivers. This is a challenging task, especially when trying to find non-intrusive measures, and the project is using AI technology to identify unusual driving behaviour. It is also important to assess the individual onset of reduced fitness, as this varies strongly between drivers. There is a strong need for standardisation in this field, which already has been communicated through meetings in the European Parliament, and this task will continue throughout the project.

The **HADRIAN** project investigated a holistic, user-centered approach to shape automated driving to meet societal mobility needs and several human-computer interaction innovations were investigated along with driver tutoring, as well as road-infrastructure integration and potential implications on legal requirements. The results and feasibility of such holistic approach were demonstrated in three field-demonstrations in 2023 and the HEIDI project mentioned above builds on some of the outcomes of HADRIAN.

NextPerception - Next generation smart perception sensors and distributed intelligence for proactive human monitoring in health, wellbeing and automotive systems, is a project in the ECSEL portfolio and has as one of three use cases an automotive application focusing on the development of a driver monitoring system able to recognize the attention, emotion and distraction of the driver. Tests and validation of the architecture has been done both using simulations and real vehicle tests. The results are both technical, such as improved precision, and societal, such as

increased safety and comfort. The project also benefits from the combination of use cases, for instance wellbeing at home using similar sensors and methods.

Summary

We are continuously learning more and more in this field, all five projects provide important building blocks in achieving several goals: a better understanding of the interplay between humans and computer controlled systems; a scientific base for future policies and legislation, not least related to professional drivers; a more holistic view improving the uptake of support systems and automated systems, having a better understanding of the suitability for different driving tasks as well as what is not only accepted by individuals but also desired, improving the uptake considerably.

PARALLEL SESSION 20:

MATERIALS AND PRODUCTION PROCESSES

Alma
ADVANCED LIGHT MATERIALS

FATIGUE 4LIGHT

Summary from **Thilo Bein** (Fraunhofer)

Introduction

Within this session the two projects **ALMA** and **Fatigue4Light** were presenting their final results on materials and lightweighting for electrified vehicles. Both projects have been presented at the RTR 2023 as well and belong to the Enlight EVs cluster. The cluster is addressing the weight reduction of EVs through eco-design and circularity. Although funded under Horizon 2020 as part of the EGVI calls, both projects contribute to pillar I "vehicle technologies" and pillar IV "LCA approaches and circular economy" of the recent SRIA of the 2ZERO Partnership with their results on applying eco-design approaches to lower weight and enabling circularity strategies.

Project presentation

The **ALMA** project is addressing an integrated circular approach in vehicle design adopting novel materials such as structural Sheet Moulding Compounds (SMC) and advanced steels as well as recycling strategies, structural health inspections and Life Cycle Assessment (LCA). In this integrated approach a weight reduction of 160 kg (about 22% of the structural weight of the baseline structure) has been achieved demonstrated in extended unbody structure of the Body-in-White (BiW). This reduction in weight translates into 24% decrease in CO_2 emissions and 6% increase in range. Besides, the feasibility of eco-design principles could be demonstrated.

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The second project, **Fatigue4Light,** also addresses eco-design and circularity but with a focus on advanced testing and computer simulation methods for fatigue life, enabling the use of new materials. Combining rapid fatigue tests with novel fatigue simulations allowing to assess advanced fatigue failures, the weight of three selected components (lower control arm, wheel and cross-member beam) could be reduced through applying advanced steels and hybrid materials (aluminium with CFRP). Overall, a weight reduction of 13% for all chassis and BiW flat steel components has been estimated. The rapid fatigue testing developed within the project has been brought forward for standardisation.

Conclusion

Both projects clearly demonstrated the potential of eco-design principles and circular economy approaches to lower the environmental footprint of vehicles and, as such, being an important measure for the transformation of our road transfer system. However, the discussion has shown that further research is needed accelerating the implementation of such solutions, such as on materials and their characterisation, circularity concepts and design approaches, digitalization as well as on manufacturing and end-of-life aspects.

Summary from **Bert Pluymers** (KU Leuven)

Introduction

The noise and emission measurement, assessment and mitigation session of the RTR 2024 conference was centred around two project presentations. Both projects aim at the development of techniques for on-line and real-time measurements and analysis of individual vehicle noise and emissions. Whereas the **NEMO** project already ended, the **LENS** project just started up. Both projects contribute to the state-of-the-use in ensuring future operators have appropriate tools for assessing overall noise and emission levels and identifying 'faulty' vehicles. The session was concluded by an interesting discussion with members of the audience on, amongst other topics, the open points for further development.

NEMO - Noise and Emissions Monitoring and radical mitigation

NEMO has developed a new remote sensing technology that can measure noise and emissions from individual road vehicles in real time. The system will make possible a limited access or charging system based on actual environmental impacts. The new technologies have been tested in several European cities, and officially validated by EU's Joint Research Centre, as a tool to control noise and air quality and to reduce the impact on people and on the environment. The NEMO project is now sharing its results to the scientific community, European policy makers, national road and rail authorities,

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cities and the European population in general. The developed tools are being further developed towards commercialisation by the partners.

LENS - L-vehicles Emissions and Noise mitigation Solutions

Cities, regulators, and enforcement officials need support in finding ways to reduce noise and air pollution generated by motorcycles and mopeds, i.e. L-category vehicles. The LENS project will apply techniques to monitor L-category vehicle noise and emissions, provide recommendations on how to control the contribution of current and future L-category vehicles, examine emissions and noise performance under real driving conditions and deploy methods to identify tampered vehicles. LENS will conduct detailed pollutant and noise characterization to more than 150 vehicles in the lab and on the road and will demonstrate the impacts of LENS recommendations in three case studies at different spatial and temporal resolutions. LENS output will be tools and methods for less noise and better air in cities.

Conclusion

It is clear that innovations in measurement techniques for noise and vibration have pushed the ability for detecting in real-time traffic situations those vehicles which are high-emitters. These innovations will contribute to improving the overall air quality in cities and urban areas. Some of the further challenges ahead, are linked to particularly the assessment and mitigation strategies. For instance, research is needed on how the environment, and elements such as pavements and facades, and even the vehicles themselves, can be co-designed towards creating a low noise and emission environment.

PLENARY SESSION:

SOFTWARE DEFINED VEHICLES: ACCELERATING INNOVATION AND DIGITALISING AUTOMOTIVE

Summary from **Simon Edwards** (Ricardo, ERTRAC Vice-Chairman & RTR Conference Chair)

Introduction

More than ever, software and hardware developments are going hand-in-hand: the road mobility sector is no exception. In the spirit of "breaking the silos" and with a wish to involve other parts of Horizon Europe in the conference programme, a plenary, panel discussion session took place on the topic of "Software Defined Vehicles (SDV)", since this topic lies at the cross-roads of various partnerships: 2Zero for the energy and environmental dimension; CCAM for the connectivity and automation aspect; and the recently launched Chips JU for the enabling technologies needed to be developed to ensure a smooth transition at the road transport system level.

The panellists were:

- **Max Lemke** (Head of Internet of Things (IoT) unit in the European Commission's Directorate-General for Communications Networks, Content and Technology (DG CNECT));
- **Armin Gräter** (Director Public Affairs EU for Digital and Automation, BMW Group and CCAM Association Chairman);
- **Jean-Baptiste Burtscher** (Sustainability, External Affairs and R&D Partnerships Director at Valeo);

- **Margriet van Schijndel** (Program Manager Responsible Mobility at the Eindhoven University of Technology (TU/e)).

The session was chaired by Simon Edwards (Ricardo and ERTRAC Vice Chairman). The primary aspects of the discussion were considering the questions: "Can the Software Defined Vehicle be a next evolution in the automotive industry?", "Can we take further actions to support European based solutions?", and "Overall, what contributions or benefits can be expected from the SDV during the twin transitions of "Green and Digital?".

Panel Discussion

The first question was posed to Armin Gräter, "What is the Software Defined Vehicle from the industry perspective (OEMs + suppliers having to move forward in a coordinated way)? What advantages and challenges will it bring?". Armin noted that we are in the transition process, software is already defining vehicles, and software will be dominant in the future. We will come from the hardware to the application, yet there will be many layers in between. Further, that these steps in between are not typically added value for the customer – so the logic is to standardise these for all vehicles in the future. Hence, there will be a standardised "middleware", which can be applied sooner, be future proof and to new hardware as well. In addition, the internal network management etc. can be standardised much more. Overall, we have agreed on this across the industry.

A second question was posed to Max Lemke, "Why do we need to act on SDV at an EU level? What are the ongoing activities?". Max responded by relating the history: we started on this two years ago, the EU industry was suffering, with the need for extra computing power and complex systems there was a shift to more centralised hardware architecture, this led to unsustainable cost drivers and resource needs as well as dependencies on other countries or competition from other companies. Hence Europe had to act, each company had its own operating system even though 80% of the software was not differentiated, hence the EU, the industry needed to gain back control of this. Therefore, the EC has reserved 250m€ on this topic, to bring this together definition together, to bring people together under the lead of the Chips JU etc. This JU will cover the software dimension, the building blocks, open source, and then the hardware dimension can come. The EC has now started investing in this pre-

competitive collaboration, in line with competition laws. There is already a CSA, "FEDERATE" and work has started on the hardware abstraction layer. There will be another project called for, for the APIs and middleware. In 2024 platform trials will also start. These will be complimentary to the calls from CCAM and 2ZERO this year.

The discussion continued with a question to Jean-Baptiste Burtscher, "Why does SDV matter to the 2Zero and CCAM Partnerships? What can we expect out of SDV in the coming years that could be taken-up by the two partnerships?". Jean-Baptise complemented the EC and the partners who have already been working together on SDV for the last two years, and noted that this needs to continue, that FEDERATE will help bring the players and stakeholders together. However, he recognised that with the move to functions to be addressed there may be a competition issue at this level; that, may be companies do not want an open eco-system. Hence, a mature version of SDV support over time is needed, so that negotiation every year or so is not needed.

The discussion moved on with a question to Margriet van Schijndel, related to an academic, university perspective, "Is the EU well equipped to address the change induced by SDV? Do we have the necessary skills, to realise SDV?". Margriet noted that there is not a yes or no answer. That SDV is not just for the OEMs, rather it will have a huge effect across the whole value chain, working, cooperating etc. Fewer mechanical engineers may be needed but other skills for development and production will be required. Further, that in the long term, we need to change how things proceed at universities, as well as for the current work force. This initiative should allow coherence and scale, with many people investing in life-long learning. It was recognised that all is not ready yet, but the eco-system will be agile to adjust to changes, but that experience from the past shows that we can get there.

This topic was continued with input from Max related to the query, "Do we do enough to attract (and retain) talent in the area and make the automotive an attractive sector?" with the combined point, "How do we, in Europe, rank in this topic compared to other regions around the world?" Max stated that we must do it in the European way, to bring companies together. That, in the USA, the size of the companies has influence, whereas in China things are led from the top. In Europe the individual companies competing on talent. Hence, in Europe a governance group has been created, with representation from many parts of the industry, to discuss issues, such as talent, to encourage new engineers. Further, open source has been chosen as the paradigm. Each can then collaborate across the sector better, pre-competitively, horizontally and vertically.

Following a "code first" approach. Hence, all become more agile: cooperating on new features for the customers.

Further input then came from Armin related to the topic: he agreed that there are challenges working together, horizontally, but that the CHIPS JU is an enabler for this. He noted that 20 to 25 years ago in BMW, with Autosar things started but evolved slowly. Now there is a good programme, to be agile as much as possible. With the new, enabling projects we will be quicker: the common software building blocks will be developed with agility. And that the industry will also adapt career paths to retain expertise.

A question was then posed to Jean-Baptiste, "There is a momentum about data usage and what added value that can bring to the economy. You are involved in Catena X, how we can create a business model around data and to what extent this can apply to SDV?". Jean-Baptised noted that the story of Catena and how we can link with SDV started two years ago, from Germany, and is now across Europe, within OEMs, the supplier and software companies. So that complex data chains can be built, pushed by the products and the regulation at the same time. There could be many platforms but this is not sustainable, so thing are addressed together, in Catena X there is a common data space. This allows those who want to, to join, to write "standards". This allows competition but also addresses the needs for many solutions but with common layers of standards. SDV cannot be mastered alone, bring players need to come together, considering digital and data maturity, whilst retaining openness <u>and</u> sovereignty. This is how it will evolve in Europe, bring competition and pre-competitive together, with commonalities and differentiation.

Simon noted that data is a core part of the SDV: therefore, following what was mentioned at the beginning of the session, asked Armin to elaborate regarding OEM's clouds versus open-source solutions? Armin noted that his is not an easy thing, that it is not easy in some areas to share data, e.g. L3 validation data. BMW have 150 Petabytes for this, this cannot be shared since it is differentiating. However, in L3-PILOT and HiDrive BMW cooperate and share other aspects, and will continue do this in future research projects. BMW will also share software when it is not differentiating.

Max came in an asked how we make sure that the research leads to business, noting that we should not reinvent the wheel, rather use the previous working groups and practices. The EC has been agile so far on this topic, a programme has been created within four months of the first discussions. Whilst industry must be in the driving seat,

there is a strong role for RTOs and universities, but the projects must support the industry.

The discussion moved on to "Software updates during the vehicle lifetime, since these will be one of the main novelties of the SDV, offering new functionalities to the users. What can we expect from these developments, particularly on the safety side?". Margriet answered that differentiating aspects should be included in European projects. Further, that the SDV offers benefits for the energy efficiency of vehicles, noting that AMSL recently announced that their newest machine uses 40% less energy than the previous generations; that, if one company do that, then the overall savings in the industry can be huge. But that we need to have a well-to-wheel approach of energy measurement across the system, to ensure that we keep energy efficiency. Jean-Baptiste agreed that we must address the carbon footprint, not just the upstream aspects, but also the in-use aspects. That we need to have a common measurement framework. He noted that this will be addressed in Catena X, how to account for CO_2 across the industry, but that support from the EC is needed for this topic. Armin chipped in on the energy consumption for automated functions, recognising that there are big steps forward: L3 in prototype vehicles was consuming more than 1kW but today it is using 50% less. The chips are getting better and Catena X gives us a good framework to support this.

Max fully supported this. In the EC we need to spend our money carefully: maybe not all hardware will be from the EU in the future, but the EU will cover many levels of vehicle types. Therefore, the EC has covered other aspects to support hardware independently to the SDV.

The discussion moved on to trustworthiness, cyber security. Margriet noted that this brings difficult questions which must be answered, since CCAM will stand or fall on the aspect of cyber security. This has to be on the SDV agenda, so that the issues are understood, the responsibilities identified etc.

Max stated that we need to also consider AI, as here the challenges are the highest. Whilst the industry is not developing self-learning cars, it trains and deliver cars, they must be Type Approval and safety compliant, cyber security must be covered.

Simon asked Jean-Baptiste about the affordability of all of this. Jean-Baptiste knows that this is an important question. People do not buy "just a car" nowadays, they need multiple functions and services. SDV will help by decoupling hardware and software,

so vehicles will last longer, upgraded along the way, so more services come through the life of the vehicle, e.g. improved range in a BEV with improved BMS over the air.

In closing, Max noted that there is a big challenge yet possibly a solution for cyber security, that is generative AI. This will help the software development processes. At the moment, this is still research but the EU needs to get that more productive but also safe, as a collective effort, in a global market. Such that Europe will keep moving forward, openly.

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