

TAAAS

TRANSPORTATION · AS · A · SERVICE 

COVID-19: An unexpected re-route for future mobility?



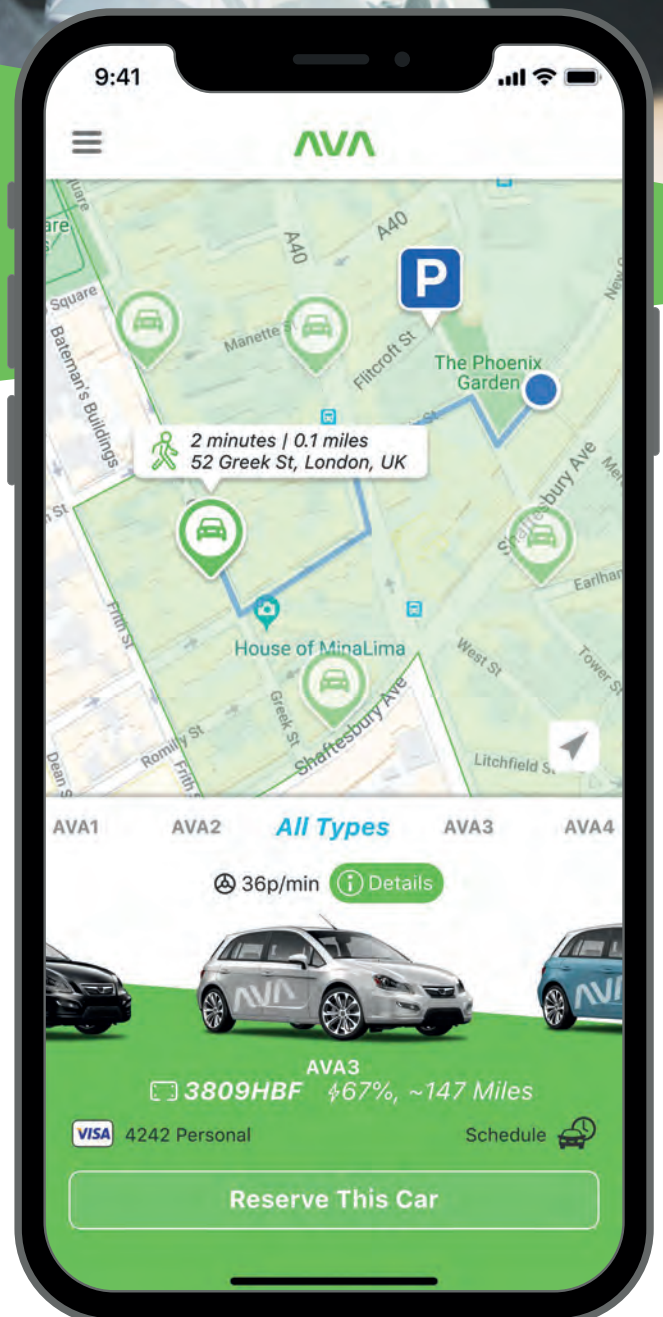
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Editor's view

AS WE START TO ENTER A NEW NORMAL, the ever-lasting effects of the pandemic seems to be behind us. With the drastic change of focus and attention that was upon our healthcare, and the eyes watching the world, we start again to look towards the future of Transportation and how we can truly make a change, being fueled more than ever, to create, build and maintain a sustainable environment not only for our generations, but for all to come.

In this feature, we have some great contributors, Robosense have recently launched an 80 laser-beam 3D sensor for LiDAR, that is looking to become one of the market leaders for autonomous driving, with some great research and figures to support. We then have a look into Bridgeworks Data Management for the Autonomous and Electric Vehicles, how will this be analyzed and where will it be stored, whilst the demand for its use continues to grow and the legal challenges that arise, we then continue with OX Part 2, following on from the last issue which talked about 'Transport Poverty', and how to aid in providing sustainable solutions for transport and infrastructure and creating a better ecosystem.

One of our partners, Ridecell discusses the digitalization and the optimization of the new era of fleets, looking to offer a new solution themselves, allowing for unmanned check-ins and check-outs of fleet vehicles, touchless driver pick-up, reservation, a multiple access options, with checks through the Motor Vehicle Records to an FBI Watchlist - talk about being secure! They are not the only ones looking at the safety of information, Millbrook provide us with an insight into research being carried out to protect 5G, vehicle networks, and cyber security.

As The TaaS Technology Conference was unable to go ahead with our annual event, you may have tuned into the Digital Event we hosted in November 2020 – this was a fantastic event that really brought together some of the experts to discuss

the direction of the Transportation industry as a whole, and as Arcadis's Natalie discuss later on how the end of 2020 will change not only the way we work, but how this will impact climate, data and transport solutions, and as Cenex believes we will feel as if 'floating on air' with the new direction of Hydrogen Vehicles which are part of the ZEFER (Zero Emission Fleet for European Rollout) project as high milage and heavy-duty transport searches for their zero emission solutions.

With a refreshed vision for the future, TaaS Technology is looking forward to the opportunities in the coming year, with a 1-day Virtual Event taking place on Wednesday 13 October 2021. As HORIBA MIRA's Nick divulges in this feature on the future of mobility, how the pandemic has inexplicably changed transport behaviour, both at a consumer and commercial level, the consensus is that it will significantly impact the shape of tomorrow's strategy." We are already working alongside the respected Conference Chair, Andrew Everett, and the direction we are taking for the event – The content will be delivered with a mix of presentations and panel sessions focussing on audience interaction. Unique networking is an important part of the event and is facilitated with a conference networking portal for the virtual event, allowing you to connect with colleagues before the event and after the event – making business development easy. Registration is free of charge so join your industry peers to discuss all things CAVs and Future Mobility - <https://taas.technology/>.

Finally, thank you to all our contributors and readers, I hope that you enjoy Issue XI, and can really see how there is a turning point that looks to really accelerate the Transportation industry into the next phase.

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Angel Business Communications Ltd
(Coventry) UK
Registration Number: 1972952

TaaS Magazine is published six times a year on a controlled circulation basis. Non-qualifying individuals can subscribe at: £96.00/e110 (UK & Europe), \$140 pa (USA). Cover price £5.50. All information herein is believed to be correct at time of going to press. The publisher does not accept responsibility for any errors and omissions. The views expressed in this publication are not necessarily those of the publisher. Every effort has been made to obtain copyright permission for the material contained in this publication. Angel Business Communications Ltd will be happy to acknowledge any copyright oversights in a subsequent issue of the publication. Angel Business Communications Ltd © Copyright 2021. All rights reserved. Contents may not be reproduced in whole or part without the written consent of the publishers. The paper used within this magazine is produced by chain of custody certified manufacturers, guaranteeing sustainable sourcing. Printed by: The Manson Group Ltd. ISSN (Print) 2397-124X (Online) 2397-2319. © 2021.



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WWW.TAAS.NEWS

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Nexperia announces new ESD protection devices for high-speed interfaces in automotive applications

NEXPERIA, has announced a new range of ESD protection devices aimed specifically at protecting the ever-increasing number of high-speed interfaces found in automotive applications, especially the in-vehicle networks (IVN) associated with infotainment and vehicle communications.

As data rates increase and vehicles feature more electric content, the need for EMC protection becomes more critical and providing the correct type of protection is a challenge for design engineers. Nexperia's TrEOS technology optimizes the three pillars of ESD protection (Signal Integrity, System Protection and Robustness) to deliver devices with the ideal combination of low capacitance, low clamping voltage and high ESD robustness.

The new PESD4USBx series comprises a total of twelve high-performance 4-channel ESD protection devices that incorporate TrEOS technology. Signal

integrity is ensured by the very low line capacitance for each channel (as low as 0.25 pF) and the sub-0.05 pF line matching capacitance. All devices offer deep snapback combined with a low resistance of 0.4 Ohm. With ESD protection up to ± 15 kV, the PESD4USBx series meets IEC61000-4-2 level 4 and ISO10605. This is the highest level of ESD protection currently available in this package size making the devices ideal for modern, densely-packed, automotive designs.

A wide range of interface standards are supported including USB 2.0, Superspeed USB at 10 Gbps, HDMI 2.0, HDBaseT and the increasing number of automotive A/V monitors displays and cameras found in vehicles. PESD4USBx devices also support video links (SerDes): GMSL, FPD-Link and LVDS.

Specifically engineered for automotive applications, the devices exceed the needs of AEC-Q101 by a factor of two. Furthermore, in Nexperia's state-of-the-

art DFN2510D packages (SOT1165D and SOT1176D), side-wettable flanks (SWF) are available as standard, allowing the use of automatic optical inspection (AOI), thereby enhancing assembly quality for customers.

Commenting on the product launch, Lukas Droemer, Nexperia product manager said: "The electronic content is growing rapidly throughout the vehicle and, coupling this with the need for high data rates, interfaces commonly found in high-end A/V applications are becoming prevalent. With the heavy electrical content, vehicles are electrically noisy environments and these sensitive interfaces need high-performance ESD protection. Our new PESD4USBx series combines strong TrEOS performance with automotive grade quality specifically for demanding automotive multimedia applications."

The new devices are available as samples and in production quantities today.



GHD survey reveals half of British consumers are considering an electric vehicle in next five years

46% OF UK consumers, who do not currently own a hybrid or electric vehicle (EV), would definitely buy or seriously consider buying an EV in the next five years, according to a recent survey by leading professional services company GHD. This figure rises to 66% when taking into account those who would seriously consider buying an EV but currently believe there to be too many barriers to purchase.

While the UK government's recently announced ten point plan prioritises the adoption of EVs, the survey clearly shows that there are challenges to the rollout in the UK. Of those that are interested in buying an EV, 47% responded that they were not confident they would have access to reliable charging infrastructure locally. This was particularly high among those living in rural and suburban areas, with 46% and 52% unsure respectively. Meanwhile, 36% expressed a lack of confidence in their ability to charge an electric vehicle at home. Interestingly, this concern was most prevalent for people living in urban and suburban areas (37% and 38% respectively) rather than in city centres or rural areas (31% and 28%).

GHD would like to see the government prioritise both the funding and proliferation of accessible charging infrastructure across the UK. There will be an ongoing requirement for close collaboration between the central government, local authorities, distribution network operators (DNOs) and the private sector developers of the charging stations themselves. In looking at the roll-out of this infrastructure, there will be a need to consider not only the uptake of the vehicles themselves, but also the behaviours of vehicle owners when it comes to the patterns of EV use and the way in which they will want to

charge them. This will vary by where people live, how they use their cars and where they work or spend time away from home. It is also important to consider who carries the cost of the new infrastructure needed to support EV charging. GHD is working closely with the private sector and the network industry on all of these regulatory, technical, social and economic themes, as there is a lot more that can be done to accelerate both innovation and investment in this area.

Further highlights from the survey include:

- 15% of UK respondents belong to a household that already owns an electric or hybrid vehicle; this is behind Singapore (21%) and the US (16%) but ahead of Australia (7%), New Zealand (8%) and Canada (8%)
- Of those that don't, 15% would definitely buy one in the next five years; 51% would seriously consider it, although two out of five of these believe there are currently too many barriers to driving one
- In the UK, those aged 18-35 are most likely to buy an EV
- Appetite in the UK is also higher among those living in city centres or urban areas, at 57% and 49% respectively
- Of those who expressed any interest in buying an EV, 47% said that they were either not at all or not very confident about having access to enough reliable charging infrastructure locally; this was second lowest level of confidence of all the countries surveyed, just behind Australia at 48%
- UK also had second lowest level of confidence in ability to install a charger at home, with 36% being not at all or not very confident (Singapore was the least confident at 37%)



These findings form part of an international survey conducted by GHD among over 8000 consumers in the UK, the US, Canada, Australia, New Zealand and Singapore in order to gain insight into how changing attitudes and behaviours will shape the way we power our future, as part of its whitepaper "The World of Energy Post-COVID". In the UK, 1,004 consumers were surveyed.

Commenting on the survey's findings, Dr David Maunder, Technical Leader - Future Energy, at GHD, said: "It is clear that we are entering the era of the electric vehicle, with our survey showing strong demand among UK consumers. However, there are perceived obstacles that remain a handbrake on consumer uptake, as shown by the number of respondents who say they would seriously consider buying an EV but currently believe there are too many barriers to ownership. "Accessible charging infrastructure is clearly critical to EV uptake, and an area of particular concern for consumers. However, with batteries and point-of-use technology becoming more accessible, we should see a rapid uptake of this infrastructure in the coming five years, which will help drive the roll-out.

Spark Connected's new 2.4kW Titan wireless charging solution

SPARK CONNECTED, a global leader in developing advanced and innovative wireless power technology and system level solutions, announces a partnership with gapcharge GmbH to bring the Titan wireless charging solution to LEVs (Light Electric Vehicles), AGVs (Automated Guided Vehicles) and AMRs (Automated Mobile Robots).

The transition to Lithium-ion batteries in automated factory logistics and eMobility has continued to accelerate in recent years. Forklift manufacturers have vehicles in the market today with lithium-ion. Driverless transport systems and mobile robots, AGVs, AMRs and LEVs utilize powerful lithium-ion technology.

However, battery charging using plug-in cables is a significant challenge in automating these emerging applications. The ground-breaking 2.4kW Titan solution takes the next step toward effective, convenient, safe and cost-effective wireless charging.

According to Ruwanga Dassanayake, COO at Spark Connected, "eMobility and factory automated robotics are undergoing unprecedented changes. The ability to wirelessly charge these applications is becoming critical in order for these to be truly automated. The 2.4kW Titan solution helps accelerate this paradigm shift in the automated factory and electric mobility markets".

Spark Connected is a Co-chair with the Wireless Power Consortium's (WPC) High Power LEV standard group. Spark is driving innovation within the committees while working with key LEV and AGM manufacturers to advance and improve charging technology for small and medium sized electric vehicles and mobile robots.

The Titan solution was developed to simultaneously take advantage of new component technologies while building on Spark's robust industrial wireless power solutions and flexible Pantheon™ software architecture.



According to Gregor Schmid, CEO at gapcharge, "The current wireless charging systems do not reach the target costs and the stringent and high-performance requirements for today's automated logistics vehicles. gapcharge and Spark Connected are collaboratively driving this change in the market."

The Titan is a complete transmitter and receiver solution and provides a flexible platform for 2.4kW one-to-one wireless battery charging. Applications include LEVs and AGVs, e-bikes, autonomous robots, drones, and factory mobility.

Panasonic and McAfee agree to start building vehicle SOC

PANASONIC CORPORATION and McAfee Corp., have agreed to jointly start building a Vehicle Security Operation Center (VSOC) to commercialize vehicle security monitoring services. To protect connected vehicles around the world against cyber-attacks, the companies will build vehicle SOCs that enable accurate detection and early response to attacks and help strengthen Cybersecurity measures in the automotive industry.

Panasonic has already been operating SOCs for factories since 2016 to protect systems and networks that manage and control factory equipment and production processes against cyber-

attacks - prior to SOC for automobiles.

For automobiles, they have developed a Automotive Intrusion Detection System that mounts on a vehicle, detects the occurrence of a cyber-attack and the type of attack, and transmits analysis data to the vehicle SOC and a Security Information and Event Management System that analyzes and visualizes a large amount of data received from the Automotive Intrusion Detection System in the vehicle SOC. McAfee supports world-class SOCs and Managed Security Services (MSSs), and has the know-how cultivated by building and operationally supporting numerous SOCs. The Company will bring these together and start building vehicle

SOCs to monitor cyber-attacks that may be conducted against vehicles around the world.

With the innovative development of autonomous driving, the advancement of digitalization, and the increasing number of connected cars, the risk of cyber-attacks against automobiles is increasing every year. It has become urgent for the automotive industry to establish mechanisms to protect and monitor vehicles from cyber-attacks.

The VSOC will enable the provision of monitoring services to monitor connected cars around the world and contribute to the development of a safe and secure mobility society.

Volvo partners with Aurora to speed up autonomous transport solutions

VOLVO Autonomous Solutions has partnered with Aurora to jointly develop globally leading autonomous transport solutions at scale. The partnership's initial focus is to develop and deploy an autonomous transport solution for hub to hub applications for North America.

Volvo Autonomous Solutions has entered a strategic partnership with US-based self-driving company Aurora to jointly develop on-highway autonomous trucks. The agreement signed between Volvo Autonomous Solutions and Aurora is a long-term partnership spanning over several years. The initial focus is on hub-to-hub applications for customers in North America. Automation is aimed at creating tangible benefits for both customers and society in terms of productivity, safety, sustainability and energy efficiency.

This partnership will center on the integration of the Aurora Driver into Volvo's on-highway trucks and the development of industry-leading

Transport as a Service solutions. These solutions build on Volvo's leading products and track record within safety and Aurora's deep expertise in the development of self-driving systems.

"Creating a viable autonomous on-highway offering requires close partnerships with both customers and tech partners to develop the needed capabilities," says Nils Jaeger, President of Volvo Autonomous Solutions. "This exciting partnership brings our goal of transport as a service an important step closer and will accelerate our commercial offer for hub-to-hub applications in North America. Aurora is already a leading force in autonomous systems, and its integrated self-driving stack, software, hardware and data services platform combine to offer a clear path towards efficient and safe on-highway solutions in the medium term."

"Since the first project together in 2018, Aurora has developed a deep respect for Volvo, its engineering process,



and its commitment to safety. With the groundwork now laid through the establishment of Volvo Autonomous Solutions and the creation of Aurora's industry-leading sensor suite, we're excited to join forces to develop self-driving solutions with Volvo's impressive network of customers," said Sterling Anderson, Co-founder and Chief Product Officer at Aurora. Previously announced Volvo Group collaborations with partners such as Nvidia and others continue in parallel with the collaboration with Aurora.

Exploring how smart infrastructure can help Ford build a great self-driving service for Miami

AS FORD brings together a self-driving commercial business in Miami-Dade, the company is thinking about all the complex pieces needed to build its service. One of the most critical pieces is being built by our partner Argo AI: A robust self-driving system that will drive safely, fit in with the natural traffic flow and local driving behaviors and provide a great ride experience for customers. Self-driving vehicles need to be prepared to navigate intersections, some of which can be particularly tricky with obstructed views due to buildings or street designs. That's why, in Miami-Dade County, our autonomous vehicle research team at Ford is exploring

how emerging technology like smart infrastructure can provide a self-driving vehicle with an extra layer of information before it even arrives at an intersection.

Researching smart infrastructure and self-driving vehicles: To set the groundwork for our new research in Miami-Dade County, Ford recently installed a new, Ford-designed infrastructure node at two intersections in Saline, Michigan. The node is equipped with sensors like radar, LiDAR and cameras and situated above the intersection, so it can offer a birds-eye view of the area to support a self-driving vehicle as it analyzes its surroundings

at a street level. While it is not required for a Level 4 self-driving vehicle to operate safely, this sensor node can quickly relay even more information to a self-driving vehicle, providing additional context about the situation it's about to encounter long before it approaches the intersection.



World-leading circular solution for charging of vehicles inaugurated

A SYSTEM for charging of vehicles was inaugurated at the hygiene and health company Essity's business center in Mölndal, Sweden. An energy storage made by batteries from electric cars and charged by solar panels provides 78 charging stations for electric and hybrid cars, and 24 for electric bicycles, with climate-neutral electricity.

The solution at Essity has been developed through a collaboration between Volvo Cars, Essity, Stena Fastigheter and BatteryLoop, a company within Stena Recycling that is a leader in the reuse and recycling of batteries, primarily from the automotive industry.

"This is a very exciting collaboration where we together close the circle and create a sustainable cycle around cars powered by batteries. We give the batteries a second life in our smart energy storage system BLESS™ (BatteryLoop Energy Storage System) and the commercial life of batteries is ensured, while the burden on the environment is reduced. With BLESS, we contribute to achieving the goal of zero emissions and to secure the future for the environment and the next generation," says Rasmus Bergström, MD of BatteryLoop.

When an electric vehicle, after many years in traffic, is at the end of its life cycle, the battery still has a large part of its capacity left, sufficient for use in the energy storage systems built by BatteryLoop. So instead of sending the batteries for recycling, they get a second life.

"Volvo Cars has great ambitions regarding circular economy and we put a lot of effort into finding new business models that make it possible to maximize the use of batteries throughout their life cycles.

This project is in line with those ambitions and will teach us more about the life span of batteries and how they can be used outside of our cars," says Susanne Hägglund who is responsible for the global aftermarket business at Volvo Cars.

For Essity, sustainable energy solutions are an important part of their sustainability work.

"In Essity's climate work, more sustainable energy solutions are in focus, for example with renewable energy. It is a crucial factor in our work to achieve our scientifically based climate targets. In this case, it is about providing sustainable solutions for our employees, where the possibility of charging at the workplace can be crucial to take the step towards a more sustainable transport solution. Essity has also taken the step to restructure the company car fleet, where in practice only rechargeable vehicles are allowed," says Axel Thegerström Edh, Sustainability Director at Essity.

When Stena Fastigheter, which owns and manages Essity's property in Mölndal, was asked by Essity about a large number of charging stations for electric cars, the company wanted to find a sustainable solution. Stena

Fastigheter has previously built a small facility in Gothenburg, Sweden together with Volvo Buses and BatteryLoop. With the investment at Essity, this can now be tested on a larger scale.

Stena Fastigheter sees the collaboration as an important step along the way in offering their tenants a solution for a sustainable and environmentally friendly electricity supply.

"Because we can offer our customers the ability to charge their cars with solar energy, regardless of weather, around the clock, we contribute to even more sustainable travelling for Essity's employees.

With a battery storage of this scope, we can contribute to improved power regulation and energy storage in the building, which constitutes a stabilizing function for an evolving electricity network. We are very much involved in and drive the development forward, which feels very satisfying," says Agneta Kores, MD of Stena Fastigheter Göteborg.

BatteryLoop estimates that the demand for solutions such as the one currently in place at Essity will increase a lot in the coming years. This is partly due to the fact that the growth of electric vehicles means an increased need to handle the batteries in a sustainable and commercial way.

There is also a strong demand in the market to be able to supplement electricity supply with renewable energy for, for example, properties and charging stations and to be able to meet peaks in energy demand.

In addition, many see an advantage in that surpluses from the energy storage system can be sold and delivered to the electricity grid and thus generate revenue.



Continental and Iteris join to explore intelligent infrastructure technology

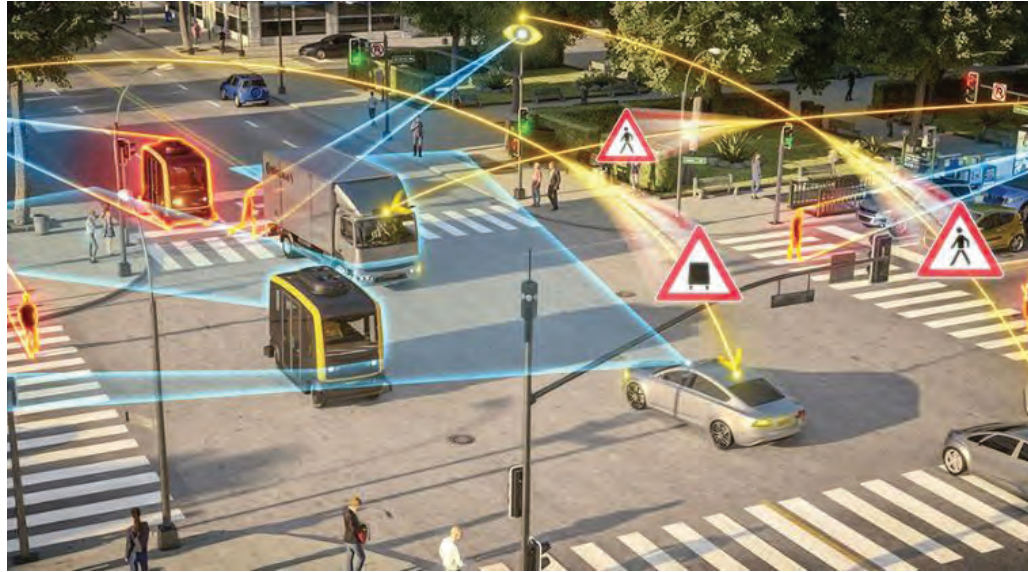
GLOBAL MOBILITY SUPPLIER

Continental and Iteris, Inc., the leader in smart mobility infrastructure management, has announced they have entered into a collaboration agreement to explore intelligent infrastructure solutions for communities across North America. With the goal of readying cities for advancements in connected and automated vehicle technologies, the partnership is designed to help ensure safer and more efficient mobility.

“Smart mobility is in our DNA at Continental and we are constantly improving and innovating solutions that help make roadways safer for all who use them. As we look to a future with more connected and automated vehicles (CAVs), the infrastructure will play a bigger role, demanding updates in sensing, connectivity and communication capabilities,” explained Murali Srinivasan, Vice President, Passive Safety and Sensorics, Continental North America. “Our long and proven history in safety sensorics fits naturally with Iteris’ expertise in intelligent infrastructure management to deliver solutions that will contribute to greater environmental awareness and increased road user safety.”

The future-oriented traffic infrastructure collaboration will leverage automotive sensors, and infrastructure-to-vehicle (I2V) connectivity to make city transportation systems across North America more efficient, while supporting local and regional transportation agencies’ efforts to achieve their Vision Zero goals.

Information generated by the automotive sensors will be used to enable cooperative perception capabilities. In addition to sharing a connected vehicle’s location with other V2X-enabled devices, cooperative perception messaging enables that



vehicle to also share what it senses - a pedestrian or car, for example - with the rest of its connected environment. The collaboration is focused on improving the current transportation infrastructure while working toward a more balanced, intelligent and optimized infrastructure that communicates seamlessly with the mobility ecosystem in the future thanks to expanded sensing capabilities.

“At Iteris, we are committed to helping public transportation agencies and our commercial partners achieve safe, efficient and sustainable mobility through the use of innovative technology, and advanced sensing and communications systems,” said Todd Kreter, senior vice president and general manager, Advanced Sensor Technologies at Iteris. “We are thrilled to announce this partnership with Continental, a pioneer of automotive safety and connected mobility technologies, to explore new intelligent infrastructure solutions that will help make roads safer, more efficient and sustainable, while readying cities and automotive OEMs for advancements in connected and

automated vehicle technologies.”

“Historically, infrastructure and automotive development happened largely independent from one another. Our efforts will help blur that boundary, ensuring that sensor data can be used in new and important ways to create a fuller, real-time picture of a traffic situation,” Murali added.

In addition to offering more comfort and convenience to drivers, this safety-focused partnership can contribute to stronger V2X effectiveness - critical in reaching the goal of Vision Zero. The U.S. Department of Transportation states that V2X technology has the potential to address approximately 80 percent of unimpaired vehicle crashes. Roadway injuries and fatalities also impact people outside of vehicles.

According to the National Safety Council, in the United States approximately 30 percent of all road fatalities are vulnerable road users, which include pedestrians, cyclists, scooters and motorcyclists. Continental and Iteris are committed to helping the mobility industry realize this potential.



Time for an EVolution

The car industry is in the middle of a historic transformation through the rapid global adoption of Electric Vehicles, accelerated by the Paris Agreement with binding commitments to reduce greenhouse gas emissions. Although the share of EVs in total car sales is still small, it is growing rapidly, and is targeted to reach 28% market adoption as early as 2030, according to Bloomberg.

BY PER LÖFBERG, KARIN EBBINGHAUS AND MATS ALAKÜLA, ELON ROAD

WITH AN INCREASED ADOPTION of EVs, access to efficient charging is essential. Picking Sweden as an example, sales of EVs reached a new peak with 65% increase in the past 12 months¹. In order to keep up with the growing demand of efficient charging, Sweden would need to significantly increase the number of public charging stations. According to calculations from Lund university, a charging

network density of about 30 unique fast charging positions per gas station is needed by 2030.

Rethinking EV charging

Solving this logistic challenge by expanding the network of charging stations might not be the only solution to this looming problem – in southern Sweden, an innovative project is currently underway

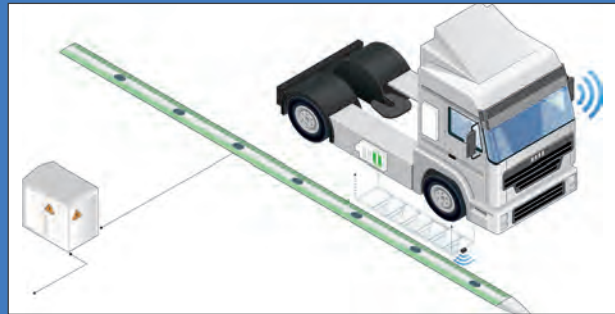
FACTS ABOUT EVOLUTION ROAD

The Evolution Road project takes part in the Swedish governments' program for electrification and has been commissioned by the Swedish Transport Administration to build a demonstration facility for electric roads.

The goal is to test and gain more knowledge about ground based conductive electric roads, a climate-smart technology that allows electric vehicles to be charged from the road while driving, using fewer batteries.

Evolution Road is a private-public partnership with partners from industry, academia and the public sector. The technology is developed by the Swedish company Elonroad AB together with the Faculty of Engineering at Lund University.

Other partners are Innovation Skåne AB, Kraftringen Energi AB, Lund municipality, Ramboll, Skånetrafiken, Solaris Sverige AB and the Swedish National Road and Transport Research Institute, VTI. The Evolution Road project started in 2019 and will continue until 2022.



HOW IT WORKS

The energy is transferred from charging rails in the road to the vehicle via a retractable pick-up under the vehicle. The retractable pick-up connects with the charging rails, and enables efficient conductive transmission of up to 300 kW of power to the vehicle. The rail is powered in short meter-long segments under the vehicle, making the system safe to deploy on any road. The rail contains advanced technology that upgrades existing roads to a smart and digital network, providing communication benefits in addition to energy supply.

that may lead the way to alternative solutions. Instead of EV charging stations, that offer stationary charging, the pilot project called Evolution Road focuses on evaluating a novel approach for charging EVs seamlessly, while in motion or stationary. The concept is called Electric Road Systems, or electric roads, and is a charging technology that is integrated with the actual road to charge EVs while on the go.

– The idea of electric roads is inspired by the benefits of continuous energy supply to trolley buses. In the Evolution Road pilot, we're now testing and developing the next generation electric roads, a charging infrastructure that automatically charge most types of EVs when parked or in motion, says Per Löfberg, project manager from Innovation Skåne.

Sweden is one of the world's pioneering countries when it comes to electric roads with four different technologies being tested on public roads. The Swedish government recently announced an effort to build out 3,000 km of electric roads, as part of the government's goal to reduce emissions from domestic transportation by 70% by 2030.

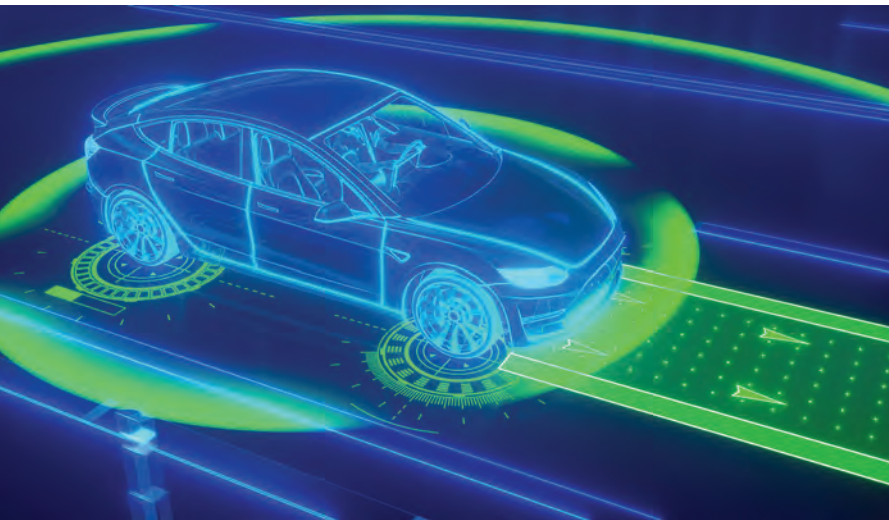
Accessible charging infrastructure

In order to transition to fossil-free transportation

and achieving the climate goals, an accessible and efficient charging infrastructure that works for all types of EVs is needed.

Electric roads are an emerging technology and few common standards have yet been established and thus the various electric road pilot projects being deployed in Sweden are testing different technologies, including both overhead power lines and several different ground based solutions.





The overhead power lines work much in the same way as the powerlines being used for electric trams and busses that have been deployed for many decades. The ground based systems on the other hand, use either some form of conductive rails or inductive method to transfer power to the EVs from the road. The ground based solutions make the charging infrastructure available for most kinds of EV's.

Mats Alaküla, professor of Industrial Electrical Engineering at Lund University has been involved in

the development of electric roads for over a decade.

- An electric road available not only for larger vehicles such as trucks and buses, but also for cars, significantly reduces the need for fast charging stations, says Mats Alaküla.

In addition, electric roads enables battery sizes to be significantly reduced, and EVs can benefit from extended range and usage without carrying large batteries on-board.

- On-board batteries can be reduced by 50 - 80%. Smaller batteries also mean lighter vehicles and lower environmental impact for manufacturing of those batteries, according to Mats Alaküla.

Karin Ebbinghaus is CEO of the tech company Elonroad developing the electric road technology tested in Evolution Road.

- With a reliable infrastructure, we can help the consumers make the switch to electric cars faster. With our solution we envision a seamless effective charging infrastructure on freeways and in the city – you charge while you drive, or while you're parked. You don't need to stop to refuel and you don't have to worry about charging anxiety. We turn range anxiety into range happiness!

¹ <https://press.powercircle.org/posts/pressreleases/rekord-for-laddbara-fordon-i-sverige-i-septem>



Per Löfberg, working at Innovation Skåne, is the project manager of Evolution Road keeping the consortium together.



Karin Ebbinghaus is the CEO of Elonroad AB and has a Masters in Law from Lund University. She has worked in M&A cross-border transactions for more than 15 years. After an executive MBA from Stockholm School of Economics in 2015, Karin has focused on investments in cleantech startups with a focus on reducing CO2.



Mats Alaküla has been a Professor of Industrial Electrical Engineering at Lund University for 25 years. Since 2007 he has also worked part time as a Scientific Advisor in electric vehicle technology at one of Sweden's largest vehicle companies. From 2007 to 2019, he was a Research Leader in electric drive and charging systems at the Swedish Electromobility Centre. He has worked in electric road system development since 2009 in collaboration with several of the companies in the ERS industry.



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The automotive industry is being disrupted by connected car technologies and seismic changes to existing business models, which require new digital strategies and IT architectures.

Digital and connected services are driving new industry revenue growth, whilst consumer preference is being shaped by innovative digital and connected features as well as greater appetite for energy efficient, green and autonomous vehicles. These require not only that companies harness emerging technologies whilst fundamentally changing their mindset but also highlights the need to re-architect IT on a single global platform to enable more effective, real-time interactions, greater data privacy, and collaboration with supply chain partners, business ecosystems and customers.

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2020: The end of a biblical year!

We live in a world where climate change and unforeseen events are changing human behaviour. People want, and need, to live and work differently.

BY NATALIE SAUBER, ARCADIS



WE STARTED THE YEAR with events of almost biblical proportions - droughts, fires, floods, and now a global pandemic. COVID certainly has been the event of 2020 and we have learned that the world is less resilient than we thought. There is a high chance this will not have been the only pandemic of our lifetime, and we must learn to live with this new normal. At the same time, this presents an opportunity to re-invent ourselves and step out of our comfort zone.

Or simply put, there is no plan B. From David Attenborough to Greta Thunberg, the world is witnessing a wave of people demanding greater

action on things like climate change, pollution and deforestation. With a few unfortunate exceptions, humans now mostly understand that climate change is a long-term threat to the world, and it is happening right now.

68% of the world population is projected to live in urban areas by 2050

This rapid rise in urbanisation will dramatically reshape how we live our lives. The world's population is expected to peak at 11 billion by the end of this century. Are we ready for this? From climate change to mobility, the impact of population growth means we will need to rethink many of the ways in which we, as citizens, interact with our environment – from the production of food to the design of cities. This is the opportunity for us to become smarter, more customer centric and sustainable. COVID has shown us that we are facing many challenges on our path to increased urbanisation. We will have to find ways to make our cities more resilient.

Home has become a workplace. Work has become home. And people need to find peace

Over the past year, work and leisure have been comingling. I have found myself waking up on a Sunday, turning on my laptop ready to dial into the team morning call, before realising that it was still weekend. At the same time, I have had to do my groceries on a workday to avoid the crowds during the heights of the lockdown. But this doesn't only impact me, it impacts everyone.



The office as we knew it is not the answer. It needs to change

Colleagues still need places to meet, because sometimes the exchange of ideas is better in-person. What does this mean for the future? If I had to guess, we will see more satellite offices and a smaller overall office footprint. Together, this can be a win-win, as the company saves on rent, while the employee benefits from less commute and a more balanced work environment. Let us reinvent the places where we work, to become a place we can use safely and creatively.

Tap into the power of technology at home and at work

This year has brought technology to the forefront of how we work. Eleven months ago, face-to-face meetings were the norm and now the whole world is using Zoom. A lot has changed almost overnight, and it is encouraging to see how adaptable and willing humanity has become. Firms such as Alibaba, Amazon and Shopify have shown that technology can make our economy more resilient, even during a global lockdown. But not everything is as black and white.

Big Data: With great power comes great responsibility

Machine learning and related technologies have given us the ability to use data and improves our lives. This creates new opportunities but also poses problems. While personal data can be used for track and trace to respond to outbreaks, governments also have the ability to gain in-depth knowledge about their citizens. While these new technologies hold tremendous potential, it will be on all of us to ensure that they do not damage our institutions or trust in society.

Use data and digital solutions to maximize our resources and keep people safe

But let us not forget the trends mentioned above require physical infrastructure. The data produced globally is doubling faster every two years. Data centres are quickly becoming the backbone of this data driven future.

The electrification of transport is now one of the major trends of the 21st century

Not only energy production but also consumption has an impact on the environment. The latest forecasts assume that by 2040 EV sales will rise to nearly 60% of the global automotive market - compare that to 2010 when annual sales were close

“(Climate change) is the biggest crisis humanity has ever faced. This is not something you can like on Facebook.” - Greta Thunberg

to zero. With consumer consciousness on the rise and market forces gaining momentum, alternative fuel vehicles are quickly becoming the future of the automotive industry. Not only are government's policies across countries pushing this forward, but companies are realising the other benefits of switching, such as reducing CO2 emissions, improving air quality, better choice of electric vehicles and rapidly increasing electric vehicle charging infrastructure.

Let's use our knowledge to create sustainable futures and improve quality of life

This all brings us back to the environment and how we generate the electricity needed for the future just described. Instead of the global reliance on coal and gas plants we need to build more solar, wind and hydro power. Without the support of policymakers, businesses and other organizations, the transition is





unlikely to happen quickly enough. It is on all of us to drive this change together.

Keep people and businesses moving without hurting our planet

This year we have seen a renaissance of active travel. From cities launching pop up cycling infrastructure, to a major boost in micro mobility such as e-scooters. Like many sectors, transportation is evolving. Transportation planners must respond to people's needs, but also make way for new innovative ideas such as autonomous vehicles.

Creating the transport solutions we need

Cities are growing, and urban populations are rising. With approximately 2.5 billion additional people expected to move to urban areas by 2050, what does this mean for the future of our cities? How can we better facilitate the movement of people and goods in and around these cities, without increasing congestion, road accidents, air pollution, noise and

climate change? Transport planners must respond to people's needs, lifestyles and travel behaviours but also make way for new innovative modes such as micro mobility or autonomous vehicles.

The world has become more globalised yet in some respects it has become more fragmented

Aside from the environment there are also important societal issues to address. It feels like we live in a world where everyone's voice has been amplified, but at the same society has become more fragmented. From political unrest across many countries to growing signs of nationalism and of course the very public black lives matter movement. There are many challenges we have to face, from the impact of COVID on inequality & unemployment to the impact of social media and fake news on our politics.

If we want to succeed in this fast-changing world, we have to adapt, move forward, and above all have to do it together.

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COVID-19: An unexpected re-route for future mobility?



For some time now, the future mobility vision – in which totally autonomous vehicles are an everyday reality and shared mobility services are widely adopted – has been heralded as the future of mass transport. As the ongoing COVID-19 pandemic has inexplicably changed transport behaviour, both at a consumer and commercial level, the consensus is that it will significantly impact the shape of tomorrow's strategy. With the lockdown expected to leave a legacy of increased home working, less travelling and unprecedented delivery demand, here, **NICK TEBBUTT, HEAD OF GLOBAL STRATEGIC SALES AT HORIBA MIRA**, future gazes as to how the evolving post-coronavirus industry landscape may look.

IT IS WIDELY ACCEPTED that mobility in the decades to come will look dramatically different from what it does today. As we all expect, in the long-held vision for future mobility widespread shared ownership will be supported by an intelligent ecosystem of self-driving 'taxis' – the remit being to reduce vehicle numbers and congestion, and, in turn, create and integrate in to a much greener urban transport infrastructure.

However, this vision, of course, did not account for the unforeseeable impact of the COVID-19 pandemic and the transformative impact it has had on transport behaviour.

With the nationwide lockdown seeing a large majority of the population tasked with working from home, businesses and consumers alike have been quick to realise the ease at which operations can be managed remotely, along with the multiple ensuing efficiencies.

According to one recent study, 140 per cent of UK businesses saw an increase in productivity during the remote working period, with 85 per cent looking to expand remote working policies as a result of

the pandemic. Only recently Twitter, Square, and Facebook announced that they will allow most of their employees to telecommute permanently, while many other major employers, including Nationwide and Barclays, have talked openly about a permanent shift to working from home and reduced office space.²

And there's the environmental benefits too. Home working cuts commuting requirements, transport congestion and environmental impacts as demonstrated by the huge falls in air pollution during the lockdown - particularly during weekday commuting hours. Thus, with businesses already under pressure to go greener, the compelling case for increased home working as a way to tackle emissions has also come to the forefront.

The result could be an irrevocable impact on modern transport requirements. To put it into context, one expert study³ estimates that 87% of those currently working from home would like to continue to do so to some degree, the result of which could see the 10.8 million pre-lockdown number of regular remote workers soar to as much as 17 million. This would mean that 1 in 5 commutes by car could be avoided, equating to 11 billion miles saved per year.

But, for the busy automaker whose future designs will inevitably be based on a very different picture, the question begs – how will these changes in consumer behaviour and commercial preferences impact the future mobility requirement?

Sudden acceleration or a foot on the brakes?

Although the automotive megatrends that were occurring pre COVID-19 are still relevant, the ongoing impact of the pandemic is likely to see some fast-tracked and cause others to slow.

Take, for example, electric vehicles (EV). Only this June (2020) saw the Transport Secretary confirm a £12m funding pot to support EV research and development (R&D) projects in a bid to turbocharge the UK's transition to zero emissions vehicles. Although this amount may be marginal compared to the cost of EV battery development itself, it offers a positive indication of the government's continued commitment to leading the EV transition, the consensus being that further stimulus may be on the way as part of its recovery plans.

Add to the equation increased consumer gravitation with an estimated 12 million UK drivers considering making the EV switch in the next two years⁴, and

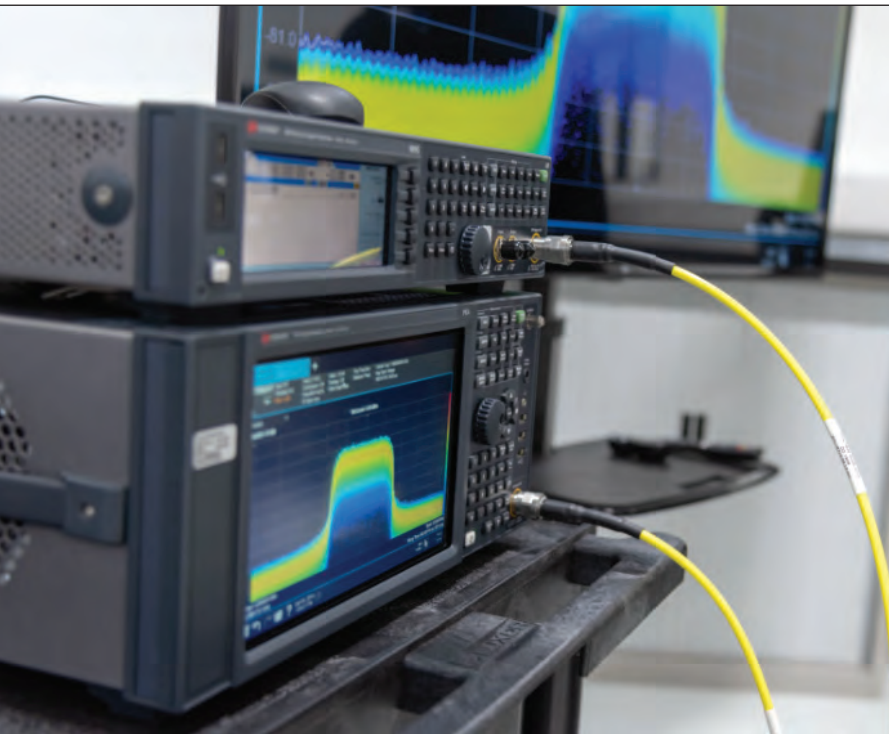
the EV category clearly remains a key target area for automakers.

Another area of potential growth is that of the commercial vehicle market. With the lockdown forecast to leave an enduring legacy of increased e-commerce, many consumers are now choosing to conduct their grocery shopping online on a permanent basis, and generally minimise their visits to bricks and mortar stores. This will see a huge flow-on effect for distributors and work to accelerate a more advanced, technologically-driven approach to delivery services.

A good future indicator of this market shift can be found by looking at Nuro, the ground-breaking Silicon Valley robotics company which tellingly saw its autonomous grocery pod delivery service triple in demand during the recent pandemic⁴ and recently partnered with Kroger (the largest supermarket chain in USA) as part of its major expansion plans. This marks the start of what promises to be a global shift towards driverless grocery deliveries.

And it's not just about food shopping either. With the business case for driverless commercial EVs offering huge Total Cost of Ownership benefits - thanks to lower refinement needs, reduced non-safety electronic requirements and the opportunity to optimise a system via localised operation in a key catchment distribution area - it looks like this is a huge cost-efficiency opportunity which will be embraced by many industries in the future.





In contrast, in the short to medium-term it may be that some key future automotive trends, particularly shared-mobility solutions, see a slightly lower uptake as the industry awaits the full outcome of the crisis. After all, if permanent home working increases drastically, it may be that the level of mobility required may not be as much as originally conceived or it may look slightly different, being used for personal purposes rather than the commute.

Ultimately though, the need for a much cleaner transport system isn't going to go away and the future mobility vision will take prevalence in the long-term – potentially just taking a slightly different shape.

Navigating the New Normal

There is no doubt that it is an incredibly challenging time for the automotive industry as it remains in recovery from the ongoing impact of the pandemic – all while seeking to remain competitive, profitable and future-focused.

Thus, amid what is very much an evolving landscape, the onus for automakers will be on ensuring maximum productivity, increasing income efforts and generating the maximum profit margin.

As part of this, at HORIBA MIRA we believe that there is an industry need to take a much more agile

approach to product development and optimisation, whereby vital engineering and testing is completed at a much earlier stage of the development process to reduce project time and cost risks.

For example, when our expert Vehicle Resilience team undertake any type of independent assessment for a client in the field of electrified, connected and automated vehicles we will always seek to be involved in the very initial stages of vehicle development. From thereon in, whether working in the realms of functional safety, automotive cybersecurity or electromagnetic resilience, we will take a staged approach where we go in at key gateways throughout the programme to ensure early identification of any potential related issues.

Working in this way with many of the world's leading automakers, we are able to help negate issues in the development cycle in the initial design stages and maintain a continual process of monitoring and checking at each key stage in order to ensure the highest level of engineering integrity. The result is less prototype vehicle requirements, improved accuracies and optimised efficiencies – helping to reduce project times and overall costs.

Thus, as we look forward to the emerging new 'normal' we find ourselves in, the onus for automakers, more than ever, will be on ensuring they remain profitable and progressive. With this in mind, early engagement with assessors offers one easy way of reducing the bottom line and maximising profit potential – helping OEMs to remain in good stead amid an emerging post-coronavirus world and future mobility vision which may look slightly different.

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OX delivering opportunity: Part 2

Transport-as-a-Service makes more sense to walkers than drivers

The magnitude of the economic and societal benefits to introduce transport-as-a-service in countries like Africa is the driving force behind the OX Ecosystem. Providing the opportunity for efficient and equitable trade, economic growth and positive social impact, is central to our vision.”

BY EMILY FRASER, OX CUSTOMER PROPOSITION OWNER



THE IMPACT of a lack of accessible transport in Africa, particularly in rural areas, was depicted in Part 1 (here). Now, with this in mind, we will explore the opportunity that is presented in targeting non-consumers of transport and how generating demand for transport will support local economic growth and deliver positive social impacts where it is most needed.

Looking at a transport-as-a-service model in developed countries, such as the UK, major challenges are presented in offering this service where there is already a well-established principle of car ownership, an emotional connection with vehicles and an expectation of convenience. With nearly 40 million vehicles on the road in the UK today, the barriers to the acceptance of a shared mobility service are high and provides a starting

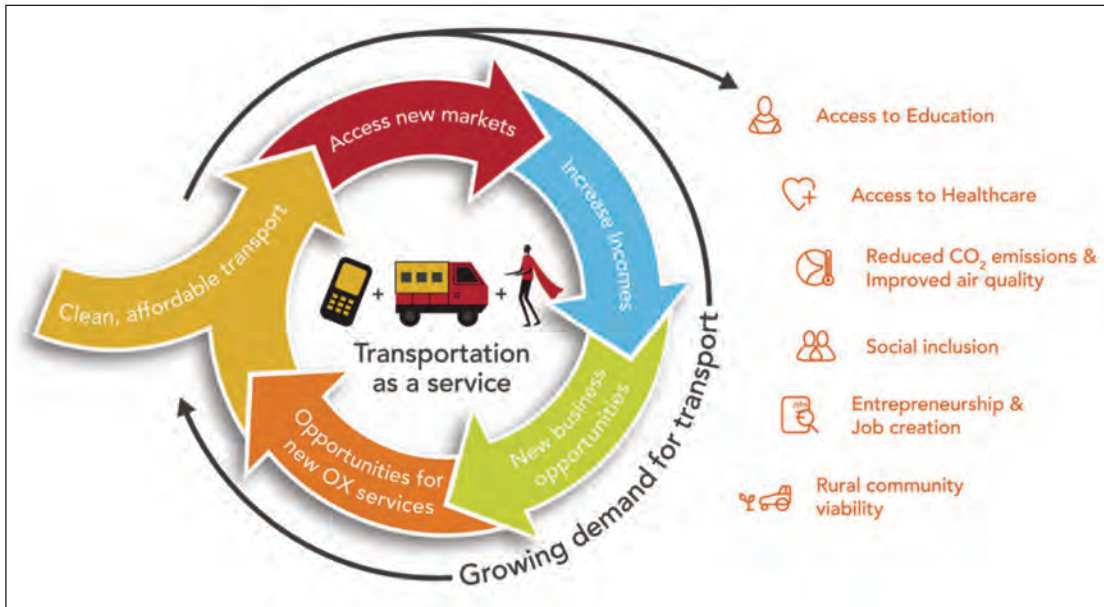


point that is less than favourable. The convenience of each household having access to 1.2 vehicles (Department for transport stats 2019) is difficult to match by offering a service – the barre of customer expectation is set incredibly high! This leads us to the title “TaaS Makes More Sense to Walkers Than Drivers”.

Customer expectation for a walker, someone that does not have access to motorised transport, exists but on a completely different level. In Sub-Saharan Africa, it is typical for someone living rurally to carry heavy loads on foot for considerable distances. Rwanda has a population of 12 million people, yet only 216,000 vehicles - the expectation on having instant access or ownership of a vehicle is not the “norm”. Where there is a significant impact of access to transport is where there is a real opportunity to introduce transport-as-a-service. By utilising models that have already been established by the likes of Uber and Airbnb, where they have shown that sharing can work, even in countries where ownership is king, we can start to break down the main barrier of access to transport in rural Africa - affordability.

This brings us to discuss how the OX Ecosystem works...

To enable an affordable solution, transport must be offered as-a-service, as selling a vehicle directly to the people who need to transport most is not



possible no matter how “low-cost” the transport is considered to be. To ensure the offer is affordable to a country with an average GDP/capita of \$4 per day, multiple services need to be offered to spread the cost, therefore expanding the service to more than just the transportation of goods and produce, but perhaps energy and data too. This turns the traditional transport-as-a-service offering into something that is affordable, accessible and unlocks opportunities for everyone within the “ecosystem” that is created by these services. This makes it better than just affordable - it will encourage local economic growth which is at the heart of eradicating extreme poverty.

Enabling access to new markets by providing transport broadens scope for trade and increases equitability and efficiency. To do this, the vehicle usage itself must allow the user to increase their revenue by a higher margin than any associated costs of the service. Just as importantly, the vehicle itself needs to be fit for purpose and must reliably meet the demands of the customer, prove itself capable over challenging terrain, increase quantities and improve the condition of produce that is sold. With the livelihood of the farmers at stake, the service needs to be reliable, to allow them to introduce the service as part of their business model, reduce produce waste and ensure they meet commitments to others in their supply chain. Reliability here does not just refer to the reliability of the vehicle itself, but also to the availability of the service, on time. All of this will contribute to a better bottom line to the end user.

So, what does this increase of income mean to the customer? Not only can they have better access to education, healthcare and further opportunities, but they will use this extra money to invest in their business. This will drive an increase in demand for access to off-grid energy, payment services and further transport demands, such as higher quantities of produce and transporting raw materials. All of which will drive further demand for transport.

To summarise, the OX ecosystem is a self-reinforcing cycle of economic growth that is kickstarted by introducing a clean, affordable transport-as-a-service solution to businesses in rural areas. This transport provides access to new markets and increased profitability for businesses, which not only gives societal benefits but also allowed businesses to grow, creating further opportunities for OX services.

If every cent spent on transport could create more cents worth of economic growth then the difference this will make is almost unimaginable. The scope of the opportunity is huge – taking only Africa into consideration, the population of Sub-Saharan Africa is 1.1bn which is projected to double by 2050, with an estimated 60% of the population living rurally.

In the next and final part of this series of articles we will explore the enablers for the solution, the OX truck and a 2G capable mobility-as-a-service ecosystem, that we believe will enable Africa’s transportation system to be more efficient and sustainable than that which exists today in countries such as the UK.



Energy efficiency or local **zero emission**

The change in our mobility is going on and the question of whether this is the right change is constantly being rejected as being backwards and inconsistent with the mainstream.

BY HANS RODESTOCK, CEO OF HR FUEL CELL

IN OUR TIME, being trendy is more important than standing for the truth or seeing reality. Asking and thinking is uncomfortable and only disturbs the new alternative view of the holy world. It's easier to swim with the crowd to get the feeling that you are doing something right and to believe you are helping the environment. But just to be on trend and just run it is a bad and unhelpful way of solving problems.

This type of behavior is more representative of the self-loving ecological idea, where you can pretend to be hip and follow an ideological idea for the environment, than actually doing something good. There is always climate change because the world is like a living organism. The question is how quick and catastrophic it will be if we overdo it with our energy consumption.

Our goal should be to keep the generation of greenhouse gases as low as possible, the best is far below the absorption rate of nature. Mobility can make a very large contribution to this. It is not possible to infuse this with persistent ideology;

real common sense must be used. Not a few local zero-emission strategies, in which the exhaust of the greenhouse gas is released at other points, will help us, rather a concept of the entire system is required. It must be seen that in our current situation the energy is also paid for by the currency of the greenhouse gas. An efficient use of the energy leads us to reduce the climate gas.

The new trend of saying local zero emission is more of a specification of the term zero emission to take the pressure of the critics about it. In the end, nothing changes in the efficiency of a system and you are only state the end user for your intentions. With the saying zero-emission or the new local zero emission marketing strategy, the only focus is on the tank-to-wheel part rather than the whole system. In contrast, energy efficiency is used for the entire system from cradle to grave. This reflects all of the energy consumption, for production, service and use, and this changes the complete view of the impact on the environment.

The local zero emission rather stands for a new marketing product that does not really make progress in minimizing climate change. With its focus on the close environment of the end user, it is more to powder the soul of green enthusiasts who do not question green fantasies. This strategy can be defined very well with the saying “Not in my backyard”. Keep my area clean, what happened elsewhere isn’t here. On the one hand it is pointed out that we only have this one world, on the other hand the local zero emission is celebrated. It is a huge contradiction. The local zero emission focuses only on the end user and his/her immediate surroundings and leaves the whole picture before and after unattended. A very good description of this is the tank to wheel view, ignoring everything around you. There is no interest in knowing what energy you need to put into the system to reach this level. The energy comes from the power cord and the battery is already installed.

To bring honesty into the whole system it is important to see and count the entire structure and not just the part of the end user. To do this, we have to use the currency of energy consumption. In the long run, energy will still be associated with the emissions from greenhouse gases, even if it could decrease by a certain percentage. By combining the energy consumption with the kilometers traveled, we can define the most energy-efficient system for our mobility. This is important for the environment, not some ideological trends. Efficiency also means what kind of energy source we use. You want to supply a stationary system like a house or a company with electricity or support the traffic infrastructure. Different needs have different advantages and disadvantages in terms of their efficiency due to different energy sources.

There are three main types of energy sources, each with advantages and disadvantages, that can be used in modern electric mobility. Two of them are the non-solid energy carrier’s methanol and hydrogen, the third is a solid energy carrier and is called a battery. The best thing is to take advantage of them all, but this means in different ways. The most efficient way for traffic is to use electromobility, but there are differences due to the energy source. With the exception of the overhead line or the conductor rail, there are also track-independent power sources such as fuel cells and batteries. Both types will play the main role in modern individual mobility, but they have differences in efficiency that need to be thought through. The solid energy source called battery requires a lot of energy due to its production

and function, so that even modern combustion engines can exceed its energy efficiency. A better economical use of energy will be possible through the fuel cell.

Methanol and hydrogen, which are used as energy carriers to feed the fuel cells as an energy source in electromobility, have a much higher degree of efficiency in the overall system than a battery power source. Again, the efficiency of both kind of fuel cells is better, but it is not the same. In order to convert the energy from the carrier into electricity, there is an advantage of hydrogen over methanol in the

Methanol and hydrogen, which are used as energy carriers to feed the fuel cells as an energy source in electromobility, have a much higher degree of efficiency in the overall system than a battery power source

efficiency directly in the fuel cell. But only if you use the Tank to Wheel view, when you expand it to the Cradle to Grave view, the reverse is true. Because the production and handling of hydrogen is a very energy-intensive process compared to methanol. Which is a simple and efficient energy carrier to produce and very easy to handle.

It has to be a pragmatic and open way to achieve the goal of preventing or at least minimizing climate change. There should be no ideological blockade or selfish thinking. The most popular type of electromobility is currently the most energy-inefficient one with batteries. Just seeing the local zero emission, which was previously referred to as zero emission for end-user, is not the right way to reduce greenhouse gas emissions. This and the trend towards driving a BEV is the wrong answer to our problem of climate change. There may be situations where a BEV is the best option, but not in large numbers.

With the electric vehicle powered by fuel cells, we can better reduce greenhouse gas emissions. As



long as we are not in a position to use nuclear fusion to cope with the higher energy demand for hydrogen in terms of processing as an energy carrier, and thus the generation of greenhouse gas, using methanol should be our first choice to minimize the greenhouse gas emissions from our daily traffic. In chemical processes, hydrogen is also available in limited quantities as a by-product, which can be used as an environmentally friendly source of energy. In order to achieve the climate target, however there is currently no alternative to methanol fuel cells in terms of energy efficiency and possible quantities.

There are two currencies that energy deals with; One is the ecological, which pays with the greenhouse gas, and the other is the economic, which wants money. Here, too, energy efficiency and the local zero-emission perspective are taking different paths. While the local zero emission only sees the tank-to-wheel part and ignores the world, it is massively financially supported and enforced by ideologically motivated decision-makers. Not only are batteries very expensive, they are also not the best choice when it comes to energy efficiency. Very expensive, but on the other hand with better energy efficiency than the battery is the hydrogen technology. Both are favored by the fact that the end user does not emit any greenhouse gas; but is it enough, since the effect of a drastic reduction in greenhouse gas over the entire system is more than questionable. For the really successful dissemination of climate-friendly technologies that really reduce the emissions of greenhouse gases, it must be possible to pay for them without subsidies and other support. There aren't that many countries that can afford such expensive technology because of the cost; and

in these countries there are not so many solvent people who can live their dreams compared to the number of normal drivers. The alternative would be to support a technology that is cheaper and also more energy efficient. Methanol fuel cell technology is the solution to both problems, it is more energy efficient and can be paid for by the normal driver.

It is important to find the right strategy that ordinary motorists can use to buy an electric car and choose the one for their needs, with the least amount of greenhouse gas possible in the entire system. Just planning a burner ban and support for just one type of electric car without demonstrating climate efficiency is not the best option. This runs behind a hip thought and a pure act without any reflection. History has shown that subsidies and other forms of support often go in the wrong direction. How long can countries fund the purchase of a vehicle on a large scale? We have to break away from subsidizing the local zero-emission ideology and support the energy efficiency of entire systems. According the fact that all electric vehicles are identical with the exception of the power supply it would be a remarkable step in the right direction for manufacturers to develop platforms that can be equipped with different power supplies. It would be the right direction and the customer chooses what is right for their needs.

The current structure for building electromobility must be changed. Governments need to set standards that the wheel is not developed twice, and that's it. They shouldn't follow trends without reflecting on their ecological and economic sense. Automobile manufacturers do not need to develop batteries and fuel cells because they would better be more care about the electric vehicle platform, which is flexible in the choice of power source. Also, the energy sector should use its network to build infrastructure for the energy carrier for a large number of users, and this is where governments could help businesses to reduce the financial burden. The infrastructure not only means that charging stations for BEVs have to be built, but also hydrogen stations. It will be very easy for methanol, as it can be handled over the current infrastructure of a normal gas station, only minor adjustments are required. An alliance between the hydrogen and methanol industries to make fuel cells affordable through the quantities would also be of great help. We are already seeing prototypes of hydrogen trucks and trains and so on, but the obstacle is the economic run. Here, the low costs and the easy-to-adjust infrastructure for methanol would be a great motivator for the establishment.

Keep Your City Moving with the Power of MaaS



Branded Apps



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Real-Time for Buses



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Why innovation and collaboration are key to the next generation of parking

When it comes to digitisation, the UK has a well-deserved reputation for being an early adopter. We were one of the first European countries to adopt mobile payments en masse, and among the first to embrace cashless parking. When JustPark launched in 2006 to offer peer-to-peer parking via an app, it's no coincidence that the UK was its primary target market.

BY HANNAH FULLER, CLIENT SERVICES DIRECTOR AT JUSTPARK



WHETHER it's our island mentality or pioneering heritage, the UK can almost always be relied on for helping new technologies thrive within the market, and that's no different for the parking sector. Our communities' willingness to embrace innovation means that over the past 10 to 15 years, digital parking vendors, such as JustPark, RingGo and Pay By Phone have been able to thrive.

However, innovation can also create unforeseen complications in the long term. The prevalence of several digital parking vendors is incredibly convenient for consumers, but it does create a headache for local authorities.

For example, someone from Cornwall may have the JustPark app downloaded to their phone because all of their local car parks use us as a vendor. However, if they travel into Devon, they will likely need a number of other apps in order to pay remotely, at which point the driver may feel more inclined to pay at the existing Pay & Display and machine.

The risk that customers might not have access to the local authority's chosen vendor's app means that the authority may be less likely to fully embrace cashless parking. This not only means that authorities are missing out on significant savings available by removing fees related to cash handling and maintenance, it also makes it harder for authorities to deploy a contactless strategy around Covid-19.

The solution to this is multi-vendor parking, which allows authorities to choose more than one digital parking vendor to operate across their sites. This is a solution that has already been deployed successfully in mainland Europe, with Belgium, France and The Netherlands all using a multi-vendor approach to touchless parking. While multi-vendor is in its infancy



in the UK, it is currently being trialled in Cambridge, where JustPark is one of the vendors.

The obvious consumer benefit is that – if this model is prevalent across the country – motorists will need fewer parking apps. By making touchless parking simpler for the consumer, it will become more popular, allowing authorities to quicken the rate at which they digitise parking.

However, the benefits, and indeed the challenges, for local authorities go deeper than this. First, multi-vendor parking means that the battle between vendors for market share doesn't end once the authority has awarded the contract. Ultimately, if several parking platforms are available, vendors know that customers will choose the best overall solution and vote with their thumbs.

This means that vendors will place an even greater focus on innovating their platforms to make them valuable to the customer. User journeys will become even smoother, and vendors will learn more about their customers, to make their parking experience as positive as possible.

This may also extend to pricing. Vendors have always competed with each other on costs during the tender process, but this is always done 'blind'. If authorities move to a multi-vendor model, and pass the vendors' costs on to the customer, they will very quickly reach a neutral level. Ultimately, no one vendor will want to be more expensive than its competitors, so they are more likely to find a common ground.

The final challenge that multi-vendor parking poses to local authorities is administrative. Authorities would be excused for thinking that three vendors operating across their parking estate means three sets of financial data, reporting and enforcement.

The answer is to assign an aggregator. This is a concept used particularly successfully in The Netherlands, where one aggregator works across entire regions. In a UK setting, we expect that one of the parking vendors will also act as the aggregator, building in an aggregation layer, which acts as a go-between for the authority and the other vendors. This means one set of reconciliation for the authority, while still providing customers with the multi-vendor experience.

The introduction of multi-vendor parking is a great example of how the UK is able to innovate in order to overcome its challenges. By embracing the



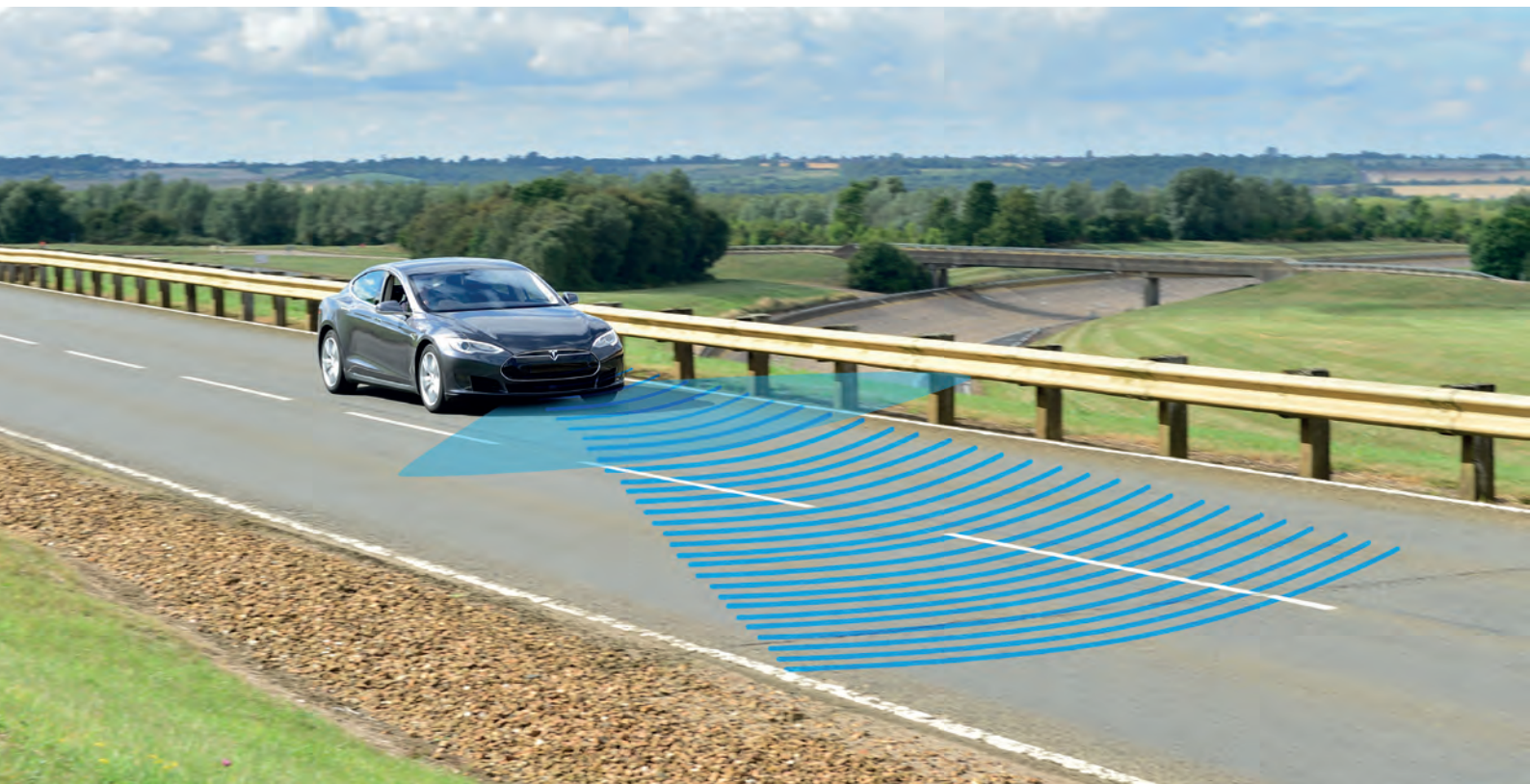
country's innovative parking vendors, like JustPark, local authorities can make parking in their area even easier for residents and visitors while achieving necessary cost savings. We're looking forward to working with authorities on this challenge and are ready to help them make a change.

JustPark

Founded in 2006 and backed by some of the world's leading investors, JustPark helps more than 6 million drivers make smarter and more sustainable journeys using its industry leading app. JustPark users can find, reserve and pay for parking across a network of over 50,000 car parks, hotels, residential driveways and a variety of other real-estate providers.

Since 2017, JustPark has operated the UK's fastest growing and multi-award-winning mobile parking payment service, helping local authorities and parking operators provide Covid-safe and faster payment solutions. In 2020, JustPark took over the operation of all public sector parking payments in Northern Ireland, while continuing to support Cornwall, Cambridge and more than 20 other public sector contracts and now process in excess of 1 million transactions every month.

By unlocking the potential of under-utilised real-estate, JustPark helps motorists find a convenient and often cheaper place to park, while providing real-estate owners with new revenue opportunities and cutting-edge technology solutions.



5G, cyber security and protecting future vehicle networks

PETER STOKER, CHIEF ENGINEER – CONNECTED & AUTONOMOUS VEHICLES AT MILLBROOK, provides a fascinating insight into the valuable work and research being undertaken by Millbrook and others in relation to cyber security.

REGULAR READERS will hopefully recall this article in issue 10 of TaaS magazine, which examines Millbrook's role in the AutoAir consortium. For those who did not get the chance to read that piece, AutoAir installed a fully operational, private, high-speed cellular network at Millbrook to support the development, testing and validation of 5G communications in transport.

Since the advent of this government-backed project, the 5G testbed has acted as the cornerstone for innovation in the UK, positioning our automotive industry as a leader in global connected autonomous vehicle (CAV) and driverless vehicle technology development.

After the early successes of the 5G testbed, we needed to ask ourselves "what next?" for the project as it moved into its operational phase. At the same time, the UK Government, via Zenzic, put out a feasibility study call to examine the threats to vehicle networks in the future.

These two strands – AutoAir and Zenzic – merged, and, thanks to some earlier connections with Cisco, the start of a consortium was in place. Other members of the new consortium included Telefonica, a partner in AutoAir, and Warwick Manufacturing Group (WVG), who are at the forefront of

cybersecurity study and research. The consortium's aim of Baselining Automation and Response for CAV Testbed Cybersecurity led to its name, BeARCAT.

The first order of business was research. BeARCAT's key findings from this provided context for the rest of the feasibility report and can be summarised as follows:

Security considerations of the CAV ecosystem will require ongoing research and assessment as the technology and threat landscape change. A dedicated vehicular and 5G Cyber Test Facility (CTF) can build upon the UK's existing world-class expertise in this space to develop leadership in CAV security.

Vehicles are increasingly cloud-connected, and as such their security can no longer be considered in isolation. Furthermore, the emergence of cellular Vehicle to Everything (C-V2X) is expanding the CAV attack surface. For these reasons, CTFs need to continue research in order to understand emerging threats.

For vehicle manufacturers, future type approval will require evidence of cyber security assessment processes. Procedures will likely be based around ISO SAE 21434 (Road vehicles - Cybersecurity engineering), which can be regarded as a superset of the UNECE Cyber Security Management System (CSMS). These will need to be developed and embraced by vehicle manufacturers.

The development of a Security Framework for the Connected and Autonomous Mobility (CAM) ecosystem, and the 5G and CAV super-systems that are emerging within that space, will be essential for all stakeholders to maintain control of the security research and testing challenges. A common Reference Architecture, supported by software tooling, to enable efficient handling of Threat Analysis and Risk Assessments (TARAs) would be beneficial to all stakeholders.

What is Zenic?

Zenic is a leader in the move to a safer, more inclusive and productive mobile future. It is shaping the roadmap and ecosystem for the connected and self-driving future by enabling industry, government and academia to work together.

Development of an industry-wide knowledge base on CAM security issues would help encourage stakeholders to engage and network in order to exchange information and resources on cyber security threats to the CAV ecosystem.

How exactly might a security breach manifest itself in the CAM ecosystem? The simple answer is that there are several security threats that can have an impact. This can include disruption of connectivity to prevent operation of CAV services (denial of service), data privacy issues (including data exfiltration and tracking), and the planting of malicious malware within equipment, both at source and by threat actors.

Evidently, the threats posed by a 5G cybersecurity breach are potentially far more serious than those of previous generations of the technology, such as 3G and 4G. The harsh reality is that, just as 5G is a step up in capabilities for its users, with enhanced broadband speeds, latency and connectivity advantages, those abilities also aid threat actors. They can extract data sets from systems quicker, increase the capabilities of botnets, and target more devices as 5G IoT devices become widespread.

One of the main differences between 5G and its forebears is that 5G will be used in more critical applications. Therefore, the impact of a security breach will be more significant. Generally, 5G provides much stronger cybersecurity protection than 3G and 4G, but it needs to be recognised that it also brings cybersecurity threats that have never been faced before because of its wider application.

The development of a Security Framework for the Connected and Autonomous Mobility (CAM) ecosystem, and the 5G and CAV super-systems that are emerging within that space, will be essential for all stakeholders to maintain control of the security research and testing challenges



Those are the threats, but what about the potential ramifications of a cyber attack for the average road user? As we've learned, with vehicle systems becoming more sophisticated, the possibility of undetected vulnerabilities existing within those systems increases. Furthermore, increasing commonalities of vehicle components and use of commodity operating systems means that manufacturers and researchers must guard against the possibility of attacks causing mass disruption of vehicles.

The rise in ransomware attacks presents a further threat. This may be an attack at scale, as seen in WannaCry – where a worldwide cyberattack by the WannaCry ransomware cryptoworm targeted computers running Microsoft Windows – and could consequently affect other road users by causing major traffic chaos. Identity theft from any device is a cyber-threat and, as vehicles contain more of our data, it is inevitable that they will be targets for cyber-attacks. Vehicle systems must therefore have strong data protection mechanisms. Most seriously, cyber-attacks that compromise the driving algorithms of a CAV could cause accidents, with potentially fatal consequences for occupants of the vehicle and any neighbouring vehicles.

The task facing the consortium and vehicle manufacturers, then, is to identify where digital defences need to be focused for protection against

cybersecurity breaches, and to effectively safeguard them when developing new technologies. This is performed through threat modelling, which allows manufacturers to focus on the highest risk threats first. The first priority will always be the vehicle control systems to ensure that safety can be maintained in the presence of a cyber-attack.

The industry is becoming aware that cybersecurity is not an end goal but an ongoing arms race, and cyber-resilience is the key. It is important that we maintain an up-to-date understanding of the current threat landscape for the whole system. It is also essential that we keep revising security of the mobility entities through testing and analysis, especially when new breaches are reported. The lifetime of any security certification may need to be continuous, or at least only be valid for short timeframes – say, six months.

To be involved in such a pioneering, dynamic area of research, which is crucial to the feasibility and safety of connected mobility, is yet another example of how multi-faceted and rewarding a role in CAV engineering – especially at Millbrook – can be. Our site boasts an enviable array of facilities and equipment for CAV and ADAS testing and development, placing us right at the cutting-edge of the industry. The cyber threat landscape is changing very fast, and we just need to make sure we keep up with it.

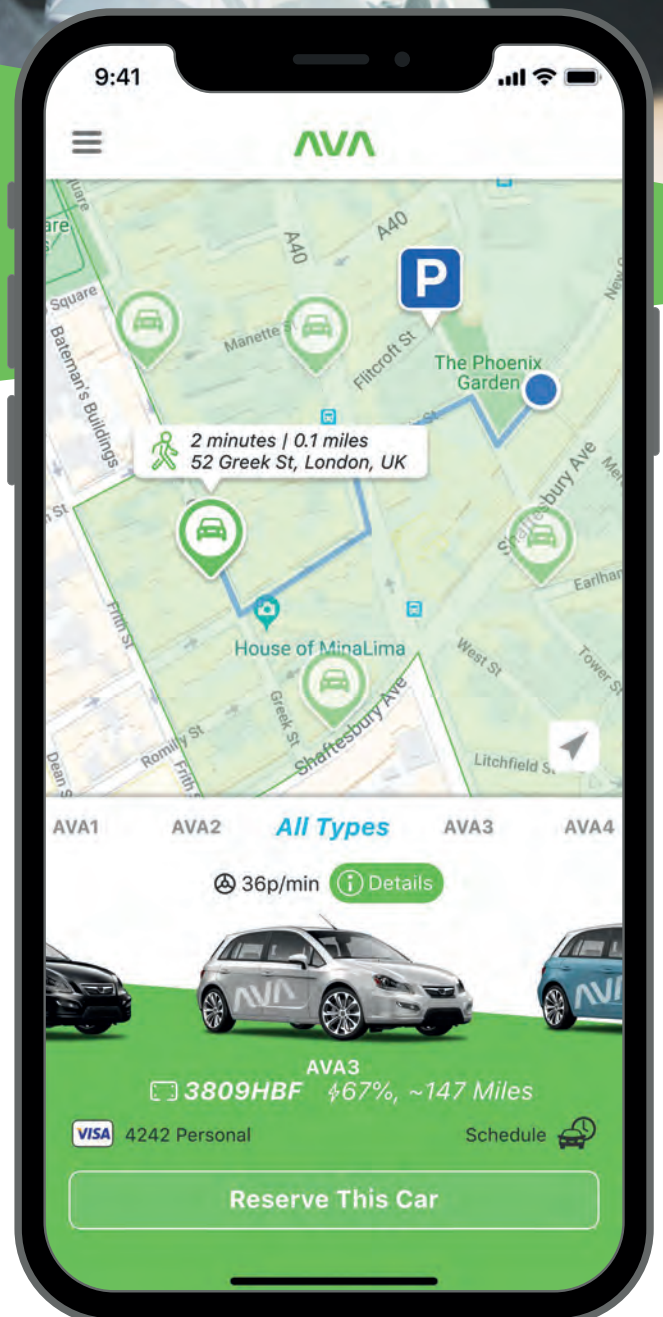
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Public charging networks – the metrics that really matter

MATTEO DE RENZI, CEO of BP PULSE, explains why the debate over the suitability and progress of electric vehicle charging networks needs to be re-framed.

DATA FROM Zap-Map shows that there are currently close to 40,000 charging ‘connectors’ in the UK, stationed at more than 14,000 different locations. Some commentators argue that we simply need to increase these numbers, and that this alone is the best measure of network quality.

However, such a crude analysis doesn’t account for what really matters when it comes to making EV ownership as easy and seamless as possible for all UK motorists.

Using network size as the only barometer for progress, or as the main basis for comparison between service providers, is an outmoded and

overly simplistic approach. We need to re-frame the narrative and start looking at the metrics that really matter.

When considering the the UK public charging network, we need to look at its suitability to the user. This means considering the location and geographical spread of charging points, as well as examining the power supply and operational support available across the network.

After all, having 100 underutilised 3kW slow chargers within a one-mile radius of one another in a borough of London might bolster a network’s headline



numbers, but what is the true value compared to two or three strategically positioned 150kW ultra-fast chargers that get used virtually all day, every day?

There are two important points. The first is the significance of location and geographical coverage. Our research tells us that the type of charger you need depends on the situation. If I need to quickly charge my car then an ultra-fast 150kW charger (UFC) on one of our retail sites is incredibly useful. But if I'm going to the cinema, I don't need to charge that fast as the car will be charged before the adverts have finished. There, a 7kW charge point could add 60 or so miles of range during the course of the movie.. Overnight charging on the street can be slower still. What we really need are different speeds for different needs.

If we want nationwide EV adoption, we must also ensure that certain areas of the UK are not left behind. According to Zap-Map data, there are more chargepoints in Greater London than in Scotland, Wales, Northern Ireland, the North East of England and Yorkshire and the Humber combined. At the moment, this correlates with level of EV ownership in each region, but as we move towards 2030, levels of EV uptake will ramp up across the country. This is why we're investing nationwide, and partnering with local authorities the length and breadth of the country.

A decade has passed since the first public chargers were installed, and technology has evolved. This means that there is a significant amount of legacy infrastructure in the UK that is no longer fit for purpose – either because it no longer works or it doesn't meet the needs of today's EV driver. Clearly, a poorly functioning chargepoint is no better than no chargepoint at all, which is why bp pulse is making £2 million available to help local authorities upgrade legacy infrastructure with vastly superior equipment.



Of course, when the first public charging units were installed, nobody knew how and when the EV market or charging technology would evolve. However, with a decade of experience on our side, we now know what motorists need from public EV infrastructure. Local authorities now face a challenge – to shift the approach to one where the size of your network is less important than what it is able to do. At bp pulse, we're collaborating closely with the public sector partners who understand that public EV charging infrastructure is much more than just a numbers game.



About bp pulse

bp pulse is the new name for bp Chargemaster and the Polar network

bp pulse (formerly bp Chargemaster) is one of the UK's leading providers of electric vehicle charging infrastructure and operates the largest electric vehicle charging network in the UK. Founded in 2008, the company provides a comprehensive, flexible and practical range of electric vehicle charging solutions. bp pulse has supplied over 60,000 public, workplace and home charging units, and is now rolling out 150kW ultra-rapid chargers on bp retail sites.

Contact

tom.callow@bp.com or 07387 418967

Floating on air:

Hydrogen vehicle driver ready for zero emission future

A private car hire employee details his experience with hydrogen vehicles, as high mileage and heavy-duty transport search for zero emission solutions.

BY CENEX

PETER JOSEPH was one of the first drivers to take customers in a hydrogen fuelled vehicle in London. Back in 2018, following early retirement from a career in IT and well-earned break travelling abroad, he decided to take on a new role as a driver for Green Tomato Cars.

A few weeks later, London's self-proclaimed "green and ethical car service" received 25 Toyota Mirais

as part of a five year, pan-European trial into the viability of using hydrogen as a zero emission fuel and Joseph was quick to jump at the chance to drive one – he still does so to this day. "We all have to do our bit for the environment and the Mirai is at the forefront of that technology," he said.

"The proposition was extremely attractive, the chance to trial this new car and the employment package with Green Tomato Cars allows me to use it for my own personal use too.

"It's a lovely car to drive.

"Driving it feels like you're almost floating on air as you take off as it's so smooth and quiet - it's really comfortable and ticks all the boxes, not just for my passengers but even my family enjoy it when I take them out.

"I get a number of passengers who specifically request to be driven in a zero emission car because they want to do their bit for the environment and the Mirai meets that need.

"Green Tomato Cars is the only private hire operator to offer a dedicated zero emission service, which is only possible thanks to the scale and range of our Mirai fleet through the ZEFER project."



ZEFER (Zero Emission Fleet for European Rollout) aims to demonstrate viable business cases for captive fleets of fuel cell electric vehicles (FCEVs) in operations which can realise value from hydrogen vehicles.

FCEVs use compressed hydrogen gas as a fuel to generate electric power via a fuel cell, producing only water from the tailpipe with no greenhouse gas emissions. The zero emission characteristics of the FCEVs mean they are exempt from Clean Air Zone charges in London, therefore present a strong business case for fleet operators as the city focuses on reducing air pollution with the proposed expansion of the Ultra-Low Emission Zone.

ZEFER is a €26 million project co-funded with Fuel Cells and Hydrogen Joint Undertaking (FCH JU) and will deploy 180 FCEVs across Paris, Brussels and London: 170 will be operated as taxi or private hire vehicles and the remaining 10 will be used by the Metropolitan Police Service as emergency response vehicles.

To date 117 of those are in operation, including an additional 25 deployed to Green Tomato Cars in November 2019, and data collected shows they have driven over 4.15 million km (May 2020) and offer 99% availability across all applications (a small amount of off road time is associated with normal taxi use for minor impacts and tyre replacements). It is inevitable, due to the high mileage nature of the vehicles, that collisions occur, and safety is high on the agenda for all users given the reported dangers of hydrogen.

Of the incidents reported within the trial, none involved the release of hydrogen or problems with the fuel cell system.

“I’ve had no problems at all with safety and I’ve always felt safe in the two years I’ve been driving the car. “When I first started driving the car, especially in the first six months, I had customers who knew that hydrogen was flammable and were keen to know the safety levels of the car.

“Part of my induction involved someone from Toyota talking us through their research into hydrogen and protecting the tanks to make sure everything runs above board so I’m able to reassure any passenger concerns.”

As the coronavirus pandemic swept across the UK, Joseph noticed a rise in demand for private hire vehicles as commuters turned to safe transport

methods that avoid potential contamination.

“At the start lockdown, I was much busier than usual because a lot of people weren’t using public transport, and I averaged over 300 km each day,” he said. “I noticed more NHS staff were using our services and many key workers live quite a way away from London, so I covered more miles than normal. “I had someone who works for one of our corporate clients travel from Southend to West London which is quite a long journey”.

The only caveat to covering more miles, and using hydrogen in general, is the availability of refuelling stations. Hydrogen is being trialled as an alternative to battery electric passenger cars which can take several hours to recharge, time drivers do not have when being on the road pays the bills.

The vehicles deployed by Green Tomato Cars average 8 journeys and 170 km per day (as of December 2019), with one particular vehicle travelling over 8,400 km in a single month, which means they get through plenty of fuel.

Filling up on hydrogen can take a matter of minutes at a reported rate of around 1 kg/minute, giving comparable refuelling times to conventional petrol or diesel - the Mirai can hold up to 5 kg of hydrogen for a range of around 550 km, although one has just completed over 600 km on a single tank.

Hydrogen also has superb mass-based energy density, as it is almost three times more energy dense per kilogram than diesel (120 MJ/kg compared to 45 MJ/kg), which means larger increases in range bring only a small increase in mass.

This is key to the range dilemma, as heavy-duty cycles (high mileage on a regular basis) for battery electric vehicles would require large, heavy batteries that cause an increase in the energy use per mile. So in order for the hydrogen vehicles at Green





Tomato Cars to complete high mileage on a daily basis they require regular access to hydrogen refuelling stations, of which there are only six in operation in London, including the most recent opening at Gatwick.

The latest data collected shows a significant majority of all the hydrogen dispensed to Green Tomato Cars' FCEVs is from two of those stations: Teddington to the west and Rainham to the east.

"You have to plan it correctly and arrange to refuel before you get too low," Joseph explains. "I'd like to see petrol stations incorporate hydrogen as that will make life easier for people like myself to go and top up.

"I think hydrogen can be the future as long as refuelling stations become more commonplace across the city to meet the increasing driver demands".

More widely, there are 198 refuelling stations across Europe, with 65 of those funded by the FCH JU; the Hydrogen Mobility Europe project, also co-funded by the FCH JU, targets 49 new hydrogen refuelling station installations before 2022.

As is the typical chicken-egg paradox, vehicles require refuelling stations to be viable and vice versa, so deploying hydrogen vehicles in a network of multiple refuelling stations increases station usage, which in turn can decrease the cost of hydrogen over time and make the operational costs of FCEVs more attractive to fleet operators.

Hydrogen can become an efficient and cost-effective solution when it is in the right location with the right demand and utilisation is as high as possible, which also means looking at wider transport applications. Nick McCarthy is a technical specialist at Cenex, a low emission transport consultancy and research organisation involved in real-world hydrogen transport trials across the UK and Europe, including ZEFER.

"Hydrogen produced in a green and sustainable way can provide emissions-free energy for all forms of transport however we are still in the early stages of this transition," he says.

"The transport sectors with the most intensive energy use are the ones where hydrogen has the highest potential, therefore we need to identify the markets with the highest energy use and the highest level of emission restrictions to be commercially viable.

"Commercial transport - such as large vans, trucks, trains, buses, ships and aircraft - requires power for long periods of time, up to 20 hours a day.

"The amount of energy they need, the number of miles they cover, and the sheer amount of goods and people they need to transport, makes it challenging to use battery power, which makes hydrogen very attractive given its energy density and refuelling time.

"If we build the hydrogen refuelling infrastructure and get serious about air quality and climate change, hydrogen-powered commercial transport could become a significant part of the world economy".

As the technology matures, the results from the hydrogen vehicle trials across Europe highlight the positive impacts for the environment and justify the business case for large scale adoption.

Finding the right zero emission technology for the right application is essential in achieving the 2050 carbon targets and reducing transport's environmental impact. Hydrogen is proving itself to be a viable zero emission alternative to fossil fuels in a range of vehicle applications, and only by growing confidence in the technology can it integrate into our transportation network.

Cenex lowers your emissions through innovation in transport and energy infrastructure, operating as an independent, not for profit, consultancy and research technology organisation.

Challenges and opportunities of the multimodal planner for the widespread adoption of MaaS

Large number of private cars in urban areas has become a huge civilizational and commercial issue worldwide. In many cities, the demand for the usage of the road network infrastructure such as roads or parking lots significantly exceeds their capacity.

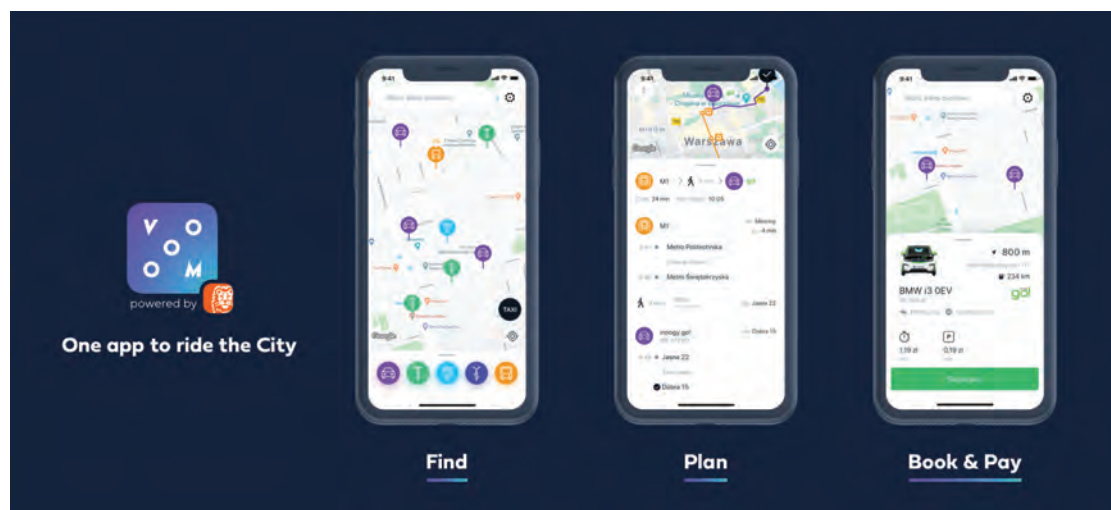
BY RADOSLAW NIELEK, PHD: CO-FOUNDER AND R&D DIRECTOR, AND PAWEŁ GORA, ITS SPECIALIST VOOM

THE COSTS OF TRAFFIC JAMS are counted in billions of dollars and these are amounts obtained by taking into account only wasted time and fuel. The other negative impacts include air pollution, noise and stress of drivers, all of them having harmful effects on health.

On the other hand, it is estimated that in some cities even 30% of congestion in city centers is generated by the drivers searching for a free parking lot. There are many possible approaches to optimize traffic based on improving the supply side: optimizing traffic signal control, building more roads and parkings etc. However, the experience so far

shows that even the most extensive road network becomes clogged very quickly, and the costs of its maintenance reduce investments in areas that improve the quality of life in the city (such as education, culture or green areas and parks). The future of cities is inextricably linked with the need to reduce the number of private cars and the demand for spaces on roads and parkings.

It can only be achieved by simultaneously raising the cost of owning a private car in the city and offering a diverse transport service combining various means of transport, such as: buses, e-kick scooters, car-sharing, bikes, van-pooling etc.





The use of vehicles such as scooters, e-kick scooters or bikes in this mix is particularly important as they occupy much less space, can make shortcuts by using dedicated lanes or bicycle paths, and tremendously increase the comfort of using public transport (and also help to plan public transport network) by helping to cover first/last mile of the trip. Moreover, micro mobility transport modes help in ensuring social distancing, which is so important during the current pandemic crisis.

If cities invest in an infrastructure for the shared micro-mobility by building special pathways or bike tracks, the micro mobility may flourish bringing benefits to the cities and citizens but also challenges, at the same time. Having such an abundant amount of transportation options, complex road network topology and complex fares (there might be different costs of travel depending on the time or distance of a trip, a time of a day or purchased packages and subscriptions), it is difficult for the passengers (even for residents) to make the

optimal mode choice and route choice decisions. Therefore, there is a need for route planners - software applications giving the users good transportation options including transfers between various modes. This brings both the opportunities and challenges.

Opportunities of the multimodal planner

On the one hand, multimodal planners may facilitate the adoption of innovative transportation means and help to overcome habits by suggesting non-obvious (but more comfortable, efficient and relatively cheap) mobility options. The usage of micro mobility modes may be enhanced even further when planners are integrated with advanced applications letting the users not only to plan the trip but also to make and manage bookings and payments. Thanks to that, the whole process can be relatively simple and user-friendly. In addition, the users may make more conscious decisions thanks to being informed about the routes and availability of vehicles, as well as travel times, costs and environmental impact.

Potentially, planners integrated with the public transport management systems can also take into account the current and predicted occupancy of vehicles, which is so important from a perspective of social distancing during the current pandemic crisis, and to offer some users a journey through alternative means of transport (e.g. instead of traveling in a crowded vehicle, a 7-minute scooter ride to the stop of another line).

Planners may be beneficial not only for the user, but also for the micro mobility providers. Beside the potential increase in the number of users thanks to simplified procedures and interfaces, they can also promote returning vehicles in areas where the forecasted demand is high and, thus, increase the utilization of vehicles (help to make services economically viable). Therefore, they can help in implementing subscription-based plans by helping to deliver reasonable quality of service (availability of vehicles) and keep the costs manageable at the same time.

A greater adoption of micro mobility to which multimodal planners can significantly contribute may also trigger passing innovation-friendly regulations as well as soft enforcement of existing regulations (e.g., leaving e-kick scooter in places where it doesn't bother others) and improving the existing transport infrastructure (e.g., building more bicycle paths). It may also help in better management of the supply side, for example, optimization of the public

transport usage (e.g., it may be possible to reduce the costs of maintaining fleets of buses by optimizing schedules in locations where public transport is rarely used, while micro mobility can be easily introduced).

Challenges of the multimodal planner

On the other hand, it is good to be aware of the existing challenges that developers of multimodal planners have to face. First of all, the planners should handle the user requests very fast, typically in less than 2 seconds and no more than 5 seconds. This is a non-trivial task, especially when one takes into account that the space of possible transportation solutions is huge (there are many types of vertices and edges in road network graphs, pedestrian walkways, bicycle paths, underground passages, as well as different types of lanes).















The dynamic urban environment makes precalculation impractical or even impossible, e.g., the vehicles may appear/disappear, buses may be delayed or canceled, some roads may become blocked due to crashes. There may be also certain restrictions hampering the planning process, e.g., bikes/e-kick scooters can use only some routes, electric cars can use bus lanes, parking zones may be available only at certain locations.

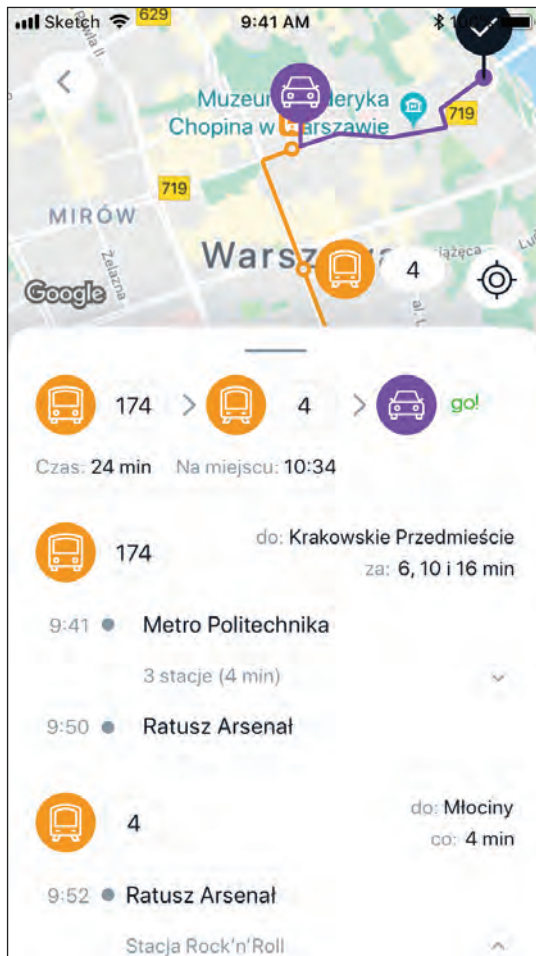
Also, there might be complex price policies (caps, costs per kilometer/minute, different packages and subscription plans etc), which makes planning even more difficult. Lack of timetables for shared vehicles introduces uncertainty and makes the prediction models necessary (I suppose to change from metro to e-kick scooter in 20 minutes; what is the chance that the e-kick scooter will be there?).

Many challenges may appear even in the phase of designing the development of multimodal planners. For example, it is not obvious who should pay for such a development: private companies, micro mobility providers, public sector / urban authorities or maybe several entities should contribute? Also, the planner and its prediction models require huge amounts of transportation data ranging from the static data like road network topology or fixed schedules of public transport, to dynamic data such as real-time traffic conditions and travel times as well as availability of vehicles (and range), tariffs, and upcoming events in the city that gather a significant number of people. From one perspective, there is a diversity of data sources, each of them has some advantages and disadvantages, so it is not easy to find the optimal option, integrating data from different sources may be challenging as well due to different formats and legal restrictions. On the other hand, the amount of data required to perform some computations, e.g., traffic or availability prediction, may be huge, which brings the challenges of storing and processing such data.

Voom's approach

The aforementioned challenges were among many issues we had to tackle while designing and developing a multimodal planner at Voom. The project is in active development since February 2020 within a research grant funded by the National Centre for Research and Development in Poland and our goal is to build a multimodal planner that can be a practical and effective implementation of the MaaS concept. We took advantage of the existing open source solutions and extended it toward a planner that will take into account specificity of different modes of transport (e.g., their

	Support for various means of transportation		Engine for simulating influence of tariffs and vehicles' deployment strategies on vehicles utilization		Vehicle availability prediction
	Parking zones		Possibility to express complex tariffs		Variety of objective functions
	Editable maps		Language versions		"Push me to walk"
	Global and individual preferences		Turn-by-turn navigation		Analytics
	Hot and cold zones		Traffic model based on average travel speeds with an interface for live updates		



availability), preferences and priorities of the users (e.g., selecting mode of transport depending on the weather conditions or baggage), emergent effects (e.g., consequences of recommending the same routes/options for several users) and costs.

We use advanced routing algorithms extending the A* algorithm and proprietary heuristics that speed up computation by several orders of magnitude in order to propose to the users the optimal routes while taking into account different typical speeds of various means of transport, real-world travel times, transfers to other modes and uncertainty of vehicles' availability. For the latter issue, we use historical data about the presence of vehicles in different locations and apply advanced machine learning algorithms (spatio-temporal neural networks) to predict the current and future availability of different transportation options in various time periods. Beside the data collected by Voom and its partners (micro mobility providers), we also use publicly available data such as GTFS data concerning public

transport and the aforementioned OpenStreetMap data. We also use real-world data about average speeds in different time periods acquired in order to ensure accurate estimations of travel times for a purpose of finding optimal routes and trip options. Integrating large amounts of data from several sources was another challenge that we solved using efficient data representation.

We are still working on improving the Voom planner and making it even more efficient but it can be already considered as a state-of-the-art solution in the multimodal micro mobility planning domain, and is already a useful and convenient application which can efficiently help citizens in their day-to-day travels and helps to make MaaS concept economically viable.

Conclusions

Multimodal planning is an interesting functionality which may trigger flourishing of micro mobility and Mobility-as-a-Service, in general. There are many challenges which should be tackled and solved on a road toward fully operational and efficient planners, but overcoming them may bring great benefits and opportunities, leading civilization to better regulations, development of new technologies, their applications in the transportation field, and eventually to a more sustainable and efficient mobility. Thanks to developing Voom's multimodal planner we are on an optimal road to make it happen.



Pawel Gora: *ITS specialist at Voom, scientist, IT specialist and entrepreneur working mostly on applications of AI (in transportation and medicine) and quantum computing. Graduated from the Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw (M.Sc. in Mathematics and M.Sc. in Computer Science).*



Radoslaw Nielek, PhD: *co-founder and R&D director at Voom, professor at Polish-Japanese Academy of Information Technology, entrepreneur, consultant and advisor working in the area of social informatics and algorithms that helps to realise social goals and make profits.*

Modelling the transmission of energy between electric vehicles and the local energy network

WMG's contribution to EV-elocity

JAMES MARCO, PROFESSOR OF SYSTEMS MODELLING AND SIMULATION AT WMG, UNIVERSITY OF WARWICK



AT WMG, University of Warwick our Energy Research spans multiple modes of travel, from automotive and marine to rail, aerospace and autonomous vehicles. Our Energy Innovation Centre is our research hub for developing new battery technologies – from new materials and cell designs through to complete battery systems, supported by new battery control systems, models, testing and manufacturing methods.

Balancing energy availability with demand

Efficient storage is a key part of ensuring that the

availability of energy is balanced with demand. However, such systems come at a price, and therefore add an extra layer to economic decision making, especially when assessing the viability of such systems in large contexts. Bi-directional charging is a solution to this challenge, which enables services like frequency regulation and load balancing through utilising the batteries on-board the respective Electric Vehicle (EV). Integrating such Vehicle-to-Grid (V2G) technologies within EVs can result in effective matching between time of electrical generation and time of load and, by feeding unused electricity back to the grid, can reduce the strain on the energy network underpinning this technology.

Such EVs are now becoming more readily available on the market, for example the Nissan ENV200 commercial vehicle. The economic viability of V2G systems in commercial vehicles will hinge on the level of profitability that the service generates for both consumers and network or system operators. Often when we talk about future mobility, future vehicles and sustainable travel, we think of electrification and its integration within a new sustainable energy network. When we think of electrification in vehicles, a consistency emerges as interest naturally gravitates towards elements such as performance, charging, degradation, consumer behaviour and the infrastructure required to support our future of mobility.

Tracking the transmission of energy from Vehicle-to-Grid (V2G)

Whilst a focus is placed on the performance of the EV itself, it's important to consider how consumers use the vehicle and how this compares with current traditional combustion engines. We need to quantify





the possible level of battery degradation and therefore the economic impact or V2G implications that different strategies and use cases elicit. This will allow us to effectively model the transmission of energy between the respective vehicle and the local energy network.

Relieving the strain on the network

As EV markets expand and become more accessible, the pressure on the energy network that such markets are built upon will rise. A vehicle's ability to facilitate services such as frequency regulation and load balancing through bi-directional charging systems and on-board high energy capacity batteries will help to relieve some of the strain on the network.

This forms a key objective within the EV-elocity project, funded by the Department for Business Energy and Industrial Strategy (BEIS) and the Office for Zero Emission Vehicles (OZEV), with Innovate UK acting as 'delivery partner'. WMG at the University of Warwick has installed and is operating three V2G units on our main campus to delve deeper into these considerations through real-time applied research, encapsulating real-world data analysis on vehicle use and battery performance and creating new models of battery ageing bespoke to V2G operation. The use of three V2G units will allow a more diverse range of uses cases to be captured as each charger is strategically located on the University campus to interact with different users and vehicles.

These models will provide new insights into degradation due to charge throughput and calendar ageing. The models will be used to optimise new charging control systems and the way the battery is used in V2G. Building on the progress made

during the initial phase of the project, WMG has completed installation of the three units currently held on campus. We have also worked with Cenex to complete the installation of data loggers to our Nissan ENV200 fleet. Throughout 2021 we will collect real-world data from the charger units and the University's fleet of ENV200 electric vans. The model will be updated in real-time, utilising new data that becomes available.

The model will also be refined and validated further through an experimental programme conducted within WMG's Energy Innovation Centre (EIC). Battery ageing will be conducted in a testing environment that is synthesised from recorded vehicle and charger data. This element of the project demonstrates the bridge between the reliability and controlled environment of the laboratory, and the relevance of real-world usage. This experiment will reveal whether additional battery degradation is observed through the V2G services tested. Furthermore, the project will also validate opportunities to mitigate degradation and potentially extend battery life.

Building the battery degradation model

WMG will also seek to extend existing battery degradation models to include the impact of V2G operation. Use cases will be synthesised from data collected from the V2G units installed as part of this project and from datasets held by WMG where confidentiality agreements permit their use. The degradation model will take account of both cycle ageing (vehicle drive and charging) in addition to calendar ageing (e.g., extended periods of vehicle inactivity). Different use cases will be used to underpin different scenarios to highlight what may be feasible with increased levels of EV-infrastructure integration and forecasting capability.

The Project EV-elocity is part of the Vehicle-to-Grid (V2G) competition, funded by the Department for Business Energy and Industrial Strategy (BEIS) and the Office for Zero Emission Vehicles (OZEV), in partnership with Innovate UK, part of UK Research and Innovation.

In January 2018, OZEV and BEIS announced that 21 projects (8 feasibility studies, 5 collaborative research and development projects, and 8 real-world V2G trial projects) were to receive funding of £30m to develop the business proposition and the core technology to support Vehicle 2 Grid deployment in the UK, including its demonstration with large scale trials. The projects involve more than 50 industrial partners and research organisations from both the Energy and Automotive sector, marking the largest and

most diverse activities on V2G in the world, and trialling more than 1,000 vehicles and V2G charger units across UK. The V2G projects represent a significant step towards the transition to a low carbon transportation and a smart energy system. Allowing EVs to return energy to the Power Grid when parked and plugged for charging, will increase Grid resilience, allow for better exploitation of renewable sources and lower the cost of ownership for EV owners, leading to new business opportunities and clear advantages for EV users and energy consumers.

For further information please contact:

Tom Hartwell, Marketing and Communications Executive
 WMG, University of Warwick
 Tel: +44 (0) 2476 150678 E-mail: Tom.Hartwell@warwick.ac.uk



Find the right electric vehicles for your fleet!

Discover where EVs can fit in your fleet with an EV Suitability Assessment (EVSA) from Geotab. Powered by the largest dataset for real-world EV performance, the EVSA helps make your transition to electric as seamless as possible. Receive personalised make and model recommendations that reveal the potential costs-savings of making the switch to EVs.

Already operate a partial or fully electric fleet? Benefit from Geotab's extensive model support and data insights including, real-time battery state of charge while driving, energy consumption, and charging metrics all in one platform.

Your electric fleet blueprint includes:



Detailed cost analysis



Range assurance for EV recommendations



Best fit analysis for your fleet



Calculated emission reductions

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Vodafone and Immense join Midlands Future Mobility with commitment to deploy 5G on key test routes

The largest real-world Connected and Automated Mobility (CAM) testbed in the UK announces Vodafone and Immense as its latest partners.

BY VODAFONE

OVER 300 MILES of West Midlands' roads are set to trial connected and automated vehicles, making UK roads safer and allowing for more predictable goods delivery and journey times.

Midlands Future Mobility is funded by business partners and the UK Government as part of the wider Zenic CAM Testbed UK initiative that facilitates and promotes the development of connected and self-driving cars. Midlands Future Mobility is backed by a consortium of organisations, including WMG at the University of Warwick, HORIBA MIRA, AVL, Transport for West Midlands, Costain, Amey, Wireless Infrastructure Group, Coventry University and Highways England.

The Midlands Future Mobility route offers a combination of campus (mini-city), urban, rural and highways roads on which CAM trials can be supported. The route encompasses major city centres (Coventry and Birmingham) and key interchanges (rail, HS2 and Birmingham International Airport). The wide range of route types provides businesses with opportunities to trial different technologies, from low speed 'shared space' vehicles through to next generation Advanced Driver Assistance Systems (ADAS) and autonomous vehicle technologies. Vodafone will deploy new 5G macro coverage along the route to strengthen the capability of Midlands Future Mobility.

Thanks to Vodafone and Wireless Infrastructure Group, 80% of the Midlands Future Mobility route will

have 5G connectivity – making the West Midlands one of the best-connected environments in the country.

5G can deliver faster data speeds than previous generations of mobile technology. It can also offer extremely low latency (the time it takes for data to complete its journey). This is crucial when it comes to avoiding collisions, where every millisecond counts. Increased bandwidth will also allow the sharing of high definition images between infrastructure and vehicles, which will help an autonomous vehicle make sense of its environment and operate without human involvement. This summer, Vodafone and the Transport for West Midlands and West Midlands 5G committed to work in partnership to share information and expertise and develop cutting-edge transport systems and technology using the region's growing 5G mobile network. Joining Midlands Future Mobility is the next step in this commitment.

Anne Sheehan, Business Director, Vodafone UK, said: "5G will help revolutionise transport on our roads. The ultra-reliability and high bandwidth of 5G will enable new progress for connected and autonomous vehicles, and we are delighted to bring our state-of-the-art 5G network to the Midlands Future Mobility project."

Immense will bring largescale simulations to Midlands Future Mobility, bridging the gap between operational use cases (i.e the local performance

of individual vehicles) and strategic use cases (i.e the global performance of the transportation system). This will leverage the learnings from other work packages to create a fully capable simulation environment that appeals to a range of test-bed users. In collaboration with the other consortium members, Immense will enhance the capability of the Midlands Future Mobility digital assets to answer a range of questions around the impact of CAM. Immense’s work has fundamental applications for regulation and permitting, and facilitates addressing questions such as: How do we ensure ‘mobility for good’? How do we manage the network of the future? How do we deploy CAM?

Robin North, CEO of Immense, said: “Midlands Future Mobility will accelerate the transition to a world where we can enjoy safe, seamless journeys. At Immense, we’re delighted to join a highly skilled group of consortium partners and play our part to make this vision a reality.”

The addition of Vodafone and Immense means the wealth of knowledge that companies can access when trialling their technology in the region will be second-to-none. Benefits include:

- Co-ordinated access to local authorities and highways agencies for testing, approvals and collaboration support;
- Understanding of the latest emerging standards in CAM;
- Support in test design and analysis campaigns from an experienced network;
- Access to experts with academic and industrial experience.

John Fox, Programme Director of Midlands Future Mobility at WMG, said: “It’s increasingly clear that 5G has a huge role to play in CAM, in addition to more established comms methods which we’ve already deployed in Midlands Future Mobility. Bringing 5G to a much larger area than first planned with a leading mobile operator in Vodafone, means Midlands Future Mobility will reach and remain at the forefront of 5G development in the UK for years to come.

“I’m also delighted to welcome Immense on board. Their advanced multi-actor simulation methods and capability perfectly complement the areas of simulation support for CAM creators that Midlands Future Mobility is already developing.”

Daniel Ruiz, CEO of Zenzic, said: “Having industry leaders such as Vodafone join Midlands Future Mobility is a perfect example of the kind of collaboration that is needed for the UK to remain a



world leader in the development of 5G for the CAM industry. Zenzic is continuing to encourage this kind of cutting-edge collaboration to make Connected and Automated Mobility a reality on UK roads by 2030 and this is a great step in the right direction.” Vodafone UK is a technology communications company that connects people, businesses and devices to help our customers benefit from digital innovation. Our services span mobile, fixed line connections, home and office broadband, and the Internet of Things (IoT).

We have a strong track record as a tech pioneer, making the UK’s first mobile phone call, sending the first text message, and making the UK’s first live holographic call using 5G in 2018. We were also the first to start carrying live 5G traffic from a site in Salford, Greater Manchester. As of October 2020, we have 5G in 57 locations in the UK and 193 across Germany, Spain, Italy and Ireland.

In September 2020, leading mobile benchmarking company, umlaut, named Vodafone as London’s best network for 5G. Our 4G network coverage currently reaches over 99% of the UK population. And in October 2020, Vodafone was named Network Provider of the Year by readers of leading technology advice website, Trusted Reviews.

Today, Vodafone serves more than 18 million mobile and fixed-line customers in the UK. To help deliver Gigabit UK, our full-fibre broadband roll-out programme now covers 15 UK towns and cities through partnerships with CityFibre and Openreach. For more information about Vodafone UK please visit: www.Vodafone.co.uk

Procurement drives the private car away?

In an attempt to provide more space for their socially distanced locked down citizens, many cities around Europe this year banned motor vehicles from (parts of) their city centres.

BY JON JONOSKI, COMMUNICATIONS OFFICER AT ICLEI – LOCAL GOVERNMENTS FOR SUSTAINABILITY

FOR MANY, this decision highlighted just how much public space is sacrificed to cars, leading to increased calls to make the pandemic bans permanent. That would certainly help the environment. 24% of all greenhouse gas emissions (GHG) in European cities can be traced back to mobility issues, such as traffic congestion and inefficient transport systems. And further urbanisation of the continent could push that number even higher.

At the same time, it can be hard to imagine the demise of the private car. There are still many cultural, social and economic connotations tied to car ownership, and industries and jobs kept alive by it. Moreover, many citizens still find public transportation and other alternatives inconvenient, and do not know how their transportation choices impact their carbon footprint. Raising citizen awareness around these issues can contribute to

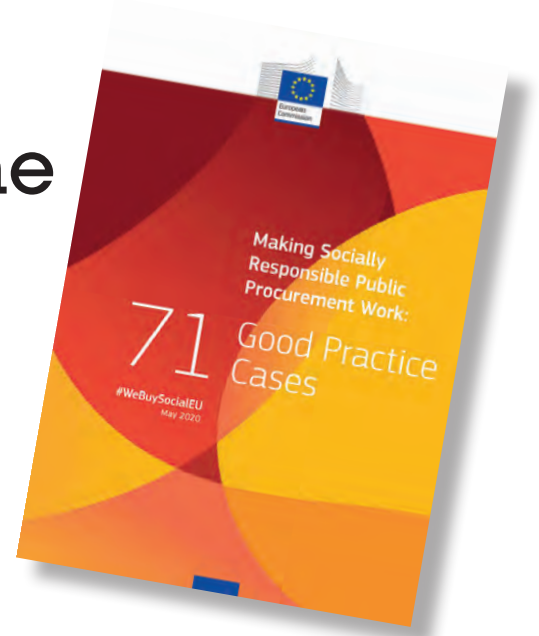


change, but transforming urban transportation is only possible through interventions by local and regional governments.

As public authorities have significant control over cities' infrastructure and public transportation systems, they can use the tools at their disposal to reduce their environmental impact. One such tool is public procurement. Public buyers are among the biggest investors in the European single market, spending 2 trillion euro per year on goods, works and services. That gives them a lot of potential to have a positive influence on the broader (transportation) market – both on the demand and the supply side – by demanding that suppliers operate in more sustainable or socially responsible ways.

Public authorities use public funds when procuring goods, works and services. The European Union (EU) has created a well-regulated public procurement market founded on the core principles of transparency, equality and open competition to ensure that these funds are not misspent and that tenders are fair. Socially Responsible Public Procurement (SRPP) aims to go one step further and to address the impact on society of the purchases made by the public sector. SRPP is about implementing social in public contracts to achieve positive social outcomes.

The European Commission (EC) has recently published the report "Making socially responsible public procurement work: 71 good practice cases".



The 71 cases included in the report make the potential of SRPP visible, showing how procurement can affect the broader market. By promoting employment opportunities, decent work, social inclusion, accessibility, design for all, ethical trade, and compliance with social and environmental standards, public buyers can increase demand for “socially responsible” goods, works and services. Public procurers can be especially impactful in sectors where they command a large share of the market, such as construction, healthcare and transport. As public procurers spend around 14% of the EU’s gross domestic product, their power does not stop there. The EC report also contains cases relating to cleaning and facility management, food/catering services, furniture, gardening services, social services, ICT and textiles.

Some of the cases featured in the report have contributed to goods being transported over shorter distances, leading to the reduction of energy use and CO2 emissions. One such example comes from the French department of Vendée, where a tender for the delivery of organic food to school children incorporated an environmental aspect in its award criteria, which led to an annual reduction of 281,59 tonnes of CO2 emissions, while also saving 1.03 GWh per year. Vendée is now considering taking a similar approach to meat and fish procurement and to the delivery of food to municipalities and retirement homes. This could lead to even bigger reductions of CO2 emissions and more energy savings. That is, of course, great news, but a reduction of transport is not a transformation of transport. In fact, none of the cases in the EC report contributes to that, but the methods and tools they use to achieve their goals are not case-specific. They can be applied across sectors, industries and nations, making the report incredibly useful to authorities who want to use procurement to change our transformation habits and drive down car ownership.

There are many cases in the report which use service contracts to improve labour conditions and to increase employment. They can do this by demanding that suppliers employ people with a distance to the labour market, provide transparency in supply chains to ensure that workers’ rights are not violated, or that workers are paid fairly, regardless of gender. What would happen if they started demanding that potential suppliers paid for the public transportation of their workers? That is not an unreasonable demand if you want to help people with a distance from the labour market, as in many cases that distance is literal. People are living far away from urban centres with



employment opportunities and cannot afford to pay to go to a potentially unsuccessful job interview. In some cases, there may not even be good public transportation connections. Would it then not be an option to integrate some sort of Mobility-as-a-Service initiative in contract demands? This could be especially relevant when tendering out reserved contracts for social enterprises that employ a minimum amount of people with disabilities, knowing that the organisation of ‘traditional’ transport systems, favouring private cars, is not in favour of people with disabilities.

More inspiration could come from Budapest, where a tender for cleaning services aimed to address the discrimination of Roma on the labour market, by including employment opportunities of Roma people in the award criteria. Increasingly innovative digital technologies using complex algorithms are seen as a potential solution to unsustainable and ineffective transport systems. Unfortunately, due to a lack of diversity in the tech industry, there have been many examples (not only in the transportation sector) where these algorithm-based technologies have not been programmed to optimally function for non-white people. Adding employment diversity criteria when procuring such technologies would not only lead to more job opportunities for people with a distance from the labour market, but also to a more inclusive public space and less embarrassment for transportation planners.

Further reading

What is socially responsible public procurement about?

Watch these videos to learn more:

#WeBuySocialEU – Case from Vendée, France:

<https://www.youtube.com/watch?v=Sri4Hdd6-cQ>

#WeBuySocialEU – Case from the Czech Republic:

https://www.youtube.com/watch?v=vGRvf_J3fJ4&t

#WeBuySocialEU – Case from the City of Toledo, Spain:

<https://www.youtube.com/watch?v=Nx6XVjkabZg&t>

New Age Fleets:

Digitization and optimization of rental fleets

Fleet management is a constantly evolving industry, and it can be challenging to keep pace. COVID-19 and the subsequent global lockdown brought to the forefront the biggest challenge facing rental fleet managers today: namely, a lack of digitization.

**BY KRISHNAN SANGAMESWARAN, PRODUCT MANAGEMENT, RIDECELL
AND ROSMAN SIDHIK, DIRECTOR OF ENGINEERING, RIDECELL**

IN AN ERA NOW defined by a preference for less human contact and quicker, more digital, and highly personalized experiences, fleet managers need technology solutions that help them meet their customer's needs.

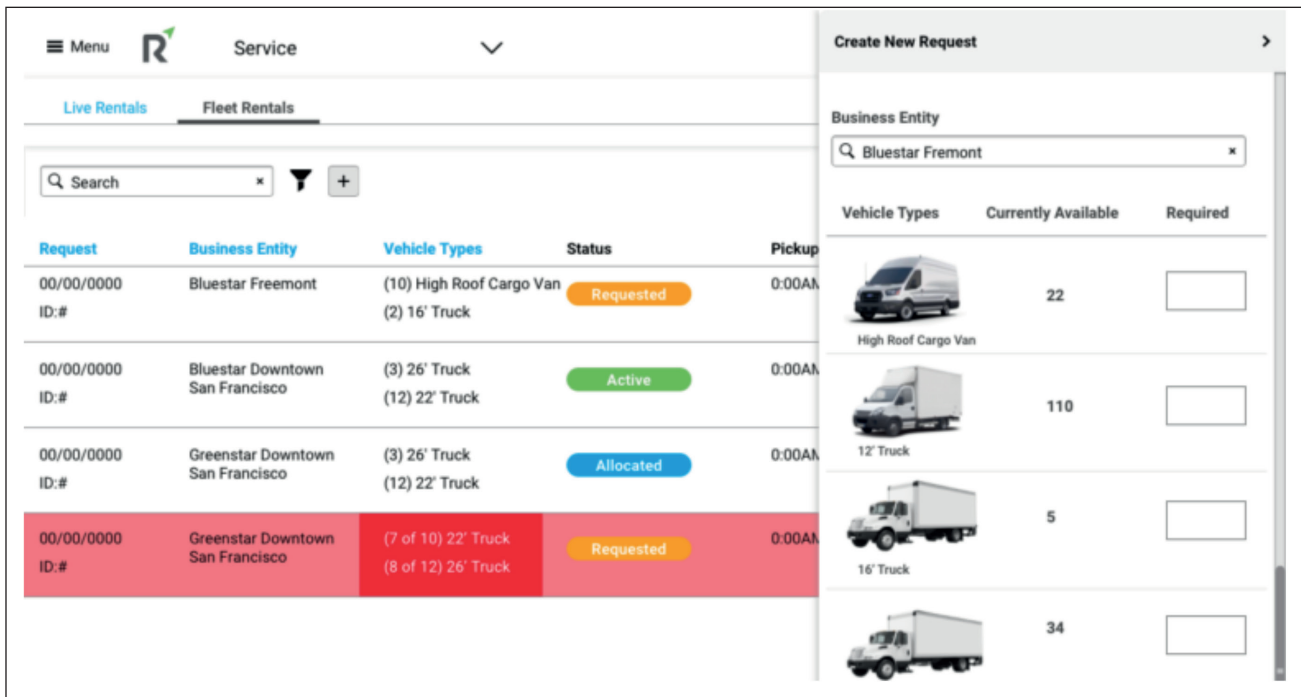
Typically, the vehicle rental process, everything from the reservation experience and vehicle assignment, to vehicle pick-up and return, to vehicle security, safety, and maintenance, has proven time-consuming and inefficient for today's fleet managers' needs.

- Reservation requests, for example, are still mostly conveyed over the phone. The associates at the location make sure they have a vehicle to assign to the request nearer to the date. On the day of the reservation, they run a yard check and assign a specific vehicle to the reservation.
- For vehicle pick-up, the driver shows up at the front desk and provides his/her driver's license. The associate runs a background check to ensure the license belongs to the person in its possession. Once cleared, he walks the driver around the vehicle as part of the inspection check and has him sign the inspection report and the rental agreement.
- Finally, in terms of asset security, once the vehicle is driven out of the hub, there is no insight into who is driving the vehicle and where it is.

Challenges with the current process include:

- Limited working hours – a manual process of assignment means that associates need to be present at all times, and vehicles can be rented only during regular working hours from 9am – 7pm.
- Time-consuming inventory management – associates spend a good part of their time marking vehicles that have arrived, checking the odometer and fuel levels to close the previous and prep for the new reservation
- Physical interaction between the driver and associate
- Long wait times for drivers at pick up locations





- Inability to disable access and secure the vehicle if it's stolen

The Ridecell Fleet Rental solution was designed to maximize operational efficiency. It allows for unmanned check-out and check-in for vehicles, reduces efforts for fleet associates in managing inventory, and allows hubs to rent vehicles 24/7. It gives drivers a seamless, touchless, and automated process for renting and accessing vehicles while significantly increasing the security of vehicle fleets. Read on to find out more about how the Ridecell Fleet Rental solution addresses today's fleet managers' most pressing needs.

The Ridecell Fleet Rental solution

1. Reservation and Inventory management

Ridecell's solution can support multi-vehicle and multi-day requests for business accounts per reservation. These reservations can be made via a web interface (op-center) deployed at the rental fleet company's hubs or via a web interface designed for the customers (businesses) of the rental fleet company.

Additionally, once the reservation is put into the system, Ridecell supports the auto-allocation of available vehicles at the hub to the reservation. Using vehicle telematics, we capture key data points that go into the rental flow, such as odometer reading and fuel levels. With the ability to edit vehicle allocation, the associate on the ground can always

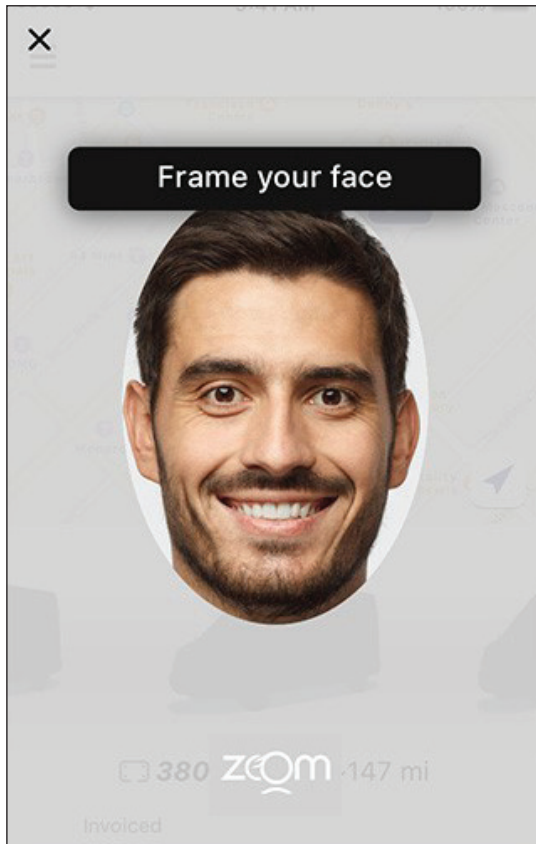
switch the vehicle based on, e.g., the fuel level. The Ridecell solution also provides maintenance states in which the vehicles aren't available for allocation to a reservation. The Ridecell Fleet Rental solution delivers full automation once the vehicles have been readied and made available for rentals.

2. Touchless Driver pick-up

The reservations can be started either manually or can be automated to start at the scheduled time. Once the reservation is in the active state, the vehicle/vehicles associated with the reservation are visible to the driver/drivers who have been registered by the business account. See below.

Upon initiating the check-out process, the driver is prompted to take a selfie. This is the ID authentication stage where we will validate that the driver is who he claimed s/he is. Also, we provide the ability to run extensive background checks on the driver ranging from Motor Vehicle Records (MVR) to an FBI watchlist check.

Once the background check has passed successfully, the driver is asked to do an Inspection check. The driver takes a mandatory set of photos of all sides of the vehicle and tags any damages. These images are then compared with another set of images taken by the driver at the time of vehicle drop-off (check-in), allowing the rental fleet manager to hold the customer responsible for any damages caused.



Once the inspection report is submitted, the driver is presented with the rental agreement to accept. The driver is then able to unlock the vehicle via the app and drive away. Similarly, the drop off (check-in) of the vehicle at the hub is also enabled from within the driver's app.

3. Multiple Access options

We offer our customer's business accounts the option of App-based, NFC cards, or Original Keys as their preferred method to operate the rented fleet of vehicles. These preferences are captured at the time of reservation. The advantages of using Apps or NFC cards over physical keys are twofold:

- Ability to easily manage lost or stolen keys with reduced cost
- Ability to track trips on a per driver basis
Many businesses will need time to move to a purely digital interaction, and for them, we continue to support a physical key workflow.

4. Asset security and management

Asset security is a key part of fleet management. The telematics in the vehicle allows the vehicle to be immobilized remotely from the Ridecell operation center.

Additionally, key pieces of data including, odometer readings, fuel levels, and a small subset of all vehicle data that we capture, are recorded at regular intervals and readily available in the operation center (web interface) deployed at Ridecell's customer's hubs. This means that there isn't a requirement for associates to walk up to returned vehicles for this information, which is how it's done today.

Ridecell also offers a separate fleet product focused entirely on making all this data that we capture actionable.

Digital transformation is critical for fleet managers looking to compete in a world defined by shifting customer demand and a desire for more seamless, tech-enabled experiences. Ridecell works with our fleet partners to ensure they can maintain the highest levels of security, safety, and efficiency to help maximize their fleet operations and ultimately drive profitability. Contact us today to learn more about how we can help automate your fleet management.





HARNESS ONE PLATFORM WITH ALL THE POWER

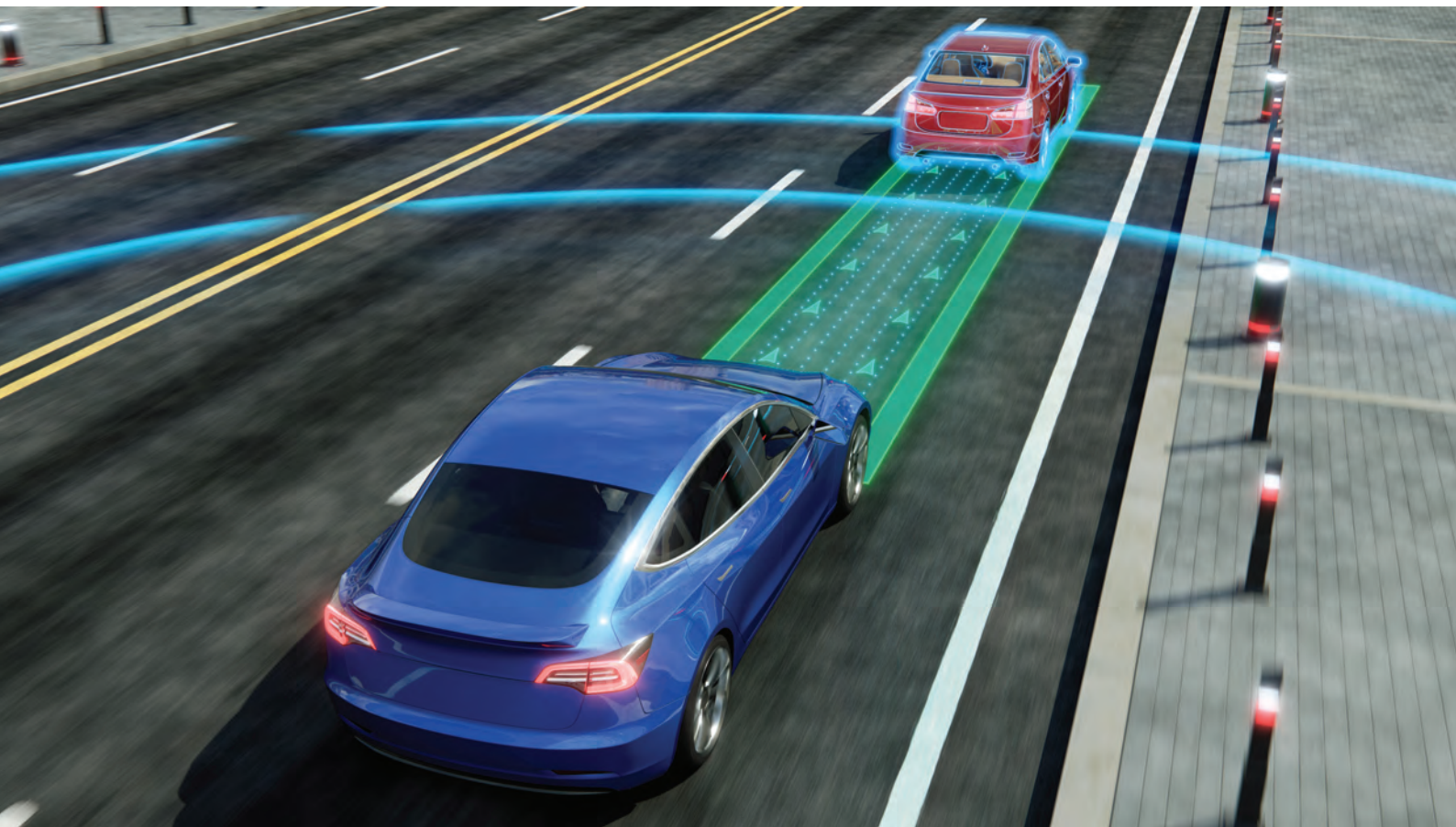
Platform Equinix® enables you to bring together all the right places, partners and possibilities you need to fast-track your digital advantage

The automotive industry is being disrupted by connected car technologies and seismic changes to existing business models, which require new digital strategies and IT architectures.

Digital and connected services are driving new industry revenue growth, whilst consumer preference is being shaped by innovative digital and connected features as well as greater appetite for energy efficient, green and autonomous vehicles. These require not only that companies harness emerging technologies whilst fundamentally changing their mindset but also highlights the need to re-architect IT on a single global platform to enable more effective, real-time interactions, greater data privacy, and collaboration with supply chain partners, business ecosystems and customers.

Equinix is the world's digital infrastructure company, enabling digital leaders to harness a trusted platform to bring together and interconnect the foundational infrastructure that powers their success. Equinix enables today's businesses to access all the right places, partners and possibilities they need to accelerate advantage. With Equinix, they can scale with agility, speed the launch of digital services, deliver world-class experiences and multiply their value.

**See us online at the TaaS Technology Conference,
10-11 November 2020**



Data Management:

The march towards connected, autonomous and electric vehicles

There are many predictions about connected and autonomous vehicles, some of them suggesting that fully autonomous, levels 4 and 5 vehicles will begin to become commonplace on public roads from 2025.

BY GRAHAM JARVIS – FREELANCE BUSINESS AND TECHNOLOGY JOURNALIST

A STUDY by Vynz Research says the global connected and autonomous vehicle market size was 17.7 million units in 2019; and it predicts that this will reach 51.2 million units by 2025 – a compound growth rate of 17.1% during the period of 2020 to 2025.

At present, most vehicles aren't fully autonomous, yet still increasingly rely upon data to operate.

Growing data volumes

With their emergence will be a growth in data. Rich Miller writes in his article for Data Center Frontier, 'Rolling Zettabytes: Quantifying the Data Impact of Connected Cars': "The Automotive Edge Computing Consortium (AECC) is working to help stakeholders understand the infrastructure requirements for connected cars. At Edge Computing World, AECC board member, Vish Nandall, outlined

the group's findings on the volume of data created by autonomous cars and the challenges they will create." Vish Nandlall, VP at Dell Technologies and board member of the Automotive Edge Computing Consortium, said in his talk, 'Driving the Zettabyte Edge' at Edge Computing World in December 2019: "Automotive data volume will drive the edge and we're going to hit zettascale volumes." before adding: "We're really starting to challenge the limits of the cloud technologies we've been using. It's a challenge to the infrastructure and cloud communities, and a challenge to the automotive community."

The AECC also said that "data traffic from autonomous vehicles could surpass 10 exabytes per month by 2025 – about 1,000 times the present volume." Such are the amounts of data involved with the future of connected and autonomous vehicles that Nandlall believes vehicle manufacturers will have to become hyperscale computing companies with a single vendor operating at a zettascale. In other words, they will become landlords of amounts of data real estate.

CAVs and data

Data will need to be analysed and, to some extent, stored within connected and autonomous vehicles – particular when 5G coverage is poor. Data will have to be transmitted to and from the vehicles, too. This

data will need to be offloaded and transmitted to data centres for backing up and storage, as well as to enable big data analysis.

While much of the data relating to driving will be carried out at the edge, close to the sensor on each vehicle, there will be a need to store it somewhere other than only in the vehicle. This is to allow historical data to be stored efficiently, which will be as crucial to autonomous vehicles as any other kind of data – including for insurance and vehicle maintenance purposes. Autonomous vehicles will also need to connect with everything in the world around, including road infrastructure and other vehicles. These vehicles will need to use artificial intelligence and machine learning to obey road rules, respond to traffic signals and learn from common and uncommon (unexpected) situations to avoid accidents.

Streaming media

On top of the driving and vehicle data, there will be more data to and from the vehicles for media, entertainment and for big data analysis. This data analysis will be needed to enable machine learning, allow the vehicle to adapt to new situations; Permit software developers and engineers to provide patches and upgrades and for manufacturers and their ecosystem partners to improve their vehicle's overall performance.

With the steering wheel being handed over the vehicle itself, with no human driver, there will be time for its passengers to enjoy music and streaming services, play games or shop while on the go. Big data will therefore be used to analyse their behavioural patterns and to make suggestions based on their preferences, location, browsing and shopping habits.

Addressing data ownership

With the data there will come legal challenges, which means there will need to be an eye on regulatory compliance, too. Dr. Stephan Appt, LL.M. Partner, Head of German TMT at Pinsent Masons, writes in his article 'Legal challenges of data-driven mobility': "Data is central to the way new connected, autonomous and electric vehicles operate. This requires automotive businesses to address issues such as data ownership, data access and data sharing, as well as the protection of





personal data, at the outset of vehicle development.” “Sound data governance, beginning at the earliest stage of development, can help original equipment manufacturers (OEM) and their suppliers address the legal challenges that arise around data privacy and security, as well as broader data-related issues of availability, accessibility, consistency, integrity and efficient data and risk management.”

Appt adds that data trusts have the potential to improve data sharing within the automotive sector, despite the fact that stiffer data protection regulations are anticipated. He thinks that automotive manufacturers should explore such options as data trusts and believes they should understand how the regulation of data within the sector is likely to evolve.

SD-WANs and WAN Acceleration

With data growth, and with it the need to improve data management – including to prevent cyber-attacks from causing significant operational and financial damage to organisations – SD-WANs have become a popular choice. David Trossell, CEO and CTO of Bridgeworks says they are a great technology, but with them latency and packet loss can still dog them. Increasing bandwidth won't resolve latency and packet loss issues, either.

To boost the data transfer, egress and ingress capabilities of SD-WANs, he argues that they can benefit from having a WAN Acceleration overlay, and while the chosen connectivity for connected and autonomous vehicles is likely to be 5G, the data will at some point go over a wide area network. Trossell therefore provides his top 5 tips for best practice data management, relating to connected and autonomous vehicles – particularly relating to the transport, storage, regulatory compliance, and data analysis over WANs:

- With the projected data volumes, data as it is collected at the edge will have to undergo immediate prioritisation to separate the data that requires immediate response from that of non-urgent auxiliary data.
- Holding data at the edge for longer than required could overload the edge storage capacity. The quicker this can be dispatched to the central Data Ocean the better.
- Moving this data over large distance will affect data throughput unless tools are used to mitigate Latency and Packet Loss.
- With Global car manufacturing and the European GDPR philosophy of data protection beginning to roll out across other countries, there will be a need to encrypt this data whilst in flight and storage – traditional data deduplication products will struggle to move this type of data over distances.

- With all the differing types of data being created some will have a short life cycle, whilst other data type such as GDPR data will require storage for possibly a number of years and has to be backed up for regulatory requirements.

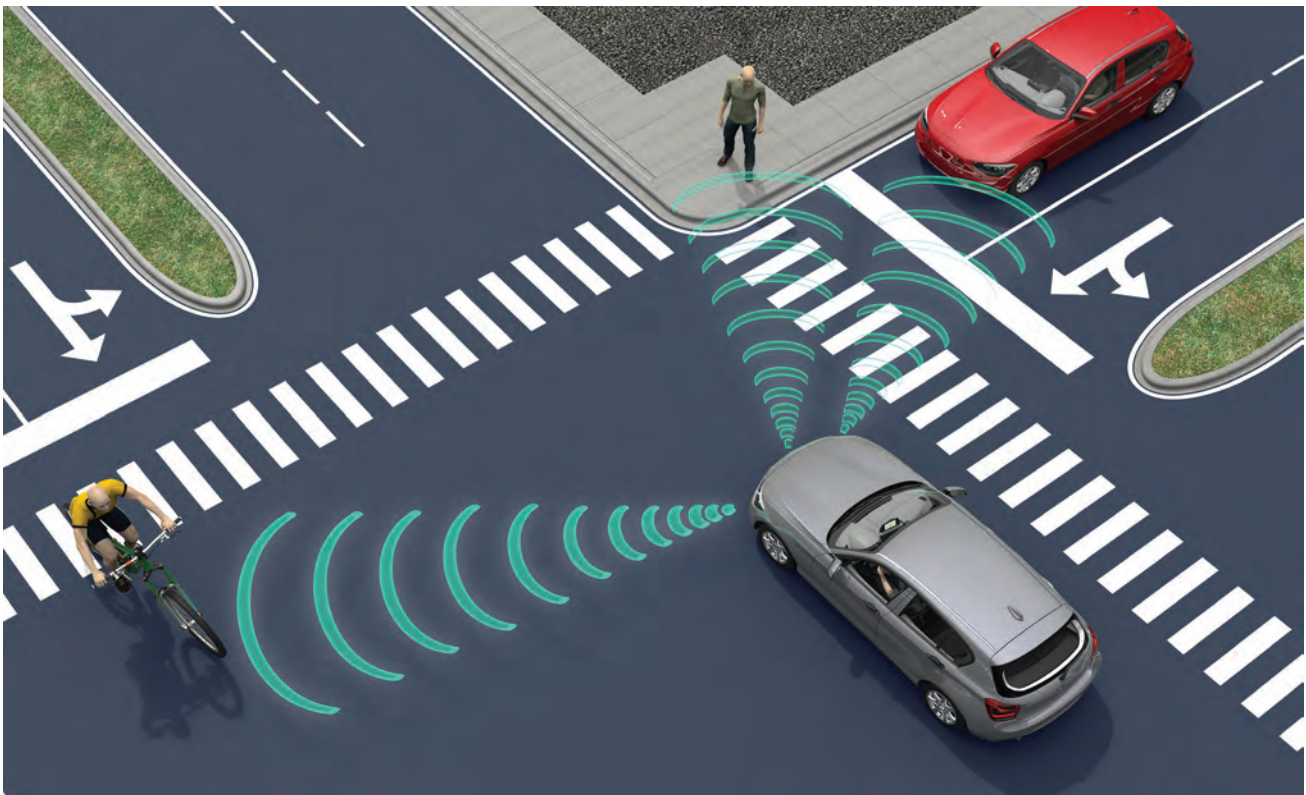
The data management challenges are never-ending, and they will continue with the end of the Brexit transition period at the end of 2020. No matter what your views are on Britain leaving the European Union, connected and autonomous vehicle manufacturers (as well as their ecosystem partners) will be keeping a close eye on any legislative and regulatory changes that occur in the U.K. Evolving data models

The same applies to elsewhere in the world, including in the EU, because data protection has to evolve with new situations and with new technologies. This includes the development of new insurance business models. At present, when someone drives a car and is involved in an accident that they caused, they are liable. Without a human driver, this will change and may involve OEMs being held accountable for the failure of a connected and autonomous vehicle to avoid an accident. So, data will be at the heart of how they operate, and at the core of how new insurance policies are developed.

With the prospect of electric cars being pushed forward a decade by the UK government, with a ban being introduced on new petrol and diesel engine vehicles in 2030, there are also calls for new ways of charging vehicle owners tax. At present, tax is charged on petrol and diesel sales, but once petrol and diesel cars are taken off the road, there will be a need for a new model. This could involve implementing systems into the cars to permit charging owners on a per mile travelled basis. Data will again play a key role to determine how much people will need to pay for their journeys.

However, the need to ensure that the Treasury's coffers remain healthy, has to be balanced with the ambition to encourage more people to buy electric vehicles. As autonomous vehicles are also likely to be electrified, despite the demands that their automated systems create. As many people are still wary of the idea of being driven by a computer, the Government, as well as industry, will need to be careful how they implement new pricing models.

They will need to be enticing and not punitive. However connected and autonomous vehicles develop, good data management, data security and data protection will also be imperative. Without which, consumers might not jump aboard.





The most affordable LiDAR for medium-and-high-speed autonomous driving: **Robosense 80 Laser-Beam LiDAR**

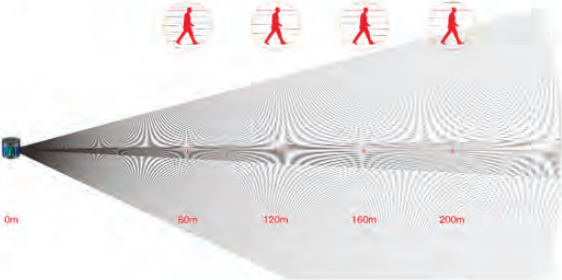
RoboSense, the leading provider of smart LiDAR sensor, has launched an 80 laser-beam 3D sensing LiDAR ready for customer delivery with price of \$15,800.

THE PERFORMANCE of the RS-Ruby Lite is close to that of the 128 laser-beam LiDAR RS-Ruby, with a vertical angular resolution of 0.1 degrees and 160m@10% ranging ability (with the longest detection range of 230 meters), making it suitable to address medium-and-high-speed autonomous driving applications with a price much more affordable to accelerate the commercialization of smart and safe transportation.

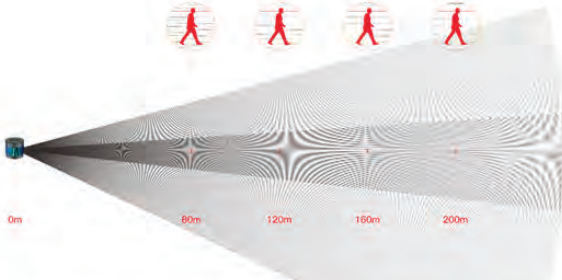
Laser-Beam LiDAR RS-Ruby

The RS-Ruby Lite has inherited the superb performance from the 128 laser beams LiDAR RS-Ruby, whereas, it collects reduced amounts of but essential data of the environment and has lower requirements on the bandwidth (to 75%), perfectly fulfills environment sensing requirements of self-driving passenger cars, driverless mining cars, driverless trucks, vehicle-to-infrastructure, etc.

	RS-Ruby Lite	RS-Ruby
Of Lines	80	128
Range	230m (160m@10%)	250m (200m@10%)
Range Accuracy (Typical)	Up to ±5cm	Up to ±3cm
Vertical Angular Resolution	Up to 0.1°	Up to 0.1
FOV	40° x 360°	40° x 360°
Points Per Second	1,440,000pts/s (Single return Mode) 2,880,000pts/s (Dual return Mode)	2,304,000pts/s (Single return Mode) 4,608,000pts/s (Dual return Mode)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C



0.1° , 40-channel lasers scanning on +1.01°~-2.99°



0.1° , 102-channel lasers scanning on +3.81°~-6.39°

0.1° vertical angular resolution

To date, 0.1° vertical angular resolution is the highest standard among all mechanical LiDARs available on the global market. The 80 laser-beam LiDAR RS-Ruby Lite also boasts an ultra-high angular resolution of 0.1° with 40 laser beams scanning the front area of the car.

160m measurement range @10% Reflectivity

The RS-Ruby Lite can detect objects even in 230 meters away.

Reflection intensity reaches a perfect balance of consistency and distinction

Inheriting from the RS-Ruby’s advanced hardware and signal processing technology, the reflection intensity of RS-Ruby Lite reaches a perfect balance between consistency and distinction, further facilitating accurate road sign extraction and localization.

Anti-interference capability under multi-LiDAR jamming & various ambient lights

With special laser encryption technology to filter

interference signals, the RS-Ruby Lite addresses interference under multi-LiDAR jamming & various ambient lights.

Availability and pricing

Thanks to the proven technology platform of the 128 laser-beams LiDAR RS-Ruby and the modular design, the mass-production-ready RS-Ruby Lite is able to benefit from much lower material and process costs.

The sensor has undergone a large number of verification and reliability tests and is proved with outstanding stability and reliability. The product is also backed with sufficient production capacity.

High resolution and performance LiDAR sensor with affordable price is the key to move medium-and-high-speed autonomous driving projects from R&D towards commercial viability.

The RS-Ruby Lite is the most competitive and cost-effective high laser-beam LiDAR, making it ideal for medium-and-high-speed autonomous driving applications.

Accelerate automated driving

How teleoperation can be the accelerating factor for earlier deployment

Since the beginning of the autonomous vehicle hype in the past, a variety of challenges have emerged that need to be tackled first: safety, cost efficient business cases and coverage of new driving scenarios.

BY MICHAEL SCHUNKE, SENIOR CONSULTANT, MORITZ LEWANDROWSKI, TRANSPORTATION EXPERT AND ANNIKA FÄHNLE, ENTREPRENEUR IN RESIDENCE OF P3-GROUP

NOWADAYS the industry is busy finding use cases and workarounds that master these challenges. However, it has become clear that in the near future there will be no technical way to ensure the safety of an autonomous vehicle without a safety driver. Hence, leaders of the industry are starting to evaluate ways to overcome this issue. One of these ways may be teleoperation, i.e., remote control. Remote control services have initially been explored in 1955 and the pattern is still present in today's discussions about autonomous vehicles. As the autonomous driving industry is progressing, many experts think that remote control, or teleoperation services, might yet be the accelerating factor

towards full autonomy. While remote control is often understood as regular driving by a remote operator who simply doesn't sit in the vehicle but somewhere else, the meaning in the context of teleoperation services is different.

Teleoperation means the remote monitoring of an automated vehicle and assisting it if needed, instead of actively controlling and steering it.¹

This method of assistance from afar promises great accelerating potential for the industry. In combination with machine learning processes, teleoperation could become the missing ingredient to achieve wide-spread acceptance for autonomous vehicles and overcome the above-mentioned challenges.

Slowing factors of the industry

Before introducing the benefits of teleoperation for the industry, it is crucial to discuss its present challenges.

First, the most obvious challenges of autonomy are technical. For instance, the connectivity of mobile networks is a core issue for the entire automation endeavor of not only vehicles but also other machines such as IoT solutions. A consistent and gapless low-latency and redundant network connectivity is a key factor to enable automation and teleoperation. Current 4G and 5G networks are far from providing a nationwide coverage in most countries. Next to the issue with connectivity, the autonomous driving industry is facing other



technical challenges such as functional safety and cybersecurity.

A second challenge is the usability aspect

Usability is a typical problem of human-machine-interactions which manifests itself in the so-called human-machine-interface (HMI). To achieve acceptance by the human user, the HMI must be intuitive and ideally hides the technology's complexity from the user.

The third challenge is of regulatory nature

Concurrently, in most countries there exists legal framework that considers autonomous vehicles. This results mainly in restrictions as one has to rely on human-centered driving. However, there has been some progress. For instance, Germany introduced a framework to regulate automated driving in June 2017 which includes a total of 20 ethical rules. One rule states that protecting human lives always takes priority. If one takes an international perspective, it becomes clear that the lack of unity in national regulations is a major hurdle for the entire autonomous driving industry.

Regulators will have to make an effort to keep up with technological progress, in order to not slow down the innovation potential, otherwise autonomous vehicles might not be brought to the road. The existing traffic regulations of most countries cannot be applied driverless vehicles.

In addition to the challenges above, public acceptance is also a crucial factor for the future of automation technologies. That should not be underestimated. Without public acceptance and trust, technological development will suffer due to the lack of people's willingness to pay and operate with it (check out the P3 paper "Trust in Autonomy"). For that matter, for instance, Daimler acknowledges that "vehicle manufacturers are unable to answer all of the questions surrounding autonomous driving, including those involving ethical issues, themselves. These must be discussed as part of a wider debate"². This shows that the legal debate is closer to the public debate about autonomy than some might think.

Big players of the industry

Before discussing accelerating factors that teleoperation services could add to the topic, we want to introduce the leaders of the autonomous driving industry. While searching for information about autonomous vehicles, it is likely to come across the approaches of Waymo, Cruise and Argo AI.



Waymo's approach "Waymo One" is the first commercial service launched in Phoenix, Arizona last year. Waymo One can be used with every smartphone by downloading the Waymo app. The app includes e.g., booking service, live tracking of position or time-planning assistant for each inquiry made by customers.

Next in the line is "Argo AI", an alliance by Ford and Volkswagen with investments of 1 billion \$ (Ford) and 2.6 billion \$ (Volkswagen). The CEO of Argo AI, Bryan Salesky, estimates that in order to succeed, a self-driving car company must be allied with a major partner of the automotive industry.³

The third project to mention in this list is Cruise.

Acquired by General Motors in 2016, and currently valued around \$19 billion with investments of GM, Honda and a vision fund from SoftBank, Cruise's project "Origin" is supposed to hit the roads with a fleet of fully electric robotaxis.⁴

But what do all these approaches have in common?

The problems mentioned above show up when it comes to testing or even closer towards the rollout. Current news articles indicate that the companies are further away from a completely autonomous driving experience than it seems.

Reporters from "azcentral", a local Arizona newspaper, who followed one of Waymo's cars through the traffic in Phoenix, describe the vehicle's self-driving behavior as "clunky [and] cautious", especially when changing lanes or turning in traffic.⁵ And Waymo are not alone with their issues: Cruise for example has been reported to have similar



problems with their system when reacting to mass transit and humanly operated cars in traffic.⁶ On top of that we have to consider that all of these approaches are so far only tested and meant to operate in urban areas with a good infrastructure, but limitations in more complex areas seem obvious.

Can teleoperation be an accelerator?

As described above a lot of problems and difficulties are linked to the autonomous driving approach. At P3, we think that technology of teleoperation has enormous potential to be the accelerating factor to overcome these issues. As a result of a joint business development partnership with FERNRIDE (a TU Munich-spinoff, which offers a vehicle-agnostic end-to-end teleoperation solution), we worked out three core-factors that have the potential to accelerate the deployment of autonomous vehicles or hold chances for the industry.

Bridging the automation gap

Teleoperation serves as a bridging technology for self-driving vehicles as is it benefits the extension of the operating area. Take edge cases in traffic for example. We have to assume that the vehicle will operate as hesitantly as shown in the Waymo-case above if not worse. If the vehicle is equipped with a teleoperating technology, the car could request help from a remote operator and later continue its route. This brings up three essential parts of the bridging idea:

1. Extending the Operational Design Domain (ODD)
2. Build a fallback layer for problems that autonomous vehicles face in traffic
3. Help to improve public trust in the technology

Replacing the physical safety driver boosts the overall efficiency

The above-mentioned issues in mind, a physical safety driver is legally required to operate an

autonomous vehicle on public roads in many countries. This is a great cost driver regarding fleet operation and trainings. A safety driver can – of course – only drive one vehicle at a time. A teleoperator, on the other hand, can monitor and operate multiple vehicles simultaneously depending on the vehicle's level of automation. Already today, one operator can support 10 vehicles at once. Efficiency improves even more when offering Teleoperation as a Service. FERNRIDE is building a business around their teleoperation technology by offering it as a service and integrating driverless vehicles at their customers with a focus on the logistics industry. The idea is simple: Every customer can either upgrade their fleet by acquiring new trucks with teleoperation technology or retrofit their existing fleet with the help of FERNRIDE to make them teleoperatable.

Chances of machine learning

As the research success of machine learning is growing, it holds a lot of possibilities for Teleoperation. If machine learning makes its way into vehicles, teleoperation can be a big success factor, as illustrated in this example: A partly autonomous vehicle faces a situation it cannot handle on its own, sends out a request for help to a teleoperating service, the operator solves the incident by steering the car out of the situation and gives the control back to the vehicle itself. The benefit of machine learning in this kind of incidents can be enormous if the vehicle systems are able to “remember” the incident every time something similar appears on its future rides. This can be guaranteed by means of the help of a continuously improving learning algorithm. This benefit can be extended to overcome the problem of instable network connectivity as the vehicle can use its “memory” to solve a problem when there is no connection to the remote operators.

At P3, we are convinced that this technology will have a huge accelerating impact on the deployment of autonomous vehicles.

Exemplary use cases

When talking about teleoperation we should mention at least some of the obvious competitors like Phantom Auto (e.g., delivery robots) and Ottopia. There are various examples on the market that already use teleoperation services in our public environment. An unusual but very attractive example that could hit a lot of urban areas in the future are teleoperated scooters in some of Atlanta's suburban areas. This approach is built on the usability of E-Scooters by using the app “GoX Apollo”. With the help of the teleoperation startup Tortoise, customers

can order a scooter which is driven by a remote operator to a specific location.⁷

Another promising approach comes from BASF in collaboration with VDL and Götting. They designed an AGV to autonomously transport tank containers across the BASF production site in Ludwigshafen, Germany. This system will cut the duration of the transport from 22 hours to 1 hour. To accelerate full functionality of the AGV during the testing phase each vehicle was continuously monitored by a designated remote operator.

Our p3rspective

As the teleoperation industry is growing, we at P3 already established a partnership with the specialists from FERNRIDE. By offering their teleoperation technology as a service, FERNRIDE is entering the market by integrating end-to-end driverless processes into their customers' operations. Furthermore, this service offers innovative measures of cost saving and increased asset utilization as companies do not have to employ a physical driver at a specific location but rather profit from centrally pooled teleoperators across the world. Our vision combined with the expertise of FERNRIDE is, to replace physical drivers in specific and matching ODDs with teleoperation services.

Joint activities in logistics

While there are numerous use cases for teleoperation, FERNRIDE is focusing on the

logistics industry which is in dire need for driverless processes today due to cost pressures and driver shortages.

To establish a customer-oriented business development, P3 participates in a proof of concept, that focusses on the technical feasibility and efficiency potentials offered by FERNRIDE. This proof of concept takes place at one of the logistics sites of DB Schenker in Nuremberg, Germany. A teleoperator remotely steers a swap-body-truck from a control station in one of P3's offices in Cluj, Romania. The distance of about 1600 km between both locations is technically challenging, but feasible. The actual challenge is guaranteeing a lean and reliable process between the teleoperator and local employees as well as an efficient integration into up- and downstream processes.

Therefore, the goal of this project is to achieve full customer acceptance by providing proof of a safe and secure teleoperation. From a customer's perspective Sebastian Schuhmann, Head of Global Innovation Portfolio at DB Schenker, summarizes that teleoperation is crucial to understand the challenges of driverless use cases at an early stage and adapt all relevant processes and infrastructures to meet the respective requirements. As mentioned in the interview with Hendrik Kramer (CEO of FERNRIDE), the industry is further away from solutions that include complete autonomy than some autonomous mobility companies admit. It is confirmed that a





fully autonomous vehicle, able to handle a variety of possible situations without support, can only operate in a very restrictive ODD.

Even with the latest developments in machine- and deep-learning technology, it is almost impossible in order to cover every situation to operate in extended areas. Teleoperation makes it possible to extend the ODD to any area that provides a sufficient Wi-Fi or LTE mobile connection. As a ready to deploy support technology, it will also reduce the development cost for upcoming or existing fleet operators regarding autonomous vehicles and accelerate the time to market.

Together with FERNRIDE, P3 can be your

accelerator for the future of autonomous driving. Solutions to overcome network problems are available for most ODDs and Teleoperation as a Service is about to launch in the near future. Due to the simplicity of FERNRIDE 's system it can be installed in almost every vehicle. At P3 we are convinced that teleoperation is a cost-efficient and safe technology that can control both manual and automated vehicles – independent of situation and location. The possibility to take control over the vehicle via remote operators offers a big potential, not only for logistics processes, but also for testing and developing automated vehicles as it lifts the safety-standards. The application scenarios promise huge market potential, and we at P3 strive to realize its entrepreneurial advantages!

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