25th ANNIVERSARY 1994-2019

traffic TECHNOLOGY INTERNATIONAL

April/May 2019

Beat HOT lane fraud
New tech can detect vehicles flouting high-occupancy rules

Events preview special

DC ITS AMERICA JUNE 2019

13th ITS EUROPEAN CONGRESS FULFILLING ITS PROMISES

WWW.TRAFFICTECHNOLOGYTODAY.COM

ALPR overload?

Is excessive use of automatic license plate recognition by unregulated private companies undermining public trust in traffic enforcement?

NEW COLUMNIST!
Former Michigan DOT director Kirk Steudle joins *Traffic Technology International*, page 55

FEATURING

comtrans
Your essential guide to the future of transportation communications

Testing 5G for CAVs

Meridian, a new UK project, is testing all aspects of CAV operation, and preparing for a future of 5G connectivity

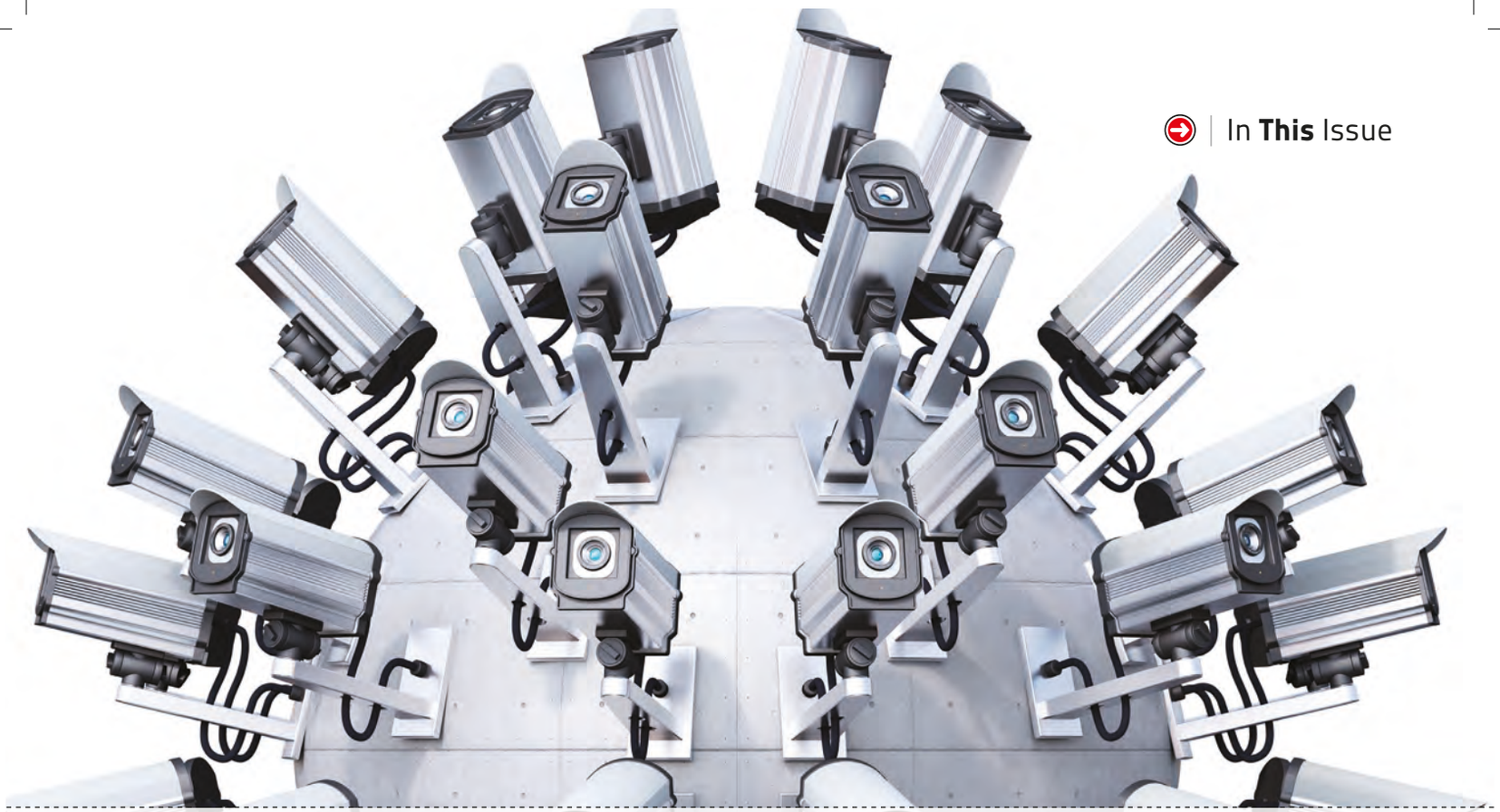
At your side. To help you move mobility forward.

Together, we can transform the way the world travels — with intelligent transit systems, integrated curbside management, dynamic roadway charging and advanced public safety solutions. All backed by advanced analytics and scalable platforms to ensure everything works as one today, tomorrow and beyond.

Ready to move mobility forward?
ConduentTransportation.com

CONDUENT
Transportation

PUBLIC SAFETY | TRANSIT | CURBSIDE MANAGEMENT | ROADWAY CHARGING & MANAGEMENT



Cover story

20 ALPR overload?

Could the use of ALPR beyond traffic enforcement functions erode public trust?

With targeted marketing beginning to rely on ALPR systems, David W Smith considers the risks of such practices being more widely embraced

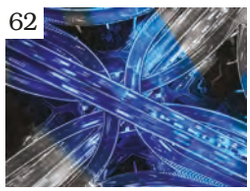

16


28


36


42

Cover illustration: F Schmidt/Shutterstock



Technology Profiles

Editor's letter

Conference season is upon us once again. Over the next few weeks there are three events that are hugely relevant to *Traffic Technology International* readers, all of which are previewed in this edition. On page 4 you can find out about highlights of the 13th European ITS Congress; on page 12 there's a quick update on what to expect at Intertraffic China; and on page 16 you can read my interview with Ford's AV chief, Sherif Marakby, one of the key speakers at this year's ITS America Annual Meeting.

Conferences and expos, not just in the transportation world but across many industries, are undergoing a sustained period of growth. Every year most such events report higher numbers of visitors and exhibitors. How long can this last? Will a natural upper limit eventually be reached?

Just last month I was paying a visit to the world's largest trade fair, Bauma Munich. It's an event focused on off-highway vehicles for the construction industry and includes its fair share of road-building machinery.

It was at this mind-bogglingly huge event (620,000 visitors over the course of a week) that a fellow attendee I was chatting to wondered how much longer the event would go on. It seemed a strange thought, given the scale of the site we stood in and the hordes of visitors crowding every corner of it.

But his point was a salient one – in a digital, connected world that's becoming increasingly questioning of the wisdom of excessive air travel, how long can the expense, not to mention the carbon footprint, of such events be justified, when perhaps similar results could be achieved in a virtual world? It's an interesting thought, but for now and in the near future it seems likely to remain just that. For while the level of resources poured into industry events is huge, the payback clearly justifies it. It's difficult to see how the same number of relevant meetings and conversations, both planned and unplanned, along with hands-on practical demonstrations, could be replicated in a virtual world. Perhaps the solution isn't to try to digitize everything, but to make greater use of VR at real-life events and also to reduce carbon footprints with smarter travel solutions – neatly bringing us back to the *raison d'être* of this magazine and associated events!

I hope you get the chance to visit at least one of this year's transportation industry gatherings, but unless you fancy hopping across the pond halfway through the first week of June you'll struggle to do both the ITS events as, frustratingly for me, they happen at exactly the same time. I'll be at one of them, for sure!

Tom Stone, editor

traffic TECHNOLOGY INTERNATIONAL comtrans — 25th ANNIVERSARY 1994-2019

Editor
Tom Stone
(tom.stone@ukimediaevents.com)
Deputy editor
Rachelle Harry
(rachelle.harry@ukimediaevents.com)
Assistant editor
James Allen
(james.allen@ukimediaevents.com)
Production editor
Alex Bradley
Chief sub editor
Andrew Pickering
Deputy production editor
Nick Shepherd
Senior sub editor
Christine Velarde
Sub editors
Tara Craig, Alasdair Morton
Design team
Andy Bass, Anna Davie, Louise Green, Patrick MacKenzie, Craig Marshall, James Sutcliffe, Nicola Turner, Julie Welby, Ben White
Head of production and logistics
Ian Donovan
Deputy production manager
Robyn Murrell
Production team
Carole Doran, Frank Millard, George Spreckley

Subscription updates
datachanges@ukimediaevents.com

Circulation
Adam Frost
Publication manager
Godfrey Hooper
(godfrey.hooper@ukimediaevents.com)

CEO
Tony Robinson
Managing director
Graham Johnson

Traffic Technology International
UKi Media & Events, Abinger House,
Church Street, Dorking, Surrey, RH4 1DF, UK
Tel: +44 1306 743744 • Fax: +44 1306 742525
Email: traffic@ukimediaevents.com
www.ukimediaevents.com

Traffic Technology International USPS 012-893 is published bi-monthly – in January, March, May, July, September, and November – by UKi Media & Events, Abinger House, Church Street, Dorking, Surrey, RH4 1DF, UK. Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping USA Inc, 155-11 146th Street, Jamaica, New York 11434. Periodicals postage paid at Jamaica, New York 11431.

US Postmaster: send address changes to *Traffic Technology International*, c/o Air Business Ltd, c/o Worldnet Shipping USA Inc, 155-11 146th Street, Jamaica, New York 11434. Subscription records are maintained at UKi Media & Events, Abinger House, Church Street, Dorking, Surrey, RH4 1DF, UK. Air Business is acting as our mailing agent. UKi Media & Events is a division of UKIP Media & Events Ltd.

If you wish to cancel your subscription to this magazine please email datachanges@ukimediaevents.com. For more information about our GDPR-compliant privacy policy, please visit www.ukimediaevents.com/policies.php#privacy. You can also write to UKi Media & Events, Abinger House, Church Street, Dorking, RH4 1DF, UK to cancel your subscription or request a copy of our privacy policy.

UKi MEDIA & EVENTS

Published by UKi Media & Events, a division of UKIP Media & Events Ltd

abc **Member of the Audit Bureau of Circulations**

Average net circulation per issue for the period January 1 to December 31, 2018, was 17,413
Annual subscription US$120/£90
USPS Periodicals Registered Number **012-893**
ISSN 1356-9252 (Print)
ISSN 2397-5970 (Online)
Traffic Technology International

Printed by William Gibbons, Willenhall, West Midlands, WV13 3XT, UK

Destination Eindhoven

13th ITS EUROPEAN CONGRESS

FULFILLING ITS PROMISES

Brainport Eindhoven, the Netherlands | 3-6 June 2019

Rachelle Harry speaks to Didier Gorteman, CFO and congress director at ERTICO ITS Europe, to find out how, in line with the ITS European Congress's theme, ITS is 'fulfilling promises'

This year, the 13th ITS European Congress will take place in Brainport Eindhoven, in the Netherlands, from June 3-6. The Congress will enable visitors to network and form partnerships with professionals and experts in the intelligent transportation (ITS) industry, as well as enabling them to contribute toward the latest trends in smart and integrated mobility.

"With great changes happening in the mobility sector at the moment, the ITS European Congress will present an unsurpassed opportunity for visitors to learn, and to get ITS updates on the best practices in cities, trends, pilots and ITS deployments," says Didier Gorteman, CFO and congress director at ERTICO ITS Europe.

"It has been an enriching experience working with ERTICO partners – the European Commission, Connekt, the cities of Eindhoven and Helmond and the Ministry – and we look

Experience new technologies

With its extensive experience in providing business solutions in the road charging sector, T-Systems offers comprehensive and innovative services for all areas in the tolling market. In addition to exciting expert talks on its stand, T-Systems will also showcase its services in realistic scenarios. The company will demonstrate a state-of-the-art, high-quality GNSS- and DSRC-based road user charging solution. This includes bring your own device (BYOD), e-ticketing,

and an easy-to-install onboard unit (OBU) that covers all European electronic toll service (EETS) requirements. Visitors can experience the T-Systems Tolling-as-a-Service portfolio, as well as its Satellic Tolling Platform, in real conditions.

T-Systems is looking forward to welcoming visitors to Stand 2.3 at the ITS European Congress.

Far left: **The event will be held in Brainport's iconic Evoluon Congress Centre**

Left: **The C-ITS Corridor – real-life Dutch ITS experience**

forward to welcoming the whole ITS community at the ITS European Congress.

"I am also looking forward to various coinciding events, innovative demonstrations and the biggest ITS European Congress exhibition ever."

The 2019 ITS European Congress will attract 3,200 visitors from more than 50 countries. The conference program will include over 100 speaker sessions and workshops, and the exhibition will showcase innovations from more than 100 companies. In addition, visitors can look forward to product and concept demonstrations, technical tours and social events associated with the Congress.

"The 2019 congress program will be more vibrant and dynamic than any congress program we have seen to date," says Gorteman. "This year we are introducing streams, themed around Smart Cities, Automation and Integrated Mobility, organized in different formats from Tuesday, June 4, to Thursday, June 6. The streams will be complemented by related technical and special interest sessions.

"The demonstration venue in Helmond will showcase approximately 20 demonstrations of implemented ITS solutions. Demonstration rides

> "Never before has there been such a keen interest in mobility and the ways digital solutions can help the transportation sector"
>
> ***Didier Gorteman, CFO and congress director, ERTICO – ITS Europe***

Above: **Brainport Eindhoven bills itself as 'the smartest square kilometer in the world'**

can be booked beforehand via the ITS European Congress 2019 App."

The demonstrations, located between the Evoluon Congress Centre and the Automotive Campus, will display how mobility boundaries are being pushed with the latest technologies. Demonstrations will include various driver assistance systems, semi-automated and fully automated driving, smart data exchange, smart infrastructure, easy-to-use electric car sharing, and delivery drones.

3,200
Visitors expected to attend the ITS European Congress

"We are also looking forward to delivering the first-ever 'Your Future Festival', which is being organized by ERTICO – ITS Europe; the Dutch host, Connekt; and Here Technologies," says Gorteman. The Festival will act as a platform for students, young professionals and companies to connect with each other to share their inspirations, research and experience, to make valuable connections for their futures.

Gorteman believes that ERTICO needs to, and must, continue raising awareness on how ITS can contribute to an improved quality of life – a central theme from the 2018 World Congress held in Copenhagen. "Never before has there been such a keen interest in mobility and the ways digital solutions can help the transportation sector," he says, "This is definitely a game-changer in our field."

That is why the 2020 ITS European Congress, taking place in Lisbon, Portugal, will be themed: 'ITS: The Game Changer'; and the 2021 Congress, taking place in Hamburg, Germany, will be themed: 'Experience Future Mobility Now'.

For more information about the 2019 ITS European Congress and to book a pass, visit: www.2019.itsineurope.com

Innovation as a nation

Nico Anten, managing director of ITS Netherlands project Connekt, explains why Brainport is ideal for the ITS European Congress – and why the Dutch nation is so accepting of ITS.

"The congress is taking place in Brainport, located in the southeast Netherlands. It is a leading technology region and known as one of Europe's most prominent and innovative high-tech centers.

At the ITS European Congress, ITS Netherlands will conduct visits to various destinations in the Netherlands where delegates can experience the latest innovations for improving mobility solutions.

The Dutch firmly believe in the potential of intelligent transport systems (ITS) and smart mobility solutions. We have millions of bikes, cars and trucks on our roads and some 4,500 trains running daily across a surface area of only 41,000km^2 [15,830 square miles]. The challenges we face in terms of accessibility, road safety and liveability, demand innovative and realistic solutions that are smart, green and immediately applicable.

The Netherlands owes much to its stakeholder-based approach toward economic development. In an early stage of [the preparations for] automated driving, we are stimulating public-private collaboration. We are inviting authorities, OEMs, the automotive industry, insurance companies and planners, to the table.

We Dutch are not only ready for innovation, but we also understand the consequences of having connected cars and connected homes, to enhance connections throughout our lives."

SWARCO

The Better Way. Every Day.

1969 – ANNIVERSARY – 2019 50 swarco 1969 – ANNIVERSARY – 2019

You encounter us every day on the roads of our planet. At the traffic light, on the motorway, in a car park, at the charging station or on board public transport.

Our products, systems, services and turnkey solutions offer direction, information, safety and convenient travelling, and all this as environmentally sound as possible.

We improve quality of life for all people on the move. SWARCO's over 3,700 traffic experts are looking forward to providing you with the solutions that really meet your individual needs.

What can we do for you today?

Meet us at the
13th ITS European Congress

13th ITS EUROPEAN CONGRESS
FULFILLING ITS PROMISES
Brainport Eindhoven, the Netherlands | 3-6 June 2019

3 – 6 June 2019
Brainport Eindhoven / NL
Stand 0.14

www.swarco.com

swarco

Eyes on Eindhoven

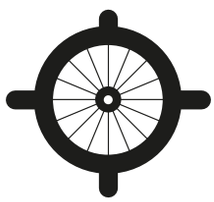
Europe's transportation luminaries will be heading to the Netherlands in June for the 13th ITS European Congress. Here are some transportation-related facts about the host city

227,000
people live within the city's boundaries

5.7 million
passengers passed through Eindhoven airport in **2017**

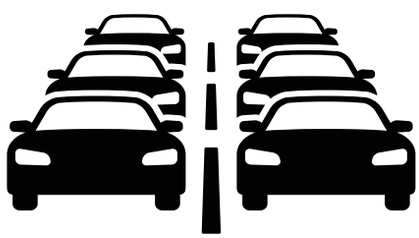
79 hours
added to the average driver's annual travel time due to congestion

It takes
15 minutes
to drive from the city center to the Netherlands' second-largest airport



The world's first suspended cycle path roundabout is in Eindhoven

5th



most congested city in the Netherlands

46,614,703 miles
(75,019,115km)
were covered by vehicles in Eindhoven in **2016**

888,400ha
the size of Eindhoven (88,84km²)

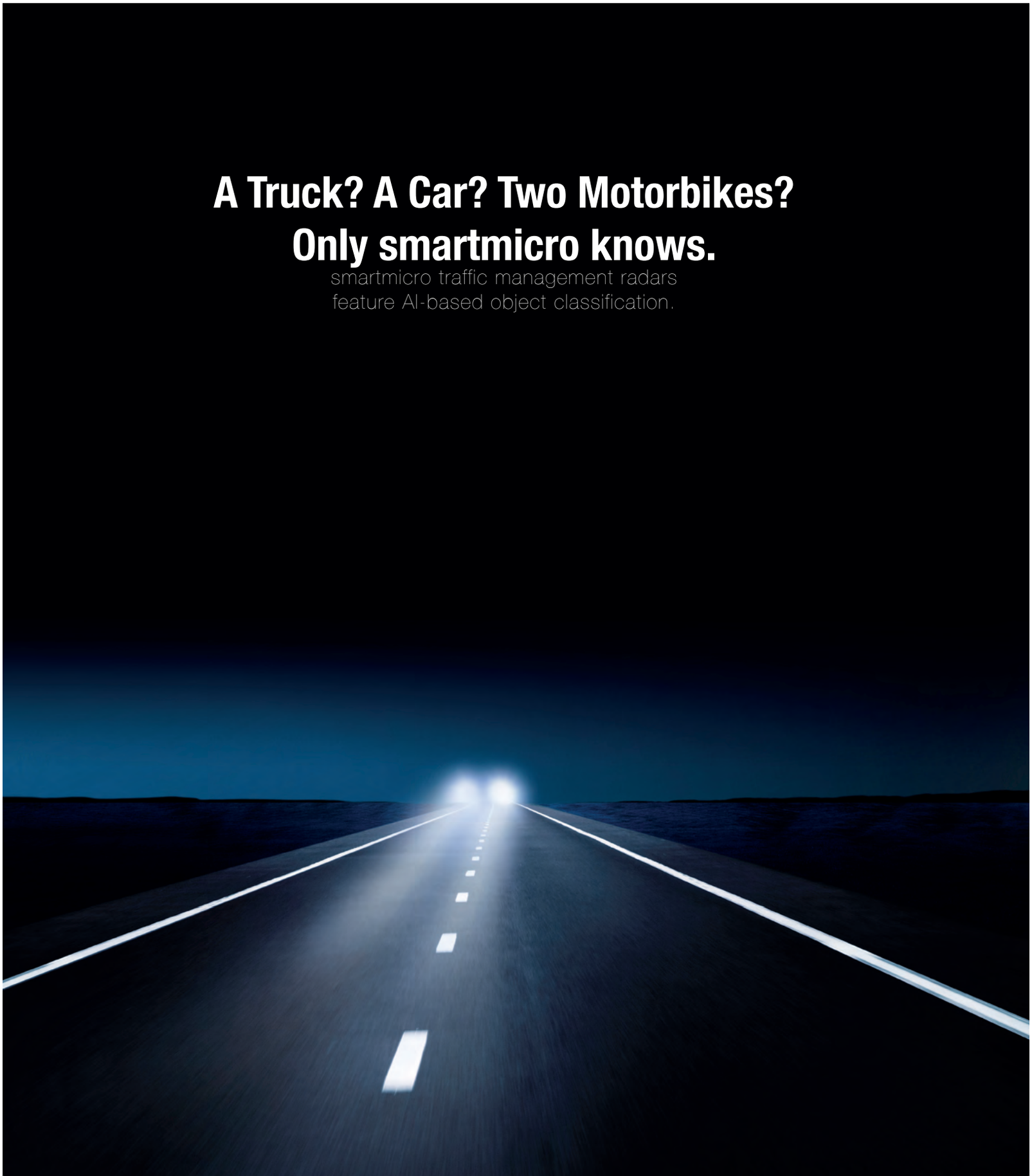
A 1km (0.6 mile) cycling path with over **50,000** solar-powered glow-in-the-dark stones was inspired by Vincent van Gogh's painting Starry Night

2,303 miles
of roads make up the city's network (3,707km)

smartmicro
SMARTMICRO.DE/TRAFFIC

A Truck? A Car? Two Motorbikes? Only smartmicro knows.

smartmicro traffic management radars
feature AI-based object classification.



Left: **New transportation modes such as Segways are adding to the number of vulnerable road users**

Using data to improve safety

John Lower reports on a new drive by the US Department of Transportation to use data to make roads safer

The US is looking to make progress in its national road safety performance, especially where vulnerable road users (VRUs) are concerned. The National Transportation Safety Board (NTSB) released its *Pedestrian Safety Special Investigative Report* in 2018 to address the continuing increase in pedestrian fatalities and now the NTSB has called for the implementation of a comprehensive strategy to reduce speeding-related crashes. Higher vehicle speeds are strongly associated with more VRU crashes and more serious VRU injuries. Now under review by the Federal Highway Administration (FHWA), the NTSB recommendations include requiring crash and VRU statistics to be analyzed as part of an assessment of appropriate speed limit setting, and the incorporation of the 'safe systems' approach for urban roads.

16%
The proportion of all road fatalities in the US in 2016 that were pedestrians (up from 11.4% in 2007)

> Advances in data science have the potential to transform the Department's approach to safety research and provide insights that can help improve highway safety
>
> ***Elaine Chao, US Secretary of Transportation***

The safe systems approach emphasizes that some degree of roadway user error will always occur, but such errors should not result in a fatality or serious injury. With this approach, speed limits are set according to the crash types most likely to occur. The primary criterion is the safety of all road users. This approach usually results in lower speed limits than those that would be determined by the engineering and expert system approaches. Tactics such as traffic calming, physical separation of roadway users, and treatments that enhance VRU visibility to give drivers greater reaction time are safe systems. A safe systems approach requires holistic planning of roads and interconnected factors to provide optimal safety.

Vision Zero

Efforts to reduce speeding are a major focus of many Vision Zero programs, which emphasize intensified traffic engineering measures. Innovative agencies are exploring smart sensor options to quantify VRU use on roadways and communicate suggested variable speed limits, including explanations of why reduced speeds are suggested. This takes advantage of the increasing connectivity being built into new vehicles, which communicate posted speed limits on the vehicle instrument panel.

The USDOT's strategic plan for 2019-2022 sets a roadmap for improved safety by integrating traditional data sources with new, external ones, increasing data analysis capabilities, and promoting the use of data to understand safety risk better. "Advances in data science have the potential to transform the Department's approach to safety research and provide insights that can help improve highway safety," said US Secretary of Transportation Elaine Chao.

In the age of data, there is exponentially more VRU-related data out there that, when collected, analyzed and used to its full potential, could help city, state, national and international transportation bodies reduce rising VRU injuries and fatalities.

John Lower is a fellow of ITE and past chair of its Transportation Systems Management and Operations Council, a League of American Bicyclists certified instructor, and a city transportation manager for over 20 years. He is currently associate vice president at Iteris

For more on VRU data turn to page 36

AGD®

PRODUCT SOLUTIONS FOR
INTELLIGENT TRAFFIC SYSTEMS

Next-generation traffic and pedestrian control solutions

AGD **318**
TRAFFIC CONTROL RADAR

Enhanced Traffic Control Radar

- MOVA IN & X compatible
- New stationary and queuing traffic detection
- Non-intrusive virtual loop technology
- Fast, easy WiFi AGD Touch-setup

AGD **645**
PEDESTRIAN DETECTOR

Smart Optical Pedestrian Detector

- Larger 10x3m detection zone
- IP and real-time video for effective decision-making
- New volumetric capability in wait area
- Fast, easy WiFi AGD Touch-setup

Create integrated traffic and pedestrian control solutions for large-zone crossings with AGD traffic control radar teamed with the AGD 645 Pedestrian Detector. This smart optical kerbside detector, with its large 10 x 3m detection zone, is super-crossing compatible. Volumetric detection provides real-time dynamic adjustment to the pedestrian green phase to cope with fluctuating demand. Advanced optics offer enhanced detect and reject, and IP capability delivers real-time video and cancelled demand data straight to control rooms.

+44 (0) 1452 854212 enquiries@agd-systems.com www.agd-systems.com

safer, greener, more efficient

THE TRAFFIC GROUP

Spotlight on Shanghai

It's almost time for Intertraffic China! Here are the key highlights of the not-to-be missed event that will connect global suppliers with traffic technology professionals in Asia

11,892
The number of traffic and mobility professionals that attended Intertraffic China in 2018

This year Intertraffic will host its 13th traffic technology exhibition in Shanghai, China. The three-day event, taking place from May 27-29, 2019, at the National Exhibition and Convention Center, will help traffic technology industry professionals from around the globe to explore commerce opportunities and establish partnerships in China, as well as broaden their industry knowledge.

As with all Intertraffic events, visitors at Intertraffic China will be the first to experience the latest infrastructure, traffic management, parking safety and smart mobility innovations from more than 300 exhibiting companies.

57
Different nations were represented at Intertraffic China in 2018

In addition, the Smart Mobility Conference program, jointly organized by Intertraffic and ITS China, will offer presentations from key industry players on topics such as Mobility as a Service, big data and smart mobility. Delegates at Intertraffic China can attend the conference program free of charge.

Attendees at Intertraffic China will also be granted access to the coinciding Intertraffic ITSUP China event – a platform that enables startup companies in the traffic technology sector to meet and showcase their innovations to stakeholders, investors and potential partners.

To find out more about Intertraffic China and to book your pass, visit: www.intertraffic.com/china

emovis
an Abertis company

IBTTA PLATINUM 2019 SPONSOR

TOLL EXCELLENCE AWARDS
IBTTA ★ 2018

LESS TIME IN TRAFFIC, MORE TIME WITH THE FAMILY

Move and flow with us

emovis.com | Follow us

FROM THE PUBLISHER OF *TRAFFIC TECHNOLOGY INTERNATIONAL* MAGAZINE

the FUTURE of TRANSPORTATION World Conference

December 10 & 11, 2019

VIENNA, AUSTRIA

Multiple streams, over 200 speakers,
PLUS *meet the companies shaping the future of transportation in our exhibitor zone!*

www.thefutureoftransport.com

2020-2030

AND BEYOND...

CHANGING THE WAY PEOPLE THINK ABOUT TRANSPORTATION & URBAN MOBILITY!

STREAMS & SESSIONS INCLUDE:

URBAN CITY AND INTERCITY eVTOL AIR MOBILITY

MASS DEPLOYMENT OF LEVEL 5 AUTONOMOUS VEHICLES

5G – HIGH-FIDELITY COMMUNICATION NETWORKS

ENERGY – POWERING THE FUTURE OF TRANSPORT

MOBILITY AS A SERVICE

CHANGING LANDSCAPE FOR THE AUTOMOTIVE INDUSTRY

QUANTUM SHIFTS

VISIT THE WEBSITE FOR MORE DETAILS AND TO REGISTER!

www.thefutureoftransport.com

Attendees of this year's ITS America Annual Meeting will find Ford's **Sherif Marakby** in a collaborative mood when it comes to planning AV deployment

Interviewed by Tom Stone

In June, Sherif Marakby, president and CEO of Ford Autonomous Vehicles, will take part in the keynote discussion at ITS America's Annual Meeting in Washington DC, which may serve as a rallying call to traffic management authorities, inviting them to collaborate with automotive makers in developing the technologies and infrastructure that will enable a future of genuinely integrated autonomous vehicles (AVs). He may also highlight the crucial role that ITS knowledge must play in ensuring AVs fulfill their promise of easing – and not merely aggravating – urban congestion. He is also likely to suggest that local and state entities should be relieved of ad hoc responsibilities for AV testing standards, arguing instead for a more unified, global approach.

Beginning the journey

In 2018 Ford created Ford Autonomous Vehicles as a separate unit, dedicated to developing AV systems in partnership with Argo AI. Together they are trialling the types of service and rider experience that AVs could one day provide. Its declared aim is to establish an operational self-driving mobility service in 2021. Yet, with Nissan, Uber and Waymo beginning to distance themselves from previous claims about an imminent future of fully driverless cars in general circulation, Ford CEO Jim Hackett recently admitted that Ford may have 'overestimated' their arrival. While Marakby is committed to the 2021 target, he acknowledges that Ford's proposed system will have significant limitations, remaining segregated from general traffic in geofenced areas and falling short of full Level 5 automation.

> If specific cities decide to partner with OEMs to put infrastructure in, we would be happy to work with them now

ITS America Annual Meeting

This year ITS America's Annual Meeting will be held in the US capital, Washington DC, at the Walter E Washington Convention Center (June 4-7). With the offices of the USDOT being nearby, it is expected that engagement from federal officials will be higher than ever before, meaning this could be the moment for a real change in transportation that will affect state DOTs for years to come.

As in previous years, sessions will be split into three main categories – Executive, Special Interest and Technical – in addition to which there will be keynotes, workshops and practical demonstrations.

As part of the keynote presentation at 9:45am on Wednesday, June 5, Ford's Sherif Marakby will join keynote speaker Jeff Klei, president of Continental for North America, for a discussion around the day's theme: Safer, Greener, Smarter. Also scheduled to take part in the discussion are Angel Mendez, CEO of Here Technologies, and Gabe Klein, co-founder of Cityfi.

The following day, Amazon.com vice president for global innovation policy and communications Paul Mizener will give the keynote and discuss the theme Moving People, Data and Freight with panelists currently set to include Joe Bergera, president and CEO of Iteris; Therese McMillan, executive director of the Metropolitan Transportation Commission; and Dr Josh Switkes, founder and CEO, Peloton.

Anyone wishing to attend can register at **www.itsamerica2019.org** and should book local accommodation early to avoid disappointment. Special housing deals are available through the Annual Meeting website after registration is complete.

"For a non-geofenced, Level 5 vehicle that can go anywhere, a lot of things still need to happen," says Marakby. "The mapping technology needs to be fully embedded. The cost of sensors needs to come down significantly. The human element – how people interface with autonomy on a personal level – must still be worked out." Currently Ford is tackling such issues for a Level 4 service, capable of driving in normal conditions without human intervention. "Our strategy is shared mobility, with a purpose-built hybrid-electric vehicle moving people and goods, starting in 2021, taking us a step toward a non-geofenced system."

Managing AVs

Traffic managers may face new challenges contending with AV operations in geofenced zones within wider traffic networks. But though Ford's AVs will be connected to the cloud and cellular networks, at first Marakby expects them to be substantially independent, not relying on vehicle-to-infrastructure (V2I) connectivity for safety-critical functions such as collision avoidance. "First-generation AVs are going to be heavy-sensing and computer on board," he says. "Eventually I think the industry will progress two ways: connecting to the infrastructure, maybe getting the data necessary to do more difficult maneuvers at intersections; then connecting vehicle-to-vehicle [V2V] getting data from outside, rather than from onboard sensing. It's a two-phased approach: initial and future." For that future phase to be attained, involving traffic authorities will be paramount.

"The industry is developing AVs that are reliant on themselves rather than their environment, because the infrastructure needed for that does not exist." It's a chicken-and-egg situation for which Marakby hopes to enlist the support of America's ITS community to resolve. "There are some efforts in China, Europe and the US in that regard, but to varying degrees," he continues. "If specific cities decide to partner with OEMs and autonomy developers to put infrastructure in, we would be happy to work with them now. It's going to take years, so we don't need to wait to begin working on this." Local traffic expertise will moreover be crucial in determining whether AVs provide a remedy or a complication to existing traffic ailments.

Whereas AVs are often credited with utopian potential to resolve mounting congestion, naysayers think them more likely to compound gridlock through their laborious operations, stopping when confronted with unfamiliar safety scenarios and encouraging more journeys to be embarked upon, and over longer distances, meaning vehicle numbers will greatly increase.

Can AVs really have a positive, transformative effect? "It depends," says Marakby. "It's a promising technology for cities and the environment, but just adding AVs that are not shared into business areas could actually increase congestion. I believe we can reduce congestion by working with city traffic managers, who are experts on traffic patterns and where congestion is. The relationships we're building with cities are going to be fundamental to that."

Setting standards

Bearing in mind the much-reported 2017 Uber self-driving fatality, Marakby concedes that it will take time to achieve public confidence in AV operations. "The US has 35,000 road deaths each year, 90% human-caused, but when we have an AV accident,

consumer perception is much more alert. In surveys, more than 50% of people who haven't experienced these vehicles immediately say they don't want to be in one. We would all love to get to zero accidents, but realistically some things will be unavoidable."

A gradual path to public acceptance must encompass methodical simulation and testing with cross-industry cooperation. Marakby welcomes USDOT plans for the National Highway Transport Safety Administration (NHTSA) to adapt existing US safety standards, currently requiring motor vehicles to have traditional controls, to accommodate new, driverless configurations. "On the regulatory front, it is helpful to have a national or global standard, not local standards that mean designing vehicles differently for different communities. We believe individual cities should be regulating the things they do today, such as permits – not the standards on the vehicle itself."

Disruption for OEMs

In the end, auto makers could face an fundamental shift away from entrenched business models centered on private ownership of vehicles over at least 10 years, clocking perhaps 150,000 miles while parked 95% of the time. Like the airline industry, the shared-mobility business that could make AV deployment viable will rely on high use of AVs engineered to endure hundreds of thousands of miles in much shorter times.

"We could actually have a lot of volume, because we're going through more cars in a shorter period. Some models say we could grow, others say our base business will shrink. In reality I don't think anybody really knows. I realize it's a disruption," he concludes, "but if we don't disrupt ourselves, somebody else will." Though humans may not be driving, there is surely an interesting ride ahead.

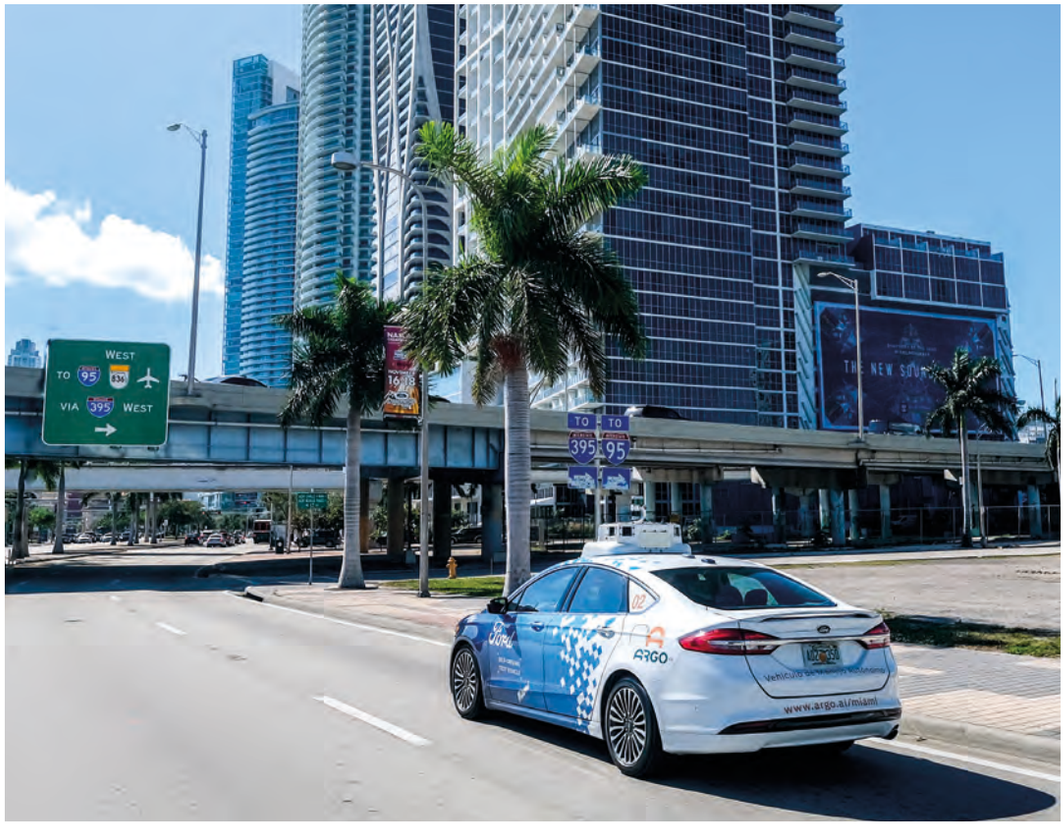
Planning for the future

Ford Autonomous Vehicles LLC is headquartered in downtown Detroit, with an AV design team working in Dearborn, Michigan. It has a facility in Silicon Valley and is poised to open a major manufacturing center in Michigan to produce the electric and hybrid vehicles on which AVs will be based. Ford bought Pittsburgh-based Argo AI in 2017 and plans to provide self-driving services in designated areas by 2021. As traditional auto makers grapple with disruptive outside competition from the likes of Uber and Waymo, a cost-saving partnership could see Ford manufacture Volkswagen-branded AVs in America while VW produces Ford AVs in Europe.

As the technology progresses, Ford is pursuing a parallel effort to explore business services and forms of interface that may provide a best fit for AVs. In Miami-Dade County, a pilot project with delivery-focused partners Walmart, Postmates and Domino's Pizza is afoot, simulating possible AV experiences. When an AV delivery vehicle arrives, users might be prompted by text message to enter an access code on the vehicle door to retrieve their package.

Ford hopes to develop a common language for AVs to signal their intentions via flashing lights – and last August tested pedestrian responses to an 'autonomous' car that in fact had a concealed human driver dressed to resemble a seat.

> On the regulatory front, it is helpful to have a national or global standard, not local standards that mean designing vehicles differently for different communities



Right and below: **Ford is currently testing autonomous vehicles on public roads in the USA**

ALPR overload?

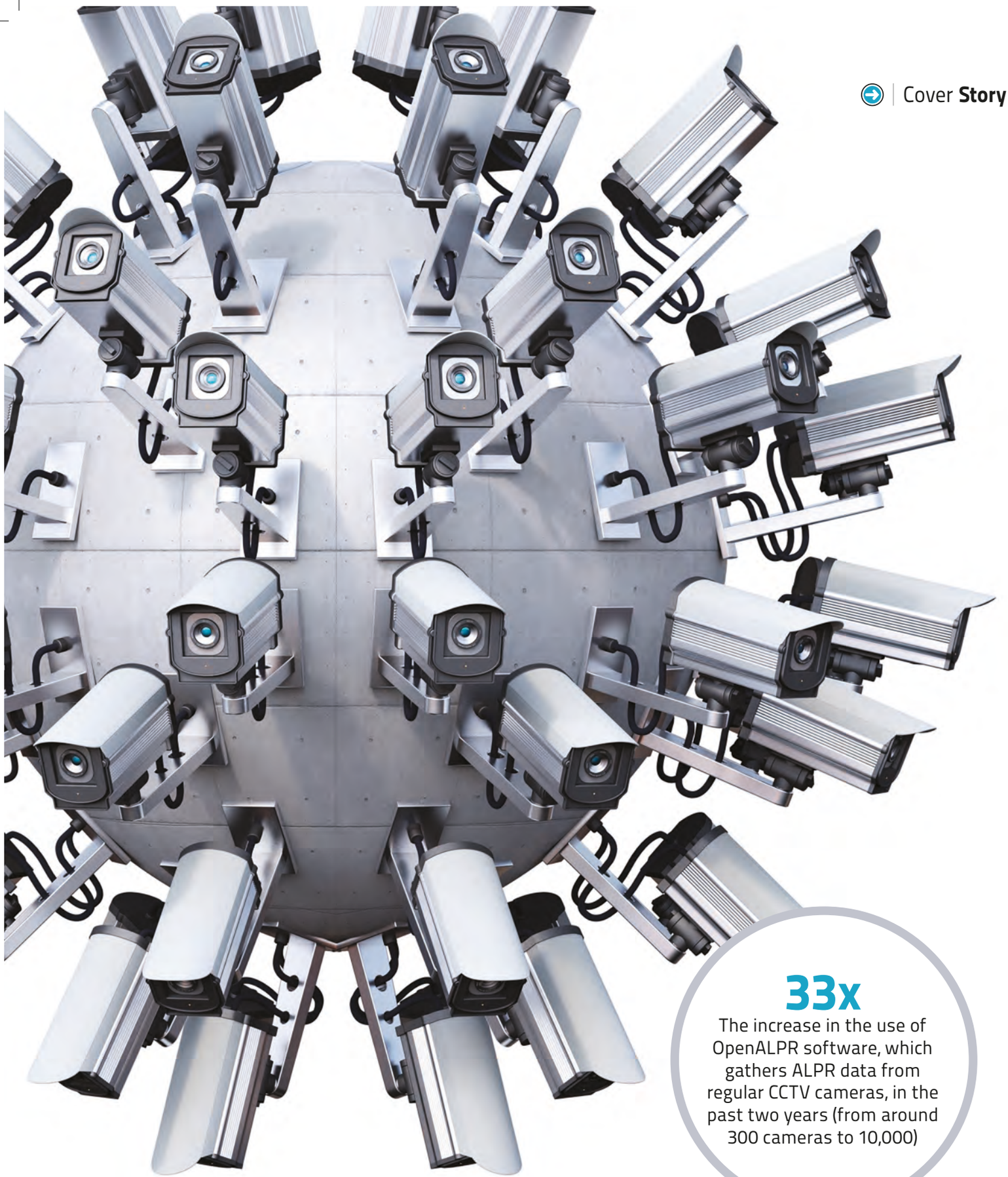
As ALPR becomes cheaper and easier to deploy, private companies are beginning to use it to enable targeted marketing and more. **David W Smith** asks if such developments represent an overuse of the technology that could erode public trust in traffic enforcement techniques

Police and road authorities have become increasingly reliant on vast networks of ALPR (automatic license plate recognition) cameras to monitor their territories. Tens of thousands of these controversial devices screen vehicles across the US every minute and similar camera systems have provided the evidence for 6.9 million penalty notices in the UK in the past five years. But authorities on both sides of the Atlantic are now facing the likelihood of a backlash against the use of the cameras as concerns about abuses of personal data proliferate. Campaigners argue that the only way to avoid public distrust is to introduce strict policies governing legitimate use of the data. To date, however, few jurisdictions have taken this step.

In the USA, privacy campaign groups such as the non-profit San Francisco-based Electronic Frontier Foundation (EFF) have been warning about the dangers of creating a 'surveillance state' for years. The EFF has repeatedly exposed how private ALPR companies take advantage of weak legislation to sell sensitive personal data commercially. But the legislature in the USA has been slow to respond. So far only 16 US states have enacted statutes relating to ALPR use and data retention, and even where rules exist, they are rarely publicized.

> The US is very light in terms of regulating what the private ALPR providers can collect, store and sell commercially
>
> **Kabrina Chang, professor of business law and ethics, Boston University**

The risk of bad publicity surrounding the cameras is intensifying. Free off-the-shelf



33x

The increase in the use of OpenALPR software, which gathers ALPR data from regular CCTV cameras, in the past two years (from around 300 cameras to 10,000)

Left: **ALPR enables police to gather vehicle data quickly and covertly, but this opens up opportunities for abuse of power. For example, US police departments have been accused of using such data to monitor minority groups, such as Muslims and the gay community**

2.8bn

The approximate number of ALPR scans held in a database by Vigilant Solutions, which is used to help collect unpaid fines in collaboration with police

software now makes it easy for any private company to set up an ALPR camera. For example, software from OpenALPR turns any web-connected camera into an ALPR one that can monitor traffic with 99% accuracy. The software was used in only 300 cameras two years ago, but now around 10,000 cameras use it in 70 countries. The software works with any basic CCTV camera, so it's cheap to set up. What's more, there are hardly any legal restrictions on private companies wishing to capture and store personal data.

"Unfortunately the USA is very light in terms of regulating what the private ALPR providers can collect, store and sell commercially," says Kabrina Chang, professor of Business Law and Ethics at Boston University. "ALPR data is arguably even more invasive than social media data, and we've witnessed a huge backlash against Facebook's sharing of personal information. The weakness of the controls risks undermining public trust in the legitimate use of ALPR cameras for tolling and traffic control."

In the wrong hands, ALPR cameras become powerful tools in the suppression of freedom, argues Shahid Buttar, a lawyer and director of Grassroots Advocacy at the EFF.

> Mass data can be used to undermine individual and community speech. It becomes a threat to democracy, not just privacy
>
> **Shahid Buttar, director of Grassroots Advocacy, EFF**

Buttar says that ALPRs provide governments, or any other operator, with a 'time machine' to discover who was at a given location at a given time. "That's an incredibly authoritarian power with hugely dystopian possibilities," he argues. "The tools can be used against people whose perspectives might make them unpopular where they live. And it's not just about individual data. Mass data can be used to undermine individual and community speech. It becomes a threat to democracy, not just privacy. We've seen this happen with social media."

Unethical practices

Although it is theoretically possible to put in place robust policies to prevent the misuse of the cameras, it rarely happens. Only 10 jurisdictions in the US, including Seattle and a handful of cities in California and Massachusetts, have done so. "Over 99% of jurisdictions have no process in place to allow public checks on the unaccountable secret acquisition of surveillance data by local police departments and government," Buttar says.

Such complacency inevitably leads to unethical practices, he says. One of the worst cases, in Buttar's view, is in Texas, where police forces have struck a deal with Vigilant Solutions, one of the country's largest brokers of ALPR technology. Vigilant provides Guadalupe County, the City of Orange and the City of Kyle free access to a suite of ALPR equipment,

massive databases of more than 2.8 billion scans and analytical tools. In return, Vigilant gains access to information about outstanding court fees. It creates a 'hot list' of drivers that officers use to spot offenders and give them a choice of arrest or paying the original fine plus an extra 25%. All the money goes to Vigilant. The contracts also allow Vigilant to retain the ALPR data "as long as it has commercial value".

"Effectively ALPR cameras are used to turn the police into debt collectors," says Buttar. "The Texas situation is what happens in the absence of legislation – and that is generally the case."

Another EFF report showed how the Californian real-estate group Irvine Company was sharing ALPR data from a chain of around 50 shopping centers across the state with the US Immigration and Customs Enforcement (ICE) contractor, giving the agency the ability to track license plate numbers it captures in near real time.

Oversharing?

Few citizens are aware of the quantity of their personal data being widely shared across state lines. EFF last year filed Freedom of Information requests via Muckrock, a government transparency platform, about Vigilant's deals with local and federal agencies. Responses showed that 173 entities in 23 states, including police departments and federal agencies, scanned 2.5 billion license plates in 2016 and 2017. Only 0.5% of the cars belonged to individuals who had committed crimes, yet the data was widely shared. The EFF found that each agency was on average sharing the data with 160 other jurisdictions at various levels of government. The worry is that sharing such personal information across state lines makes it harder to carry out appropriate oversight, especially as privacy laws differ from state to state. EFF is also concerned about data vulnerability to hackers when there are so many points of vulnerability right across the US.

Despite the obvious dangers, ALPR companies don't even hide their commercial intentions. A brochure advertising the ALPR systems offered by German technology company Sheidt and Bachmann says that plate scanning "provides statistically informative data on customer use patterns" for marketing purposes. Meanwhile PlateSmart technologies advertises various uses in security and "business intelligence" including tracking the demographic information of people who drive into parking lots. The brochure also says PlateSmart's ALPR systems can connect casinos to police when individuals on its hotlists of criminals turn up.

Although some of the purposes for the ALPR cameras are legitimate, the potential for abuse is high, says Prof. Joseph Giacalone, a retired policeman who is now a legal expert at the John Jay College of Criminal Justice.

"As an ex-policeman, I'm always skeptical of people and their intentions," he says. "I'm not a fan of governments, or private ALPR operators, selling personal data to private companies and we know it's happening. One concern is that the data could be used to stalk ex-spouses, or that perpetrators of domestic violence could use it to

Parking spies

While legislation appears to offer more ALPR data privacy in the UK than in the USA, there is some concern that loopholes are being exploited

The UK's police and local governments are just as reliant on ALPR cameras as their US counterparts. Last year police forces in the UK recorded 10.1 billion license plate scans. Meanwhile, ALPR cameras installed by local authorities have generated nearly £500m (US$650m) of fines for councils in the last five years for offenses such as parking illegally.

According to a freedom of information request from Auto Express, councils, police forces and Highways England operate 8,768 ALPR cameras in the UK (though the UK police website estimates 11,000 cameras).

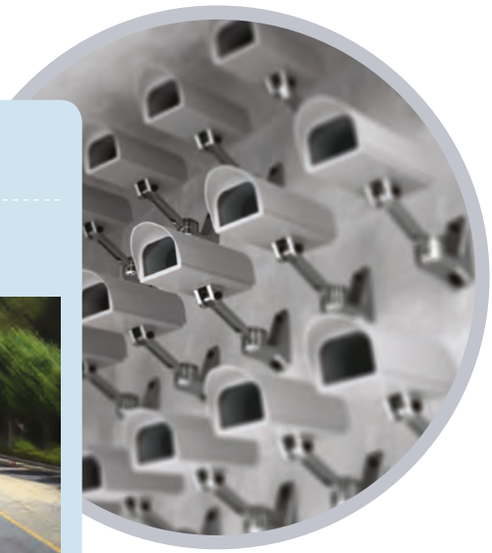
As in the USA, privacy campaigners in the UK object to the scale of the "secret surveillance", although British police are legally obliged to delete ALPR footage after 12 months. One of the campaigners' concerns is that private parking companies – not included in the investigation – are buying the personal details of thousands of motorists every day from the licensing authority.

Right: **Today, regular CCTV cameras in parking garages can be used to gather ALPR data**

0.5%

The proportion of ALPR data in the Vigilant Solutions database that relates to the cars of criminals

> I'm not a fan of governments, or private ALPR operators, selling personal data to private companies – and we know it's happening
>
> **Prof. Joseph Giacalone, criminal investigation expert, John Jay College of Criminal Justice**



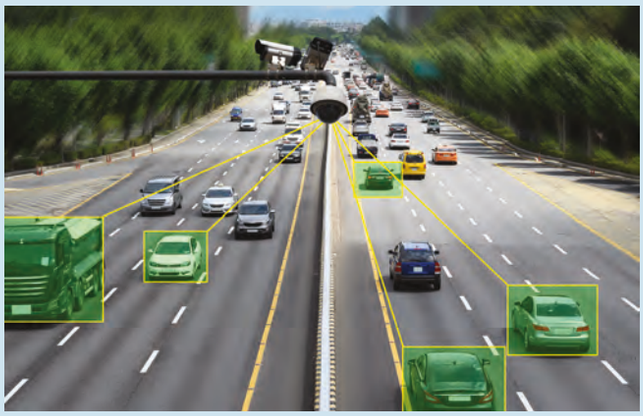
Immigration under scrutiny

ALPR is a useful tool for border control, but widespread access to a vast, unfiltered database risks undermining civil liberties

Newly released documents have shown how the US Immigration and Customs Enforcement (ICE) uses enormous ALPR databases to track and target immigrants.

The documents were obtained through a Freedom of Information lawsuit by the American Civil Liberties Union (ACLU). They reveal that more than 9,000 ICE agents have access to the national database operated by Vigilant Solutions under a US$6.1m contract that runs until September 2020.

It provides more than five billion data points of location information collected from private businesses, such as insurance companies and parking lots. ICE also gains access to an additional 1.5 billion records collected by law enforcement until September 2020. The ACLU says more than 80 local law enforcement agencies have agreed to share ALPR data with ICE. Vigilant says its database grows by an additional 150-200 million unique license plate scans per month.



ACLU staff attorney Vasudha Talla says: "The ACLU's grave concerns about the civil liberties risks of license plate readers take on greater urgency as this surveillance information fuels ICE's deportation machine."

For an investigation of the traffic challenges faced at borders, and how ALPR can help, turn to page 42.

track down their victims. We must also remember that police and local governments are playing technological catch up with the private sector, where they eat, sleep and drink this stuff, and what they can do with it is scary and fascinating."

Giacalone acknowledges that transport authorities have valid reasons to deploy ALPR cameras, including analyzing traffic patterns. And he even suggests police might justifiably tap into the municipality data if they are looking for vehicles that have left the scene of a crime. But he believes the public will never trust the cameras until they are reassured that their personal data is anonymized and won't be shared with third parties.

> It is theoretically possible for city authorities to design tools to respect civil liberties and it is absolutely in their interests to introduce accountable processes that involve civilian oversight
>
> **Shahid Buttar, director of Grassroots Advocacy, EFF**

Smarter in Seattle

One municipality that has come to the same conclusion is Seattle, where the government is a leader in safeguarding citizens' data. Since 2014 the city has worked closely with the public to create policies that prevent residents from being spied on while also allowing the implementation of smart city technologies. Seattle's initiatives include appointing a privacy officer, creating a set of privacy principles and setting up a privacy advisory committee (PAC) that includes citizens. Last year the city council passed an ordinance requiring an audit of all systems used for surveillance, including ALPR cameras.

One of the most important of Seattle's policies is to use technology to de-identify personal information. The city is aware that taking data sets from multiple sources can create a 'mosaic effect' that compromises individual privacy. "Creating guidelines for data use is a big step in the right direction," says Chang. "People know there is a diverse group made up of their fellow citizens and public servants reviewing how their data is being collected and what is being done with it. But it's unusual for city councils to take such steps."

Boston, where Chang lives and works, is the scene of some of the biggest data abuses involving ALPR cameras. In 2015 a reporter from the Boston Institute for Nonprofit Journalism alerted the authorities that anyone could freely access a City of Boston ALPR system to download dozens of sensitive files, including hundreds of thousands of motor vehicle records dating back to 2012. This was the most recent of several ALPR data breaches in Boston, although the city is far from unique in the USA. The EFF calls this type of warehousing of vehicle information a "public records nightmare".

"It is theoretically possible for city authorities to design tools to respect civil liberties and it is absolutely in their interests to introduce accountable processes that involve civilian oversight," says Buttar. "If the tools are misused, the PR backlash will be substantial and the costs could be enormous. But even that pales in comparison to the liberty principle and the harm to civil society."

160

The average number of additional agencies ALPR data is shared with in the USA, beyond the one where it was originally captured

Are HOT frauds laughing at you?

High-occupancy vehicle and toll (HOV and HOT) lanes are designed to reward passenger-carrying drivers with faster journey times and discounts. But cheating is rife. **Paul Willis** looks at the enforcement solutions authorities can use to fight back, from manual checks to automated cameras and the latest in smartphone-based systems

Some drivers have been caught using dummies – and even fake skeletons – in an attempt to fool vehicle occupancy detectors

The driving public is certainly creative. On a single day last September, US highway patrol cops in the state of Washington pulled over three separate motorists attempting to drive solo in high-occupancy vehicle (HOV) lanes.

In each case, the motorists had tried to fool authorities into believing they had passengers by installing dummies in their cars. In one case, the dummy was a fake skeleton sporting a baseball hat. In another it was a pillow dressed in a long coat. The third pseudo passenger was a manikin in glasses and face mask.

HOV lanes – road lanes on highways reserved for multiple occupancy vehicles – are a common feature in the USA, as are high-occupancy toll (HOT) lanes. They are meant to reduce congestion by incentivizing car pooling, but the reality is that the system is frequently abused, say highways agencies.

"We're seeing between 20% and 30% cheating, which is comparable to what other agencies around the country are seeing," says Timothy Lew, senior director for countywide planning and congestion reduction at Los Angeles County Metropolitan Transportation Authority (LA Metro, for short).

> It's costly to have officers in all the gantries. There's also a safety aspect because a lot of these lanes are high speed so there's a risk when an officer pulls someone over
>
> **Natalie Bettger, senior program manager for congestion management and system operation, NCTCG**

This is confirmed by Natalie Bettger, senior program manager for congestion management and system operation at the North Central Texas Council of Governments (NCTCG), which has oversight for the road network in Dallas. Bettger says that police estimates of violators on the HOT roads under their jurisdiction run to "anywhere up to one-third of motorists".

Most agencies currently deal with cheaters through some type of police enforcement. In Dallas, highway patrol cars at gantries read the toll tags of motorists passing below. Those registered as high occupancy are flagged by the scanners, prompting a visual check by police.

"If the police notice a cheater, they can pull them over and give them a ticket, and from there it goes to the courts," says Bettger.

But the system is problematic for several reasons, she says. "It's costly to have officers in all the gantries. There's also a safety aspect because a lot of these lanes are high speed, so there's a risk when an officer pulls someone over. You also have an impact on the transportation network: the main point of these managed lanes is to allow people to travel faster and more efficiently than they do in other lanes and when someone is pulled over it inevitably slows everyone down. So we've been looking at whether we can move from enforcement to verification."

A number of technological solutions on the market can help in this regard. They can be divided into two broad categories: camera-based and app-based.

Cameras vs phones

Most of the camera-based systems verify occupancy using near-infrared technology to photograph the inside of vehicles. The app-based systems are less intrusive, although more dependent on user interaction, requiring travelers to install a car pooling app on their smartphone that can be tracked remotely.

The Metropolitan Transportation Commission (MTC), which oversees car pool lane operations for the San Francisco Bay Area, is looking at both app- and camera-based solutions to tackle its problem of cheaters.

"The camera-based system would require cameras installed every mile and it would necessitate a lot of power alongside this," says Linda Lee, the MTC's principal transportation engineer. "So our board was interested in looking at technologies that may be less costly and may require less infrastructure."

"We've completed a request for information from various providers of occupancy-verification apps," adds Lee's colleague, Pierce Gould, MTC head of field operations and asset management. He says they plan to update the MTC operations committee soon on recommended next steps.

Above left: **Vehicle occupants are not always what they seem...**

Above right: **An automatic occupancy detection pilot underway in San Francisco**

20-30%

The approximate proportion of HOT users who are using the lanes fraudulently in the USA

MTC is further along in its testing of camera-based systems, having already conducted a pilot last year with three different automated technologies. According to Lee, the three companies behind the technologies – Conduent (formerly Xerox), Transcor and Indra – tested their systems along the same stretch of freeway in consecutive months.

Lee says, "Our pilot was short term and each vendor had just a month to go to the site, set up, calibrate, collect six days' worth of data, decommission their equipment, and vacate the site.

"So they didn't have a lot of time to do their machine learning, which is based on thousands and thousands of images. They're telling me that they can get the accuracy rates up to 95% and more, given more time."

As it was, the three technologies were able to record accuracy rates ranging from 78% to 88%. Because of these lower rates, any large-scale roll-out of the system would require flagged images to be sent for manual review, says Lee. In the long term,

The 13th ITS European Congress 2019

Brainport Region - The Netherlands
3-6 June 2019

A unique opportunity to

- Exchange information with 3000 industry stakeholders and influencers
- Discover the latest mobility solutions
- Share experiences and lessons learned
- Monitor progress and measure results of implementation and deployment
- Exhibit and experience cutting-edge technologies and innovative products and services
- Enter business and partnership opportunities
- Experience the latest technology first hand through demonstrations

Visit **www.2019.itsineurope.com** for information on Call for Contributions and Commercial Partnership & Exhibition opportunities.

Organised by: ERTICO ITS EUROPE

Hosted by: EINDHOVEN, Gemeente Helmond

Supported by: Connekt ITS Netherlands, Ministerie van Infrastructuur en Waterstaat, Brainport Development, Provincie Noord-Brabant

Far left and left: **The pilot installation of an automatic vehicle occupancy detection system that LA Metro undertook in partnership with Conduent**

however, the goal would be to push the accuracy rates up high enough that the system could be close to, if not fully automated.

At this stage, MTC is unable to disclose publicly which system proved most accurate, as it is in the process of selecting a single vendor for a phase-two pilot, says Lee. However, she says the way the three systems operate is technologically similar: "When the vehicle drives into the detection zone, there's a laser that triggers the presence of the vehicle. This causes the camera and the near-infrared flash to go off simultaneously."

Since near-infrared is at the very limit of the visible spectrum, drivers aren't disturbed by the flash going off. The only major difference between the systems was in the camera setup, says Lee. "Two of the companies use a two-camera system – one camera for the front feed, and one for the back feed. The other uses just one."

LA camera-based enforcement

LA Metro is further along in the process than MTC, having already conducted a pilot of the Conduent system in 2015.

It is now moving to proof of concept. To be installed in July and in operation by October, this will involve a larger-scale installation of the cameras into HOT lanes on the San Bernardino (Interstate 10) and Harbor (Interstate 110) freeways in Los Angeles.

The most crucial part of the next step will be the integration of the Conduent cameras into the existing toll system, says Lew.

"Right now, toll collection is via a transponder tag that motorists place in their car," he says. "The transponder has a switch on it that allows motorists to select one-, two- or three-plus occupancy. On the Harbor freeway, you need at least two occupants to be exempt from the toll, and on the San Bernardino during peak periods you need three.

"Under the new model, the Conduent system will determine occupancy and the toll system will match it to the car license plate and transponder to determine whether the motorist set the switch incorrectly.

"In the beginning, the system will respond to violations by sending out messages to the user telling them we reported that they had set their transponder incorrectly and asking them to correct it. In the future, if the system is proving to be successful, we might switch to a system where toll exemption is rescinded."

Timothy Lew says that to begin with, most of the images will be sent for manual review. "Once we have more confidence in the technology, we'll let the software review more. We don't know what the final percentage of human versus tech will be, but there will always be a human element to it."

While not disclosing the cost of the Conduent system, Lew says he believes it "will provide enough value to us to pay for the up-front installation costs and ongoing operating costs."

In any case, he says "our core principle here is congestion reduction and this system is going to help reinforce that principle."

> When the vehicle drives into the detection zone, there's a laser that triggers the presence of the vehicle. This causes the camera and the near-infrared flash to go off simultaneously
>
> **Linda Lee, principal transportation engineer, MTC**

US$23.1m

Estimated cost of manual enforcement of HOT lanes over the next 10 years in the Dallas area

Texas smartphone solution

In Dallas, on IH-30, the installation costs of camera-based occupancy verification proved too prohibitive, says Bettger. For this reason, they have opted for a cheaper app-based system created by the Irish app developer Carma.

NCTCG expects to pay US$20m over the next 10 years to implement the new system. This is compared with a cost of US$23.1m over the same period if they stayed with their current system of police enforcement. The relatively modest cost saving is enhanced by other benefits of the smartphone-based system, including improved detection rates, safety, ease of use, scalability and delay reduction.

The system, which uses an occupancy verification technology patented by Carma known as VeriRide, will be up and running on six HOT lanes in the Dallas area by December 2019. Like the Conduent roll-out in LA, it will work in collaboration with the existing toll system of transponder tags.

50%

The reduction in toll charge that the Carma app secures for drivers of HOVs in Texas

Bettger says, "You download the app and register your tag and license plate number, because that lets us match you correctly. Once registered, the customer is pretty much done. The app just works in the background."

All occupants of a vehicle traveling in a HOT lanes need to have the Carma app installed on their phones. The apps then communicate their location back to the cloud to verify vehicle occupancy. Those without a phone will be assigned a transponder that can be detected via Bluetooth on the driver's smartphone.

Integration into the toll system is done through an automated back-and-forth communication between Carma and the operators of the NCTCG's HOT lanes, either the Texas Department of Transportation (TexDOT) or third-party private operators contracted by TexDOT.

"Carma has a list of everyone who has downloaded the app," says Bettger. "They send that list to TexDOT and the private sector operator. The operators then send back a list containing all the Carma users that were recorded traveling in the toll lanes at the time the reductions applied. Carma verifies the number of occupants in those users' vehicles and the list of the ones that were HOV compliant are sent back to the operators who can apply the discount – 50% during peak hours.

"We have a separate entity that oversees the toll transactions, the North Texas Tollway Authority, and they apply the reduction in the customer's toll tag account," she says.

The fact that the full toll must be paid up-front and then a high-occupancy discount is applied retrospectively means there is no need for any additional enforcement.

Theoretically, there's nothing to stop a motorist from cheating the system by carrying multiple phones with the apps on them. To prevent this, Carma verifies smartphone locations at other times during the day, not only when the motorist is in the HOT lane.

"If there are two smartphones that are always together, that's a sign that we need to reach out to that individual and remind them of the rules," says Berger. "If it's an ongoing problem, the user could reach the point where they're no longer eligible for the HOT account."

Legal challenges

Privacy legislation creates a varied picture across different US states when it comes to using automated HOT and HOV enforcement

Finding an automated system to verify how many travelers are in a vehicle would solve a lot of problems for US transportation agencies. But it could potentially create a legal minefield, especially in the area of privacy rights.

Camera-based occupancy-tracking technologies in particular have already been singled out by civil liberty campaigners, and some transport agencies say they would be a non-starter because of the privacy issue.

"Statutorily, we're not allowed to take videos or photography that would let us identify a person," says Annie Gillespie, director of engineering at the State Road and Tollway Authority (SRTA), which runs toll roads in Georgia.

In the San Francisco Bay Area, meanwhile, the legal issues arise not around privacy, but in the enforcement of violations.

"Right now we do have legislation that would allow us to issue toll violations with a camera-based system, but not violations for occupancy," says Linda Lee, of the Metropolitan Transportation Commission (MTC).

In other words, they would be able to pursue cheaters in HOT lanes, but would have no power to stop the same violations in HOV lanes.

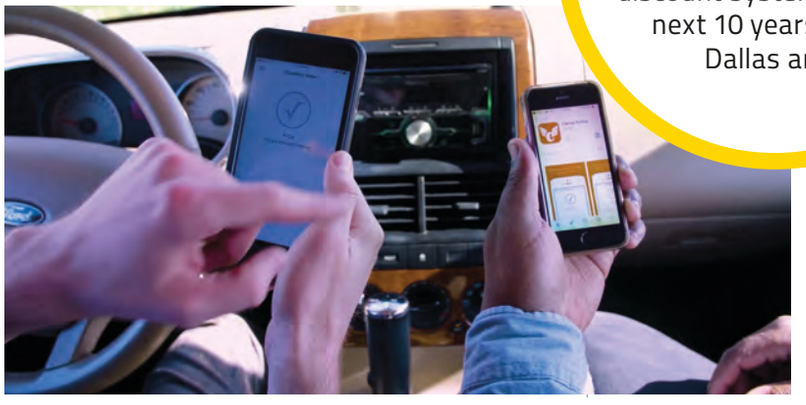
What's more, under California's strict privacy laws, the MTC can't even pass on information gleaned from their cameras to the agency that does have authority to punish violators – the California Highway Patrol.

"So, for example, if our camera system were to identify a repeat violator in an HOV lane, we wouldn't be able to pass on that person's details to the police and ask them to watch out for them," says Pierce Gould, also of the MTC. "The legal framework is something that needs to be looked at."

> Statutorily, we're not allowed to take videos or photography that would let us identify a person
>
> **Annie Gillespie, director of engineering, State Road and Tollway Authority, Georgia, USA**

US$20m

Estimated cost of a smartphone-based HOT discount system over the next 10 years in the Dallas area



Left: **The Carma app communicates the user's geolocation to the cloud, to verify vehicle occupancy**

Lufft

Meteorology Division of OTT HydroMet

EVERYTHING FROM ONE SOURCE

Discover the latest road weather sensors

VS20k

- Measures visibility with a range of 20 km
- Rugged & special coated housing for long durability
- Self-monitoring function: automatic contamination detection

WS100

- Smart radar precipitation sensor and disdrometer
- Maintenance-free
- Low power consumption & smart heating
- Low response threshold for very fast measurements

StaRWIS

- Stationary non-invasive road weather sensor
- Based on award-winning LED technology
- Easy to install and connect
- All-in-one: issues 9 parameters simultaneously

www.lufft.com | www.otthydromet.com

Pedaling data

London's cycling boom may be slowing, but innovative developers and campaigners in the city are now making rapid progress in incorporating bicycles into an ever-richer traffic data picture. **Michael Donlevy** discovers how it's being done, why it's important for traffic managers and planners, and how it can help to improve safety for these vulnerable road users

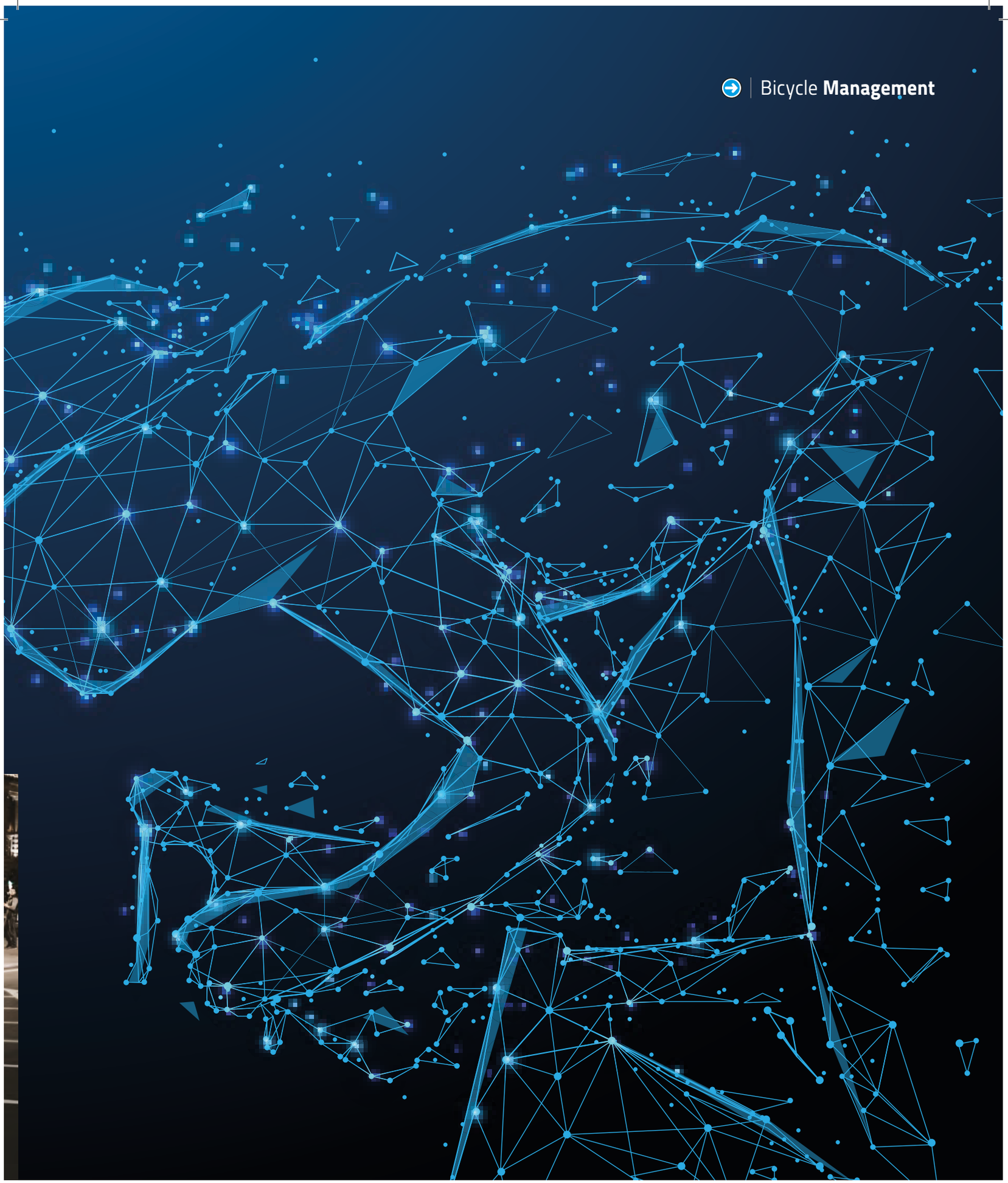
Photographs Beryl

290,000
Number of daily cycle journeys in London in 2000

Beryl started out selling lights but now also supplies data-gathering sensors

Cycling is London's fastest-growing mode of transportation this century. That's hardly a surprise, given that Transport for London (TfL) and successive mayors have invested in the city's cycle rental scheme, Cycle Superhighways and Quietways, additional bike parking, upgraded junctions and Mini-Holland programs to help outer boroughs improve their cycling infrastructure and encourage more people onto bikes.

These initiatives have helped to more than double the number of daily cycling journeys in the capital since the turn of the millennium, according to the London Assembly Transport Committee, from 290,000 in 2000 to 730,000 in 2016. Yet despite that, London has a lower cycling mode share than many other leading world cities. Cycling accounts for 2% of all journeys made, compared with



32% in Beijing, 20% in Tokyo, 13% in Berlin, 6% in Mumbai and 3% in Paris.

Increasing congestion and pollution are encouraging authorities around the world to prioritize cycling as an environmentally friendly and healthy way to commute, make short local journeys, and even deliver goods and services. But integrating this mode of transportation with traffic management and infrastructure planning to make cycling as safe as possible requires a very modern development in traffic technology: data.

Riding the data

In terms of cycling, and how traffic planners make decisions about long-term strategy, there are three types of data: historical, predicted and live. While live data is relatively new, bike sensors and GPS tracking mean it could be a valuable tool in the future, especially for cities such as London that want to increase the mode share of cycling journeys.

That's the view of Beryl, a firm that began by supplying bike lights, but now also provides data-gathering sensors for the Santander London bike-sharing scheme.

"Analyzing historical data is easier than analyzing live data," says Phil Ellis, COO, head of policy and head of product at Beryl. "Planners need the support of mature data-gathering tools, and while some authorities have those resources, others struggle.

"We have a team of developers to create a front end for our data, but it's not just about having a dashboard that *looks* useful. You must be able to develop a tool that helps traffic planners make informed decisions about cycling volumes and routes, about infrastructure, and about a long-term strategy for moving people around a city using all methods of transportation. It's the analysis of data that's key, not just the data."

This view is echoed by Simon Munk, an infrastructure campaigner at London Cycling Campaign. "Data is already being used, but the issue is data versus live data, which reflects the difference between where cycling is now and where it will be in the future," he says.

730,000
Number of daily cycle journeys in London in 2016

"But there's a lot happening already. Social fitness network Strava has started working with local councils to show who is riding, and where, right now. And now we're seeing trucks with sensors, and cyclists wearing sensors that alert HGV drivers that they're in the vicinity.

"The issue is that, in the UK, we don't have a mature cycling culture or network usage model. Many people who do cycle at the moment are fast, fearless and fit, and their data doesn't correlate to those who might cycle if the road conditions were better. The data from the Cycle Superhighways reveals that most people ride fast. And very few people start or end their journeys at either end of these routes – they usually have a journey before or after the Superhighway on busy roads, so tend to be experienced cyclists."

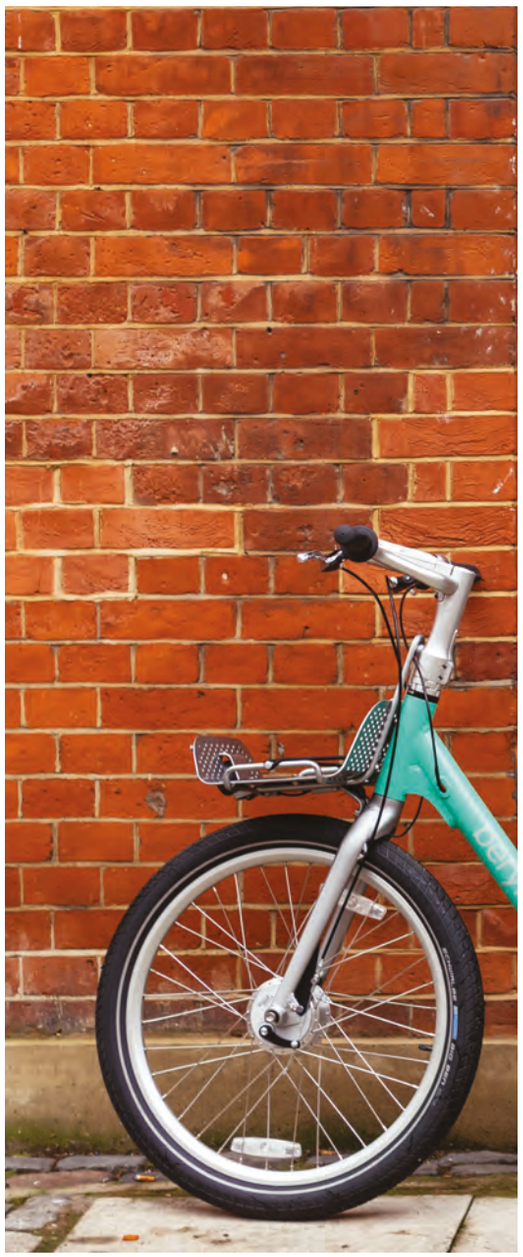
> Many people who do cycle at the moment are fast, fearless and fit, and their data doesn't correlate to those who might cycle if the road conditions were better
>
> **Simon Munk, infrastructure campaigner, London Cycling Campaign**

In fact, despite cycling's rapid growth up to 2016, the number of daily journeys actually fell slightly in 2017, from that 730,000 the previous year to 721,000. And data is the key to driving more people out of their cars and onto bikes.

The data of today

Current usage can't predict the future entirely, but there are solutions: firstly, the DfT has its Propensity to Cycle tool, and secondly TfL has Strategic Cycling Analysis. "These use census ward data to track postcodes and map journeys," says Munk. "If lots of people are going from roughly the same A to B, the journey is less than 3km [1.9 miles] and it's flat, then these are journeys that could be shifted from cars to bikes with the right planning and infrastructure."

There is also Cynemon modeling data, which surveys Londoners and their last journey to work. "It can identify people who are making short



trips, with no heavy loads, no passengers and in daylight hours," says Munk. "All this data is being used by City Hall to identify potential corridors and zones where we can increase the level of cycling. Combine that with tracking data and it's changing the way London is planning its cycle network."

Beyond London there is CWIS, the Cycling and Walking Investment Strategy, a project in which local councils use the Propensity to Cycle tool to develop long-term strategies for encouraging residents to move away from using cars.

Above: **Beryl COO Phil Ellis considers traffic planning, rather than management, the best use of his company's data**

The key is to identify desire lines – what routes are being used and where is the potential for new cycling routes to be developed? "This is where we come in, along with a lot of other people, because there are a lot of technology companies generating data from GPS that authorities can use in their planning," says Ellis.

"There is the potential to add more sensors to our offering in the future," he adds. "For example, we could incorporate accelerometers or sensors that measure road conditions, which certainly meet a desire for live data

[See *The right path*, p40, for the ways such sensors are already being used].

"These sensors could be used to send alerts about crashes or danger spots, but we have to be careful – cities are complex and there's also potential to set off false alarms, especially if a sensors mistakenly believes there's been a crash. There's still a lot of development to be done."

New bikes, new data

Data gathering will gain new layers from – but also be made more complicated by – new forms of cycling that are already starting to change how both people and goods move around cities.

"There is potential to consolidate," says Munk. "This term includes dockless bikes, Mobility as a Service and bike sharing. It also includes companies such as Pedal Me, the bike delivery service that Crossrail, for example, is using to deliver across London. These companies have a massive opportunity to gain data, and the second wave of dockless bikes are opening up an entirely new market that could also open up new data sources."

721,000
Number of daily cycle journeys in London in 2017

Automotive manufacturers have spotted the potential for diversifying here, too. Ford has developed a routing and logistical cloud software service called MoDe:Link that, in a trial with delivery company Gnewt, aims to deliver parcels more efficiently. It will coordinate last-mile deliveries using multiple modes of transportation including vans, pedestrians and, in the future, bicycle couriers. This type of service certainly counts as a new data source, if the relevant companies are prepared to share that data with local authorities.

Then there are e-bikes. "They're particularly popular in places such as Germany, France and Holland, and they have the potential to attract new cyclists because the in-built motor makes it easier to go up hills," says Munk. "They have the potential to collect data easily because they're already geared toward technology."

Ellis views e-bikes as an important part of future planning and data gathering, especially now that companies such as Uber are offering e-bike-sharing schemes – in this case its Jump service. "In the future, connected bikes will link with other connected vehicles at a local level, and for me, in bike-share terms, that means verifying data for e-bikes so authorities can plan e-charging points for bikes as well as cars.

"Mobility hubs that offer automated connectivity and charging points for all electric vehicles will form an important part of Mobility as a Service to stitch journeys together," he adds. "I also think this is important because e-bikes can go faster but are also heavier than regular bikes, so the data they generate may be very different to the sort of data you see on an app such as Strava. There may be routes that are safe for cyclists, but not so safe for e-bikes, for example."

40%
The proportion of commutes completed by bicycle in the 'world cycling capital' of Amsterdam, compared with 32% in Beijing and just 2% in London

In private

One issue with all this data is privacy. Just as many people feel uncomfortable with having their movements on foot recorded by CCTV, some cyclists – particularly those who don't use apps such as Strava – may object to having their journeys tracked.

"Big Brother is a factor, and we have to take it seriously," Ellis concedes. "From our perspective we track each bike as an asset, and we track the bike only, not a user's GPS from his or her phone. We share our data with each local authority, but that's a very different data set than you'd get from a user's entire journey. Still, we have to have internal policies for managing and sharing data.

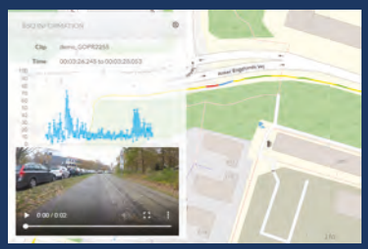
"It's important because we need as much journey data – publicly available data – as possible to help authorities make planning decisions, and I'd like to think that one day our users would rather we collate their bike share data if it means we can use a sensor that alerts a nearby truck driver to their presence. Data is all part of working with cities to develop long-term strategies for cycle planning and cycling safety."

The right path

How Hermes Traffic Intelligence can help improve safety by improving the quality of the roads on which cyclists ride

Danish company Hermes Traffic Intelligence offers local authorities a service called Bike Path Surface Quality that uses sensors and cameras to help gather data on the quality of bike paths and identify potential danger spots.

Once an authority has chosen the section of path to assess, the company will help a nominated test cyclist choose the right bike, fit the camera and accelerometer, and determine the time of the test and the speed at which to ride. The cyclist rides the chosen route so data and video can be recorded, and the results are then uploaded to a platform called HOTS for the relevant planners to assess which routes need repairs and when.



> I'd like to think that one day our users would rather we collate their bike share data if it means we can use a sensor that alerts a nearby truck driver to their presence
>
> **Phil Ellis, chief operating officer, Beryl**

Ellis believes traffic planning, rather than traffic management, is the best use of this data.

"Bike share schemes have a platform to help improve cycling safety within a city, but I think it's been demonstrated that the best way to keep cyclists safe is to keep cyclists and vehicles away from each other. From that perspective, I'm not sure that live data can help traffic management, in terms of adjusting traffic lights for example, because I don't think the authorities will have the resources for that. Live data is better used to help the active management of cars to get around congestion. But live data can help planners build a bigger picture when it comes to infrastructure, and deciding where authorities need dedicated cycling lanes."

It won't happen overnight, however. "Just ask the Dutch," says Ellis. "It takes decades to get the right cycling infrastructure in place, and it's not as easy as simply dropping in random cycle lanes. There's a lot more to cycling safety than that."

Stuck at the border?

Are frictionless borders possible? Or will vehicles and passengers always have to negotiate a certain amount of bureaucratic tape? **Saul Wordsworth** looks at how technology may help traffic flows between nations in the future

Anyone following the ongoing saga that is Brexit will likely have heard the phrase 'frictionless border' countless times over the past couple of years. At the time of writing the exact terms under which the UK will leave the EU and when this will happen, if ever, remains uncertain. But it's clear that a key challenge is the issue of the Irish border, because if Great Britain and Northern Ireland exit the EU, with the Republic of Ireland remaining part of the union, goods crossing the border would need to be checked. However, again at the time of going to press, the UK government wants to leave the single market and customs union and yet avoid a hard Irish border: a case of having one's cake and eating it?

"The UK government has pointed toward technology as the solution but the technology they are relying on is either untested or does not exist," says Katie Daughen, head of Brexit policy at the British Irish Chamber of Commerce.

"In some ways 'frictionless border' is an oxymoron," says Katy Hayward, professor of political sociology at Queen's University Belfast, who has 20 years' research on European integration behind her. "The whole point of a border is having different arrangements on either side. One of the most frictionless borders in the world is the Irish border in its current state. This isn't just on account of European integration but also because we've had very particular arrangements in

place that were established as a result of the peace process, especially the Good Friday Agreement."

This touches on what makes a border as frictionless as possible, namely the rules and environment that enable integration and ease of movement across it. The greater difference you have on both sides – be it tariffs on goods, standards relating to food, social security issues or healthcare – the less frictionless the border. Technology comes into play only at the end.

"In a border scenario, the presence of technology is like thinking about the light fittings or curtains in a house," says Hayward. "Useful, certainly, but what you really need to focus on are the foundations, walls, ceilings and roof. At the moment technology facilitates the arrangements you have in place. If those arrangements are ones that see great divergence between the rules that apply on both sides of the border, then the technology has its work cut out and will struggle to make a border frictionless."

310
Length in miles of the Northern Ireland-Republic of Ireland border

Even the likes of Prof. Hayward would accept that a major element of border friction relates to the receiving and handling of information. If you have means of submitting accurate data, and that data is being handled effectively and processed quickly so that goods or people can be moved across a border swiftly, this is a prime example of technology aiding more seamless movement.

"What has already been introduced in most countries is the lodging of your declaration electronically prior to the arrival of goods at the border," says Michael Lux, formerly head of unit customer procedures with the European Commission and now an international consultant. "That way you can perform risk analysis on the basis of that information. The more common the rules, for instance within the EU, the easier the process and the smoother the border crossing."

ALPR, drones and blockchain

ALPR is in use at most border crossings and plays a vital role, screening vehicles associated with smuggling, illegal crossings and criminal activities. It can help establish a database of vehicles, triggering an alarm when flagged vehicles attempt to cross. ALPR's deployment at borders will not wane and may even expand, but its ability

Bullet holes in a road sign at the Irish border are a reminder that this is a frontier where territorial tensions run high

to address fundamentals in this area remains limited.

"ALPR can note that a particular truck crossed the border at a particular time but it doesn't tell us what's in the vehicle, whether it tallies with what has been declared or whether the right duty has been paid," says Hayward. "It is an excellent starting point but if you're trying to manage a customs border you want to know what's crossing, where it has come from, and whether the right duties have been paid. You will likely need to be able to inspect the goods."

Blockchain is the record-keeping technology behind Bitcoin. At its basic level the 'block' is digital information stored in the 'chain', or public database. Blockchain has been suggested as a means of guaranteeing a transaction is secure, logging each time a product moves to a new part of the supply chain and generating a unique code that holds information about a product's origin, where it has been and who has handled it. However, it would still need to be used in conjunction with other processes, not least spot inspections.

Above and right: **Increasingly, drones are being used to patrol national borders**

77
The number of border walls or fences in the world in 2019

7
The number of border walls or fences in the world in 1945

Without friction?

Efficient handling of data and technologies such as ALPR may help smooth border control, but can it be made truly frictionless? Lars Karlsson is a former director of the World Customs Organisation. In 2017 he was entrusted with preparing an academic research paper for the EU on how to design the post-Brexit borders between the EU and the UK. In the report he creates a blueprint for a frictionless arrangement that could in theory be applied universally.

His solution is predicated on what he calls "maximum level of trust between the two countries on each side of the border". There needs to be a "trusted trade lane" for companies registered as trusted traders, which moves the border formalities and inspections away from the border prior to and after the operational trade transaction. The trusted trader makes an export declaration via self-assessment and/or intervention at the trader's premises. Such a declaration is backed up with various active border solutions such as ALPR, RFID and CCTV, along with passive solutions like GPS/GSM. According to Karlsson, this combination of process, technology and trust establishes a seamless process.

> The more common the rules, for instance within the EU, the easier the process and the smoother the border crossing
>
> **Michael Lux, consultant, former head of unit customer procedures with the European Commission**

Norway-Sweden

"There are no frictionless borders in operation at the moment, but the model I described has in the past been tested operationally by the EU and Norway for four years on the Norway-Sweden border," he writes in a blog on the subject. "Let me underline that this model is more about a change of processes and working methods – customs techniques – than technology. What it requires is political will on both sides."

His proposal, Smart Border 2.0, has been presented to the European and UK parliaments. However, while the Norway-Sweden border employs IT systems that automatically inform customs when goods leave a warehouse, along with x-ray scanners and ALPR to identify suspicious-looking vehicles, a report on the solution still found clearance times for vehicles of between three and nine minutes. The stops were mostly to lodge paperwork or when vehicles were selected for inspection.

In other words, the need for physical checks, at least in this example, remained. Karlsson's report was rejected by the UK government in 2018, but elsewhere in the world the search for a technological solution to border controls continues…

Japanese optimism

Earlier this year Fujitsu announced it had been testing a solution for a technology platform enabling an "open, free-flowing border". The centerpiece of the proposal is a web portal that links to a mobile app through which drivers can accept jobs. Once the job begins, GPS is triggered, tracking the journey until its completion. At the border GPS is supplemented by geofencing technology that alerts customs authorities to a crossing vehicle. To aid officials, AI will be deployed to spot suspicious vehicles based on their appearance, route and even posts on social media. In other words, a spider's web of security possibilities – that could easily lead to mass surveillance of citizens.

Perhaps this should filed under 'solutionism', a word first coined by Belarusian writer Evgeny Morozov, which he defines as the ethos turning to technology in order to solve problems in society, regardless of whether a better, non-technological solution may in fact exist.

30,000
The number of workers who cross the Irish border daily

A world without borders?

At some borders, x-ray scanners are used to examine inside vehicles. And while efforts are underway to improve the efficacy and range of such technology, currently an accurate scan is only possible below certain speeds (usually around 13mph [20km/h]). Furthermore, if something suspicious is detected a full stop and search must be carried out to confirm if the initial suspicions are correct. While such technology may speed some processes, it is still far from creating a frictionless border. Currently, whatever solution is in place, border control will always lead to some kind of traffic delay.

> Technology can certainly help play a role in minimizing the need for physical infrastructure and checks of goods crossing a border
>
> **Katy Hayward, professor of political sociology at Queen's University Belfast, Ireland**

"Technology can help play a role in minimizing the need for physical infrastructure and checks of goods at borders," says Prof. Hayward. "The submission of information and its verification reduces the need for physical inspections.

"However, anyone who says there's a technological solution to the issue of a frictionless border is wide of the mark. The primary way to keep borders as open and friction-free as possible is to minimize the divergence in rules that apply on both sides."

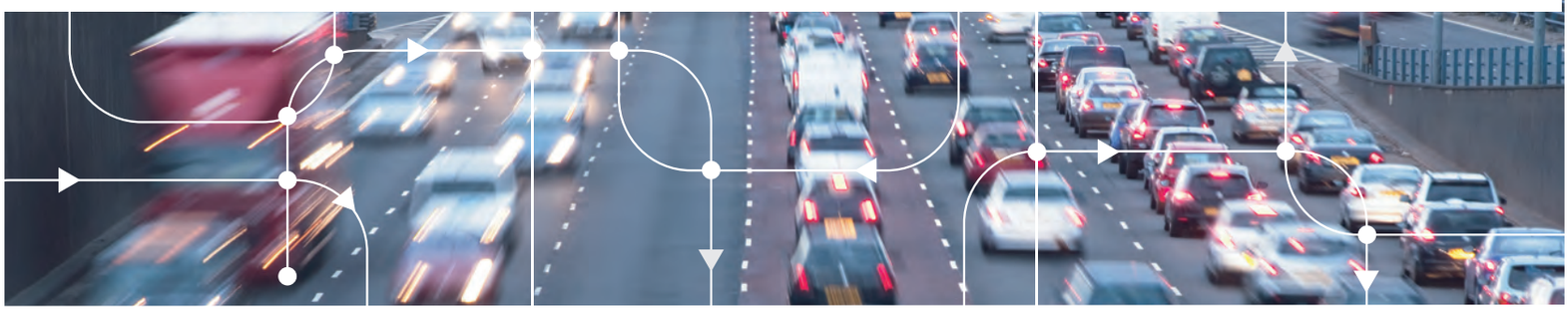
Below: **The beauty of parts of the Irish border belie its contentious nature**

270
Roads between Northern Ireland and the Republic of Ireland

Intertraffic

The leading traffic technology events connecting traffic professionals worldwide

INFRASTRUCTURE • TRAFFIC MANAGEMENT • SMART MOBILITY • SAFETY • PARKING



Save the dates for our upcoming events

SHANGHAI - CN
27 - 29 MAY **2019**

JAKARTA - ID
6 - 8 NOV **2019**

MEXICO CITY - MX
12 - 14 NOV **2019**

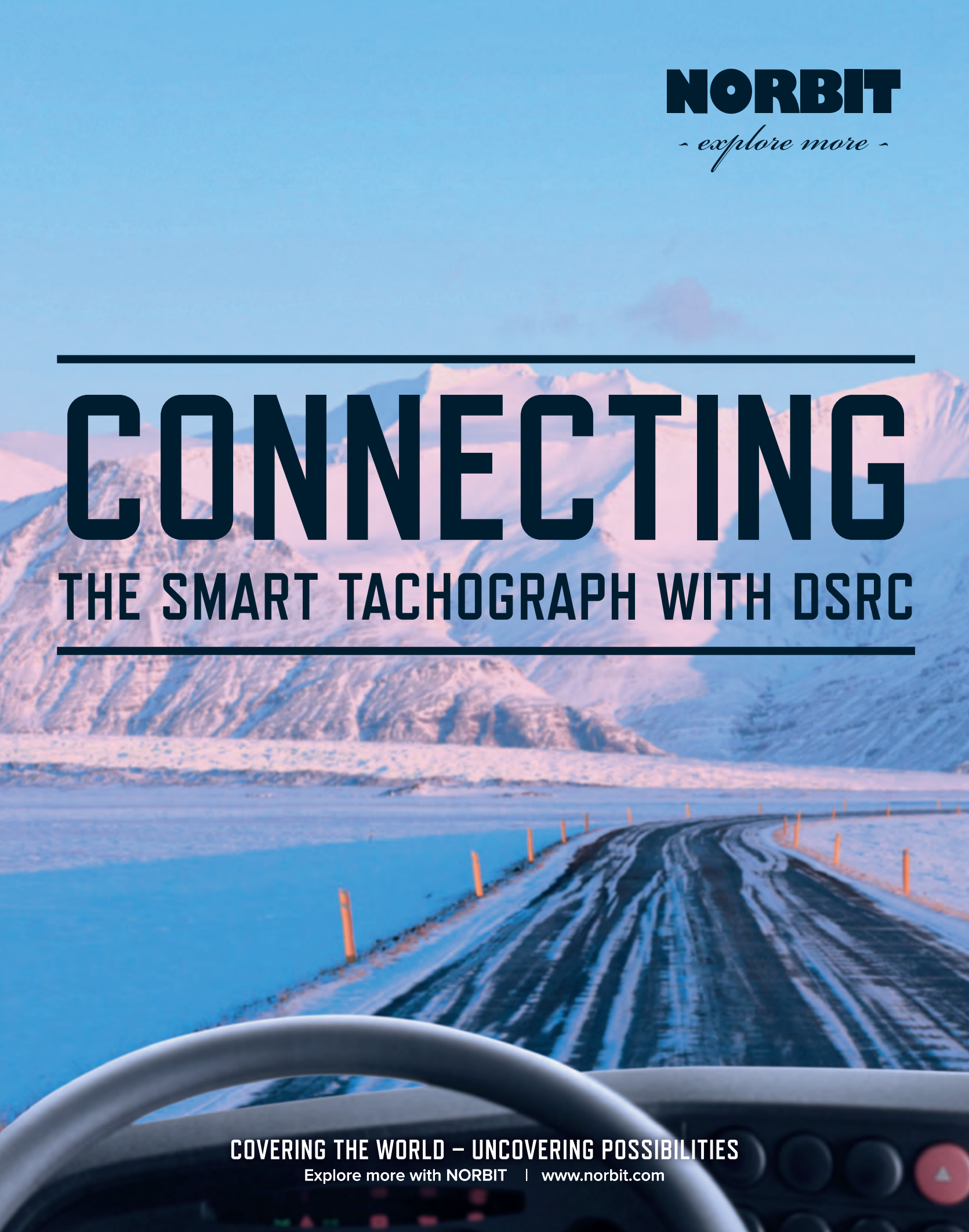
AMSTERDAM - NL
21 - 24 APR **2020**

ISTANBUL - TR
Spring **2021**

Organised by: rai AMSTERDAM

In partnership with: TIEC, ITS China, UBM, Tarsus Mexico, Tarsus Indonesia

www.intertraffic.com


NORBIT
- explore more -
CONNECTING
THE SMART TACHOGRAPH WITH DSRC
COVERING THE WORLD – UNCOVERING POSSIBILITIES
Explore more with NORBIT | www.norbit.com

comtrans

Your essential guide to the future of transportation communications

5G tests for C-V2X live map tech

Trials are underway in South Korea to update maps and traffic information in real time, using data collected from connected vehicles via a 5G network

Hyundai Mobis is partnering with South Korea's largest telecoms company, KT Corp, to test 5G-based cellular vehicle-to-everything (C-V2X) technologies.

As part of the trials, 5G communications infrastructure has been deployed at a proving ground in Seosan, South Korea.

The partners are developing C-V2X connected vehicle systems, including navigation technology that can be updated in real time.

Existing 4G cellular network-based navigation programs take several minutes to update maps and recalculate routes, but with a 5G network – which is 100 times faster – it's possible to display traffic information in near real time.

Hyundai Mobis (the parts and service division of the automotive giant) is developing a technology that collects real-time traffic information through the various sensors fitted to its M.Billy SAE Level 4 autonomous test vehicle, extracts key information that affects travel times, and transmits it to a server. KT supports connection between the 5G terminals fitted inside the vehicle and the 5G communication base stations.

Once live traffic information is on the server, navigation updates can be propagated to all other vehicles that are connected.

"As the connected vehicle enters real-world scenarios, cross-industry cooperation to develop relevant technologies is becoming more important," said Jang Jae-ho, head of the Hyundai Mobis electrical and electronics R&D center.

"This alliance means we will be able to secure competitive connected vehicle technologies that can lead the global market in the future."

50: Strategic thinking

The UK's famous Millbrook Proving Ground has become the focus for the latest round of connected and autonomous vehicle testing, and is being used by the UK government's Meridian initiative to push 5G communication to its limits

Strategic thinking

Meridian is a government-backed entity set up to ensure a comprehensive approach to the testing of connected and autonomous vehicles in the UK. **James Allen** reports on the approach the organization is taking to ensure the technology is the best it can be

The potential of Millbrook's new 5G-enabled mobile network was demonstrated by vehicles traveling at speed streaming live 4K video to a screen on a bus

Turn the clock back to the summer of 2016. The UK government, keen to make the most of the benefits that connected and autonomous vehicles (CAVs) could offer to enhancing mobility, put out a call for evidence as to how this should be done.

After much consultation, the Department for Business, Energy & Industrial Strategy concluded that there was a need for a body devoted to ensuring testing of CAVs, to reduce the risk of ad hoc or piecemeal development of the technology.

Fast-forward to today, and Meridian, now more than a year old, is that body. It is backed by £100m (US$132m) from the government and £100m from the private sector and carries considerable clout.

"One of the things we do is to manage that investment and direct it strategically to testbeds," says Mark Cracknell, Meridian's head of technology. "We have invested in five physical testbeds, covering everything from rural, to urban, and even inter-urban, as well as highway scenarios in controlled, semi-controlled and public environments."

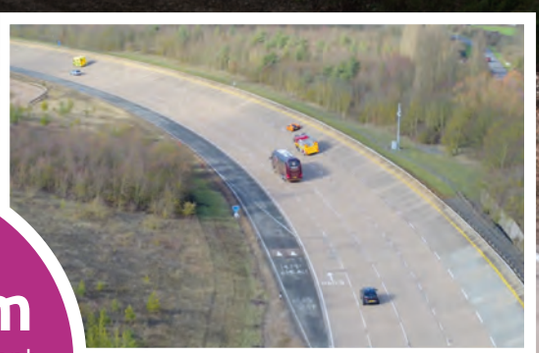
Experimental playgrounds

Pre-existing, traditionally automotive UK proving grounds at Millbrook, Bruntingthorpe and Mira are to benefit from new on-site facilities, while 62 miles (100km) of urban roads in Coventry, as well as two sites in London, will complete the testbeds that will serve as the experimental playgrounds for the futuristic technologies.

The relatively close proximity of the testbeds is not a coincidence, with Cracknell confident that the groundwork Meridian is putting in is laying a strong foundation for future possibilities.

"We have this goal of, through these testbeds, creating what we call Test Bed UK. Once they are all online, they will put the UK at the forefront globally as a place to come and test CAV, because the nature of the UK being geographically quite small is actually an advantage," he says.

"We will have every capability you might want within two or three hours' drive of each other, plus the UK is a hotbed for high-value tech when you consider robotics, artificial intelligence and machine learning, and then obviously we also have motorsport valley, so all these things come together to make for a very attractive proposition for CAV development. We are hosting visits of delegations from all over the world who want to come and see what we're



US$232m
Combined government and private business investment in UK CAV testing project Meridian

Cybersecurity collaboration

Setting aside the question of what channel V2X communication takes place on, the act of transferring lots of safety-critical data presents concerns of its own. Not surprisingly then, cybersecurity is also very much on Meridian's radar.

Mark Cracknell says, "As you connect these vehicles, suddenly the problem doesn't sit with one company or organization, or even one sector, so one of the things we're really keen to do is to bring together a network and capability that enables us to not just come up with a secure solution now, but actually have an ongoing capability to continually push the boundaries of what best-practice cybersecurity looks like."

Taking this comprehensive approach, the focus is less on finding a silver bullet answer to the issue now, and instead methodically assessing what investments are required to ensure the entire ecosystem is secure in the connected world of the future.

It will be intriguing to see the effects of Meridian's research on the CAV landscape in the UK five years from now.

doing. A lot of them are seeing what we're building and remarking that it is the first time they've seen government, industry and academia all coming together, and so what we're building is quite unique."

The first of the testbeds, Millbrook, in Bedfordshire, was officially opened back in February, with the expectation that the other four sites will be fully operational before the close of the calendar year.

As well as listening to senior figures involved in the project, the dignitaries and members of the press attending the launch saw a live demonstration of the UK's only independent 5G-enabled mobile network.

Capable of transmitting data at speeds of 1GB/s to fast-moving vehicles via a 70GHz datalink, the mobile network is an indication of the direction of travel for vehicle to everything (V2X) communication.

Not part of the script

Outside of the testbed environment, the UK cellular network is currently 4G. Although providing relatively good coverage across the country, 4G was never designed for CAV technologies on any scale.

A major question mark over 5G is the significant level of funding required to roll it out.

"A UK-wide 5G network would be a huge expense. It is not simply an evolution of 4G that can be rolled out in the same fashion. Technologically, it is quite a step change and a much denser network to get the speed and capacity required," explains Cracknell.

He does not consider the possibility of a dedicated network for CAVs as a viable option, but wonders who the potential partners with government could be.

"Until now, mobile phone operators have typically funded UK networks, but with 5G the business case is different. My 4G phone already has pretty good speeds; there can be coverage issues in some areas, but that is a different issue so there are questions around the use cases for 5G other than CAV," he says.

"One of the things we're doing with the 5G testbed is to bring mobile network operators on board to see if there is an investment case for them."

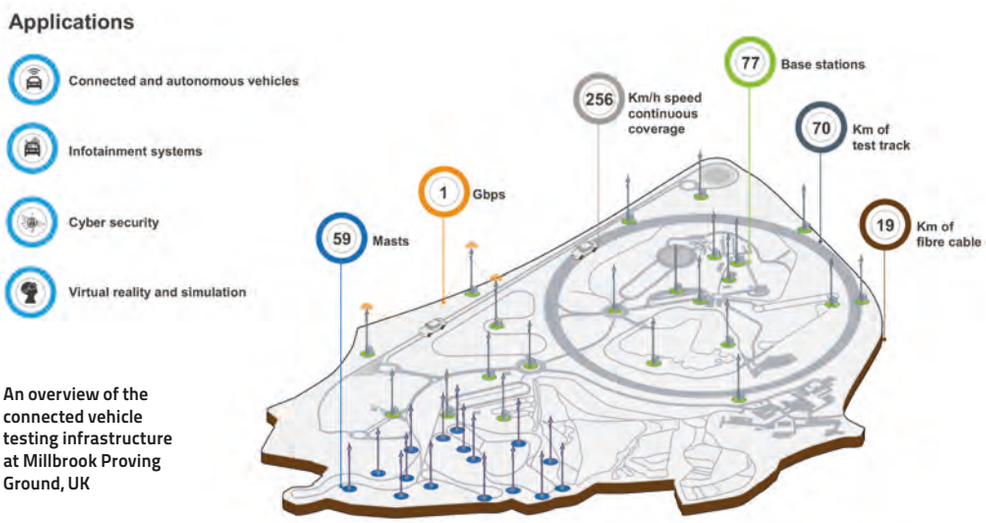
Debate continues back and forth among the wider CAV community as to whether 5G or DSRC is the most suitable communication channel for fully realizing the benefits of the connected vehicles.

Given the role Meridian plays in overseeing UK-based CAV testing, the organization most certainly has a contribution to make in influencing where the nation will land on the debate. However Cracknell believes theirs should be just one voice of many: "We undoubtedly will influence what the broader market does and we would seek to be a strong voice in that conversation, but connectivity affects so many different industries and players that I don't think it's our decision to make.

"Whether it should be DSRC or cellular to pass information across is up for debate, but the information itself – whether traffic light, incident detection, or safety information – that's really what we're focusing on. What are we sending? What are we going to use it for? Once that's worked out, then a lot of trials that are happening now will have started to produce results and sensible, informed decisions about what infrastructure is needed can be made.

"We do think, though, that both of them have real merit and can even see a future where a hybrid mix of the two is possible," he concludes.

> We are hosting visits of delegations from all over the world who want to come and see what we're doing
>
> **Mark Cracknell, head of technology, Meridian**



An overview of the connected vehicle testing infrastructure at Millbrook Proving Ground, UK

LEARN MORE ABOUT OUR ADVERTISERS

NOW!

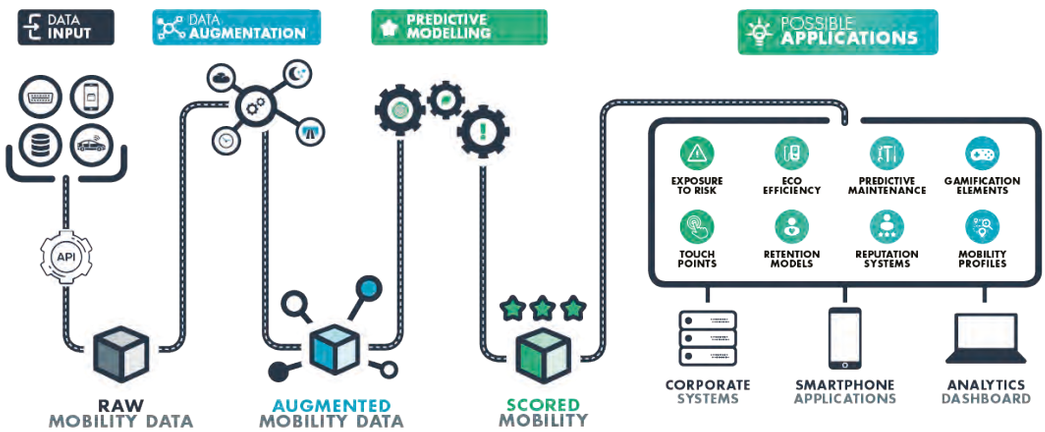
FREE SERVICE!

Visit **www.ukimediaevents.com/info/tfm** to request exclusive and rapid information about the latest technologies and services featured in this issue

www.ukimediaevents.com/info/tfm

traffic TECHNOLOGY INTERNATIONAL

Calculating total cost of mobility enables more competitive services



The seamless integration of shared mobility, public transportation and last-mile solutions is instrumental in overcoming traffic congestion. To successfully achieve this, people need to move from individual transportation to shared mobility, with Mobility as a Service (MaaS) acting as a key enabler. However, for this to happen, mobility solutions need to be convenient and competitive. For that, mobility offerings need to be customized to individual needs, which requires analyzing data to understand the demands of users and the supply level of mobility solutions. One way to do this is to create mobility profiles that calculate the total cost of mobility (TCM) – this is what Motion S delivers.

Motion S is a mobility data analytics company that provides advanced, collection-device-agnostic services. It generates objective and reliable mobility profiles, consisting of the main driver behavior components, to explain TCM, helping its customers to be more efficient and profitable.

Personalized data

Whenever mobility is offered at fixed prices – whether for a set time or distance – in the past the provider has had to anticipate the worst possible driving behavior in its price calculation, to ensure that it covers the maximum possible cost of insurance, fuel and wear on the vehicle. Such basic models do not allow dynamic pricing that positively rewards good drivers. Nevertheless, increasing competition in mobility is leading to aggressive pricing, which creates an increased risk of giving discounts and incentives to the wrong customers.

Motion S delivers transparency in driver behavior that enables mobility providers to positively select and retain good drivers. As a result, its customers are able to reduce operational costs and increase profit margins.

How does it work?

The Motion S solution relies on a powerful new platform for mobility data collection, augmentation and profiling, which includes a predictive approach. It can extract mobility data from almost any source and performs augmentation through contextualization – meaning it enriches pure mobility data with information on the environment and driving styles. Once the data is augmented, it is processed with the help of smart algorithms that extract the most important features to explain risk exposure, eco-efficiency and vehicle wear to create user profiles. These user profiles are of interest to all stakeholders in the mobility ecosystem.

The profiles explain the main components of TCM, enabling mobility providers to create innovative and dynamic pricing schemes based on user behavior and to provide active coaching to ensure even high-cost users remain competitive.

Motion S customers can make use of its platform using its ready-to-go, customizable products. To enable mobility data to be collected from smartphones, Motion S offers native Android and iOS Software Development Kits (SDK) that can be used to create apps that enable trip-data collection. The SDK allows detection of trips, collection of GPS data and seamless transmission to the Motion S platform. For customers with telematics data, Motion S offers access to its API (application programming interface), which is able to handle several million trips per hour.

For further insights into mobility data and profiles, Motion S also offers access to its customized Data Visualization

Need to know

Motion S offers deep insights into mobility data for a variety of potential customers...

- Transportation authorities wishing to make public transit more efficient
- Mobility as a Service providers who want to be more competitive
- Traffic managers looking for new solutions to congestion
- Fleet managers and operators of carshare services who want to offer bespoke discounts
- Vehicle insurance companies and vehicle OEMs hoping to tailor their offerings

Left: **The architecture of the Motion S total cost of mobility (TCM) service**

Platform. It is also able to provide data science as a service via its team of highly skilled data scientists.

Real-life example

Motion S recently analyzed a huge data set for one of its customers, consisting of a nationwide bus network – more than 1,000 buses providing millions of journeys. Based on its data augmentation approach, it was able to explain the existing bottlenecks of the bus network resulting from road topology and environment (weather, time of the day, etc), schedule planning, road environment and traffic congestion, and driver behavior. It's one example of how Motion S can use its augmented features and analytics services to enhance historical mobility data and optimize the performance of mobility businesses. ○

NEW!

by **Kirk Steudle**

Collaborations between DOTs, OEMs and Silicon Valley are the future

"We need to upgrade infrastructure now in preparation for connected mobility"

I'm excited and honored to provide my insights into one of the most important topics facing us today – mobility. Like my esteemed colleague and predecessor in this column, Don Hunt, I bring a DOT's perspective. For those of you who do not know me, I was the director of the Michigan Department of Transportation (MDOT) from 2006 through 2018. I spent 30 years with MDOT, starting as an engineer, working my way to director. During my tenure, I had the privilege of developing leading-edge connected and automated vehicle (CAV) programs locally, as well as advocating for and helping shape CAV policies nationally.

While the convergence of technologies brings an exciting time in our industry, the technology proponents are barraging transportation agencies and DOTs from all angles, creating uncertainty and raising more questions than answers. Unfortunately, from a DOT perspective, uncertainty begets risk. As a result, we are slow to act when there is additional risk – actual or perceived.

Nevertheless I believe connected mobility is the answer to our future transportation challenges. Whether we like it or not, it's already happening. From the collaborations between Silicon Valley and Detroit to automated ridesharing services and the Internet of Things (IoT), connected mobility is marching full steam ahead. This means the real issue will be how we adapt, accept, integrate, and apply these technologies into an increasingly connected mobility ecosystem.

In my view, connected mobility means a technology-based, multimodal transportation ecosystem that provides new levels of mobility, sustainability, and equal accessibility. While that sounds simple on the surface, it comes with deep-rooted complexities.

Among the non-traditional traffic issues I had to consider at MDOT for CAV infrastructure were cloud computing, AI, data analytics, cybersecurity, and DSRC versus 5G communications.

Auto makers are accelerating their own connected technologies programs (according to automation levels 1 to5 as described by SAE J 3016-2018). Supporting this, many OEMs will offer level 2 automation subsystems within a couple of years. Moreover, research and development commitments are scheduled to make level 4 and 5 automation available within the next five to seven years. The CAV considerations are daunting to say the least.

The critical issue is the CAV transition period – the many years where a combination of vehicles with varying levels of connectivity and automation will share the road. This will be a challenging time for drivers, infrastructure owners (municipalities, DOTs) and maintenance crews, enforcement agencies, insurance providers, educators and others.

I believe our efforts should be focused on this transition period. We need to appropriately upgrade our infrastructure now in preparation for the larger connected mobility ecosystem. But how will we maintain and pay for it? How will we future-proof the required upgrades? How much of a role will private and public partnerships play? I look forward to the journey with you as we take on these questions and challenges in upcoming columns. Until next time, travel safe.

Kirk Steudle is senior vice president of Econolite and former director of Michigan DOT. He can be reached at ***KSteudle@econolite.com***

Optimizing traffic signals with smart software

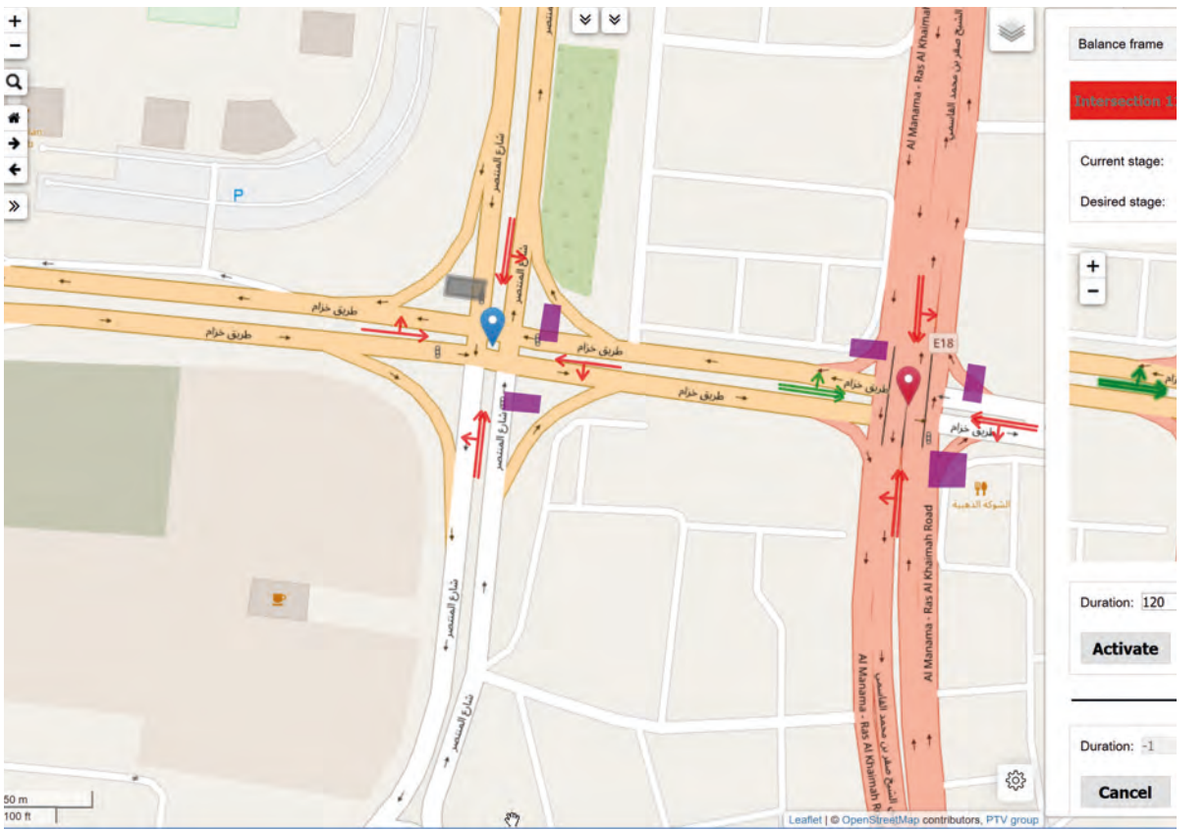
To ensure optimum use of road network capacities, and to keep emissions and vehicle delays at a minimum, it is essential for traffic flow to be improved in inner cities.

PTV Epics and PTV Balance are traffic-adaptive signal control software solutions that continually optimize the switching of traffic signal lights at single intersections and across entire networks. They react to live conditions on roads and manage capacity efficiently with the most appropriate signal timing, taking all modes of transportation into account, and can help to reduce planning costs and contribute to road safety.

Streamlined operation

PTV Epics reduces planning efforts and minimizes delays for all road users. Every second, the adaptive signal control forecasts the traffic situation for the next 100 seconds based on the detector value, current queue lengths, cyclic flow profiles and public transportation prioritization. At individual intersections, the software gives control of signal timing priorities for different modes – private traffic, public transportation and pedestrians – in to the hands of the planner.

PTV Epics was developed specifically for single nodes and runs directly inside the control unit. It observes local conditions and calculates numerous control options every second. The traffic-adaptive signal control then uses its internal model to evaluate the options before applying the most suitable one. In this process it takes all modes of transportation into account – from individual motorized traffic and pedestrians to public transportation and its prioritization. The software controls traffic at individual intersections and entire corridors to minimize the number of vehicle stops and reduce emissions.



Need to know

Benefits of PTV Epics include:

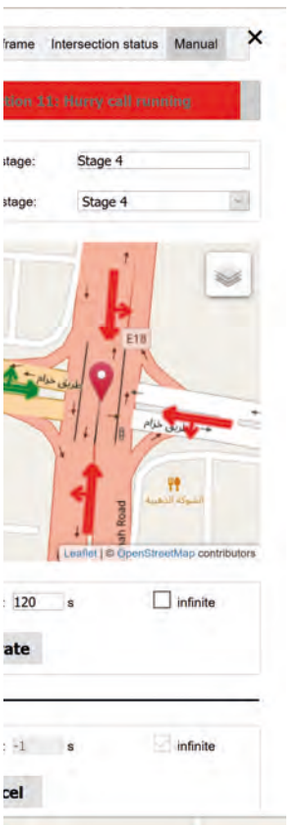
- User friendly and efficient
- Enables the integration of public transportation prioritization
- Traffic optimization and bus prioritization to reduce stop/start emissions

PTV Epics is supplied with data from its own signal control editor – a module of the PTV Vissim microsimulation software into which PTV Epics is directly integrated, providing an ideal test setting. Here you can set all stage parameters and interstages to coordinate green waves at intersections for all road users.

Traffic engineers define the underlying fixed time signal program and its weighting for PTV Epics, along with other parameters such as minimum and maximum phase duration, and green times for the various signal groups. They also configure the permitted phase sequences and the weighted requirements for private and public transportation and pedestrians. The weightings for the elements feed into the total performance index, which summarizes the resulting waiting times and tail backs during the evaluation of a control option for the node.

In operation, PTV Epics accesses the detector data for the node, uses it to recognize the incoming vehicle flows, and adjusts its simulation model to calculate the effects of various control options.

In less than a second, the traffic-adaptive signal control for nodes optimizes the phase



Above: **Taichung City improved journey times using PTV Balance**

Left: **Traffic data on PTV Epics is updated every second**

sequence and its timings by improving the total performance index. In this way, for example, a bus or tram line receives priority at an intersection when public transportation is assigned a high weighting.

With PTV Epics' adaptive signal control you can prioritize different modes at a single node by individualizing travel times, calling-point pairs and lane information, to react to the live conditions on the road, minimize the number of vehicle stops and thereby lower emissions in your city.

Coordinated traffic flow

With PTV Balance, users can benefit from a macroscopic traffic model that estimates flows in accordance with detector data, a control model and a mesoscopic traffic flow model to calculate the effects of a specific signal plan and, most importantly, different optimization algorithms.

PTV Balance measures current traffic conditions and adjusts and optimizes green time splits, offsets and cycles for entire networks every five minutes, preventing spillbacks and long queues. With adaptive signal control, PTV Balance safely and efficiently directs traffic across networks.

At the heart of the software is a two-layer real-time transportation model. In the macroscopic stage, PTV Balance uses detector data to derive the traffic density on individual routes and side roads.

Based on the results of the macroscopic model, PTV Balance calculates strategic framework signal plans. An integrated mesoscopic model evaluates the signal control options over multiple nodes within seconds, taking into account their effects on stops, waiting times and blocking backs. This evaluation is based on a custom performance index, which represents the weighted sum of all stops, waiting periods and tail backs.

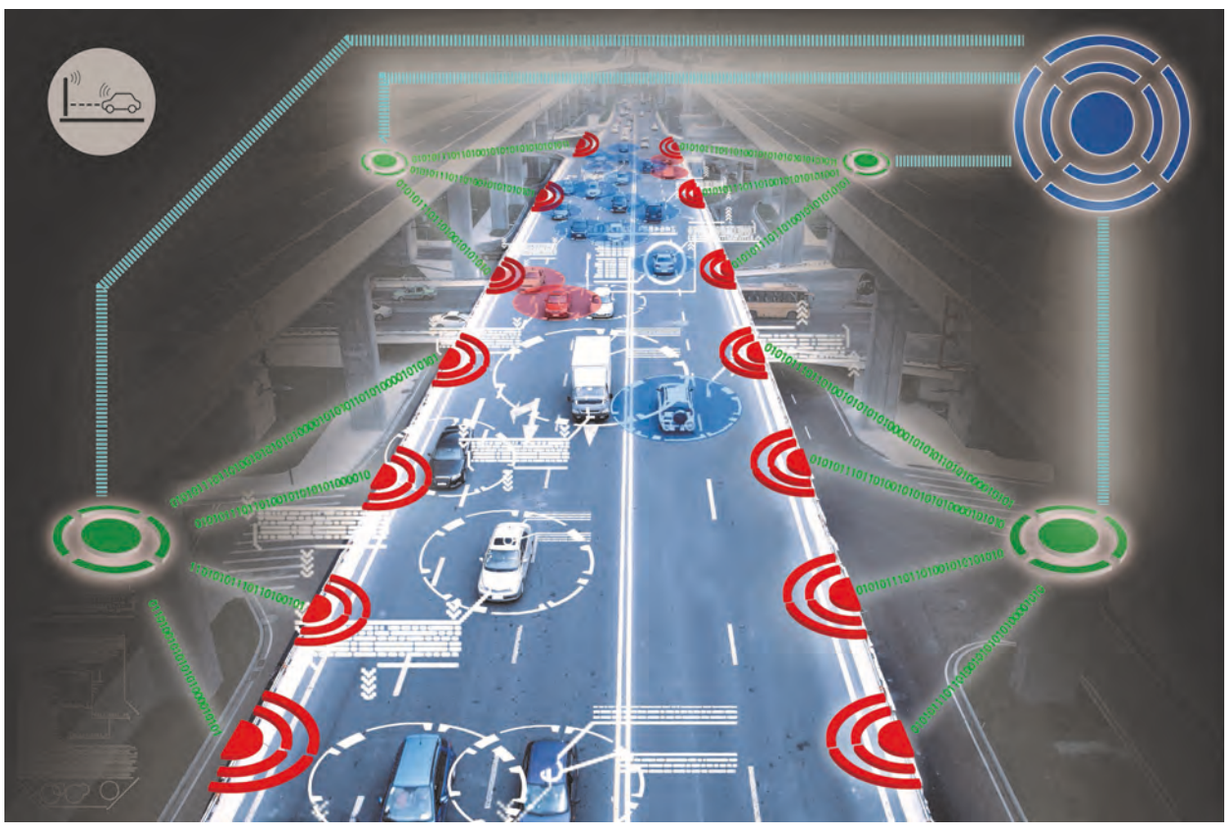
Traffic engineers can adjust the weighting for each signal group and have the calculation results ready and on display in the graphical user interface. This makes it easier to calibrate PTV Balance as part of a simulation and improves monitoring during operations.

The adaptive signal control for networks transmits the optimal framework signal plan to the local control devices, where they are either applied directly or refined locally with PTV Epics. The adaptive signal control for networks repeats the full optimization process every five minutes.

A demand model created in PTV Visum provides PTV Balance with network and demand data. At the same time, this can also be used as input for PTV Vissim simulations and for testing and calibration. With PTV Balance, you can create dynamic green waves without extensive detailed planning and simulation and reduce waiting times at intersections, travel times, emissions and noise in your network.

The city of Taichung, Taiwan, has reduced travel times by 9% and increased speed by 8% with PTV Balance. The French city of Strasbourg has reduced waiting times at traffic signals controlled with PTV Epics in 85% of cases, while Gdansk and Gdynia in Poland have cut travel times at 150 intersections by 5.5% for individual traffic and 6.5% for public transportation, relying on PTV Epics and PTV Balance.

Integrating connected vehicles into traffic



Data on vehicle positions could feed forecast engines, helping spot anomalies

Connected and autonomous vehicles (CAVs) are the next revolution in the world of transportation. Although these concepts are often presented together, vehicle-to-everything (V2X) technologies are evolving so quickly that connected vehicles are expected to become commonplace long before autonomous vehicles are mature enough for large-scale deployment.[1]

Research has demonstrated the benefits of connected vehicles, but it is less clear how today's traffic management systems should and will evolve to deal with them.

Overcoming challenges

New functionalities, such as traffic-data crowdsourcing and in-vehicle communications will rapidly make obsolete some of today's tools – such as inductive loops and variable message signs (VMS) – for monitoring and controlling traffic flows.

Simply by anonymously collecting data about the positions and speeds of vehicles traveling on infrastructure, traffic management systems can accurately estimate the level of service – and as a result, feed forecast engines to spot anomalies and potential risky situations in advance – while providing users with relevant information and control measures via their vehicles. (For example, warnings for accidents or congestion on the road ahead.) This would make traffic control measures implemented by road operators more effective, as well as increasing revenues and safety, and reducing operational costs and maintenance.

In future, information from traffic management systems, sent from traffic management centers, may be able to interact direct with autonomous vehicles' routing systems in a timely and effective manner.

Need to know

Sinelec creates technologies for current and future roads. Its products and services include:

- Implementing and managing highways and logistics systems
- Designing and creating traffic detection and mobility systems
- Developing and installing video surveillance, electronic monitoring and emergency response systems

Edge-based approach

Sinelec is a technology provider for Gavio Group, the third-largest operator in toll highway management. To cope with technological improvements and new business practices, Sinelec has designed a traffic management solution based on a flexible and distributed

by **J J Eden**

architecture. By leveraging the concept of edge-computing within Industry 4.0, new systems can be distributed through several layers. This includes the roadside level, in charge of V2X communication, with local controllers that collect information from roadside units and coordinate it with each other and with the traffic management center to implement response flows.

This logical structure is robust and flexible, enabling distribution of services at different layers based on their criticality. For example safety-related services are kept as close to the physical infrastructure as possible, to make them faster and fault tolerant, while traffic-related functions (such as congestion alerts and rerouting suggestions) will be broadcast from the traffic management center, with lower layers in charge of filtering so as to deliver only relevant information to each vehicle.

The aforementioned structure will be implemented in a pilot for the Italian Road Management Authority ANAS, in the context of a smart road project through a state-of-the-art internet of things (IoT) platform. This functional design will be scalable to cope with the huge amount of data exchanged as a result of having a large number of connected vehicles on the road.

[1] *Are we putting enough C into CAV?* by Don Hunt, *Traffic Technology International*, February/March 2019

MaaS is a more important enabler than infrastructure

Mobility as a Service (MaaS) engages customers to help shape transportation infrastructure investments that matter. The transportation industry is changing, with major disruptors investing billions in transportation mobility options outside traditional revenue sources.

Local and state jurisdictions are taking action on their own to future-proof transportation solutions by developing mobility plans. An important role for government is to ensure that consumers are protected through standards, and transparent and enforced service level agreements. We need to implement safe options from qualified vendors while maintaining an environment of innovative free-market growth that will facilitate better mobility solutions. These plans must provide transparent, long-term thinking and near-term actions to address mobility issues in local communities.

In some areas, industry operators are beginning to look at smart mobility solutions such as pricing strategies to help generate new revenue sources and provide solutions that can then be an investment in infrastructure. For example in Georgia, USA, transit and toll agencies have combined forces to promote transit options on express lanes. The use of its Xpress rapid transit buses has saved over 55 million annual vehicle miles while promoting express lane use to provide travel time savings. Another example is congestion pricing initiatives from LA to New York. Operators are leveraging pricing strategies to help provide real mobility solutions while generating alternative revenue sources. These solutions require flexible, lightweight technology solutions that help deliver results without major infrastructure upgrades that can cost billions and take years to construct and realize the benefits.

Government agencies in transportation continue to be asked to do more with fewer resources. A key opportunity here is to leverage commercial services to reduce the cost of these highly customized solutions. Industry must look at a reverse integration of existing commercial services and leverage the economies of scale that those solutions offer, along with tapping into new payment options. There must be a greater focus on addressing regional transportation and other innovative strategies, such as cordon pricing, to fund desperately needed infrastructure improvements. Tolls are not being used just to finance the building of a bridge, but increasingly to help provide a sustainable revenue source for statewide networks.

"We need to implement safe options from qualified vendors while maintaining innovative free-market growth"

As pioneers of disruptive user fees for the past few decades, the toll industry understands the importance of proving value to customers to encourage them to use its services. However, we have now reached a crossroads as our current approach is not enough to engage new transportation users, who are less likely to buy a car but still use a toll road in shared mobility services. Some current operating models are cost prohibitive to use. On-demand transportation is here today and is a forward-looking tool that can reduce operating costs, increase customer participation and provide much-needed mobility solutions for a new generation of transportation customers.

J J Eden is director of tolling at Aecom
james.eden@aecom.com

Weather sensors for bridges and difficult-to-access roads

StaRWIS (Stationary Road Weather Information Sensor) is Lufft's new non-invasive pavement sensor.

StaRWIS can detect road weather conditions, surface temperatures, relative humidity, dew point and freezing temperatures, ice and friction using spectroscopy through four LED transmitters and two receivers. It can be mounted at a height of 5.5m (18ft) above the ground.

The technology behind the StaRWIS sensor is based on the mobile MaRWIS sensor, which was launched in 2015. It can transfer data as open UMB protocol either wirelessly via Bluetooth or wired through RS485 and CANbus.

Case study: St Gallen

St Gallen is a city in Switzerland located in a valley between Lake Constance and the Appenzell Alps at a height of about 700m (2,300ft) above sea level. It is therefore one of the highest-altitude cities in Switzerland and gets a lot of snow during winter months – an average of 198cm (78in) per year. It also rains a lot in St Gallen, with the average of 188 rainy days each year. By comparison, London, UK, has an average of 106 rainy days per year.

It can be challenging for traffic to maneuver on roads in such challenging climates. Ice and accumulated snow can dangerously lengthen braking distances. As a result of this, in 2018, St Gallen's Civil Engineering Office installed a Lufft StaRWIS non-contact road weather sensor at the central station's forecourt.

The sensor helps to prevent the accumulation of snow and ice on the road surface, and warns against water accumulation.

Need to know

Advantages of the StaRWIS road sensor include:

- No moving parts, due to innovative, award-winning LED technology
- Non-invasive installation measurement principle
- Data transfer via Bluetooth, RS485 or CANbus
- Mulifunctionality
- Can take measurements of the ground
- Easy to install and to clean

A WS400 multiparameter weather sensor also notifies the Civil Engineering Office of ambient weather conditions. This data includes: air temperature, relative humidity, precipitation amount and type, and air pressure.

St Gallen's road weather station marks a step toward it becoming a smart city. The city's goal, first outlined in 2017 legislative objectives, is to install a sustainable networked infrastructure for mobility, energy and communication, which can be used both publicly and privately by 2030.

Case study: Key Bridge

The Francis Scott Key Bridge, also known as Key Bridge, is a four-lane road bridge in Baltimore, Maryland, USA. It opened in 1977 and is part of the Interstate 695 (Baltimore Beltway) ring highway.

The Key Bridge is a toll facility operated by the Maryland Transportation Authority (MDTA). In total, including the ramp bridges, it has a length of 2,632m (8,636ft). It carries an estimated 11.5 million vehicles annually. Its 366m (1,200ft) width is the third-longest of any continuous truss in the world. Furthermore, hazardous materials trucks frequently travel across it, because they are prohibited in the Baltimore Harbor and Fort McHenry tunnels.

Opposite: **The StaRWIS from Lufft was launched in 2016**

Left: **The StaRWIS spectroscopic sensor on the Francis Scott Key Bridge in Maryland, USA**

The Key Bridge is surrounded by a humid subtropical climate zone, with average temperatures of 15°C (59°F). Winters are variable, with sporadic snowfall.

In January, the average temperature is 2°C (36°F), but they can also become as low as -7°C (20°F), when the area is affected by Arctic air masses.

Baltimore has an average of 127cm (50in) of precipitation and 111 rainy days per year. The average seasonal snowfall is 51cm (20in) but this varies greatly, depending on the weather conditions of each winter.

The MDTA commissioned Lufft USA's partner Communications Electronics to find a suitable sensor for monitoring the Francis Scott Bridge. In February 2018, they installed a Lufft StaRWIS sensor and it has delivered satisfying results ever since.

The sensor was chosen for a number of reasons. A benefit of contactless sensors is that they require less installation effort than embedded ones.

However in this case, it wasn't possible or permissible for the sensors to be installed into the bridge's pavement anyway, in case its structural integrity was affected. The engineers from Communications Electronics realized that the bridge vibrated more than others bridges they had worked on so far. Therefore, the sensors selected had to be able to withstand strong vibrations. As the StaRWIS technology is based on the MaRWIS mobile sensor that collects data from driving vehicles, it proved to deal with vibrations very well and turned out to be an ideal choice.

"The sensor has been working well since it's been in operation," says Scott Humphreys, project manager at Communications Electronics. "The data seems both stable and accurate."

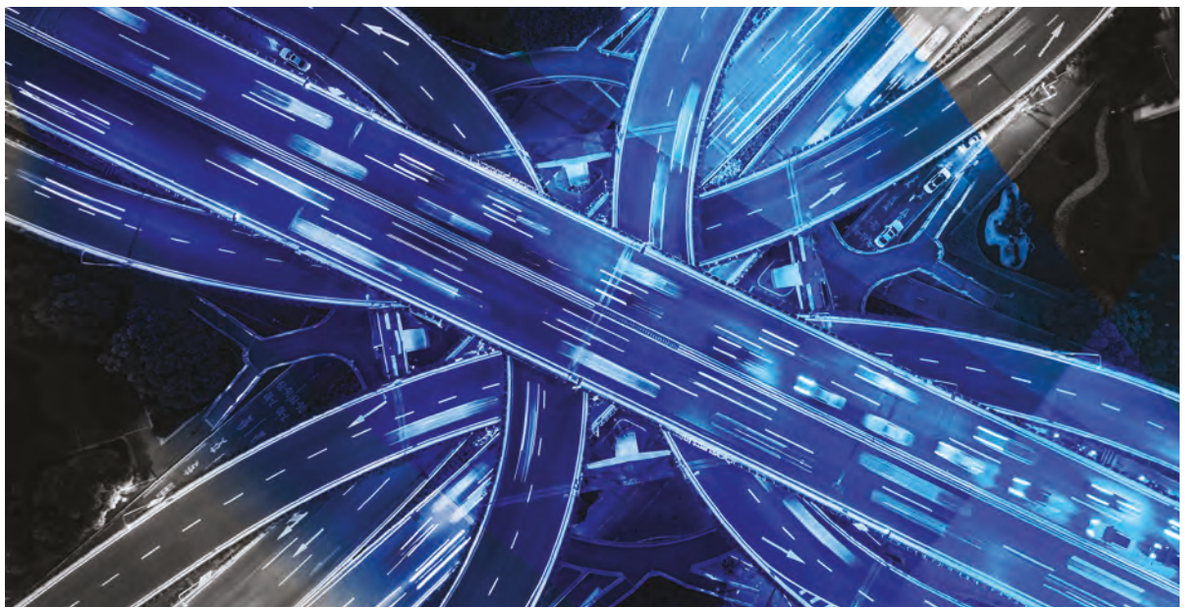
For data evaluation, MDTA uses SmartView monitoring software, also provided by Lufft. The software checks the data on a daily basis.

Above: **The sensor can be installed and used at a height of 5.5m (18ft) above the ground**

Average speed enforcement gets impressive results in Scotland

Disruptive technologies have drastically changed the way people move in cities across the globe. Urban populations accustomed to on-demand mobility services, rideshare, trip planning, and ticketing apps that reflect the latest advances in mobile communications, cashless payments and remote monitoring increasingly depend upon the flexibility and convenience afforded by smart urban mobility when moving from point A to point B.

But with over half of the world's population currently residing in urban areas, demand for road space far exceeds supply, resulting in growing levels of congestion throughout the USA and Europe. In fact, the global urban population grew 52% from 2.7 billion to 4.1 billion between 1997 and 2017, and data predicts that by 2050 some two-thirds of the world's population will reside in urban areas. Cities are agents of economic growth and social change, but it is the responsibility of industry to develop innovative, financially and environmentally sustainable solutions capable of supporting existing numbers and scaling to accommodate growing urban populations.



Combating congestion

In 2018, US drivers incurred US$87bn in congestion costs and spent on average 97 hours in traffic, while the American Transportation Research Institute estimated the total cost of congestion in the freight sector to be US$74.5bn annually, US$66.1bn of which was lost in urban areas. Boston, Massachusetts, ranked number one in the list of most congested cities in the USA in 2018. On average, drivers spent about 164 hours in traffic that year and lost about US$2,291 in productivity. Moreover, nearly 70% of greenhouse gas emissions from regional transportation come from the use of personal vehicles. While Boston must confront unique challenges posed by age and density, other cities that previously ranked ahead of it have found success in implementing sustainable solutions aimed at alleviating congestion.

In 2018, Seattle, Washington, implemented a Road Usage Charge Pilot Project that would explore a smarter approach to revenue collection. Together with Intelligent Mechatronic Systems (IMS), A-to-Be delivered a back office platform capable of analyzing roadside data to inform new funding methods for infrastructure management and investment.

A-to-Be's product, MoveBeyond, uses satellite-based and smartphone alternatives to collect data capable of informing and implementing new funding methods and infrastructure management and investment.

While congestion is in many ways indicative of a city's economic vitality and desirability, the absence of smart policies in the face of growing urban populations can result in an environment of frustration and lost opportunities harmful to the overall growth of the city.

Confronted with sprawling masses of people occupying sidewalks, subway cars and buses, longer lines at retail stores, and growing wait-lists at restaurants, young families increasingly opt to buy a home outside the city center. Urban sprawl, however, costs the USA around US$1tn per year and incurs additional infrastructure and public service costs of up to 40%. If cities want to retain talent that attracts business and generates revenue, they must prioritize innovation through public-private partnerships. The Netherlands, for example, used A-to-Be solutions to implement congestion pricing in Rotterdam. The governing entity can leverage dynamic pricing and incentive planning to better control, identify, charge and enforce vehicular traffic within city limits. Project results have been above expectations with more than 5,000 participants and a

Need to know

Benefits for MaaS of A-to-Be's MoveBeyond include:

- It is interoperable
- It seamlessly integrates into existing mobility systems, minimizing investment costs
- It enables new smart-pricing criteria, adjusted to each consumer's profile

42% peak hour travel reduction among participants.

Improving mobility

Investment in seamless mobility yields significant dividends beyond economic growth. Road transportation currently accounts for 80% of CO_2 emissions in the USA. Cities that invest in sustainable and efficient solutions that reduce road demand to cut the number of cars on the road stand to reduce greenhouse gas emissions by 3.7Gt of CO_2 per year by 2030 and generate savings of up to US$17tn by 2050.

The propensity for urban mobility to foster innovation, yield substantial revenue returns and clean up the environment will position major metropolitan cities worldwide in such a way that facilitates greater levels of seamless solutions, such as Mobility as a Service (MaaS). Assets, such as storage and maintenance facilities for shared autonomous fleets, fast-charging infrastructure, and dedicated AV lanes equipped with vehicle-to-infrastructure communications and IT systems will be required to power urban mobility. To reach the levels of autonomy that experts anticipate, government, industry and the public must collaboratively address their unique urban congestion problems and invest in financially sustainable and environmentally friendly mobility solutions. ○

Richard Butter

What can the transport industry learn from logistics giants like Amazon?

"I promise you that companies like Amazon will be Intertraffic's future clients"

The first months of 2019 have already passed, but here in the Netherlands, the Intertraffic team is still fresh and working hard. For us, this year is particularly interesting and full of opportunities. It will soon be time for us to put together the 2020 issue of *Intertraffic World* magazine, which will be distributed at Intertraffic Amsterdam in April next year. This is one of our priorities and we continue to focus on building the impact of our brand wherever we can.

As I write this, the Intertraffic team is putting together a roadmap for 2019 to 2024. It is interesting to see that our business is increasingly taking place within an urban environment. I sometimes wonder how companies like Amazon have affected the way that we move around our cities. The field of play for Intertraffic is no longer only about people moving around, but also about logistics. In this era of digitization, Intertraffic will fully embrace logistics – following the example of Amazon, which has transformed itself from simply a book retailer to a master of logistics. I promise you that companies like Amazon will be Intertraffic's future clients.

In today's world of digitization, online companies are increasingly focusing on delivering innovations that make our lives easier. Amazon's continuous efforts to make product deliveries in the fastest possible times make it a logistics pro, not just a leader in the retail industry.

The company's own warehouses are strategically placed, moving closer and closer to main metropolitan areas and city centers. As a result, Amazon uses a pure push strategy for the products it stores in its warehouses. On the other hand, it uses a pure pull strategy when it sells the products from third-party sellers.

The interesting thing is that Amazon's supply chain heavily depends on outsourcing its inventory management. For instance, products that are not frequently purchased or ordered are not stored in regular Amazon warehouses. It may come as a surprise to you that nearly 82% of Amazon's sales consist of third-party sellers.

If you and your business want to be successful, according to the Balance Small Business website, you must adhere to Amazon's 14 leadership principles. (It's really interesting and worth a read – see innovatie-site.nl).

Having read Amazon's business case, I am convinced. Tomorrow I will log on to the Amazon website using my Intertraffic account, and I will place an online order. That means that Amazon will very quickly be one of our partners. And helpfully, in terms of Amazon's delivery time, the RAI Convention Centre, where the Intertraffic team is based, is only just outside the city center and easy for Amazon's small electric vehicles to reach.

Richard Butter is director of traffic technology at RAI Amsterdam and is responsible for Intertraffic worldwide events, ***www.intertraffic.com***

Why multifunctional sensors are the future of traffic management

A modern radar sensor is capable of delivering an all-in-one traffic management sensor solution that provides a database for smart cities. A single sensor from smartmicro, for example, can precisely measure the position, lane and speed vector, as well as the elevation of the objects in the field of view, across all lanes. The radar can be simultaneously used for adaptive intersection control, as well as collecting statistical data such as counting and object classification.

Enabling smart cities

When smartmicro radars are installed at intersections, cities get a future-proof traffic management sensor that allows multilane, multi-object detection on straight and curved roads. By using microwave technology, the radars can deliver key information based on big data, such as estimated times of arrival (ETA), stop bar and advance detection, detailed vehicle counting options, and an object classification that can recognize pedestrians and bicycles.

The implementation of an adaptive traffic signal control results in truly smart intersections with signal phase extension where needed.

Modern traffic radars detect moving and stopped traffic and use queue length measurements to determine the optimum traffic light phase duration. This can all be done with a single forward-firing radar sensor per road approach. This can help cities achieve fewer unnecessary stops in traffic and less congested streets, which in turn reduces CO_2 levels as well as optimizing travel times for all road users.

Looking to the future

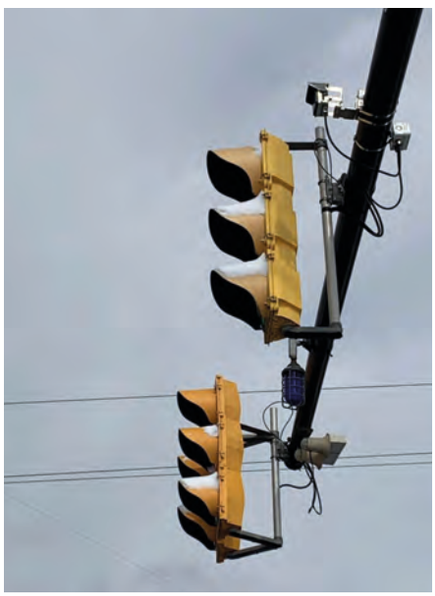
Today there are two common traffic radar technologies: forward-firing and side-firing. While side-firing radars need to be installed at the side of a road and often come with additional poles, forward-firing radars can be installed on existing infrastructure alongside the road – for example, on poles, gantries, mast arms, bridges and street signs. This is especially handy when installing the devices in cities – where existing infrastructure is fixed and limited. The forward-firing radar's mounting position means that forward-firing radars can be integrated seamlessly in present infrastructure without additional construction work.

Unlike side-firing sensors, which have narrow beams, forward-firing radars use multiple beams. This brings many advantages: all objects remain inside the field of view for much longer; and their positions and speed vectors are measured with much higher accuracy. At an intersection, for example, one single forward-firing radar is able to provide stop bar and advance detection.

Road safety for everyone

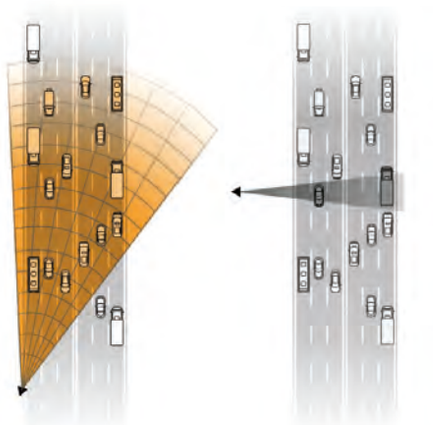
The latest offering in the smartmicro range of traffic radar sensors is the 4D/HD UMRR-11 forward-firing sensor device. The compact and lightweight sensor is one of the most cost-efficient radar solutions available on the market. Thanks to the rugged and waterproof (IP67 certified) casing, it is suitable for use in all weather conditions and is easy to install. It can operate in a temperature range of -40°C to 85°C (-40°F to 185°F).

As smartmicro's latest sensors have V2X capabilities, they can share real-time data about traffic signal statuses at intersections. This data can then be transmitted to roadside units and received by V2X-equipped vehicles. This in turn can pave the way for a future in which cars automatically stop at crossings when pedestrians are being signaled to walk.



Left: **A smartmicro multifunctional sensor UMRR-11 installed at an intersection**

Below: **smartmicro's forward firing technology versus side firing**



Need to know

Benefits of smartmicro's multilane traffic management radar technology include:

- 4D/HD resolution
- Sensors for end users and for OEM integration
- Infrastructure sensors for smart cities with V2X functionality
- Setup software and accessories
- Suitable for use in intersection management, arterial management and enforcement

Reliable, above-ground detection solution

The UK's West Sussex County Council needed an efficient stop-line detector to improve safety at the junction of Felpham Way and Downview Road in Bognor Regis. The authority had tried a number of above-ground solutions but found that drivers waiting to turn right sometimes went undetected and were therefore kept waiting at the traffic signal. The AGD 645 Pedestrian Detector provided an ideal solution to this issue.

"There have been problems at this junction for some time," says Barry Edmunds, manager of traffic signals and street lighting at West Sussex County Council. "We have a straight-ahead lane and a right-turn lane next to each other, but there's usually only a small number of vehicles that want to turn right."

The County Council needed an effective way of detecting stationary cars at the stop line in the right-turn lane, but this proved difficult because the existing infrastructure meant that loops couldn't be cut into the road surface.

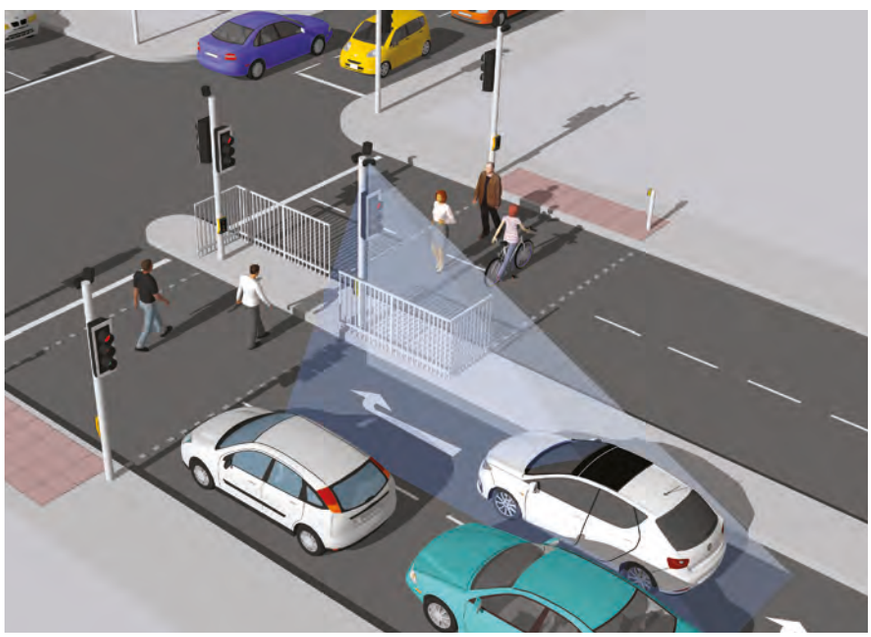
The authority had previously tried various above-ground solutions without success. "Some had been very difficult to set up, particularly in terms of defining the right detection zone," says Edmunds. "We tried thermal cameras but they were unreliable and missed the odd car. We had to make sure we weren't picking up traffic that wanted to go straight ahead, so it was important to be able to select the detection zone very precisely. AGD suggested we try the 645."

Detection at its best

The AGD 645 is a smart curbside detector that provides highly accurate above-ground stop-line detection. Its volumetric capability monitors the level of occupancy in the defined zone, while advanced optics offer enhanced detection. Crucially for this application, it is easy to set up using a smartphone or laptop, with an intuitive graphical user interface that enables engineers to define the detection zone accurately.

With the 645's flexible polygon tool and large, 10 x 3m (33 x 10ft) detection zone, precise boundaries could be defined for the right-turn vehicle zone without encroaching on the straight-ahead lane. Also useful is the ability to monitor performance in the control room – due to the 645's real-time video output, which uses IP connectivity – and adjust the zone remotely.

The solution, which uses two 645 detectors, was installed at the beginning of 2019 and is operating smoothly. "It was really easy to set up and we have been left with no problems at this junction," concludes Edmunds. "We'd know immediately if there were any issues, so we're delighted with this result."



Left: **The IP-capable AGD 645 detects right-hand turning vehicles at the stop line**

Need to know

Key features of the AGD 645 detector include:

- New volumetric capability in the wait area
- A 10 x 3m (33 x 10ft) detection zone
- IP and real-time video capable
- High-definition 3D optics
- Advanced shadow and clutter rejection

Above: **The 645 detects targets in larger zones with 3D HD stereo optics**

Free reader inquiry service

AGD Systems inquiry no. **507**
To learn more about this advertiser, please visit: www.ukimediaevents.com/info/tfm

How can modern mobility be made safer for vulnerable road users?

Transportation innovations such as autonomous driving, e-mobility and driver-assistance systems are sure to be a part of our future. Yet innovators of future transportation technologies must not forget the most vulnerable of individuals who use roads – namely pedestrians, including children and the elderly, the blind and visually impaired.

There are many challenges for vulnerable road users (VRUs) on busy roads and at intersections, for example.

Blind pedestrians walking on a sidewalk typically orient themselves to face oncoming traffic. Their sense of direction and orientation depends somewhat on the noises produced by vehicles traveling on the road.

Another challenge faced by the blind and visually impaired is that they often have to share sidewalks or their pathways with cyclists and other pedestrians. A system that offers safe, destination-oriented guidance is therefore critical. Reliable solutions that are used to improve traffic safety can play a role in assisting VRUs.

Need to know

LOC.id has a range of functions to assist visually impaired VRUs in crossing roads

- LOC.id has Bluetooth capabilities
- The user can operate the system with a one-button transmitter device; or as an app that functions as a transmitter, installed on a smartphone

Assistance at crossings

RTB has been a global leader in push buttons and acoustic units for traffic signal systems for more than 25 years. The company offers push buttons for a wide range of requirements and for use in a selection of environmental conditions.

RTB's products include special models for the blind and visually impaired with tactile symbols and mechanisms that signal when the path ahead is clear. They are particularly effective when combined with acoustic units that can be attached to traffic signal poles.

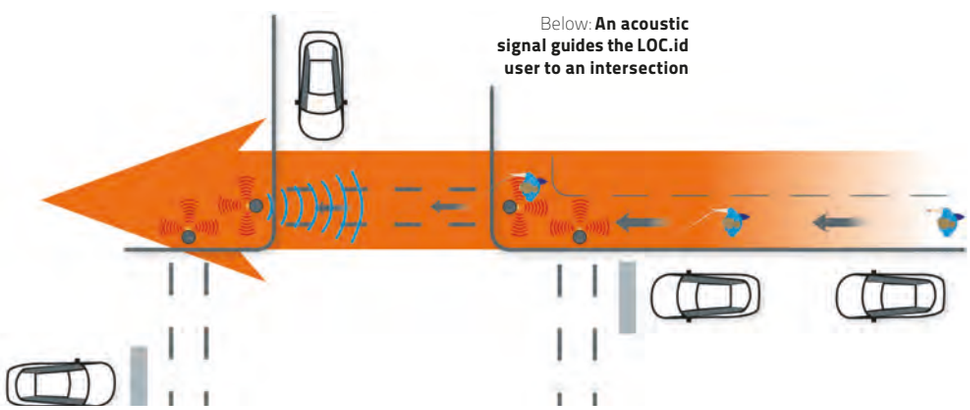
Below: **LOC.id users can choose between an app and a one-button transmitter device**

Acoustic units issue a guide signal to help blind and visually impaired pedestrians orient themselves and find the traffic signal pole. In addition, the unit sends a walk signal to the pedestrian to notify them when it is safe to use the crossing. It is important for blind and visually impaired pedestrians to be notified of a clear time to cross a road, especially as some vehicles are being made to travel more quietly. For instance, electric and hybrid vehicles.

The following scenario illustrates this more clearly. Let's assume a blind person is walking down the sidewalk on the right side of the street, parallel to moving traffic, approaching an intersection. At the same time, a car with an automatic stop/start system is waiting in the right-turn lane and an electric vehicle approaches from the right. The pedestrian plans to continue walking straight ahead by crossing at the intersection. The signal indicates that the intersection is clear, however the traffic signal gives the car in the right-hand lane a green light and the driver starts the motor. Now, let's put ourselves in the shoes of the blind person at the intersection. They have suddenly become aware of the adjacent car and the situation may cause a great deal of anxiety.

As a solution in this scenario, RTB's Bluetooth-based LOC.id system can provide assistance to the blind pedestrian. The

Below: **An acoustic signal guides the LOC.id user to an intersection**



system, which is an app for the blind and visually impaired, functions like a transmitter. If the user approaches a system equipped with a receiver, then they are detected as a pedestrian. An acoustic signal increases and becomes quieter when the pedestrian walks away from the intersection after having crossed it. The walk signal is also issued by the acoustic units.

Connective capabilities

The LOC.id can extend walk signals if longer cross times are required. This is a useful solution for the elderly or physically disabled. Another ideal area of application is on public transportation. RTB's technology solutions enable users to receive individual verbal announcements.

Future modern mobility calls for effective communication between innovative systems and vehicles. For example, LOC.id has vehicle-to-everything (V2X) capabilities. It can communicate with vehicles that also have V2X capabilities and then produce artificial electric noises to help the blind and visually impaired perceive vehicles. Drivers of emergency vehicles can also use this communication channel to be made aware of vulnerable individuals who are sharing the road space at that time.

Safety and modern mobility should exist as separate entities. Instead, they can be partnered to create a safer world. ○

by **Larry Yermack**

Is the USA actually ready to charge drivers for the congestion they create?

"I've been involved in the NY Congestion Pricing debate for nearly 40 years (yes, that long)"

Until now, pricing was based on how much time you are willing to spend in traffic, not how much money you are willing to pay. The current debate in New York about pricing access has triggered discussion in several other major US cities: LA, Boston, Seattle and San Francisco so far. If New York implements charges, then the impact could ripple out.

I've been involved in the NY Congestion Pricing debate for nearly 40 years (yes, that long) and as this plays out I am reminded of my first conversation with the late NYC Mayor, Ed Koch. I was an assistant to the Mayor responsible for among other departments, the DOT. Ed asked his Deputy Mayor, Bobby Wagner what position the City Planning Commission had taken on charging when he was Chair. Wagner's response was "We ducked that one". Not to be deterred, Koch followed up with: "What would your position have been, had you taken a position?" I forget the response to that question.

What does that 1982 conversation mean today? Only that charging drivers to enter the city core, when they are not crossing a tolled facility, has been a third rail issue for a long time. Ed Koch never publicly endorsed it.

In the beginning, the idea was to place tolls on the free bridges into Manhattan and the first study of tolling the free crossings was in the 1970s. At that point, it was physically impractical to build enough booths at the free bridges to collect tolls. The advent of electronic toll collection and free-flow tolling has obviated that constraint.

Under Mayor Dinkins, the DOT announced a scheme to toll the bridges to raise money for their repair and upkeep. Nobody either believed that they needed the money, or that it would actually go to the bridges. The idea quietly died in a few days.

Later, the idea was to toll the free crossings, place a surcharge on those already tolled, and create a cordon line at the southern end of Central Park. Mayor Michael Bloomberg made a serious run at implementing this approach as a congestion charge and ran into the expected firestorm. His argument was that there was too much traffic in midtown. He needed approval from both houses of the state legislature and that's where it ran aground. In the Assembly the speaker, later himself to go to prison, opposed the idea and killed it. Another iteration died in the Senate.

From these failed attempts, what do we learn and what does it mean for today's push for cordon pricing in Manhattan? The technical problems of the 1970s are obviated by today's open road tolling, albeit with some tweaks for Manhattan avenues. Everybody knows how badly public transit needs the money for a subway system in crisis and Manhattan traffic is simply ridiculous. Cross-town speeds are reminiscent of horse-drawn carriage days.

Will it be enacted? It's still up to the political leadership to corral the votes in Albany. I, for one, hope that they do.

Larry Yermack is strategic advisor to Cubic Transportation Systems, California. He can be reached at ***lyermack@gmail.com***

Enabling smart tachograph with DSRC technology

Norwegian technology company Norbit has developed a dedicated short-range communication (DSRC) solution to enable tachograph vendors to meet the clause in a new EU directive that requires all trucks registered after June 2019 to have a DSRC interface to enable remote reading of tachograph data.

Market leader Continental has awarded Norbit a five-year breakthrough contract for the DSRC solutions for the smart tachograph.

The new smart tachographs will be mandatory for all new trucks registered after June 2019. According to the European Automobile Manufacturers Association, approximately 500,000 new trucks are registered in the EU every year. As a DSRC specialist, Norbit is delivering technology for intelligent tachographs.

Fewer roadside checks

"Our short-range communication technology – and our many years of expertise as an automotive electronics supplier – have enabled us to customize DSRC technology to this new application," says Per Jørgen Weisethaunet, CEO of Norbit.

"We are proud that Continental Automotive, an international technology leader in the automotive sector, has chosen us as a partner and the contract is proof that our strategy of tailor-made solutions for carefully selected market niches works," he continues.

Via the DSRC interface, a defined minimum amount of data from the intelligent digital tachograph can be transmitted wirelessly from the moving vehicle to the devices of the control officers following authentication. This dataset contains vehicle and calibration data and information about security breaches and malfunctions. Using this data, control officers can selectively stop vehicles and thus ensure greater road safety. Companies and drivers that comply with all legal regulations will be subject to fewer checks and unplanned roadside stops.

As the DSRC device in the truck needs to be mounted on the windshield or dashboard, where there is limited space available, Norbit and Continental's design target was to make the device as small as possible. The mandatory wide antenna lobe made a totally new design of the antenna necessary.

Two smart tachograph vendors have chosen to use the Norbit DSRC solution. For those suppliers, Norbit tailored the product to each vendor's special requirements.

Weighing checks

The standardized DSRC interface can also carry out other key functions, such as the transmission of data for onboard weighing. In 2021 a Europe-wide amendment will come into force providing an integrated measuring system for the safe observance of axle loads and total vehicle weights. The information could then also be transmitted wirelessly via the DSRC interface. Standardization activities at the European level are currently taking place.

Norbit is an international, knowledge-based group of companies providing high-tech products, systems, solutions and services. Norbit ITS focuses on electronic vehicle recognition via DSRC, boasting cutting-edge technology and extensive experience in designing and manufacturing DSRC-based technologies. Norbit ITS has strategically positioned itself as an independent DSRC provider.

Left: **Norbit ITS's detached antenna for smart tachographs**
Below: **The DSRC CAN acts as a DSRC server in the truck**

Need to know

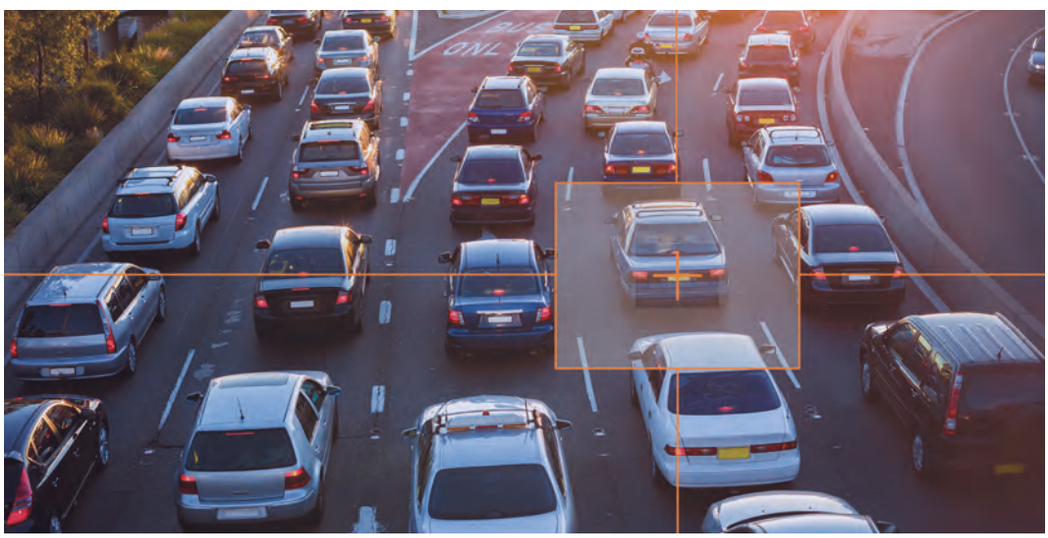
Key new technologies found in smart tachographs, mandated by the EU, include:

- Full vehicle CANbus integration
- GNSS location information
- Effective roadside check of vehicles via DSRC
- Bluetooth ITS integration interface

Free reader inquiry service

Norbit ITS inquiry no. **509**
To learn more about this advertiser, please visit: www.ukimediaevents.com/info/tfm

Improving road safety and civil security with ALPR solutions



Vision-based technology and back-office systems can support automated traffic enforcement.

"The question is how well the industry can provide answers to new trends and requirements in specific markets," says Tobias Deubel, Jenoptik's new director of global sales, light and safety. "You have to be a player who is able to offer flexible, cutting-edge solutions from a variety of technologies and at the same time be able to understand regional characteristics. "

Jenoptik's large customer base is fully supported by its mature dealership network, which combines international expertise, as well as its knowledge of national and regional markets. This fusion of knowledge enables the company to tailor its solutions for use around the world.

London: ALPR analysis

Jenoptik has supplied London's Metropolitan Police with its ALPR back-office system. The Metropolitan Police is responsible for the safety of the UK capital's nine million inhabitants and also plays a role in national security matters. The back office provided by Jenoptik handles more than 50 million ALPR reads from cameras across the UK, including 100 Vector cameras. Real-time data analysis, based on the ALPR camera data, enables the police to optimize operational effectiveness.

Jenoptik's back office handles more than 50 million ALPR camera reads per day in the UK

Lithuania: Speed control

In Lithuania an ALPR-based solution for average speed control is an improvement of an existing point-to-point (average speed) measurement system. To improve public and traffic safety and security, the Lithuanian Road Administration needed to identify wanted vehicles, monitor average speeds and monitor vehicles' license plates for third-party purposes (such as insurance, technical inspections and customs). The solution combines traffic enforcement and security into one application.

Need to know

Jenoptik's traffic safety and security systems include:

- Reliable back-office software for evaluating traffic data
- Digital camera technology with optional ALPR functionality
- Stationary and mobile systems for speed and red-light enforcement

Oman: Traffic monitoring

Jenoptik is working with the Royal Oman Police (ROP) to improve road safety and reduce casualties in densely populated urban areas. Jenoptik has installed 191 speed and 180 red-light monitoring systems, upgraded 125 existing systems, and delivered 125 further systems for installation into empty housings. Its TraffiDeskPro back-office software enables the ROP to run its entire back-office evidence-chain operations using one modular software application, including automated enforcement systems supplied by other vendors.

USA: Safer cities

In Ocean Ridge, Florida, Jenoptik ALPR cameras are being used to support police in their efforts to efficiently monitor, identify and deter criminal behavior. Multiple cameras are used to capture live ALPR data and feed it into a back-office monitoring and reporting software solution that is capable of accepting in excess of 100 million camera reads every day.

Real-time feeds captured by ALPR cameras, together with analysis of data collected from them, can give a true picture of criminal activity in a given area. Not only are the cameras able to detect where a vehicle has been, but they are also able to identify patterns in driver behavior. This can contribute toward predictions of future driver behavior.

Washington DC upgrades transportation network

Washington DC, the US capital, continues to face massive challenges in the management of its traffic and transportation. The 70 square mile (180km²) city includes 1,500 miles (2,400km) of public roads, more than 7,000 intersections, 1,600 traffic signals and hundreds of CCTV cameras.

The DC Department of Transportation (DDOT) manages and maintains transportation infrastructure in the DC area. Its responsibility is to ensure that people, goods and information move efficiently and safely, with minimal adverse impact on residents and the environment.

The DDOT was looking for a solution that would allow it to support the bandwidth required for new applications and devices, such as new controllers' smart sensors and, specifically, an emphasis on video. The challenge was to gradually advance the current twisted copper pair-based network with minimal impact on everyday traffic, as well as to ensure scalability and enable future migration to fiber. The platform selected was also expected to significantly cut management costs by minimizing the number of service call-outs and relying more on remote management from the DDOT traffic operation center (TOC).

The right solution

After a thorough analysis and evaluation of multiple solutions, the DDOT selected Actelis Networks.

Actelis offers an advanced and robust ITS platform that meets the need for a faster communication network. The devices assimilate information from multiple video streams and smart sensors to enable on-the-fly adjustments and alignment of the city's traffic flow. "Our continuous partnership with Actelis during the last few years has enabled us to significantly and gradually enhance the DC ITS network with minimal impact on traffic, while keeping within budget," notes Harvey Alexander, division signals and ITS maintenance manager at DDOT. "The Actelis solution is future proof. It allows growth and scalability with bonded copper as well as integrated migration to fiber if required."

Actelis smartly uses the existing copper infrastructure, offering more than 10Mbps per pair and over 100Mbps with eight bonded pairs, even at very long distances of up to 30,000ft (9,100m), supporting backhauling of multiple streams of high-quality video. The advanced bonding mechanism enables growth to support the city's growing number of CCTV and signalized intersections. The ability to bond pairs offers high reliability and redundancy, ensuring that a network connection is extremely resilient and can sustain even multi-failure scenarios.

The Actelis portfolio, which includes ML600/D, ML500/D hybrid access devices and ML2300/ML230 high-density aggregators, can be flexibly used to accommodate various network scenarios. The portfolio offers the scalability to support more intersections as well as the ability to support increased bandwidth per intersection. All devices are hybrid, offering a mix of bonded copper and GIGA Ethernet interfaces over fiber.

At the DDOT centralized TOC, real-time information from CCTV cameras and sensors is constantly analyzed to ensure all traffic signals, across all intersections, are synchronized. The Actelis MetaAssist EMS management system, installed in the TOC, plays a crucial role in this regard, allowing full remote control along with easy troubleshooting and network-wide monitoring. The increase in TOC-centric activities improves efficiency and considerably decreases the time required for typical day-to-day activities, including service call-outs. In addition flexibility is improved, enabling the TOC to quickly and efficiently respond and adjust the network according to events in the DC area.

The Actelis platforms are hardened and designed to maintain integrity in cold and hot weather, rain and snow – and even during lightning storms. The system offers a high level of security by employing data scrambling and advanced 256bit encryption. All management traffic is protected as well, using SSHv2 and SNMPv3.

Left: **Actelis's ITS solution was chosen by the DC Department of Transportation to improve its road networks and mobility**

Need to know

Benefits of the Actelis ITS solution include:

- Capability to use readily available copper
- Extremely high mean time between failures
- Stable, reliable high-performance links
- Can be installed without disruption to traffic

Free reader inquiry service

Actelis inquiry no. **511**
To learn more about this advertiser, please visit: www.ukimediaevents.com/info/tfm

Advanced automated traffic image analysis

Built on the Teledyne Lumenera Ls Series Embedded Vision Platform, the Teledyne Lumenera Ls245R traffic camera provides an advanced solution for automated traffic image analysis. Integrated self-triggering vehicle detection (VDET) and automated license plate recognition (ALPR) makes short work of detecting cars on high-speed freeways and extracting information from license plates.

Instead of relying on a separate camera and computer to work together over a network, the Ls245R traffic camera can image, analyze and extract data all on its own. This all-in-one package enables the unnecessary parts of an imaging system to be removed and provides the benefit of a high level of synthesis between sensor, software and processing technology.

Above: **Teledyne Lumenera Ls245R traffic camera**

Customizable hardware

The flexibility of the Embedded Vision Platform enables the selection of a sensor from the Sony Pregius family (IMX392) to precisely meet the requirements of traffic applications and leverage the latest advances in artificial intelligence using Xilinx Zynq Ultrascale+. The computer architecture in the platform allows for custom solutions for traffic imaging with the field-programmable gate array (FPGA), using the power of the processing system (PS) and the programmable logic (PL).

Similarly to a computer processor, the PS runs software to extract data for a specific application. Additionally, instead of using a traditional processor-only design, the PL is optimized to provide computational benefits because the logic can be set up to work through specific imaging challenges more efficiently.

Removing the need for a separate processing device enables the Ls245R traffic camera to push a new generation of imagers to their limits using the PS and PL architecture. Without the need for external interfaces such as USB, the camera can take full advantage of the imager without being bottlenecked by the bandwidth of the interface.

Since there is no dependence on an interface, the camera comes with its own internal triggering system. Vehicles passing by a traditional traffic vision system require physical triggers in roads to activate a high frame-rate camera, whereas the Ls245R can use VDET to take an image whenever a car is seen within the field-of-view of the imager.

Onboard processing

Images are only transmitted to a destination (e.g. law enforcement) after they have been processed. The VDET triggers the camera when vehicles pass by and only sends processed images instead of constantly taking images or sending every image to be processed at the destination. In the event of a network outage, images and data can be backed up on the camera and then sent out when the device reconnects to a network.

The Ls245R traffic camera supports various lighting situations with a day/night mode by automatically controlling a lens shuttle. This adaptive lens enables the camera to take images with near-infrared light. Using LED lighting, the camera can accurately detect license plates even in low-light environments.

Because of the flexibility of the FPGA architecture, other imaging applications beyond traffic and toll monitoring can take advantage of the Ls Series Platform. For example, various inspection and monitoring applications can benefit from the versatile options for software using the PS and the added computational power of the PL.

Need to know

Advantages of the Teledyne Lumenera Ls245R camera and the Embedded Vision Platform

- Harnesses the latest AI to meet traffic application requirements and create custom solutions
- Internal processing means no bandwidth bottlenecks
- No need for physical triggers on roadways – a vehicle need only be in the imager's field of view
- Only sends processed images to the back office


NEXT GENERATION MOBILITY
TOLLING AS A SERVICE
VISIT US:
ITS CONGRESS
BRAINPORT EINDHOVEN
EVOLUON CONGRESS
CENTRE
STAND 2.3
With our extensive experience in providing business solutions in the road charging sector, T-Systems offers comprehensive and innovative services for all areas in the tolling market.
www.t-systems.com/toll
T · · Systems ·

Is it possible to re-imagine mobility? We believe so.

A-to-Be MoveBeyond™
Advanced Mobility Platform

By having a unique back office to integrate all mobility services. By offering seamless journeys. By making mobility simpler and exciting.

A-to-Be MoveBeyond™ is our Advanced Mobility Platform, a backoffice that integrates all smart city players on a central account, improving operation and business.

We are changing mobility for the better, sharing the ride with the citizen.

A-to-Be

Powered by Brisa

www.a-to-be.com
Mobility-Beyond™