

Intelligent  
Transport

A YEAR IN  
REVIEW



# Smart scooters: How technology enhances shared micro-mobility

Technology has opened up the door for shared multimodal travel in our cities. *Maxim Romain*, Co-Founder and Chief Operating Officer at Dott, explains how technological connectivity is enhancing safety, driving efficiency and increasing accessibility to the company's green e-bikes and e-scooters.

**A**CROSS SOME of Europe's cities, a transformation is underway. Cycle lanes are appearing; new speed limits are being enforced in city centres; and car-free and low emission zones are being adopted. We welcome all initiatives which make it easier for people to choose shared micro-mobility as their main way to get around a city, and these progressive steps are, of course, a driving force for the increase in demand that we are seeing across Europe for our e-scooters and e-bikes.

But, whilst these measures may have the biggest visual impact, the adaptation of micro-mobility isn't entirely down to infrastructure. Technology plays a major part in keeping shared services safe for the riders, other road users and pedestrians.

## Using technology to enhance safety

Internet connectivity allows us to have a deep understanding of where our vehicles are located and how they are being used. We want to ensure that our e-scooters and e-bikes are operated in line with local regulations and restrictions, so they are all fitted with speed restrictions aligned to the requirements of city authorities.

This covers general speed limits, but can be more tailored than that, with specific 'go-slow' zones where there might be a high density of pedestrians and a slower speed is more suitable. An example of this is in Paris, where low speed zones have been created in pedestrian areas to limit e-scooter speed to 10 km/h. We can even create 'no-go' zones, where the vehicle is no longer powered in specific areas that it is not deemed safe to operate.



In close collaboration with city authorities, these speed measures can ensure that shared e-scooter and e-bike riders safely co-exist alongside pedestrians in compact locations.

In some cases, restrictions are more appropriate by time of day than location. For example, in Oslo, we have worked with the city authorities to ensure that our vehicles cannot be operated between the hours of 00:00 and 05:00, where the city had previously seen a higher number of accidents. Additionally, for new riders, we can set vehicles to operate at lower speeds during their initial journeys. This tool is particularly beneficial in markets which are new to e-scooters, where the population may not be familiar with the vehicle, and can help the user to become comfortable with moving around at a lower speed initially.

### Smart Parking technology

We firmly believe that, for our service to be a success, we must work closely with the city authorities to ensure that our vehicles provide an effective solution to as broad a range of people as possible, without being a nuisance to any other city resident. Our 'Smart Parking' technology was thus developed as a measure to combat parking in wrong locations undertaken by a number of users.

Tracking the location of our vehicles, Smart Parking ensures that a journey on an e-scooter or e-bike can only be ended in a designated parking zone. Dott initially used this technology in Paris, where we now see 98 per cent of our vehicles parked correctly. The feature is also now in place in London, among other European cities. To succeed, a proportion of parking spaces must be given over from cars to become e-scooter and e-bike parking, meaning that, instead of a single car occupying that space for a large portion of time, these bays can then host a variety of vehicles throughout the day, helping to free our cities from cars.

### In-app software educates and increases safe vehicle use

Dott also uses technology in the software of its app to ensure the safe use of its vehicles. In some cities, we are verifying driving licenses to prevent underage drivers. We have also built a series of e-learning modules, where new users must read a series of tips and guidance on the local regulations before being able to hire a shared vehicle.

Whilst these measures offer effective controls to encourage the safe use of our vehicles, we are continuing to explore new tools and initiatives to help us to improve. We are currently working closely with a data service called See Sense, which monitors the riding conditions of our e-scooters and collates the data to show areas that riders are more likely to swerve, break or encounter poor road conditions. This data can be shared with city authorities to help to make roads safer for all users. We are also exploring options for audible warnings when the scooter is in use to improve audibility, especially for visually impaired road users.

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### Connective technology allows multimodality

Beyond these safety uses, technology is the fundamental reason that shared services can operate. Connectivity has transformed whole industries, and now it is improving the way that we move around our cities. It allows us to know where our vehicles are located, so that we can move them if needed to where the demand is. We can monitor battery usage, and even predict maintenance based on patterns emerging over time, so that our engineers can work to prevent an issue, rather than waiting for it to happen.

This technology has unlocked the ability for businesses such as Dott to operate whole fleets of shared e-scooters and e-bikes and shift the perception that every individual should purchase their own vehicle. As we move towards multimodality, and offer a broader range of products, people can choose the type of transport that suits them best at any given time. This could be based on their journey, whether they have luggage, the weather or even their mood. As technology advances to help us to become even more efficient, the cost will be reduced for the user, so that they can benefit from the freedom, flexibility and convenience of a private vehicle, but with the affordability and accessibility of public transport.

Whether to enhance safety measures, or to provide an effective service, the technology embedded in both our hardware and software is fuelling our ambition to free our cities with clean rides for everyone. 

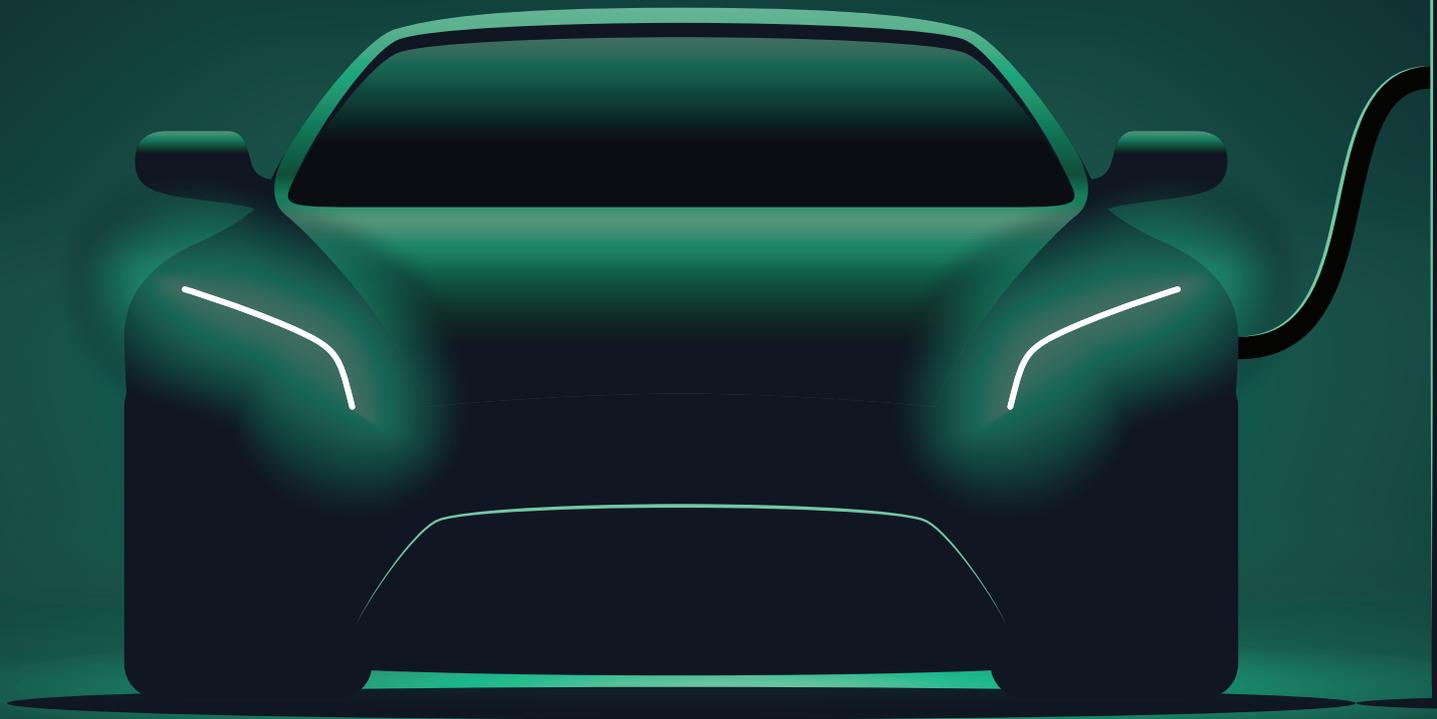


**MAXIM ROMAIN**

Romain is the Co-Founder and Chief Operating Officer at Dott. Romain is French and was previously Ofo's Head of EMEA, Wayfair Europe MD and previously worked for Decathlon Asia in operations and manufacturing. He holds a Master's degree in Engineering from Ecole Centrale Lille and MBA at Insead.

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# Electrification and the road to sustainability

Ride-hailing app Uber has pledged to make its operations more sustainable by committing to becoming a zero-emission mobility platform by 2030. In this article, *Uber* tells *Intelligent Transport* more about how it is working to support its drivers in making the switch to electric vehicles.



*In London, there are now more EVs on Uber than any other city in the world* ”

**A** YEAR ON FROM outlining our global sustainability commitment to become a zero-emission mobility platform across Europe and the U.S. by 2030<sup>1</sup>, London is leading the way in driving this progress.

## The shift to electric vehicles

Drivers are switching to electric vehicles (EVs) at a much faster rate than in the mass market, putting us on track to meet our ambitious commitment to be fully electric in the capital by 2025. In London, there are now more EVs on Uber than any other city in the world.

However, as we highlighted in Uber's 2020 SPARK! Report<sup>2</sup>, this sort of progress towards a fully electric platform is only achieved in cities where we enjoy constructive relationships with local governments who have prioritised a green recovery, such as the Mayor of London, Sadiq Khan. We want to work with cities to deliver a joint goal of a cleaner, more sustainable urban mobility system.

## Uber's Clean Air Plan

Making it as easy and as financially attractive as possible for drivers to transition to electric vehicles has



Uber has doubled the number of fully electric vehicles in London since the launch of Uber Green in March 2021.

been at the forefront of our efforts to date. Our Clean Air Plan, where we added a small fee to all trips in London, has been a critical part of our approach to helping drivers to save. Over £135 million has so far been saved for drivers in the capital and millions spent by thousands of drivers in switching to an electric vehicle.

This has meant that there are now over 4,000 EVs on Uber in London – almost 10 per cent of the total number of vehicles. This is an extraordinary rise from the 100 or so that were available in 2019. Together, these drivers are taking over 700,000 trips and driving over one million miles per month.

Drivers in London can use their Clean Air funds towards a selection of exclusive deals with companies such as Hyundai, Kia and Nissan to buy or lease an EV. We are also working with UK-based startup Arrival on the development of an EV built specifically for the ride-hailing market, with cars hitting the road by the end of 2023.

#### Improving EV charging infrastructure

We are also focused on improving charging infrastructure, which is one of the key concerns for drivers when assessing whether to switch to an EV. By working with cities to help to identify the key areas where charging is needed most, we believe that it can make a difference to the current charging infrastructure map. We are spending at least

£5 million by the end of 2023 in boroughs with the greatest need for new EV infrastructure, based on where our drivers live.

#### Uber Green

We have doubled the number of fully electric vehicles since the launch of Uber Green in March 2021, whereby riders can request a zero-emission ride option for the same price as a regular Uber, and drivers can earn more per trip. By creating this market dynamic, we are helping both riders and drivers to take greener trips.

So much so, that more than 90 per cent of all drivers who join Uber with a new vehicle are now opting for a fully electric car. This progress is significant, but we still have a long way to go.

#### Looking to the future

As we look ahead, we will double down on our efforts to provide drivers with further vehicle and charging options to accelerate the transition to EVs. We will accelerate towards our goals with clear action.

We can't do this alone, however. Success in the coming years will be defined by how we continue to work with all stakeholders – manufacturers, charging providers, NGOs and, crucially, cities and governments. Going green is a team effort, and we are proud of the role that we are playing to clean up urban mobility. 🌱



*As we look ahead, we will double down on our efforts to provide drivers with further vehicle and charging options to accelerate the transition to EVs* ”

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## ABOUT UBER

Founded in 2009 in San Francisco, California, Uber is a global Mobility-as-a-Service provider, with operations in over 900 metropolitan areas worldwide. It started as a simple idea: what if you could request a trip from your phone?

But what began as just a thought quickly grew into a global brand focused on helping to move people towards opportunity out in the world.

## A little less **conversation:**

# Why it's time to address **gender imbalance** in the transport industry

With the debate growing on the roles for women in leadership positions, *Tamara Eelsing*, Diversity and Inclusion Manager at STIB, the public transport operator in Brussels, Belgium explains how the Diversity and Inclusion Working Group she heads at UITP, is proud to be doing its part on challenging the gender imbalance in leadership.

**W**HY PLACE the focus on women in leadership? I am sure those of us working towards bringing a better gender balance to their own sector are familiar with this question.

For me, it is simple; the research and evidence available tell us what a gender-balanced management and staff brings to the workplace. Multiple studies have proven that gender-balanced boardrooms lead to better results, regardless of

the sector. A balance within leadership brings complementary visions and skills, which leads to better decision making, more creativity and innovation. Besides, women in leadership are great role models for women inside and outside their companies.

Many industries face the same daily struggles with bringing about gender equality. Public transport is no different. So why place a focus on women in leadership? I think the answer is quite clear.

### A transport workforce that reflects society

Every single day, all across the globe, public transport networks serve people from all walks of life. The workforce keeping our cities moving is made up of all different types of people, as are the passengers boarding transport services in those cities.

Half of our populations are women, yet public transport networks and services have traditionally been designed, operated, and maintained by men. If we can work towards bringing a better gender balance to our own workplace, we should absolutely do this.

As Diversity and Inclusion Manager for STIB, the public transport operator in Brussels, I work every day on attracting women to, and retaining women in, our organisation – and if they choose to leave STIB at a certain moment in their careers, then they do so as ambassadors.

I'm very proud to say that STIB has recently appointed a female Deputy Chief Executive Officer for the first time in our history. Tamara de Bruecker is a strong advocate for diversity and inclusion, and it is inspiring to see her take on this position within our company.

My position within STIB has brought me closer to the work of UITP and the commendable focus they have placed on diversity and inclusion for all, and in particular on gender equality with their Women in Leadership initiative.

I was proud to take on a new role for UITP as Chair of the Diversity and Inclusion Working Group where members from around the world bring their expertise, insight, and passion to the table as we consider what needs to be improved, and how best to implement those changes, in the discussion on gender equality and equal leadership within public transport.

There is a lot of work to be done to attract more women to jobs across the public transport sector in order to become more representative of our customer base and redress the imbalance we currently face.

By taking a closer look at the issue of gender, we can work together to best address what these challenges are, and how to bring about lasting change. No one is saying it is an easy task... but the tough questions are always worth asking! Action speaks louder than words and I am confident we can make our mark.

There are challenges ahead, for UITP, STIB and every other company in our sector... but that does not mean we should shy away from what is in front of us.

### Where do we stand and what needs to be done?

Currently, at a global level, less than 15 per cent of the workforce within public transport are women.

We live in a visual society and we see that our cities are made up of all different types of people – yet our sector still needs to reflect this better; our sector is behind the curve when it comes to representation between genders.

If women are not present in all levels of public transport, then it will not seem perfectly normal for them to reach the very top of the sector. My motto is "you cannot be, what you cannot see."

A woman bus driver is a leader and role model for boys and girls on their daily bus route. If children grow up seeing both male and female bus drivers, they will not question the relevance of the job for either gender.

A woman CEO is a leader and role model to all staff within her company. A woman at the highest level normalises for her entire staff the idea of a woman in a leadership position, especially if she is supported by a gender balanced board and/or top management team.

A woman board member of UITP is a leader and role model to all UITP members. It tells other women that there is a place for them in UITP and inspires them to be active.

Over the last few years, steps have been made to bring about gender equality within public transport, with new recruitment drives and focused campaigns, but as significant as these steps may be, more still needs to be done. We see that a lot of focus goes to attracting women to our sector, but we must not forget that we also need to make these women feel welcomed and psychologically safe in our sector. We need to make sure that women do not come in through the front door, but leave through the back door within a year or two.

As a member of UITP, it is exciting to see the progress made in some areas so far, but there is always more to be done. By bringing a focus to the role of women in the workplace, and their leadership potentials, this benefits all of us.

In order to attract and involve more women to a sector that clearly increases the quality of life by transforming our cities and societies, our women role models need to be more visible.

By promoting these leaders, we hope to attract more women and other diverse talent to the sector, ensuring that public transport in the future draws on a diverse range of skills to better serve the whole of society.

There is much to focus on, and much to achieve. I am proud to play my part in helping to move that progress forward. 📶



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**TAMARA EELSING**

Tamara Eelsing has been Diversity Manager at STIB since 1 January 2019 and previously worked at ING Belgium for 3.5 years as Diversity & Inclusion Manager and Consultant Leadership Development. Her mission is to help people and organisations on their journey to more Diversity and Inclusion.

# What does the future hold for connected transport?

*Giancomo Somma* and *Nikolaos Tsampieris* of ERTICO sat down with *Intelligent Transport's* Luke Antoniou to discuss the future of connected transport, and outline the exciting new technology emerging in the industry.

## **In order to improve transport network connectivity, where should transport authorities be focusing their investment?**

**GIACOMO SOMMA:** We have been living in the so-called information society for more than a decade now, with it affecting every aspect of our life. As we enter a new digital era where personal data, non-personal or industrial data, and public data (or mixed datasets) is creating a data-agile economy, smart mobility is key. It is in this area of our lives that this transformation will be evident and that we need to anticipate and manage change.

Public authorities at national, regional and urban level (each one with its own specific mission and role, and also all together in a coordinated way)

can play a central role, ranging from regulatory and policy actions, to mobility planning, and actual deployment of innovative solutions.

As an important enabler, connectivity plays a crucial role in improving mobility in terms of safety, emissions, social inclusion, and liveability. The ITS Directive (2010/40/EU) set the basis for the deployment of EU-wide federated, interoperable national access points (NAPs). The deployment of NAPs expanding and integrating connectivity capabilities and data sources to the comprehensive transport network (highways, national and urban roads) and mobility actors (public, commercial, private) is where public authorities can primarily plan their investment. This will entail the integration of cooperative intelligent transport systems and

**How important is it to maintain the balance between advancing digital and physical infrastructure?**

**NIKOLAOS TSAMPIERIS:** The advancement of road infrastructure in both its physical and digital manifestations will play a critical role in the deployment of autonomous vehicles (AV) and towards a fully-automated transport system in the future, where they will travel within intelligent, connected and automated road infrastructure.

Digital infrastructure, enabled by technologies such as artificial intelligence and the Internet of Things, and aided by wireless communications (vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-everything), positively affects safety, and accommodates the coexistence of conventional and automated vehicles during the transition period, allowing for the incremental introduction of full vehicle automation.

In addition, as the penetration of vehicles with higher automation levels (SAE) gradually increases, road infrastructure will also gradually change. Since the digital infrastructure involves the digital representation of the road environment, it follows that any adaptations in the digital domain should also be reflected on its physical counterpart – the physical infrastructure. The corresponding upgrades in the physical domain highlight this duality and the necessity for a balanced approach, which becomes even more significant in the case of the deployment of connected autonomous vehicles with higher levels of automation.

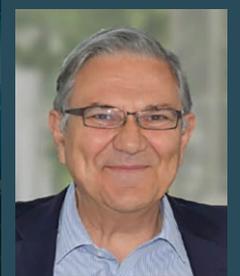
**What role does digital openness and open data have to play in developing digital infrastructure?**

**NIKOLAOS TSAMPIERIS:** Data, as it is continuously being generated, transmitted, stored and processed, permeates all different levels of the digital infrastructure, including the core infrastructure (connectivity), data infrastructure (data centres and cloud infrastructure), digital platforms, as well as digital devices and applications.

This all-pervasive data is core to new digital technologies, including advanced analytics, AI, virtual/augmented reality, machine learning, deep learning and blockchain. All of these have the potential to underpin the transformative change from the analogue world to a new digital reality in the transport sector.

As an increasingly critical resource, data is 'fuelling' CAVs, which are prime examples associated with the production of big data for the transport sector. Turned into open data, this could bring multitudinous benefits for transport authorities and cities. Effectively utilising readily ▶▶

**“ IoT is forming the core of a rapidly growing digital economy ”**



**NIKOLAOS TSAMPIERIS**

Nikolaos Tsampieris holds a MEng in Electronics & Computer Engineering, an MSc in Digital Communication Systems and a PhD in Digital Signal Processing Techniques for Communication Systems. Nikolaos has over 20 years of experience in digital signal processing for communication systems, wireless sensor networks (WSN), IoT, embedded security systems, cryptography and 5G. Prior to his engagement at ERTICO, he was leading the INLECOM IoT and security division and was the project manager for SELIS, a flagship EU programme in transport and logistics.

services with interactive traffic management, and the realisation of a truly multimodal transport system – encompassing road, rail, water and air transport – for people and goods.

Such investment will create the technology backbone to enable a new, user-centric mobility paradigm that is service-based rather than ownership-based, which will also involve autonomous vehicles. On the level of interconnectivity and interdependence, national networks can no longer be conceived independently from each other in a fragmented way. The EU dimension is critical to achieving societal sustainable development goals and ensuring harmonisation and synchronisation at European level in terms of mobility systems, with a focus on services' interoperability and continuity. This will allow additional applications in cities that tailor to local needs and policies.



Cloud infrastructure will be crucial in ensuring effective data sharing between organisations

available open data can further promote the seamless integration of all transport modes, subsequently increasing the capacity, enhancing the quality, and potentially improving the environmental footprint of transport.

Despite the potential to overcome the barriers between different transport modes, leading towards a homogenised customer-orientated approach, a lack of data openness and trust in data sharing acts as a stumbling block to the full realisation of the gains of digital transformation.

Accessible and re-usable data will permit the optimum utilisation of the wider digital infrastructure. Taking into account the relevant privacy and cyber-security aspects, the need to strengthen and further develop security and privacy mechanisms is of prime importance. This in turn will allow the provision of a wide range of enhanced security and privacy services requiring no third parties, thus resulting in safer and more agile digital infrastructures overall.

### **To what degree do data-driven insights collected by sensor technologies (and similar) affect the decisions authorities must make about developing their physical infrastructure?**

**GIACOMO SOMMA:** ITS solutions support a wide range of applications, including:

- Advanced driver assistance systems (ADAS) and related services
- E-tachograph
- Satellite-based navigation and location services, enabling the sharing of real-time (RTTI) and safety-related (SRTI) traffic information, and up-to-date maps based on common standards
- Traffic apps such as smart traffic lights 'talking' to road users; real-time information panels making travel time more predictable for public transport users and informing drivers about road and traffic conditions, estimated time of arrival

enabling more integrated, multimodal transport for people and goods, including travel/resting time planning and real-time slot booking at hubs

- New public/shared mobility services.

All of these solutions are based on sensor and/or communication technologies. In this setting, public authorities should look at the physical and digital infrastructure as two manifestations of one integrated ecosystem, in which different technologies and actors need to come together.

The main challenge will be the creation of mobility data spaces (e.g. cloud, edge, fog computing and storage). This will enable both businesses and governments to reap the benefits of sharing public non-personal data, and take advantage of data portability and re-use, ensure data accuracy enhancement, real-time accessibility, reliability, liability, definition and service level agreements execution in line with FAIR (findable, accessible, interoperable, reusable) principles and GDPR.

All in all, IoT is forming the core of a rapidly growing digital economy. A unique common architecture will allow for the management of big data sets and create a data marketplace for smart mobility services in an integrated smart cities context. Evolving towards an integrated and interrelated mobility system known as the Internet of Mobility, this requires a firm basis of understanding and agreement among both data users and data providers.

The digitalisation of mobility infrastructure will need to take into account safety and cyber-security, and translate physical attributes to digital sensors and in-vehicle receivers so that both 'legacy' and autonomous vehicles can make optimal use of the physical and digital infrastructures needed for smart mobility. The potential to implement and operate cross-border mobility systems and services across multi-vendor platforms in Europe will depend on harmonisation and interoperability at system, application and service levels.

### At the points where the physical and digital overlap, such as V2X technology, how important is it that critical communications are developed to support the constant flow of information?

**NIKOLAOS TSAMPIERIS:** V2X connectivity allows vehicles to access services through a wireless connection and uses a number of different wireless modes to communicate with other vehicles (V2V), the road network infrastructure (V2I), the cloud (V2C) and the network (V2N).

V2X, a critical technology at the intersection of the physical and digital infrastructure domains, is a key enabler for the deployment of highly-

and fully-automated vehicles and it is expected to achieve substantial penetration within the next decade. Through 5G (and in combination with standards such as ITS-G5 and C-V2X) it will be able to offer ubiquitous connectivity in most instances, and guarantee the timely, reliable, seamless exchange of V2X messages, allowing connected vehicles to constantly sense and interact with the environment for enhanced road safety, reduced congestion and environmental impacts and improved traffic flow.

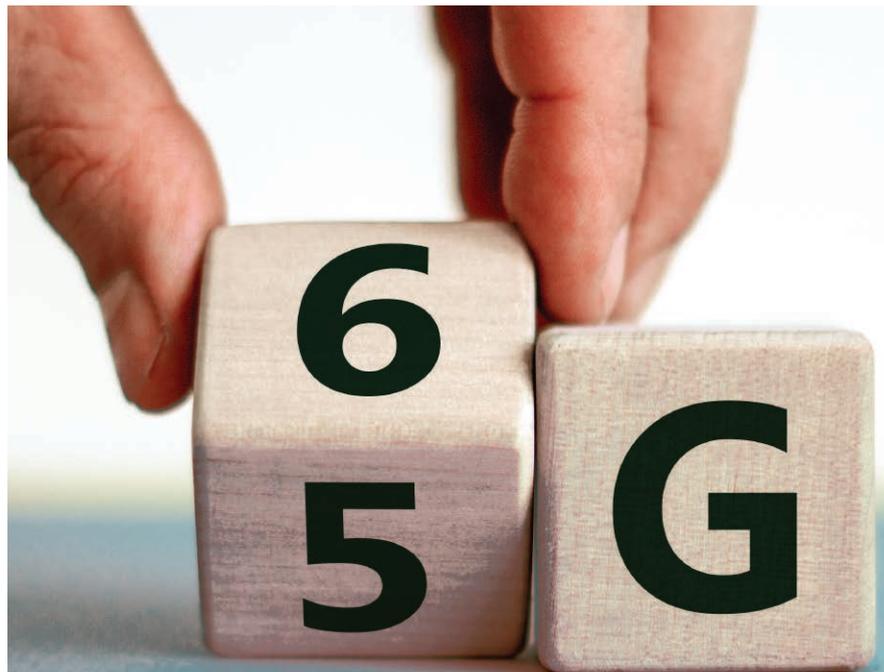
5G is expected to meet the ever-increasing need for secure, robust, uninterrupted communications and ubiquitous connectivity to a certain extent when fully deployed. However, fast emerging, ultra-demanding, real-time paradigms – such as autonomous vehicles, with the massive amounts of generated data associated with them – will require the next step that can take us beyond 5G (B5G) and towards 6G technologies and future communication systems.

The integration of computing (cloud, edge and fog) along with the use of new frequencies (for more efficient spectrum utilisation), new computational algorithms, novel multiplexing methods, new enhanced security mechanisms, anti-jamming techniques and the combination of assets and communication modes – such as in the satellite/UAV-assisted V2X – will enable the communications of the future. These low-latency, highly-reliable, 6G-powered V2X communication networks will ensure the constant and accurate data transmission necessary for safety-critical applications in fully connected and automated vehicles. 📶



**GIACOMO SOMMA**

Giacomo holds a Master of Science in Civil Engineering at the University of Catania, Italy, and a Ph.D. in Agricultural Engineering at the University "Federico II" of Naples, Italy. Giacomo joined ERTICO in June 2014 and his expertise lies within bid and project management of EU-funded projects, as well as the development and management of new activities and platforms at ERTICO corporate level. Before joining ERTICO, Giacomo worked as a researcher at the European Commission at the JRC, the Italian National Research Council and the University "Federico II", and as a senior R&D&I consultant and project manager in France and Italy.



Though 5G isn't yet widely available on our mobile phones, the transport industry is already looking to 6G as a tool to better connect vehicles



# Integration is essential to the post-COVID-19 recovery of local public transport

**Alistair Gordon**, CEO of Keolis UK, outlines the progress that the transport operator has made in transitioning to sustainable fuel alternatives, and outlines how the bus sector can improve connectivity for passengers after the pandemic.



**ALISTAIR GORDON**

Gordon is CEO of Keolis UK.

**C**OVID-19 has placed immense pressure on our public transport systems. Even as we emerge on the other side of multiple lockdowns and months of restrictions, the way that we use our trams, trains and buses is unlikely to ever return to normal.

Changes brought about by the pandemic - such as the shift to home working - look set to stay, at least in some form, prompting a permanent shift in our travel patterns and commuting habits.

For the public transport sector to recover and return to a state of growth, there will need to be

some new thinking to reflect the 'new normal' of travel. But the key to this new thinking must be centred on creating truly integrated transport networks by utilising a variety of modes.

Now, more than ever, we need to think about the opportunities for using bus networks to form a more integral part of the transport mix. In our post-COVID-19 recovering cities, we need to find efficiencies for buses - particularly where they are forced to compete with other local services, such as trains and trams, leaving passengers with disjointed services and fragmented journeys. With central

and local government finances stretched, some common sense needs to be brought into play.

### Balancing passenger needs and sustainability

As well as being bad for passengers, this approach is ultimately bad for the environment, too. Poor route planning is at odds with sustainable mobility practices, resulting in greater congestion, idling and fuel usage for the many diesel buses that are still in operation.

For local authorities, faced with the twin challenges of promoting sustainability and satisfying demand for effective public transport networks, placing buses at the heart of their strategies could be the key to success. Already, the likes of Andy Burnham, Greater Manchester's elected Mayor, have taken the first steps to addressing this, with his announcement that the region's bus services will be re-regulated. Passengers will benefit from 'joined-up' timetables across buses and trams, and more straightforward ticketing and fare structures, as part of the mayor's strategy. It is not difficult to see the efficacy of this approach when, with London, we have a world-leading public transport city setting the global standard.

Embracing opportunities to re-think bus networks, ensuring that they satisfy first- and last-mile customer journeys, along with capitalising on advances in alternative fuel technologies (electric and hydrogen vehicles), will help our urban centres to adapt to new passenger expectations of post-COVID-19 public transport that is both efficient and sustainable.

### Electric dreams

Our experience at Keolis clearly demonstrates the benefits of this double-pronged approach to enhancing both mobility and sustainability. A first key step for local public transport authorities (PTAs) is to make the transition from diesel buses, which are still the most common fuel type on UK roads, to eco-friendly fleets.

We recently helped to introduce Europe's largest electric bus fleet in the Netherlands – a 246-strong fleet to serve the provinces of Gelderland and Overijssel. A bespoke e-bus network was designed specifically to meet the needs of the local population, with 120 new lines and 50 stations connecting more than 180 villages and four cities.

By replacing the existing diesel fleet, the PTA is forecast to slash emissions by 15,755 tonnes of CO<sub>2</sub>, 5.31 tonnes of nitrogen and 133 kilos of fine particulates every year. Noise pollution is also significantly reduced, with electric buses operating at less than 70 decibels, compared to 85 decibels for diesel engines.

Another example is in Sydney, where a partnership with Transport for New South Wales (TfNSW) is helping to enhance the passenger experience and boost ridership, as well as support the network's green energy transition by 2030. Over the next eight years, we will work to introduce 125 new electric



Keolis has recently helped to introduce Europe's largest electric bus fleet in the Netherlands.

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buses by 2030. This is the Australian bus market's largest green transport transition to date.

### Embracing alternative fuels

Advances in bus innovation over recent years means that electric is not the only low-carbon fuel on offer for local authorities that are looking to go green. In the French city of Pau, for example, Keolis is delivering a fully hydrogen-powered bus rapid transport (BRT) service.

As a long-standing partner of the Pau transport operator Société de Transport de l'Agglomération Paloise, Keolis has operated the city's transport network, IDELIS, for more than 20 years. Now, we are collaborating on its modernisation through the Fébus network, with the operation of eight 100 per cent hydrogen buses.

Operating on the route between the city's main hubs, passengers benefit from enhanced connectivity between Pau's educational, administrative, commercial and leisure districts.

The six-kilometre route runs in dedicated lanes, protected from other traffic and benefitting from a priority system at crossroads, with a significant reduction in travel minutes across the city.

It is clear that change is needed to help the UK's public transport network to properly serve the evolving needs of passengers as we emerge from the worst of the pandemic. Taking advantage of the opportunity to address new mobility demands and drive down emissions will set local authorities up for success.

There is a wealth of best practice from around the world for transport leaders to draw inspiration from, as well as closer to home, as already mentioned. But the benefits of adopting more sustainable, integrated networks underpinned by a robust bus provision are clear to see.

For the UK, as it looks to build back better after the pandemic, taking steps to rethink its public transport system will be key to supporting an essential return to sustained economic growth. 📶



*It is clear that change is needed to help the UK's public transport network to properly serve the evolving needs of passengers as we emerge from the worst of the pandemic* ”

# Putting collaboration at the heart of MaaS

*Andrew Stober, Head of Public Partnerships and Carpool at Waze, speaks to Intelligent Transport's Luke Antoniou about data sharing, public-private partnerships, shared transport and the outlook for post-pandemic transit.*

## **Could you tell us about the Waze and the Waze for Cities programme?**

Waze is a crowd-sourced navigation app, created in 2009, which aims to improve issues associated with driving – specifically traffic, road damage and events that could disrupt drivers. Our community of volunteer map editors, beta testers, translators, partners, users and carpoolers, help to make each drive made

using the app better – even if you've made the same journey every day for the past few years.

The Waze for Cities programme has been running for more than five years. The core essence of the partnership is data sharing between Waze and our public partners. We now have over 1,900 partners on five continents. They range from small towns and volunteer fire departments in Georgia, USA, to national departments of ministries of transportation.

It includes a number of transit agencies, many city departments of transportation, 40 US state departments of transportation, and major motorway operators in Europe and Latin America.

We provide our public partners with crowdsourced data from 140 million monthly active Waze users worldwide. This enables them to see all the reports that those users are submitting in their area.

Data alone, however, is not enough. What actually helps executives, policymakers, elected officials or even the public to make decisions, is information. This becomes evident once the data has been analysed and processed. Data is useful for analysts and researchers, but it's not useful for driving decisions. To that end, we have a series of tools that transform our data into information that's actionable for our partners, some of whom have the capacity to do their own analysis and get access to the raw data as well.

In exchange for our data and insights, we ask that our partners provide us with critical information for their area that will improve navigation for our users. Road closures, major events, marathons and parades, or major incidents that our users may not yet be aware of, can all be flagged in the live map; this alerts our users and enables them to prepare for the journey ahead.

Waze for Cities is cost-free to our partners, and it emerges out of Waze's mission and ethos. Waze started as a community project, before becoming a global navigation tool that generates revenue through advertising. It allows us to help our users and their communities to address infrastructure issues head on.

**What role do public-private partnerships have to play in ensuring cities can meet wider policy objectives?**

The role of public-private partnerships can be divided into two broad categories. The first is delivering information to help drive decisions; that's the space Waze operates in. The second is delivering services to help meet those policy objectives. Ultimately, the policy environment has to be right. All of those individuals, businesses and governments, are responsive to those policy objectives. When they're clear and the incentives are structured correctly, you get the best out of partnerships.

There also needs to be policy coherence from top to bottom. If, for example, you were to set a goal of reducing carbon emissions from transportation, you would need to ask yourself "how are we going to meet that goal?" The answer is taking vehicles off the road, so then you work through how to do that. You take single-occupant vehicles off the road by providing excellent transit, so that it becomes peoples' choice of travel mode. You can

*When it comes to transportation data, you're looking at the two most private areas of people's lives when it comes to data – their movements and their health*



also increase the cost of driving, whether that's in monetary terms through taxes and fees, or the 'experience cost' in terms of time; then you add elements such as HOV lanes to make transit the more appealing option.

What you've done is set up a policy context that promotes carpooling services. When you think about an urban environment, it's the city, typically, that controls the right of way and controls parking. When you create parking spaces for car share companies at either no or low cost, and provide yet another reason for people to not have their own private car, you help reduce the demand. Hence, you need to have a policy objective with a coherent set of plans, decisions and regulations behind it. >>



### **Where does the bulk of the responsibility lie in terms of public/private organisation in developing more multimodal transport networks?**

Better policy decisions have to be made, and the operators of most of our transportation infrastructure are either public or private entities that are managed by the public, depending on what part of the world you're in. Waze has a role in providing those entities with better data and information so they can make better planning and operational decisions.

One question implied here, which I think is worth noting, is "what makes public-private partnerships work?" From my experience of building partnerships around bike share, recycling programmes and other kinds of transportation offerings, I think the key is a realistic set of expectations. There also needs to be transparency about what each side has to offer in terms of its organisational capacity and financial investment. When public-private partnerships go awry, it's usually because there's been a breakdown in one of those things, or a set of unrealistic expectations or requests.

Situations can arise, particularly in the public sector, where they think they can get something at little or no cost – and believe they have a private sector entity willing to provide that. Then it turns out the investors

are never really willing to go for broke and the public sector gets left holding the bag. On the public sector side, you have to really understand what the business interest is and what's going to keep your private sector partner invested in the partnership.

For the private sector, it's important to understand that public sector organisations are frequently very strapped for resources – not just financial resources, but also time. The demands on public sector organisations are enormous. It can be very hard for them to dedicate resources to projects, even when they want to. It can be frustrating for the private sector if they're at the end of a partnership where they never feel they're the priority.

### **Following the pandemic, do you think the boom in shared transport modes (car-share/scooter-share etc) can pick up where it left off?**

On the transit front, at least in the short-term, I remain very concerned. Publicly available data at [waze.com/covid19](https://waze.com/covid19) shows how the current driven miles on Waze compare to the pre-pandemic baseline. If you look at three places in the world – Sydney, Singapore and Tel Aviv – that are closest to what we're going to see in the short-term on the other side of the pandemic, all of them are showing



strongly car-led recoveries. In Sydney, the data shows over 20 percent more miles driven than the pre-pandemic baseline. Singapore, a place with very low case rates, with exceptional and trusted public transit, and where it's very expensive to drive, is seeing people driving seven percent more miles than they did before the pandemic. In Tel Aviv, the congestion is back and driving is far surpassing what it was pre-pandemic.

I'm not convinced that in North America, or any of the places where it's even easier to drive, that we're going to see numbers much less than those environments. The Recovery Act in the United States has provided a lifeline for transit systems that's going to keep them going for the next 12-18 months. We've seen the most progressive transit systems try to consolidate the gains they've secured in travel time to make themselves competitive. But the challenges are enormous.

With carpooling, we have an unparalleled platform to match drivers and riders for trips they are already taking, to get folks off the road. The purpose of Carpool is not to compete with transit – it's to provide for trips where transit isn't a good alternative. In the context of the economic recovery, it's going to be an important way to connect people with employment and help them manage their transportation costs.

Scooters have proven to be a powerful lesson in the limits of public-private partnerships. If the business model can't sustain itself, the service is not going to sustain. There's a reason why most mass transportation in the world is publicly-funded or subsidised, because it's not viable as a private business.

Publicly-supported bike-share schemes have done very well during the pandemic, as people have chosen to get around by bike more. We've seen infrastructure put in place, and there have been fewer cars on the road. I think there's a case for those.

If you look at bike-share trips, the US numbers show they're typically a mile or so less. That's likely not replacing transit trips. It's replacing walking, and frankly, it's not likely replacing driving trips either. It's induced demand because something that used to take 20 or 25 minutes to walk to, I can now get to in five minutes. When I used to talk about bike share, I talked about it as the common man's Concorde – it cuts your travel time by more than half. It'll be interesting to see with better bike infrastructure in place, bearing in mind some of greater safety concerns about transit, if people are willing to bike longer distances rather than get on transit.

I also think a fundamental point is how core changes in people's travel behaviour affect transit. If one of the primary reasons for taking transit was to commute to work, and some significant percentage of the population is now only commuting two or three days a week, that is going to be far more fundamental to transit than other options.

### **With all of the above considered, do you think public and private entities need to be more open with their data to improve transport networks?**

When it comes to being open with data, significant tension has emerged in the last two or three years between the good motivations around transparency to improve decision-making, management and regulatory schemes, and privacy. When it comes to transportation data, you're looking at the two most private areas of people's lives when it comes to data – their movements and their health.

In transport, we're not talking about health, but people's individual privacy. There's a lot of good motivation from the public sector to want to see all of those individual movements and act in aggregate. That comes into tension with this increasing demand from the very same public to keep that information private. This issue of how to provide anonymised data at the aggregate level that's in the public interest, while at the same time protecting individuals' privacy, is a lot harder than it seems. Achieving that balance is something we're going to see evolving in the next five years. 📡



*For the private sector, it's important to understand that public sector organisations are frequently very strapped for resources – not just financial resources, but also time ”*



**ANDREW STOBER**

Andrew Stober has worked across sectors in transportation with a track record of leading teams to move people and ideas. Currently, Andrew manages public partnerships for Waze. He helps public agencies get the most from the Waze for Cities program and works with partners to accelerate the adoption of Waze Carpool to meet transportation demand management, climate, and transportation equity goals.

# Does eliminating public transport

Eliminating fares within public transport is a topic of greater discussion now than it has ever been. For *Intelligent Transport*, Carol Schweiger takes up the debate.

**T**WO MAJOR events in our recent history have expanded the discussions regarding eliminating fares from public transport: the COVID-19 pandemic and the death of George Floyd. COVID-19 caused many public transport systems to suspend on-board fare collection, particularly if fares were collected within close proximity to the vehicle's driver. The death of George Floyd, while not directly responsible for agencies considering eliminating fare collection, brought about a renewed interest in making public transport more equitable.

One element of public transport that is thought to be a barometer of equity is collecting fares, as those who use and need public transport the

most are often within lower income brackets or have challenges accessing public transport due to the cost. There are many legislative actions taking place across the US to make transit free, such as those in the Boston, Massachusetts<sup>1</sup> and Providence, Rhode Island<sup>2</sup> areas. Finally, agencies, such as Los Angeles Metro, are moving forward with pilot programmes to make all, or part, of their systems free to many riders. "The two-phase pilot would offer free trips for low-income bus and rail riders starting January 2022. In August 2022, fareless travel would extend to all K-12 students in L.A. County. Metro reported that 70 per cent of its riders make less than \$35,000 a year and would qualify for free trips under the current pilot



# fares make more equitable?

proposal. The pilot would run to June 2023, then Metro's leaders could decide to continue or expand free transit to more riders and services."<sup>3</sup>

Personally, I have always felt that while public transport is a 'public' service, it does not mean that it should be offered for free to everyone. The primary reasons for my thinking are two-fold: firstly, fares can defray the costs of operations and improving service; and secondly, there may not be a dedicated source of funding needed to support increased operations and capital expenditures, particularly if free transit results in large increases in ridership. Expanding on these initial thoughts, before examining the equity aspect of free fares, it is useful to look at the pros and cons associated with free public transport.

The pros: obvious, and both qualitative and quantitative:

- Dwell time at bus stops would be reduced
- Passenger convenience would be increased
- Hardware and software would no longer be required to collect fares and be maintained (e.g. fareboxes, turnstiles, gates)
- The following efforts to conduct fare-related tasks would no longer be needed:
  - Supervisory and clerical support for fare collection and counting activities
  - Producing, purchasing and managing fare media
  - Controlling the distribution and sales of tickets and tokens »



**CAROL SCHWEIGER**

Carol Schweiger has over 40 years of experience, and is nationally and internationally recognised in transportation technology consulting. She has wide-ranging and in-depth expertise in several specialty areas, including technology strategies for public agencies, public transport technology, traveller information strategies and systems, and systems engineering. Schweiger has provided over 55 transportation agencies with technology technical assistance. She co-developed and was the lead instructor for five transit technology training courses for the National Transit Institute (NTI) and six modules regarding transit technology standards. She has also authored numerous Transit Cooperative Research Program (TCRP) Synthesis reports and full TCRP reports.

- Pulling vaults, and downloading credit and debit card data from fare collection devices
- Transporting cash, credit card and debit card data to accounting facilities
- Counting cash, transfers and tokens
- Performing credit and debit card sales accounting
- Destroying used fare media
- Providing security for the fare collection process
- Auditing and controlling fare collection including reconciling readings to cash, credit card and debit card collections
- Additional hardware and software would no longer be needed for riders to purchase fares off-board (e.g. ticket vending machines)
- Inspecting passes or fare media (a.k.a. fare enforcement), which may result in boarding taking longer
- "Improving equity and economic parity for riders
- Creating an incentive to take public transit over personal vehicles"<sup>4</sup>
- Reducing pollution and congestion levels.
- Additional vehicles could be needed due to increased ridership (particularly during the COVID-19 pandemic if the agency wishes to keep physical distancing in place)
- Additional labour could be needed if additional vehicles have to be added
- Without fares, other sources of funding will be needed (e.g. local or state taxes, contributions from educational institutions, donations from philanthropic organisations) because fares contribute to transit revenues (that can assist in funding operational improvements)
- Hardware and software could be required to provide passenger counts
- The perception of free transit may create unexpected situations such as vandalism.

The cons – mostly funding related but significant:

- Dwell time at transport stops could be increased due to a potential increase in ridership

So, it would seem that the pros outweigh the cons, and free public transport could eliminate a good number of costs, especially those associated with fare collection. However, it is not that simple. There are at least three factors that should be considered before assuming that the benefits of fare free public transport outweigh the costs. First, the complexity of the public transport system should be assessed. Does the system have multiple modes of travel (e.g. bus, subway, commuter rail)? Will making

fares free assist a majority of riders? Do the majority of riders transfer between modes to make their trips? Will making fares free on one mode affect what can be charged for another mode?

An example is provided by Laurel Paget-Seekins, former Assistant General Manager for Policy at the Massachusetts Bay Transportation Authority (MBTA), the regional public transport authority in the greater Boston area. Paget-Seekins points out<sup>5</sup> that if the MBTA's fixed-route services became free, complementary paratransit service must also become free<sup>6</sup>. As I stated earlier, free fares could result in higher ridership – in this case, both on fixed-route and demand-response services. With the high cost of paratransit service, any increased demand and ridership on The Ride, the MBTA's paratransit service, would be extremely costly, possibly necessitating additional vehicles and drivers. Further, in thinking about just making buses free, “the [MBT]A network is designed for bus riders to transfer to rapid transit. Of all the journeys on the bus and rapid transit network, about 30 per cent involve bus-only. The vast majority of T riders do not exclusively take buses – and many trips are not possible only by bus.”

Second, it is critical to understand how much existing fares contribute to total revenue in a transport authority, as well as recognising funding sources to not only cover this portion of the revenue, but also cover the costs of new vehicles and labour to operate those vehicles. For example, in examining the potential for fare free service in Olympia, Washington, “fare collection accounted for less than two per cent of the agency's net operating revenue. [As a result,] the agency [in Olympia] successfully asked voters in 2018 to raise the local sales tax to fund better bus service.”<sup>7</sup>

Another example is the MBTA, in which fares account for 40 per cent of operating costs. Eliminating fares across the MBTA would mean replacing almost half of the MBTA's revenue as well as funding for increased operations and capital costs<sup>8</sup>. This is one of the several reasons that the MBTA is now looking at designing “a low-income fare programme [which] would provide lower cost, perhaps free, access to all MBTA services, which is a greater benefit to people for whom fares are a barrier.”<sup>9</sup>

Finally, examining the long-term impacts of free public transport (even in a pilot programme), both positive and negative, is crucial. Once free transport is offered it is challenging to revert back to charging fares. One example is in Lawrence, Massachusetts, where three bus routes operated by the Merrimack Valley Regional Transit Authority (MVRTA) have been operating for free for three years. These routes cover major destinations in Lawrence including the regional hospital, the Senior Center, grocery stores and schools. Lawrence Mayor Daniel Rivera has been extremely supportive of keeping these



*Examining the long-term impacts of free public transport (even in a pilot programme), both positive and negative, is crucial*

routes free, even though the price of operation has increased since the beginning of this free service. The impact of “eliminating the fare made a substantial difference because over 90 per cent of riders make less than \$20,000 per year.”<sup>10</sup>

So, now that we have discussed the key factors in considering a fare-free system, does making fares free address equity issues? The short answer is yes, but the longer answer is that ‘it depends.’ An example from Los Angeles Metro helps to show how ‘it depends.’ In designing their Fareless System Initiative<sup>11</sup>, two of their reasons for considering a fareless system are: first, there will be an equity benefit for many riders in that 70 per cent of all riders have annual incomes that are under \$35,000; and second, having a fareless system would save riders up to \$1,200 each annually and these savings can be spent within the local economies. So this sounds like a fareless system for Los Angeles Metro would directly address equity. However, Los Angeles Metro provides a wide variety of transport services, and considering making all services free would be unrealistic – similar to the MBTA situation mentioned earlier in the article. So Los Angeles Metro is taking a pilot approach to providing fare-free services.

This pilot programme consists of the following elements<sup>12</sup>:

- One of six possible scenarios, focused on low-income riders and K-12 students, will be piloted in a phased approach. The first phase will begin with fareless for low-income riders (70 per cent of Metro riders), then students will be added seven months later. This pilot programme will conclude 11 months later, and may be continued and expanded subject to securing funding
- The pilot will cover Metro bus and rail services, but will not include Metro Bikeshare, Metro Micro (microtransit service), regional services, paratransit and commuter rail
- Other required components of the pilot have been determined: projections of pilot boardings, readiness of operational and security elements, detailed cost estimates for the pilot, and identification of all possible sources of Federal, State, and local funding
- Significant outreach has been done in the community to inform and guide the pilot.
- The Los Angeles Metro fare-free pilot programme not only incorporates all of the considerations mentioned earlier in the article, but also meets the primary goal of providing a more equitable transport service. 🗺️

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# Waymo One: The future of autonomous ride-hailing

In this article for *Intelligent Transport*, *Waymo* tells us more about the *Waymo One™* ride-hailing service, and explains why this autonomous transport offering is gaining momentum.

## What is Waymo One?

Waymo One is our autonomous ride-hailing service, currently offering fully autonomous rides with no human driver in the East Valley of Phoenix, Arizona, and testing in San Francisco, California, through our Waymo One Trusted Tester programme. In fact, the beginning of October 2021 marked the one-year anniversary of Waymo opening up the Waymo One rider-only service to the public in Phoenix. To date, Waymo One has celebrated tens of thousands of trips, thousands of riders and hundreds of thousands of miles driven autonomously. As the first and only fully autonomous ride-hailing service, we're looking forward to bringing Waymo One to more people in the future.

## Why did Waymo decide to launch this service?

Our mission at Waymo is to make it safe and easy for people and things to get where they're going. Waymo One was built to provide a safe, reliable and altogether better way to get from point

A to B. Freeing people from the stresses of driving, Waymo One offers a space for people to make the most of their commuting time, from catching up on a book in-between running errands, to getting some work done on the way to the office.

## Have trials of the Waymo One service been successful? What has the reaction been to the trials?

Waymo One has completely changed transportation in Phoenix, being described by riders as their "primary mode of transportation."<sup>1</sup> One rider, John, has taken over 400 rides in the past year. In San Francisco, the response to trials has been positive, too. In addition to the troves of positive reactions that we receive, our riders also provide useful feedback on more detailed aspects of their ride, from the in-car features that they want to see and whether or not the drive felt smooth, to how accurate the estimated time of arrival (ETA) for their trip was. All of that feedback is reviewed by our team and used to improve our service. Simply put, our riders are happy thus far, and we're



Waymo One was built to provide a safe, reliable and altogether better way to get from point A to B.

happy to continue evolving to ensure that they get to their destinations efficiently and safely.

### How does Waymo ensure passenger safety?

Safety is at the forefront of Waymo's focus. Over a million people die on roadways annually, and 94 per cent of vehicle crashes in the United States involve human error or choice. The Waymo Driver, our autonomous driving technology, has the potential to help to reduce these tragedies by eliminating that human error. The Waymo Driver knows its exact location on the road; knows its surroundings; can see 360 degrees and up to three football fields away; makes predictions about what other vehicles will do; and decides on the best action to take next, all based on over 20 million miles of real-world driving experience and 20 billion miles of simulated driving experience.

### What are the benefits of utilising autonomous vehicles in ride-hailing services?

Autonomous ride-hailing services provide a level of overall convenience and safety that other services don't currently provide. Our Waymo riders feel safer on the roads, are happy with the convenience and delight of our service and feel comfortable in our vehicles. One frequent rider says that she prefers autonomous rides so that she doesn't have to worry about the emotions or driving experience of a human driver<sup>2</sup>. Also, because there is no human driver, Waymo cars are available to hail 24/7. This makes them a much more accessible option for those who need rides very late at night or early in the morning. Some riders have also expressed that they prefer using Waymo over other ride-hailing services, as there's no need to tip an autonomous driver.

 @IntelTransport

### How can autonomous technology benefit public transport on a wider scale?

Beyond providing a new way to seamlessly get from point A to point B, autonomous technology can integrate with other forms of public transportation. For example, from September 2019 to March 2020, Waymo One partnered with Metro Valley – Phoenix Metro area's public transportation authority – on their RideChoice programme. RideChoice is a programme that provides public transportation for those with disabilities and those over the age of 65. In a survey that we conducted<sup>3</sup> about our partnership with the programme, we found that autonomous vehicles provided easier and accessible public transportation for our participants. Not only did they feel safe and found Waymo One rides convenient, they also began using public transportation more. With the introduction of our Waymo One service, 59 per cent of participants began taking more trips than usual with the RideChoice programme. Overall, 93 per cent of all participants said that they would like to see autonomously driven rides become a permanent option of public transportation. 



*Beyond providing a new way to seamlessly get from point A to point B, autonomous technology can integrate with other forms of public transportation* ”

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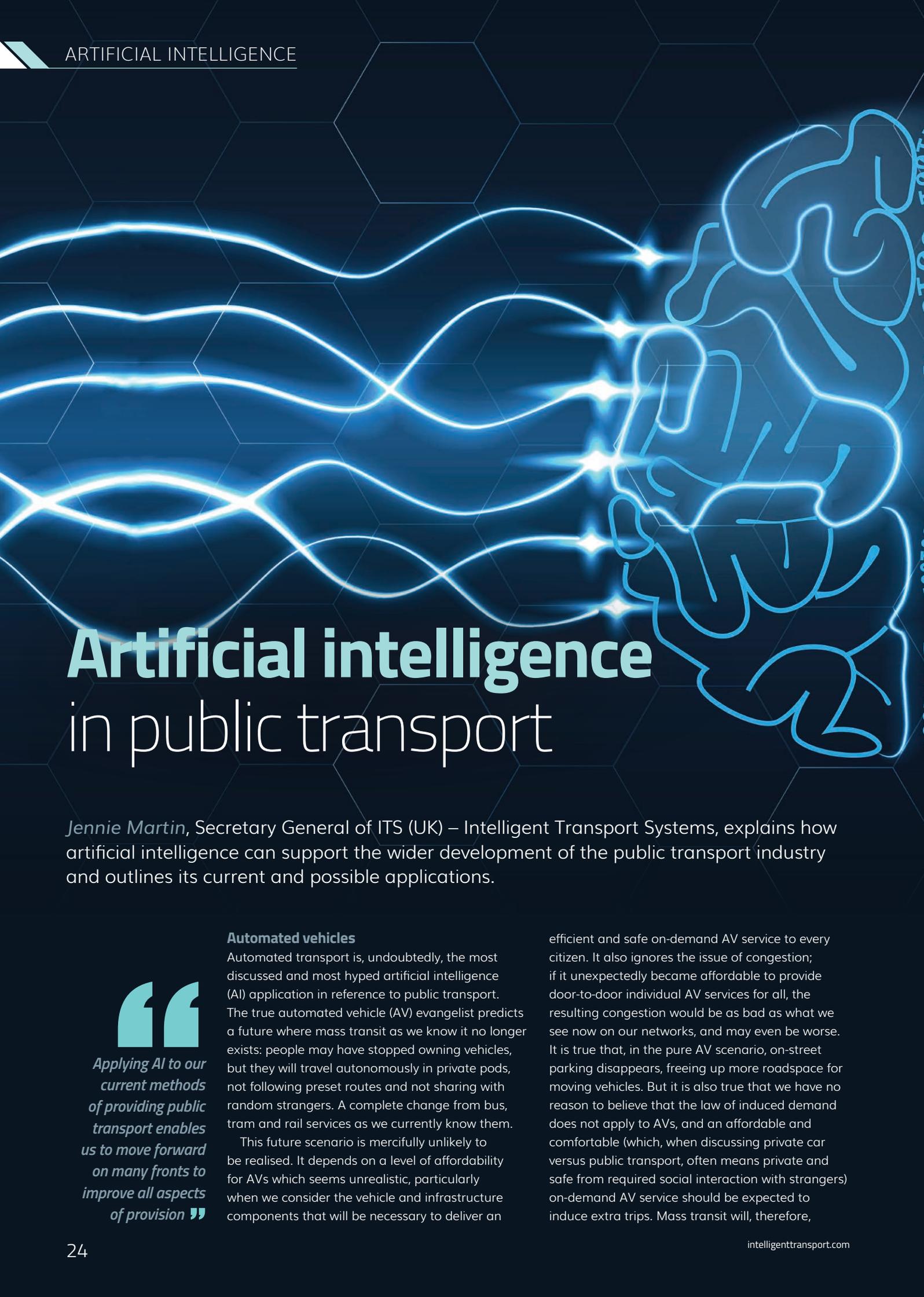
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## ABOUT WAYMO

Waymo is an autonomous driving technology company with a mission to make it safe and easy for people and things to get where they're going. Since its start as the Google Self-Driving Car Project in 2009, Waymo has been focused on building the Waymo Driver, the World's Most Experienced Driver, to improve access to mobility while saving thousands of lives now lost to traffic crashes. The Waymo Driver powers Waymo One, the world's first fully autonomous ride-hailing service, as well as Waymo Via, our trucking and local delivery solution. To date, Waymo has autonomously driven tens of millions of miles on public roads and tens of billions of miles in simulation across 10 U.S. states.

For more information, visit: [waymo.com](https://waymo.com)





# Artificial intelligence in public transport

*Jennie Martin, Secretary General of ITS (UK) – Intelligent Transport Systems, explains how artificial intelligence can support the wider development of the public transport industry and outlines its current and possible applications.*



*Applying AI to our current methods of providing public transport enables us to move forward on many fronts to improve all aspects of provision* ”

## **Automated vehicles**

Automated transport is, undoubtedly, the most discussed and most hyped artificial intelligence (AI) application in reference to public transport. The true automated vehicle (AV) evangelist predicts a future where mass transit as we know it no longer exists: people may have stopped owning vehicles, but they will travel autonomously in private pods, not following preset routes and not sharing with random strangers. A complete change from bus, tram and rail services as we currently know them.

This future scenario is mercifully unlikely to be realised. It depends on a level of affordability for AVs which seems unrealistic, particularly when we consider the vehicle and infrastructure components that will be necessary to deliver an

efficient and safe on-demand AV service to every citizen. It also ignores the issue of congestion; if it unexpectedly became affordable to provide door-to-door individual AV services for all, the resulting congestion would be as bad as what we see now on our networks, and may even be worse. It is true that, in the pure AV scenario, on-street parking disappears, freeing up more roadspace for moving vehicles. But it is also true that we have no reason to believe that the law of induced demand does not apply to AVs, and an affordable and comfortable (which, when discussing private car versus public transport, often means private and safe from required social interaction with strangers) on-demand AV service should be expected to induce extra trips. Mass transit will, therefore,

remain an essential component of a liveable city, and we include less dense urban areas in this.

### **An evolution, not a revolution**

Moving on from the AV scenario, AI actually has a lot to offer to improve public transport in many different ways. Not through a revolution – as with AVs – but through an evolution such as we are already familiar with: from tickets issued from a roll of paper, through to magnetic stripe paper tickets, smartcards and contactless; from route and timetable planning with pen and ink, to using PCs, through to the use of dedicated software. AI is just the latest new tool being added to these chains of improvement, and AI itself is only in its infancy in terms of capability and application.

The fuel of AI is data, and we are well supplied with that by this point. The ticketing, journey planning and fleet management software now in everyday use yields a mass of useful data, enough of it already granular and formatted in such a way as to be reusable without expensive or time consuming extra processing. We talk about the

problems with poor quality data in non-standard formats because these take up our time, and they do exist, but there is a lot of perfectly serviceable public transport data available.

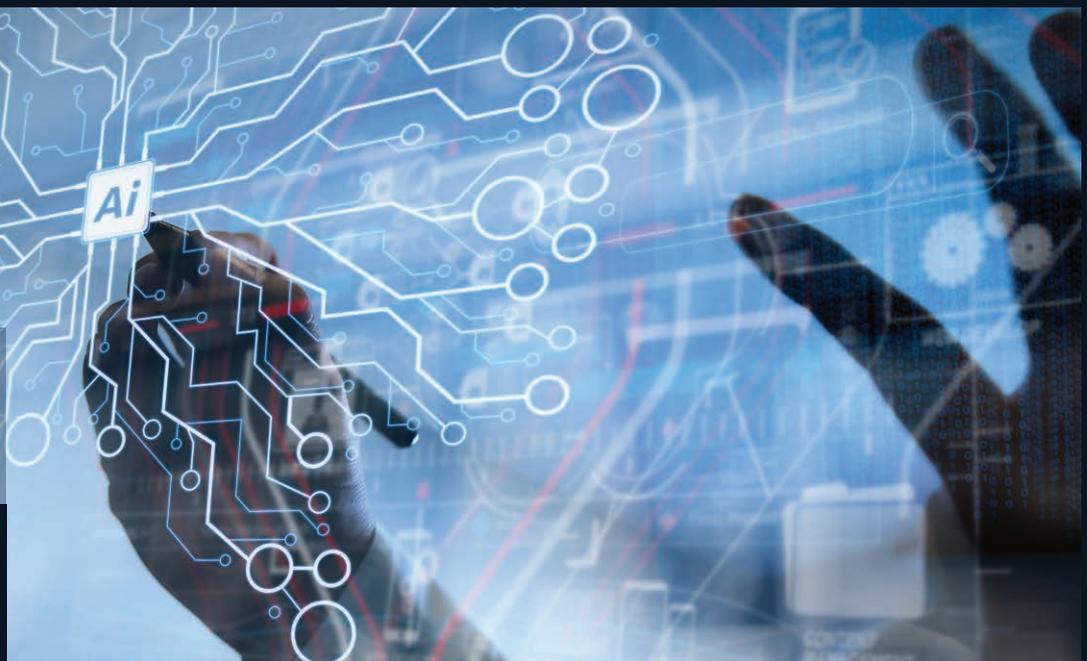
### **Fleet and staff optimisation**

Applying AI to our current methods of providing public transport enables us to move forward on many fronts to improve all aspects of provision. For a start, we can optimise the use of fleet and staff by using AI to analyse demand across networks, days and times. It is easy to assume that travel patterns were already changing before the pandemic, with factors such as the growth of the 24-hour economy and the decline of the traditional eight hour working day or shift. AI applied to the data that we are already collecting can pinpoint changes and trends in more detail and in shorter timeframes than we were able to with previous methods. Thinking about the serious changes imposed by the pandemic on our patterns of work, study and leisure makes it obvious that the detailed analysis and prediction enabled ➤



*Maybe the greatest contribution we can see AI make to public transport provision is by underpinning Mobility-as-a-Service* ”

AI has a lot to offer to improve public transport in many different ways. Not through a revolution, but through an evolution such as the industry is already familiar with.



**JENNIE MARTIN**

Martin joined ITS United Kingdom, the Intelligent Transport Society for the UK, in 1998. She started with ITS (UK) as Membership Secretary, and was promoted to Secretary General in 2004. Prior to that, she worked in the City Engineer's Department at the Corporation of London, the local authority for the 'Square Mile' financial district of London. Martin began her working life with the then British Rail in 1986. Martin has a BA (Hons) in History from Kings College London, and an MA from the UK's Open University. She wrote her MA thesis on the institutional framework of the introduction of camera technology for traffic applications in London. Martin is a past Chairman of the Network of National ITS Associations, an organisation of 28 European ITS associations. She serves on the UK ITS Standards Committee BSI EPL278, and leads PIARC working group 2. 4.3.

by AI will be essential in renewing our public transport provision to serve the new reality.

### Route analysis

One complex problem in public transport provision is working out what services people would use if they existed. Often, bus services run on historic routes which are no longer optimal, or are missing from areas where there is undiscovered demand. By aggregating large, anonymised datasets about these areas – who lives there, where they work and study, how they currently travel and so on – AI can make it possible to recommend changes with confidence. Conducting this type of complex analysis without AI would be so time consuming as to be pointless.

### Safety and security

Safety and security are often raised when discussing barriers to public transport use. AI applied in the form of video analytics has so much to offer in this area. By detecting and alerting about potential issues – such as aggressive or furtive behaviour, or people and their luggage parting company in unexpected locations – AI can support the effective working of staff. It is, of course, essential that the final decision on intervention based on these alerts is made by a human; we know that AI for these applications can come with its own stereotyping, created by how the programmes for collecting the base data were written and by whom, maybe up to a decade ago.

### Fraud prevention

Another useful application in this area is fraud prevention. Certain behaviours – jumping over or

creeping under barriers, barging people at ticket gates, hanging back or reversing a journey when inspections are in progress – all point to potential fare evasion. The word 'potential' is key. As above, the AI alone may produce a wrongful suspicion. Hanging back at ticket gates may be due to remembering a piece of luggage left behind, it does not automatically indicate ticket fraud, and so on. Specifying what type of person should cause an alert by hanging back is unethical, as well as counter productive. If all fare evaders could be recognised by appearance, the crime would have become obsolete long ago.

### Mobility-as-a-Service

Maybe the greatest contribution we can see AI make to public transport provision is by underpinning Mobility-as-a-Service (MaaS). The MaaS principle of all possible transport services – how to find them, pay for them and plan journeys – being available on one platform for users depends on masses of disparate data sources being mined and combined. The very complex needs to be rendered simple and accessible. AI has an important role to play here, in analysing what users need and matching it to the data available. It should be used to learn from what MaaS users search for and utilise; both to personalise the service for them, and for finding the bigger patterns and, particularly, the gaps in services.

Our urban areas need mass transit to continue to be available in the coming age of automation. MaaS is the key to supporting this, by making it simpler and more convenient to access than it has ever been. And AI is the key to realising the delivery of MaaS. 📺